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GENERALIZED DARWINISM AS MODEST UNIFICATION

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ABSTRACT

This paper examines the nature of Hodgson and Knudsen's version of Generalized Darwinism, asking to what extent it has explanatory force. The paper develops two criteria for potential explanatory transfer of theories between disciplines, and argues that Generalized Darwinism does not meet these. The paper proposes that Hodgson and Knudsen's version of Generalized Darwinism is best understood as a research program aimed at modest unificationism *sensu* Kitcher, that provides a heuristic perspective to guide research, but does not produce actual evolutionary explanations.

Introduction

There is a long tradition of applying evolutionary thinking outside the biological sciences, for instance in economics (with evolutionary economics tracing back to the late nineteenth century), epistemology, psychology, social science (with studies of cultural evolution tracing back as far as Darwin's work), and so on. Recent decades have witnessed a considerable increase in the number of programs in areas outside biology that attempt to understand phenomena in evolutionary terms. Numerous so-called "evolutionary" research programs have emerged in medicine, archaeology, history, literary studies, cosmology, electronics, computing and programming, robotics, and elsewhere (see, e.g., Heams et al. 2015, part 5). Many—though certainly not all—of these programs encompass attempts to expand the scope of *biological* evolutionary theory to new areas of application.

In part, these attempts at expansion constitute a promising development. Biological evolutionary theory is a powerful scientific theory that was devised to explain particular aspects of the living world (the organized complexity of organisms, clustered diversity, adaptation, and functionality). As similar phenomena occur outside the biological realm, the thought lies near that evolutionary theory might—at least partially—explain those phenomena too. The problem, however, is that we do not know a priori how broad exactly the scope of applicability of evolutionary theory is: it is not implausible that evolutionary theory is applicable in areas outside biology, but a priori it is not clear where exactly the theory can be applied and where it cannot. A problem with approaches like the ones mentioned above is that we usually do not know how to assess their potential for achieving understanding, explanation, and prediction, other than by judging their success with the benefit of hindsight. The only way to know whether evolutionary theory can be used to explain and predict the behavior of non-biological phenomena, it seems, is to develop evolutionary models and see whether these hold up in long-term studies of the phenomena under consideration, and generate explanations that in the end are accepted as good explanations by the relevant community of researchers. If the observed behavior does not fit the models, the reason lies near: the systems under study simply are too different from biological evolutionary systems for the theory to be applicable. But if it turns out that some success *is* achieved, several interesting philosophical questions arise.

For one, why is it that widely different kinds of phenomena in distinct areas of investigation can be covered by the same theory? In addition, does the fact that evolutionary models fit non-biological phenomena entail that full-fledged *evolutionary* explanations of the phenomena (i.e., explanations of the same kind as are generated in evolutionary biology) can be formulated? And if no full-fledged evolutionary explanations are in the offing, what *can* the approach in question achieve? These problems cannot be answered by empirical means or with hindsight, but must be addressed by examining the epistemological and ontological aspects of the case.

The present paper examines one such approach to applying evolutionary thinking outside biological science. In focus is the specific version of Generalized Darwinism (henceforth "GD_{HK}") that was developed by Hodgson, Knudsen, and co-authors from the early 2000s onward. As one of several emerging "evolutionary" programs outside the life sciences, GD_{HK} aims to facilitate the development of full-fledged evolutionary explanations of economic and social phenomena. My aim is to clarify the nature and the explanatory potential of GD_{HK}. While at first glance GD_{HK} looks like a straightforward case of using a scientific theory taken from one domain of science (evolutionary biology) to do explanatory work in other domains of investigation (economics and social science), I argue that this interpretation doesn't fit the program. I suggest instead that it is better understood as a minimalist Lakatosian research program with much more modest aims than the development of scientific explanations, transferring much less than the explanatory core of evolutionary theory and aimed at the modest unification (*sensu* Kitcher 1999) of a broad range of phenomena of adaptive change in natural and social populations.

I start by sketching the structure and central claims of GD_{HK}. I then formulate two criteria for potential explanatory transfer of scientific theories between distinct domains of investigation, drawing on work on interdisciplinarity. I then argue that GD_{HK} does not meet these criteria, and conclude by formulating a new account of the nature of GD_{HK}.

The Hodgson-Knudsen Version of Generalized Darwinism

The specific approach examined here is one among a considerable variety of approaches to applying evolutionary theory outside biology. The approach was devised by Geoffrey Hodgson in the context of evolutionary economics (Hodgson 2002; 2003; 2004; 2005) and later developed further into a more widely applicable framework in collaboration with Thorbjørn Knudsen and others (Hodgson and Knudsen 2006; 2008; 2010; Aldrich et al. 2008). Only later did GD_{HK} spread to the area of organization studies (Breslin 2008; 2011; Hodgson 2013; an early predecessor was Stoelhorst 2005) and evolutionary social science more generally.

