Generalized Darwinism: An Auxiliary Hypothesis

Spagano, Salvatore

University of Catania, Department of Economics and Business

19 July 2021

Generalized Darwinism: An Auxiliary Hypothesis

Abstract

Human teleological intentionality represents the biggest challenge to a Darwinian metatheoretical framework including socio-economic domain. In order to face the problem, this paper introduces an auxiliary hypothesis: the human will has to be considered as a constitutive component of the socio-economic environment. This means that the human will is the place where evolutionary socio-economic events occur. This perspective absorbs the objection that Continuity Hypothesis theory addresses to Generalized Darwinism.

1. Introduction

According to an old Veblenian claim, the socio-economic reality depends on institutions subjected to Darwinian evolutionary forces. In 1898, Veblen explicitly recognized Darwin's authority and reproached scholars of both Classical and Historical Schools for missing the appointment with modern science:

The economists of the classical trend have made no serious attempt to

depart from the standpoint of taxonomy and make their science a genetic account of the economic life process. As has just been said, much the same is true for the Historical School. The latter have attempted an account of developmental sequence, but they have followed the lines of pre-Darwinian speculations on development rather than lines that modern science would recognize as evolutionary. They have given a narrative survey of phenomena, not a genetic account of an unfolding process. (Veblen, 1898, p.388)

Veblen was not the only one to bring Darwinism outside of the biological field. For example, James (1890) exported Darwinian insights in the fields of psychology, and Baldwin (1909) and Dewey (1965 [1910]) showed Darwinian influence on philosophy. It was the James' philosophy, in turn inspired by the Darwinian logic, that induced Veblen to establish the pair habit-instinct at the very foundation of his institutional approach (Camic and Hodgson, 2010). Darwin himself had legitimated these attempts by offering several parallelisms between living beings and human language, each of which yet belong to clearly distinct domains: see Darwin (1860 [1859], pp. 40, 422; 1871, I, pp. 57, 58, 104, 174, 181).

Nevertheless, the Veblenian followers soon dismissed the Darwinian legacy. Hodgson (2004) and Rutherford (2011) describe the reasons for such abandonment. Over time the stigma of social Darwinism worried the scholars, and the attribute "Darwinian" could hardly match something different from strictly biological issues. It needed to wait for the second half of the twentieth century, when the first organic attempts to generalize the Darwinian logic started. Campbell (1970) proposed natural selection as a real epistemological model and Dawkins (1983) coined the phrase "Universal Darwinism" to name the systematic extension of Darwinism beyond the traditional biological boundaries.

Hodgson (2002) reconnects these endeavours to make Darwinism general with the Veblenian insights. The resulting proposal consists in shifting Darwinism from being only the place where good analogies may be found, to being the

ontological premise underlying evolution in a number of distinct domains, including the socio-economic one. In this view, Darwinism would be "a compelling ontology", "a universal metatheory in which specific theories must be nested" (Hodgson 2002, p. 27). In order to do so it was necessary to identify an essential core of Darwinian elements able to explain the evolution within fields of reality that are distinct but yet show certain communalities. The resulting metatheoretical framework is known as Generalized Darwinism (GD), according to which, the Darwinian explanation of the biological world would be just the implementation of that metatheoretical framework into the biological domain. The fact that the first systematic description of the evolutionary forces has concerned the living beings, and not something as the human language, for example, could be either just a coincidence or more likely the consequence of the large quantity of available data: after all, organisms have left traces of themselves for billions of years on Earth.

The main conceptual challenges of such an approach are likely to account for the role that the teleologically oriented human will plays in it. Differently from the biological domain, indeed, the socio-economic one is an epistemic reality that cannot exist without human acceptance (Searle, 2005). The related objection does not coincide with the debate on whether social evolution is natural or not: Hodgson (2002) solves the problem in the sense that the so-called "artificial" selection does not fall outside the "natural" one. Rather, the question concerns the peculiarities of human agency, which represents something of unparalleled in the known universe. Is the appearance of such peculiarities an exception that prevents the Darwinian scheme from being applied to a domain where human agency is so decisive?

