The Varieties of Darwinism: Explanation, Logic, and Worldview

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Abstract

Ever since its inception, the theory of evolution has been reified into an "-ism": Darwinism. While biologists today tend to shy away from the term in their research, the term is still actively used in the broader academic and societal contexts. What exactly *is* Darwinism, and how precisely are its various uses and abuses related to the scientific theory of evolution? Some call for limiting the meaning of the term "Darwinism" to its scientific context; others call for its abolition; yet others claim the term refers to a myth-like story. In this paper we propose a conceptually grounded overview of the term. We show how the scientific dimension of Darwinism feeds into, and is influenced by, guises of Darwinism as a methodology and as an ethically and politically charged "worldview". 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 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).

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 scientific and public discourse continues 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.[i] 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, going all the way back to Kropotkin (1902), where cooperation is emphasized over competition (Singer 2000), and community over the individual (Wilson 2019). In sum, while the term "Darwinism" may be very difficult to pin down, it continues to 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 the 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 restrict 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 and similar approaches to Darwinism the "thin conception" of Darwinism.

The thin conception of Darwinism appears attractive for many reasons, chief among which is a neat distinction between science and policy (and between "is" and "ought"). It labels Darwinian-inspired discourse or policy, such as Darwinian eugenics or Darwinian communitarianism, as extra-scientific and outside the proper scope of Darwinism. On the thin view of Darwinism, such discourse or policy involves *superimposing* ethical-normative claims onto the scientific core of evolution by natural selection and descent with modification.

However, as we will argue, the thin conception does not work either as a representation of Darwin's own ideas, nor of the ways in which these ideas were received by his contemporaries. In contrast to such a thin conception, this paper will explicitly endorse and outline a "thick conception" of Darwinism, where the scientific, ethical, and political dimensions are understood to constitute the intrinsic meaning of Darwinism. The label "thick" is borrowed from ethics and epistemology where it refers to concepts that have both evaluative and non-evaluative content.[ii] In other words, "thick concepts" straddle the is-ought distinction, and defy straightforward categorization as either an ethical-normative concept or as a descriptive-explanatory concept. The "thickness" in thick concepts thus refers to their richness and complexity. In arguing that "Darwinism" is a thick concept, we hold that we must explicitly acknowledge the richness of its meanings, and not seek to re-engineer or artificially simplify the term. The meaning of Darwinism, as we will argue, cannot be limited to referring to a causal or explanatory theory. 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 on the choice of terminology. Terming our account of Darwinism as "thick" raises the worry that this entails some kind of naturalistic fallacy, confusing "is" with "ought". The history of Darwinism is

replete with such confusions, and the concepts of fitness, adaptations, and most recently "success" (Desmond and Ramsey 2023) seem to lend themselves to being viewed as outright normative concepts. 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. Later on we give more detail on just how this happens, but in brief: 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. The content of Darwinism thus does not determine the outcome of ethical and political deliberation, but it cannot be said to be entirely irrelevant either. 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.

This brings us to why we, with this paper, wish to raise the issue of what Darwinism means. This is not self-evident, because as a term, "Darwinism" is insufficiently precise for their explanatory goals of biologists, and would be passed over in favor of referring to a specific mechanism of evolution or evolutionary pattern. However, as we will document in this paper, the term "Darwinism" has resisted being abandoned in the broader academic and societal context. We therefore cannot avoid the question of how "Darwinism" has been understood outside the biological context, and what relation "Darwinism" bears to Darwin's ideas which by now have become largely subsumed in the standard conceptual toolkit of biologists. By reflecting about this relation – between evolutionary theory and Darwinism in the broader academic and societal context – this paper hopes to contribute to a fuller understanding why

Darwin's ideas continue to be of broad interest, and how these ideas can be both used and abused, especially in public policy and science communication.

The paper is structured as follows. 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 worldview 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

An influential thin conception of Darwinism involves the identification of Darwinism with a set of abstract conditions for evolution by natural selection (Hodgson and Knudsen 2006; Aldrich et al. 2008; Hodgson 2019; Schurz 2021). In particular the three core criteria of variation, differential reproduction, and heritability, have been popular among biologists and philosophers as specific criteria for the occurrence of natural selection (e.g. Lewontin 1970; Godfrey-Smith 2007). According to the thin conception, these criteria can be used determine the scope of Darwinism: wherever these conditions of application are met 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. Using the label "Darwinian" when it is not justified can then be characterized as either a "distortion" or an "instrumentalization" of Darwinism.

