Merging Biological Metaphors. Creativity, Darwinism and Biosemiotics

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Abstract

Evolutionary adaptation has been suggested as the hallmark of life that best accounts for life's creativity. However, current evolutionary approaches still fail to give an adequate account of it, even if they are able to explain both the origin of novelties and the proliferation of certain traits in a population. Although modern-synthesis Darwinism is today usually appraised as too narrow a position to cope with all the complexities of developmental and structural biology—not to say biosemiotic phenomena—, Darwinism need not be if we separate metaphor from reality in natural selection in order to show the axiological complexity of this concept. This can shed light on the relationship between biosemiotics and biological evolution.

Keywords

evolutionary creativity; axiology; adaptation; natural selection; biosemiotics; hallmarks of life; philosophical naturalism

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Introduction

A common ground of defenses of the biosemiotic approach to explaining biological phenomena seems to be the belief in the special features of living systems as compared with other kinds of natural systems. To Jakob von Uexküll (1982 [1940]), a classic reference for biosemiotic proposals, an intrinsic characteristic of life is meaning, a phenomenon that is not to be encountered in non-living material systems. While many contemporary scientists would yet consider meaning to be an exclusively mental phenomenon, biosemioticians have seen the need to extend the use of this notion in order to characterize some of the features of life that purely mechanistic models tend to ignore or to consider only in reductionistic terms.

When confronted with biosemiotics, contemporary naturalists find themselves at a crossroads where they either reject the whole project as a categorical mistake—since biosemiotics puts together meaning and biology—, or embrace notions of meaning—or other categories traditionally considered as exclusively applicable to humans—that can be applied to most biological systems (but which can sometimes be extremely deflationary) at the same time that they try to evade reductionistic pathways.

The first choice seems to be doomed to ignore lots of aspects that we, humans, share with other living beings, and which have traditionally been expunged from the scientific world view because of their dissimilarity with features that all physical systems share, like mass, spatial dimension, and energy, which have been a common research topic of physics in the past centuries. Biology, psychology, and semiotics, on the other hand, have been occupied with another set of phenomena, which, although share much with, and are also enabled by, the usual physical processes that operate in non-living systems, are, at the same time, closely intertwined with human experiences of the world and linked to behaviors and properties that many authors, scientists and not scientists, recognize in other living beings.

The second choice, surely the best option for consistent naturalists, implies a big challenge, which biosemioticians seem to embrace, namely, to figure out methods to both observe and then study phenomena which seem alien to non-living systems in ways alike to those that have been successfully employed to analyze physical and chemical phenomena, but without excluding from such analyses aspects that seem essential to life.

One such aspect is creativity, which has commonly been recognized as a central issue in attempts to define life as a scientific concept or to operationalize its detection in extraterrestrial environments. Concepts like ‘open-ended evolution’ (Pattee 2012 [1995]; Ruiz-Mirazo and Moreno 2012; Ruiz-Mirazo et al. 2004) or ‘supple adaptation’ (Bedau 1996; Bedau 1998) have worked as scientific proxies to the creativity that many authors, from Darwin to Kauffman *via* Bergson and Dewey, have seen in living processes. However, we must ask if such proxies offer an adequately naturalistic account of the evolutionary creativity that has brought meaning, value and also minds into the world.

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Today, the biggest challenge to a consistent naturalism is to be able to overcome metaphoric construals of mentalist concepts like meaning and value and accept that such concepts have also a truth value with respect to biological systems, just like physical concepts do. Accordingly, my goal in this paper is to point out the axiological components which surround the idea of creativity in an evolutionary context and to suggest how they can be approached in a naturalistic account.

Creativity and Value in Evolution

Creation is not only a common term related with art and scientific theorizing, but it has also been a frequent topic in biological thinking and in research on Artificial Intelligence and Artificial Life (see Boden, 1994). Indeed, creativity is at the center of many proposals about the definition or the characterization of life as a scientific concept, but, as many other ideas that have entered into our scientific horizon, it is heavily linked to many other concepts which have not an easy translation into scientific language. In particular, creativity is closely related to value, as Boden's definition makes clear:

> Creativity is the ability to come up with ideas or artefacts that are *new*, *surprising* and *valuable*. 'Ideas' here include concepts, poems, musical compositions, scientific theories, cookery recipes, choreography, jokes – and so on. 'Artefacts' include paintings, sculptures, steam engines, vacuum cleaners, pottery, origami, penny whistles – and many other things you can name (Boden 2004: 1).