Since its inception, GD_{HK} has been the subject of intense debate and criticism within the areas of evolutionary economics (e.g., Witt 2004; Buenstorf 2006; Cordes 2006; 2007; Levit et al. 2011; Schubert 2014) and philosophy of economics (e.g., Vromen 2004a; 2004b, 2012; Thomas 2018). More recently, philosophers of biology have begun to add to these criticisms (e.g., Callebaut 2011a; 2011b; Levit and Hoßfeld 2011; Scholz and Reydon 2013; Reydon and Scholz 2014; 2015). In the course of these debates, versions of generalized Darwinian theory were developed that attempted to avoid some of the problems confronted by Hodgson and Knudsen's original formulation (e.g., Stoelhorst 2005; 2008a; 2008b; Pelikan 2011; Tang 2017). While the debate focused on the applicability of Darwinian principles in economics, organization studies and social science more generally, the nature of GD_{HK} as a line of investigation and the specific way in which it employs evolutionary thinking in non-biological areas of investigation have remained under-analyzed. This paper focuses on these two latter issues.

GD_{HK} rests on the assumption that there exists a general category of processes—Darwinian evolutionary processes—that occur in various realms both in and outside the living world, in particular the domain of social institutions and organizations. While GD_{HK} recognizes that Darwinian processes occur in a large variety of manifestations, the assumption is that notwithstanding the differences in the details, all are instances of the same general process, such that all can be explained in the same way (Hodgson and Knudsen 2010, pp. 23, 26, 31). That is, there is "an assertion of common ontological features [that] involves a supposition that evolutionary processes at different levels are in some respects identical" (Hodgson 2003, p. 359; 2013, p. 978), such that a central part of GD_{HK} is to identify "some general ontological characteristics that must apply to all evolving systems" (Aldrich et al. 2008, p. 582). Based on this assumption of common ontological features between Darwinian processes/systems in different domains the features and behaviors of which are to be explained, the program aims to formulate a general evolutionary framework that allows researchers to devise full-fledged evolutionary explanations in any domain in which the relevant phenomena occur.

The program's core assumption has been welcomed as an "imaginative and bold theoretical conjecture" that still is in need of support and testing (Thomas 2018, p. 150). So far, however, GD_{HK}'s proponents have not shown that their assumption is correct, or even provided sufficient theoretical support to make it plausible (Scholz and Reydon 2013; Reydon and Scholz 2015). Much of the work in the program consists in the construction of selectionist accounts of social phenomena and the development of models based on GD_{HK}'s core assumption. This is problematic, because it is all too easy to construct selectionist narratives that *seem* explanatory but do not actually explain much (e.g., Gould and Lewontin 1979). Clarifying the explanatory potential of GD_{HK} thus is important, and characterizing the nature of GD_{HK} is a crucial part of this endeavor.

Before examining GD_{HK} in more detail, note that Generalized Darwinism should not be confused with Dawkins' (1983) Universal Darwinism. The principal claim of Universal Darwinism is that Darwinian evolution is a universal property of *living* systems, such that if life occurs anywhere in the universe it can be expected to evolve by Darwinian processes. This is different from GD_{HK}'s claim that Darwinian evolution also occurs in *non-living* systems. GD_{HK} is also disconnected from current attempts at developing biological evolutionary theory further by elaborating a so-called Extended Evolutionary Synthesis (Pigliucci and Müller 2010; Laland et al. 2015). The Extended Synthesis program is aimed at adding explanatory elements (niche construction theory, social learning as an inheritance system, epigenetics, and so on) to the current standard version of biological evolutionary theory, the Modern Synthesis. As such, it is concerned only with the further development of evolutionary theory *within biology*, not with applications outside biology.

Explanatory Theory Transfer

The preceding section sketched GD_{HK}'s aims and ontological core assumption. To analyze what, exactly, this core assumption encompasses and whether GD_{HK}'s attempts at explanatory theory transfer are likely to succeed, in this section I develop two criteria for potential theory transfer. To do so, I draw on work on interdisciplinarity.

