# Personification as 'Epistemic Practice' in Evolutionary Biology

Victor Elgersma

Submitted 16 April 2026

Revised 6 May 2026

3558 words

## Abstract

I scrutinise the epistemic practices used in the initial formulation of Darwin's theory of evolution by natural selection and its subsequent gene-centric development. 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, two seminal papers by the sociobiologist W.D. Hamilton (1964, 1972) reveal that this same practice was used to justify the application of game-theoretic mathematical models to the problem of altruism in the animal kingdom. I propose that *heuristic personification* is sufficiently distinct from recognised epistemic practices in the existing literature that it deserves its own, special category.

# Contents

# 1) Introduction

In *Ways of Knowing* (2004), John V. Pickstone introduced a taxonomy of epistemic practices employed in natural sciences: *natural history* (describing and classifying (2004, p. 37), *experimentation* (controlling phenomena and systematically creating novelties (2004, p. 2)), and *analysis* (reducing complex phenomena to simple principles (2004, p. 56)).

I will first elucidate how Pickstone's categories have applied to the development of Darwin's theory of evolution by natural selection (Darwin, 1859) and to the sociobiology of W.D Hamilton (1971). Next, I will show that a close reading of Charles Darwin's *Origin of Species* (1859) (hereafter "the *Origin*") and two of Hamilton's seminal papers (1964, 1972) reveal Pickstone's categories to be insufficient to categorise a key epistemic practice employed by both authors, 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 phenomenon, while simultaneously denying the objective reality of such agency. This is consistent with how the term "personification" has been used in discussions by Darwin (1859), Richard Dawkins (1976), and Gillian Beer (1996). I will argue that *heuristic personification* was an indispensable tool for generating knowledge for Charles Darwin and W.D Hamilton (1936–2000). More concretely, I will show that the personification of *Nature* as a 'selecting agent' was indispensable for Darwin's initial discovery of the theory of evolution as it allowed him to explore the parallels between an artificial and a 'natural' selector. Moreover, the two seminal papers on altruism in social insects by W.D Hamilton (1964, 1972) rely on game-theoretic mathematical models rooted in the *personified gene*, as game theory itself presupposes the existence of 'players' with rational agency.

Having established that the initial formulation and subsequent gene-centric turn of Darwinian theory has depended heavily on the 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. Both criticisms will be addressed by emphasising that *heuristic personification* is a *useful fiction*, in sharp contrast with the the ontic commitments inherent in analysis and vitalism.

# 2) Darwinian Evolution in Three Epistemic Practices

We begin by applying Pickstone's categories to the epistemic practices used in the initial formulation of Darwinian evolution, and its subsequent gene-centric turn.

## 2.1) Natural History

For Pickstone, *natural history* relies on “describing and collecting, identifying and classifying, utilising and displaying” (2004, p. 60). This epistemic practice therefore includes the accumulation and dissemination of facts and objects as well as the journeys and expeditions necessary for their collection.

The *Origin* is permeated by natural history. From wheat (1859, p. 9), ducks (p. 12), to the Platypus (p. 78), Darwin is constantly citing his own observations as well as those made by a total of one hundred and sixteen fellow naturalists (Beer, 1996b). Still, Darwin maintains that he has only shared a sliver of the “long array of facts” he has collected (p. 114).

For each organism, Darwin focuses on peculiar characteristics which appear unlikely under the “ordinary view of each species having been independently created” (1859, p. 121), but can be readily explained by evolution. For example, “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). The *Orangutan* provides a clear case: its distinctive long arms—the very feature that separates it from other apes—also happen to exhibit the greatest variation between individuals (p. 114). While Darwin sees “no explanation” for this phenomenon under the “view of each species [being] independently created” (p. 116), evolution provides a plausible explanation. After all, individual variations provide “the materials for natural selection to accumulate” (p. 38). Individual variations are thus “generative” of evolution (p. 117). Darwin argues that we would expect exactly those parts which have evolved the most in a species’ recent phylogenetic history to still be varying the most to this day (p. 116). Just like if the engine of a car is hot we can infer that it has recently been used, if an anatomical part has a lot of individual variation we can infer it has recently been the object of evolutionary change. Natural history thus provides key empirical evidence for evolution.