A corollary of the thin conception of Darwinism is that its broader uses in public and policy debates will invariably be a distortion or instrumentalization of Darwinism. As documented later on in the paper, many of the prominent examples of policy-makers invoking Darwinism do not involve precise stipulation of conditions of applicability. Moreover, the three criteria of variation, heredity, and fitness differences are typically not met in Darwinian approaches in the social sciences and humanities (see e.g. the criticisms elaborated by Reydon and Scholz 2015 or Ramsey and De Block 2015). So while the thin conception of Darwinism does not in principle restrict Darwinism to the biological domain, it largely does in practise.

We believe that the thin conception of Darwinism, in trying to avoid the complexity inherent in the term, ultimately runs into fundamental problems. We offer three reasons to reject the thin conception: the history of the reception of Darwin's ideas, the evident usefulness of Darwin's ideas for broad swathes of academic research as well as normative debate in ethics and politics, and finally, the self-defeating nature of the thin conception.

First, the relation between Darwin's ideas and its purported ethical and political ramifications have in fact 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 with respect to Darwinism, however. 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 Henry 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 their broader normative implications. 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.

This leads us to the second reason for rejecting the thin conception. 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. However, 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 – about reality (we make the case for this in section 4). This feeds into a *proto-ethical normativity* inherent to Darwinism (elaborated on in section 5): 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. These normative dimensions help explain better the evident broad instrumentalizability of the theory of natural selection, which on the thin conception remains somewhat of a puzzle.

Finally, one could perhaps reject the first two reasons by holding that the theory of natural selection is more likely to be instrumentalized than thermodynamics because it merely contingently speaks to human imagination. This is a rather radical stance, since it involves

rejecting as misguided the views of a long list of figures, from Huxley and Galton to Mayr and arguably Darwin himself. However, is it a coherent stance? Is it coherent to limit the meaning of Darwinism to its biological core, and categorize its uses in other academic fields and in public discourse as distortions or instrumentalizations of Darwinism? The problem here is that this stance, if followed to its logical conclusion, would imply that the term "Darwinism" should be eliminated. After all, to continue to speak of an "-ism" implies it is a set of *values* – an ideology if you will – and not just a set of descriptive or causal generalizations about reality. 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 term "Darwinism" has already been largely abandoned in contemporary research in evolutionary biology, and the reason why the term is not abandoned in broader academic/societal contexts is precisely because "Darwinism" is *not* a thin concept referring merely to value-neutral causal premises. The reason to use the term "Darwinism" is precisely because of the value-laden dimensions of Darwinism: values on how to conduct scientific research, and values on how to guide action and organize society. In this way, the thin conception is self-defeating: if it is true, it undermines the rationale for reifying Darwin's ideas into an "-ism".

3. Darwinism as an Explanatory Scheme

If the thin conception is to be rejected, how precisely should a thick conception be understood? We will answer this question by pointing out the various aspects of such a thick conception that is found in the various contexts in which the term is used. In this section we briefly review a first important sense in which 'Darwinism' is widely used, namely to refer to an abstract explanatory scheme. This dimension of Darwinism is one that is common to both the thick and

thin conceptions of Darwinism; the difference is that, on the thick conception, the explanatory scheme is intertwined with the value-laden dimensions of Darwinism.

Saying that one of the dimensions of Darwinism is that of an explanatory scheme simply means that Darwinism identifies an explanans and an explanandum, or rather, *type* of explanans and a *type* of explanandum. Precisely identifying what these explanantia and and explananda are, is a more detailed and controversial question. It is not clear whether there is any unified scheme that characterizes Darwinism. Multiple candidate schemes can compete – and as we will discuss later, *have* competed – for the title of "Darwinism": the one long argument" of the *Origin* (Darwin [1859] 2008) both concerned the establishing of the *fact* of evolution (or transmutation of the species, as Darwin called it) as well as the theory of natural selection. Thus, a selectionist scheme of would define the explanandum as some adaptive state of affairs (e.g., a distribution of traits, the existence of a particular species, or the existence of some complex structure: Lloyd 2021, 3), and the explanans is natural selection. Another scheme based on the hypothesis of common descent would similarly define the explanandum as a distribution of traits, but with the difference that this distribution may not necessarily be adaptive, and define the explanans as a process of descent with modification. As we will discuss later, debates about how precisely the explanatory scheme of Darwinism should be analyzed often become entangled with the normative dimensions of Darwinism.