In an exploration of various forms of interdisciplinary research, Mayntz (1992) distinguished a mode of interdisciplinarity which she called "borrowing" or "theory transfer," and that fits the case of GD_{HK} well. Borrowing does not usually involve the transfer of *entire* theories between disciplines (Mayntz 1992, p. 65), but rather "the transfer of methods, concepts, and theoretical models of another discipline" (Mayntz 1992, p. 28)—which I will call *theoretical content*. This can occur with varying degrees of strictness—as Mayntz explains:

> [t]heory transfer in a strict sense presupposes—and assumes—isomorphism *between the empirical phenomena to be described and explained* (i.e., a 1:1 relationship between the elements, properties, and relationships of interdependence in two phenomenal fields). Two substantive theories with an identical formal structure can thus be considered two different empirical applications of one underlying formal theory. Where the *ontological basis for the transfer of theories* (i.e., the basic isomorphism between the physical, organismic, and social worlds) is lacking, substantive borrowing is restricted but can still take place, for instance in the form of conceptual analogies. (1992, p. 30, emphasis added).

Substantive borrowing here encompasses the transfer of sufficient theoretical content such that explanations in the target domain (into which content is transferred) are possible using the same theoretical content that supports explanations in the source domain. At base, Mayntz' isomorphism criterion says that for substantive (i.e., explanatory) borrowing to be possible, the phenomena in the two domains should be the same in relevant respects. If they are not, then borrowing will be non-explanatory (but might still yield useful insights). At first sight, this seems plausible enough, but the criterion is insufficiently elaborated to be applicable in practice.

For one, requiring strict isomorphism between phenomena in different domains is overly restrictive, as strict isomorphisms often do not even exist between phenomena within the same domain of investigation. When it comes to evolutionary phenomena, for instance, an evolving bacterial population and an evolving population of oak trees certainly do not constitute isomorphic phenomena. Moreover, it remains unclear *in which respects* different phenomena should be isomorphic: is it sufficient that they are isomorphic in their coarse structure, allowing for large differences in the details? And how does one establish whether two distinct natural or social phenomena are isomorphic in the first place?

A better strategy is to rely on the notion of similarity instead of isomorphism, I suggest, and formulate the criterion for borrowing as the requirement that the phenomena under consideration in the involved domains must be sufficiently similar. I call this the *similarity of explananda* criterion. While it confronts similar questions as Mayntz' criterion, the advantage is that assessing similarities can be done in informal ways and more flexibly than assessing isomorphisms (we assess similarities all the time), whereas assessing isomorphisms requires an overarching, formal reference structure in which the phenomena can be represented (e.g., a representation of the phenomena as a graph of nodes and relations of interaction between them). Mayntz' mentioning a "1:1 relationship between the elements, properties, and relationships of interdependence in two phenomenal fields" (1992, p. 30) suggests that such a formal structure is what she had in mind.

Fleshing out the details of the criterion must involve establishing which similarities are important in individual cases, how large a degree of similarity is required, and how degrees of similarity can be assessed in practice. The answers to these questions will likely differ between cases, but two general points can be made. First, similarity of explananda can obtain at the epistemological or the ontological level. Epistemologically, there can be important similarities between our descriptions of the phenomena in the different domains—for example, different kinds of phenomena might be described by very similar sets of variables, equations, concepts, or narratives. The functional organization of organisms and social insect colonies, for example, can be described using similar concepts and narratives (to the extent that some authors have suggested that social insect colonies can be understood as "superorganisms"). But epistemological similarities suggest that underlying ontological similarities exist between the different phenomena: two phenomena can be described in similar ways because they consist of similar elements that are connected in similar ways. The *similarity of explananda* criterion thus has an epistemological and an ontological dimension, where the latter dimension is more fundamental such that the criterion at base is an ontological criterion (as Mayntz saw it too).

Furthermore, Mayntz' criterion entails a second criterion. Even if there are strong ontological similarities between explananda, this does not guarantee that they can be *explained* in the same way. Paley's (1802) famous analogy to support the existence of a designing deity is a case in point. Paley argued that the ontological similarities between mechanical watches and living organisms *as explananda* (both exhibit complex structure, composition of interdependent, functional parts, and overall functionality) indicated a similar explanation for both cases (in both cases, structure, composition, and functionality would be explained as due to a designer's actions). However, the explanations that apply in the different realms turned out to be very different. This means that an additional similarity criterion is required, which I call the *similarity of explanantia* criterion: in the same way as the phenomena under consideration must be sufficiently similar, the explanations must be sufficiently similar for borrowing to be potentially successful.

