

# The Varieties of Darwinism: Explanation, Methodology, and World-View

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## Abstract

Ever since its inception, the theory of evolution has been reified into an “-ism” and applied widely. Today, Darwinian thinking proliferates across the sciences and humanities, and informs participants in policy and public debates. But what exactly *is* Darwinism? Against a thin conception of Darwinism, where the term only refers to a scientific theory and only has scientific content, in this paper we propose a thick conception on which the scientific dimension of Darwinism feeds into its dimensions of methodological as well as ethical normativity. The full meaning of Darwinism, as well as how this meaning has changed over time, can only be understood through the complex interaction between these three dimensions.

*“What is Darwinism? This is a question which needs an answer. Great confusion and diversity of opinion prevail as to the real views of the man whose writings have agitated the whole world, scientific and religious” – Charles Hodge in 1874*

## 1. Introduction

Darwin’s *On the Origin of Species* was in the first place a scientific work. It introduced the theory of natural selection that explained how adaptive complexity arose over long periods of time. It also established the tree of life hypothesis: a common ancestor evolved and diverged into all extant species. However, the ideas present in the *Origin* also spawned talk of

“Darwinism” in a much broader sense, both within the scientific community and in the public discourse. In the century and half that followed the book’s publication, Darwin’s ideas have been used not only used to advance evolutionary approaches in economics, anthropology, linguistics, or history. Darwinism was also used and abused to undermine religiously inspired ideas about the origin of humans and their status in relation to other species, to support state-sponsored eugenicist policies, and to support a laissez-faire (and more recently, neoliberal) economic policies. This ethical-political manifestation of Darwinism changes over time but does not seem to disappear. An instance of a current controversy concerns the extent to which Darwinian ideas can be used to account for sex and gender differences (see e.g. Horgan 2017).

Even just this short history prompts the question, what exactly *is* Darwinism? The history of the reception of Darwin’s ideas invites skepticism that this question can even be answered. The first book-length analysis of the question “What is Darwinism?” dates back to 1874. It responded to what the author judged to be the “confusion and diversity of opinion” that Darwin’s ideas had produced (Hodge 1874). A very same judgment would not be out of place today. And yet, while still not much clarity has been achieved on the exact content and scope of Darwinism, it is clear that we continue to be wedded to the term and to treat it as if it had a relatively circumscribed meaning. “Darwinian” approaches continue to proliferate in the biomedical sciences, social sciences and humanities (in sociology, economics, medicine, psychology, anthropology, history, linguistics, and other fields), and even in the engineering sciences, computation, robotics, or electronics.

Darwinism also continues to seep into a broad range of policy discussions and public discourse. Some continue to promote the “survival of the fittest” as a societal norm, whether in context of economic policy (Bannister 2010), managerial approaches (e.g. McLean and Elkind 2013), or even science policy.<sup>1</sup> Others, of different political persuasion, foreground what Darwin said about the cooperation, morality, and culture in human evolution (Darwin 1871, chapter 5). Thus a “left-wing Darwinism” has been promoted as well, where cooperation is emphasized over competition (Singer 2000), and community over the individual (Wilson 2019).<sup>2</sup> In sum, while the term “Darwinism” may be very difficult to pin down, it continues to

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<sup>1</sup> For instance, in recent efforts in France to reform incentives in science and academia, a leading policy maker proposed: “We need an ambitious, unequal law - yes, unequal, a virtuous and Darwinian law, which encourages the most successful scientists, teams, laboratories, establishments on an international scale, a law which mobilizes energies.” (*Le Monde.fr* 2019)

<sup>2</sup> Add to main text (too long for introduction): Reference Piers Hale: there’s a whole tradition of leftist Darwinian thinkers. *Political Descent: Malthus, Mutualism, and the Politics of Evolution in Victorian England.*> Thus, at the start of the twentieth century Peter Kropotkin (1902)

be used and we cannot avoid the question whether there is any unified meaning underlying these usages – and if not, why not.

One approach, in face of the many uses and abuses, applications and distortions of Darwin's ideas, would be to introduce a firewall between strictly scientific instances of Darwinism and the ethically and politically laden versions of Darwinism. This approach would identify the core meaning of Darwinism to its purely scientific uses, and categorize other ethical-political uses as merely rhetorical or even manipulative uses of science. As an instance of this view, Gould once proposed that “the term [Darwinism] should be restricted to the body of thought allied with Darwin's own theory of mechanism” (Gould 1982, 380).

We call this the “thin” or “value-neutral” conception of Darwinism. It labels Darwinian-inspired discourse or policy, such as Darwinian eugenics or Darwinian communitarianism, as extra-scientific: they add ethical-normative claims to the scientific core of evolution by natural selection and descent with modification.

While a thin conception of Darwinism appears attractive, we will argue that it is inadequate as a representation of Darwin's own ideas and of how these were received by his contemporaries (section 2). In contrast to such a thin conception, this paper will explicitly endorse and outline a “thick” understanding of Darwinism, one where the scientific, ethical, and political dimensions are understood to constitute the intrinsic meaning of Darwinism. In other words, the ethical-normative usages of Darwinism are not extrinsic instrumentalizations of some “core” Darwinism: they reflect what Darwinism *is*.

One potential worry we would like to anticipate from the outset is whether going down the path of a thick account of Darwinism will lead to some kind of naturalistic fallacy, confusing is with ought. The history of Darwinism is replete with such confusions, and we will make clear later on that claims that the theory of natural selection can readily dictate ethical or political choices should be rejected as abuses of Darwinism. Darwinism is not an ethical or political theory. However, Darwinism cannot be said to be entirely free of normative implications either. It straddles the fact-value divide without involving outright naturalistic fallacies. The content of Darwinism readily informs ethical and political deliberation, since some core terms – adaptiveness, function, inheritance – influence how we understand human motivation and human behavior. This is why it can be important for ethicists and social scientists to be informed regarding the scientific details about just how Darwinian processes act especially on the human lineage and how they have acted on our common ancestors.

After examining the thin conception of Darwinism in more critical detail, we will devote the bulk of the paper to describing the varieties in which Darwinism has been

understood, categorizing these into three main categories: Darwinism as an explanatory scheme (the descriptive-explanatory dimension of Darwinism; section 3), Darwinism as logic or methodology (the scientific-normative dimension of Darwinism; section 4), and Darwinism as a world-view or ideology (the ethical-normative dimension of Darwinism; section 5). Armed with this material, in the last section we revisit the question what Darwinism exactly is, and argue why all three dimensions – descriptive-explanatory, scientific-normative, ethical-normative – should be considered as intrinsic to the meaning of “Darwinism”.

## **2. The inadequacy of a thin conception of Darwinism**

Today the most influential thin conception of Darwinism is as a substrate-neutral explanatory template with a set of necessary and sufficient conditions of application. In particular the “Lewontin criteria” of variation, differential reproduction, and heritability, as criteria for the occurrence of natural selection (Lewontin 1970) are most often used in this context. Once these conditions of application are met, some authors argue, Darwinian explanatory structures can be applied to a wide range of phenomena, ranging from the evolution of organisms to that of institutions, ideas, or computer programs. Conversely, when these conditions are not met, then the purported Darwinian approach can be judged to not be “genuinely” Darwinian but instead only involving Darwin’s ideas as a comparatively loose metaphor.

A first reason to reject the thin conception, is that the relation between Darwin’s ideas and its purported ethical and political ramifications have often not been the simple distortion or instrumentalization of a value-neutral scientific view. A textbook example of simple distortion would be tobacco executives congregating and scheming about how they could undermine public trust in oncology research (Oreskes and Conway 2010). Here there is a clear demarcation between what the science says and the intentions or values of the distorters. This model does not work in context of Darwinism. The “distorters” of Darwin’s ideas have often been also the greatest advocates of these ideas. These advocates viewed the scientific and ethical-normative content of Darwinism to be integral parts of the same package.