Another application of natural history is Darwin’s insistence that species are not ‘natural kinds’, but human conventions. The idea that species were immutable productions by a Creator implies that specieshood is a natural category which is ‘out there’. By viewing ‘species’ as a conventional, man-made category instead, Darwin was undermining a key Creationist tenet. Darwin’s *species nominalism* is most apparent in the following passage:

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

— *(Darwin, 1859), p. 43*

Evolution is thus not a matter of the behaviour of universals such as ‘species’, because for Darwin such universals do not exist independently of the particular beings that instantiate them. To support his *species nominalism*, Darwin contrasts different plant and animal taxonomies available to him, leading him to remark “what a surprising number of forms have been ranked by one botanist as good species, and by another as mere varieties” (p. 40). Darwin thus uses the *difficulties* encountered by the practice of natural history in articulating coherent taxonomies to argue that “varieties do not essentially differ from species” (p. 132), thus priming the reader to be more receptive to the possibility of species mutation, 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). By “actual passage” Darwin means the actual evolution from one species to another. If species were not conventional categories but immutable productions created by God, Darwin argues, then we would not expect to find these vague gradations (“insensible series”) in nature. Darwin has thus used natural history to argue for *species nominalism*, removing a key *a priori* obstacle to the theory of natural selection.

## 2.2) Experiment

Darwin continues his argument for *species nominalism* by drawing on the *experimental* way of knowing. The ‘standard view’ that he seeks to undermine is “that species, when intercrossed, have been **specially endowed** with the quality of sterility, in order to prevent the confusion of all organic forms” (emphasis added) (1859, p. 47). This belief in a “universal sterility” (p. 188) (of distinct species when crossed) is a matter of fact about the world which can be settled by experiment. As explained by Currie & Levy (2019), experiments provide privileged epistemic access because they represent the “repeated, fine-grained causal manipulation of focal properties” of the specimen. The *focal properties* are taken to be essential characteristics of the specimen in question - in this case the ostensible “universal sterility” induced by cross-breeding between distinct species. Darwin points out that these cross-breeding (or ‘hybridisation’) experiments were indeed performed by Kölreuter and Gärtner, “two most careful experimentalists who have ever lived”, but that “they have come to diametrically opposite conclusions in regard to the very same species” when intercrossed (p. 184). This seems hard to square with a supposed “universal” quality (p. 189). Therefore, it appears that this sterility is not a *specially endowed quality*, but an *accidental one*, thus further casting doubt on the view that species are immutable Divine productions, while boosting the evolutionary thesis.

The shift in evolutionary biology that led to the cementing of the ‘gene’ as an epistemic object in its own right was also heavily influenced by the experimental way of knowing, first as breeding experiments in the 1890s confirmed Mendel’s laws of inheritance (Rheinberger, 2008, p. 5), and later when Herman J. Muller reported on the induction of Mendelian mutations in Drosophila using X-rays in 1927 (Rheinberger, 2008, p. 6). And, perhaps most famously, the elucidation of the structure of DNA as a macromolecular double helix by Watson and Crick, drawing on X-ray diffraction data produced by Rosalind Franklin, allowed biologists to identify it as *the* autocatalytic hereditary entity, or ‘basic unit’ of heredity (Rheinberger, 2008, p. 8).

### 2.3) Analysis

Pickstone calls *analysis* the practice of “reducing complex phenomena to simple principles” (2004, p. 56). It is thus a reductive form of knowing. We can illustrate this practice with the following example from W.D Hamilton’s “Geometry for the Selfish Herd” (1971), in which the clustering behaviour of prey organisms is derived by having each model organism minimise its own probability of being attacked. When prey use their neighbours as living shields, groups and herds form, with very few assumptions about the organisms in question. This is an example of *analysis*, in the Pickstonian sense, because he has explained a complex behaviour as a natural consequence from a simple rule (an organism’s desire for self-preservation).