Formulated like this, though, the criterion is trivial. To render it non-trivial, I specify it in the following way: similarity of explanantia is the requirement that the explanations in the source and target domains are of the *same form*. Note that in the same way as the similarity of explananda criterion, the similarity of explanantia criterion has an epistemological and an ontological dimension. In the epistemological dimension, the criterion says that the explanations we give of phenomena in different domains should be of the same philosophical kind (e.g., deductive-nomological, causal, mechanistic, unificationist, how-possibly, etc.), and thus follow the same argumentative or narrative structure to connect explananda and explanantia. In the ontological dimension, the criterion says that the explanantia we provide should involve very similar ontologies—which can be interpreted as requiring that explanantia should refer to very similar (or the same) kinds of entities, kinds of properties, kinds of mechanisms, kinds of causal relations, and so on. Even though this formulation of the criterion is still quite coarse-grained, it should suffice to illustrate how the criterion can be made non-trivial.

While Mayntz only briefly discussed requirements for borrowing and only suggested isomorphism as the relevant criterion, building on her pioneering work it thus is possible to formulate two similarity criteria for explanatory theory transfer. Although the criteria are related, they are independently necessary for successful explanatory theory transfer (as satisfying the similarity of explananda criterion does not automatically imply that the similarity of explanantia criterion is satisfied). Note that I do *not* claim that they jointly are sufficient to establish that a case of borrowing *will* succeed in unfolding explanatory force. They should not be applied as strictly dichotomous criteria (that are either satisfied or not), but as criteria that can be satisfied in degrees, taking the degree to which they are satisfied as indicative of the explanatory potential of the research program under consideration. As such, they should be seen as conceptual/analytical tools that can be employed to achieve clarity about the explanatory potential of future attempts at explanatory borrowing, as well as clarity about the basis for success in cases in which a theory *is* successfully transferred. Having developed tools for my analysis, I now turn to examining the case of GD_{HK}.

Is Generalized Darwinism Explanatory Theory Transfer?

In what follows I argue that GD_{HK} is not likely to succeed in explanatory theory transfer, because it fails to meet the two criteria, developed above. As a first step, I examine what content is borrowed from biology.

Proponents of GD_{HK} deny that their program involves the straightforward transfer of a biological theory to the social sciences, or a reduction of the social sciences to biology (Hodgson 2002, p. 271; 2003, p. 368; Aldrich et al. 2008, pp. 578–579). Indeed, the program's aim is not to simply take biological evolutionary theory in its current form and extend it to the social and economic domain, nor is it the development of a detailed, general explanatory theory of evolution. Rather, the aim is a general, abstract framework built on the core principles of Darwinian evolution that can facilitate the formulation of separate, detailed explanations for concrete phenomena in various domains of the social/economic as well as the biological sciences—the aim is "to derive a powerful over-arching theoretical framework in which theorists can develop auxiliary, domain-specific explanations" (Aldrich et al. 2008, p. 578). But for GD_{HK} to achieve its aim of providing a framework that can facilitate domain-specific *evolutionary* explanations it must at the very least involve taking substantive explanatory content from Darwinian evolutionary theory. If less content is taken from biology than is minimally needed for constructing proper evolutionary explanations, it is hard to see how GD_{HK} could constitute a guide for the construction of domain-specific evolutionary explanations. The question, then, is what explanatory content GD_{HK} requires to serve as a framework for domain-specific evolutionary explanations.

The answer is not self-evident, because biological evolutionary theory is not available in the form of a stable package of univocally formulated core concepts, principles, equations, and so on, that constitutes the textbook version of the theory. Scientific theories often have a well-formulated core of concepts and principles (sometimes in the form of a set of equations) that remains largely stable as the theory is developed further—think of electromagnetic theory that centers around the four Maxwell equations. Evolutionary theory is different. The history of evolutionary theory since the publication of Darwin's and Wallace's works is a history of ongoing, considerable change (Reydon and Scholz 2015, p. 570). The different versions of the theory, such as Darwin's own theory, late nineteenth century Neo-Darwinism, the Modern Synthesis, and perhaps a future Extended Synthesis, differ considerably from one another, and prominent evolutionists have endorsed very different combinations of concepts and explanatory principles in their versions of the theory (Mayr 1985). Its core concepts (such as "species," "gene," "fitness," and "selection") are topics of ongoing debate and revision, core explanatory principles have been added and removed, and connections with other biological theories have been forged. Evolutionary theory simply is not available as a stable, unequivocally formulated explanatory package that could simply be transferred from biology to other areas of investigation.