However, even we restrict our discussion to selectionist schemes, there are multiple ways of analyzing this explanatory scheme. At a very general level, the implicit rival explanatory scheme that the *Origin* sought to undermine was one with the same explanandum (adaptations of organisms to their environments) but where the explanans referred to divine agency. The origin of the wide variety of extant species and adaptive complexity in particular, such as that manifested by the camera-type eye, was seen as necessitating such a theistic

277 explanatory scheme (as famously argued by Paley in 1802 in his *Natural Theology*) – at least,
278 until Darwin's theory of natural selection came onto the stage.

279 At a coarse-grained level of analysis, where the explanatory structure of Darwinism is
280 contrasted to theistic explanatory structures, Darwinism-as-explanation can be defined clearly
281 enough. However, at finer-grained levels, there are many rival accounts of just how the
282 explanans of natural selection entails the explanandum. Darwin himself predominantly targeted
283 the patterns of extinction and adaptive speciation– what he called the "mystery of mysteries"
284 – and spoke of natural selection in terms of the "struggle for existence", relating it to Malthus'
285 struggle between the members of human populations. However, the history of evolutionary
286 thinking since Darwin has seen many revisions to the basic explanatory scheme of natural
287 selection.

288 The Modern Synthesis in the 1930s involved one such radical revision. The revision
289 was prompted by the rediscovery of Mendel's work on genetics and the realization that Darwin
290 was mistaken about the mechanism of inheritance. This led to a reconceptualization of natural
291 selection away from an ecological "struggle" as Darwin had put it, and towards viewing
292 selection as differential reproduction or differential fitness (Lewens 2010).

293 The three abstract criteria (fitness differences, variation, heredity) have become one
294 influential way of formalizing just how the Modern Synthesis revised how natural selection
295 explains. Thus, in order to use natural selection to explain why an extant population has a
296 certain observed property, one needs to be able to posit three claims. First, one has to assume
297 an ancestral population where some individuals possessed property A but others possessed
298 other properties B, C, D, etc. Second, differences between organisms with respect to these
299 properties needed to have caused some individuals to reproduce more successfully than others.
300 Third, these properties need to be transmitted to the next generation. Only then can one

potentially explain how the population with property A evolved by natural selection. (A similar, but more detailed, set of criteria is presented by Lloyd, 2021: 5.)

There have been many other ways of precisely accounting for the explanatory structure of natural selection. We will limit the discussion in this section to just two further examples. One is Dawkins's analysis of natural selection in terms of replicators and interactors – sometimes dubbed the "gene's-eye view" since genes are the replicators in biological evolution (Dawkins [1976] 2006). On this view of natural selection, there must be a clear distinction between replicating entities and interacting entities for natural selection to occur.[iii]

As a final example, we would like to mention what has been dubbed 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", even within the adaptationist family of explanations, 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. The four views discussed here – selection as the struggle; selection as differential fitness; selection as replicator-interactor dynamics; and selection as crucially affected by the actions of organisms – illustrate why biologists in fact will very seldomly (if at all) refer to 'Darwinism' to clarify 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.

Nonetheless, this plurality of views exhibit at least a family resemblance, in that they explain some adaptive state of affairs through selection and, crucially, without overt reference to human (or divine) agency. Somewhat paradoxically, this means that the descriptive-explanatory dimension of the term 'Darwinism' has a clearer meaning when it is used outside the biological context, where Darwinian approaches are sufficiently distinct from rival explanatory schemes. In the following section we will connect the descriptive-explanatory dimension of Darwinism with two value-laden dimensions.

4. Darwinism as Logic

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 dimension of Darwinism prescribes how scientific research (observation, explanation, hypothesizing, etc.) should be conducted.

