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# Freedom in Evolution: Towards a Biosemiotic Framework for Fundamental Theological Ethics*

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**Abstract.** The article explores and critically reexamines the popular notion that biological evolution leaves little room for metaphysical freedom and free will. It guides the reader through a selection of emerging paradigms in evolutionary and theoretical biology, including the theories of autocatalysis, autopoiesis, epigenetics, and systems ecology, moving towards biosemiotics as its main focus. Special attention is given to the role of the chance-necessity interplay, the (physical) laws of nature, and the alleged directionality of evolution, as well as to the role and the scope of natural selection. The goal is to show how non-classical biology – and especially the emerging field of biosemiotics – can contribute to a better understanding of freedom as enhanced by, harnessed by, or even intrinsic to biological evolution. In doing so, the article also highlights the insights biosemiotics offers for broader engagement between theological methodology and the natural sciences (and vice versa). First, the classical Neo-Darwinian account of chance and necessity is contrasted with alternative approaches. The article then briefly presents key features of the Extended Evolutionary Synthesis (EES) and the organismal approach in biology, focusing on the concept of biological autonomy. Finally, it argues for the novelty of the biosemiotic paradigm in accommodating the notions of freedom, agency, and choice, and in methodologically engaging other disciplines, including theology. The conclusion points to possible implications for fundamental theological ethics and anthropology, as well as directions for future research in the field of science and theology.

* Parts of the article have been based on autors's doctoral research and his PhD dissertation (KU Leuven, 2021).

**Keywords**: free will, biosemiotics, moral agency, natural autonomy, theological ethics, theological method, Neo-Darwinism, non-classical biology

**Contribution:** The article offers a comprehensive introduction to alternative approaches to biological evolution and to biological science in general. It addresses the issues that remain relatively unfamiliar to ethicist and theologians, including those engaging with life sciences and science-theology dialogue. The article points to the (even more unfamiliar) biosemiotic paradigm and argues for its potential in reconsidering theological concepts of creation and life. Finally it opens a refreshing perspective on freedom, subjectivity and free will which also presents a valuable opportunity for transdisciplinary dialogue and due reappropriation of theological methods of inquiry.

**Use of AI:** For this article AI tools were used to improve the quality of the text in terms of its linguistic correctness, conciseness and style.

## Introduction

The problem of freedom – and, more specifically, the anthropological, philosophical, and theological question of free will – frequently arises in discussions of biological evolution. This is particularly evident in popular and academic discourse concerning contemporary scientific worldviews, which often appear to offer little space for these notions. Among the sciences, biology – and especially evolutionary biology – occupies a unique position in this debate. While many other scientific disciplines have, over the course of the 20th century, moved away from strict positivist frameworks in response to developments such as relativity theory, quantum mechanics, or chaos theory, biology has, in some respects, taken an opposite path: increasingly presenting itself as a rigorous, law-governed science.

This process accelerated with the discovery of DNA, which enabled the integration of natural selection with Mendelian genetics into the all-encompassing Modern Synthesis (or Neo-Darwinian theory), affirming rather than challenging modern metaphysical assumptions. The portrayal of life as governed by chance and necessity ultimately undermines any meaningful claim to freedom. Furthermore, the long-term

naturalisation[1] of mental and social life (e.g., in evolutionary psychology and sociobiology), alongside growing awareness of the determining role of food, health, genetic inheritance and other factors, brings biological constraints of freedom relatively close to everyday human experience. Meanwhile, neurophilosophical debates on free will have focused mostly on what such deterministically understood evolution had produced: the brain as a mechanistic – or at best, computational – controller of behaviour (cf. Libet 1985, Soon et al. 2008). Evolutionary and molecular aspects of cognitive neuroscience often reinforce this reductionist view, further fuelling deterministic metaphysics and free will scepticism.

Biology's peculiar position has long been striking as the discipline grapples with the complex and elusive phenomenon of life, and its dominant paradigms are indeed beginning to shift. Parallel to this change, the growing recognition of complexity and interconnectedness has already led some to herald the 21st century as the "century of biology" (cf. Dyson 1999). Many of these new developments are brought together under the umbrella of *non-classical* biology (e.g., Rosen 1991), and many have significant implications for situating freedom and free will within the evolutionary process and the living world as such. Some, like the steadily progressing field of *biosemiotics*, propose a radical rethinking of life in nearly all its aspects. This opens up new possibilities for engaging theological methodology and for bridging scientific and humanistic discourses on life, freedom, and agency. The emerging perspective offers promising insights for theological anthropology and ethics, as well as for fundamental theology, ecotheology, and the theology of creation.

