Studies in History and Philosophy of Biological and Biomedical Sciences 57 (2016) 71–79

Contents lists available at ScienceDirect

Studies in History and Philosophy of Biological and Biomedical Sciences

journal homepage: www.elsevier.com/locate/shpsc

The Principle of Stasis: Why drift is not a Zero-Cause Law

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A R T I C L E I N F O

Article history:
Received 27 July 2015
Received in revised form
7 April 2016

Keywords:
Evolutionary forces
Drift
Zero-Cause Law
Principle of Stasis
Newtonian analogy

A B S T R A C T

This paper analyses the structure of evolutionary theory as a quasi-Newtonian theory and the need to establish a Zero-Cause Law. Several authors have postulated that the special character of drift is because it is the default behaviour or Zero-Cause Law of evolutionary systems, where change and not stasis is the normal state of them. For these authors, drift would be a Zero-Cause Law, the default behaviour and therefore a constituent assumption impossible to change without changing the system. I defend that drift's causal and explanatory power prevents it from being considered as a Zero-Cause Law. Instead, I propose that the default behaviour of evolutionary systems is what I call the Principle of Stasis, which posits that an evolutionary system where there is no selection, drift, mutation, migration, etc., and therefore no difference-maker, will not undergo any change (it will remain in stasis).

> *Eliminate all other factors, and the one which remains must be the truth.*
>
> Sherlock Holmes, in Arthur Conan Doyle's The Sign of the Four

1. Introduction

Since Darwin's times, through the authors who constructed and moulded the Modern Synthesis, until our current days, evolutionary theory has been conceptualized as a causal theory. Darwin considered natural selection as a *vera causa* (Gould, 2002) and the causal-talk has been pervasive in all authors after him. In order to emphasize this causal view, textbooks and most of the evolutionary literature talk about *evolutionary forces* acting on a population. In that way, Gillespie says: "Population geneticists spend most of their time doing one of two things: describing the genetic structure of populations or theorizing on the evolutionary forces acting on populations" (2004, p. 1). Similarly, we can find chapters entitled "Interactions of Natural Selection with other evolutionary forces" (Templeton, 2006, chapter 12) or the vector representation of different forces (Rice, 2004, chapter 5). The analogy with Newtonian mechanics has been successful in both mathematical modeling and the structuring of evolutionary theory. The analogy was proposed by Elliott Sober (1984) as follows:

> All possible causes of evolution may be characterized in terms of their "biasing effects". Selection may transform gene frequencies, but so may mutation and migration. (…) All this is merely to locate evolutionary theory in a familiar territory: it is a theory of forces (Sober, 1984, p. 31).

Sober argues that evolutionary theory is a theory of forces because, in the same way that different forces of Newtonian mechanics cause changes in the movement of bodies, evolutionary forces cause changes in gene and/or genotype frequencies. As a result, selection, drift, mutation and migration would be the main forces or causes of evolution.[1]

Nevertheless, the appropriateness of the causal view, and particularly the Newtonian analogy, has been challenged in the last decade. Several authors (Matthen & Ariew, 2002, 2009, Pigliucci & Kaplan, 2006; Walsh, Lewens, & Ariew, 2002; Walsh, 2007, 2010) have argued for a new view, the *statistical view*, where the

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[1] These vary in number, sometimes introducing other factors such as recombination, population structure, etc., but the four above are canonical. It is not my aim to elaborate a complete list here.

http://dx.doi.org/10.1016/j.shpsc.2016.04.001
1369-8486/

evolutionary process and its parts (selection, drift, etc.) are mere statistical outcomes, inseparable from each other. The so called *evolutionary forces* should be conceptualized as statistical population-level tendencies, abandoning any causal role for them. Inside the causal view of evolutionary theory, its advocates have taken two different ways in order to response to this challenge: to strengthen the force interpretation (Filler, 2009; Hitchcock & Velasco, 2014; Pence, 2016; Shapiro & Sober, 2007; Stephens, 2004; 2010) or elaborate a causal view not committed to the Newtonian analogy (Brandon & Ramsey, 2007; Gildenhuys, 2009; 2014; Millstein, 2006; Millstein, Skipper, & Dietrich, 2009; Reisman & Forber, 2005; Rosenberg & Bouchard, 2005; Sarkar, 2011). Authors committed to the Newtonian analogy capture the common theoretical structure between evolutionary theory and Newtonian mechanics. On the other hand, causalists not committed to the Newtonian analogy share statisticalists' concern about some important problems in the force interpretation (the most important being the mismatch in the analogy produced by the lack of directionality of genetic drift).

In this article, I argue for a third way to defend the causal view. The aim of the force interpretation was to expose the causal structure of the theory. This is what Maudlin (2004) calls "quasi-Newtonian" theories. These are characterized by shaping them into a similar form to Newtonian mechanics whose main axis is the adoption of a default behaviour which tells us how the system would behave if external factors were not acting on it. I call Zero-Cause Law (henceforth ZCL) this default behaviour. The main purpose of building quasi-Newtonian theories is to identify the causes that affect a particular system. That is why the ZCL is necessary. The question about the proper ZCL of evolutionary systems has been implicit in the vast majority of discussions between causalists and statisticalists but never has the concept been made explicit, only a narrow sense of the ZCL such as zero-force law has been used.