What do we mean precisely by claiming that Darwinism can refer to a "logic"? First of all, the term "logic" in its informal sense, refers to a style of reasoning. Styles of reasoning are often formalizable, and Darwinism has in fact been subject to many such efforts at formalization by 20th-century philosophers of science, beginning with Hempel and Popper. The difference between Darwinism-as-logic and Darwinism-as-explanatory scheme is that in the former, the explanatory structure of the theory of natural selection is set as a *scientific-normative ideal,* while in the latter it is simply taken as a given. The normativity of the ideal consists in providing 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. Such an ideal could at first approximation be categorized as a Kuhnian paradigm[iv], but the term "logic" entails that there is from the sociology of the even more suggestively as a professional ideal that organizes work, in that such an ideal is both an "ideology" (system of values) and a "logic (manner of reasoning) (Freidson 2001; Desmond 2020).

The theory of natural selection and the tree of life hypothesis seem to have inspired a wide proliferation of "evolutionary approaches" in other domains, as illustrated by the list below.

<Table 1 here>

Like the status of "paradigm", 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, one can argue that for the existence of the difference. Whether it concerns the evolution of firms, scientific theories, or fashion trends, the evident fecundity of Darwin's ideas strongly suggests they are a "way of investigating and thinking about" a broad range of natural and social phenomena.

This dimension of Darwinism 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 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; 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.

In response to the skeptical stance on Darwinism-as-logic, it is important to clarify that a mere metaphorical instrumentalization of Darwin’s ideas is not the weakest type of relation between a scientific explanation and discoveries or developments in other fields. The weakest type of relation would be the explanation *causing* discoveries in other fields (through a sequence of psychological states) but in no way *justifying* their scientific adequacy. For sake of clarity, here is an extreme example. Playing Mozart’s violin sonatas may have been important for how Einstein came upon the idea for general relativity. If Einstein did not play these sonatas, he may not have had the inspiration or creativity to think of the principle of relativity. However, in no way do those sonatas do any explanatory work in special or general relativity. It is obvious that, even if the relation between Darwin’s ideas and Darwinian approaches in non-biological fields is merely metaphorical, it is much closer than that between

401 Mozart's violin sonatas and general relativity. Even if a relation is "merely metaphorical", it is
402 important to clarify that it is not a relation of mere incidental inspiration: at least some elements
403 of Darwin's ideas are being re-used in the novel domain.

404 So, even a relatively skeptical stance on Darwinism-as-logic cannot dismiss the latter
405 as merely incidental. Even if Darwin's ideas are being used as a mere metaphor, the
406 explanandum becomes why this metaphor is evidently so fecund (see Table 1). Moreover,
407 between the extremes of incidental inspiration and rigorous generalization lies a continuum of
408 more moderate relations, of which metaphor is but one instance. For instance, some authors
409 have argued that the relation between Darwinism-as-explanation and Darwinism-as-logic is
410 one of a loosely structured research program, that at most "modestly unifies" biological
411 evolution and other evolution in other domains (Reydon 2021). Others have argued that what
412 is distinctively Darwinian about evolutionary approaches is that individual entities are being
413 modeled as members of populations. This "population thinking" (as opposed to typological
414 thinking: Mayr 1976; see also Ariew 2008) is what underlies the theory of natural selection,
415 and is what allows it to be applied to so many different domains.

416 To systematize, it is helpful to distinguish between two questions here, one pertaining
417 to the relation between Darwinism-as-explanation and Darwinism-as-logic, and the other to
418 how Darwinism-as-logic is applied to new fields (see Figure 1 for a visual representation). One
419 can enquire about the specific features of the theory of natural selection, and to what extent
420 these features can define a logic (e.g., variation, heritability, fitness). However, one can also
421 ask separately how such a logic is being applied to a new field: are the conditions of
422 applicability met? Thus, for instance, if Darwinism-as-logic is understood as "population
423 thinking", this gives grounds for criticizing certain evolutionary approaches as misguided when
424 they lack an adequate population concept (cf. e.g. Reydon and Scholz 2009; 2015).
425

426 < Figure 1 here>

427

428 In the remainder of the section, we would like to elaborate on one added advantage of
429 acknowledging the scientific-normative dimension of Darwinism: it is not just useful to
430 understand the early reception of Darwin's ideas (by e.g. Huxley) as well as their more recent
431 broad application across scientific domains, but it is also useful to understand *sociological*
432 *developments* within biology itself. The scientific-normative content and status of Darwinism
433 within evolutionary biology have been – and continue to be – contested.

