"Heuristic Personification" as Epistemic Practice in Darwinian Evolution

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Abstract

I shed some light on the epistemically privileged practices used in the development of Darwinian evolution and its subsequent gene-centric turn. Drawing on Charles Darwin's *On the Origin of Species* (1859), I argue that *heuristic personification* was instrumental to the discovery and formulation of the theory of evolution by natural selection. Furthermore, three seminal papers by the sociobiologist W.D. Hamilton (1964, 1972, 1971) reveal that this practice was used to render intelligible the development of neo-Darwinian, game-theoretic mathematical models of altruism. I propose that this heuristic is sufficiently distinct from the existing literature on epistemic practices that it deserves its own, special category.

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1 Introduction

In *Ways of Knowing* (2004), John V. Pickstone proposes three categories of epistemic practices in the natural sciences: *natural history* (describing and classifying), *experimentation* (controlling phenomena and systematically creating novelties), and *analysis* (explaining complex phenomena

by reducing them to simpler constituents). By showing how technological developments made their way into scientific practice, the book attempts to narrow the gap between the history of ways of knowing (science) and histories of ways making and doing (technology) (2004, pp. 19-20).

I will first show how Pickstone's epistemic practices map onto the development of Darwinian Evolution. Having done that, I will show that a close reading of Charles Darwin's *Origin of Species* (1859) and W.D Hamilton's seminal papers in sociobiology (1964, 1971, 1972) reveal Pickstone's categories to be insufficient to accurately categorise a key epistemic practice for both Darwin and W.D Hamilton, which I will call *heuristic personification*.

By *heuristic personification* I mean the metaphorical attribution of rational agency to a biological entity as a means to explain a biological phenomenon, with the simultaneous denial of the reality of such agency. I will argue that it was an indispensable tool for generating knowledge for Charles Darwin (1809–1882) and W.D Hamilton (1936–2000). More concretely, I will show that the initial discovery and formulation of the theory of evolution by natural selection is built on the personification of *Nature* as a 'selecting agent', which allowed Darwin to explore the parallels between human breeders and natural selection. Moreover, the introduction of game-theoretic mathematical models to explain altruism by W.D Hamilton in the late 1960s and early 1970s is only coherent in light of the *personified gene*. After all, game theory implies the existence of a game, which implies the existence of players with rational motives.

Having established that the initial formulation and subsequent mathematisation of Darwinian theory has depended heavily on the epistemic practice of *heuristic personification*, I will respond to two potential criticisms: First, that *heuristic personification* ought to be regarded as a special case of *analysis*, in the Pickstonian sense. And second, that it ought to be seen as a special case of vitalism.

2 Applying Pickstone's Three Epistemic Practices to Darwinian Evolution

We begin by showing how Pickstone's categories allow us to understand the epistemic practices that led to the initial formulation and refinement of Darwinian evolution.

2.1 Natural History

For Pickstone, *natural history* relies on "describing and collecting, identifying and classifying, utilising and displaying" (2004). It thus relies both on the accumulation and dissemination of facts and objects as well as the journeys and expeditions that lead to their identification and collection.

Darwin's *Origin of Species* (1859) is littered with natural history. Whether it is wheat (p. 9), ducks (p. 12) or dogs (p. 17), *Lobelia fulgens* (Cardinal Flower) (p. 76), Cirripedes (p. 78), *Ornithorhynchus* (Platypus) *Lepidoriren* (lungfish) (p. 100), Darwin is constantly citing his own observations as well as those made by his fellow naturalists such as Asa Gray (p. 88) or Étienne

Geoffroy Saint-Hilaire (p. 113). In fact, the "Register of writers referred to in the text of the *Origin*" in the 2008 re-print contains 75 entries (1859, p. 361). Still, Darwin reminds the reader that due to space constraints he can only reveal a small sliver of the "long array of facts I have collected" (p. 114).

For each organism he cites, he argues that many of its peculiar characteristics appear more likely on the theory of evolution than on the "ordinary view of each species having been independently created" (1859, p. 121). To give an example, he observes that "A part developed in any species in an extraordinary degree or manner, in comparison with the same part in allied species, tends to be highly variable" (1859, p. 114). For example, the length of the arms of the ourang-outan are one of the key distinctions between it and another species of ape. It is also the part of the ourang-outan's anatomy with the greatest amount of individual variation (p. 114). Darwin sees "no explanation" for this fact "on the view of each species [being] independently created" (p. 116). But, if each species has been descended from another species through natural selection, we would expect the most changed part of a species to also be the part which is currently the most variable (p. 116). After all, Darwin sees individual variation as "generative variability" (p. 117). Individual differences are the *generator* of natural selection, since variations afford "the materials for natural selection to accumulate" (p. 38).

