Underqualified – Maximal Generality in Darwinian Explanation: A Response to Matt Gers

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ABSTRACT

Matt Gers (2011) provides a positive and constructive view of the project to generalise Darwinian principles in Geoffrey Hodgson and Thorbjørn Knudsen's *Darwin's Conjecture.* We note considerable overlap with his work and ours, and also with important recent work of Peter Godfrey-Smith (2009), which Gers cites extensively. But we also note that there are differences in research objectives between Gers and Godfrey-Smith, on the one hand, and ourselves, on the other. Gers and Godfrey-Smith focus on the elucidation of the most general principles possible. Our aim is to derive principles that are sufficiently abstract to span the natural and human social worlds, and then add additional principles to help understand the Darwinian evolution of human society. Furthermore, Gers and Godfrey-Smith critique a replicator concept that is different from ours. Once these points are made apparent, the criticisms are essentially disabled, and we end up in a position with different but complementary and overlapping research projects.

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We are very grateful to Matt Gers (2011) for his thoughtful and generous review published in this journal of our book *Darwin's Conjecture* (Hodgson and Knudsen 2010).[1] His account emphasizes the importance of fusing Darwinian theory with social science. Gers also offers a useful comparison between our framework and Peter Godfrey-Smith's (2009) generalized account of natural selection. He proposes a synthesis of the two approaches, where Godfrey-Smith's notion of reproduction is used as a basis for gradation of inheritance mechanisms.

At the same time, and much inspired by Godfrey-Smith (2009), Gers is critical of both the replicator concept in general and our concept of 'generative replicator' in particular. Gers follows Godfrey-Smith's argument that the replicator concept is insufficiently general to embrace all evolutionary processes, especially before the existence of replicators such as DNA. By this standard, 'generative replication' is also insufficiently general; it is 'overqualified' as Gers wittily puts it. In pursuit of such generality, Gers adopts Godfrey-Smith's concept of 'reproducer'. In contrast to our own view, Gers argues that physical constructs such as bicycles are reproducers, as we can observe their lineages and evolution through time. He argues that our concentration on habits, customs and routines is too narrow, and the class of 'reproducers' in social evolution is much greater.

In responding to these criticisms we wish to emphasize our agreements and point to some surmountable disagreements. There is a great deal of common ground between Gers, Godfrey-Smith and us. Gers is very positive about our book and our aim is not to confront but to enable further progress by enhancing mutual understanding and clarity. To a great extent, Godfrey-Smith's account of generalized Darwinism and our own are also convergent. This is a remarkable development, and quite encouraging for the project of advancing a unified, general framework to analyze evolutionary processes in all relevant domains. We emphasise this convergence later below.

In the following section we outline the ways in which our analytical objectives partly overlap and partly diverge. In the next section we argue that the replicator concept that is the object of criticism by Gers and Godfrey-Smith is not ours, and that our notion of replication is invulnerable to their critique, especially when differences in analytical objective are also taken into account. The third section considers the relationship between replication and

[1] We are also indebted to Jack Vromen for insightful comments on an earlier version of this response.

selection and establishes some common ground with our critics. The fourth section concludes this rejoinder.

Differences in Objectives

Part of the criticism and discord results from that fact that Gers and Godfrey-Smith are pursuing a research question that is slightly but significantly different from ours. We are all involved with the abstraction and generalisation of the core principles of Darwinian theory, but there are differences in our other objectives. For Gers and Godfrey-Smith the key question is the extraction of Darwinian principles that are as general as possible. Indeed, Godfrey-Smith (2009, ch. 8) goes further to consider types of populational and evolutionary processes that are not 'Darwinian' by his definition. He differentiates between different shades of Darwinian populations and between these shades of Darwinian populations and non-Darwinian populations. His approach is so general that Darwinian evolution is a special case.

Once we are on the road to such a highly generalised destination then it is clear that the concepts of both replicator in general, and by implication our more narrow concept of generalised replicator, must be ditched along the way. This is because replicators themselves must have sometime evolved, and there must have been evolutionary change of some kind before replicators (Maynard Smith and Szathmáry 1995, Okasha 2006). We acknowledge this point (Hodgson and Knudsen 2010, pp. 213, 215). We entirely agree with Gers that 'generative replicators themselves must evolve out of simpler components.'