The present paper takes the argument one step further and proposes a change in the perspective: it considers the human intervention neither as a force able to interfere with the Darwinian mechanisms of evolution nor as something that has just to be explained by means of Darwinian mechanisms. Rather, the human agency, and specifically the human intentionality, is considered here as part of the environment for the socio-economic evolution. In these terms, intentionality is something whose changes the evolutionary agents have to

adapt to in order to survive and replicate. Such an approach allows wholly overcoming the ostensible contradiction related to the presence of a teleological will into a generalized Darwinian mechanism. Such an assumption appears as one of those auxiliary hypotheses that the GD proponents and opponents wish for in order to fit the metatheoretical framework into specific socio-economic domain.

The paper is organized as follows. The next section describes GD in detail; the third section discusses the human intentionality as an objection to its validity; the fourth section introduces the mind-as-environment argument; the fifth section concludes.

2. The Generalized Darwinism

Hodgson (2002) and Knudsen (2002) lay the foundations for identifying an ontological connection among different areas of reality. By virtue of this connection, the Darwinian logic would explain any evolutionary paths in those areas, no matter the specificities of domains where those paths occur. Thus, social scientists can employ Darwinism to explain events, as biologists do, despite the deep differences of details between their respective fields.

Knudsen (2002) moves from the seminal works of Alchian (1950) and Nelson and Winter (1982) to suggest that economic evolutionism should embody the same causal structure that Darwinism shows. Hodgson (2002) finds in Darwinian causality the bedrock for an ontology underlying a plurality of domains. As the title of the paper makes immediately explicit, his aim is to shift the use of Darwinism in economics *from analogy to ontology*: Darwinism would not only be a treasure trove for appealing examples but, at a high level of abstraction, something underlying both the biological and the non-biological domains. This line of reasoning results in Hodgson and Knudsen (2006),

where the authors reject some of the most common objections to the use of Darwinism in social sciences. Most importantly, by following the argument of Campbell (1965), they suggest that variation, inheritance, and selection are the very essential elements for a metatheoretical framework, which they rename Generalized Darwinism (GD). Of course, different domains greatly differ in details. For example, the replication mechanisms deeply differ between, let's say, a routine and a goldfinch; even, domains can differ within themselves: replication mechanisms also differ between goldfinch and bacteria. In spite of such differences, however, whereby an evolutionary path arises, a Darwinian core of principles can account for that.

The differences among domains call for the identification of auxiliary hypotheses, which are appropriate to the different fields of reality where evolutionary forces perform their own task. The aim of assuming auxiliary hypotheses for each domain is that of allowing the Darwinian essential core to take concrete shape in different concrete circumstances. Therefore, alongside an essential set of Darwinian elements, a number of detail assumptions is needed in order to adapt the general principles to variegated domains.

As a reply to those criticisms (Buenstorf, 2006 and Cordes, 2006) that consider Darwinian evolutionism as inappropriate to social domain, Aldrich et al. (2008) offer a systematization of such metatheoretical framework. Firstly, they establish that complex population systems are the phenomena that the attention of evolutionary scholars has to be addressed to. As biology is not the only field that considers such systems, it is neither the only one that can be studied in Darwinian terms. Secondly, the GD considers populations consisting of several agents that share characteristics, which make them similar under many respects. All the members belonging to a population substantially differ from all the

members belonging to other populations. Despite the substantial similarity of the members belonging to the same population, they do differ in some degree from one another. Thirdly, two sets of core Darwinian principles are identified: the three steps of evolution namely inheritance, variation, and selection on one hand, and the replicator-interactor pair (following Hull, 1988) on the other one. On the assumption that both these sets are sufficiently general, a metatheoretical framework arises, which underlies different domains.

