Darwin's Legacy:

The Status of Evolutionary Archaeology in Argentina

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CULTURAL ADAPTATIONS: IS IT CONCEPTUALLY COHERENT TO APPLY NATURAL SELECTION TO CULTURAL EVOLUTION?

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Abstract

Critics of Darwinian approaches to the study of the evolution of human and social behavior often express their dissent claiming that cultural evolution is Lamarckian. By this they mean two things. First, that contrary to natural selection, in Lamarckian mechanisms of use and disuse plus the inheritance of acquired traits, the modifications in an organism arise as a solution to the environmental problem at hand, i.e., variation is not blind; and second, that the acquired trait is transmitted to the offspring by imitation or learning.

In this paper I will reconstruct informally the theory of natural selection as it was used by Darwin in order to show that the fact that cultural evolution has these Lamarckian features does not imply that it cannot evolve by natural selection. The appeal to Darwin's original writings has two advantages. On the one hand, the way he applies the theory makes it more transparent than in contemporary applications which are its fundamental concepts and structure. On the other, Darwin holds that Lamarckian mechanisms can be causally responsible for variations on which natural selection operates, thus showing that it is possible to hold a theory of natural selection that is not incompatible with these alleged Lamarckian features of cultural evolution.

KEYWORDS: NATURAL SELECTION, CULTURAL EVOLUTION, DARWIN, STRUCTURE OF THE THEORY OF NATURAL SELECTION

Resumen

Los críticos de los enfoques que intentan estudiar la evolución conductual humana y social con enfoques darwinianos suelen describir tal rechazo con la afirmación: "La evolución cultural es lamarckiana". Con esto se refieren, por un lado, al hecho de que, supuestamente a diferencia de la selección natural, en los mecanismos lamarckianos de uso y desuso más la herencia de caracteres adquiridos, la modificación en el rasgo del organismo en cuestión surge como solución al problema ambiental en juego, la variación no es ciega, y por el otro, que el rasgo adquirido se transmite a la descendencia. Así, los rasgos culturales se proponen para solucionar ciertos problemas ambientales y son transmitidos a la descendencia por imitación o aprendizaje.

En este trabajo se reconstruirá informalmente la teoría de la selección natural tal como era utilizada por Darwin con el objetivo de mostrar que el hecho de que la evolución cultural tenga estas características lamarckianas no implica que no puede evolucionar por selección natural. La apelación a los escritos originales de Darwin tiene dos beneficios. Por un lado la forma en que aplica la teoría resulta más transparente que en las aplicaciones actuales cuáles son los conceptos fundamentales de la teoría y cómo es su estructura. Por el otro, Darwin sostiene que los mecanismos lamarckianos pueden ser causantes de la variación sobre la cual la selección natural funciona, mostrando que es posible sostener una teoría de la selección natural que no sea incompatible con estos supuestos rasgos lamarckianos de la evolución cultural.

PALABRAS CLAVE: SELECCIÓN NATURAL, EVOLUCIÓN CULTURAL, DARWIN, ESTRUCTURA DE LA TEORÍA DE LA SELECCIÓN NATURAL.

Introduction

There are different ways of applying the theories of Darwinian evolutionary biology to cultural evolution, that is, to evolutionary processes in which inheritance does not proceed through genetic information. There are, consequently, a number of critics of these attempts. Independently of the relevance of the reasons such critics have for rejecting the application of evolutionary theories to the cultural realm, they usually use the claim *that cultural evolution is Lamarckian* as their banner. The target of this attack is in particular the application of natural selection to the evolution of cultural traits.

This paper proceeds at a metatheoretical level of conceptual elucidation. Independently of how cultural evolution does in fact occur, which is of the interest of scientists in the corresponding areas, my intention is to analyze conceptually whether there is an inconsistency between some versions of Lamarckism and Darwinism. My aim is to show that, even if cultural evolution had certain Lamarckian features – in particular, if variations were directed or if the direct instruction of the environment was possible in a sense to be explained later – this would not imply that the theory of natural selection cannot be applied to it. Someone might consider, however, that if the variation over which natural selection is to operate is not blind, such operation is superfluous. I believe this happens because the theory has not been adequately presented. I will, therefore, put forward an informal reconstruction of the theory of natural selection as it was used by Darwin. I will show how this theory did not in any sense presuppose that variation was blind. In fact, for Darwin, Lamarckian mechanisms of use and disuse were some of the mechanisms responsible for the variation required for natural selection to work.

