Teleosemantics without Etiology

Bence Nanay*†

The aim of teleosemantics is to give a scientifically respectable or 'naturalistic' theory of mental content. This paper focuses on one of the key concepts of teleosemantics: biological function. It has been universally accepted in the teleosemantics literature that the account of biological function one should use to flesh out teleosemantics is that of etiological function. My claim is that if we replace this concept of function with an alternative one and if we also restrict the scope of teleosemantics, we can arrive at an account of biologizing mental content that is much less problematic than the previous attempts.

1. Introduction: Biologizing the Mind. Many (maybe not all) of our mental states are about something; they refer to something. In other words, they have content. The question then is this: how can we explain the relation between this mental state and what it is about?

This relation between a mental state, call it M, and what this mental state is about, call it X, has some odd features that make it very different from the explananda scientific theories tend to explain. First, we can have thoughts about things that do not exist: in this case, this relation between M and X is a relation between a mental state and something nonexistent. Second, the relation between M and X is not a causal relation. Even if M is caused by Y, not X, it may still be about X, not Y.

As a result, it may seem like a real challenge to give a scientifically respectable or 'naturalistic' theory of mental content. But this is exactly what the scientific research program of teleosemantics aims to do. It needs to be emphasized that teleosemantics is not a theory, but rather a scientific research program: a temporal sequence of a set of very different theories that all share some core commitments. And in the case of teleosemantics, this

---

*To contact the author, please write to: University of Antwerp, D 413, Grote Kauwenberg 18, 2000 Antwerp, Belgium; e-mail: bn206@cam.ac.uk.

†This work was supported by the EU FP7 CIG grant PCIG09-GA-2011-293818 and the FWO Odysseus grant G.0020.12N. I presented this paper at the 2012 PSA Annual Meeting in San Diego and at the University of Bielefeld. I am grateful for the comments I received after these talks.

Philosophy of Science, 81 (December 2014) pp. 798–810. 0031-8248/2014/8105-0008$10.00
Copyright 2014 by the Philosophy of Science Association. All rights reserved.

core commitment is that we can use biology to explain mental content (Millikan 1984; Dretske 1988; Papineau 1993; Neander 2006). More precisely, we can use an account of biological function to arrive at a naturalistic, scientifically respectable account of mental content. The general outline of how this would work is the following:

> (**T**) Representing X is having the biological function to indicate (or to carry information about) X.

In other words, representation is function plus indication. As indication is a harmless causal concept (roughly, indicating X means being reliably caused by X) and function is understood as biological function, this way of explaining representation and mental content is a purely naturalistic one: it really is a case of biologizing the mind.

In the debates surrounding the scope and merits of teleosemantics a lot has been said about the concept of indication (or carrying information; see esp. Godfrey-Smith 1991, 1996). The aim of this paper is to focus on the other key concept of teleosemantics: biological function. It has been universally accepted in the teleosemantics literature that the account of biological function one should use to flesh out teleosemantics is that of etiological function. My claim is that if we replace this concept of function with an alternative one (which we have independent reasons to accept) and if we also restrict the scope of teleosemantics, we can arrive at an account of biologizing mental content that is much less problematic than the previous attempts.

I said that teleosemantics is a scientific research program. But then it must appear to be a degenerative and not a progressive one (Lakatos 1970, 1974). After the initial phase of a flurry of papers in the 1980s and 1990s, there is now, comparatively speaking, very little discussion about it. What there is consists of various defenses of various versions of teleosemantics in the face of objections. For Lakatos, a degenerative scientific research program makes no (or hardly any) new predictions or new explanations. If a degenerative research program contradicts new data, this does not falsify the research program: there are many ways of modifying the research program in such a way that the contradiction disappears. These modifications, however, involve adding extra, ad hoc assumptions to the ‘core’ of the research program, which serves only one purpose: to explain away the contradiction. These extra assumptions constitute the ‘protective belt’ of a degenerative research program. The thicker the protective belt is, the more likely it is that a research program is degenerative. The more new predictions and explanations a research program provides, the more likely it is that it is progressive. Lakatos argues that it is often worth being loyal to a degenerative research program for some time (as it may manage to recover), and my aim is to argue that we should be loyal to the scientific research program of teleosemantics and make it more progressive by updating the concept of biological function it uses.