## 3) Heuristic Personification: The Fourth Epistemic Practice

Pickstone’s three categories are remarkably well-suited to classify a large portion of the epistemic practices in the genesis and development of Darwinian evolutionary theory, as we have seen. However, I will next show that a careful reading of the *Origin* and two papers by the biologist W.D Hamilton (1964, 1972), as well as their popularisation in Richard Dawkins’ *Selfish Gene* (1976) reveals *heuristic personification* (defined in §1) to be a distinct, fourth epistemic practice.

### 3.1) In Darwin’s *Origin of Species*

Darwin personifies *Nature* and *natural selection*: we read that useful variations are given to man “by the hand of Nature” (1859, p. 50), or that “natural selection should have **preserved or rejected** each little deviation of form **less carefully**” (1859, p 114), or that variations “will **be taken advantage of** by natural selection” (p. 258). 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) (emphasis added). In each of these cases, natural selection appears personified - as if it had intelligence, discernment, agency and the desire to deliberately shape an organism a certain way.

Darwin didn’t literally believe that Nature acted with rational intent, as he explicitly clarifies in the *Origin*’s third edition:

> *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 (1861/1959) [p. 165]*

Darwin claims that his personified Nature is merely a short-hand for the natural laws gleaned from empirical observations. So, why do I insist that it should be viewed as an epistemic practice deployed in the production of knowledge, rather than a simple explanatory device? Should we not view the personification of Nature in the same light as Darwin’s other similes and metaphors, such as his comparison of species to languages: “a breed, like a dialect of a language, can hardly be said to have had a definite origin” (p. 33), thus pointing out that asking to exactly date the appearance of ‘the horse’ is akin to exactly dating the genesis of ‘the English language’. Why don’t I view this ‘language-simile’ as an epistemic practice? My argument hinges on showing that *heuristic personification* was not only indispensable for explaining natural selection, but that it was indispensable for Darwin to have his key insight in the first place. Whereas his ‘language-simile’ above did didactic and explanatory work, personification of Nature *did the work of discovery.*

It is commonly understood that Darwin revolutionised biology by making the first compelling case for the transmutation of species and proposing a plausible dominant mechanism (*natural selection*). What is less understood is the method that led him to this insight: 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 argued that this focus on individual variability was Darwin’s masterstroke, and what separated him from other evolutionists like Lamarck (1996, p. xviii). Indeed, as we have seen in §2.1, Darwin viewed individual differences as "*generative variability*" (p. 117), implying that they *generate* evolutionary change, whether employed by an artificial selector or a 'natural one'.

Whereas "the systematists" quoted by Darwin ignored individual differences, Victorian breeders knew how to exploit them, and Darwin shows a deep engagement with the challenges faced by breeders as well as the skills required to be a good one (1859, p. 25). In keeping with Beer's interpretation, Pickstone has also pointed out that the analogy with an active human selector or breeder was the insight that led Darwin to formulate his theory (2004, p. 30). Drawing on 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)*

In fact, Darwin dedicates his entire first chapter ('Variation under Domestication') to discussing man-made selection, using examples from horses, sheep, dogs, and pigeons (Darwin, 1859, pp. 9-37). He tells the reader that his study of individual differences between domesticated forms led him to take up the breeding of domestic pigeons, gaining membership of "two of the London Pigeon Clubs" (p. 18-19). Darwin undoubtedly sharpened his eye for individual differences through his pigeon-breeding, and brought this sharpened breeders' eye to bear on biological systematics. Despite having a dedicated chapter, breeding and man-made selection is ever present throughout *Origin*, and is particularly prevalent in discussions of natural selection. In the fourth Chapter ('Natural Selection') Darwin seamlessly switches between discussing a human and a 'natural' selector: "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). For Darwin, both natural and man-made selection relied on the same principle ("Multiply, vary, let the strongest live and the weakest die" (p. 181)). But Nature, in contrast to Man, has no "definite object" in its selection procedure and can only modify a species "through and for its advantage" (p. 114). It is also rendered far more powerful due to the "vast periods of time" it has at its disposal relative:

> *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.*

— *(Darwin, 1859, p. 64)*

Darwin would not have been able to even begin exploring this parallel between a 'natural' and a human selector without relying on the temporary, *heuristic personification* of Nature. It follows that *heuristic personification* enabled Darwin to see that the logic of artificial breeding practices applied, in modified form, to the action of Nature. We have thus shown that it is an epistemic practice - a way of producing knowledge, allowing Darwin to discern the generative mechanism of species change.