Another application of natural history by Darwin comes from the difficulties of classifying species. A key recurring theme in Darwin's *Origin* is the blurry line between a "strongly-marked variety" and a "doubtful species" (p. 39). The same is said for the line between "sub-species" and "species" (p. 39-42). Darwin is brought to his view using his knowledge of existing plant and animal catalogues: "How many of those birds and insects in North America and Europe, which differ very slightly from each other, have been ranked by one eminent naturalist as undoubted species, and by another as varieties" (p. 47). In addition to reported findings by his fellow naturalists, Darwin relies on his own experience on the expedition of the *Voyage of the Beagle* 1839 to argue the same point: "Many years ago, when comparing and seeing others compare, the birds from the separate islands of the Galapagos Archipelago […], I was much struck how entirely vague and arbitrary is the distinction between species and varieties" (p. 40). Since natural history relies on classification, Darwin thus uses the *difficulties* encountered by the practice of natural history to argue that "varieties do not essentially differ from species" (p. 132), priming the reader to accept the reality of the mutability of species: "The differences [between species] blend into each other in an insensible series; and a series impresses the mind with the idea of an actual passage" (p. 42).

2.2 Experiment

We can illustrate the *experimental* way of knowing with another example from Darwin. He starts by explaining the 'standard view' among his peers:

> *The view generally entertained by naturalists is that species, when intercrossed,* have been specially endowed with the quality of sterility*, in order to prevent the confusion of all organic forms.*
>
> — *Darwin 1859,* Origin *1859*

To debunk this view, Darwin brings to bear decades of experimental evidence on plant hybridism by Kölreuter and Gärtner, concluding that the "two most careful experimentalists who have ever lived, have come to diametrically opposite conclusions [...]", suggesting that intercross-sterility is not a *specially endowed quality*, but an *accidental one* based on the physical incompatibility of reproductive organs.

Lastly, to illustrate *analysis* we turn to the so-called 'Modern Synthesis' of biology. Whereas *Origin* was instrumental in convincing biologists of the reality of *evolution*, it took almost five decades for them to warm up to *natural selection* as the main driver, a period which Julian Huxley has called 'the eclipse of Darwinism' 1942. The discovery of the gene and the sequencing of DNA prompted a re-evaluation of the theory. A new research programme calling itself the 'Modern Synthesis' emerged between the 1930s and 1950s 2019. Dawkins' *Selfish Gene* aimed to put into vivid words for a popular audience the implicit beliefs held by biologists working in this tradition, namely the idea that natural selection acts on genes as well as organisms 1976.

As we have seen, Pickstone defines *analysis* as "reducing complex phenomena to simple principles" 2004. We can illustrate this with the following example from the 'Modern Synthesis': how do we explain that animals tend to form clusters or herds? In 1972 W.D Hamilton published his "Selfish Herd" model 1971, a mathematical model that predicts the clustering behavior by simulating prey organisms minimizing their own probability of being attacked. When prey use their neighbors as living shields, groups and herds form, with very few assumptions about the organisms in question 1972. Hamilton is said to use *analysis*, in the Pickstonian sense, because he has explained a complex behavior as a natural consequence from a simple rule (an organism's desire for self-preservation).

While Pickstone's three categories are remarkably well-suited to cover a large portion of epistemic practices in biology, we will next show that a careful reading of *Origin* and *Selfish* reveals *personification* to be a distinct, fourth epistemic practice.

3 Heuristic Personification: The 'Missing' Epistemic Practice

I have shown that Darwin and the neo-Darwinian W.D Hamilton used *natural history*, *experiment*, and *analysis* to generate knowledge about living organisms. Nevertheless, in what follows I will argue that these categories alone are insufficient to describe the practices that led these

men to their discoveries. In particular, what appears again and again in their writings is *heuristic personification* (see §1 for my definition).

3.1 Darwin's Personification of natural selection

Darwin personifies *Nature* and *natural selection*. Thus, we read that "natural selection should have preserved or rejected each little deviation of form less carefully [for unspecialized than specialized anatomical parts]" (1859, p 114), or that variations "will be taken advantage of by natural selection" (p. 258), or of variations "being preserved and accumulated by natural selection" (p. 91). We read that "Natural Selection, it should never be forgotten, can act on each part of each being, solely through and for its advantage" (p. 114), or that "natural selection would have free scope for the work of improvement" (p. 64). In each of these cases, natural selection appears personified - as if it had intelligence, agency, and the motivation to shape an organism a certain way.