The present article will take the reader through a selection of new paradigms in evolutionary biology and theories of biological organisation. Special attention will be given to the role of the chance-necessity interplay, the (physical) laws of nature and the alleged directionality in evolution, as well as to the role and scope of natural selection. The article will then briefly present the most important facets of the Extended Evolutionary Synthesis (EES) and of the organismal approach in biology,

[1] This reflects an underlying assumption that naturalization entails determinism, or at least determinability in principle. The underlying reductionism is even more apparent.

focusing on the notion of biological autonomy. Finally, it will attempt to show the novelty of the biosemiotic paradigm in accommodating the notions of freedom, agency and choice, as well as in addressing the differences and exploring the overlaps between evolutionary-biological and typically ethical understandings of these concepts. Therefore, the discussion will also cover biosemiotics' potential to bridge some (harmful) methodological gaps between natural sciences and other disciplines, including theology. The conclusion will point to possible implications in theological anthropology and ethics, and to possible directions for future research in the field of science and theology.

## 1. Evolution: Bridling, Enhancing, or Harnessing Freedom?

What bears on considering the freedom of our actions – also in the context of evolution – are the two most frequently evoked philosophical conditions for free will: namely, the agent's ability to do otherwise under identical conditions, also known as the *Principle of Alternative Possibilities*, and the agent's being the (sole) causal source of an action, the so-called *Principle of Self-Determination* (Timpe 2013). While the first condition is sometimes referred to as "leeway," the latter is usually associated with the "sourcehood" aspect of freedom.

These two conditions raise questions such as: Is only one future possible, given a fixed past and the laws of nature? Do agents genuinely have alternatives, or are their actions always inevitable? Are human agents truly the (exclusive or partial) causes of their actions? Is it their consciousness, the self, or intentions that actually makes them act? Or, taken further, is it even their brain or body alone – or are broader biological and social forces, including long-term evolutionary determinants, ultimately in control? While philosophers typically offer three distinct positions in response to this puzzle – hard determinism, compatibilism, or libertarianism[2] – both of the aforementioned conditions appear to be challenged by dominant evolutionary explanations.

[2] Even the fourth option – stochasticism (the view that the world and our actions are governed by chance) – raises a problem: what originates purely by chance cannot be consi-

### 1.1. Chance and Necessity

The widely accepted Neo-Darwinian paradigm views evolution as an interplay of chance and necessity: mutations occur randomly, while natural selection follows lawful, deterministic principles.[3] The apparent directionality of this process results from blind chance being utilized by relentless selection. Interestingly, this narrative has led some authors to consider similar dynamics at the level of human free will. For instance, Karl Popper's two-stage 'Cogito' model shows clear analogies to Neo-Darwinian explanations. Along with John Eccles, Popper compared the generation of new, alternative ideas in decision-making to random genetic mutations. The decision-making process, like natural selection, would then involve eliminative procedures that drive change while still conforming to deterministic laws (Popper and Eccles 1984, 539–540)

A quite different approach to chance and necessity comes from Charles Sanders Peirce. The work of the American philosopher and semiotician plays a crucial role in present-day biosemiotics, which will be discussed later. What is of particular relevance here are Peirce's ideas on both chance and non-deterministic continuity (*tychism* and *synechism*) as real properties of the world. According to Peirce, the laws of nature as we know them are inferred from a continuous accumulation of random regularities that have become habitual. The observed regularities are not absolute but remain probabilistic and averaged (Peirce 1998 [1914], 162–163; Doyle 2014). Their consistency is merely apparent, yet still real, reliable, and useful for describing and categorizing the world by means of scientific generalization (Peirce 1998, 162).

Contrary to Herbert Spencer, Peirce rejected the idea that evolutionary laws resemble mathematical principles, asserting that "[…] exact law obviously never can produce heterogeneity out of homogeneity" (Peirce 1998, 163). And while the alternative Lamarckian model of evolution

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dered more free than what is entirely determined. This very paradox forms the basis of the so-called Standard Argument Against Free Will (cf. Doyle 2011, 27).

[3] This is, of course, relative to their eventual outcome (adaptive or not) and to the human observer: within the same framework, the physical processes of mutagenesis are assumed to occur according to deterministic laws of nature.

found causality in individual effort and the inheritance of learned patterns, Peirce believed in rapid and arbitrary environmental changes systematically diverging habitual evolutionary regularities (Pierce 1998, 163).

According to evolutionary ecologist Robert Ulanowicz, (Neo)Darwinism overemphasizes competition and selection while underestimating the role of growth in evolution – an aspect to which Darwin himself paid much more attention. It is growth and the increase of complexity that provide the relevant variations to be subsequently disposed of by natural selection (Ulanowicz 2013, 82–83). For Ulanowicz, this is best explained by the common phenomenon of mutualisms, occurring between (random) events and starting with the chemical process of autocatalysis. Processes that tend to promote (speed up) themselves by interacting with other processes (or objects) are omnipresent, also at the organismal and, especially, at the ecological level. Ulanowicz calls such self-promoting tendency, which in turn instantiates competition with other systems, *centripetality* (pulling-in) (Ulanowicz 2013, 82–83). Growth by centripetality promotes complexity and provokes competition, which in turn makes even more innovations and certain directionality possible.