In this paper, I argue that the main point in the debate about the structure of evolutionary theory as a quasi-Newtonian theory is the establishment of a ZCL. Some authors agree to give drift such a role. I offer a critical analysis of the role played by drift within the structure of evolutionary theory. I defend that (i) theoretical and empirical reasons reject this claim; and (ii) drift's causal and explanatory power (for instance, in the increasing of eukaryotes' genome size) prevents us from considering it as a ZCL, because it does not correspond to the features of ZCLs.

The structure of the paper is as follows. Section 2 explains in detail the features of ZCLs and the causal account adopted in this paper. Section 3 analyses the points of view of some authors who attribute a special character to drift. They envisage drift as the ZCL of evolutionary systems, where change and not stasis is the default behaviour of them. Section 4 explains why drift does not work as a ZCL. Section 5 develops what I consider to be the proper ZCL in evolutionary theory which I call "The Principle of Stasis". Section 6 concludes.

2. Zero-Cause Law's properties and causality

The force interpretation was proposed to help identify evolutionary causes. Nevertheless not all causes are forces. Situations like "She has lung cancer because she smokes", "Sherlock Holmes died because Moriarty poisoned him", or "I came late to work because my car broke down", are conceptualized as causal claims but they are not forces in a Newtonian sense —they are not represented, for example, as vectors with magnitude and direction. When we say that smoking causes lung cancer, we are saying that smoking makes a difference (for example that the probability of cancer is greater if you smokes than it is if you do not). I argue for a difference-making account of causation (Menzies, 2004). According to this approach, then, a cause is conceptualized as a *difference-maker*, disturbing the normal behaviour of the system. In other words, a cause is "what makes the difference in relation to some assumed background or causal field" (Mackie, 1980, p. xi). The system is defined by a number of background conditions, and among these conditions the ZCL tells us how the system behaves before the intervention of external factors, what the *normal course* of the system is like. Some authors (Brandon, 2006; 2010, McShea & Brandon, 2010) call a *default state* the normal course of the system. However, I think that *default behaviour* is preferable because a default state of a system is shaped not only by the ZCL, but also by other default settings or background conditions —for example in Newtonian mechanics the default state, before forces are included in the system, encompasses notions like absolute space, absolute time or the law of inertia, but the only ZCL is the law of inertia. Thus, difference-making factors "are seen as intrusions into the system that account for the deviation from the normal course of events" (Menzies, 2004, p. 170). How to elaborate a particular system is crucial but, at the same time, it is tied to a context-relativity in the sense of relativity to the "context of inquiry" and the "context of occurrence"[2] (where this not only depends on our why-questions but also on our instrumental capacity, data availability, historical moment, computing capacity, etc., but these obstacles never stopped scientific research). The same fact can be explained in different ways depending on our "why-questions", which depends on our research field, and that is why causal statements are relative to certain contextual parameters.

This kind of theorizing is found in Population Genetics textbooks by, firstly, establishing the background conditions of the system and, secondly, by introducing factors against this background. Evolutionary theory usually takes for granted the Hardy-Weinberg law (henceforth H-W law) (Gillespie, 2004; Sober, 1984; Templeton, 2006) as its ZCL counterpart. According to the H-W law a diploid and ideal infinite population, where there is random mating (panmictic population) and whose individuals are viable and fertile, will remain or return to equilibrium (i.e. gene and genotype frequencies will remain stable) if no external factor acts on it. The best historical example following this way of theorizing is Newtonian mechanics (Maudlin, 2004; Menzies, 2004) —that is why Maudlin call them quasi-Newtonian theories and, very likely, the reason for the rise in force-talk. Thus, the first law of Newtonian mechanics functions to establish that every body continues in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed upon it (Newton, 1846 [1687]). Thus, both the law of inertia as well as the H-W law, tell us how the system would behave if nothing disturbed it, and so assuring a neutral substrate where we can introduce external factors (i.e. causes). In addition, both laws are idealizations because there are always forces applying on real objects and some H-W conditions are always violated in real populations (Gouvêa, 2015; Toulmin, 1961).

Since Sober proposed the Newtonian analogy, this default behaviour has been called *zero-force law* until now. Nevertheless, it is easy to see that the zero-force law is a special case of ZCL: it tell us how the system behaves if there is no difference-maker acting on it,

[2] In Menzies words: "One form of relativity might be called relativity to the context of occurrence. If a forest is destroyed by fire, the presence of oxygen would be cited as a mere condition of the forest's destruction. On the other hand, if a fire breaks out in a laboratory where oxygen is deliberately excluded, it may be appropriate to cite the presence of oxygen as a cause of the fire. The second form of relativity might be called relativity to the context of enquiry. For example, the cause of a great famine in India may be identified by an Indian farmer as the drought, but the World Food Authority may identify the Indian government's failure to build up reserves as the cause, and the drought as a mere condition" (Menzies, 2014).