The plan of the paper is the following: I outline the concept of function teleosemantics has been relying on (sec. 2) and argue that there are independent problems with it and that we are better off replacing it with a more plausible concept of function, the modal theory (sec. 3). I argue that if we use this concept of function as the account of biological function in teleosemantics (and if we also restrict the explanatory scope of teleosemantics to some important kinds of mental states), we can arrive at a more plausible version of teleosemantics (secs. 4 and 5). Finally, I address a potential objection, the Problem of Stupid Actions (sec. 6).

2. Teleosemantics with Etiology. The concept of function teleosemantics relies on is the etiological one. Very roughly, a trait T of an organism O has function F if T's doing F has contributed to the fitness of O's ancestors. According to this account, what fixes the function of a trait is its past, its history—hence the label: the etiological account. The function of the human heart is to pump blood because the fact that the heart pumped blood contributed to the survival and reproduction of our ancestors (Millikan 1984; Neander 1991a, 1991b; Griffiths 1993; Godfrey-Smith 1994; see also Wright 1973).

The etiological theory of function gives an elegant way of handling the possibility of malfunctioning. An important feature of the concept of function that any theory needs to be able to account for is the possibility of malfunctioning. An object may have a function but fail to perform this function. If my heart skips a beat, it still has the function to pump blood, but at that moment it fails to perform this function: it malfunctions. If we accept the etiological theory of function, malfunctioning can be accounted for very easily: it is perfectly possible that a trait of an organism has been selected for doing F, but at the moment it does not perform (or maybe could not even perform) F.

If we plug this etiological theory of function into the core claim of teleosemantics, what we get is the following:

> (**T-etiological**) Mental state M of organism O represents X if and only if M's indicating X has contributed to the fitness of O's ancestors.

Or, to put it very simply, representing X means having been selected for indicating X. This is what I take to be the dominant version of teleosemantics.

Many of the classic objections to teleosemantics are a direct consequence of the etiological theory of function embedded within teleosemantics. The most famous of these is based on the swampman thought experiment. A very direct consequence of the etiological definition of function is that what fixes the function of a trait is its past, not its present. Hence, if an organism that is molecule for molecule identical to me (the swampman) were created by chance, its organs would not have any functions, since it would lack the evolutionary history that would fix the function of these organs (Millikan 1996; Neander 1996). And as, according to those versions of teleosemantics that use the etiological function, mental content is determined by etiological function, this also means that this creature who is molecule for molecule identical to me lacks any contentful thought.

Without going into the Byzantine details of the swampman literature (Dennett 1996; Millikan 1996; Neander 1996; Papineau 1996, 2001; Braddon-Mitchel and Jackson 2002), it can be pointed out that there are many ways of answering this objection, some more plausible than others. Nonetheless, it is worth noting that the swampman problem (if it is indeed a problem) is a direct consequence of the etiological account of function that teleosemantics tends to use. If we can use a different account of function in teleosemantics, this problem (again, if it is indeed a problem) would just go away.

My aim is to argue that we have independent reasons to reject the etiological account of biological function. And if we do this, we need to replace the concept of function teleosemantics uses with a different one, which would make teleosemantics more plausible.

3. A Problem for the Etiological Account of Biological Function—the Individuation of Trait Types. I would like to raise another, more general and perhaps more fundamental objection than the swampman thought experiment that should persuade us to discard the etiological theory (see also Nanay 2006, 2010, 2011b, 2012b).

The etiological definition of function presupposes that *trait types* can be individuated in an unproblematic manner. The trait whose function is to be defined and the traits that have been selected for in the past must be *of the same type*. But how can we individuate trait types? What makes hearts different from non-hearts?