But why should we care whether Darwin used a metaphor in his writings? I will show that this is not merely a rhetorical device by showing how this metaphor connects to Darwin's major contribution to biology. It is commonly understood that Darwin revolutionised biology by making the first compelling case for the evolution of organisms, by giving a plausible (dominant) mechanism: *natural selection*. What is often forgotten is the method that led him to this conclusion: namely the scrutiny into individual differences between organisms, a topic which was much-ignored by his contemporaries:

> *Hence I look at individual differences, though of small interest to the systematist, as of high importance for us, as being the first step towards such slight varieties as are barely thought worth recording in works on natural history.*
>
> — *(Darwin, 1859), p. 42*

Gillian Beer has argued that this insight led Darwin to believe that, in the context of evolutionary change, "the potentiality for change is borne by the individual" (2009, p. xviii).

> *So again it is difficult to avoid personifying the word Nature; but I mean by Nature, only the aggregate action and product of many natural laws, and by laws the sequence of events as ascertained by us.*
>
> — *Darwin,* Origin of Species *3rd Ed. 2009*

The fact that these personifications are taken to be metaphors by their authors has probably contributed to them being neglected in existing accounts of epistemic practices in biology. Nevertheless, Gillian Beer has argued that the following passage reveals Darwin's personified Nature to more than merely metaphorical 2009:

> *as man can certainly produce great results by adding up in any given direction mere individual differences, so could Nature, but far more easily, from having incomparably longer time at her disposal*
>
> — Origin of Species *1859*

Nature appears to be endowed by the agency to "produce great results". By comparing Nature to a human breeder ("as man can certainly produce great results… so could Nature"), Darwin uses the familiar to make the novel intelligible to a Victorian audience. Personification is therefore not merely a literary metaphor, but a didactic tool. But it is more than a merely *didactic* tool, too: Victorian audiences had moral objections to accepting evolution by natural selection, which was a threat to the "assumption that all manifestations of nature are aspects of a relationship between God and Man" 2009. A common sentiment was that evolution threatened human dignity by reducing "morality to a mechanical process" 1846. Personifying Nature, therefore, was a *rhetorical tool* which helped soften the moral blow by maintaining the 'awesomeness' of creation - replacing a real, active God with a personified, metaphorical Nature.

So personification was a literary device, a didactic tool, and a rhetorical device. This is not yet enough to justify calling it an 'epistemic practice'. However, Pickstone has convincingly argued that reasoning from analogy with an active human selector was a key insight that led Darwin to formulate his theory. Citing Desmond and Moore's biography of Darwin 1991, Pickstone highlights the influence that commercially-driven human selection had on Darwin 2004:

> *In Britain from 1750, cattle and sheep were changed radically as breeders sought marketable characteristics and faster growth. […] the theory of evolution by natural selection […] can be shown to have built on this shift in breeding technology.*
>
> — *2004*

If analogies with human selection are how Darwin stumbled upon his theory in the first place, then Beer's suggestion that Darwin's theory "needs" a more strongly personified nature is spot on. Darwin's personification of Nature allowed him generate valuable knowledge about her, and thus should be viewed as an epistemic practice.

It may be suggested that *personification*, if it is an epistemic practice, should be seen as a sub-set of analysis, since it is employed as a tool to explain complex phenomena. But this view is problematic: all cases of *analysis*, as understood by Pickstone, require the breaking down of a complex phenomenon into simple, constitutive parts *which are taken to be real* 2004. But Darwin clearly did not literally hold a personified view of Nature. It is the use of *useful fictions* to come to grips with reality that makes personification a practice quite distinct from Pickstonian *analysis*.

3.2 Hamilton's Personification of the Gene

W.P Anderson personifies *genes* and *organisms.*

Dawkins is more forceful:

> *Personification of genes really ought not to be a problem, because no sane person thinks DNA molecules have conscious personalities, and no sensible reader would impute such a delusion to an author.*
>
> — Selfish Gene *1976*

We will next see how personification-as-epistemic practice reappeared in the 1960s 'Modern Synthesis', with the *gene* and *organism* replacing *Nature* as the thing being personified. By the 1960s biologists needed tools to navigate the complex, mathematics-heavy turn of the modern synthesis. Personification was one of these tools. Thus, Dawkins states that "natural selection for selfish genes tends to favour cooperation among genes", ascribing to genes (the basic unit of heredity) the (anthropomorphic) quality of *cooperation.* For Dawkins, personification of this kind is not "just a quaint didactic device":