A first illustration is found in the very coining of the term “Darwinism” in one of the first book reviews of the *Origin*, by Thomas Huxley (Huxley 1860). On one level, Huxley intended the term to refer to the novelty of Darwin’s contributions, comparing their importance even to those of Copernicus. However, on another level, one can surmise that Huxley deemed Darwin’s ideas worthy of an “-ism”, because, like Copernicus’ ideas, he saw their theological implications about humans’ place in the cosmos. In fact, a couple of months after writing that

review, Huxley used Darwin's ideas to debate the Bishop of Oxford about the origin of the human species.

Similarly, another early promoter of Darwin's ideas, Francis Galton, immediately saw the broader normative implications of Darwin's ideas. Galton credited Darwin with saving him from "old fashioned 'arguments from design'" which Galton likened to a "superstition as if it had been a nightmare" (Galton 1869a). For Galton, this meant in particular that Darwin's ideas opened up a path leading towards a (eugenicist) reorganization of society.

Perhaps one could still insist that Huxley and Galton were merely instrumentalizing Darwin's ideas for their own, pre-existing purposes. Even if this is granted, it becomes a question why natural selection possesses this *instrumentalizability*. Not all scientific theories, even those of wide applicability, possess such instrumentalizability. The second law of thermodynamics, for instance, can be formulated with a high degree of abstraction (especially in the second law's statistical formulation) such that its conditions of applicability are much wider than the original context in which the law was formulated (concerning the potential efficiency of steam engines). "Entropic approaches" have spread throughout various scientific domains, including evolutionary biology (Brooks and Wiley 1988). However, the second law has not provoked political or ethical controversy that is comparable to that provoked by the theory of natural selection.

No theoretical physicist has promoted the law of entropy increase in the way biologists have long promoted the theory of natural selection, ranging from Ernst Mayr's remark that "every component in modern man's belief system is somehow affected by Darwinian principles" (Mayr 2000, 83), to Darwin's own assessment that there was "grandeur" to "this view of life" (Darwin [1859] 2008). In fact, Darwin himself arguably was among the first to endorse a broad scope of application of the theory of evolution when he applied it to the origin of the human mind and of morality (Darwin 1871). The fields of psychology and anthropology are the two fields in which Darwinian approaches have been applied most influentially, even though heated controversy (especially regarding evolutionary psychology, cf. e.g. Smith 2020) continues to this day.

The thin conception assumes a neat division between causal-empirical generalizations such as "smoking causes lung cancer" and the way science is used to inform ethics and policy – or abused to manipulate public discourse. It does not seem that Darwin's ideas are like that. They entail looking at the world in a different way. There is an *epistemic normativity* involved: Darwin's ideas can be understood as delineating a way of thinking – a Kuhnian paradigm, one

could say<sup>3</sup> – about reality. There seems also to be *proto-ethical normativity* involved: since Darwin’s ideas have consequences for how the origin of moral norms and even of human rationality should be understood, they seem at least relevant for questions about how we should judge and act. Thus when we point to value-laden dimensions of Darwinism, there are two types of values: values on how to conduct scientific discourse, and values on how to guide action and organize society.

Could one still insist on a thin conception of Darwinism, for instance, by holding that the theory of natural selection is more likely to be instrumentalized than thermodynamics because it merely contingently speaks to human imagination? To such tenacious insistence, we add a third argument: the thin conception of Darwinism ultimately implies that the term “Darwinism” should be eliminated. To continue to speak of an “-ism” implies it is a kind of ideology, and not just an abstract set of conditions of applicability. Some have embraced this consequence, and have indeed called for abolition of the term “Darwinism” to describe the scientific theory (e.g. Scott and Branch 2009). However, this attempt at re-engineering the term has not met with much uptake. The reason for this is precisely that Darwinism is *not* a thin concept, referring merely to value-neutral causal premises.

In sum, the thin conception of Darwinism is silent on the intricacies of how the science of evolution relates to the moral and political domains. It dismisses them, as it were, as intellectual noise that does not fit the model – but it does so at the cost of implying that prominent biologists (and arguably Darwin himself) were confused as to the proper meaning of Darwinism. Moreover the thin conception cannot explain why theory of natural selection is exceptionally often used for moral and political purposes – compared to other canonical theories in the natural science. Finally, the thin conception is self-defeating: if it is true, it undermines the rationale for reifying Darwin’s idea’s into an “-ism”. These are the main reasons, we believe, why it is appropriate to try to make sense of Darwinism as a thick concept. We will lay the groundwork for such a thick concept in the following sections by examining three categories of usage of the term ‘Darwinism’.

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<sup>3</sup> Exploring whether Darwinism can be considered a Kuhnian paradigm would require a separate paper. On the one hand, the extent to which Darwin’s work shaped biology qualifies Darwinism as a paradigm for biology just as much Newton’s or Einstein’s work. However, insofar Darwinism is paradigmatic for guiding thinking about ethics and policymaking, it resembles more the way **in which theories in economics can turn into ideologies (Marx, Friedman, Keynes, etc.). For more discussion of how Kuhnian paradigms can be applied to economics, see (Redman 1991).**

### 3. Darwinism as an explanatory scheme

A first important sense in which ‘Darwinism’ is widely used, is to refer to an abstract explanatory scheme. One rough characterization of this scheme is one where the explanandum is some adaptive state of affairs (e.g., a distribution of traits, or the existence of some complex structure: Lloyd 2021, 3), and the explanans is natural selection. This is one way in which Darwinism thus can simply refer to a *way of explaining* phenomena, and in particular, a way of explaining a particular category of phenomena (adaptive phenomena) by reference to natural selection.

Ostensibly, laying out the structure of Darwinism as explanatory scheme is what the one long argument” of the *Origin* (Darwin [1859] 2008) set out to do.<sup>4</sup> The implicit rival explanatory scheme that the *Origin* sought to undermine was one with the same explanandum (adaptations of organisms to their circumstances) but where the explanans referred to divine agency. Adaptive complexity in particular, such as that manifested by the camera-type eye, was seen as necessitating such a theistic explanatory scheme (as famously argued by Paley in 1802 in his *Natural Theology*) – at least, until Darwin’s theory of natural selection came onto the stage.

While the explanatory structure of Darwinism is very clear when placed in contrast to theistic explanatory structures, it becomes vaguer once one attempts to analyze just how the explanans of natural selection entails the explanandum. Darwin himself spoke of natural selection in terms of the “struggle for existence”, relating it to Malthus’ struggle between the members of human populations. However, The history of evolutionary thinking since Darwin can be understood as revising the basic explanatory scheme of natural selection.

The Modern Synthesis in the 1930s involved one such radical revision. The so-called “Lewontin criteria” are one influential way of formalizing just how the Modern Synthesis revised how natural selection explains, namely in virtue of three criteria: (1) variation, (2) associated fitness differences, and (3) heritability. Thus, in order to use natural selection to explain why an extant population has a certain observed property, one needs to be able to posit three claims. First, an ancestral population where some individuals possessed property A but

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<sup>4</sup> Part of this admittedly concerned the establishing of the *fact* of evolution (or transmutation of the species, as Darwin called it); however, what his contemporaries took as specifically “Darwinian” (think of Huxley or Galton) concerned the theory of natural selection

others possessed other properties B, C, D, etc. Second, these properties needed to have caused to cause some individuals to reproduce more successfully than others. Third, these properties need to be transmitted to the next generation. Only then can one potentially explain how the population with A evolved by natural selection. (A similar, but more detailed, set of criteria is presented by Lloyd, 2021: 5.) This characterization of natural selection is clearly universalizable, as it only involves abstract criteria and no specification of the material basis of selection processes, and it has not only been applied to the evolution of individuals, groups, or species in the biological domain (Wilson 1975), but also beyond (Hodgson and Knudsen 2006).