434 First, Darwinism did not immediately have the normative status of a "logic". Huxley,
435 Galton and others may have quickly seen the potential of Darwinism to revolutionize biology
436 (and beyond), but not all naturalists did. Early objections played some role in this, such as
437 Jenkin's swamping argument (Jenkin 1867) which purported to show that the winnowing effect
438 of natural selection was incompatible with the fact that large variation remains in most natural
439 populations. The traditional story here (though not uncontested: Bulmer 2004) is that this was
440 a genuine anomaly for Darwin's theory of natural selection. According to Julian Huxley, it
441 resulted in the "eclipse of Darwinism" (Huxley 1942). Only subsequently did Jenkin's
442 counterargument turn out to be a merely apparent falsification, depending on a mistaken
443 hypothesis concerning the mechanism of inheritance. After the rediscovery of Mendel's work
444 in 1900 (independently by de Vries, Correns, and von Tschermak), and more definitively after
445 the 1920s and 1930s through the integration of Mendelism with natural selection by Fisher,
446 where those worries laid to rest. The discovery of the double helix structure of DNA in 1953,
447 and the subsequent development of molecular biology, further served to remove this source of
448 doubt concerning the theory of natural selection.

449 There are other, and more detailed stories to be told of how the Modern Synthesis arose
450 (e.g. Pence 2021b), but it seems safe to assert that 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 20th 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.[v] 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*. However, doubts concerning the precise scientific status of the theory of natural selection lingered for a surprising length of time – for instance, Popper famously called it a "metaphysical research program" rather than a testable scientific theory (Popper [1974] 2021).

In sum, the establishment of Darwinism as a sound logic or scientific methodology was a gradual, social process. Translated into the terms of Figure 1, 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.

Next, the normative *content* of Darwinism remains contested. It is one thing to establish Darwinism as a logic to guide research, but quite another to determine *what precisely* Darwinism prescribes. The concerns regarding the relative importance of adaptation should be viewed in this light: these are concerns about the normativity of scientific research. Over-emphases of the importance of adaptation are typically reified into an "-ism": adaptationism (following Gould and Lewontin 1979).

Debates about the normative content of Darwinism tend to influence how "the" Darwinian explanatory scheme is represented: once Darwinism-as-logic is applied to new fields, some content is deemed more important than other content, and this in turn influences Darwinism-as-explanation. An example here is how the development of the Modern Synthesis transformed the core concepts of fitness and natural selection. Ronald Fisher, one of the foundational figures of the Modern Synthesis, seemed to be 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, Fisher used and applied Darwinian ideas to novel domains – the statistical analysis of patterns of heritability in human populations or crops – and in the process transformed the original Darwinian ideas.

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. For instance, to the proponents of the Extended Evolutionary Synthesis, attributing a greater causal role to the organism, for instance, through niche construction and phenotypic plasticity, alters the fundamental understanding of fitness and natural selection (Laland et al. 2015; Müller 2017). Alternatively, in the subfield of adaptive dynamics, which seeks to unify populational dynamical and evolutionary processes in a single mathematical framework, fitness is redefined as the long-term growth rate of a variant in a given environment (Tuljapurkar 1990, 41; Metz, Mylius, and Diekmann 2008, 631). In somewhat the same way in which Kuhn described how the meaning of the terms "mass" or "energy" changed across paradigms in physics, the perceived primary meaning of terms such "fitness" and "selection" can shift as new

frameworks become dominant – though what often seems to happen in evolutionary biology is that the meanings of such core terms multiply as multiple competing frameworks arise.

In sum, in light of the continued history of the reception and use 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. It has remained contested and has changed over time. The Modern Synthesis version of Darwinism was different from Darwin's own version and the currently emerging alternatives will be different still. Nonetheless, the historical pluralism of the meaning of Darwinism, does not imply a relativism concerning the term. The pluralism is bounded, 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.

5. Darwinism as Worldview

According to some sociologists of the professions, there are two sides to a professional ideal: a "logic" and an "ideology (Freidson 2001). A logic contains normative statements about how one should reason about phenomena, but this normativity can also be used to organize the social structure of science in certain ways rather than others. In the latter guise, the logic becomes an ideology: a set of values on how some social entity (whether a scientific community or an entire society) should be organized. This is a first way in which one can

understand how Darwinism-as-logic can lead to Darwinism-as-world-view, as scientific normativity extends into the social sphere.