> *"[in] Darwinian calculations of altruism and selfishness [...] it is very easy to get the wrong answer. Personifying genes, [...] often turns out to be the shortest route to rescuing a Darwinian theorist drowning in muddle".*
>
> — *1976*

In 1964 W.D. Hamilton offered a game-theoretic mathematical proof showing that under certain idealised conditions, model organisms which have their phenotype entirely fixed by their genetic blueprint will evolve a certain limited altruism. He concludes:

> *in the world of our model organisms, whose behaviour is determined strictly by genotype, we expect to find that no one is prepared to sacrifice his life for any single person but that everyone will sacrifice it when he can thereby save more than two brothers, or four half-brothers, or eight first cousins [...] Clearly from a gene's point of view it is worthwhile to deprive a large number of distance relatives in order to extract a small reproductive advantage*
>
> — *1964*

Thus, the prediction is made by pure mathematics, but the interpretation is made by taking "the gene's point of view".

To give a concrete example, the biologist W.D Hamilton attributed "to the genes, temporarily, intelligence and a certain freedom of choice", in a paper on the sterility of worker ants 1972. Thus, the *personification of genes* becomes a way of quickly and reliably arrive at the result of a long mathematical calculation without having to explicitly go through with it.

Dawkins does not just personify genes; organisms are also given fictitious motivations and intelligence *purely for the sake of argument*. In describing the death-throes of the runt of a litter, Dawkins presents the following argument:

> *As soon as a runt becomes so small and weak that his expectation of life is reduced to the point where benefit to him due to parental investment is less than half the benefit that the same investment could potentially confer on the other babies, the runt should die gracefully and willingly. He can benefit his genes most by doing so.*
>
> — *Dawkins 1976,* The Selfish Gene *, 1976*

Dawkins does not describe the *actual* mental state of the runt when he says "the runt should die gracefully and willingly". And yet, the effects of gene selection are such that we can *pretend* that the runt is a rational actor attempting to optimize the chances of passing on his genes. Dawkins explains that this *personification of the organism* is mental short-cut for the following argument, which relies on the *personification of the gene*:

> *A gene that gives [the runt] the instruction, "Body, if you are very much smaller than your litter-mates, give up the struggle and die" could be successful in the gene pool, because it has a 50 per cent chance of being in the body of each brother and sister saved.*
>
> — *1976*

So, sociobiologists working in the 'Modern Synthesis' tradition personify organisms by giving them the fictitious intelligence and motivation to rationally calculate the maximum chances of passing on their genes. They personify genes in attributing to them what Dawkins terms 'selfishness' - i.e the motivation and intelligence to maximize their own chances of survival. Both instances of personification, like the one employed by Darwin, enable them to make discoveries and explain biological phenomena - they are thus distinct ways of knowing.

4 Why Heuristic Personification is not vitalism

As I will show, neither Darwin nor Hamilton believed in the literal truth of this *personification*, which is why it ought to be called a *useful fiction*. This makes *heuristic personification* different from vitalism, which holds that biological entities *really do* have irreducible agency (for example Hans Driesch's "entelechy" - "an organizing, directive force that consumed no energy, was immaterial, but was the factor that distinguished living from non-living matter" 2005.

5 Why Heuristic Personification is not a subset of analysis

It may be contended that *heuristic personification* is merely a type of *analysis* in the Pickstonian sense. This contention is easy to refute. For Pickstone, *analysis* concerns then "decomposition of 'compounds' into their various elements, and the reduction of systems to the 'flow' of single elements" (p. 85). Importantly, the simple elements which are used to explain complex behavior

are always implicitly taken to be really existing. It would stretch the concept to the point of meaninglessness if we expanded "analysis" to include *useful fictions* like *heuristic personification*.

6 Conclusion

Through the lens of Pickstone's epistemic practices, we have seen that personification is far more than a didactic metaphor. Personifying Nature allowed Darwin to view the similarities between artificial breeding and natural selection, and let to the formation of his radical theory. For Dawkins and the sociobiologists of the Modern Synthesis, the personification of genes and organisms serves as a rigorous analytical shortcut—a way to navigate complex mathematical probabilities by treating biological entities as rational actors. These uses of *personification* cannot be reduced to Pickstone's category of *analysis*, as they have the distinctive quality of using *useful fictions* to making discoveries about the world.

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