The transition from the “historical Darwinism” to the “Darwinism of the Modern Synthesis” already raises questions about what precisely the common elements are of these two explanatory structures. There has been much discussion on this respect, since natural selection in the Modern Synthesis is no longer fleshed out in terms of a causal “struggle” or “competition” between organisms, species, or between organisms and their abiotic environment – but rather in statistical terms, of two subpopulations (or organism types) reproducing at varying rates (Matthen and Ariew 2002; Lewens 2010). This has been viewed as raising perplexing questions about the causal status of the concept of natural selection in the Modern Synthesis (following Matthen and Ariew 2002; Walsh 2000)

However, there is no reason to believe that these two exhaust the possibilities of analyzing the explanatory structure of natural selection. We will limit the discussion in this section to just two further examples. One is Dawkins’s distinction between replicators and interactors as a different way of analyzing natural selection. Since genes are the main replicators in this view of natural selection, it is sometimes termed the “gene’s-eye view” (Dawkins [1976] 2006). This view of natural selection gives different criteria for deciding when a selectionist explanation is applicable. For natural selection to occur, there must be a clear distinction between replicating entities (genes, memes) and interacting entities (organisms, minds). Dawkins even dubs his view the “Darwinian View of Life”, suggesting that he thought of his analysis of natural selection as the “true” Darwinism (Dawkins 1996).

As a final example, we would like to mention the Extended Evolutionary Synthesis, which arguably involves a different conception of natural selection yet again. Just how fundamentally different it is from the Modern Synthesis’s natural selection is debated (cf. Laland et al. 2015), but one overarching theme is that the organism is conceptualized as playing a more active causal role in evolution: the organism shapes the selective environment (niche

construction), and the organism can adapt to its circumstances without any natural selection (phenotypic plasticity).

In this way, the multitude of distinct types of “Darwinian explanation”, shows how difficult it is to pin down the meaning of ‘Darwinism’ even when we would restrict the usage of the term to the context of biological evolution alone. This is a further illustration of how a thin conception of Darwinism does not resolve all perplexities regarding the term. There are multiple ways of construing Darwinism, depending on just how precisely the structure of explanations by natural selection is conceived. We have discussed four views of the explanatory structure of Darwinian explanations: selection as the struggle for existence between organisms (Darwin); selection as revolving around the triplet of variation, fitness differences, and heritability (Lewontin); selection as replicator-interactor dynamics (Dawkins); and selection as crucially affected by the actions of organisms (Extended Synthesis). While these views are related to each other and can be combined in various ways, they still yield fundamentally different view of how Darwinism explains biological phenomena. Also, Darwin’s view and the Extended Synthesis view, both giving organism pride of place, seem much more restricted to the biological domain than the fundamentally abstract conceptions centered on Lewontin’s criteria or Dawkins’s replicator-interactor framework.

To further complicate matters, biologists in fact will very seldomly (if at all) refer to ‘Darwinism’ as a clarificatory of their scientific investigation or their explanatory scheme. In the context of evolutionary investigation, the term ‘Darwinism’ is simply too vague as a denotation of a particular type of explanation, as it allows for a variety of views of what Darwinian explanations exactly are. Biologists will use more precise terms to indicate the relevant explanatory factors in their explanations, such as ‘fitness differences’, ‘heritability’, or ‘levels of selection’. One must conclude from this, somewhat paradoxically, that the term ‘Darwinism’ has a clearer meaning when it is used outside the biological context, where the term is usually contrasted with other approaches available in the domain of investigation and Darwinian approaches are sufficiently distinct from rival explanatory schemes. The contrast with other approaches is what illuminates the nature of a Darwinian approach. This was the case when Darwin first introduced the selectionist explanatory scheme (to contrast with theistic explanatory schemes), and continues to be so today as Darwinian approaches are introduced in novel fields.

In sum, from the preceding overview it follows that the descriptive-explanatory dimension of Darwinism is thoroughly pluralistic: ‘Darwinism’ denotes a broad style of explaining phenomena, but is not associated with one specific explanatory structure. In the

following sections we will show how one can help make sense of this plurality by involving the other dimensions of Darwinism.

#### 4. Darwinism as logic or methodology

this would mean that we may say more explicitly what ‘values’ are here involved. Given that many darwinisms are possible, i’d say that there is no ‘one set’ of values, but rather several values that can be pushed, each in its turn. For instance, ‘adaptation’ is a value in some brands of darwinism (eg think of Dawkins); in other ones, Diversity is a value.

**Good suggestion – and there needs to be more clarity on what “values” are involved. I referred to ethical/political values, but there are also theoretical values with regard to what concept is foregrounded. The big bifurcation can to some extent be traced back to the two elements in the Origin: adaptation & convergence vs. common ancestry & divergence.**

The preceding analysis of the descriptive-explanatory dimension of Darwinism – i.e., how Darwinism is sometimes used to highlight a particular explanatory scheme – leads to a second dimension that is closely connected to the first one: the scientific-normative dimension of Darwinism. Unlike the ethical-normative dimension, which concerns the prescriptive force of Darwinism for how human social behavior should be organized (through norms and policy), this scientific-normative force of Darwinism prescribes how scientific research (observation, explanation, hypothesizing, etc.) should be conducted.

This is the sense in which Darwinism can refer to a ‘logic’ or a ‘methodology’. Here we use ‘logic’ in its informal sense, to refer to a style of reasoning. Such a style of reasoning may be subsequently formalizable. And in fact, the scientific style of reasoning and investigation (i.e., scientific methodology) was subject to many such efforts at formalization by the early and mid-20<sup>th</sup> century philosophers of science, such as Hempel and Popper. The difference between Darwinism as logic and Darwinism as an explanatory scheme is that in the former, the explanatory structure of the theory of natural selection is set as an *scientific-normative ideal* while in the latter it is simply taken as a given. Such an ideal, much like a Kuhnian paradigm, should provide guidance for the scientist on how to investigate puzzling phenomena: what properties to investigate (e.g., variation, heritability, tree-like descent with modification, replication, interaction, etc.) and how to relate these properties in a coherent explanation.

Not every scientific theory can claim the status of being a “logic”. Though it is a separate question why precisely some theories – but not others – go on to inspire whole research programs, it is clear that this difference exists. Especially the theory of natural selection and the tree of life hypothesis have inspired research in other domains, as illustrated by the list below.

<b>Evolutionary domain</b>	<b>Illustrative references</b>
evolutionary economics	(Nelson and Winter 1982; Hodgson 2019; Witt 2014)
evolutionary anthropology and cultural evolution theory	(Boyd and Richerson 1985; Richerson and Boyd 2005; Mesoudi 2011; Mesoudi, Whiten, and Laland 2006)
evolutionary sociology	(Dietz et al., 1990; Hopcroft, 2016; Turner & Machalek, 2018) <sup>5</sup>
evolutionary psychology	(Barkow et al., 1992; Buss, 1995; 2008)
evolutionary literary studies	(Carroll, 2004; Gottschall & Wilson, 2005),
evolutionary archaeology	(Maschner, 1996; Barton & Clark, 1997)
evolutionary history	Stuart-Fox, 2002; Russell, 2011
evolutionary medicine	(Nesse & Williams, 1995; Nesse & Stearns, 2008; Stearns, 2012; Rühli & Henneberg, 2013)
evolutionary computation	(Mitchell & Taylor, 1999; Eiben & Smith, 2015),
evolutionary electronics	(Zebulum et al., 2002; Haddow & Tyrrell, 2011),
quantum Darwinism	(Blume-Kohout & Zurek 2006; Zurek 2018)
evolutionary epistemology	Popper, 1972; Campbell, 1974; Gontier & Bradie, 2021
evolutionary ethics	(Ruse, 1986; Joyce, 2006)
evolutionary aesthetics	(Volland & Grammer, 2003; Kozbelt, 2017)
philosophy of the evolution science and technology	(Hull, 1980; 1988; Ziman, 2000; Brey, 2008; Mesoudi et al., 2013; Scerri, 2016)

Table 1: Evolutionary approaches have invaded a broad swathe of domains in the social sciences and humanities, but also in medicine and engineering.

Whether it concerns the evolution of firms, scientific theories, or fashion trends, it seems that Darwin’s ideas have been applied to at least some effect.

In the thick conception of Darwinism, Darwinism-as-logic is considered to be an *intrinsic* part of what Darwinism means. To call some approach “Darwinian” means more than some historical explanatory scheme: it also refers to a type of thinking or reasoning about empirical phenomena that that historical explanatory scheme exemplified.