Referring to John Haught's metaphor of evolution as a drama, Ulanowicz describes evolution as a continuous game between abundant natural contingencies and emergent regularities (laws of nature). These can correspond to the autocatalytic (growth-promoting) and eliminative (selective) forces in the universe, respectively.[4] As a historical reality, evolution is neither a static, relatively unchanging tapestry (as in pre-modern, Aristotelian or Neo-Platonic, views), nor a mechanistic clockwork (as in Enlightenment-era determinism), but rather a full-fledged and unfinished drama. It contains genuine elements of both unexpectedness and continuity (Ulanowicz 2013, 87, 90).

[4] As noted by Ulanowicz, Heraclitus already observed that there appear to be two opposing tendencies at work in the natural world: one that builds up and another that tears down the observable order. Modern theories of physical entropy can be seen as following the same intuition.

This leads Ulanowicz to reframe the notion of the laws of nature even more radically. He replaces the language of laws with the language of processes, which, in the case of non-living matter, led to the establishment of the familiar, law-like dynamics (a degenerate form of the initially less-constraining physical processes) (Ulanowicz 2010, 397–398). In living matter, however, overwhelming heterogeneity and density (as opposed to the homogeneity and sparsity of isolated collections of cosmic matter) give priority to ongoing processes over any older, fixed laws. The physical laws still hold (their precipitation happened early enough in cosmic history to make them universally effective) and are not violated. But what appears ontologically and epistemologically primary – and what matters for life and its evolution – are the ongoing processes, not the laws themselves. As with anything that bears the ontological characteristics of a process, life processes unfold as "the interaction of random events upon a configuration of constraints that results in a nonrandom, but indeterminate, outcome" (Ulanowicz 2010, 397). Importantly, then, radical contingency, self-reference, and historicity (marked by indeterminacy and irreversibility) are fundamental features of living and evolving.

### 1.2. Neo-Darwinism and Its Alternatives

In recent decades, the established Neo-Darwinian paradigm, also known as the *Modern Evolutionary Synthesis*, has faced increasing critique, leading to the formulation of what is now called the *Extended Evolutionary Synthesis* (EES). The EES is a broad umbrella term that includes several claims that either challenge or supplement the established 20th-century consensus. What distinguishes this contemporary revision of Neo-Darwinism from, for example, creationist skepticism is that it has emerged from within the community of evolutionary biologists, driven by mounting pressure from new and challenging findings in molecular biology and genetics, and above all from the expanding fields of systems and process biology (Rosslenbroich 2014, 233).

Evolutionary Developmental Biology (evo-devo) explores the relationship between ontogenetic (individual) and phylogenetic (evolutionary) development, focusing on how developmental processes

evolve and, in turn, influence evolutionary trajectories (Müller 2007, 943). A central concern in many evo-devo approaches is the evolution of genetic regulatory networks and the role of regulatory gene interactions in shaping morphological traits. It is commonly agreed that developmental mechanisms show significant phenotypic flexibility, revealing a degree of autonomy from the genome.

By examining how environmental changes regulate gene expression, activate non-genetic developmental pathways (environmental induction), and subsequently alter genetic information (genetic assimilation/accommodation), as well as how non-genetic developmental processes can be inherited or reactivated across generations (epigenetic inheritance), this new approach to evolution suggests that organisms, through various forms of phenotypic plasticity, gradually gain greater control over their own evolutionary trajectories (Müller 2007; Pigliucci et al. 2006; Baravalle and Vecchi 2016, 25–26).

A rapidly expanding variant of the evo-devo approach is ecological evolutionary-developmental biology (eco-evo-devo), which pays a lot more attention to the dynamics of developmental (and e.g. microbial) symbiosis, plasticity, and niche construction. It places both evolutionary-developmental mechanisms and natural selection itself primarily within the context of ecological interactions, in a way granting them causal primacy in evolution. At the same time, eco-evo-devo takes a close look at how ecological processes, especially in the context of their (anthropogenic) disruption (such as climate change), affect the development and hence the evolution of organisms (Gilbert et al. 2015).

Developing organisms – such as larvae transforming into mature insects – can alter their morphology, physiology, and behavior in response to environmental changes, including ecological pressures from other species. Fully understanding the significance of this plasticity helps account for major evolutionary transitions (Gilbert et al. 2015, 116–118), as well as for the autonomy of individual organisms, including natural bases for human (experience of) freedom and free will. Ecological-developmental factors thus have a bearing on both the origin and nature of individual organismal autonomy, and on the actual scope and object of (increasingly free and eventually moral) biological agency.

## 2. The Organismal Approach

The growing emphasis on living beings as self-forming, self-organizing, and self-maintaining entities – or indeed as processes – suggests that understanding life and autonomy may require prioritizing autonomous biological organization over evolution and selection. In this view, organisms are the precondition for evolutionary change, not merely its products.

The organismal paradigm in biology has deep roots, notably in the Aristotelian tradition and later in Kant's critique of Cartesian mechanicism. Kant viewed the parts and activities of organisms as inseparable, unlike those of machines. He saw living beings as unified wholes whose functions are intrinsically determined rather than externally imposed, with parts existing and acting for the sake of the whole's maintenance – a form of intrinsic teleology. This led him to posit "a special kind of causality, or at least a quite distinct lawfulness of nature" (Kant 1987 [1790], §61). As "products of nature," organisms follow – and in fact they themselves are – a natural purpose (Kant 1987 [1790], §65).