The problem is that there is no coherent noncircular way of individuating trait types that is available to the etiological theory of function.

According to the etiological theory, the function of my token heart is determined by some facts about what happened to some other traits that were tokens of the same type as my heart: whether they were selected for, and if so, what they were selected for. Thus, the function of my token heart is determined by something that happened to some other tokens of the same type.

But then the etiological definition of function presupposes an independent explanation for how trait types are individuated. The real problem is that no such independent explanation is available. The most plausible candidate for how to individuate trait types uses (at least partly) functional criteria: a token object belongs to trait type T if and only if it has certain functional properties—if it has the function to do F (the most important alternatives are discussed in Nanay 2006, 2010). Those entities are hearts that have the function of pumping blood. Those entities that do not have this function are not hearts. As Karen Neander puts it, "Most biological categories are only definable in functional terms" (Neander 1991a, 180; see also Beckner 1959, 112; Burge 1989, 312; Lewens 2004, 99). But the etiological theory of function cannot help itself to this way of individuating trait types when defining function without running into circularity. As we have seen, the etiological definition of function presupposes an account of trait type individuation. Now, if we want to avoid circularity, we cannot use the notion of function in order to explain trait type individuation. When we are explaining function, the claim that x* (the trait whose function we are explaining) is a token of type X (the traits that have been selected in the past) is part of the explanans. Hence, we cannot use the explanandum (function) to explain part of the explanans (why x* is a token of type X; see also Griffiths 1993; Davies 2000, 2001; Neander 2002, 403; Neander and Rosenberg 2012).

4. A Modal Theory of Biological Function. To sum up the argument so far, the etiological theory should be disposed of, and we should look for some other theory of function. The problem is that *all* alternatives to the etiological theory of function define the function of a token trait in terms of some properties of the trait type this trait is a token of. Hence, the alternatives of the etiological theory—the propensity theory (Mills and Beatty 1979; Bigelow and Pargetter 1987), the relational theory (Walsh 1996), as well as Cummins's 'minimalist' theory (Cummins 1975, 2002)—rely on an independent account of individuating trait types (see Nanay 2010).

How can we then possibly give a plausible theory of function? The only solution I can see is to define function without any reference to trait types. If we could define function without appealing to trait type individuation, then we could use this definition of function to individuate trait types without running into circularity.

But then the function of a token trait must be determined entirely by the properties *of that very trait token* and not by the properties of other tokens of the trait type this token belongs to. How can we explain malfunctioning in this framework? When a trait malfunctions, it is supposed to do (that is, it has the function to do) F, but it does not do F. My heart malfunctions when it does not pump blood (though it is supposed to / it has the function to do so). If we define the function of a trait token in terms of the properties of that trait token alone, then it is difficult to see how the function can be different from what the trait token actually does. In other words, it is difficult to see how such an account of function could explain malfunctioning.

In the light of these constraints, options are fairly limited with regard to an unproblematic definition of biological function. In fact, I can see only one such option, namely, to attribute modal force to claims about function. To put it simply, trait x may not perform F, but if it were to perform F, this would contribute to the fitness of the organism with x. So the basic idea is that the function of x is F if and only if it is true that if x is doing F, then this *would* contribute to the fitness of the organism with x. But some clarifications, comments, and elaborations are in order.

I defined function with the help of a counterfactual. Any theory of counterfactuals could be used to fill in the details of this definition, but, for simplicity, we can use Lewis's theory (Lewis 1973): the function of organism O's trait x is to do F at time t if and only if some 'relatively close' possible worlds (different from the actual world) where x is doing F at t and this contributes to O's inclusive fitness are closer to the actual world than any of those possible worlds where x is doing F at t but this does not contribute to O's inclusive fitness (see Nanay 2010 for a detailed defense of this definition).