This dimension of the thick conception goes back to the very initial stages of the reception of Darwin’s ideas. The very first mention of the term ‘Darwinism’ occurred in a passage where Huxley worried whether Darwin’s ideas were *too* elegant, *too* simple, and

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<sup>5</sup> References in the table are missing from this row and below.

therefore too little restrictive with respect to the explanations it allowed. He asked: “What if the orbit of Darwinism should be a little too circular?” (Huxley 1860). In other words, what if evolutionary change wasn’t as simple as Darwin described it and Darwin’s work eventually was to be superseded by the work of a biological Kepler? The worry about empirical adequacy reveals the great attractiveness of Darwin’s ideas of natural selection: namely their simplicity and elegance. Moreover, Huxley was one of the first to apply this simple and elegant thinking to other domains, as is evident in his remark: “The struggle for existence holds as much in the intellectual as in the physical world” (Huxley 1880, 15–16). In other words, Huxley surmised very early on that natural selection is in principle not just applicable to competing biological species, but also competing scientific theories. In this way, he anticipated much later work on an evolutionary perspective on scientific change (Hull [1988] 2010; Smaldino and McElreath 2016).

Nonetheless, the inescapable question with a phrase as richly metaphorical as “the struggle for existence” is whether it is simply just that: a metaphor. When Huxley intimated how the struggle for existence could be applied to the realm of ideas, was this a mere instrumentalization of Darwin’s ideas, or was it a developing of Darwin’s ideas: an unfolding, as it were, of their intrinsic intellectual and scientific potential? Similarly, with respect to the other explanatory schemes associated with Darwinism the question arises whether central concepts, such as ‘fitness difference’, ‘replicator’, ‘interactor’, or ‘niche construction’, are used with the same meaning in fields outside biology as in biology itself, or we see metaphorical and analogical usages when non-biological phenomena are under investigation.

The loosest relation between Darwin’s ideas and subsequent applications to other fields is that Darwin’s ideas are merely relevant for the context of discovery. For instance, playing Mozart’s violin sonatas may have been important for the context of how Einstein had the idea for general relativity. The sonatas may have *caused* the novel theories and explanations to take shape, but in no way do those sonatas do any explanatory work in special or general relativity. The relation between Darwin’s ideas and Darwinian approaches in non-biological fields is clearly not like that. However, there are more moderate types of relation, in between the extremes of rigorous generalization and mere metaphorical inspiration. For instance, some authors have argued that the relation is one of as loosely structured research program, that at most “modestly unifies” biological evolution and other evolution in other domains (Reydon 2021).

Others have argued that what is distinctively Darwinian about evolutionary approaches is that individual entities are being modeled as members of populations. This “population

thinking” (as opposed to typological thinking: Mayr 1976; see also Ariew 2008) is what underlies the theory of natural selection, and is what allows it to be applied to so many different domains. Indeed Reydon & Scholz (Reydon and Scholz 2009; 2015) criticized the research programs of Organizational Ecology in organizational science and Generalized Darwinism in economics and institutional social science on precisely this point: these programs, Reydon and Scholz argued, lack an adequate population concept that would enable them to implement “population thinking” in their research and consequently cannot count as instances of Darwinism.

To systematize, it is helpful to distinguish between two questions here, one pertaining to the relation between Darwinism-as-explanation and Darwinism-as-logic, and the other to how Darwinism-as-logic is applied to new fields. For instance, the theory of natural selection took shape in a specific explanatory context – to explain organisms’ adaptations to their environments – and this was quickly intimated by Huxley and others to refer to a logic. Here one can enquire about the specific features of the theory of natural selection, and to what extent these features can define a logic (e.g., variation, heritability, fitness). However, one can ask separately about how such a logic is being applied to a new field: are the conditions of applicability met?

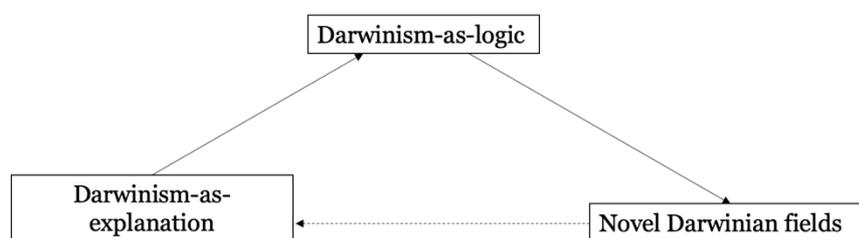


Figure 1: Systematizing how Darwinism-as-explanation and Darwinism-as-logic influence each other.

Acknowledging the scientific-normative dimension of Darwinism is not just useful to understand the early reception of Darwin’s ideas (by e.g. Huxley) as well as their more recent broad application across scientific domains, but it is also useful to understand sociological developments *within* biology itself. Until now we have presented Darwinism’s scientific-normative status within evolutionary biology as uncontested – the only question pertaining to how precisely the explanatory structure of Darwinism should be defined. However, it is more accurate to trace how it took time for Darwinism to regain this status. Huxley, Galton and others

may have quickly seen the potential of Darwinism to revolutionize biology (and beyond), but not all naturalists did.

Early objections played some role in this, such as Jenkin’s swamping argument (Jenkin 1867) which purported to show that the winnowing effect of natural selection was incompatible with the fact that large variation remains in most natural populations. The traditional story here (though not uncontested: Bulmer 2004) is that this was a genuine anomaly for Darwin’s theory of natural selection. According to Julian Huxley, it resulted in the “eclipse of Darwinism” (Huxley 1942). Only subsequently did Jenkin’s counterargument turn out to be a merely apparent falsification, depending on a mistaken hypothesis concerning the mechanism of inheritance. After the rediscovery of Mendel’s work in 1900 (independently by de Vries, Correns, and von Tschermak), and more definitively after the 1920s and 1930s through the integration of Mendelism with natural selection by Fisher, where those worries laid to rest. The discovery of the double helix structure of DNA in 1953, and the subsequent development of molecular biology, further served to remove this source of doubt concerning the theory of natural selection.

Thus, it took some decades for Darwinism-as-logic to be established within the context of evolutionary biology. In fact, “evolutionary biology” was initially not a recognized subdiscipline within biology. This restructuring of the biological communities took another few decades. Until the second half of the 20<sup>th</sup> century, biologists using Darwinist methods were housed in zoology and botany departments, natural history museums, or genetics labs (Huneman 2019). There were no “evolutionary biology departments” until the late 1960s and early 1970s.<sup>6</sup> Disciplinary journals were also a surprisingly late development. For instance, the journal *Evolution* was launched in 1947, almost a century after the publication of the *Origin*.

Arguably, the wide acceptance of Darwinism as a sound logic or scientific methodology only occurred in the second half of the twentieth century. Doubts concerning the precise scientific status of the theory of natural selection remained – Popper famously called it a “metaphysical research program” rather than a testable scientific theory (Popper [1974] 2021). Indeed, the charge of pseudoscience is never very far off, and there is some degree of internal policing to make sure that the Darwinian logic is not overapplied. Gould’s and Lewontin’s

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<sup>6</sup> The University of Arizona, for example, claims that its Department of Ecology and Evolutionary Biology, founded 1975), was one of the first of its kind “pioneering a model for the organization of biology now used in many of the world’s leading universities” (University of Arizona 2019). Harvard University set up a Committee for Organismic and Evolutionary Biology in 1971, which became a department in 1982. Stony Brook University’s Department of Ecology and Evolution was founded in 1969 “and was one of the first departments of its kind in the world” (Stony Brook 2022).

critique of “adaptationism” (Gould and Lewontin 1979) is an instance of how illegitimate applications of Darwinism have been critiqued within the field of biology. Today, as Darwinian ideas are applied to new domains, it is plausible that at least some of these applications involve an overextension of Darwinism. For instance, evolutionary psychology has been accused of involving too strong an adaptationist perspective (Buller 2005), and some versions of evolutionary institutional economics have been critiqued as an overextension of the Darwinian logic (Reydon and Scholz 2009; 2015).

