

Book review

Rui Diogo. 2017. *Evolution Driven by Organismal Behavior: A Unifying View of Life, Function, Form, Mismatches and Trends*. Springer. 252 pages.

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Received: 25 July 2017 / Accepted: 28 July 2017 / Published online: 9 August 2017
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‘*Form is both plastic and robust*’ (Diogo 2017, p. 165)

Although most students of morphology and evolution would agree with the statement above, it represents a fundamental conundrum. As currently understood, explaining it requires a suite of concepts that is part of an expanded (or new) version of the neo-Darwinian synthesis of evolutionary biology (Laland et al. 2014; Wray et al. 2014). The phenotype has been typically seen by evolutionary biologists of the classical neo-Darwinian kind as genetically determined and invariant. It has now become accepted that the phenotype results within a reaction norm determined by a dynamical and reciprocal interaction between development and inheritance. This speaks against the notion of a ‘genetic programme’ that determines the phenotype, including form. The notion of nongenetic inheritance is not a case of hopeless ‘lamarckism’ but a reality. These ideas are at the core of Diogo’s book.

We live in times of increasing specialization and that means that elaborations and critical synthesis of the subject above are rare. Rui Diogo has published a book that goes against the current in being truly large in scope but also single-authored. The goal the author has set out to achieve is remarkable. The subtitle reads ‘a unifying view of life, function, form mismatches, and trends’. The titles of the chapters already show that the author is not shy about what he sets to accomplish. I list them here:

- (1) Introduction to Organic Nonoptimal Constrained Evolution (ONCE) and Notes on Terminology

- (2) Baldwin’s Organic Selection and the Increasing Awareness of the Evolutionary Importance of Behavioral Shifts
- (3) Behavioral Choices and Shifts, Niche Construction, Natural Selection, Extinctions, and Asymmetry
- (4) Evolutionary Trends, Sexual Selection, Gene Loss, Mass Extinctions, “Progress”, and Behavioral Versus Ecological Inheritance and Novelties Versus Stability
- (5) Behavioral Leads in Evolution: Exaptations, Human Evolution, Lamarck, the Cuvier-Geoffroy Debate, and Form Versus Function
- (6) Eco-morphological Mismatches, Human “Exceptionalism”, Hybridization, Trade-Offs, and Non-optimality
- (7) Internal Selection, Constraints, Contingency, Homology, Reversions, Atavisms, von Baer, Haeckel, and Alberch
- (8) ONCE Links Internal Factors, Epigenetics, Matsuda, Waddington, Goldschmidt, and Macroevolution
- (9) ONCE Ideas Are Put Together: Evolutionary Behavioral Ecology, Adaptationism, Systems Biology, and Interdisciplinary
- (10) General remarks

This book is a roller coaster. I often got dizzy reading it. It is written with fury, it seems (Fig. 1). The value resides in the integration of information and the critical evaluation of several issues by a single author. Although I consider it a worthwhile read, I found the book messy and difficult to digest. Maybe that reflects the complexity of evolution and not just the presentation form.

Diogo argues that our search for correlations between ecology and morphological traits misguides us in the