The concept of inheritance refers to the ability of the agents to retain (descent) and pass on (replication) those characteristics that ensure them an adaptive success. In particular, replication is the ability of the agents to make copies of themselves. Being this replicative process not perfect, the variation step arises. Selection, finally, is the result of the differential adaptation of varied agents to the environment, which, in the meantime, can vary.

The replicator-interactor pair derives from generalization of the genotype-phenotype biological pair. Replicator is any entity that makes imperfect copies of itself and, in doing so, transfers adaptive information. Interactor is what interacts with the environment, working as a vehicle for the replicator (Dawkins, 1976), and causing "replication to be differential" (Hull 1988, p. 408). Institutions, such as individual habits and organizational routines, are usually considered to be socio-economic replicators, and firms are considered to be socio-economic interactors (Hodgson and Knudsen, 2004).

Regarding them as result of mere biological analogy, Stoelhorst (2008) rejects both descent and replication concepts. However, he agrees on the need of generalizing Darwinism, and for this purpose he proposes a multi-level selection approach that, following Dopfer and Potts (2004), brings about layers of adaptive complexity. Quite the opposite, Levit et

al. (2011) report an incompleteness of Darwinism itself as a theoretical system, and question the entire GD top-down research strategy. Whereas this objection concerns whether or not only one "Darwinism" in biology exists and, accordingly, whether or not it is allowed to generalize it, other objections concern the claimed Hodgson and Knudsen's version of the GD. It is the case of Pelikan (2011), who proceeds in a different, inductive fashion and, in order to account for phenomena like cooperation, reasons in terms of development rather than in terms of evolution. In spite of his methodological objections, however, Pelikan (2012) himself admits that his contribution does not exceed the boundaries of a generalization of Darwinism.

3. The human intentionality objection

A more radical kind of objections depends on which role has to be recognized to human intentionality in the evolutionary process. The problem is whether human agency can elude the Darwinian evolutionary logic by virtue of its own peculiarities. Human beings are self-aware, prescient, and act intentionally in order to reach specific goals. Being able to foresee the outcomes of a selection, for example, they could try to avoid them by disturbing the process. So, human beings would intentionally modify certain habits whereby they were aware that, otherwise, those habits would end up disappearing. Of course, they are not able to guide future outcomes with a deterministic degree of certainty: nobody can exactly foresee or lead the outcome of a complex system. Nonetheless, the human intentionality can actually affect evolutionary results and, sometimes, even in the desired direction. Thus, human behaviour would seem able to violate the chance and necessity mechanism, which excludes any form of teleology. To this end, human beings can also experience or learn something during their lifetime and pass it on before dying. So, they can transfer to the next generation something that they did not have at the time of their birth.

Consequently, even if socio-economic reality is subjected to evolutionary forces, such forces could be meant as non-Darwinian: the teleologically oriented human agency would interrupt the blind chain of events, which is usually assumed to be characteristic of Darwinism.

This fundamental remark leads to two distinct objections. On one hand, it leads to the idea that socio-economic evolution is Lamarckian rather than Darwinian (Hirshleifer, 1977; Nelson and Winter, 1982 Rosenberg, 1982; David and Olsen, 1986; Metcalfe, 1994). On the other hand, such remark induces to claim that no generalization of Darwinism is possible, and that human intentionality would demand a completely different evolutionary scheme.

At first glance, Lamarckism would actually appear to give an answer to the questions deriving from the human ability to intentionally acquire, modify, and transfer skills to the next generations. Conceiving Lamarckism as radically alternative to Darwinism prevents Darwinism from accommodating the "exception" that human intentionality would represent. The point is that Lamarckism is not, in the GD logic, an alternative to Darwinism:

> We accept the possibility, in the social if not the biological sphere, that some (social) phenotypes (or interactors) can affect their (social) genotypes (or replicators), just as firms can alter their routines […]. Contrary to a widespread view, Lamarckism and Darwinism are not mutually exclusive. (Hodgson and Knudsen, 2010, p. 65)