If one were to translate this discussion into terms of Figure 1, it would seem that the relation between Darwinism-as-explanation and Darwinism-as-logic, even though it was rapidly intuited by some, took almost a century to become established. Darwin’s original scheme (especially the explanatory structure of natural selection, connecting struggle and adaptation) was immediately influential, but it took time before it adopted the status of a trustworthy explanatory and methodological ideal that could guide investigation of biological phenomena more generally.

To complete the discussion of how the explanatory-descriptive and scientific-normative dimensions relate, one would need to acknowledge how novel applications of the logic of Darwinism led to revised accounts of just how the theory of natural selection explains. The development of the Modern Synthesis illustrates how applying Darwinism to a novel domain can transform the core concepts of fitness and natural selection. The Modern Synthesis, at least in the hands of Ronald Fisher, was less directly motivated by the purely intellectual goal of synthesizing Darwinism and Mendelism, but rather by eugenic and agricultural goals: to statistically analyze biometrics or “the causes of human variability” (Fisher 1919) and to analyze the causes of variations in crop yields. (Anecdotally, Fisher apparently hesitated whether to pursue science or farming: Kruskal 1980.) In other words, applying Darwinian ideas to novel domains – the statistical analysis of patterns of heritability in human populations or crops – ultimately transformed the original Darwinian ideas, and so it is perhaps not so surprising that the development of Darwinism as a logic eventually led to a revision of what Darwinism as explanatory scheme meant.

If history is a guide, new applications of Darwinism today may lead to future revisions in how we understand fundamental concepts such as natural selection and fitness. Some initial signs of this can be seen in the emerging Extended Evolutionary Synthesis where, among other changes, a greater causal role is attributed to the organism, for instance, through niche construction and phenotypic plasticity. To its proponents, these new applications to domains

of development and ecology suggest that the fundamental understanding of fitness and natural selection should be revised (cf. Laland et al. 2015).

In sum, in light of the history of the reception of Darwin's ideas, it seems fair to say that Darwinism refers to more than just a historical scientific theory, but also to a logic or methodology that can structure scientific enquiry. However, this same history cautions against any simplistic essentialization of Darwinism-as-logic, since common understandings of it have shifted over time. Moreover,

In this way, 'Darwinism' refers to a logic or methodology that yet cannot be understood to denote a fixed, unchanging and monolithic way of thinking. 'Darwinism' only very gradually was broadly accepted to denote a logic or scientific methodology, and in the process influenced how the explanatory structure of Darwinism was understood. The Modern Synthesis version of Darwinism was different to Darwin's own version; the Extended Synthesis version seems to differ to than the Modern Synthesis's version, and it is not likely that the Extended Synthesis, should it be established, will be the last word. Nonetheless, in pointing to the historical pluralism of the meaning of Darwinism, we do not wish to endorse a relativism concerning the term. The pluralism is bounded boundaries (i.e., some family resemblance to Darwin's ideas remains), and the history of Darwinism does seem to settle on determinate meanings for at least some time. A pure pluralism would also undermine Darwinism's normative dimension. Darwinism-as-logic entails a difference between better and worse ways of setting up a scientific enquiry or between well-supported and ill-supported ways of constructing a Darwinian explanation in a new field. This is only possible when the logic of Darwinism can be assigned operationalizable conditions of applicability.

In this way, a complex picture of Darwinism emerges, where the two elements of explanation and logic interact with each other, changing each other over time, but yet where the change of course happens within boundaries (i.e., some family resemblance to Darwin's ideas remains) and moreover is interspersed with periods of relative stasis. We will now examine the third dimension of Darwinism and draw an even more multi-faceted picture.

## **5. Darwinism as World-view**

While it took decades for Darwinism's status as a scientific methodology – i.e., as a logic or a systematic way of thinking that can be applied to domains far beyond biology – to be established, Darwinism's perceived ethical and political significance arose much more quickly, first with its perceived theological implications (consider the famous debate between Thomas

Henry Huxley and Bishop Wilberforce in 1860) and then with its use in eugenic policies (as for instance advocated by Darwin's cousin Francis Galton).

Several authors have pointed to historical reasons for which Darwinism came to be a worldview – and the specific *kind* of worldview it is – as well as an explanatory scheme and a logic. For instance, Mary Midgley highlighted this strong value-laden aspect of Darwinism: “[t]he theory of evolution is not just an inert piece of theoretical science. It is, and cannot help being, also a powerful folk-tale about human origins” (Midgley, 2002: 1). Moreover, “[e]volution [...] is the creation myth of our age. By telling us our origins it shapes our views of what we are. It influences not just our thought, but our feelings and actions too, in a way which goes far beyond its official function as a biological theory” (Midgley, 2002: 33). According to Midgley, this is due to the specific intellectual background of the mid-nineteenth century, that fitted well with Darwin's ideas. Thus, the specific historical environment in which Darwin's ideas saw the light “explains why Darwin's views, when they appeared, were put to such extraordinary use. The existing intellectual furniture provided a powerful optical illusion, making the doctrine of survival of the fittest look like the precept ‘each for himself and the devil take the hindmost’. Evolution seemed to endorse egoism and, thereby, unbridled capitalism. Despite protests from both scientists and philosophers, people still find this interpretation almost irresistible.” (Midgley, 2002: 172). On Midgley's account, then, Darwinism became a worldview of a particular kind because the biological ideas it rests on were made public within a particular social and intellectual context. Had this context been different, these ideas would probably have been interpreted differently and Darwinism would have been a worldview of a different kind. Note, however, that on Midgley's view Darwinism would always have been a worldview of *some* sort.

Another reconstruction of Darwinism-as-worldview is given by Michael Ruse. According to Ruse, evolutionary thinking encompasses different elements, one being a scientific element and the other a worldview element. Ruse reserves the name ‘Darwinism’ for the latter and goes as far as claiming it acts as a “secular religion” (Ruse, 2019: x; 40; 186). As Ruse writes: “there is a side to Darwinian thinking, what I refer to as Darwinism, that functions as a religion, or if you prefer, a secular religious perspective” (Ruse, 2019: 213) that in fact constitutes “a religious alternative to Christianity” (Ruse, 2019: 141). On Ruse's (2019: Chapter 2) account, Darwinism was able to assume the role of secular religious alternative to Christianity, because Darwin's work deeply roots in Christian religious thought. As Ruse points out, Darwin grew up in a specific religious context – Victorian England with a strong presence of various kinds of Christianity, most importantly the Anglican Church –, he studied

for a while (after he had abandoned his medical studies) to become an Anglican priest, and was more generally influenced by the Anglican version of Christianity by studying at the University of Cambridge, “a Church of England institution where many of the teachers and professors were ordained priests” (Ruse, 2019: 21). As Ruse convincingly shows, much of Darwin’s scientific thinking exhibits ways of thinking and concerns found in the religious context in which he grew up and studied.

Both Midgley’s and Ruse’s narratives show ways in which Darwinism can become a “worldview” – a set of statements about the nature of human beings that influence both ethical and political deliberation. Midgley emphasizes how Darwin’s ideas resonated with the spirit of his time; Ruse emphasizes how Darwin’s way of thinking was rooted in religion and contained traces that made it suitable to assume the role of secular alternative to Christianity. However, the history of 20<sup>th</sup> century evolutionary biology suggests it is not possible to pin down the worldview of Darwinism in terms of specific religious/secular, economic, or social values. Fisher’s study patterns of differential reproduction in human populations and farm crops was motivated by his belief in eugenicist goals (Box and Fisher 1978; Kruskal 1980). John Maynard Smith’s Marxist sympathies influenced how he understood and analyzed the evolution of altruism (Maynard Smith 1997). Richard Levins and Richard Lewontin even devoted a book-length study to a “Marxist” view on biology (Levins and Lewontin 1985).