Stuart Kauffman similarly describes organisms as entities that "act on their own behalf" (Kauffman and Clayton 2006, 505), based on autocatalytic reproduction, boundaries for reproducing individuals, and a self-propagating work–constraint cycle. Although for Kauffman this last peculiar feature evolved in the context of organisms simply searching for food and avoiding poison, organismal self-propagation clearly points to the reality of agency (Kauffman and Clayton 2006, 501–502), which forms the basis of the concept of biological (natural) autonomy.

The notion of biological autonomy builds on the earlier concept of autopoiesis. As defined by Francisco Varela (1974, 1979), autopoietic living systems exhibit circularity of relations, and they must be both spatially and operationally isolated from the environment. The environment provides a concentration of material needed to sustain the operational (metabolic) interdependence of the elements. All biological phenomena, such as reproduction and evolution, are secondary to this unitary organismal organization. Also, an organism as a whole cannot

be reduced to the properties of its parts. Organisms are not 'indivisible unities' either, as they are realized through specific relations between the components. These relational dynamics are therefore essential for maintaining the system's operational closure (Varela 1997, 73).

The concept of biological autonomy developed by Moreno and Mossio (2015) adds several important elements to this definition. In order to distinguish organisms from other self-organizing, or even self-maintaining systems, proponents of biological autonomy introduce the concept of closure through system-generated constraints. Being 'causally closed' means that the causal chain folds up, forming feedback and feedforward loops. As a result, the relevant constraints become dependent on some and enabling for others. Crucially, these constraints are not imposed externally but are self-generated and maintained within the system (Moreno and Mossio 2015, 5–6).

Therefore, the relevant "self-organization" of organisms lies in the fact that they are neither fully produced nor maintained by external causes. This becomes evident in processes such as self-repair, development, reproduction, and the reciprocal dependence of their constitutive parts. Organisms are, therefore, causally closed and thermodynamically open systems that exhibit self-determination through self-maintenance and self-constraint (Moreno and Mossio 2015, xxv, 20–21).

In terms of leeway freedom, Heisenberg's description of organisms performing random movements (*random walks*) that are subsequently 'chosen' and 'memorized' according to their adaptive value provides a good example of organisms naturally "being able to do otherwise." Heisenberg observes this phenomenon at the level of simple organisms such as fruit flies and even bacteria, suggesting that flexible "exploratory behaviour" is a very old trait that may have provided the basis for the evolutionary development of free will (Heisenberg 2009, 164–165). Another example comes from Bruce Waller and his explanation of laboratory mice's food-seeking strategies in terms of natural "autonomy as alternatives" (a non-random process aiming at keeping a sufficient number of new options open), right next to "autonomy as authenticity" (commitment to the paths that prove successful in stable environments) (Waller 1998, 19–22).

On this view, human autonomy represents an advanced form of natural exploratory strategies, with cognitive capacities enhancing its flexibility. Cognitive specialization reflects a broader trend in animal evolution, also in the development of exploration techniques. Humans, however, exhibit a distinct set of such techniques, shaped by higher-order cognitive and voluntary faculties.

Importantly, this framework supports a different reading of the "could have done otherwise" principle, where alternative options are evaluated for potential relevance in shifting circumstances. In this context, the concept of *relevant conditions* (Hájíček 2009, 104) becomes more meaningful than the counterfactual idea of acting differently under identical (or even similar) conditions. Both novelty and situational specificity – once again emphasizing life's historicity, irreversibility, and radical situatedness – drive the exploration of alternatives, forming the context in which these options gain their adaptive and developmental value.

## 3. The Biosemiotic Turn

Biosemiotics is a relatively new transdisciplinary field that combines concepts and methods from philosophy of nature, semiotics and biology. It draws extensively from the earlier work of Charles Sanders Peirce (semiotics and philosophy of nature), Jakob von Uexküll (biology) or Gregory Bateson (systems theory and cybernetics), integrating these into a relatively unified paradigm with an extremely broad scope of research around the turn of the 21st century. The thinkers who played a key role in this process include biologists Jesper Hoffmeyer, Kalevi Kull, Marcello Barbieri and Terrence Deacon, medical scholar Thure von Uexküll, and semioticians Thomas Sebeok and Martin Krampen.[5] The research in biosemiotics is continuously progressing and attracting a wide range of multidisciplinary scholarship, proposing a radical paradigm shift in biology that also provides a methodological link to the humanities and social sciences.

[5] This came to be known as the Copenhagen–Tartu school of biosemiotics.