Thus, proponents of GD_{HK} must decide what they consider to be the explanatory content of Darwinian evolutionary theory and on that basis construct their own version of evolutionary theory in such a way that it has sufficient explanatory content to be able to facilitate domain-specific evolutionary explanations. This is indeed what they attempt to do. Proponents of GD_{HK} take the three Darwinian principles of variation, inheritance, and differential reproduction (or retention) as the core of their evolutionary framework (e.g., Hodgson and Knudsen 2006, p. 16; 2010, pp. vii, 4–9, 18–19, 23, 26, 31–37; Hodgson 2013, p. 978; Thomas 2018, p. 153), and transfer these to other areas of investigation. As Hodgson and Knudsen (2006, p. 5; see 2010, p. 39) write: "the three core principles of variation, inheritance and selection have endured. They are prominent in the long, final paragraph of the *Origin* [. . .]. A generalized Darwinism essentially invokes the three core principles." Hodgson and Knudsen (2010, pp 23, 34) even call this the crucial step in GD_{HK}.

Although the authors refer to the principles of variation, inheritance, and selection, I believe they mean (and should have meant) the principles of variation, inheritance, and differential reproduction (Reydon and Scholz 2015, pp. 566–570). Biologists commonly accept these principles as constituting part of the core (but not the whole explanatory core) of biological evolutionary theory, but formulate the principles in slightly varying ways. The classical formulation is Lewontin's (1970), who conceived of these principles as together constituting the principle of evolution by natural selection. He pointed out that:

> generality of the principles of natural selection means that *any entities in nature* that have variation, reproduction, and heritability may evolve. [. . .] the principles can be applied equally to genes, organisms, populations, species, and at opposite ends of the scale, prebiotic molecules and ecosystems (Lewontin 1970, pp. 1–2; emphasis added).

Lewontin thus clearly suggests that the threefold schema is general and the occurrence of evolutionary processes is not intrinsically limited to a particular kind of material instantiation.

What is transferred, then, is not a rich evolutionary framework encompassing a variety of principles and concepts, but rather just the principle of natural selection encompassing (a variation on) Lewontin's three principles (Levit and Hoßfeld 2011). In addition, GD_{HK} uses the concepts of replicator and interactor as part of its ontological core (Hodgson and Knudsen 2010, pp. ix, 24, 61, 65, 85–88; Hodgson 2013, pp. 976, 979; Thomas 2018, p. 153). However, I do not consider this part of the content that is transferred from biology. While the replicator-interactor framework is a specification of the entities that realize natural selection (as they are the entities that vary, reproduce and realize inheritance), it was introduced by Dawkins (who used "vehicle" instead of "interactor"; 1976) as part of his gene-centered account of evolution. As such, it embodies an idiosyncratic view of evolution that is controversial among biologists. The replicator-interactor framework is not central in biological evolutionary theory, does not do much explanatory work in biology, and is largely ignored in evolutionary biology itself. Rather, it is part of the philosophical interpretation of evolutionary theory. For those reasons, and as its lack of epistemic power in GD_{HK} has been shown elsewhere (Thomas 2018, p. 163), I shall ignore the replicator-interactor framework here.

GD_{HK}, then, is not in fact a generalization of biological Darwinism or of biological evolutionary theory, but merely a generalization of the principle of natural selection. Hodgson and Knudsen acknowledge this, but still conceive of GD_{HK} as an "overarching theory"

(2010, p. 5) with explanatory force. Hodgson and Knudsen's writings are not fully clear on what they consider the explananda to be, but it is clear that they include the origins and diversity of social institutions, their varying capability for "survival," their adaptation to their respective environments, and so on. Does GD_{HK}, as a generalization of the principle of natural selection, have explanatory force with respect to these explananda? To achieve clarity on this issue, consider how proponents of GD_{HK} support their claim that the three Darwinian principles are applicable in the social and economic domains. They advance two main arguments, one of which pertains to the epistemology of Darwinism in biology and the other to the presupposed ontological underpinnings of the first argument.

First Argument: Intrinsic Potential for Theory Transfer

This argument rests on the observation that evolutionary processes in the living world differ considerably from each other in the details of how variation comes into being, how reproduction occurs, how selection takes place, etc. The living world is a highly diverse place, encompassing oak trees, slime molds, bacteria, birds, flatworms, and many other kinds of organisms, and evolution in different kinds of organisms occurs in very different ways. This means that *within* evolutionary biology to some extent theory transfer takes place:

> Not only do natural and social evolution differ greatly in their details, but also detailed mechanisms differ greatly *within* the biological world. Biological organisms differ enormously in size, lifespan and reproductive fertility. Some biological species are sexually differentiated, others not. Some biological species are social, others not. Replication among invertebrates is different from that among vertebrates. To say that two sets of phenomena are similar in highly general terms does not imply that they are similar in detailed respects. [. . .] Because the processes of selection and replication vary greatly in the biological domain, the general principles adduced from biological evolution turn out to apply to other complex phenomena as well. [. . .] The expression of the underlying core Darwinian principles of variation, inheritance and selection differ in important ways, yet the overarching general principles remain. (Aldrich et al. 2008, p. 580)

That is, notwithstanding the considerable differences between evolutionary phenomena in the living world, they are sufficiently similar to be susceptible to the same kind of explanations involving the same general principles. If constructing explanations by means of theory transfer is unproblematic for phenomena *within* biological science, the argument goes, it should be equally unproblematic for phenomena *between* the sciences, provided the phenomena under consideration are sufficiently similar. This notion of similarity is elaborated in a second, ontological, argument.