However, from a historical perspective, Darwinism's perceived ethical and political significance arose much more quickly than did Darwinism's status as an established scientific methodology. Thomas Henry Huxley, who first used the term "Darwinism", immediately saw Darwinism's perceived theological implications, using them in a famous debate with Bishop Wilberforce in 1860. Francis Galton quickly saw how Darwin's ideas opened up the possibility for "designing" the human species through eugenic policies.

There have been previous accounts of just how Darwinism is a worldview. For instance, Mary Midgley claims that Darwinism 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 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

550 a worldview of a different kind. Note, however, that on Midgley's view Darwinism would
551 always have been a worldview of *some* sort.

552 Another reconstruction of Darwinism-as-worldview is given by Michael Ruse.
553 According to Ruse, evolutionary thinking encompasses different elements, one being a
554 scientific element and the other a worldview element. Ruse reserves the term "Darwinism" for
555 the latter and goes as far as claiming it acts as a "secular religion" (Ruse, 2019: x; 40; 186). As
556 Ruse writes: "there is a side to Darwinian thinking, what I refer to as Darwinism, that functions
557 as a religion, or if you prefer, a secular religious perspective" (Ruse, 2019: 213) that in fact
558 constitutes "a religious alternative to Christianity" (Ruse, 2019: 141). On Ruse's account,
559 Darwinism was able to assume the role of secular religious alternative to Christianity because
560 Darwin's work deeply roots in Christian religious thought. As Ruse points out, Darwin grew
561 up in a specific religious context – Victorian England with a strong presence of various kinds
562 of Christianity, most importantly the Anglican Church –, studied for a while (after he had
563 abandoned his medical studies) to become an Anglican priest, and was more generally
564 influenced by the Anglican version of Christianity by studying at the University of Cambridge,
565 "a Church of England institution where many of the teachers and professors were ordained
566 priests" (Ruse, 2019: 21). As Ruse convincingly shows, much of Darwin's scientific thinking
567 exhibits ways of thinking and concerns found in the religious context in which he grew up and
568 studied.

569 Both Midgley's and Ruse's narratives show ways in which Darwinism can become a
570 "worldview" – a set of statements about the nature of human beings that influence both ethical
571 and political deliberation. Midgley emphasizes how Darwin's ideas resonated with the spirit of
572 his time; Ruse emphasizes how Darwin's way of thinking was rooted in religion and contained
573 traces that made it suitable to assume the role of secular alternative to Christianity.

Our account of Darwinism-as-worldview differs in that it can be grounded in the scientific-normative and explanatory-descriptive dimension of Darwinism. This means that the contingencies of Darwin's biography and his historical context play a less important role in identifying what Darwinism-as-worldview means. It also means that, on our account, there is a great variety of worldviews that can be called Darwinian, depending on what aspect of Darwin's ideas is highlighted and assigned a normative status.

Our chief target, as in previous sections, is the skeptical take on Darwinism-as-worldview. This take would explain Darwinism-as-worldview away as a product of ideologically motivated actors distorting a scientific theory for their own purposes, or of 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 (at least) *two* Darwinisms, one for the societal sphere and one for the scientific sphere.

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 the versions of eugenics taken up by Nazi Germany from the 1930s on were based on beliefs about genetic determinism that by then had been clearly falsified. Nonetheless, even if we classify Nazi eugenics as a pseudoscience, the question about how it relates to Darwinism persists. 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" (Radick 2019, 299). 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 (the late 19th and early 20th century) the mechanism of inheritance was a genuine unknown. The main rationale supporting eugenics relied heavily on the 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 the "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. The point is that eugenics was not a merely "myth" or "story" or "secular religion" that was inspired by Darwinian logic: rather, it focused on particular elements present in the Darwinian logic and used (and overapplied) them for purposes of social