Biosemiotics sees life as a phenomenon and a process that can be best described as meaning-making/seeking and interpretation, with *signs* being the most basic units in biology (instead of genes, populations, or even organisms) (Tønnessen, Sharov and Maran 2019, 361). What pervasively characterizes living processes at all levels is (self)referencing, (de-) coding, communication and signification, so that life and *semiosis* become coextensive or even synonymous. Importantly, this includes human use of signs – be they linguistic, symbolic, cultural, religious or otherwise – with semiosis or signation being a natural yet self-perpetuating phenomenon transcending the (modern) nature-culture, science-humanities and e.g. mind-body divide (Hoffmeyer 2015, 154–155).

Importantly, while maintaining strict naturalism, biosemiotics scholars often argue that biological meaning does not only escape purely physico-chemical explanations, but in certain respects also transcends the underlying material realm as such. Biological signs, purposes, and relationships are thus seen as ontologically real and epistemologically primary, shaping rather than merely resulting from biophysical processes. These radically embodied yet clearly *nonmaterial* relations are what enable material organisms to exist and act as they do (cf. Hoffmeyer 2008; Hendlin 2025).[6]

The biosemiotic turn has clear consequences for understanding evolution and the kind of freedom it exhibits, enhances, and eventually enables. Sharing the main concerns of the EES and organismal approach, biosemiotics adds a few critically important aspects to this discussion. Seeing life as essentially producing, interpreting, passing on, complexifying and accumulating signs does not only take the discussion about life's (inherent) directionality (teleology/teleonomy) to a different level – by transcending arguably mechanistic biological explanations of epigenetic inheritance, plasticity, or niche construction (Sharov 2021, 101).

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[6] This arguably marks a step further away from the Aristotelian–Thomistic account of the soul as the form of the material body, wherein the alleged immateriality of the human soul (and later of the human mind) is strictly linked to its rationality. In biosemiotics, all Aristotelian souls would be treated as immaterial in the abovementioned sense, with the semiotic complexity of rational (human) souls – and *their* minds – proportionally justifying their ontological distinctiveness.

By focusing on life as semiosis, it brings the notions of aboutness, creativity, relationality and community into serious scientific consideration. The evolved or, in fact, self-evolving organisms are not only autonomous subjects at their own respective levels of complexity (Hoffmeyer 1996, 51). Relying on, fitting into and co-creating ecological communities, they also exhibit increasingly efficient, complex, and eventually abstract ways of signification and interpretation, knowledge and communication, learning and future-making.

Seen through a biosemiotics lens, this starts with the stabilisation of molecular metabolic processes in bacteria and is most developed in large-brained animals.[7] Accounting for this process and its facets includes concepts such as *Umwelt* (the world as it is sensed and experienced by an organism), *habit* (the stabilisation of new functional-semiotic relations), *semiotic scaffolding* (potentially useful traces of semiotic relations accumulated across different levels and generations) and, importantly, the notion of *semiotic agency*.

Just like in theories of autocatalysis, autopoiesis and natural autonomy, semiotic agents are distinguished from non-living self-organized systems by their ability to change their far-from-equilibrium state by manipulating the energy flow. What the biosemiotic perspective adds – beyond viewing this manipulation as essentially semiotic rather than thermodynamic – is an emphasis on the agent's long-term self-determination and flexibility within an evolutionary lineage. Living agents, by passing on semiotic relations onto descendant agents, do not merely create copies but enable the descendants to repeat and eventually enhance the process of meaning-seeking and meaning-making. As put by Sharov (2021, 102) "[T]he trajectory of agent state becomes a heritable *habit* or function." Parallel to that, *scaffolding* of semiotic choices – at the individual, group, or lineage level – provides direction in making new decisions and in establishing more complex semiotic relations (such as, eventually, human meta-semiosis and language) (Kull 2015, 227; 230).

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[7] Not only, and not exclusively, human, the process is non-definitive and historically open within the entire biosphere (with the possible extension to artifacts such as AI or artificial life being a subject of ongoing discussion).

Biosemiotics too maintains that organisms are active players (co-) shaping the (direction of) their own evolution. Natural selection of randomly appearing variants, then, serves at most as a mechanism of amplification (Sharov 2021, 104). It has even been suggested that this (secondary) driver of evolution is better described in terms of inherent *arbitrariness* and innovation – rather than sheer mutability – being filtered through *semiotic fitting* within relevant ecological relationships (rather than by natural selection); or that both variants of selection operate independently (Kull 2023, 172).

When applied to the Neo-Darwinian paradigm, one must conclude – as Kull aptly puts it – that there is always a specific problem to be solved through the trial-and-error process of natural selection or semiotic fitting. Simply relying on mechanisms, or even on arbitrariness alone, is insufficient. Since the conditions for replication do not, in themselves, present a challenge (replication either succeeds or it does not), the problems at stake are the true alternative possibilities open to a system (Kull 2015, 224).