So, if Lamarckism and Darwinism are not mutually exclusive, then Lamarckian characteristics in the socio-economic world would not undermine a generalization of Darwinism that includes that world. Besides, in the GD view, at least in the Hodgson and Knudsen's version, neither the non-randomic character of socio-economic variation would appear to be an obstacle:

> The volitional acquisition of characteristics is often contrasted to the allegedly blind or random mutations in some versions of Darwinism. However, Darwin himself never wrote of *random* mutations, and, in

principle, core Darwinian principles are broad enough to accommodate both contrasting accounts. Furthermore, volition and randomness are neither mutually exclusive (think of the stock market) nor strictly necessary for Darwinian evolution to occur. (Hodgson and Knudsen, 2010, p. 64, italic in original)

A different and more demanding challenge to GD comes from the claim that human beings "have sufficient intelligence and incentives to anticipate and avoid selection effects" (Witt, 2004, p.128). In this approach, intelligence and incentives would originate a feedback between variation and selection. For example, humans can intentionally modify certain institutions in order to avoid that the axe of selection falls on them. Thus, the inception of human teleological attitude would undermine the Darwinian logic not, as in the previous case, because of the ability to acquire, modify, and pass on acquired traits, but due to the human peculiar ability to anticipate and avoid the outcomes of the evolutionary selection:

In the presence of a systematic feedback, the distinction between variation and selection, which is a fundamental premise of the neo-Darwinian theory, is no longer valid – a result that does not just live up to the expectations of Universal Darwinism. (Witt, 2004, p. 129)

This approach, also known as Continuity Hypothesis (CH), does not refuse Darwinian evolution. On the contrary, it claims that human intentionality is itself an outcome of Darwinian evolution. In spite of such an ontological continuity, CH also claims that evolution of socio-economic reality, which radically depends on that intentionality, cannot be explained by Darwinian schemes due to the systematic feedback that intentionality gives rise to. The biological evolution, which characterizes living organisms and has led to the self-conscious and teleologically oriented human brain, can be explained in Darwinian terms. But the socio-economic evolution, which strictly depends on that brain, needs instead a different, non-Darwinian, scheme of explanation. In

this view, continuity exists between these two phases of the evolutionary history, since those human abilities find their own origin in the pre-human biological evolution, but a deep discontinuity also occurs. This nominal contradiction did not go unseen to Hodgson and Knudsen (2010, p. 59), who remarked "[…] Witt ends up defending a good measure of discontinuity rather than continuity." However, their teleological attitude allows humans to foresee future (evolutionary) outcomes with a given degree of probability, and their consequent choices can in turn cause a feedback of the selection step towards the variation one. Hodgson and Knudsen (2010, p. 58) reply by considering CH fully consistent with Darwinian principles albeit

> Witt claims that cultural evolution is driven by different mechanisms and principles than biological evolution. He therefore questions the relevance of the principles of variation, selection, and inheritance for understanding cultural evolution.

The point is that GD is first of all a generalization of the three Darwinian evolutionary steps, and human intentionality actually causes a difference in the mutual relationships among such steps. This is something unknown to (pre-human) evolutionary biology as teleology is. For this reason, advancements in the GD demand to account for such a discontinuity. Otherwise, in the better hypothesis, the differences between the two approaches would remain irreconcilable because ultimately it depends either on the semantic extent of terms as "variation" and "selection" or on whether to admit or not that a human exception exists, which prevents the Darwinian scheme to be applied to socio-economic reality.

The next section offers a perspective to overcome the GD versus CH contrast: CH gathers correctly that human teleological abilities constitute a discontinuity, and nonetheless it can be brought back into the boundaries of GD thanks to one of those auxiliary hypotheses that both sides focus on (Aldrich et al., 2008; Levit et al., 2011).