While this author applies her definition mostly to artificial products, evolutionary biologists in general, and researches on models of minimal life in particular, gladly apply the same term to the 'solutions' and evolutionary 'innovations' that organisms possess with regard to their environments and to other species. For instance, in describing his theory of life, Bedau (1998: 127) proposes "that an automatic and continually creative evolutionary process of adapting to changing environments is the primary form of life."

The central issue regarding evolutionary creativity, at least since Darwin's time, has been—as can be perceived in Bedau's proposal—evolutionary adaptation, that is, the process of acquiring or developing traits that enable a lineage to cope with or even to thrive in its environment. For modern-synthesis Darwinism, which took its final form after the near consensus reached around the middle of the past century, the key for all creative aspects of life was the process of natural selection, which could produce adaptation through the selection of random mutations (see Ayala 1999; Dawkins 1987).

In contrast to mutation and recombination, which are essentially random with respect to organisms' needs, selection is usually considered the result of interactions between an organism's traits and its environment. Hence, novelty, in this account, is brought about by the former two processes, while surprise and value—the two other components of Boden's definition—could only be provided (or,

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more correctly, *assessed*) by the conjoining of competition and differential reproduction.

While natural selection's exclusive role in the production of evolutionary novelties has been challenged in the last decades (Gilbert 2006)—mainly as a result of the recognition that development is not only a passive product of an organism's genotype, but that it can also play an active role in the production of adaptation through its susceptibility or reactivity to the environment (West-Eberhard 2003)—, its central role in evolution has remained mostly uncontested in contemporary proposals. This is evident when contemporary critics of the synthetic orthodoxy are glad to pay homage to Darwin (see Gilbert (2006: 209), Gould (1982) and Gould and Vrba (1982: 4–5, 14) for just a tiny sample). But this deserves a little more examination.

According to Gould (1982: 381; 2002: 1028), most controversies in natural history are related to the relative frequency of distinct phenomena, and not to exclusivity. Hence, the issue of evolutionary creativity would be linked to the relative importance that each one of the proposed factors of change has in evolution. However, as is clear from his 1982's paper, positive and negative views of natural selection which have existed through the history of Darwinism do not differ only regarding how much selection or other factors influence organismic change, but they are opposed with regard to which is the one which plays a positive role in producing evolution (and progress, even if it is only local).

This aspect of debates about evolutionary creativity is also evident from Gould's (2002) book, where he elaborates his own views on the positive role that different kinds of constraints can play in modeling life's evolution: structural, historical, and developmental constraints. It is most interesting that Gould's remarks about our tendencies to consider anything that limits natural selection's power as constraints (in a negative sense) conclude with an appeal to consider anomalies to "reigning paradigms" (Gould 2002: 1032-1037) in a positive way, because of the challenges they bring to the research field.

These oppositions and arguments regarding the axiological aspects of a phenomenon like evolutionary creativity highlight the closeness between our ideas of human creativity and the way we approach creativity in the biological domain. Without pretending to have assessed the scope and success of each one of the contributions that have been suggested (epigenetics, developmental plasticity, structural constraints, etc.) to form the core of the alleged evolutionary synthesis of the 21st century (Pigliucci (2007) summarizes some of these proposals), I intend, in the following pages, to point out some of the axiological components that have remained unnoticed in most biological discussions, but whose theoretical relevance is responsible for some disputes regarding the relationship between creativity and evolution.

Beyond the Selection Metaphor: the Axiology of Evolution

At least since little more than a century ago (Dewey 1965 [1910]), natural selection has been a groundbreaking concept in philosophy and it has also served as a touchstone for naturalistic projects in

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philosophy. However, the nature and the reach of such projects cannot but depend on the particular construal—or metaphor—of natural selection that is chosen. In this philosophical arena, controversy surrounding the orthodoxy of the modern evolutionary synthesis has manifested in the form of exchanges about the nature of selection (Sober 1993), about its causal role in evolution (Millstein 2013) and also about its sufficiency or insufficiency to explain or reduce concepts central to philosophical attempts to understand diverse aspects of human nature (Fodor and Piattelli-Palmarini 2011).

Regarding creativity, both Ayala (1999) and Neander (1995) ground it in the way in which natural selection constraints evolutionary pathways and drives, this way, different lineages through ever surprising—that is, improbable to reach by mere randomness—routes. Unfortunately, much of the literature which looks for mechanistic explanations of natural selection's creative powers lies on metaphors that have been insufficiently analyzed in recent philosophy of science (see Martínez and Moya (2009) for a summary). According to Neander (1995: 68), gardening metaphors have a special place in defenses of the negative view, however, defenses of the positive view, from Darwin on, have also adopted their own metaphoric and analogical ways to describe the creative role of selection in evolution (Peteiro 2012; Martínez and Moya 2009; Young 1971; Young 1993).