While Lewis's theory is useful in many ways—especially in clarifying how function attribution depends on the explanatory context in terms of what counts as a 'relatively close' possible world (see esp. Nanay 2012b)—it is somewhat misleading in some other ways. If x is doing F in the actual world and this contributes to O's inclusive fitness, then this, being the actual world, is closer than the closest possible world where x is doing F but this does not contributes to O's inclusive fitness. Should we then conclude that whatever x is doing in the actual world in such a way that it contributes to O's inclusive fitness automatically makes it x's function? No, we shouldn't. This is why the definition put a restriction on the 'relatively close' possible, *but not actual*, worlds. What this means is that x may or may not be doing F in the actual world, but when looking for the closest possible worlds where its doing F contributes to O's inclusive fitness, we should ignore the actual world.

If x is not doing (or even cannot do) F in the actual world, but in a 'relatively close' possible world it is doing F and its doing F contributes to the organism's inclusive fitness, then we can still attribute function F to x. This is exactly what happens if a trait is malfunctioning, that is, if it fails to perform its function.

The concept of 'relatively close' possible world in the definition needs some further elaboration. If wiggling one's ears, for example, would kill all approaching predators, this would contribute to one's fitness. But it is not the function of my ears to kill all approaching animals because the possible world where this happens is not 'relatively close'. What possible worlds count as ‘relatively close’ depends on the explanatory context—this is what makes function attributions depend on the explanatory context (see Nanay [2012b] for an elaboration on this point).

How can this proposal deal with the cases that are problematic for the etiological approach? If the swampman’s heart pumped blood, then this would contribute to the inclusive fitness of the swampman (this follows from the supposition that the swampman is molecule for molecule identical to a human being); hence, the swampman’s heart has the function to pump blood, in spite of the fact that he lacks history.

Finally, the modal theory of function is obviously not vulnerable to the trait type individuation objection, because it does not use trait types when defining function. It defines the function of a token trait entirely in terms of the properties of this token trait. To sum up, if we conceive of function the way I suggested, some of the worrying consequences of the etiological view disappear.

5. The Scope of Teleosemantics. To sum up, we have independent reasons to use the modal theory of biological function and not the etiological one in teleosemantics. We have seen that the core claim of teleosemantics is the following:

> (**T**) Representing X is having the biological function to indicate (or to carry information about) X.

If we plug in the modal theory of function in this claim, what we get is the following:

> (**T-modal**) Mental state M of organism O represents X if and only if some ‘relatively close’ (non-actual) possible worlds where M carries information about X and this contributes to O’s inclusive fitness are closer to the actual world than any of those possible worlds where M carries information about X but this does not contribute to O’s inclusive fitness.

Or, more simply, M represents X if M’s carrying information about X would contribute to O’s inclusive fitness.

So far so good, but replacing the etiological notion of function with a modal one is only half of the story. We also need to specify what ‘M’ is in this definition: we need to specify the scope of teleosemantics—the set of mental states that can be explained with the help of this explanatory scheme.

As we have seen, teleosemantics is a naturalistic account of mental content—it aims to explain mental content in a scientifically respectable, naturalistic manner. But naturalistic accounts of mental content come in two varieties. As Godfrey-Smith says, “Immodest theories attempt to give a fully general analysis of representation in naturalistic terms. Modest theories try to divide and conquer. Modest theories only try to give a naturalistic account of the most basic representational capacities. Then theories which are not themselves naturalistic, as they presuppose representation in some form, can be used to explain more complex types of representation” (Godfrey-Smith 1996, 176; see also Sterelny 1990). Many (maybe even most) versions of teleosemantics are immodest theories: they are supposed to apply to all of our mental states. The version I am outlining here is a modest, maybe a very modest, theory. It only applies to one kind of mental state, one that I call ‘pragmatic representations’.