4. The socio-economic environment

The hypothesis this paper suggests is that human teleological intentionality has to be considered neither as an external force altering the Darwinian scheme nor as a mere agents' attribute, ultimately not crucial for the extension of the core Darwinian principles to socio-economic domain. Rather, human intentionality has to be considered as a component of the environment of the socio-economic domain.[1] As GD and CH agree, intentionality is an outcome of the Darwinian biological evolution. In addition, I suggest, it is the place where socio-economic evolutionary events occur. In this view, human intentionality and teleological attitudes are something that socio-economic replicators like habits and routines have to comply with in order to survive and replicate. This approach acknowledges full human free will and is auxiliary to GD framework. Furthermore, it overcomes the variation-selection feedback objection by Witt, and reconciles such an objection and GD.

In a very general meaning, the biological evolutionary environment is the complex place including physical, chemical, and biotic factors, where organisms live, where they have available sustenance and information, and which they interact with. At a more detailed level, such an environment shows some features that participate in the three steps of the evolutionary process, and which are very relevant for the aims of the current analysis. First of all, (a) the environment is the place where the replication happens. Next, (b) it can directly provide variations in the replicator: it is the case, for example, of genetic heritable mutations caused by chemical elements or radiation exposure. Also, (c) the environment can interrupt replication. By means of this, the environment selects which genes will be passed on and which will not, based on the rate of survival and reproduction of a phenotype. Finally, (d) the

---

[1] The human intervention, both intentional and unintentional, has also to be considered as a component of the biological environment. Nonetheless, the environmental role of human intentionality in the socio-economic domain is incomparably more pervasive than the one in the biological domain.

biological environment, according to the hypothesis of the primordial soup, provided the conditions for the primigenial forms of life to appear.

The aim of this section is to show that all these four features repeat in the socio-economic environment, carried out by both intentional and unintentional human agency. The consequence is the hypothesis that human minds belong, in their mutual relationships, to the socio-economic environment. We may be brought to think that the human intentionality is something able to intervene in (and possibly able to alter) the evolutionary process as such. This is the CH approach. Differently, I consider the human intervention as something *where* the evolutionary events occur. If this change of perspective is accepted, the feedback between variation and selection disappears: the evolutionary path of socio-economic replicators proceeds with its own course regardless human intervention. This course will face human intervention just as any other environmental element that is able to house replication, to introduce variation, and to set disappearance of replicators off.

(a) Consider the replication of behavioural rules.[2] This kind of institution is an example of socio-economic replicator. Both imitation (intentional and unintentional) and teaching (intentional) are examples of socio-economic replication mechanisms. What does this replication consist in? It results in the transfer of the rule from a human mind to another one. In a sense, the replicator employs human minds to do copy of itself, just as an organism employs the ecosystem to replicate: both the matrix and its copies live in the same environment, the human minds, where they replicate. Importantly, while the biological agents replicate in just one biosphere (or, more precisely, in just one biome), the minds we are considering have to be at least two, and this can be considered as specificity, a sort of sub-hypothesis for the socio-economic domain.[3] The behavioural rule can be learned by imitation without the

---

[2] For the sake of simplicity, the line of reasoning concerns only institutions as behavioural rules, but it can be extended to the rules of thought without running in contradiction.

[3] This is the reason for which we need to consider the human minds in their mutual relationships. One could think that, just because more than one, each mind could be considered as the interactor of the rule/institution. However, the mind where the rule transfers to, existed already before the replication. Therefore, the mind cannot be considered as an interactor because the interactor cannot pre-exist to its own replicator. Differently, the complex

intervention of a full intentionality. This is the case of a specific accent that pools the people of a certain place together. Usually, the people do not notice their own inflection of pronunciation. They learned it unintentionally. In the same manner, we can acquire many other behavioural rules unintentionally, just by following other people. Alternatively, a rule can be intentionally learned or taught. The first is the case of somebody who learns the custom of a new community; the second is the case of a mother who teaches the child to walk on the zebra crossing, thus, intentionally replicating this behavioural rule in the mind of the daughter.