Second Argument: Ontological Commonality

Hodgson and Knudsen (2006, p. 16) write:

> As long as there is a population of replicating entities with varying capacities to survive, then Darwinian evolution will occur. Social evolution deals with populations of entities, including customs and social institutions that compete for scarce resources. Accordingly, we believe that social evolution is Darwinian. This is not essentially a matter of analogy; it is a partial description and analysis of reality. *Social evolution is Darwinian by virtue of (social) ontology*, not (biological) analogy. (emphasis added; see also Aldrich et al. 2008, p. 585)

The core of this argument is that both in the biological and social realms entities of a particular kind—populations of replicating entities with varying capacities to survive—are found that can instantiate evolutionary processes. This argument fleshes out the ontological details of the first, and together they yield the claim that the program "relies on the claim of common abstract features in both the social and the biological world; it is essentially a contention of a degree of *ontological communality*, at a high level of abstraction and not at the level of detail" (Aldrich et al. 2008, p. 579; also Hodgson and Knudsen 2006, pp. 14, 16).

There are several ways in which this argumentation can be reconstructed and I suggest a plausible reconstruction is as follows. The fact that very different instances of biological evolution can all be explained using the same general set of principles (i.e., the observation that within biology similarity of explananda indicates epistemological similarity of explanantia) is due to the fact that these instances are realized by systems of the same general kind (i.e., there is ontological similarity of explanantia within biology). The fact that those instances differ considerably in the way in which evolutionary processes occur shows that the kind consists of evolutionary phenomena that are similar in their general structure, but not in the details. This in turn suggests that there can be phenomena of the same general structure in non-biological areas of investigation, which will differ in the details from instances of biological evolution (i.e., similarity of explananda between biology and the social sciences). This in turn suggests that the explanations of the phenomena of this general kind should also be of the same general kind, involving the three principles of variation, reproduction, and inheritance (i.e., similarity of explanantia between biology and the social sciences). The argumentation thus starts from the similarity of explananda as well as explanantia within biology, takes this to indicate similarity of explananda between biology and the social sciences, and in turn takes this to imply similarity of explanantia between biology and the social sciences.

But this argumentation is problematic. As noted above, the fact that phenomena can be *described* in the same way does not necessarily entail that they can be *explained* in the same way. This is why I introduced the similarity of explanantia criterion as a criterion that must be satisfied independently from the similarity of explananda criterion. Proponents of GD_{HK}, however, fail to distinguish between these criteria and simply assume without further argumentation that within biology both are always satisfied simultaneously.

They are not, however. Many instances of evolution are not explained by means of the three principles—think of evolutionary change through genetic drift. There is an ongoing debate in biology between proponents of a Darwinian perspective and proponents of the neutral theory of molecular evolution (Kimura 1983) on the question how large a percentage of evolutionary phenomena can be explained by invoking the principle of natural selection. While the phenomena in question are considered to be of the same kind and can be described in largely similar ways (as change of gene frequencies in a population), some are explained by Darwinian selection and others by neutral drift, where the different forms of explanation work in different ways and invoke different causal factors.

Moreover, for cases that *can* be explained by Darwinian selection, the principle of natural selection by itself is not a sufficient basis for explanation. Biologists must invoke additional explanatory factors independent of selection to build evolutionary explanations of organismal functional organization, adaptedness, and diversity—most importantly, common descent, reproductive barriers (e.g., as causes of speciation), developmental entrenchment (as a cause of stabilization of traits over generations), and so on. Thus, *even if* we concede that similarity of explananda obtains both within biology and between biology and the economic and social sciences (which proponents of GD_{HK} have suggested, but not actually shown), this does not entail that similarity of explanantia obtains.