This work, therefore, falls within the scope of the reconstructive and elucidatory goals established by logical positivists (Hahn et al. 1929). The reconstructive tools they provided, however, have over the years turned out unsatisfactory. I will utilize the more powerful and sophisticated tools provided by metatheoretical structuralism (but in an informal fashion) (Balzer et al. 1987).

Lamarkian cultural evolution

Although he was not the first to hold this idea (e.g. Medawar 1960), Stephen Jay Gould has been one of the authors that have insisted the most on the Lamarckian character of cultural evolution:

> "Cultural evolution has progressed at rates that Darwinian processes cannot begin to approach. Darwinian evolution continues in Homo sapiens, but at rates so slow that it no longer has much impact on our history. This crux in the earth's history has been reached because Lamarckian processes have finally been unleashed upon it. Human cultural evolution, in strong opposition to our biological history, is Lamarckian in character. What we learn in one generation, we transmit directly by teaching and writing. Acquired characters are inherited in technology and culture " (Gould 1980: 83-84).

Or, in a more recent text:

> "Human culture has introduced a new style of change to our planet, a form that Lamarck mistakenly advocated for biological evolution, but that does truly regulate cultural change–inheritance of acquired characters. Whatever we devise or improve in our lives, we pass directly to our offspring as machines and written instructions. Each generation can add, ameliorate, and pass on, thus imparting a progressive character to our technological artifacts" (Gould 1993: 215-216).

These texts seem to point to the fact that cultural traits are acquired during ontogenetic processes of development and are transmitted to offspring nor through genetic material, but through learning. But if the claim that cultural evolution is Lamarckian only intends to state this, then it becomes trivial. Given that cultural evolution is defined as the evolution of traits that does not involve any kind of genetic change, the prase "cultural evolution is Lamarckian" means the same as "cultural evolution is cultural", and it is safe to assume that this is not the point (Kronfeldner 2007: 502). The main point

has to do with the way in which the traits that are transmitted to the offspring are acquired. In the phrase "acquired traits are inherited" a more restricted sense of "acquired" is usually presupposed, one that expresses the acquisition of traits adequate to solve certain environmental problem as a response to the environmental problem itself (Kronfeldner 2007: 495). This is the reason why, for instance, Boyd and Richardson characterize the cultural process of problem solving as Lamarckian (Boyd et al. 1985, p. 82). Variation would not be blind, but would rather be guided by the resolution of the problem at hand (Fog 1999: 65-67). And this is the central point according to Gould himself:

> "Why can't organisms figure out what would do them good, develop those adaptative features by dint of effort during their lifetimes, and the pass those improvements to their offspring in the form of altered heredity? We call such a putative mechanism "Lamarckism" or "the inheritance of acquired characters"" (Gould 1996: 221).

Lamarck explains the adaptation of organisms to their environment mainly through two laws (Lamarck 1809, chap. VII):

First law: During the life of animals, they exercise the use of certain organs and others get disused. The used ones get strengthened and developed, the others get weakened. (Commonly called the "law of use and disuse of organs").

Second law: The small and gradual changes individuals of a species experience throughout their lives are transmitted to their offspring. (The "law of inheritance of acquired traits" in the restricted sense).

The use of a given organ to solve some problem peculiar to the environment is what triggers the development of the organ improving previous solutions. Although the law of use and disuse can hardly be applied literally to cultural evolution, it is this feature of the way that variation arises that seems to be in play here. Indeed, according to many authors, it would be an essential feature of the theory of natural selection that the variation over which it operates is random, blind or decoupled (e.g. Fracchia et al. 2005:17; Gomila 2009: 340; Gould 1996: 221).

According to Campbell, for variations to be blind they must meet the following requirements (Campbell 1974, p. 421):

1. They must arise without a prior knowledge of which ones, if any, are going to be selected for.
2. They are independent of the environmental conditions at the moment of their occurrence.
3. The occurrence of each trial is not correlated with the solution, that is, specific correct trials are not more probable that the rest.
4. A variation succeeding an incorrect trial is not a correction of it.