But contrary to Gers, we do not limit the 'Darwinian' appellation solely to evolving systems where there are replicators. Also contrary to Gers, we do not 'argue that replicators are necessary to sustain an evolutionary process'. For us, 'evolution' is a vague and broad word, and it would be inappropriate and unwarranted to confine its meaning in this way (Hodgson and Knudsen 2010, pp. 30-31). Replicators, as typically defined, are of limited generality, and generative replicators are even more special. They cannot fit in an ultra-general conceptual framework.

We too are concerned with general principles, but in making the claim (which we share with Gers and Godfrey-Smith) that social evolution is Darwinian, we are interested in establishing principles and concepts of sufficient but not maximal generality. The principles and concepts must be sufficiently general to span the key common features of biological and social evolution, but they need not encompass any conceivable definition of evolutionary processes (and implied phenomena) in these domains.

We argue that both replicators in general and generative replicators in particular (as we define them) are found in both domains. But we also fully admit that Godfrey-Smith's more broadly defined 'reproducers' are also found in both domains. We are especially interested in replicators and generative replicators because we ask additional questions concerning particular evolutionary processes.

One of the puzzles that emerge from the comparison of biological with social evolution is the very rapid growth of complex social institutions and technologies in the last few thousand years. This is a very short time span in relation to the millions of years of evolution of the human species. We seek out the conditions and basic mechanisms that enhance the potential for complexity in evolving systems (Hodgson and Knudsen 2008, 2010). Our contention is that this capacity is related to generative replication. Generative replicators embody program-like information to guide the development of the entity that hosts the replicator. We show that a condition for the increase of the potential for complexity is the minimisation of copying error in the replication of these programs.

We argue that generative replication is a necessary condition for the evolution of structures that are potentially unbounded in complexity. Even if only a few Darwinian replicators (or reproducers) have evolved to become generative replicators, we believe that they are particularly important to identify. Genes are paradigm examples of generative replicators in nature. They are rightly thought to be particularly important for evolutionary processes in the biological domain. This is not to say that biologists ignore other kinds of adaptive change in nature. For reasons that are similar to those that made biologists enthusiastic about genes and DNA, we point to the existence of generative replicators in the social domain.

But we do not imply that other kinds of adaptive change are unimportant. Indeed, many forms of adaptive change in the social domain are instances of replication (or reproduction) processes that are weaker or less well understood than generative replication. Even so, we believe that it is of great value to understand the possibility of generative replication, so that it can be identified through empirical research. We believe that the theoretical possibility of generative replication is particularly important because it helps understand the processes that have advanced cultural complexity to such an enormous degree.

Our identification of generative replication in increasing the potential for complexity is aligned with a further objective, which is to build 'middle-range theory' that has empirical and practical implications. This is a long way from the Godfrey-Smith objective of maximal conceptual generality. By contrast, we aim to identify specific types of mechanism that may begin to have middle-range theoretical and practical implications.

In sum, Gers is right to say that 'the replicator approach limits the generality of this account'. But limiting generality is the price of descending to middle-range theory and developing practical applications. The pursuit of generality is important and we acknowledge the great achievement of Godfrey-Smith (2009) in this direction. But all attempts at generality are within the context of a restricted ontological specification. Godfrey-Smith assumes populations, for example. The pursuit of absolute theoretical generality, applicable to all ontological possibilities, at best would yield very limited results. The grand 'theory of everything' is a chimera.

The tension between generality and specificity is a familiar dilemma in social science (Hodgson 2001). In 1904, Max Weber (1949, pp. 72-80) wrote that 'the most general laws' are 'the least valuable' because 'the more comprehensive their scope' the more they 'lead away' from the task of explaining the particular phenomenon in question. This argument is similar to the philosopher Ernest Nagel's (1961, p. 575) 'principle of the inverse variation of extension with intension'. This principle alleges that there is a trade-off between the generality and the informative content and practical application of a theory. Our contention is that both general and specific theories have a place in the study of complex phenomena, and a key problem is building conceptual ladders between different levels of analysis.

Different depictions of the replicator

Despite the forensic efforts of Godfrey-Smith (2000), Sterelny et al. (1996) and others, the replicator concept has become mangled in some accounts. Despite our use of ideas from Godfrey-Smith (2000), it is clear that when Gers (2011) and Godfrey Smith (2009) refer to replicators they have something quite different in mind from us.