The reality of choice (sometimes understood in terms of 'choiceful actions' (Kull 2025), rather than absolute counterfactual reality) is the immediate consequence or an inherent part of semiosis itself – a life process in which the need for interpretation and open-endedness always implies "deciding" between different options. Unlike in the computational world, what prevails in life is a situation in which it is not clear which of the many overlapping rules (physical, chemical, or other) is to be used, and there are different real possibilities open. Kull calls it "the reality of confusion," which presents itself as a logical conflict or contradiction – one reason it cannot be resolved computationally (Kull 2023, 173). Organisms are constantly forced to choose, in a way similar to Heidegger's *Geworfenheit* (1996 [1927], 128) or Bauman's *homo eligens* (2007, 26). Importantly, however, this bio-existentialist necessity of choice is constitutive of life itself and enables its purposive yet historical, situated, and in some ways arbitrary, change over time.

Admittedly, this account of choice still differs from strong notion of free will, insofar as alternative possibilities are not ontologically present in a counterfactual sense and self-determination typically lacks

a robust self-conscious element. It also diverges, albeit less sharply, from somewhat weaker accounts (often accepted in theological ethics), where self-reflective and rational dimensions of freedom remain crucial. Nonetheless, several aspects of biosemiotic choice may prove helpful in bringing biological and ethical understandings of free agency closer to each other, while avoiding both the panpsychist anthropomorphisation of the former and the eliminativist deflation of the latter.

As most theorists emphasize, semiosis itself always happens in a phenomenal present – "the now." As put by Kull, simultaneity (synchronicity) of options – even if "only" phenomenal[8] – is necessary to talk about a situation of choice. "[A]n organism can only have the freedom to make a decision if several possibilities are presented and available at the same time" (Kull 2015, 226). Also, the Peircean triadic relationship between the *sign* (e.g., genetic code), the *object* (something that the sign refers to, e.g., protein production), and the *interpretant* (the locus of interpretation and the produced effect) is essentially simultaneous, not sequential – even if it has a duration (Peirce 1906; Kull 2025).[9] Choices of interpretation made by organisms in their life and in evolution are therefore not something primarily related to the chronological sequence of *efficient* causation (an approach that has been typical for early neuroscience of volition and free will [cf. Libet 1985]) but are an intrinsic condition and precondition of living and evolving, accounting for its final, *semiotic* (semeiotic) causation (Hulswit and Romanini 2014).

Within this vision of organisms' phenomenological 'subjectivity,' the experiential awareness of the world and its meanings (*Umwelt*) serves as the space of semiotic interpretation. Many biosemioticians regard the *Umwelt* as forming a certain continuum with (human) consciousness

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[8] Phenomenal experience of the organism signifies the true reality of an entire living (sub)system on its own time scale (relative to the level of consideration), something that is therefore functionally and causally realistic and has little to do with (human) psychological or cognitive subjectivity (unless the relevant choice indeed occupies this level). According to Kull, whether such a feature would be applicable to matter as such (on a quantum level) is 1) impossible to assert and 2) irrelevant for the subjective perspective of a living system (cf. Kull 2023, 173).

[9] This, alongside the inherent lack of strict exactness, is what makes biosemiotic relations different from algorithmic ones.

and even view it as a seed of quasi- or pre-moral normative experience (Hendlin 2025). This, together with the natural (functional) 'normativity' of semiotic choices – insofar as they promote or diminish organismal well-being – may be seen as constituting a biological condition of possibility for a (uniquely) human world of values.

One can thus say that, while the process of *signation* (semiosis) characterizes life itself in its constitutive open-endedness and communicative character, the accumulated *signification* of it directs the future through stabilizing *habits* and through *semiotic scaffolding*. All this guarantees growth in *semiotic freedom*, referring to a richer semiotic capacity or, in other words, "a multiplicity of choice possibilities involved in a sign" (Kull et al. 2002, 29). Seeing this growth helps to account for major evolutionary transitions – something that often remains challenging for traditional Darwinism. Each step taken by a species along this route potentially opens new agendas for further change, as well as increasingly robust realms of freedom, both in its leeway and sourcehood aspects.

Barbieri (2003, 2011) conceptualizes these changing realms as organic *codes* or semiotic systems. Every major step in evolution is marked by the appearance of a truly novel kind of organic code, beginning with the genetic code at the very origin of life. Classical biology sees this as perpetuating evolution by enabling mutations and natural selection, but for Barbieri, every new code brings true novelty to the process. The new codes emerge in the stable, historically contingent process of *natural convention* and include, among others, the signal, splicing, adhesion, or cytoskeleton codes (Barbieri 2003, 252). With the evolution of the brain, the organic semiosis of the primitive brain gives rise to experiential capacities on which interpretive (memory and learning) and finally cultural (language) semiotic codes are built. Importantly, the older codes do not cease to work but rather provide the context for life's discovery of the new ones (Barbieri 2011; Kłoś 2014). Within this context, human freedom and free will are fully embodied in the history of life yet retain true qualitative otherness and uniqueness that fit the realm of human moral agency (cf. John Paul II, 1996).

## 4. The Biological, the Ethical, and the Theological

As dominant paradigms in biology gradually shift, changing approaches to evolution and agency allow us to view freedom – and even certain aspects of free will – less as something opposed to (or to be reconciled with) the actual dynamics of the living world, and more as something inherent to it, albeit strongly varying both in degree and in kind. Much like recent developments within the cognitive sciences, the uncovering of relative yet real, and increasingly robust, traces of autonomy and freedom in evolution also invites a reframing of the largely brain-, consciousness-, and individuum-centered understanding of rationality and self-awareness – capacities traditionally associated with human freedom and moral agency.