Besides the swampman cases, the other often-noted objection to teleosemantics is that we have many beliefs and thoughts about states of affairs that clearly couldn’t have contributed to anyone’s fitness, let alone our ancestors’. My belief about the differences between iPhones and BlackBerries couldn’t have contributed to any of my ancestors’ fitness. There are many ways of dismissing this objection, but my strategy is to just disqualify mental states like beliefs, thoughts, and desires (and other propositional attitudes) from the scope of teleosemantics. I am not sure what function beliefs or thoughts have, or whether they have the function to indicate anything. All I claim is that the explanatory scheme of teleosemantics can be applied to some (phylogenetically and ontogenetically) basic mental states—ones that mediate directly between sensory input and motor output.

What mediates between sensory input and motor output? This is probably the most basic question one can ask about the mind. There is stimulation on your retina, something happens in your skull, and then your hand reaches out to grab the apple in front of you. What is it that happens in between? What representations make it possible for you to grab this apple? My answer to these questions is that it is pragmatic representations that mediate between sensory input and motor output; pragmatic representations make it possible for you to grab the apple.

Pragmatic representations are, at first approximation, the representational components of the immediate mental antecedents of action. The immediate mental antecedents of action are what make actions genuine actions. They constitute the difference between actions and mere bodily movements. They guide our ongoing bodily activities. And pragmatic representations are the representational components of these immediate mental antecedents of action.

They represent the world as being a certain way: they are *about* the world, they *refer to* the world. In other words, they have representational *content*: they represent objects as having certain properties. This, however, does not mean that they must have a syntactically articulated propositional structure or that they really are sentences written in some mental language. Pragmatic representations can be correct or incorrect. If they are correct, they guide our bodily activities well. If they are incorrect, they guide us poorly.

What properties do pragmatic representations represent objects as having? Suppose that you want to pick up a cup. In order to perform this action, you need to represent the cup as having a certain spatial location; otherwise, you would have no idea which direction to reach out toward. You also need to represent it as having a certain size; otherwise, you could not approach it with the appropriate grip size. And you also need to represent it as having a certain weight; otherwise, you would not know what force you need to exert when lifting it. I call these properties 'action-properties': action-properties are the ones that need to be represented in order for the agent to perform the action. Pragmatic representations attribute action-properties: they represent objects in an action-oriented manner (Nanay 2011a, 2012a, 2013a, 2013b, 2014). And they typically attribute these action-properties unconsciously; for similar mental states with different labels, see Myles Brand's 'immediate intentions' (Brand 1984), Kent Bach's 'executive representations' (Bach 1978), John Searle's 'intentions-in-action' (Searle 1983), Ruth Millikan's 'goal state representation' (Millikan 2004, chap. 16), Marc Jeannerod's 'representation of goals for actions' or 'visuomotor representations' (Jeannerod 1994, sec. 5; Jeannerod 1997; Jacob and Jeannerod 2003, 202–4), Andy Clark's and Pete Mandik's 'action-oriented representations' (Clark 1997; Mandik 2005; Nanay 2012a), and Stephen Butterfill and Corrado Sinigaglia's 'motor representations' (Butterfill and Sinigaglia, forthcoming; for more see also Hommel et al. 2001; Norman 2002; Grush 2004; Pacherie 2011).

These mental states are both phylogenetically and ontogenetically quite basic. Animals and small children are capable of performing goal-directed actions, such as running away from predators or chasing prey. But if they are, they must be able to have pragmatic representations. Hence, even organisms that may be incapable of entertaining complex thoughts and beliefs must be able to have pragmatic representations.

As pragmatic representations are directly relevant for the successful performance of actions, there is obvious selection pressure on them. This makes them a good candidate for being the explananda of teleosemantics. So the explanatory scheme would be the following: pragmatic representations represent action-properties if and only if they have the function to carry information about these action-properties. Or, to plug in the modal account of function:

> (**T-modal, modest**) Pragmatic representation M of organism O represents action-property X if and only if some 'relatively close' (non-actual) possible worlds where M carries information about X and this contributes to O's in-

> clusive fitness are closer to the actual world than any of those possible worlds where M carries information about X but this does not contribute to O's inclusive fitness.