Godfrey-Smith (2009, p. 5) describes the replicator as 'anything that makes copies of itself.' This is a commonplace formulation but it is misleading. It is also striking that his critique of the replicator concept, and indeed his entire treatise, make minimal reference to the twin concept of an interactor (Hull 1988). It is misleading to describe a replicator as a 'thing', at least without careful qualification, because the interactor is the entity that contains the replicator. The replicator is an information-retaining and copiable mechanism, hosted by the entity of the interactor. Crudely, the interactor is a type of 'thing' and the replicator is a type of information mechanism within it. Treating the replicator as an informational mechanism (rather than an entity), which is associated with an interactor, dispenses with some of the problems identified by Godfrey-Smith.

Our insistence on the informational character of replicators is also in line with other recent interpretations (Beinhocker 2011). This conceptual foundation then serves as a basis to understand the transmission of knowledge in human society and the evolution of different levels of information transition (Hodgson and Knudsen 2010, ch. 8).

In our formulation, replicators do not make copies of themselves, at least independently of informational and other inputs. Their reproduction, both in nature and human society, is entirely dependent on contextual conditions. The language of 'self-reproduction', especially with replicators as 'entities' or 'things', is both flawed and misleading. Our definitions circumvent these problems.

Gers wishes to cast the net so widely that he describes collections of bicycles and other entities as possible 'evolving populations'. According to him, the 'evolution of bicycles from 1800 to 2000 seems to fit very well with a macro-evolutionary model of adaptive radiation.' It is true that we can trace lineages in bicycle design. And from the high level of abstraction achieved by Godfrey-Smith (2009) it is neither necessary nor possible to identify mechanisms of reproduction to describe these lineages.

But we also need to consider lower levels of abstraction, and from these vantage points it becomes obvious that there is a fundamental difference between technological entities such as bicycles and natural organisms such as beavers or bacteria. Gather together a small population of bicycles, even taking care to mix male and female versions, and watch them. Feed them with oil and polish them with care. Sadly they will fail to reproduce, and they will eventually rust or wither away. This would not be the case with natural organisms in comparable circumstances.

The fact that we do not need to know about the mechanisms of reproduction at one level of abstraction does not mean that we do not need to know about these mechanisms at all. When we link the framework of generalised Darwinism with specific socio-economic phenomena it is vital at some stage to understand such mechanisms. Correspondingly, evolutionary biology made huge leaps when the structure and mode of replication of DNA was discovered.

The evolution of technology is very important in human society. For that reason we need to know the mechanisms involved. For us, 'technology is part of a social system, and if we place it in this social context we can identify its replicators. Technology involves relations between a group of individuals who share knowledge about the employment and usefulness of particular devices … clusters of social relations and human-artefact relations are the relevant replicators' (Hodgson and Knudsen 2010, p. 144).

Gers closely follows Godfrey-Smith who prefers the notion of reproduction to replication. Godfrey-Smith (2009, p. 34) notes that thinking about types (rather than continuous distributions) is often integral to replicator analysis. He also asserts that the replicator view is often expressed in a way that assumes that replication is asexual. Our version of replicator analysis avoids both of these problems. First, our use of the notion of replicators includes the possibility that they are points in a continuous distribution. Second, we explicitly include sexual reproduction as an instance of replication.

While Godfrey-Smith (2009) prefers the notion of reproduction to replication, our approach is different. We seek to clarify the concept of replication and refine its definition. This has led us to define two notions of replication. First, in the literature a broad definition of replication and replicators has emerged, with attributes of causality, similarity, and information transfer. This notion of replication is convergent with Godfrey-Smith's (2009) notion of reproduction. It is also consistent with the claim of Eörs Szathmáry and John Maynard Smith (1997) that there are gradations or degrees of replication.

Second, we define a more potent and narrow version of replication. This is the concept of generative replication, which excludes nests, burrows, prions, photocopying and a good deal of cultural processes that are broadly evolutionary. To the triple conditions of causality, similarity, and information transfer, we add a fourth condition that defines a generative replicator as including a 'conditional generative mechanism' or program that can turn input signals from an environment into developmental instructions. The special case of generative replication has the potential to enhance complexity, which, in turn, requires that developmental instructions are part of the information that is transmitted in replication.