It can easily be seen why mechanisms as use and disuse, which presuppose the inheritance of acquired traits, would not be blind. They would not satisfy the second requirement, since environmental conditions would be causally responsible for successful variation, and neither the third, because successful variations would be more probable than unsuccessful ones. If the variation postulated by the theory of natural selection is blind, then the theory of natural selection is inconsistent with Lamarck's first law. Of course, it is precisely this blindness that has been found attractive by some authors in order to think of cultural change. For instance, it is this feature that drives Popper into considering the change of scientific theories as analogous to biological evolution. Just as there is no direct instruction from the environment in biological evolution, there is no inductive process from experience to the discovery of new theories in the logic of scientific research (Popper 1974, pp. 34-41). Moreover, the fact that the theory of natural selection can operate over variations that are relatively spontaneous is what gives it much more explanatory scope than Lamarck's theory. Since Darwin accepted these two Lamarckian laws (unlike other aspects of his theory, as the tendency towards complexity that according to Lamarck drove evolution), but considered that the majority of the traits adequate for the environment remained unexplained:

> "Naturalists continually refer to external conditions, such as climate, food, &c., as the only possible cause of variation. In one very limited sense, as we shall hereafter see, this may be true; but it is preposterous to attribute to mere external conditions, the structure, for instance, of the woodpecker, with its feet, tail, beak, and tongue, so admirably adapted to catch insects under the bark of trees. In the case of the misseltoe, which draws its nourishment from certain trees, which has seeds that must be transported by certain birds, and which has flowers with separate sexes absolutely requiring the agency of certain insects to bring pollen from one flower to the other, it is equally preposterous to account for the structure of this parasite, with its relations to several distinct organic beings, by the effects of external conditions, or of habit, or of the volition of the plant itself" (Darwin 1859, p. 3).

The reference to explanation by means of habit or the will points to the fact that use and disuse presuppose the will or the habit of using or not using certain organ.

Part of the explanatory power of the theory, then, lies in that it is not necessary to accept any mechanism of direct instruction by the environment in order for adaptation to such environment to be increased. But, is it necessary that variation in all cases be independent in this sense from the environment? Variation can be blind, but must it be so? If that was the case, then, indeed, the theory of natural selection would be inconsistent with direct instruction by the environment and, if cultural traits arise as a direct response to environmental problems, then the theory of natural selection could not be coherently applied to cultural evolution.

It is customary to characterize the theory of natural selection using the expression "blind variation and selective retention". I believe there are two reasons why it is affirmed that variation must be blind. On the one hand, it is because ordinary applications of the theory involve genetically determined traits, and current molecular biology has shown (though previous authors such as Weissmann had already suggested it) that there is no system that allows modifications acquired during the process of ontogenetic development to be inscribed into the genome that will be passed on to the offspring. The other reason is that, since there is not any good reconstruction and presentation of the theory of natural selection, it is not clear why a case of selection over variations produced in a non blind manner would count as a case of natural selection rather than of the operation of Lamarckian laws. Thus, for instance, Richards describes Toulmin's appeal to a non-blind or, in the latter's own terminology, "coupled" theory of natural selection to account for the evolution of conceptual populations (Toulmin 1972, pp. 324-340), as an abandonment of natural selection altogether and an acceptance of a Lamarckian mechanism (Richards 1987, p. 578).

Even those authors that are not committed to blind variation and that purport to provide a version of the theory of natural selection general enough as to allow for its application to cultural phenomena present it poorly as consisting of the three principles of variation, reproduction and selection, without much elucidation of such concepts and the way they are applied (Álvarez 2009: 321; Fog 1999: 60). This makes room for unfounded suspicions about whether, in effect, it is the same theory which is operating. I will now present a reconstruction of the theory of natural selection that, though informal and sketchy, suffices for showing that this theory is more complex than the mere variation and selection. The presentation of its fundamental concepts, the form of its fundamental law and the different ways in which the latter is applied in its special laws, will erase any fear that accepting directed variations for natural selection destroys what is peculiar to the theory.

The Darwinian Theory of Natural Selection

As is well known, what Darwin wants to explain with the theory of natural selection (TNS) is certain adequacy or adjustment of organisms to their environment.