Given natural selection's birth as a metaphor (Darwin 1872; Young 1971), it is an interesting fact, that we still need, after so much time, additional metaphors to illustrate the relationship of this scientific concept to creativity in evolution. If—as most metaphors which now form an uncontroversial part of common language—the metaphor ("selection") which accompanied this concept from its inception were dead, after a long process of literalization and scientific theorizing, then it would be difficult to explain the existence of different construals of this concept which do not seem to differ regarding mechanisms nor mathematical models, but with respect to their axiology.

The metaphor of selection is an evaluative one, and Darwin felt no shame employing concepts like benefit, usefulness, favorable, detrimental, etc. when explaining natural selection. He also employs such concepts to distinguish natural from artificial and sexual selection. The reason for this is precisely the same that compels Gould to defend positive roles for constraints, and which distinguishes positive and negative views of selection: the need to make explicit assertions regarding axiological frameworks in evolutionary biology. This issue, which is usually disregarded by many biologists, shows its centrality in biological thought when one tries to make sense of evolutionary creativity.

For example, for West-Eberhard (2003: 35) distinctions between adaptive and nonadaptive plasticity seem difficult to establish—based on Williams' (1966) *dictum* about the onerousness of adaptation—, however, she has no troubles distinguishing between the benefit brought by a plant's phototropism and the benefit due to a human baby's head flattening when passing through the birth canal—indeed, she recognizes the first process as active, and the second one as passive.

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Gilbert (2016), in a text that shows him less entangled in the strictures of modern-synthesis orthodoxy, seems freer to employ evaluative concepts whose interpretation is not inextricably linked to the idea of natural selection. Hence, he talks about cells "using/interpreting" DNA (Gilbert 2016: 53), and about *neutral* emanations that are converted "into functional cues for altering development" (Gilbert 2016: 56).

Terms like those used by Gilbert are, in fact, not unusual in biological literature; what makes them remarkable is that once one stands at the margins of the modern-synthesis paradigm, the axiological framework to fix their interpretation, which 20th-century neo-Darwinism consolidated so intensively that it became practically inconspicuous (see Kitcher (1993)), is not anymore a safe ground.

West-Eberhard's deference to Williams (1966) regarding the complexities of adaptive thinking is illuminating since he is one of the few evolutionary biologists who bit the bullet and tried to fix the interpretation of biological terms which seem to be of a metaphoric nature, like "plasticity" and "adaptation." In doing this, however, he chose the most problematic sense of "adaptation—from a naturalistic perspective—, which links adaptation and design, where design would be produced by natural selection (Williams 1966: 6, 9). Beyond our naturalistic suspicions of the employment of "design" in a natural context, this understanding of adaptation has been challenged by several authors due to its near-inapplicability to concrete cases (see Lauder (1996)).

"Lest our old robes sit easier than our new!" The modern-synthesis view of creativity went astray when it required us to appeal to images of natural selection that relate it with intentionality or agency. If we face the choice between a philistine construal of creativity (which centers only in mechanisms, novelty, and patterns in morphological space, but dispenses with evaluative aspects) and other one based on an intentional concept of selection, we cannot but ask ourselves if there is not a third way. There is one, in fact, and—paying again homage to Darwin—it is, perhaps subtly but clearly enough, contained in Darwin's *Origin*:

> Can it, then, be thought improbable, seeing that variations useful to man have undoubtedly occurred, that other *variations useful in some way to each being in the great and complex battle of life*, should sometimes occur in the course of thousands of generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind? On the other hand, we may feel sure that any variation in the least degree injurious would be rigidly destroyed. *This preservation of favourable variations and the rejection of injurious variations, I call Natural Selection.* (Darwin 1859: 80–81, my italics)

This quote gives us a glimpse into a crucial fact about the relationship between natural selection and biological creativity: it is not only novel variations which appear in unexplained, to Darwin, ways in

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each generation and are then useful from the perspective of natural selection, but it is novel and useful (to each being) variations, which appear and are then preserved by natural selection. Therefore, the emergence of value (and function), which is key to our understanding of creativity, precedes selective episodes temporally. Assessing the nature of such value—its positivity or negativity regarding an organism's, a species' or an ecosystem's life—is not only a critical step, but also a common one, when biologists explain adaptation as a product of natural selection.