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

In evolutionary biology, an organism is said to behave altruistically when it provides a benefit to other organisms, at a cost to itself (Okasha, 2020). Charles Darwin struggled to explain why natural selection would not eliminate altruistic traits given that they disadvantaged the altruist. He attempted to argue that these traits would benefit the group, thus introducing the concept of 'group selection' (ibid). This explanation fell into disrepute in the 1960s, however, when mathematical models of group selection showed that it was an inherently weak evolutionary force, and hence unlikely to promote significant altruistic behaviours (Maynard Smith, 1964; Okasha, 2020; Williams, 1966). W.D. Hamilton's "The Genetical Evolution of Social Behaviour" (1964) offered a game-theoretic mathematical proof showing that altruism *can* evolve as a trait as long as the benefits of altruistic acts fell on individuals that were genetically related to the donor (Segerstrale, 2026).

Hamilton's core insight was that a gene's success isn't tied solely to the survival of one specific body. Because relatives share a significant portion of their DNA, a "replica" of a gene can exist in a sibling, cousin, or nephew just as easily as in a direct descendant (1972, p. 192). By helping a relative survive and reproduce, an organism is indirectly ensuring the survival of its own genetic material. Under this logic, the gene—not the individual—is the fundamental unit of selection, the protagonist of evolution, so to speak; the individual is merely the "vehicle" that carries the gene into the next generation (Dawkins, 1976; Segerstrale, 2026)

Hamilton's highly mathematical paper concludes by employing *heuristic personification* to interpret his results, writing that "from a gene's point of view [...] behaviour that involves taking too much from close relatives will not evolve" (1964, p. 16). Thus, the prediction is made via pure mathematics, but the interpretation is done by personifying the *gene*. Eight years later, in a paper on the sterility of worker ants, Hamilton begins by attributing "to the genes, temporarily, intelligence and a certain freedom of choice", using this *heuristic* to explain under which conditions the gene would cause "purely self-interested behaviour by its bearer" versus behaviour “that benefits in some way a relative” (1972, p. 195). After using this tool to derive the coefficient of relatedness (p. 196), a result that is now integral to the field of sociobiology (Michod & Hamilton, 1980). Hamilton says: “We can now abandon the fanciful viewpoint of individual genes” (1972, p. 195). But just because he has abandoned the *objective reality* of the personified gene does not mean that it wasn’t essential to establishing what he sought to prove.

Richard Dawkins’ *Selfish Gene* (1976) fully commits to Hamilton’s personification of the gene. Dawkins states that “natural selection for selfish genes tends to favour **cooperation among genes**” (emphasis added) (p. xi), ascribing to the gene the rational agency needed to pursue a certain type of mutually beneficial interaction. Dawkins’ account supports viewing personification as an epistemic practice; personification is not just a “quaint didactic device” (p. xii), rather, it is a *tool* for biologists working with the dense algebra of game theory:

> *“[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”.*
>
> — *(Dawkins, 1976, Introd. p. xii)*

Thus, *heuristic personification* of the ‘gene’ is presented as the surest route to truth for the sociobiologist. It is thus a ‘way of knowing’ - an epistemic practice.

## 4) Objections to Heuristic Personification as Distinct Epistemic Practice

It may be contended that *heuristic personification* is simply vitalism in disguise. Vitalism, the reader will recall, is the view that “living organisms defy description in purely physico-chemical terms, because organisms possess some non-material, non-measurable forces or directive agents that account for their complexity” (Allen, 2005, p. 267). But vitalism implies that biological entities *objectively have* irreducible agency. For example, Hans Driesch’s “entelechy” is taken to be “an organising, directive force that consumed no energy, was immaterial, but was the factor that distinguished living from non-living matter” (2005, p. 271). There is no hint that this force might be heuristic or fictional. 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*, saying that “no sane person thinks DNA molecules have conscious personalities” (Dawkins, 1976, p. xi). The insistence on the *fictionality* of the agency that is so useful as a heuristic tool is why it ought to be considered a *useful fiction*. This makes *heuristic personification* different from vitalism.