For instance:

> "The giraffe, by its lofty stature, much elongated neck, fore-legs, head and tongue, has its whole frame beautifully adapted for browsing on the higher branches of trees. It can thus

> obtain food beyond the reach of the other Ungulata or hoofed animals inhabiting the same country; and this must be a great advantage to it during dearths" (Darwin 1872, p. 177).

The way Darwin explains the fixation of this trait in the population of giraffes is the following:

> "So under nature with the nascent giraffe*, the individuals which were the highest browsers and were able during dearths to reach even an inch or two above the others*, will often have been preserved; for they will have roamed over the whole country in search of food. That the individuals of the same species often differ slightly in the relative lengths of all their parts may be seen in many works of natural history, in which careful measurements are given. These slight proportional differences, due to the laws of growth and variation, are not of the slightest use or importance to most species. But it will have been otherwise with he nascent giraffe, considering its probable habits of life; *for those individuals which had some one part or several parts of their bodies rather more elongated than usual, would generally have survived. These will have intercrossed and left offspring*, either inheriting the same bodily peculiarities, or with a tendency to vary again in the same manner; whilst the individuals, less favoured in the same respects, will have been the most liable to perish" (Darwin 1872, pp. 177-178, my emphasis).

If we consider, following metatheoretical structuralism, that TNS's fundamental law is that statement in which the fundamental concepts of TNS appear related (Balzer, Moulines & Sneed 1987, p. 19), we can extract an instantiation of the fundamental law of TNS from the previous passage:

Giraffes with the longer necks, fore-legs, heads and tongues are more effective in feeding from the higher branches of trees, thus improving their survival and, consequently, their differential reproductive success.

Nothing seems superfluous in this statement. If we removed any if its parts, the explanation it provides would falter. If the function assigned to the trait by the organism, that of reaching the higher branches of trees, is removed, we would not know why such trait could improve survival. It could improve it for other reasons, for instance, by intimidating possible predators. This would be an alternative and competing explanation to the one offered by Darwin. If we remove the improvement in survival, the relation between the trait and reproductive success would remain indeterminate. As we will see, this connection is not always established by improvement in survival.

We can find this very explanatory structure in other places in the *Origin*. For instance, it is possible to give a similar explanation in answer to the question "How was it that certain population of caterpillars acquired shapes similar to those of the branches in which they feed that allow them to pass unnoticed in order to protect them from predators?"

> "But in all the foregoing cases the insects in their original state no doubt presented some rude and accidental resemblance to an object commonly found in the stations frequented by them. Nor is this at all improbable, considering the almost infinite number of surrounding objects and the diversity in form and colour of the hosts of insects which exist. As some rude resemblance is necessary for the first start, we can understand how it is that the larger and higher animals do not (with the exception, as far as I know, of one fish) resemble for the sake of protection special objects, but only the surface which commonly surrounds them, and this chiefly in colour. Assuming that an insect originally happened to resemble in some degree a dead twig or a decayed leaf, and that it varied slightly in many ways, then all the variations which rendered the insect at all more like any such object, and thus favoured its escape, would be preserved, whilst other variations would be neglected and ultimately lost; or, if they rendered the insect at all less like the imitated object, they would be eliminated" (Darwin 1872, p. 182).

In this case the law-like statement presupposed is the following:

Caterpillars whose shape and color allow them to camouflage with the plant on which they feed tend to leave more descendants in virtue of having improved their survival in their environment.

Abstracting from these two statements we come closer to what I consider to be the fundamental law of TNS:

Individuals with traits that perform certain function more efficiently improve their survival, thus improving their differential reproductive success.

The fundamental law of TNS would have at least three components:

- The trait that performs certain function more efficiently.
- The differential reproductive success.
- The connection between the proper trait and reproductive success, which in these cases obtains by means of an improvement in survival.

To arrive at a more general version of the fundamental law of TNS we have to take into account that there are explanations that possess the same structure, but in which the connection between the proper trait and the improvement in differential reproductive success does not obtain by way of an improvement in survival. For instance, in the following case of sexual selection:

> "Generally, the most vigorous males, those which are best fitted for their places in nature, will leave most progeny. But in many cases, victory will depend not on general vigour, but on having special weapons, confined to the male sex. A hornless stag or spurless cock would have a poor chance of leaving offspring. Sexual selection by always allowing the victor to breed might surely give indomitable courage, length to the spur, and strength to the wing to strike in the spurred leg […]" (Darwin 1859, p. 88).

