The Explanatory Scope of Generalized Darwinism: Towards Criteria for Evolutionary Explanations Outside Biology (GenDar)

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Abbreviated project description

The ideas that were published Darwin's *On the Origin of Species* have had, and continue to have, major impact on our understanding of the world in which we live and the place that humans occupy in it. They constitute the core of contemporary life science, and serve as the basis for explanations in biology and biomedical science. They are also frequently used in psychology, neuroscience, nutrition science as well as other areas of the "human sciences" and the importance of evolutionary thinking in the sciences can hardly be overstated. In the public sphere, in contrast, the impact of Darwin's ideas often manifests itself in a negative way, as illustrated by fears of social Darwinism or genetic determinism often associated with evolutionism by the general public.

Both hopes and fears associated with evolutionary thinking are at present becoming acute due to an increasingly widespread use of evolutionary concepts, models, and explanations in areas of research outside biology. A central motif in such research is the idea that processes very similar to, or even the same, as biological evolution are not confined to the living world, but can in principle also occur outside biology. As a consequence, researchers in a variety of areas of research have begun to interpret the phenomena they study in evolutionary terms and to use evolutionary concepts and models to describe and explain them. Numerous "evolutionary" research programs have emerged that attempt to use evolutionary thinking to account for the phenomena under study or to design new solutions to extant problems more effectively. Examples include evolutionary epistemology, evolutionary ethics, evolutionary aesthetics, evolutionary psychology, evolutionary medicine, evolutionary economics, evolutionary archaeology, evolutionary computing/programming, evolutionary electronics, evolutionary social science, and attempts by philosophers to understand science and technology as evolutionary systems (see Heams et al. 2015). Chemical evolution applies Darwinian explanatory schemes, such as the one formulated by Lewontin (1970). The evolution of science has been addressed in a Darwinian way by Hull (1980; 1988a), Mesoudi et al. (2013) and Scerri (2016). Here, Hull understood theories as transmissible entities that can meet more or less success (i.e., being adopted by more or less scientists), and scientific progress as resulting from selection and variation of those theories. Similarly, a variety of evolutionary accounts of technological change has been advanced (see Ziman 2000; Brey 2008). More exotic fields have also emerged, such as evolutionary literature studies (Gottschall & Wilson 2005), cosmological Darwinism (considering Darwinian evolution of galaxies; Smolin 2001), and quantum Darwinism (an interpretation of quantum processes as selection of preferred quantum states; Ball 2004; Blume-Kohout & Zurek 2005; Zurek 2009).

But while finding good evolutionary explanations of suitable non-biological phenomena clearly would advance our understanding of these phenomena, it seems that many evolutionary explanations that are constructed in some areas do not actually constitute good scientific explanations. As it began, the field of evolutionary psychology, for example, has been severely criticized for presenting highly speculative, unfounded and incorrect evolutionary explanations of human behavior that could have profoundly adverse effects on society (e.g., Dupré 2000; 2010; Downes 2017). This shows that applying evolutionary thinking outside biology proper can be risky when evolutionary explanations of non-biological phenomena are accepted too quickly. At present, it still is an open question under which conditions evolutionary theory can be applied to formulate good evolutionary explanations of phenomena outside the biology.

The project will focus on this question with the overarching aim to achieve clarity on the epistemic potential of applying evolutionary thinking outside biology. The project will examine research programs that attempt to construct Darwinian explanations of non-biological phenomena. (Note that the project does not address Dawkins' (1983; 1992; 2008) Universal Darwinism, which only considers Darwinian evolution a universal property of any possible *living* systems.) The shared epistemological outlook of such programs is that Darwinism can assume the role of multi-purpose explanatory framework or unifying paradigm that could bring a diversity of fields of investigation both within and outside the life sciences together under a common framework. Underwriting this epistemological approach is the metaphysical assumption that the various phenomena, processes and systems under study all instantiate the same basic process and hence can be accounted for by the same explanatory theory, presumably some nuclear form of Darwinian evolutionary theory that is to be filled in on a case-by-case basis for application to the various phenomena under study (cf. Aldrich et al. 2008; Hodgson & Knudsen 2010). An important question for philosophers of science is to what extent such epistemological views and metaphysical assumptions are warranted. And if they are warranted to some extent, what follows for the unity and structure of sciences, as well as for human life and for society from applying evolutionary thinking to societal phenomena?