Or, to put it very simply, a pragmatic representation represents action-properties if and only if its carrying information about these action-properties would contribute to the organism's fitness.

The version of teleosemantics that this explanatory scheme gives rise to is an extremely modest theory of mental content—it only purports to explain the content of pragmatic representations. And this modesty is what helps this explanatory scheme to address yet another widely advertised objection to previous versions of teleosemantics: the problem of functional indeterminacy.

Any given mental state carries information about a number of different entities. But the content of any given mental state is supposed to be determinate. According to the general explanatory scheme of teleosemantics, it is the concept of function that gets rid of this indeterminacy. The problem is that it is not at all clear how the concept of function can do so. To use the eternal example in this literature, when the frog snaps at a fly, what is the content of its mental state? Is it a fly? Frog food? A parcel of chemicals nutritious for frogs? Something small, dark, and moving? Small dark and moving food? All of the above? All these options have been suggested in the literature (for an exasperated overview see Neander 2006, 168).

One way of putting this problem is to ask whether it is the function of the representation-producing system or that of the representation-consuming system that fixes content. And here focusing on pragmatic representations has a major advantage: pragmatic representations are produced to be consumed in one and only one way—to help us perform the action successfully. In other words, the pragmatic representation-producing and representation-consuming systems both have the function to indicate action-properties.

6. The Problem of Stupid Actions. Finally, I need to address an important potential objection to this version of teleosemantics (which is also a potential objection to any version of teleosemantics). Successful actions are not always fitness enhancing. They do not always contribute to one's fitness. Take the action of drinking a cup of poison. This action, if successful, does not contribute to one's fitness. But then even if the correctness of a mental representation increases the chances of the successful performance of an action, this does not guarantee that it thereby also increases the organism's fitness. I call this problem the Problem of Stupid Actions.

Why is the Problem of Stupid Actions a problem for my version of teleosemantics? Because while pragmatic representations are, by definition, mental states the correctness of which increases the probability of the successful performance of actions based on them, they may not increase the fitness of the organism. And if this is so, then it is just not true that a pragmatic representation's carrying information about the action-properties it represents would contribute to the organism's fitness. But as it follows from the definition that a pragmatic representation's carrying information about the action-properties it represents would contribute to the organism's fitness, this means that the version of teleosemantics I outlined is not tenable.

Here is an example: Suppose that you throw a hand grenade at me and I catch it. My pragmatic representation makes it possible for me to catch this hand grenade: I attribute the correct spatial location property to the grenade that allows me to reach out in the right direction. I attribute the correct size property that allows me to form the appropriate grip size. And so on. The correctness of my pragmatic representation is responsible for the success of my action of catching the hand grenade. But, as a result of this successful action, I die. Carrying information about the relevant action-properties does not increase my fitness. Nonetheless, my pragmatic representation represents these relevant action-properties correctly. We seem to have found a counterexample to the explanatory scheme of teleosemantics I outlined above.

Or, have we? It would be difficult to deny that carrying information about the relevant action-properties does not increase my fitness in the actual world. But what fixes function and, as a result, mental content is not the actual world, but the nearby possible worlds. And carrying information about the relevant action-properties does increase my fitness in some nearby possible worlds.

In order to duck and avoid being blown up by the hand grenade would also require a pragmatic representation that carries information about the relevant action-properties. The problem with the actual world is that my pragmatic representation is connected to the wrong beliefs/desires. In other words, my pragmatic representation is malfunctioning in the actual world. But it does have the function, fixed by the nearby possible worlds, to carry information about the action-properties of the hand grenade. There is no contradiction here. The Problem of Stupid Actions is not a problem for my version of teleosemantics.