The law-like statement presupposed in this case would be:

Roosters with spurs more effective for fighting against other roosters tend to mate more, consequently improving their differential reproductive success.

In other cases the explanation may resort neither to improvements in survival nor improvements in the ability to attract sexual partners. For example:

> "Those individual flowers which had the largest glands or nectaries, and which excreted most nectar, would be oftenest visited by insects, and would be oftenest crossed; and so in the long-run would gain the upper hand" (Darwin 1859, p. 92).

The law-like statement presupposed would be:

Plants that produce flowers more attractive to insects tend to increase their fertility improving, consequently, their success in differential reproduction.

The concept that varies through the different applications Darwin makes of his theory is proposed with TNS to explain what it purports to. It is an abstract concept that receives different interpretations and that affords Darwin many different explanations. The connection between the trait that is adequate for the environment and success in differential reproduction does not always obtain by means of an improvement in survival, as is generally supposed. If we call this concept "aptitude", the fundamental law of TNS could be:

Individuals with traits that perform certain function better improve their aptitude, thus improving their success in differential reproduction.

These are some of the fundamental concepts of the theory. There are others that I have not considered, such as that of environment or that of inheritance. But with this presentation it can already be seen

that the structure is more complex than is usually acknowledged, as much in textbook presentations as in available reconstructions.

We can find different instantiations of this structure in the different special laws that arise from the several instantiations of the concept of *aptitude* throughout Darwins's writings. It is interesting to notice that this very same wide explanatory structure, that does not always include an improvement in survival, can already be found in Darwin's earliest evolutionist writings. For example:

> "[…] if the number of individuals of a species with plumed seeds could be increased by greater powers of dissemination within its own area (that is if the check to increase fell chiefly on the seeds), those seeds which were provided with ever so little more down, or with a plume placed so as to be slightly more acted on by the winds, would in the long run tend to be most disseminated; and hence a greater number of seeds thus formed would germinate, and would tend to produce plants inheriting this slightly better adapted down" (Darwin 1844: 92).

In this case the instantiation of the fundamental law would be:

Organisms whose seeds have traits that allow them to glide in the air spread their seeds better, thus improving their success in differential reproduction.

It is also interesting to point that in Darwin himself we can find adaptations presented at a wider level than that of the individual:

> "[…] it may be believed that under certain circumstances individual differences in the curvature or length of the proboscis, &c., too slight to be appreciated by us, might profit a bee or other insect, so that certain individuals would be able to obtain their food more quickly than others; and thus the communities to which they belonged would flourish and throw off many swarms inheriting the same peculiarities" (Darwin 1872, pp. 74-75).

The law-like statement presupposed in the explanation would be the following:

Bees whose tongues have the most effective curvedness or length to collect nectar from certain flowers will improve the performance of the community they belong to, improving the differential reproductive success of that community.

All these explanations share the same structure and there is an interesting sense in which it can be held that they are part of the same theory, even though Darwin himself uses the expression "natural selection" in a more restricted sense on certain occasions. Only if we consider this wide theory of natural selection can we understand why, according to Darwin, the strongest reason to accept the theory is its unifying force.