As the project investigates the epistemology, metaphysics, and societal aspects of applying Darwinian evolutionary theory outside the biological domain, a first issue to clarify is the nature of Darwinian evolutionary theory itself. Here, the project builds on the ongoing debates in the philosophy of biology on evolutionary theory and its core concepts. Unlike most theories in the sciences, Darwinian evolutionary theory is not a stable, finalized and clearly circumscribed scientific theory that rests on a core of unequivocally clear concepts, principles or laws, and is available in the form of a stable set of equations or principles. Rather, it is a non-sharply delimited collection of ideas, principles, concepts, etc., which has undergone considerable change since the publication of Darwin's work and continues to be in flux to the present day. For one, according to Mayr (1985) Darwin's theory is best understood as a set of five separate theories that evolutionists have endorsed and rejected in various combinations. Since the mid-19th century, evolutionary theory has gone through several stages of development, most notably Darwin's own set of ideas; the Neo-Darwinism (ultra-selectionism) of Weismann, Wallace and others; the Modern Synthesis of the 1930s-1940s; and current developments like the Extended Synthesis. During the history of evolutionary theory, most of its central concepts have undergone profound change, such that at present they are associated with a number of different competing interpretations – consider the ongoing controversies on the nature of fitness and the question whether the fitness of genes, traits or organisms is central in evolution (Rosenberg & Bouchard 2015; Ramsey 2016); on the nature of genes and the various available gene concepts (Griffiths & Stotz 2013); on the nature of species and the various available species concepts (Reydon 2004; 2005; 2006; 2008; 2019; Reydon & Kunz 2019; Richards 2010); on the units and levels of selection (Okasha 2008); on the correct interpretation of selection as a force, a process, a cause, or just a statistical outcome (Walsh et al. 2002; Lewens 2010; Huneman 2012; Millstein 2013; Walsh et al. 2017), etc. In sum, evolutionary theory never has been a fixed and stable theory. Rather, it is a somewhat loosely interconnected cluster of principles that has undergone profound change throughout the history of biology, and still is in the process of changing further.

Metaphysics comes into play in the clarification of these issues. Many of the abovementioned "evolutionary" research programs use Dawkins' (1976; 1982) and Hull's (1980; 1981; 1988a; 1988b) ontology of replicators and vehicles/interactors as the ontological basis for their formulation of evolutionary explanations of phenomena under study (e.g., Hull 1981; 1988a, on the evolution of scientific theories). The idea is that whenever it is possible to identify replicators and interactors in a particular domain of reality, these entities engage in processes of differential replication and selection that produce phenomena that can be explained evolutionarily. Genes and organisms are examples of replicators and interactors, respectively, as are memes and their bearers (human beings) (Dawkins, 1976; Blackmore, 1999; Wilkins & Hull, 2014), organizational routines and the entities in which those exist (forms, companies, franchises, etc.) (e.g., Hodgson, 2003; 2013; Hodgson & Knudsen, 2004; 2010), and cultural characters and their bearers (individual people as well as groups) in evolutionary archaeology (O'Brien & Lyman, 2002).

A question is, however, whether a basic ontology of replicators and interactors is necessary and sufficient to identify evolutionary phenomena. A working hypothesis of the project is that it is not. This hypothesis is suggested by several suggestions that have been made in the literature. Some authors have argued that replicators are not strictly necessary parts of the ontology of evolutionary systems and evolution without replicators is possible (Godfrey-Smith 2000; Wilkins et al. 2012). Others have introduced the notion of 'reproducers' as denoting a third kind of entity next to replicators and interactors (Griesemer 2000a; 2000b; 2002; Wilkins & Hull 2014). At the very least the replicators and interactors in a particular domain must stand in appropriate causal relations to each other to make evolution possible – they cannot be disconnected, as the interaction between interactors and their environment causes the differential replication of replicators, and the differential replication of replicators causes differential interaction of the interactors in the next generation. So, on the replicator-interactor scheme both kinds of entities must be embedded in an adequate causal framework to make evolution possible. This is where the notion of 'population' becomes important:

populations "bound genes in space and time" (Gannett 2003: 989). This view of populations as the "containers" of the replicators and interactors that evolve as a consequence of interaction and differential replication is a core element of biological evolutionary thinking.

This part of the research will constitute a metaphysical analysis of two questions: which elements does a basic ontology of evolution have to encompass, and can these basic elements plausibly be identified in domains outside the biological realm? Work on these questions will build on available work in the philosophy of biology, evolutionary economics, organizational studies, and evolution of scientific concepts (e.g., Hodgson 2002; Hodgson & Knudsen 2006; Stoelhorst 2008; O'Brien 2009; Lesourne et al. 2006; Chavalarias & Cointet 2013). In particular, it will pursue the idea that an adequate ontology of evolutionary theory should include populations as the entities that evolve through time. In recent work, Godfrey-Smith (2009; 2011) has developed an account of what he calls "Darwinian populations" in the context of selection processes, which will be an important starting point in the project for work on the ontology of populations. While the notion of 'population' (and the associated higher-level concept of 'metapopulation' that was introduced in Levins 1969) is central to biology and other areas of research (such as biomedicine and social science), there is no clear understanding of the nature of populations and metapopulations. Besides Godfrey-Smith's work, only a very small volume of literature is available on the nature of evolving populations and the population concept in biology (most importantly: Jonckers 1973; Gannett 2003; Schaefer 2006; Millstein 2009; 2010; 2014; Stegenga 2010; 2016; Hey 2011; Charbonneau 2014; Winther et al. 2015; Stencel 2016), or on the metapopulation concept (Hanski & Gilpin 1991; Hanski 1998; Chesson 2013). An important part of the metaphysical work in the project thus will be to develop an account of the nature of evolving (meta-)populations that applies both to biological and non-biological cases.