624 reorganization. Early eugenics cannot be dismissed as based on a *misunderstanding* or
625 *distortion* of the theory of natural selection. The 19th-century commentators who believed
626 Darwinism gave rise to eugenics turned out to be ultimately *wrong,* but there is a difference
627 between a mistaken belief and a biased or bad-faith distortion of the underlying science (or
628 style of reasoning). The eugenicists lacked relevant facts about heredity, but did not
629 egregiously misrepresent the action of natural selection. After all, Fisher's *Genetic theory of*
630 *natural selection* first laid the groundwork for the mathematical treatment of natural selection,
631 and then in the second half went on to apply this understanding to further eugenicist goals. In
632 fact, Darwin's own understanding of how natural selection acts in contemporary human
633 populations could easily be interpreted to imply the necessity of eugenic policies – as Darwin
634 wrote: "the reckless, degraded, and often vicious members of society tend to increase at a
635 quicker rate than the provident and generally virtuous members." (Darwin 1871, 2:167)
636 This brief analysis of the relation between eugenics and Darwinism-as-logic implies
637 that a plurality of worldviews can be generated from Darwinism-as-logic, depending on what
638 is emphasized. And in fact, Darwinism-as-worldview cannot be pinned down to any segment
639 of the political spectrum. Consider how Darwinian ideas about competition and cooperation
640 have inspired broadly varying policy ideas. Competition is inherent in ideas such as the
641 "struggle for existence" or "survival of the fittest"; cooperation was invoked to explain how
642 altruistic behaviors are so widespread across animal species and especially common in the
643 human species. Insofar as policy measures and ethical norms are attempts to regulate patterns
644 of competition and cooperation, it is not surprising that the Darwinian dynamic of competition
645 inspired those of individualist and neo-liberal leanings, while those of social liberal leanings
646 found support in the dynamic of cooperation (Singer 2000). Similarly, if Darwinian ideas about
647 adaptation were foregrounded, policies promoting success, optimality, and/or normality would
648 seem to be supported by "Darwinism", but if Darwinian ideas about the tree of life were

649 foregrounded, policies promoting the diversity, contingency, and relatedness of human beings
650 would also seem to be supported by "Darwinism". Different worldviews can be generated by
651 emphasizing different elements present in Darwinian logic: competing ethical-political values
652 seem to find support in different scientific-normative values.

653 Moreover, in the way that changes in beliefs about Darwinism-as-logic can influence
654 how Darwinian explanations are construed, it seems also that worldviews can influence
655 scientific investigation. Ronald Fisher's study of patterns of differential reproduction in human
656 populations and farm crops was motivated by his belief in eugenicist goals (Box and Fisher
657 1978; Kruskal 1980). John Maynard Smith's Marxist sympathies influenced, by his own
658 admission, how he understood and analyzed the evolution of altruism (Maynard Smith 1997).
659 Richard Levins and Richard Lewontin even devoted a book-length study to a "Marxist" view
660 on biology (Levins and Lewontin 1985). Interestingly, Lewontin elsewhere quite explicitly
661 endorsed a thick conception of Darwinism: "While they are more relevant to proteins than to
662 politics, Darwin's writings have a great deal more in common with those other grand theorists
663 of the nineteenth century, Marx and Freud, than with, say, Newton." (Lewontin 1983) [vi]

664 With the argument thus far we have only pointed to historical and contemporary
665 evidence that biologists and intellectuals have *believed* Darwinism-as-worldview to be closely
666 linked to Darwinism-as-logic. They have *in fact* used scientific values to justify ethical-
667 political values. However, the more important – and more difficult – question is whether these
668 beliefs were justified. Thus, one could agree with our limited point about the relationship
669 between Darwinism and eugenics, namely that eugenics cannot be dismissed as a distortion or
670 material misunderstanding of the theory of natural selection, and one could still question the
671 kind of support that Darwinism-as-logic offers for (some version of) Darwinism-as-worldview.
672 After all, why should a causal theory of the evolution of some human traits – or some type of
673 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 is loose and not significant.

In the abstract, a neat is-ought distinction seems justified. However, scientific explanations can be used to predict (and control) human behavior, and thus the relation between the "is" of science and the "ought" of politics is closer and more muddled than textbook representations of the is-ought distinction suggest. Hence, while this is a larger question that would require a much more extensive discussion than is possible here, we would like to suggest some potential ways in which the relation between logic and worldview can be conceived. The scope of our argument here is to show how the distinction between causes and values is not necessarily a reason for undermining the case for a unified understanding of Darwinism. In other words, one can reject the idea of two Darwinisms – one for the societal sphere and one for the scientific sphere – while respecting is-ought distinction.

The crucial step here is to realize a causal theory of human evolution can *inform* ethical reasoning without *determining* it (see also Desmond 2021). There is a variety of ways in which a causal theory can be relevant for ethical (and political questions):

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 thinkings (which can reinforce value hierarchies).