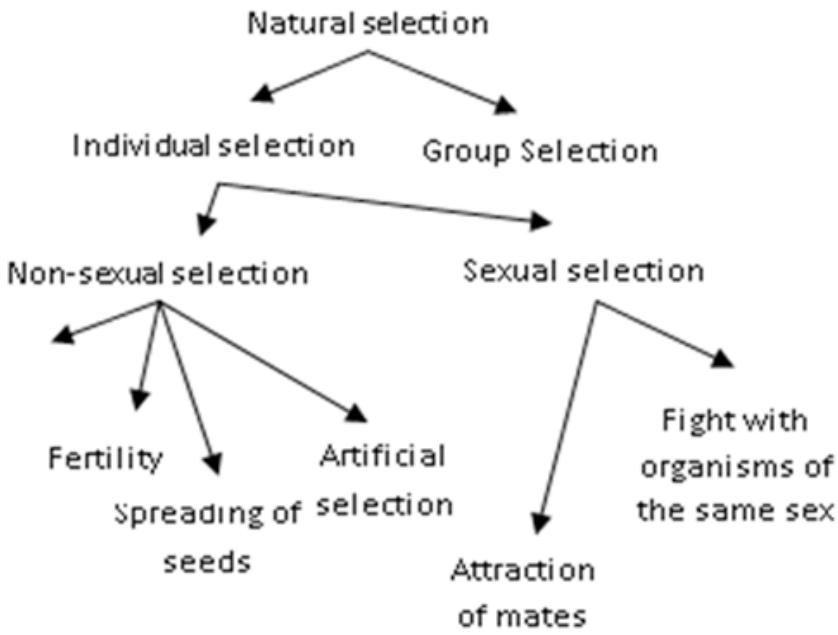

FIG. 1: THEORY-NET FOR THE THEORY OF NATURAL SELECTION

Structuralists use the expression "theory-net" (Balzer, Moulines & Sneed 1987) to refer to the web of special laws that arise by specialization from the fundamental law and that constitute the most usual sense that in practice is given to the term "theory". The theory-net based on the different specializations of *aptitude* would look like figure 1.

Nature of the variation

The fundamental law of the theory of natural selection as has been presented in the previous section presupposes the existence of the variation. In a given population it is possible to explain the differences in reproductive success only if there are differences regarding traits of the organisms from such population that imply differences in aptitude. But, as can be seen in the texts from Darwin reproduce above, he says nothing about the origin or the causes of the variation. That is because he just ignored them:

> "Our ignorance of the laws of variation is profound. Not in one case out of a hundred can we pretend to assign any reason why this or that part differs, more or less, from the same part in the parents. But whenever we have the means of instituting a comparison, the same laws appear to have acted in producing the lesser differences between varieties of the same species, and the greater differences between species of the same genus" (Darwin 1859: 167).

Darwin was aware that he did not know the causes of variation. He only knew some empirical generalizations regarding them. The theory of natural selection was born independently from any theory about the causes of variation and its behavior, building upon the empirical fact of phenotypical variation. Did Darwin consider that the variation over which natural selection operated ought to be "blind" in the sense explained above? In countless places in the Origin of Species Darwin subscribes to what Mayr calls "soft inheritance" (Mayr 1982: 687-698). In a characterization anachronical for its application to Darwin's ideas, Mayr describes the belief in soft inheritance as the belief that genetic material was flexible. Of course, Darwin did not speak of genetic material in any way, but there are two beliefs of his that, according to Mayr, would imply the belief in soft inheritance. The belief in the direct effects of the environment and in the effects of use and disuse as causes of evolution. Regarding the direct influence of the environment we can find many passages in which Darwin holds that the direct action of the environment could have had some influence in the production of the races. For instance:

> "Some little effect may, perhaps, be attributed to the direct action of the external conditions of life" (Darwin 1859: 29).

or,

> "How much direct effect difference of climate, food, &c., produces on any being is extremely doubtful. My impression is, that the effect is extremely small in the case of animals, but perhaps rather more in that of plants" (Darwin 1859: 132).

As for the effects of use and disuse,

> "I think there can be little doubt that use in our domestic animals strengthens and enlarges certain parts, and disuse diminishes them; and that such modifications are inherited" (Darwin 1859: 134).

These passages show that Darwin thought that the direct instruction of the environment and the two laws from Lamarck mentioned before work as mechanisms alternative to natural selection. This is possible only because Darwin, in effect, thought of inheritance as "soft". But these mechanisms also have an interesting role regarding our current issue. Darwin is explicit in holding that those mechanisms worked, in addition, as causes of the variation over which natural selection operated:

> "I may add, that when under nature the conditions of life do change, variations and reversions of character probably do occur; but natural selection, as will hereafter be explained, will determine how far the new characters thus arising shall be preserved" (Darwin 1859: 15).

Near the end of the chapter dedicated to the laws of variation, after revisiting all the possible causes of variations, among which we find use and disuse and the influence of the environment:

> "Whatever the cause may be of each slight difference in the offspring from their parents—and a cause for each must exist—it is the steady accumulation, through natural selection, of such differences, when beneficial to the individual, that gives rise to all the more important modifications of structure, by which the innumerable beings on the face of this earth are enabled to struggle with each other, and the best adapted to survive" (Darwin 1859: 170).