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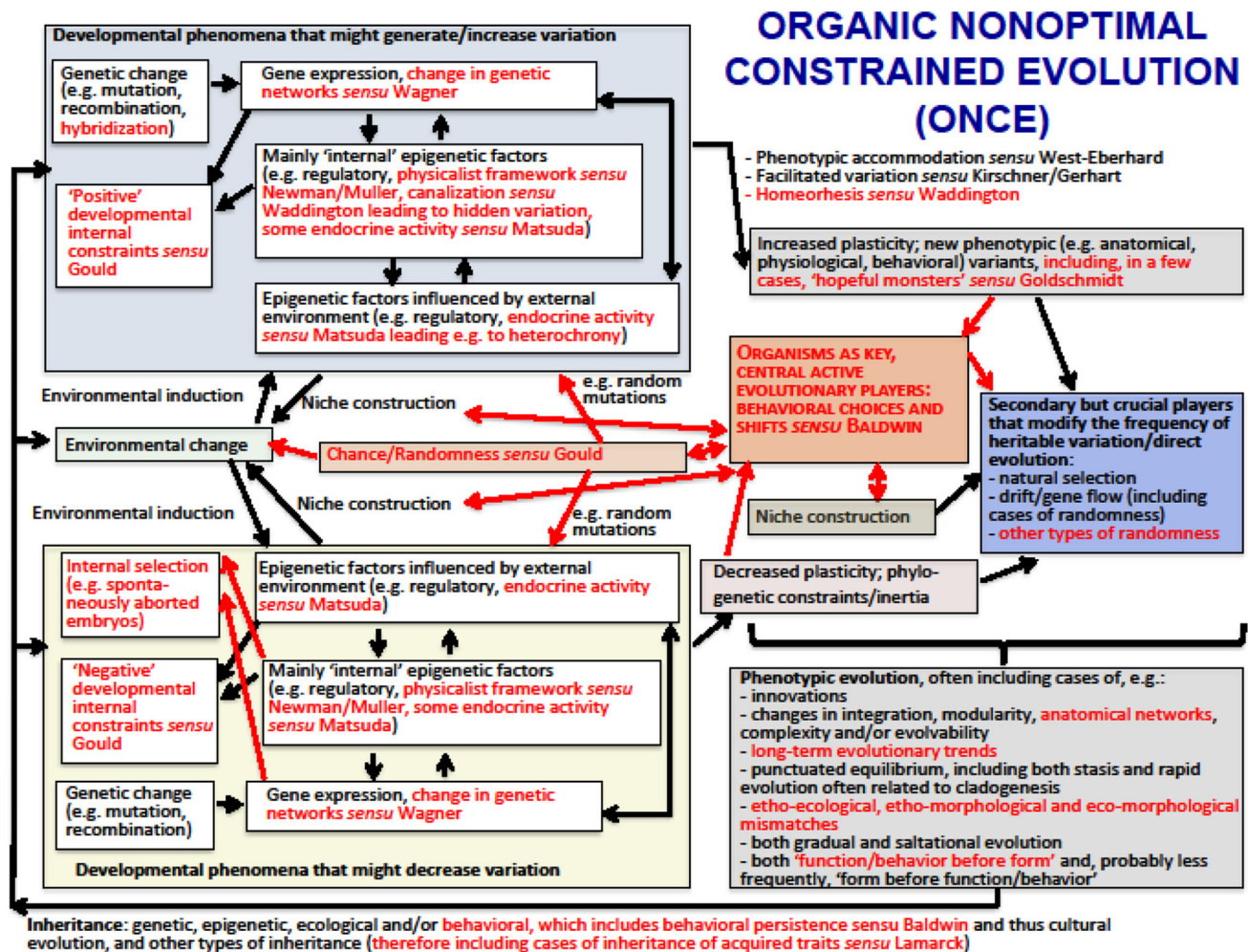


Fig. 1 ONCE, as presented in a single graphic by Diogo (2017), a summarized version of the many of the core ideas of Diogo's book discussed here. Courtesy of Rui Diogo, with permission

interpretation of results or even in the design of studies on this matter. He reviews many cases of imperfect matches between the two and claims that indeed the incidence of mismatches may be even larger than suggested by the published literature—the latter ignoring 'negative' results. The critical look at this matter is one of the strongest points of this book. Diogo may be criticized in his treatment of some of the examples, or in he himself having an agenda to defend, but the onus is on those working in ecomorphology to test for correlations in a non-biased way.

Diogo claims there are two main problems with the neo-Darwinian synthesis: 'the frequent occurrence of long-term evolutionary trends and of etho-eco-morphological mismatches' (p. 54)—with the latter he means that both in behavior and anatomy and physiology, there is no optimal correspondence of form to function. Diogo argues that sexual selection and especially Baldwin's effect can explain these two phenomena. He proposes a 'new' theory that integrates these two aspects and many more (e.g.,

niche construction), which he calls ONCE—'organic nonoptimal constrained evolution' (Fig. 1). Among other aspects, ONCE emphasizes 'the importance of contingency and of randomness' (p. 21)—not only because of considering genetic drift but also behavioral choices that while having long-term effects, were not optimal solutions but rather the combination of contingency (Beatty 2006), decision, opportunity and timing.

A main point of book is that 'organic selection *sensu* Baldwin can be more powerful than (external) natural selection *sensu* neo-Darwinism' (p. 53). In Baldwin's organic selection—named after the American philosopher and psychologist to whom this idea is mainly attributed (Simpson 1953)—behavioural choices persist across generations by way of social heredity. These greatly influence the fate of features in evolution, by elimination or creation of new ones. The influential palaeontologist George Gaylord Simpson (1953) stated that these ideas were consistent with the Modern Evolutionary Synthesis, while doubting

that it, the “Baldwin effect” as he called it, occurred very often or that it could be proven to occur. Julian Huxley (1942) considered the Baldwin effect as part of the modern evolutionary synthesis.