So while Darwinism-as-worldview does seem to show great variety, our concern here is how it relates to the scientific-normative and explanatory-descriptive dimension of Darwinism. A skeptical take on this relationship would be that Darwinism-as-worldview involves either ideologically motivated actors distorting a scientific theory for their own purposes, or legitimate scientists who allow their idiosyncratic political convictions to play a role in the “context of discovery” (without detracting from scientific legitimacy of the discoveries in the “context of justification”)? In this skeptical view, Darwinism-as-worldview has nothing to do with either Darwinism-as-logic or Darwinism-as-explanation. In other words, in this view, we would have *two* Darwinisms, one for the societal sphere and one for the scientific sphere.

This paper makes the case for a unified understanding of Darwinism, and a particularly important litmus test is the case of eugenics. Eugenics is a crucial case because it was ethically and politically normative and ostensibly justified its prescriptions by reference to evolutionary science (Galton 1869b; 1883). What relation does eugenics have with the scientific theory of natural selection and the Darwinian style of thinking? Can eugenics be categorized as simply based on a misunderstanding or distortion of evolutionary science? This issue is, of course,

very controversial and complicated. One complication, for instance, is how certain versions of eugenics were taken up by Nazi Germany from the 1930s on, even though they were based on beliefs about genetic determinism that had been clearly falsified by then. Nonetheless, even then the question persists about the link between Darwinism and Nazi eugenics. Based on a passage in *Mein Kampf* where some “survival of the fittest” rhetoric is clearly being invoked, Gregory Radick notes that the two extreme views that “Darwinism was somehow responsible for the death camps” and that “Darwinism had nothing to do with the death camps” are “equally unappealing”. The relationship between the two is complex, and while we will not try to disentangle this relationship, we wish only to note that, even in the extreme case of Nazi eugenics, Darwinism-as-logic cannot be straightforwardly cordoned off from Darwinism-as-worldview.

When one turns attention to early eugenics, it becomes yet more difficult to disentangle Darwinism-as-logic from Darwinism-as-worldview. In contrast to the Nazi eugenics of the 1930s, in the early days of eugenics (late 19<sup>th</sup> and early 20<sup>th</sup> century) the mechanism of inheritance was a genuine unknown. The main rationale supporting eugenics relied heavily on theory of natural selection. In particular, for early proponents of eugenics, Darwin’s ideas seemed to clearly imply that the lack of selection pressures in modern society would lead to the “degradation” of “human stock”. In particular, it was seen as problematic that the lower socio-economic classes – which possessed apparently hereditary traits such as “pauperism”, “feeble-mindedness” or “imbecility” (Kevles 1985, 20–21) – were outreproducing the upper classes. The reasoning was that, in a “natural” environment (without the improved nutrition and health care of modern societies), this discrepancy would not be observed, and hence an intervention was needed to change the distribution of traits over a population. In this way, the Darwinian logic *seemed* to justify a host of policy measures all involving “artificial selection” to “counterbalance” natural selection: anti-miscegenation laws, forcible sterilization, and worse.

Note that we are not claiming that Darwinian logic justified (or justifies) the worldview of eugenics – far from it. In fact, Darwinism-as-worldview cannot be pinned down to any segment of the political spectrum. Consider how Darwinian ideas about competition and cooperation have inspired broadly varying policy ideas. Competition is inherent in ideas such as the “struggle for existence” or “survival of the fittest”; cooperation was invoked to explain how altruistic behaviors are so widespread across animal species and especially common in the human species. Insofar policy measures and ethical norms are attempts to regulate patterns of competition and cooperation, it is not surprising that the Darwinian dynamic of competition

inspired those of individualist and neo-liberal leanings, while those of social liberal leanings found support in the dynamic of cooperation (Singer 2000).

The history of the reception of Darwinism shows very varied political worldviews. We wish only to focus on eugenics because it was so dominant in the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, and self-consciously presented itself as based on the science of evolution. The point we wish to make is that early eugenics cannot be dismissed as based on a *misunderstanding* or *distortion* of the theory of natural selection. The 19<sup>th</sup>-century commentators who believed Darwinism gave rise to eugenics turned out to be ultimate *wrong*, but there is a difference between a mistaken belief and a biased or bad-faith distortion of the underlying science (or style of reasoning. The eugenicists lacked relevant facts about heredity, but did not egregiously misrepresent the action of natural selection. In fact, Darwin's own understanding of how natural selection acts in contemporary human populations could easily be interpreted to imply the necessity of eugenic policies – as Darwin wrote: “the reckless, degraded, and often vicious members of society tend to increase at a quicker rate than the provident and generally virtuous members.” (Darwin 1871, 167)

In so doing, we wish to separate the Darwinian sympathies of eugenicists from their adherence to forms of genetic determinism. Genetic determinism can be more straightforwardly analyzed as a distortion of the underlying science of genetics. Genetic determinism can take many forms, depending on how much importance is allowed for phenotypic plasticity and the role of the environment in development. Contemporary forms of genetic determinism typically allow for some plasticity, but look to foreground the role of genes. That was the case, notoriously, some claims about the genetic basis of intelligence (Herrnstein and Murray [1994] 2010) – which goes back to (Jensen 1969) – but also more recently with the emphasis on the “polygenic scores” enabled by the development of genome-wide association studies (GWAS) (Plomin 2018; accused of promoting genetic determinism by Comfort 2018). It seems that genetic determinism continues to have some folkbiological intuitive force – to the extent that educators debate how basic genetics should be taught (Jamieson and Radick 2017). However, while the eugenicist worldview had many faults (both moral and scientific), distorting the specific impact of the principle of natural selection was not one of them.

Even if one grants that Darwinism-as-worldview does not *necessarily* involve a distortion of Darwinism-as-logic or Darwinism-as-explanation, one could still question what the strength of the relation between the two elements is. Even if one would agree with our limited point about the relationship between Darwinism and eugenics, namely that eugenics

cannot be dismissed as a distortion or material misunderstanding of the theory of natural selection, one could still question the kind of support that Darwinism-as-logic offers for (some version of) Darwinism-as-worldview. After all, why should a causal theory of the evolution of some human traits – or some type of population thinking – be invoked to support normative claims about ethics or politics? In this skeptical take, one could acknowledge that Darwinism both can manifest as a logic and as a worldview, but that the relation between the two does not go much further than metaphor. (This is the same question that can be asked of generalizations of Darwinism to novel academic fields.)

While also this is a larger question that would require a much more extensive discussion, we would like to suggest some potential ways in which the relation between logic and worldview can be conceived. It is possible to identify some lines of reasoning where the causal theory of human evolution *informs* ethical reasoning. These lines of reasoning can be thought of as manifestations of a Darwinian “worldview”.

1. By providing selectionist explanations of certain traits or patterns of behavior, Darwinism directly supports certain specifications of what “normal” traits are or “normal” patterns of behavior. Such concepts of normality inform ethical reasoning about whether the causal-evolutionary normality should be endorsed or rejected as an ethical norm. Examples:
  - i. Altruism and cooperation are “normal” (i.e., have been selected for), and should be ethically endorsed (e.g. Singer 2000)
  - ii. Selfishness and competition are “normal”, but should be rejected by rational beings (e.g. Dawkins 1996).
  - iii. Selfishness and competition are “normal”, and should be endorsed as ultimately contributing to a greater good (examples reviewed in Bannister 2010).
2. By providing selectionist explanations of certain traits or patterns of behavior, Darwinism provides information about how easily or how difficult it would be for changes in the social environment (either through changes in ethical norms, or through policy change) to change those patterns of behavior.
3. By providing tree of life explanations, value hierarchies and asymmetries between the moral standing of different species seem to be undermined. Thus they emphasize commonality between humans and other, previously “lower” animals. They undermine the hierarchy of races. The perceived normative implications of

tree of life explanations, can be in tension with the perceived normative implications of selectionist (which can reinforce value hierarchies).

It is by no means obvious that all linking of Darwinism to normative deliberation follows a single logical template. The second line of reasoning is more cautious than the first, but both may be present in the reception of some manifestation of Darwinism (thus leading to considerable confusion).

In these lines of reasoning, Darwinism-as-worldview does not *determine* precise ethical and policy consequences. Rather, it implies a view of the human species and society where many (though not all) of our traits and behaviors have been shaped by a long history of natural selection, and that these traits or behaviors can be considered “adaptive” in the environment in which this selection took place. It is a naturalization of human thought and behavior that does not determine ethics or policy, but simultaneously *does* imply that human thought and behavior cannot be shaped by ethics or policy as if it were a blank slate. For the ethicist or political thinker, this is a very weak conclusion that is consistent with almost any plausible ethical or political view.