For at least several centuries, ethical thinking has been either disconnected from the biological realm or subjected to oversimplified forms of reduction; nuancing our understanding of biology may therefore contribute to bringing these two realms closer to each other in a more mature and mutually respectful manner. The loosening of biological determinism, together with the framing of life as a fundamentally semiotic process, invites the realization that human freedom – even if it remains unique in many respects – may be a continuation, or a remarkable harnessing, of the most salient characteristics of living organisms. Such a view of freedom thus departs from seeing it as a suddenly emergent feature, an instance of external causality, or an epiphenomenal narrative coexisting with an otherwise deterministic reality.

Importantly, as becomes clear in biosemiotic accounts of evolution and freedom, a semiotic framing of human dynamic embodiment and radical biological continuity does not exclude but rather in its own way reappropriates the essentially nonmaterial and even 'transcendent' character of meaning, relationships, and agency. These, along with a non-random and realist account of normativity, constitute the elements traditionally associated with human freedom and moral agency (cf. Wojtyła 1969, 36, 61–62). At the same time, the biosemiotic turn encourages the recognition that a largely modern ideal of absolute freedom – both in its

counterfactual reading of alternative possibilities and in its Cartesian variant of self-determination – may be not only incompatible with the ways in which nature and society equip us to act, but also at odds with moral affirmations of human (inter)dependence and with theological traditions that emphasize the created theonomy of human free will.

Within the broad scope of ethical reflection, theological ethics might be naturally more receptive to the proposed reframing, given its constitutive openness to notions such as meaning, aboutness, ontological dependence, and teleology. Interestingly, the incorporation of biosemiotic perspectives may also contribute to bringing theological ethics and moral theology closer to its own theological grounding, as understood in relational, personal, spiritual and eschatological terms. [10]

While (theological) anthropology and ethics do not *need* empirical evidence to sustain their foundational concepts (such a demand would affirm rather than undermine problematic positivist epistemology), they can benefit greatly from connecting these concepts to our developing understanding of life in its broadest context. This, as well as the reverse process of integrating the language of human and social sciences to benefit understanding in biology, has been the particular focus of the biosemiotic approach.

## Conclusions

New understandings of freedom in evolution point to its increasingly robust, yet essentially non-absolute, multidimensional, ecologically and socially entangled, and largely long-term character. Historical change in life is not a blind or directionless mechanism; rather, it is a self-propagating, self-directing, increasingly autonomous process that may involve meaning-making and interpretation. Metaphysically

[10] This would hold especially for the more philosophical strand of Christian theological ethics and moral theology, often including characteristically modern, arguably dualist and rationalistic elements. The elements to which, somewhat paradoxically, Catholic theology has long sought to offer correctives as part of its broader resistance to modernism.

absolutist notions of chance and necessity give way to natural (historical) arbitrariness and to non-random, meaningful and yet non-determinate biological processes. This not only opens the possibility of a nontrivial proximity between the biological and the ethical realms, but may also render certain approaches within ethical theory – and within moral theology – philosophically preferable.[11]

Evolution clearly enhances the *sourcehood* aspect of freedom by increasing spatial separation and compartmentalisation, alongside active selective openness in physical, chemical, perceptual, and informational communication. Autonomous interactions are never one-sided, though often asymmetrical, and the delicate balance between self-sufficiency and (inter)dependence appears to be the key feature of life. Moreover, organisms' activities both co-shape and constrain the autonomy of others, while simultaneously enabling their existence and evolution. For human agency and free will, this implies that willing and choosing never occur in isolation from context, and that one can never be(come) free on one's own. Importantly, ecological networks can be regarded as autonomous too. While this hypothesis raises several challenges, the dynamic – and at times chaotically unpredictable – behaviour of ecosystems and smaller ecological networks suggests a degree of natural freedom at the ultra-organismal level, including human social networks, which may have significant implications in the areas of collective moral agency.

Finally, the relative availability of natural alternatives suggests that they are limited, finite and depend on the circumstances. One cannot choose anything at any time, but always chooses from a range of real options. Just as with semiotic or interpretative choices, one often has more freedom regarding some options than others. *Leeway* freedom, then, appears to be a matter of degree – both evolutionarily and at the level of individual organisms and different situations. At the same time, the clearly increasing reality of semiotic freedom paves the way for meta-

[11] In this regard, (Christian) virtue ethics – relying on the notion of embodied dispositions attained through habituation and aligned with a balanced, communitarian understanding of normativity and flourishing – may serve as a good example.

semiotic, symbolic, and arguably moral capacities – and with them, a degree of free will.