To strengthen their case, proponents of GD_{HK} (in their second argument) invoke an alleged ontological similarity of the systems that realize evolutionary processes. Their claim is that in biology as well as the economic and social sciences we find material systems of the same kind—populations of entities—that can instantiate evolutionary processes. But this, too, is a mere assumption. So far proponents of GD_{HK} have merely suggested—but not actually shown—that the required ontological similarity of explananda between biology and the social sciences actually obtains, and there are good reasons to doubt that it does (for details, see Scholz and Reydon 2013; Reydon and Scholz 2015). In this respect, the burden of proof is squarely on proponents of GD_{HK}.

Summarizing, GD_{HK} fails to meet the two criteria for explanatory theory transfer formulated above. In addition, GD_{HK} crucially rests on the assumption that *if* the similarity of explananda criterion is met, the similarity of explanantia criterion is automatically satisfied too, but leaves this assumption unsupported. This failure to meet necessary criteria means that GD_{HK} cannot be understood as a case of substantial borrowing in Mayntz' sense: it is doubtful whether GD_{HK} in fact transfers sufficient theoretical content between disciplines to achieve its aim of facilitating the formulation of full-blown Darwinian explanations. But how is GD_{HK} then best characterized—and what *can* it achieve?

Modest Unificationism

Lakatos' (1970) notion of research programs can help answer this question. I want to suggest that the three principles of GD_{HK} can be thought of as the "hard core" of a Lakatosian research program: they constitute a "negative heuristic" (Lakatos 1970, p. 133) for the development of domain-specific explanations in the sense that the validity of the principles is not questioned, as well as a "positive heuristic" (p. 132) by specifying core elements that any acceptable explanation of a particular kind of phenomena should minimally incorporate. However, GD_{HK} does not fit Lakatos' notion in several respects. Most importantly, GD_{HK} is not built around the idea of a sequence of theories that replace one another, where replacement is progressive if the replacing theory predicts new facts that are retrospectively corroborated (Lakatos 1970, p. 134). GD_{HK} simply focuses on a minimal set of three principles that allegedly is retained throughout revisions of evolutionary theory, and disregards all other aspects of the sequence of revisions of evolutionary theory. As such, GD_{HK} does not fit the framework of progressive or degenerative programs. Also, a "protective belt" around the program's "hard core" is missing—the "hard core" is simply kept unquestioned. Still, the heuristic roles of its core principles define a program for doing research on a particular kind of phenomena. Thus, I suggest that GD_{HK} can be understood as a Lakatosian research program, albeit a bare-bones program that only encompasses a heuristic.

At base, then, GD_{HK} encompasses a bare "hard core" that guides research, but is too meagre to ground actual evolutionary explanations. So, what can GD_{HK} achieve? One thing GD_{HK} could achieve—and aims for—is a unifying treatment of evolutionary phenomena in different domains (Hodgson and Knudsen 2010, p. 34). By aiming at an overarching framework that covers a variety of biological as well as non-biological phenomena and within which domain-specific explanations can be developed, GD_{HK} strives for unification. But what kind of unification can be achieved? To answer this question, I will briefly explore three modes of unification: reductionist unification, explanatory unification, and modest unification.

In their classic paper on the unity of science, Oppenheim and Putnam (1958) formulated three aspects of scientific unification. From the weaker to the stronger aspect, these are: unification of the theoretical vocabularies of the various disciplines by reducing these to the vocabulary of one fundamental discipline; unification of the laws of the various disciplines by reducing these to the laws of one fundamental discipline; and unification of the laws of the fundamental discipline. The third aspect clearly is not in focus here, as this pertains only to unification within one discipline. The two other aspects might play a role in GD_{HK}, as the program involves a partially unified vocabulary and the use of the three core Darwinian principles in different fields. However, unification is at most only partially realized, as GD_{HK} does not aim to unify entire vocabularies or entire sets of laws or principles. Moreover, while for Oppenheim and Putnam unification involves reduction, GD_{HK} merely claims that certain social phenomena are similar to biological phenomena without claiming that they are reducible to biological phenomena. Indeed, proponents of GD_{HK} emphatically reject the interpretation of their program as being reductionist (Aldrich et al. 2008, pp. 579, 592–593). GD_{HK}, then, falls far short of *reductionist unificationism sensu* Oppenheim and Putnam.

A mode of unification less strong than reductionist unification is *explanatory unification*, i.e., explanation of divergent phenomena by one and the same theory (Friedman 1974; Kitcher 1981; 1989). As highlighted, however, GD_{HK} does not aim to explain all evolutionary phenomena in the biological sciences, the social sciences and elsewhere with one single theory. The aim is weaker, and merely involves deploying the three principles of natural selection to construct domain-specific explanations. But such explanations need more components than just the three principles to actually do explanatory work. GD_{HK} thus also falls short of instantiating explanatory unificationism in any strong sense.