In these lines of reasoning, it is acknowledged that the ethical-normative dimension of Darwinism does not *determine* precise ethical and policy consequences. The is-ought distinction is respected; there is no naturalistic fallacy being committed. Rather, Darwinism-as-worldview implies a view of the human species and society where many (though not all) of our traits and behaviors have evolved and have been handed down by ancestors, where they have been shaped by a long history of natural selection. It provides a causal history of how human cognition and behavior arose, and while this does not determine ethical or political deliberation (for a similar point, see Reydon, 2015), it simultaneously *does* imply that human thought and behavior cannot be engineered by ethics or policy without constraint. For the ethicist or political thinker, this is a very weak conclusion that is consistent with almost any plausible ethical or political view.

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.

The potential for abuse opens up the possibility that one should be careful in science education or science communication in talking about these value-laden aspects of Darwinism. To acknowledge that Darwinism-as-logic can generate a multiplicity of political worldviews can mistakenly be believed to imply that all scientific disagreements about Darwinism-as-logic are "really" political. Thus it could be prudent to present Darwinism *as if* it were a value-neutral scientific theory. The thin conception of Darwinism may not yield a full understanding of Darwinism (the critiques in section 2 still hold), but the conception may still be a useful category for science communication.

This, we believe, helps explain why thin conceptions of Darwinism were promoted following the advent of sociobiology and research on intelligence and race (Jensen 1969). When Gould stated the thin conception of Darwinism so clearly, in 1982, it came in the heels of his *The Mismeasure of Man (Gould 1981),* a systematic critique of eugenics but also work of Arthur Jensen (and in a later edition, Herrnstein and Murray (Herrnstein and Murray [1994] 1994)). Similarly, while Richard Lewontin seemed to stop short of promoting a thin conception of Darwinism (and indeed, advanced his own thick conception), he did label eugenics and Jensen's work as a "vulgar Darwinism", partially for being adaptationist (Lewontin 1983). Here both Lewontin and Gould can be understood to be reacting against what we in this paper could categorize as *abuses* of the thick conception of Darwinism: construals of Darwinism that not only misinterpret the core logic of Darwinism (e.g., by over-emphasizing the role of natural selection), but also undermine is-ought distinction by taking Darwinism-as-logic as direct ground for determining the outcomes of policy deliberations.

In sum, acknowledging this third and most complex dimension of Darwinism – Darwinism-as-worldview – 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. Darwinism has a subtle proto-normative status: not an ethical theory, but not irrelevant to ethics. In itself it is politically neutral, but as certain concepts are emphasized over others (e.g., cooperation over competition), different worldviews are generated that have more determinate ethical and political consequences.

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 this paper we have showed why this option is not plausible. If one tries to restrict Darwinism to the biological context only, one quickly runs into confusion about the precise causal and explanatory structure is of key components, such as the theory of natural selection. "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 many 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.

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[i] 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)

[ii] Note that our usage of the thick/thin distinction, we use "thick" to refer to a way of thinking or reasoning – as opposed to referring to concepts such as "generous" or "self" as is standard in in ethics and epistemology (Roberts 2013). Moreover, in ethics and epistemology "thin concepts" tend to refer to purely evaluative concept (such as "good" or "bad"), but such concepts are not relevant in the context of science or philosophy of science. The interesting contrast class of "thick ones that confuse the is-ought distinction, are the purely descriptive/explanatory concepts. Hence we use "thin" to refer to the latter.

[iii] Interestingly, Dawkins dubs his view the "Darwinian View of Life", suggesting that he thought of his analysis of natural selection as the "true" Darwinism (Dawkins 1996).

[iv] Exploring to what extent Darwinism could be considered a Kuhnian paradigm is beyond the scope of this paper. Darwin's work shaped biology to a degree that would certainly qualify it as "paradigmatic". However, is *Darwinism* – as distinct from Darwin's historical work – a paradigm? This calls to mind how theories in economics can be reified into "-isms" (Marxism, Keynesianism, etc.), and the question of whether such "isms" can be considered Kuhnian paradigms is quite a subtle one. See e.g. (Redman 1991).

[v] 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).

[vi] We thank an anonymous reviewer for pointing out this passage.