A question in relation to the metaphysics of populations is which aspects of the metaphysics of Darwinian processes are found in areas outside biology. Lewens (2015) argued that "Darwinian" cultural evolution is not any kind of population-level view of the dynamics of cultural change, but that purely Darwinian views (such as memetics), in which natural selection plays a key role, are a subset of all the 'population centered' views. What is Darwinian according to him would then be the key role conferred to natural selection, in accordance with the tenets of the Modern synthesis. Our task here will be to consider the existing extensions of Darwinian evolution, and ask to what extent they are indeed Darwinian, or whether they just borrow some but not all al elements of Darwinian processes (as some cultural evolution theories borrow only the population-level view but not the selectionist explanatory strategy).

The philosophical work will be strongly intertwined with historical elements, and as such the project will fall in the area of integrated history and philosophy of science. The historical elements involve tracing the development of evolutionary thinking in the literature in the history of biology (e.g., Bowler 2003; Mayr & Provine 1980; Smocovitis 1996; Cain 2009; Depew 2011; Beatty 2017; O'Malley 2017; Grodwohl 2019; Huneman 2019) as well as in writings from major figures in that developmental history (such as Ernst Haeckel, Alfred Russell Wallace, Thomas Hunt Morgan; August Weismann, and others).

This state of affairs leads to the following set of research questions. When inquiring into the explanatory scope of evolutionary theory a central issue is what exactly "Darwinian evolutionary theory" or "Darwinism" encompasses. The project addresses this issue by asking (Q1) whether there is a core set of principles, concepts, etc. that was retained throughout the development of Darwinian evolutionary theory from Darwin's work to the present-day, and serves as the foundation of evolutionary explanations. This question has a formal/ epistemological and a metaphysical aspect, and as such gives rise to two further questions: (Q1a) Is there an **epistemologically preferred way of formulating the core of Darwinism**? That is, is there one way in which the explanatory framework of Darwinism is best described verbally and/or mathematically? Are there multiple ways of describing this core that all have equal explanatory force, or do some have less explanatory force than others? What is the minimal set of concepts, principles, etc. that is needed to formulate good evolutionary explanations? (Q1b) Is there a **preferred metaphysics of evolutionary processes** that best underwrites the explanatory potential of Darwinism? That is, is there a preferred account of the ontology of evolution (of the nature of Darwinian processes, the entities participating in them, etc.) that best accounts for the explanatory force of the frameworks that are considered under Q1a? Are there multiple, equally adequate such ontologies? (Such a preferred account might be found among the already available metaphysical accounts of evolution, or might need to be formulated on the basis of available work on the metaphysics of evolution.)

Work on these questions will involve examining various proposals for generalizing or formalizing Darwinism that have been advanced in (theoretical) biology and in the philosophy of biology (here prominently Schurz 2011). Consider, for example, Fisher's fundamental theorem (Gayon 1998; Plutinsky 2006; Gardner 2017); the Price equation (Price 1995; Kerr & Godfrey-Smith 2009; Grafen 2002), Lewontin's (1970) "Darwin's Scheme", Adaptive Dynamics (Metz et al. 1996; Geritz et al. 2004), Replicator Dynamics (Nowak 2006), and Grafen's Formal Darwinism (Grafen 2009; 2014) as well as other attempts at formalizing evolution (Barberousse & Samadi 2015; Jagers op Akkerhuis 2016). All these are candidate "core Darwinisms" that could be exported from biology and applied elsewhere.

In addition, the project will consider the possible societal implications of the application of a generalized Darwinian theory in the social and economic sciences, by asking: (Q2) Can a formulation of the explanatory core of Darwinism be found that minimizes the risk of adverse implications for society and for human life of using Darwinian thinking in those areas?

The project thus encompasses epistemological, metaphysical, as well as "science and society" elements. While the project falls squarely within the field of philosophy of science, it is interdisciplinary in nature and integrates research in several fields of work, namely philosophy of biology (with respect to central concepts and the explanatory structure of evolutionary theory), general philosophy of science (with respect to accounts of scientific explanation), history of biology (with respect to the conceptual development of Darwinian thinking), theoretical biology (with respect to possible future developments in evolutionary thinking, e.g., the "Extended Evolutionary Synthesis"), and philosophy of the social sciences and economics (with respect to current attempts at applying evolutionary thinking in research in social science and economics). The project is aimed at yielding results that will be useful for biological science (conceptual clarification of its central theory with respect to its explanatory scope, and a proposal how Darwinism is best generalized) as well as for the philosophy of science (an analysis of how biological science is related to non-biological domains of investigation, more clarity regarding the unifying potential of evolutionary thinking in the sciences, contributions to the debate on the epistemology and metaphysics of evolutionary theory, a proposal for a basic ontology of evolutionary systems and evolutionary explanations, and more clarity about possible societal implications of applying evolutionary thinking outside biology).