But there is a weaker interpretation of explanatory unificationism that might constitute a feasible way to understand GD_{HK}. Kitcher proposed a *modest unificationism* in the sense of "a *regulative ideal*, the ideal of finding as much unity as we can by discovering *perspectives* from which we can fit a large number of apparently disparate empirical results into a small number of *schemata*" (Kitcher 1999, p. 339; emphasis added). This seems precisely what GD_{HK} aims at: to provide a perspective or schema into which apparently disparate phenomena studied by distinct disciplines can be fitted and that provides a heuristic to guide the explanation of the phenomena under study. I suggest that GD_{HK} can be interpreted as a modestly unificatory research program that provides the following regulative ideal: the three principles of selection have proven to provide unity in biology, and striving for unification of phenomena is a virtue, so there is potential in trying to bring more phenomena into the fold. This is a long way from doing explanatory work, but it does provide guidance.

Conclusion

In sum, GD_{HK} is not a research program with explanatory force. Even if proponents of GD_{HK} succeed in showing that the similarity of explananda criterion is satisfied, this does not imply that the similarity of explanantia criterion is satisfied too. GD_{HK} confronts Paley's problem: phenomena that look strikingly similar can be produced by very different causes. But GD_{HK} can avoid this problem by conceiving of itself as a program that uses biological Darwinism as a guideline—in the specific Lakatosian sense of a positive and negative heuristic—that provides a unificatory perspective for research in disciplines outside biology.

Other authors have suggested interpretations of GD_{HK} that might be seen as similar to the view developed here. Vromen (2004a, pp. 225–226), for example, argued that GD_{HK} can be seen as offering a rudimentary explanatory scheme that can serve as a heuristic for research by identifying "elementary explanantia" (Vromen 2004a, p.

226). According to Vromen, GD_{HK} involves a move from highlighting a specific category of explananda in the economic domain to highlighting a particular category of explanantia—which is an understanding similar to my reconstruction (above) of how proponents of GD_{HK} argue. However, I think Vromen too easily allows GD_{HK} explanatory force. While Vromen does not clarify what "elementary explanantia" are, it is clear that he is willing to accept GD_{HK}'s claim that the three Darwinian principles constitute an explanatory core of the program. I have argued, however, that because of its minimalism GD_{HK} is unable to facilitate full-fledged evolutionary explanations of the phenomena under study and thus cannot be understood as an explanatory research program. Instead of a view of GD_{HK} as an explanatory research program (as Vromen suggests), I have offered a view of GD_{HK} as a program with much more modest aims.

Stoelhorst (2008b) pointed out that while GD_{HK} proposes that the three Darwinian principles can do explanatory work in economics, its proponents failed to specify what, exactly, the explananda are that the principles can explain. He suggests that if we take the explananda to be "how open, complex systems become adapted to their environments, how variety evolves from common origins, and how design accumulates over time" (2008b, p. 358), the three principles are both necessary and sufficient as explanantia. While I agree with his characterization of GD_{HK}'s explananda, I disagree that the three principles are sufficient as explanantia. As I argued, Darwin's three principles together only provide conditions for selection to occur. But selection alone does not explain the origins of adaptation, variation, and functionality (or, "good design"). To explain these phenomena, additional principles, such as common descent, trait correlation between parents and offspring, etc. are required. This is why I characterize GD_{HK} as a bare-bones research program: it merely highlights one key ingredient of evolutionary explanations (and unifies phenomena by using this ingredient as a perspective from which they can be analyzed), but it misses out on other key ingredients of evolutionary explanations. Thus, Stoelhorst too sees too much explanatory power in the Darwinian principles by themselves.

Thomas (2018) is less optimistic and (following an argument that I developed elsewhere—see Reydon and Scholz 2014) does not grant GD_{HK} explanatory power. He instead proposes a view of GD_{HK} as a version of evolutionary epistemology with routines instead of organizations as the central entities in the evolutionary process (i.e., with routines rather than organizations being subjected to selection). While Thomas in part builds on earlier work by Reydon and Scholz, it should be pointed out that he reaches a very different view of GD_{HK} than I do.

Proponents of GD_{HK} should welcome the characterization of their program as a modestly unificationist research program. On this characterization, the three principles constitute a perspective from which a variety of phenomena can be understood with a common guiding heuristic. How good a guide this heuristic is, remains to be shown in practice, but the view presented here strengthens GD_{HK}'s claim of being a research program with scientific potential, and it shows what that potential consists in. In addition, the similarity of explananda and similarity of explanantia criteria can show GD_{HK} the way forward by specifying what the program's proponents must do to enhance its potential.

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NOTES

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