Although natural selection was linked from the beginning with a particular axiological framework, such framework was embedded in a metaphor, which turned inconspicuous after some time. Until now, scientific theorizing about natural selection has essentially disregarded the axiology of evolution and has focused on mechanisms and mathematical models, while axiological aspects have remained anecdotal or have been tried to be assimilated to mechanism. However, the growth of Biosemiotics in the last decades opens a path to study this aspect of evolution in a systematic way.

The Generation of Functions: Province of Biosemiotics

In his *Bedeutungslehre*, Jakob von Uexküll (1982: 44) describes the intricate relationships that exist between the pea beetle and the pea plant, where the development of the beetle from larval to adult stage is deeply coupled with the development of the peapod. Beetle and pea development are coordinated in some sort of harmony, says von Uexküll. In his book, he argues profusely that meaning is the rule that governs both the relationships between many organisms—for example, the bee and the flower, the bat and the moth, the tick and the mammal, etc.—, as well as the development processes that carry organisms from seeds or germ cells to the adult stage.

Von Uexküll emphasizes meaning as the key to understanding biological phenomena, and in doing this he produces a wonderful view of the creativity that so much has impressed evolutionary theorists. Organisms, in his account, are not merely passive objects which are effected by their surrounding environments; to the contrary, their *Umwelten* are formed by significance relationships and each element of these surrounding worlds is interpreted by the organism and is replied with corresponding and adequate responses.

However, when we consider von Uexküll's proposal from an evolutionary perspective, we get not only a glimpse into a wonderful view of natural creativity but also a full-fledged paradox. The behavior of the tadpole has a meaning that embeds the frog's behavior, but how could the adult influence the production of a behavior that always happens before the adult is in the situation where such previous actions are most significant? If we extend this to the copious and intricate relations that each organism has with other organisms and with the physical factors, we see that many such relationships are always established once the organism is not anymore an undifferentiated cell, but it is exactly such developmental process—from the zygote or the spore—which in multicellular organisms is the

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condition of possibility that enables such relations to occur.

Interestingly, Darwin detects this same set of “infinitely complex relations to other organic beings and to external nature” (1859: 61) that organisms have, but he thinks that it is a precondition for natural selection to occur; in the struggle for life this network of relationships and dependencies is an important source of limiting, or selective, factors. However, for Uexküll, this network of relationships cannot be a *cause* of development of the organic traits, because relations that conform the network, such as those existing between the pea beetle, the peapod and the wasp, are relationships of meaning.

According to von Uexküll, the picture of the biological world that Darwin proposes not only gives too much place for chance but also attributes too much prodigality to nature. On the contrary, for him, nature is a place of harmony, in which the melodies played by each being are at the same time the expression and the “germ of meaning” of other beings and from the physical world.

Evolution remained an unresolved issue for von Uexküll (Kull 1999: 62) and he was certainly more inclined toward mutations, that toward the effects of variation, in explaining organic changes. However, the precise relationships that relate each living being as significance bearer and motive for other beings, make it difficult to conceive a saltationist process that could spontaneously be able to compose a new harmony.

If we want to overcome the problems of a naturalist approach to creativity in a fruitful (neither reductionistic nor blatantly anthropocentric) way, we should be able to find a common ground between the two biological theories that best have accounted for the axiology of living beings: Darwinism and uexküllian Biosemiotics. The new evolutionary syntheses which have been propounded in the last decades need a comprehensive theoretical framework if they are going to thrive, but to do this, they cannot turn their back to the philosophical concerns motivated by an evolutionary view of life.

The axiological framework assumed by the modern evolutionary synthesis was wrong, since it implied that selection does semiosis in a primary sense. The idea of teleonomy (Pittendrigh 1958; Mayr 1961; Mayr 1974; Mayr 1992) is a good example. For Mayr, for instance, natural selection does semiosis, that is, it builds genetic programs in which the meaning of an organism’s relationships with its environment is literally codified. Changes in temperature and day-light duration *mean* to natural selection that the warbler must migrate to warmer latitudes in order to survive and reproduce. This is the function of such behavior, in case the warbler is enough young to reproduce—otherwise, it would perhaps be a dysfunction in Mayr’s view, and it would certainly be for Dawkins.