What Darwinism-as-worldview does imply is that it would not be entirely correct to claim that Darwinism merely refers to a value-free scientific theory. Darwinism is not like quantum mechanics or nonlinear dynamics, or even like genetics. Neither could Darwinism be called an interesting or distinctive ethical or political view, since the causal picture that Darwinism paints is so complex and heterogeneous that it can support political views across the spectrum. In this sense Darwinism can be called a “world-view”: it explains patterns of behavior, even those which can be politically contested, through a causal history of natural selection, and thus can “naturalize” even behaviors that are paradigmatically immoral (murder, rape).

Note also that acknowledging that Darwinism can also refer to a value-laden (and yet ethically/politically neutral) “world view” does not imply that Darwinism cannot be hijacked or (willfully) misunderstood. Just as Darwinism-as-logic can be misused and applied in an overly loose way (such as in adaptationism), so can Darwinism-as-worldview. For instance, learning about the causal etiology of sex and gender differences could prompt sexist individuals to find in Darwinism a confirmation of their prejudices. This is a distortion of Darwinism, since explaining some properties of gender differences as being caused by a history of natural selection does not hold any strong conclusions about how gender types can culturally evolve, especially as social environments change through technological and scientific progress. The

same point can *a fortiori* be made about racist abuses of Darwinism, where the theory of natural selection is again used to downplay phenotypic plasticity in human development (i.e., to downplay the role of the environment in the expression of genotypes, *even if* the latter were previously selected for). Even though such sexist or racist ethical/political judgments may self-identify as “Darwinian”, we would thus argue that they can be categorized as *extrinsic* to the core meaning of Darwinism. While some worldview aspects are intrinsic to Darwinism (see also our discussions of Midgley’s and Ruse’s views, above), it should be emphasized that many ways in which Darwinism has been (ab)used as a worldview are extrinsic to it.

In sum, acknowledging this third and most complex dimension of Darwinism – Darwinism-as-world-view – helps make sense of why the theory of natural selection has been imbued with ethical and political significance in the past century and a half. Darwinism is not itself an ethical or political theory: it does not generate any specific judgments that can guide concrete action. However, it is not a value-neutral theory in the way quantum mechanics or general relativity arguably are. Nonetheless, it is plausible to believe that the subtle normative status of Darwinism – not an ethical theory, but not a value-neutral scientific theory either – would easily lend itself to misunderstanding and caricature. We therefore let open the possibility that it could be prudent – in science education or in science communication – to present Darwinism *as if* it were a value-neutral scientific theory. This would allow a simple and clear rejection of prejudiced abuses of Darwinism as pseudoscientific.

## **Conclusion**

Given the great confusion and political controversy surrounding the term “Darwinism”, it is tempting to create order by restricting the term to a purely scientific context. In his paper we have showed how this option is not possible. If one tries to restrict it to the scientific context, as a set of scientific theories and hypotheses, one quickly runs into confusion about just what their explanatory structure, especially regarding the theory of natural selection. Moreover, even within the scientific context, “Darwinism” has important normative content, not regarding moral or political normativity, but regarding epistemic and scientific normativity: how one should enquire and reason about phenomena. This normativity even has social consequences, since it has influenced how journals and departments have developed in the field of biology. Today the theory of natural selection is seen as one of the greatest scientific achievements – a paradigm, even – and the question is not *whether* it informs a broadly applicable logic or methodology, but *to what extent* it should do so.

This source of normativity helps make sense why Darwinism, once it is applied to origin of human traits, should be seen as value-laden, or at least as relevant for moral and political deliberation. This is also exemplified by the long history of the reception of Darwin's thought: from its very inception it has continued to be perceived as ethically and politically significant. Explaining this dimension of Darwinism away as politically or ideologically motivated distortion does not seem plausible – even though such distortion can happen and has happened in particular instances. This picture inevitable complicates the analysis of Darwinism, and motivates the necessity of a truly interdisciplinary investigation, but it is necessary to do justice to richness of Darwinism and the influence it has had in the past century and a half.

## REFERENCES

- Ariew, André. 2008. "Population Thinking." In *The Oxford Handbook of Philosophy of Biology*, edited by Michael Ruse. <https://doi.org/10.1093/oxfordhb/9780195182057.003.0004>.
- Bannister, Robert. 2010. *Social Darwinism: Science and Myth in Anglo-American Social Thought*. Temple University Press.
- Box, Joan Fisher, and Sir Ronald Aylmer Fisher. 1978. *R. A. Fisher, the Life of a Scientist*. Wiley.
- Boyd, Robert, and Peter Richerson. 1985. *Culture and the Evolutionary Process*. Chicago: The University of Chicago Press.
- Brooks, Daniel R., and E. O. Wiley. 1988. *Evolution As Entropy*. University of Chicago Press.
- Buller, David J. 2005. *Adapting Minds: Evolutionary Psychology and the Persistent Quest for Human Nature*. Cambridge, MA: MIT Press.
- Bulmer, Michael. 2004. "Did Jenkin's Swamping Argument Invalidate Darwin's Theory of Natural Selection?" *The British Journal for the History of Science* 37 (3): 281–97. <https://doi.org/10.1017/S0007087404005850>.
- Comfort, Nathaniel. 2018. "Genetic Determinism Redux." *Nature*, no. 561: 461–63.
- Darwin, Charles. 1871. *The Descent of Man*. D. Appleton and Company.
- . (1859) 2008. *On the Origin of Species*. Oxford World's Classics. New York: Oxford University Press.
- Dawkins, Richard. 1996. *River Out of Eden: A Darwinian View of Life*. Phoenix.
- . (1976) 2006. *The Selfish Gene*. Oxford University Press.
- Fisher, R. A. 1919. "The Correlation between Relatives on the Supposition of Mendelian Inheritance." *Transactions of the Royal Society of Edinburgh* 52 (02): 399–433. <https://doi.org/10.1017/S0080456800012163>.
- Galton, Francis. 1869a. "Galton to Darwin, 24 December 1869." Darwin Correspondence Project, Letter 7034. 1869. <https://www.darwinproject.ac.uk/letter/DCP-LETT-7034.xml>.
- . 1869b. *Hereditary Genius: An Inquiry Into Its Laws and Consequences*. Macmillan.
- . 1883. *Inquiries Into Human Faculty and Its Development*. Macmillan.