(b) In both polar cases, intentional or unintentional, as well as in all the intermediate cases, the replicative outcome can ideally be either faithful to its own matrix or different. When it is different, variations arise. What is specific of the socio-economic domain is that variations can intervene according to two ways[4], depending on whether the human teleological intentionality intervenes or not. The unintentional variations of the rule may depend on errors in the replicative mechanism just as it usually occurs in the biological domain. For example, an unintentional misunderstanding in the imitation of a custom may originate a new and different custom. Variations can also be intentionally introduced. It is the case of a variation inserted in a routine in order to improve its outcomes. As the biological environment can directly intervene in modifying the DNA, so the human mind can directly intervene to modify a rule of behaviour regardless of whether the intention will end well or not; viz. independently from either the attempt of modification will be a success or not, and independently from either the modification itself will reach the desired result or not. Only afterwards the selection step will set the destiny of that modification. We need to resist the temptation to exclude the feasibility of the natural evolution scheme due to the conscious and teleological orientation of

---

of the human minds, just as the biological environment, exists before the copying process. In this sense, it is maybe arguable that a socio-economic interactor is the single human agency that "expresses" that rule. So, for example, the single behaviour adapting to the rule could be meant as an interactor of that specific rule/replicator, which is nested in the mind of the subject. Just thanks to this single behaviour, moreover, the replication is possible via imitation.

[4] According, also, to each intermediate element of the countless possibilities included between these two extremes: see below in this subsection.

the free human mind. In the considered case, the human mind remains free, conscious, and also teleologically oriented but, from the replicator point of view, the human intervention is just an external source of direct variation like radiations are for the DNA. Obviously, there is a quantitative difference between the two cases. The variation of the biological replicator that directly depends on the environment is a rather infrequent possibility, differently from what happens in the socio-economic domain. However, again, this quantitative difference can be ascribed to the intrinsic differences between the two domains. Rather, what is very relevant is that human intentional minds can produce direct variations in institutions just like biological environment can produce direct variations in DNA. In the socio-economic field, either unintentional variations or intentional but unsuccessful attempts to improve replicator may prevent it to do copy of itself. Such inability may also depend on an arisen environmental obstacle.

c) In our approach, such an obstacle may also be represented by a human intervention that suppresses the replicator. In this case the environment changes in the sense that human intervention places some kind of obstacle to the replicator survival and spreading. The obstacles depending on human intervention can again be either unintentional or intentional.[5] As an example of human unintentional obstacle, consider the case of a technological change: the introduction of some forms of automation can force the agents to shelve old routines. The routines cannot replicate due to an obstacle that neither is the accidental consequence of a failed attempt to improve them, nor it has been put there intentionally to suppress them. Anyway, such an obstacle exists and depends on human intervention, which in the example reveals itself by a technological transformation, and ends up impeding those routines to replicate and survive.

An example of intentional obstacle recurs instead when legal sanctions succeed to suppress certain behavioural patterns. In this case, a change in the mind (the fear of the consequence related to maintaining a given behaviour) corresponds

---

[5] Obviously enough, the intentional obstacle could be unsuccessful and the rule could proceed to replicate.

to an environmental change hostile to survival and replication. This change is not the undesired effect of other (maybe intentional) choices, but it is precisely the one that the conscious design of a legislator aims to. For whatever reason a rule suffers the selective cut, the mechanism remains the same of the biological domain: some obstacle in the environment impedes either survival or replication.

Thus far, I described the two intentional-unintentional polar characteristics of the human mind as socio-economic environment. Note that such characteristics correspond to the two systems of Kahneman (2003). As it is well known, the system 1 includes all the basically automatic behaviours, and the system 2 refers to the basically intentional behaviours. The human minds, meant as the whole of the two systems, and in mutual relationship, are components of the socio-economic environment. We concentrated on the functioning of system 2, which appears to be more problematic because able to cause the feedback that we talked about in the previous section. More in general, we may claim that the system 1 is the sub-environment where unintentional replication, variation, and selection happen, whereas the system 2 is the sub-environment where intentional replication, variation, and selection happen. The boundaries between intentional and unintentional behaviours are obviously fuzzy, meaning that the two polar cases (in all the three features so far considered) are only the extremes of a continuum, which includes infinite intermediate cases. However, the paper focused only on the two polar cases, resting on the premise that the better way to start understanding a continuum is to study its extremes.

