

Heuristic Personification as Epistemic Practice in Darwinian Theory

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3590 words

Submitted 16th April, 2026

Substantial Revision 02th May, 2026

Abstract

I scrutinise the epistemic practices used in the initial formulation and subsequent development of the theory 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 Darwin's theory. Furthermore, three seminal papers by the sociobiologist W.D. Hamilton (1964, 1972, 1971) reveal that this same 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 recognised epistemic practices in the existing literature 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 attempt to field 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) Darwinian Evolution in Three Epistemic Practices

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 (1859/2008, 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 is Darwin’s insistence that species are not ‘natural kinds’. That is to say, they are invented, rather than discovered. Darwin’s species nominalism is most apparent from the following quote:

[...] it will be seen that I look at the term species, as one arbitrarily given for the sake of convenience to a set of individuals closely resembling each other, and that it does not essentially differ from the term variety, which is given to less distinct and more fluctuating forms. The term variety, again, in comparison with mere individual differences, is also applied arbitrarily, and for mere convenience’ sake

— 1859, p. 43

To support this view, Darwin points out the difficulties that naturalists have faced in drawing the line between a “strongly-marked variety” and a “doubtful species” (p. 39), or between “sub-species” and “species” (p. 39-42). Darwin is brought to his view using 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 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), thus priming the reader to be more receptive to the mutability of species, for “[t]he 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.

2.3) Analysis

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 Fourth 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, and deserves closer scrutiny, is *heuristic personification* (see §1 for my definition).

3.1) In Darwin's *Origin of Species*

Darwin personifies *Nature* and *natural selection*. Thus, we read that that "We have seen that man by selection can certainly produce great results, [...] through the accumulation of slight but useful variations, **given to him by the hand of Nature**," (1859, p. 50), or 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, discernment, agency and the desire to shape an organism a certain way.

Darwin didn't literally believe in a Personified Nature, as he forcefully makes clear in an addition made to the third edition of the *Origin*:

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 (1861) in (Peckham, 2010, p. 165)*

So, if Darwin claims he merely uses personification as a metaphor, why do I insist it should be viewed as an epistemic practice? Should we not view the personification of Nature in the same light as Darwin's other similes and metaphors, such as when he compares species to languages: "a breed, like a dialect of a language, can hardly be said to have had a definite origin" (p. 33). Why don't I argue that the language-simile was an epistemic practice?

My argument hinges on showing that *heuristic personification* led Darwin to his most important contribution, by allowing him scrutinise what others ignored. It is commonly understood that Darwin revolutionised biology by making the first compelling case for organismic evolution and giving a plausible (dominant) mechanism: *natural selection*. What is less understood is the method that led him to this conclusion: namely the careful scrutiny of *individual differences* between organisms, a topic that, as he pointed out, was much-ignored by his fellow naturalists:

[...] 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 also argued that Darwin’s key contribution, and what separated him from other evolutionists like his grandfather Erasmus or his French predecessor Jean-Baptiste Lamarck, was his realisation that that “the potentiality for change is borne by the individual” (2009, p. xviii). Indeed, Darwin repeatedly refers to “*generative variability*” (e.g. p. 117), implying that individual difference is what *generates* evolutionary change.

Whereas “the systematists” quoted by Darwin ignored individual differences, breeders were obsessed with it. In *Ways of Knowing*, 2004, Pickstone has pointed out that the analogy with an active human selector or breeder 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:

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.

— (Pickstone, 2004, p. 30)

Darwin dedicates his first chapter ‘Variation under Domestication’ to discussing man-made selection, using examples from horses, sheep, dogs, and pigeons (Darwin, 1859, pp. 9-37). In fact, Darwin tells us that his study of individual differences between domesticated organisms has led him to take up breeding domestic pigeons himself, gaining entry into “two of the London Pigeon Clubs” (p. 18-19). It was thus bringing the eye of a breeder to bear on problems of biological systematics that led Darwin to his masterstroke. Darwin dedicates his first chapter (‘Variation under Domestication’) to man-made breeds, but breeding and man-made selection is ever present throughout *Origin*, even in discussions of Natural Selection. For example, in the Chapter ‘Natural Selection’ he seamlessly switches between discussing natural and human selection: “Though nature grants vast periods of time for the work of natural selection [...] In man’s methodical selection, a breeder selects for some definite object” (p. 79).

To bring a final example to bear, here Darwin explicitly draws a comparison between the work of human breeders and that of nature:

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 (Darwin, 1859, p. 64)

From the aforementioned discussion, it is reasonable to suppose that analogies with human selection are how Darwin stumbled upon his theory in the first place. This is because individual differences were Darwin’s generator of change, and it is precisely *breeders* that paid attention to individual differences in Victorian England. Then, it follows that the *heuristic personification* of nature was how Darwin was able to apply a certain procedure of breeding “Multiply, vary, let the strongest live and the weakest die” (1859, p. 181) to the action of Nature. We have thus shown that it is an epistemic practice - a way of producing knowledge.

3.2) In W.D. Hamilton’s Game-Theoretic Explanations of Altruism

W.P Hamilton personifies *genes*.

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”.

— (Dawkins, 1976, *Introd. p. xii*)

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

— (Hamilton, 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 (Hamilton, 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, p. 168)

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.

— (Dawkins, 1976, p. 168)

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) Objections to Heuristic Personification as Epistemic Practice

It may be contended that *heuristic personification* is simply vitalism in disguise. But, as we have seen in §3.1, Darwin rejected a literal view of personified Nature. In his defense of W.D Hamilton, Dawkins is even more forceful in denying the reality of the personified *gene*:

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 (*Dawkins, 1976, Prologue*)

The rejection of the reality of the very agency that is so useful as an epistemic tool is why it ought to be considered 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 organising, directive force that consumed no energy, was immaterial, but was the factor that distinguished living from non-living matter” (Allen, 2005, p. 271)).

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*.

5) Conclusion

We have seen that, for Darwin and W.D Hamilton, *heuristic personification* was far more than rhetoric: it did real scientific conceptual heavy-lifting. Personifying Nature was essential to Darwin’s core argument in the *Origin of Species*. When we realise that natural selection implies a selector, we are led to the key insight that led Darwin to see what others missed: that human breeding was a minified version of the work of nature - an that is only possible with *heuristic personification*. Similarly, for W.D Hamilton, the personification of the *gene* allowed him to justify the application of game-theoretic models to explain altruism as ‘kin selection’. Indeed, without personified (rational) actors there can be no “game” in “game theory”. And as Dawkins pointed out, it also served as an epistemic shortcut for practising biologists: a way to navigate complex mathematical probabilities and quickly arrive at an answer without having to explicitly go through the mathematical proofs offered by Hamilton (1964, 1972, 1971).

These considerations lead us to the conclusion that Pickstone’s account of epistemic practices are simply not sufficient to understand the key conceptual changes that have punctuated the

history of Darwinian evolution. Thus, we must elevate *heuristic personification* to its rightful place as a distinct epistemic practice in biology.

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