Darwin, therefore, believed that the variations over which the selective mechanisms ran could be caused by direct influence of the environment and as a result of use and disuse. That variations might be caused by the influence of environmental conditions goes against Campbell's requisite (2) mentioned before that variation should be blind. That they might be caused by use and disuse is incompatible with requisites (3) and (4). That is, the variation for Darwin did not need to be blind in Campbell's sense (Hodgson 2001: 103-105; Kronfeldner 2007: 499).

The additional explanatory power of the Darwinian theory of natural selection consisted precisely in that it could work on variations that did not depend on habit and were, therefore, more or less spontaneous. The force of the theory lay in that the variation might not arise as a response to the demands of the environment. But it did not have to be like this in all cases. The issue of it being impossible to distinguish between Lamarckian and Darwinian mechanisms if variation is blind can, I think, be eluded by paying attention to the complexity of the explanation. On the other hand, there is no risk either of the theory of natural selection becoming vacuous or irrefutable by making it more general than the version that works only on blind variations, since each of its parts is independently testable. If we claim, for instance, that fowl with tails with certain characteristics are more attractive to females and, therefore, get to mate more, improving their reproductive success, each of these claims can be tested by empirical means, with absolute independence of the nature of the variation. Finally, if the variation was generated by non-blind mechanisms, this does not make natural selection irrelevant, since the particular variation obtained non-blindly might still improve or worsen the reproductive success of the organism (Dawkins 1986: 300).

Darwinian cultural adaptions

As we saw, Darwin thought it possible for natural selection to work over directed variations. This makes it conceptually possible for the theory he devised to be applied to cultural evolution. But, in addition, he expressed, even if on few occasions, his openness to applying his theory without the need that variations be transmitted through hereditary material (Lewens 2008):

> "Now, if some one man in a tribe, more sagacious than the others, invented a new snare or weapon, or other means of attack or defence, the plainest self-interest, without the assistance of much reasoning power, would prompt the other members to imitate him; and all would thus profit. The habitual practice of each new art must likewise in some slight degree strengthen the intellect. If the new invention were an important one, the tribe would increase in number, spread, and supplant other tribes" (Darwin 1874: 129).

In this case the trait arises as a response to a need, that is, by a directed non-blind variation, and the inheritance mechanism is not genetics, but imitation. We can find, however, the same structure as in the cases considered. There is a trait, in this case a cultural one, the new technological artifact, and there is an improvement in the aptitude of the tribe that will lead to an improvement in its reproductive success. It is a case of selection at group level.

Another interesting case is the following:

> "We see variability in every tongue, and new words are continually cropping up; but as there is a limit to the powers of the memory, single words, like whole languages, gradually become extinct. As Max Müller has well remarked:—"A struggle for life is constantly going on amongst the words and grammatical forms in each language. The better, the shorter, the easier forms are constantly gaining the upper hand, and they owe their success to their own inherent virtue." To these more important causes of the survival of certain words, mere novelty and fashion may be added; for there is in the mind of man a strong love for slight changes in all things. The survival or preservation of certain favoured words in the struggle for existence is natural selection" (Darwin 1874: 90-91).

In this case, the theory of natural selection does not even apply to living organisms, but, in a way that seems to anticipate memetics, to forms of language. The Darwinian theory of natural selection, in addition to being consistent with it, was applied to cultural evolution by Darwin himself.

Conclusion

I have presented a sketch of the fundamental law of the theory of natural selection as it was conceived by Darwin and of the several ways in which it was applied. I have tried to show that if the claim that cultural evolution is Lamarckian only holds that cultural traits obtained as a response to demands of the environment are transmitted to offspring through imitation or more complex forms of learning, that does not imply that natural selection cannot play an explanatory role regarding the evolution of traits of this kind. This supposed inconsistency is based on the usually held idea that natural selection works over a blind variation and, as we saw, it is possible to hold versions of natural selection that only require variation. One example is the theory as it was conceived by Darwin. Of course, one can hold, as many epistemologists do (such as Popper or Campbell), that cultural evolution is not Lamarckian in this sense. But if it was, that does not imply that it cannot be studied in a Darwinian way. The use of the phrase "cultural evolution, in opposition to biological evolution, is Lamarckian" as it is usually used to attack Darwinian studies of cultural evolution, does not have any conceptual ground at all.

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