(d) Finally, the hypothesis of the human mind as socio-economic environment is also coherent with the problem of the origin of the institutions-replicators. In parallel to the hypothesis of the primordial soup, which originated the conditions for the spread of life on Earth, we may maintain an environmental origin of institutions. After all, where do primal rules arise from, either in the spontaneous or designed forms, if not in the human mind?

These four characteristics, which environment shows in the biological domain, are therefore characteristics that the human mind shows. This is why we can conclude that, from the "replicator point of view", the human mind (in its

entire range from the perfectly unintentional to the completely intentional acting) can be considered as environment of the socio-economic evolutionary process.

5. Conclusions

Human intentional teleological volition represents the main obstacle to Generalize Darwinian framework and to directing it to socio-economic domain. The reason is that human mind is able not only to foresee future evolutionary outcomes but also to alter socio-economic replicator in order either to promote or to impede their spread. According to CH approach, these abilities would give rise to a feedback between variation and selection, which would undermine the Darwinian logic. This approach rests on the idea that human intentionality can compete with Darwinian forces in order to orient the evolutionary outcomes. This paper changes perspective and suggests considering human intentionality (and, more in general, minds in their mutual relationships) as a part of socio-economic evolutionary environment, namely as the place where replication, variation, and selection happen. This hypothesis can be considered as one of the auxiliary hypotheses needed to carry Generalized Darwinism to the socio-economic domain specificities.

Furthermore, such hypothesis reconciles GD and CH because it admits a singularity in the inception of human mind but reconnects such singularity to a metatheoretical Darwinian framework: the human beings' appearance on Earth produces a discontinuity in the sense that, contextually, the socio-economic domain appears. Human intentional specificity does not alter the working of Darwinian scheme. Rather, it starts a new environment for a new domain of reality, which a Darwinian core of elements continues to apply to.

Other studies are needed in order to account for a number of questions that remain open. First of all, the paper only examines the case of institutions as rules and not as organizations. Secondly, the idea of mind as environment demands to clarify what other elements the socio-economic environment

consists of. Thirdly, further reflections are needed about the nature of interactors. One possibility is that the concrete behaviours complying the rule have to be considered, at least at a first level of complexity, as socio-economic interactors.

References

Alchian, A. (1950) 'Uncertainty, evolution, and economic theory', *Journal of Political Economy*, **58(3)**: 211–221.

Aldrich, H., G. Hodgson, D. Hull, T. Knudsen, J. Mokyr and V. Vanberg (2008) 'In defence of Generalized Darwinism', *Journal of Evolutionary Economics*, **18**(5): 577–596.

Baldwin, J. M. (1909) 'The influence of Darwin on theory of knowledge and philosophy', *Psychological Review*, **16**(3): 207–218.

Buenstorf, G. (2006) 'How useful is generalized Darwinism as a framework to study competition and industrial evolution?', *Journal of Evolutionary Economics*, **16**(5): 511–527.

Camic, C. and G. Hodgson (eds.) (2010) *The essential writings of Thorstein Veblen*. Routledge, London and New York.

Campbell, D. (1965) 'Variation and selective retention in socio-cultural evolution', in H. Barringer, G. Blanksten and R. Mack (eds.) *Social change in developing areas: A reinterpretation of evolutionary theory*, 19–49. Schenkman, Cambridge, MA.

Campbell, D. (1970) 'Natural selection as an epistemological model', in R. Naroll and R. Cohen (eds.) *A handbook of method in cultural anthropology*, 51–85. National History Press, New York.

Cordes, C. (2006) 'Darwinism in economics: From analogy to continuity', *Journal of Evolutionary Economics*, **16**(5): 529–541.

Darwin, C. (1860 [1859]) *On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*. Murray, London.