7. Conclusion. Finally, it is important to emphasize again the modesty of my proposal. Even if the explanatory scheme I put forward in this paper does work, we still have a lot to do in order to explain the content of our mental states in general. If the argument I presented here is correct, then the content of pragmatic representations can be explained in terms of teleosemantics. Whether and in what way the content of all other mental states can be explained is a different question; nothing I have said here helps us with that task. But if we do manage to explain the content of pragmatic representations with the help of the explanatory scheme of teleosemantics, then at least we have a good starting point.

REFERENCES

Bach, Kent. 1978. "A Representational Theory of Action." *Philosophical Studies* 34:361–79.

Beckner, M. 1959. *The Biological Way of Thought*. New York: Columbia University Press.

Bigelow, J., and R. Pargetter. 1987. "Functions." *Journal of Philosophy* 84:181–97.

Braddon-Mitchel, David, and Frank Jackson. 2002. "A Pyrrhic Victory for Teleonomy." *Australasian Journal of Philosophy* 80:372–77.

Brand, Myles. 1984. *Intending and Acting*. Cambridge, MA: MIT Press.

Burge, Tyler. 1989. "Individuation and Causation in Psychology." *Pacific Philosophical Quarterly* 70:303–22.

Butterfill, Stephen, and Corrado Sinigaglia. Forthcoming. "Intention and Motor Representation in Purposive Action." *Philosophy and Phenomenological Research*.

Clark, Andy. 1997. *Being There: Putting Brain, Body and World Together Again*. Cambridge, MA: MIT Press.

Cummins, Robert. 1975. "Functional Analysis." *Journal of Philosophy* 72:741–65.

———. 2002. "Neo-Teleology." In *Functions*, ed. Andre Ariew, Robert Cummins, and Mark Perlman, 157–73. Oxford: Oxford University Press.

Davies, Paul Sheldon. 2000. "Malfunctions." *Biology and Philosophy* 15:19–28.

———. 2001. *Norms of Nature: Naturalism and the Nature of Functions*. Cambridge, MA: MIT Press.

Dennett, Daniel C. 1996. "Cow-Sharks, Magnets and Swampmen." *Mind and Language* 11:76–77.

Dretske, Fred. 1988. *Explaining Behavior.* Cambridge, MA: MIT Press.

Godfrey-Smith, Peter. 1991. "Signal, Decision, Action." *Journal of Philosophy* 88:709–22.

———. 1994. "A Modern History Theory of Functions." *Nous* 28:344–62.

———. 1996. *Complexity and the Function of Mind in Nature*. Cambridge: Cambridge University Press.

Griffiths, P. E. 1993. "Functional Analysis and Proper Functions." *British Journal for the Philosophy of Science* 44:409–22.

———. 1994. "Cladistic Classification and Functional Explanation." *Philosophy of Science* 61: 206–27.

Grush, R. 2004. "The Emulation Theory of Representation: Motor Control, Imagery and Perception." *Behavioral and Brain Sciences* 27:377–442.

Hommel, Bernhard, Jochen Müsseler, Gisa Aschersleben, and Wolfgang Prinz. 2001. "The Theory of Event Coding: A Framework for Perception and Action Planning." *Behavioral and Brain Sciences* 24:849–931.

Jacob, Pierre, and Marc Jeannerod. 2003. *Ways of Seeing: The Scope and Limits of Visual Cognition*. Oxford: Oxford University Press.

Jeannerod, M. 1994. "The Representing Brain: Neural Correlates of Motor Intention and Imagery." *Behavioral and Brain Sciences* 17:187–245.

———. 1997. *The Cognitive Neuroscience of Action.* Oxford: Blackwell.

Lakatos, Imre. 1970. "Falsification and the Methodology of Scientific Research Programmes." In *Criticism and the Growth of Knowledge*, ed. Imre Lakatos and Alan Musgrave. Cambridge: Cambridge University Press.

———. 1974. "Science and Pseudoscience." In *Philosophy in the Open*, ed. Godfrey Vesey, 96–102. Milton Keynes: Open University Press.