Selection and replication

The mathematical basis for Godfrey-Smith's (2009) generalized account of natural selection, and the one presented in *Darwin's Conjecture* are identical. Both accounts are anchored in exactly the same formal representation of selection processes, namely the approach originally developed by George Price (1995). Following Price, we acknowledge two concepts of selection. One involves the selection of a subset of elements from a set. Examples include the selection of a subset of chickens that survive an attack by a fox and the selection of a subset of firms that survive an industry shakeout. Price (1995) termed this subset selection. It is very different from the concept of successor selection where offspring are not subsets of parents. Successor selection involves replication, whereas subset selection is a simple elimination process. The term successor selection is ours; Price (1995, p. 390) referred to this form of selection as 'Darwinian selection'.

Subset selection is defined as selection through one cycle of environmental interaction and elimination of entities in a population structured in such a way that the environmental interaction causes elimination to be differential. Each cycle of subset selection eliminates some variation. Many natural and social processes involve subset selection. Molecules, cells, plants, moths, reindeer, and tigers are biological populations whose properties are altered by subset selection. Hard winters, hot summers, and various natural catastrophes commonly eliminate organisms. Similarly, firms and institutions are social populations whose properties are altered by subset selection, for example through bankruptcy. All of these processes involve adaptive change that is in some sense evolutionary. But the explanation does not account for the generation of new variation as an integral part of the selection process.

We define Darwinian evolution as a process involving repeated cycles of successor selection. The generation of novelty is integral to this process. New variation is generated because replication is imperfect or because it involves novel combinations of existing variants. Empirical studies of cultural evolution have documented processes of adaptive change. We believe it is time to take further strides towards a complete understanding of such processes. In that regard, we believe it is of great value to understand the possibility of successor selection, so that it can be identified through empirical research. But this is *not* to say that the study of weaker, more rudimentary or less well understood forms of adaptive change is unimportant.

We include subset selection in our account of general principles of evolution and find it uncontroversial that subset selection is associated with adaptive change. There is no replication involved, only faithful reproduction, or enduring identity. This move allows us to include adaptive processes in culture that are only Darwinian in a weak sense. We do *not* spend many pages elaborating this point because we find it fairly obvious – it is much more exciting to us that we have discovered a principle of replication that can lead to increases in social complexity. But we do note (Hodgson and Knudsen 2010, p. 108) that the empirical study of selection dynamics in the social world does not require knowledge about the mechanism by which the members in a population replicate (or reproduce). In that regard, we explain how the Price equation provides a useful means of empirical verification of possible selection effects in a population of interest. We also note (Hodgson and Knudsen 2010, p. 110) that it is possible to use the Price equation on trait frequencies (the fraction of a population with a particular trait), rather than trait values.

We should probably have elaborated on these observations and the way they admit a gradation between weaker and stronger forms of selection. This implication from Gers' review is well taken. But it is not entirely correct when he writes that we insist 'that replication is necessary for evolution by natural selection'. Subset selection can be natural and it need not involve replication. Gers is also wrong to suggest that we require that selection processes have 'the potential to increase complexity'. We include subset selection as an instance of the general principle of selection, but subset selection can in no way increase complexity. The basis for these misunderstandings may in part be related to our emphasis on generative replication as a central building block for theories of cultural evolution. But they also seem to reflect some of Godfrey-Smith's views on replication, rather than those we develop in the book.

Conclusion

We have spared the reader many details in showing how our framework of generalized Darwinism is convergent with Godfrey Smith's. Both of these frameworks are anchored in the same formal description of selection processes, and we have explained the basis for a unified treatment. Apart from issues related to marketing, we do not see any great difficulty in aligning our replicator analysis with Godfrey Smith's concept of reproducers. What we have to offer is a systematic treatment of evolution in a social context. At one pole, our approach includes weaker forms of adaptive change. At the other, we are able to identify conditions that characterize evolutionary processes with the potential to increase complexity. Since cultural evolution is characterized by enormous gains in complexity, we see great promise in this approach. As social scientists, one of our aims is to make Darwinism operational in this domain, rather than to pursue maximal generality for its own sake.

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