Darwin, C. (1871) *The descent of man, and selection in relation to sex*. Murray, London.

David, P. and T. Olsen (1986) 'Equilibrium dynamics of diffusion when incremental innovations are foreseen', *Ricerche Economiche*, **40**(4): 738–770.

Dawkins, R. (1976) *The Selfish Gene*. Oxford University Press, Oxford.

Dawkins R. (1983) 'Universal Darwinism', in D. Bendall (ed.) *Evolution from Molecules to Man*. Cambridge University Press, Cambridge, UK.

Dewey J. (1965 [1910]) *The influence of Darwin on philosophy*. Indiana University Press, Bloomington.

Dopfer, K. and J. Potts (2004) 'Evolutionary realism: A new ontology for economics', *Journal of Economic Methodology*, **11**(2): 195–212.

Hirshleifer, J. (1977) 'Economics from a biological viewpoint', *The Journal of Law and Economics*, **20**(1): 1–52.

Hodgson, G. (2002) 'Darwinism in economics: from analogy to ontology', *Journal of Evolutionary Economics*, **12**(3): 259–281.

Hodgson, G. (2004) *The evolution of institutional economics: Agency, structure and Darwinism in American institutionalism*. Routledge, London and New York.

Hodgson, G. and T. Knudsen (2004) 'The firm as an interactor: Firms as vehicles for habits and routines', *Journal of Evolutionary Economics*, **14**(3): 281–307.

Hodgson, G. and T. Knudsen (2006) 'Why we need a generalized Darwinism, and why generalized Darwinism is not enough', *Journal of Economic Behavior & Organization*, **61**(1): 1–19.

Hodgson, G. and T. Knudsen (2010) *Darwin's conjecture: The search for general principles of social and economic evolution*. University of Chicago Press, Chicago.

Hull, D. (1988) *Science as a process: An evolutionary account of the social and conceptual development of science*. University of Chicago Press, Chicago.

James, W. (1890) *The principles of psychology*. Henry Holt, New York.

Kahneman, D. (2003) 'Maps of bounded rationality: Psychology for behavioral economics', *American Economic Review*, **93**(5): 1449–1475.

Knudsen, T. (2002) 'Economic selection theory', *Journal of Evolutionary Economics*, **12**(4): 443–470.

Levit, G., U. Hossfeld and U. Witt (2011) 'Can Darwinism be 'generalized' and of what use would this be?', *Journal of Evolutionary Economics*, **21**(4): 545–562.

Metcalfe, J. S. (1994) 'Evolutionary economics and technology policy', *The Economic Journal*, **104**(425): 931–944.

Nelson R. and S. Winter (1982) *An evolutionary theory of economic change*. Harvard University Press, Cambridge, MA, and London.

Pelikan, P. (2011) 'Evolutionary developmental economics: How to generalize Darwinism fruitfully to help comprehend economic change', *Journal of Evolutionary Economics*, **21**(2): 341–366.

Pelikan, P. (2012) 'Agreeing on generalized Darwinism: a response to Geoffrey Hodgson and Thorbjørn Knudsen', *Journal of Evolutionary Economics*, **22**(1): 1–8.

Rosenberg, N. (1982) *Inside the black box: Technology and economics*. Cambridge University Press, Cambridge, UK.

Rutherford, M. (2011) *The institutionalist movement in American economics, 1918–1947: Science and social control*. Cambridge University Press, Cambridge, UK, and New York.

Searle, J. (2005) 'What is an institution?', *Journal of Institutional Economics*, **1**(1): 1–22.

Stoelhorst, J. (2008) 'The explanatory logic and ontological commitments of generalized Darwinism', *Journal of Economic Methodology*, **15**(4): 343–363.

Veblen, T. (1898) 'Why is economics not an evolutionary science?', *Quarterly Journal of Economics*, **12**(3): 373–397.

Witt U. (2004) 'On the proper interpretation of 'evolution' in economics and its implications for production theory', *Journal of Economic Methodology*, **11**(2): 125–146.