Other concepts concerning evolution other than natural selection and besides Baldwin’s effect—and the historical figures behind them—are discussed in the book. We get an intricate dissection of them (e.g., Table 8.1, p. 168); but they are difficult to grasp and dissociate in this book as they are sometimes in the literature. These concepts include C. H. Waddington’s genetic assimilation, or his ‘homeorhesis’, or West-Eberhard’s (2005) ‘genetic accommodation’, or Kirschner and Gerhart (2005) ‘facilitated variation’, or Goldschmidt’s ‘regulation’.

I found the use of the concept of Baldwin’s selection unclear in some points of the book. For example, according to Diogo the kind of selection that goes on in dog domestication for special breeds he calls a case of Baldwin’s selection (and rightly criticizes the term ‘artificial selection’). Whereas the Darwinian external selection is ‘highly variable and random’ (p. 54), that in the case of selective breeding is consistent and directed. That is a worthwhile observation on this clear contrast—and yet, I much doubt this helps to support the argument for Baldwin.

Diogo (p. 126) states that ‘new studies on hybridization and its importance for biological evolution, including the creation of new species, present problems for neo-Darwinism and, although Darwin was clearly aware about cases of hybridization, also to his general ideas, e.g., for his vision of a mainly bifurcated “tree of life”.’ I am not sure what Darwin’s ‘bifurcated’ views were or how hybridization cases can be seen as supporting ‘ONCE’. But once again, the pluralistic and critical views are enlightening.

Diogo is an avid reader, and he tells us about the authors and books and papers he reads and enjoys, and these concern both animals and plants all across the tree of life. Although this is fun at times and one can in that way get good reading lists, this makes the text often times messy. It also makes more evident what books or authors or ideas are not mentioned—the subjects that Diogo treats are so many and so complex that it would be impossible to cover all. Diogo refers to the case of the two-legged goat that learned to walk and run by using its hind limbs alone as classic example of developmental plasticity, but does not mention the Dutch morphologist—Slijper—who first referred to this case.

The historical treatment of subjects is patchy; it is easy to see missing aspects in many of the summaries, but one does get the gist of a historical development and gets to read about some of its most prominent actresses and actors.

I enjoyed the defense of Lamarck (p. 92), the French evolutionist who according to textbooks got it simply wrong with the giraffe—never mind that the giraffe story was not prominent in his writings (Padian 2013) and that Darwin and later most biologists around 1900 followed Lamarck’s ideas on mechanisms.

The book is full of vignettes of ideas and of papers and the alternative explanations the author provides to some of the conclusions of those papers. This makes Diogo’s book dense and idiosyncratic. I find it is in places too asserting on matters that are controversial. There are many convoluted apologies and caveats and semi-reviews that predate the many conclusions and such. But understanding its message is worthwhile. I thought of the long, detailed writings of Leo Croizat, the encyclopaedic scholar who so greatly influenced the field of biogeography. In comparison, this book is shorter and its concepts are packed together.

Progress in developing an understanding of the principles of phenotypic evolution—including long-term trends, much treated in the book—will maybe come from a pluralistic and empirical approach. In this regard, the discoveries of the author and his colleagues discussed in the book are valuable. For example, those concerning modularity in the evolution of head and neck muscles, or the subject of homology or rather lack thereof between forelimbs and hind limbs.

Many of the ideas presented by Diogo, if not all—as he himself recognizes—go back to many of last century’s ones and even further back. This does not reduce the merit of this synthetic book. One of concluding points of the book states that ONCE is testable, while referring to a complicated graph (Fig. 1). I find it difficult, if not impossible, to see how this could be accomplished.

This otherwise unconventional book follows the mainstream in taking a personal perspective. Much self-analysis and statements on the preferences and opinions of the author make the book quite honest, but also less effective. I much prefer a ‘remote, even austere authorial voice’ (Leroi 2005, p. 9). The complexity of the subject and the style of presentation make me skeptical about how appropriate is the book for a general public, the goal set by the author. Hopefully I am wrong, as the message is important.

In one of the concluding points summarizing the book, Diogo (p. 215) criticizes the notion that ‘struggle’ for existence and optimality are central to evolution. In spite of many excellent books emphasizing the importance of cooperation and development in evolution (e.g., Weiss and Buchanan 2009; Arthur 2011), Diogo’s critique is still timely and relevant.

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