Besides its blatant immorality, this view of natural selection also goes theoretically astray, because of its conflation of ends (in the sense of *finious* processes, as suggested by Peirce) with goals. Programs, understood as mechanisms, are not able to explain any more than *finious* processes, i.e. processes that end in some particular way. If we use them to explain more, it is only because we understand their

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results (their functions) in the axiological context of their users, their creators or their beneficence (their service) to someone else (see Achinstein (1977)).

A useful distinction in semiotics is the one that exists between symptoms and symbols, or between natural and conventional signs: symbols are produced by convention, while symptoms are a necessary consequence of some phenomenon (Barbieri 2008: 582). The challenge that contemporary Biosemiotics faces is to build approaches to biological meaning that do not depend on a mentalistic concept of symbol, but that, also, do not conflate symptoms with symbols. Natural selection will have a place in explaining evolutionary creativity only if its theoretical deployments do not constrain biological value to the organism's reproductive efficiency, because it is precisely this fact, that organisms do extremely much more things (which are valuable) than merely reproduce, which can explain that inheritance, development, and reproduction, jointly act as a semiotic process.

This way, evolutionary semiosis is the result not of blind chance, neither of consciousness, intentionality or prevision in nature. It is rather the product of freedom. When the *Umwelten* of the peppered moth, the bird, the bat, the tree and the man meet, the survival rate of the moths—to pick just one aspect of this encounter—is affected: it is a symptom of the clash. When this happens—what evolutionary biologists usually call natural selection—, the moth's pigmentation, which has its own developmental and hereditary explanation, acquires a new meaning, an evolutionary meaning, but this meaning can only be encoded (and decoded) in terms of the moth's *Umwelt*.

Natural selection is a process. It is no subject and it has no *Innenwelt*. This is the reason why it alone cannot give existential support to the symbol (it is not semiotic in a primary sense, as suggested by some authors). If we understand this process correctly—not as a mechanism, but as the interface between two or more axiological realms (one is given by the impact of some evolutionary innovation over population dynamics; the other ones are based on the influence of the innovation on the existing semiotic relationships between an organism and its *Umwelt*)—, it is, in fact, semiotic but in a derived or secondary sense, rather than primary. The conventions that get established through this process depend, in turn, on the semiotic nature of life and one, perhaps the most important goal for Biosemiotics as a naturalist program, is to explain satisfactorily the evolutionary way from symptoms to symbols in the history of life.

Conclusions

Metaphors, just like organismic variations in Darwinism, can be beneficial, detrimental or innocuous to a scientific field, but, in general, they play some role either in structuring a new paradigm or in continuing an already consolidated view. Many such devices become part of common language and lose something of their starting controversial sense, but this does not avoid that they keep influencing part of a scientific view, even if they do this in an inconspicuous form.

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If Biosemiotics has been structured around the metaphor of "nature as language" (Emmeche and Hoffmeyer 2009), the central metaphor in Darwinism has been that of "natural selection" (Young 1971). Both metaphors have conveyed their own preferred inquiries and their challenges, rooted perhaps in the original controversial meaning of such images. While Darwinism has been concerned with temporal or historical aspects of biology, Biosemiotics, on the other hand, has been interested in synchronic or spatial issues (Kull 2001: 3).

The relationship between these two paradigms has been marked by mutual neglect or dismissal, but a real biological synthesis should be able to merge both views in a fruitful form to forge a new metaphor which can recover life from mechanicism without invoking special creations or pernicious vitalisms. However, for this, we need to be able to see which parts of our biological view have become inconspicuous as a result of our metaphors losing part of their controversial meaning.

A first step in this direction has been essayed in this paper. Value and life are entangled, but the metaphor of natural selection—particularly as construed by proponents of the modern-synthesis—has fixed a special axiological view in our evolutionary theorizing. A closer exam of biological evaluative practice can easily reveal that many more axiological frameworks and levels exist in biology, however, to be able to discern about them we need to bring metaphors alive again, just to see how the world saw before we were entangled in them.

Even when no one, today, will deny the importance of evolution as one of the most impressive dimensions of life, the exaggerated emphasis on the informational, and hence hereditary, aspects of life has caused that we forget that most of the extent of a living being's existence involves a copious amount of dynamic relationships with its surroundings, which usually have no—and this is not a negative appraisal—evolutionary significance. The biological synthesis of evolutionary and biosemiotic paradigms should of course center in evolution and inheritance, but to do that we also need a strenghtened scientific approach to two subjects that play fundamental roles in an organism's life: freedom and value. Biosemiotics has already engaged in such a research, but to be successful, this project needs that biologists leave behind metaphorical construals of such concepts like meaning and value, and embrace them as part of biological reality.

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