It may also 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 the "decomposition of 'compounds' into their various elements, and the reduction of systems to the 'flow' of single elements" (p. 85). Importantly, these 'simple elements' are always implicitly taken to be real. 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 or didactics: it did the work of discovery and theory formulation. 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 allowed Darwin to see what others missed: that human breeding was a minified version of the work of Nature - an insight that is only possible with *heuristic personification*. Similarly, for W.D Hamilton, the *heuristic personification* of the *gene* allowed him to justify the application of game-theoretic models, which involve considered judgment by actors participating in a 'game', to explain altruism in social insects and derive the coefficient of relatedness. As Richard Dawkins further elaborated, personification also served as a trusty epistemic tool 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 first offered by Hamilton (1964, 1972).

These considerations lead me to conclude that Pickstone's taxonomy seems insufficient to adequately classify the practices that have underpinned the conceptual development of evolutionary biology. Thus, I propose that we elevate *heuristic personification* to its rightful place as a distinct epistemic practice.

## Bibliography

Allen, G. E. (2005). Mechanism, Vitalism, and Organicism in Late Nineteenth and Twentieth-Century Biology: The Importance of Historical Context. *Studies in History and Philosophy of Biological and Biomedical Sciences*, *36*(2), 261–283.

Beer, G. (1996b). Appendix 1: Register of Writers Referred to in the text of Of The Origin. In G. Beer (Ed.), *On the Origin of Species* (Revised). Oxford University Press.

Beer, G. (1996a). Introduction. In G. Beer (Ed.), *On the Origin of Species* (Revised). Oxford University Press.

Currie, A., & Levy, A. (2019). Why experiments matter. *Inquiry*, *62*(9–10), 1066–1090. https://doi.org/10.1080/0020174X.2018.1533883

Darwin, C. (1859). *On the origin of species, 2nd ed.* (Revised Edition. Edited by Gillian Beer (2008). Oxford University Press.

Dawkins, R. (1976). *The selfish gene* (40th anniversary edition). Oxford University Press.

Desmond, A., & Moore, J. (1991). *Darwin: The Life of a Tormented Evolutionist.* Michael Joseph.

Hamilton, W. (1971). Geometry for the selfish herd. *Journal of Theoretical Biology*, *31*(2), 295–311. https://doi.org/10.1016/0022-5193(71)90189-5

Hamilton, W. D. (1964). The Genetical Evolution of Social Behaviour. I and II. *Journal of Theoretical Biology*, *7*, 1–52.

Hamilton, W. D. (1972). Altruism and Related Phenomena, Mainly in Social Insects. *Annual Review of Ecology and Systematics*, *3*(1), 193–232. https://doi.org/10.1146/annurev.es.03.110172.001205

Maynard Smith, J. (1964). Group Selection and Kin Selection. *Nature*, *201*(4924), 1145–1147. https://doi.org/10.1038/2011145a0

Michod, R., & Hamilton, W. (1980). Coefficients of Relatedness in Sociobiology. *Nature*, *288*. https://doi.org/10.1038/288694a0

Okasha, S. (2020). Biological Altruism. In E. N. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy: The Stanford Encyclopedia of Philosophy* (Summer2020 edn). Metaphysics Research Lab, Stanford University.

Pickstone, J. V. (2004). *Ways of knowing: a new history of science, technology, and medicine.* Manchester University Press.

Rheinberger, H.-J. (2008). *Gene Concepts* (S. Müller-Wille, Ed.; Issue 39). Blackwell Pub.

Segerstrale, U. C. (2026, March 3). *William Donald Hamilton.* Encyclopedia Britannica. https://www.britannica.com/biography/William-Donald-Hamilton

Williams, G. C. (1966). *Adaptation and Natural Selection: A Critique of Some Current Evolutionary Thought.* Princeton University Press.