Lewens, Tim. 2004. *Organisms and Artifacts*. Cambridge, MA: MIT Press.

Lewis, David. 1973. *Counterfactuals*. London: Blackwell.

Mandik, Pete. 2005. "Action Oriented Representation." In *Cognition and the Brain: The Philosophy and Neuroscience Movement*, ed. Andrew Brook and Kathleen Akins, 284–305. Cambridge: Cambridge University Press.

Millikan, Ruth G. 1984. *Language, Thought and Other Biological Categories*. Cambridge, MA: MIT Press.

———. 1996. “On Swampkinds.” *Mind and Language* 11:103–17.

———. 2004. *Varieties of Meaning*. Cambridge, MA: MIT Press.

Mills, S., and J. Beatty. 1979. “The Propensity Interpretation of Fitness.” *Philosophy of Science* 46:263–86.

Nanay, Bence. 2006. “Symmetry between the Intentionality of Minds and Machines? The Biological Plausibility of Dennett’s Account.” *Minds and Machines* 16:57–71.

———. 2010. “A Modal Theory of Function.” *Journal of Philosophy* 107:412–31.

———. 2011a. “Do We Perceive Apples as Edible?” *Pacific Philosophical Quarterly* 92:305–22.

———. 2011b. “Function, Modality and Mental Content.” *Journal of Mind and Behavior* 32:84–87.

———. 2012a. “Action-Oriented Perception.” *European Journal of Philosophy* 20:430–46.

———. 2012b. “Function Attribution Depends on the Explanatory Context: Reply to Neander and Rosenberg’s Reply to Nanay.” *Journal of Philosophy* 109:623–27.

———. 2013a. *Between Perception and Action*. Oxford: Oxford University Press.

———. 2013b. “Success Semantics: The Sequel.” *Philosophical Studies* 165:151–65.

———. 2014. “ ‘Every Act an Animal Act’: Naturalizing Action Theory.” In *New Waves in Philosophy of Mind*, ed. M. Sprevak and J. Kallestrup, 226–41. London: Macmillan.

Neander, Karen. 1991a. “Functions as Selected Effects.” *Philosophy of Science* 58:168–84.

———. 1991b. “The Teleological Notion of ‘Function.’ ” *Australasian Journal of Philosophy* 69:454–68.

———. 1996. “Swampman Meets Swampcow.” *Mind and Language* 11:118–29.

———. 2002. “Types of Traits. Function, Structure, and Homology in the Classification of Traits.” In *Functions*, ed. Andre Ariew, Robert Cummins, and Mark Perlman, 402–22. Oxford: Oxford University Press.

———. 2006. “Content for Cognitive Science.” In *Teleosemantics*: *New Philosophical Essays*, ed. Graham Macdonald and David Papineau, 167–94. Oxford: Oxford University Press.

Neander, Karen, and Alex Rosenberg. 2012. “Solving the Circularity Problem for Functions: A Response to Nanay.” *Journal of Philosophy* 109:613–22.

Norman, J. 2002. “Two Visual Systems and Two Theories of Perception.” *Behavioral and Brain Sciences* 25:73–144.

Pacherie, E. 2011. “Nonconceptual Representations for Action and the Limits of Intentional Control.” *Social Psychology* 42:67–73.

Papineau, David. 1993. *Philosophical Naturalism*. Oxford: Blackwell.

———. 1996. “Doubtful Intuitions.” *Mind and Language* 11:130–32.

———. 2001. “The Status of Teleosemantics; or, How to Stop Worrying about Swampman.” *Australasian Journal of Philosophy* 79:279–89.

Searle, John. 1983. *Intentionality.* Cambridge: Cambridge University Press.

Sterelny, Kim. 1990. *The Representational Theory of Mind*. Oxford: Blackwell.

Walsh, D. M. 1996. “Fitness and Function.” *British Journal for the Philosophy of Science* 47: 553–74.

Wright, L. 1973. “Functions.” *Philosophical Review* 82:139–68.