All these features of ever-changing life mean that freedom – and, in a certain sense, even free will – not only predate human beings, but are also not confined to the brain or nervous system alone. Moreover, many of these insights are increasingly supported by contemporary neurobiological understandings of the brain, cognition, and agency, as elaborated elsewhere (Jarmużewski 2021, 2022). The biosemiotic perspective adds yet another layer of importance to those considerations, a layer that is arguably well suited for reappropriating the personal, phenomenal experience of freedom and autonomy, the existential dimension of the free will and the communitarian character of moral agency and responsibility. Within this understanding, naturally equipped and evolutionarily shaped human freedom retains its distinctive, morally significant character, and remains open to theological interpretation in terms of the *Imago Dei* and personal soteriological futures.

Furthermore, with self-reference and aboutness as central concepts, biosemiotics may offer a framework that accommodates theological emphases on both autonomy and the normative relationality of Creation. The interpretative history of life can be understood as having created the natural conditions for uniquely human hermeneutical awareness, personal identity, transcendence, and (therefore) a relationship with God. But it may also point to life itself as signifying (sic!) something of inherent responsiveness and striving toward its Creator – a form of responsiveness that goes beyond mere metaphor or sentiment. Interestingly, this form of theocentrism also appears in aspects of papal ecological teaching in the early 21st century (Benedict XVI 2009, 43–52; Francis 2015, 1–2).

The biosemiotic dimension opens a way for theologians to more fully engage in the debate about the directionality and the growing freedom of creation as its natural features. It enables moving beyond mere emergence or compatibility theories toward a more dynamic interpretation of *creatio continua* (John Paul II, 1985). While seeing created freedom as rooted in horizontal as well as vertical dependence helps move past deistic frameworks, biosemiotic notions of auto-teleology and open-endedness may also align with certain strands of process theology (Keller 2003;

Delio 2013). Further research into this aspect of biosemiotics – and its theological implications or even potential theological inspirations – has yet to shed more light on whether it could be integrated with both process and traditional theism (cf. Clayton 2008).

The apparent teleology of life and evolution – often viewed by non-classical biology as genuinely directional and non-random, yet essentially free and marked by arbitrariness – also hints at another theological challenge: how to reconcile created freedom with the theonomy of human free will. According to the Catholic tradition, human freedom is both created and ultimately caused by God, and is necessarily drawn toward the good, of which God is the ultimate source and definition (S. Th. I–II 9, 6; Hofmann & Michon 2017). This raises the question of how human beings – and perhaps other life forms – can integrate life's auto-teleological arbitrariness with the (rational) apprehension of normative goodness. At the same time, the biosemiotic emphasis on the radical situatedness, interconnectedness, and mutual interdependence of living agents offers new opportunity for addressing this tension.

The world as it appears in naturally teleological or semiotic evolution is less deterministic, less mechanistic and more free. As is apparent in the semiotic approach, it also makes it more intelligible to see life as inherently open or even directed to meaningful relationships, including its relationship with the Creator. At the same time, locating freedom and (non-random) indetermination in the evolving life itself implies that its *telos* is no longer fixed, but unfolding and self-directed, so that accommodating any definitive notion of (human) nature becomes more challenging. Whether biosemiotic concepts such as scaffolded functional stability or semiotic habit (across sufficiently long timescales) can provide sufficient basis for the language of universal human values, virtues, or Natural Law remains an open question.

The biosemiotic turn in biology inspires and informs several normative considerations such as the moral status of animals and other beings, or the value and possibly the rights of creation in the context of environmental ethics and protection. Within theological anthropology that underpins fundamental Christian ethics, discovering more freedom in evolution and in the created living world calls for once again reconsidering the human

relationship to the rest of nature. The project of "semioethics" puts strong emphasis on these moral problems, placing them in the context of the entire biosphere communicating with itself, and on their meaningful relations being disordered or destroyed (Petrilli and Ponzio 2024).

Semioethics also makes a case for human responsibility and the moral aspect of culturally transmitted signs, interpretations and symbols (Petrilli and Ponzio 2024). In this context, the call for the importance of the semiotic virtues (Moser 2025) can be linked with the growing importance of epistemic virtues in the age of confusion, over-information and manipulation. Finally, in the age of AI, fatalism and materialism, reemphasizing and demystifying the embodied reality of human freedom and responsibility by entering into serious discourse with non-classical biology appears more urgent than ever.

Above all – and in direct support of a freedom-sensitive, biologically grounded framework for theological ethics – viewing life as both directional and open-ended, and more importantly, as interpretative, opens a promising new avenue for integrating theological methodology into contemporary scholarly discourse. While the field of biosemiotics aspires to bridge biology with the humanities and social sciences, theology often remains overlooked or underrepresented. This is particularly striking, given that biosemiotic explanations – especially within the broad spectrum of rising biosemiotics scholarship – at times find themselves on the edge of a typically religious and/or theological language. The connection is thus not limited to the shared use of hermeneutical methods or the emphasis on interpretation. It is precisely theology's communitarian, person-centered ontology and its commitment to relational metaphysics that position it as a natural partner for non-classical biology and biosemiotics, particularly in shaping an adequate ethical and anthropological framework for the 21st century and beyond.

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