- Gould, S. J., R. C. Lewontin, J. Maynard Smith, and Robin Holliday. 1979. "The Spandrels of San Marco and the Panglossian Paradigm: A Critique of the Adaptationist Programme." *Proceedings of the Royal Society of London. Series B. Biological Sciences* 205 (1161): 581–98. <https://doi.org/10.1098/rspb.1979.0086>.
- Gould, Stephen Jay. 1982. "Darwinism and the Expansion of Evolutionary Theory." *Science, New Series* 216 (4544): 380–87. <http://www.jstor.org/stable/1688091>.
- Herrnstein, Richard J., and Charles Murray. (1994) 2010. *The Bell Curve: Intelligence and Class Structure in American Life*. Simon and Schuster.
- Hodge, Charles. 1874. *What Is Darwinism?*. New York: Scribner, Armstrong, and Company.
- Hodgson, Geoffrey M. 2019. *Evolutionary Economics: Its Nature and Future*. Cambridge University Press.
- Hodgson, Geoffrey M., and Thorbjørn Knudsen. 2006. "Why We Need a Generalized Darwinism, and Why Generalized Darwinism Is Not Enough." *Journal of Economic Behavior & Organization* 61 (1): 1–19. <https://doi.org/10.1016/j.jebo.2005.01.004>.
- Horgan, John. 2017. "Darwin Was Sexist, and So Are Many Modern Scientists." Scientific American Blog Network. 2017. <https://blogs.scientificamerican.com/cross-check/darwin-was-sexist-and-so-are-many-modern-scientists/>.
- Hull, David L. (1988) 2010. *Science as a Process: An Evolutionary Account of the Social and Conceptual Development of Science*. University of Chicago Press.
- Huneman, Philippe. 2019. "How the Modern Synthesis Came to Ecology." *Journal of the History of Biology* 52 (4): 635–86. <https://doi.org/10.1007/s10739-019-09570-9>.
- Huxley, Thomas Henry. 1860. "The Origin of Species." *The Westminster Review* April. <https://www.gutenberg.org/files/2929/2929-h/2929-h.htm>.
- . 1880. "The Coming of Age of the Origin of Species." *Science* os-1 (2): 15–20. <https://doi.org/10.1126/science.os-1.2.15>.
- Jamieson, Annie, and Gregory Radick. 2017. "Genetic Determinism in the Genetics Curriculum: An Exploratory Study of the Effects of Mendelian and Weldonian Emphases." *Science & Education* 26 (10): 1261–90. <https://doi.org/10.1007/s11191-017-9900-8>.
- Jenkin, Fleeming. 1867. "[Review of] The Origin of Species." *The North British Review* 46 (June): 277–318. <http://darwin-online.org.uk/content/frameset?pageseq=1&itemID=A24&viewtype=text>.
- Jensen, A.R. 1969. *Environment, Heredity, and Intelligence*. Environment, Heredity, and Intelligence. Cambridge, MA, US: Harvard Educational Review.
- Kevles, Daniel J. 1985. *In the Name of Eugenics: Genetics and the Uses of Human Heredity*. 95. Harvard University Press.
- Kruskal, William. 1980. "The Significance of Fisher: A Review of R.A. Fisher: The Life of a Scientist." *Journal of the American Statistical Association* 75 (372): 1019–30. <https://doi.org/10.1080/01621459.1980.10477590>.
- Laland, Kevin N., Tobias Uller, Marcus W. Feldman, Kim Sterelny, Gerd B. Müller, Armin Moczek, Eva Jablonka, and John Odling-Smee. 2015. "The Extended Evolutionary Synthesis: Its Structure, Assumptions and Predictions." *Proc. R. Soc. B* 282 (1813): 20151019. <https://doi.org/10.1098/rspb.2015.1019>.
- Le Monde.fr*. 2019. "« Le darwinisme social appliqué à la recherche est une absurdité »,» December 6, 2019. [https://www.lemonde.fr/idees/article/2019/12/06/le-darwinisme-social-applique-a-la-recherche-est-une-absurdite\\_6021868\\_3232.html](https://www.lemonde.fr/idees/article/2019/12/06/le-darwinisme-social-applique-a-la-recherche-est-une-absurdite_6021868_3232.html).
- Levins, Richard, and Richard C. Lewontin. 1985. *The Dialectical Biologist*. Harvard University Press.
- Lewens, Tim. 2010. "Natural Selection Then and Now." *Biological Reviews*, March, 829–35. <https://doi.org/10.1111/j.1469-185X.2010.00128.x>.

- Lewontin, Richard C. 1970. "The Units of Selection." *Annual Review of Ecology and Systematics* 1 (1): 1–19.
- Lloyd, Elisabeth. 2021. *Adaptation*. Cambridge University Press.
- Matthen, Mohan, and André Ariew. 2002. "Two Ways of Thinking About Fitness and Natural Selection." *Journal of Philosophy* 99 (2): 55–83. <https://doi.org/10.2307/3655552>.
- Maynard Smith, John. 1997. "John Maynard Smith - Hamilton: Political and Ideological Commitment - YouTube." 1997. <https://www.youtube.com/>.
- Mayr, Ernst. 1976. *Evolution and the Diversity of Life: Selected Essays*. Harvard University Press.
- . 2000. "Darwin's Influence on Modern Thought." *Scientific American* 283 (1): 78–83. <https://www.scientificamerican.com/article/darwins-influence-on-modern-thought1/>.
- McLean, Bethany, and Peter Elkind. 2013. *The Smartest Guys in the Room: The Amazing Rise and Scandalous Fall of Enron*. Penguin Publishing Group.
- Mesoudi, Alex. 2011. *Cultural Evolution: How Darwinian Theory Can Explain Human Culture and Synthesize the Social Sciences*. University of Chicago Press.
- Mesoudi, Alex, Andrew Whiten, and Kevin N. Laland. 2006. "Towards a Unified Science of Cultural Evolution." *Behavioral and Brain Sciences* 29 (4): 329–47. <https://doi.org/10.1017/S0140525X06009083>.
- Nelson, Richard R., and Sidney G. Winter. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, MA: Harvard University Press.
- Oreskes, Naomi, and Erik M. Conway. 2010. "Defeating the Merchants of Doubt." *Nature* 465 (7299): 686–87. <https://doi.org/10.1038/465686a>.
- Plomin, Robert. 2018. *Blueprint: How DNA Makes Us Who We Are*. MIT Press.
- Popper, Karl. (1974) 2021. "Darwinism as a Metaphysical Research Programme." In *Darwinism as a Metaphysical Research Programme*, 167–75. Princeton University Press. <https://doi.org/10.1515/9781400831296-023>.
- Redman, Deborah A. 1991. *Economics and the Philosophy of Science*. New York: Oxford University Press.
- Reydon, Thomas A. C., and Markus Scholz. 2009. "Why Organizational Ecology Is Not a Darwinian Research Program." *Philosophy of the Social Sciences* 39 (3): 408–39. <https://doi.org/10.1177/0048393108325331>.
- . 2015. "Searching for Darwinism in Generalized Darwinism." *The British Journal for the Philosophy of Science* 66 (3): 561–89. <https://doi.org/10.1093/bjps/axt049>.
- Reydon, Thomas A.C. 2021. "Generalized Darwinism as Modest Unification." *American Philosophical Quarterly* 58 (1): 79–94. <https://doi.org/10.2307/48600687>.
- Richerson, Peter J., and Robert Boyd. 2005. *Not By Genes Alone: How Culture Transformed Human Evolution*. University of Chicago Press. <https://doi.org/10.7208/chicago/9780226712130.001.0001>.
- Scott, Eugenie C., and Glenn Branch. 2009. "Don't Call It 'Darwinism.'" *Evolution: Education and Outreach* 2 (1): 90–94. <https://doi.org/10.1007/s12052-008-0111-2>.
- Singer, Peter. 2000. *A Darwinian Left: Politics, Evolution, and Cooperation*. Darwinism Today. New Haven: Yale University Press.
- Smaldino, Paul E., and Richard McElreath. 2016. "The Natural Selection of Bad Science." *Royal Society Open Science* 3 (9): 160384. <https://doi.org/10.1098/rsos.160384>.
- Smith, Subrena E. 2020. "Is Evolutionary Psychology Possible?" *Biological Theory*. <https://doi.org/10.1007/s13752-019-00336-4>.
- Stony Brook. 2022. "About the Department | Department of Ecology & Evolution." 2022. [https://www.stonybrook.edu/commcms/ecoevo/\\_about/index.php](https://www.stonybrook.edu/commcms/ecoevo/_about/index.php).

- University of Arizona. 2019. "About EEB." Ecology & Evolutionary Biology. December 12, 2019. <https://eeb.arizona.edu/about/about-eeb>.
- Walsh, Denis. 2000. "Chasing Shadows: Natural Selection and Adaptation." *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 31 (1): 135–53. [https://doi.org/10.1016/S1369-8486\(99\)00041-2](https://doi.org/10.1016/S1369-8486(99)00041-2).
- Wilson, David Sloan. 1975. "A Theory of Group Selection." *Proceedings of the National Academy of Sciences* 72 (1): 143–46. <https://doi.org/10.1073/pnas.72.1.143>.
- . 2019. *This View of Life: Completing the Darwinian Revolution*. Knopf Doubleday Publishing Group.
- Witt, Ulrich. 2014. "The Future of Evolutionary Economics: Why the Modalities of Explanation Matter." *Journal of Institutional Economics* 10 (04): 645–64. <https://doi.org/10.1017/S1744137414000253>.