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Laland, Kevin. 2017. *Darwin's Unfinished Symphony: How Culture Made the Human Mind*.
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Thomas Morgan

It has been a good year for those looking for accessible introductions to the role of genes and culture in human evolution: three books on the topic have been published by Princeton University Press. The first to be released was Joe Henrich's *The Secret of Our Success*, which argues that cultural evolution and not our individual intelligence explains how humans have come to dominate virtually the entire planet. Most recent is Rob Boyd's *A Different Kind of Animal*, released only a few days ago, which, I confess, I am yet to read. Arriving between these two is Kevin Laland's *Darwin's Unfinished Symphony*.

Laland has already produced several books, ranging from heavyweight expositions of evolutionary theory, such as *Niche Construction: The Neglected Process in Evolution* (Odling-Smee, Laland, and Feldman 2003), to gentler introductions to the evolutionary study of humans suitable for undergraduates, as is the case in *Sense and Nonsense* (Laland and Brown 2011). *Darwin's Unfinished Symphony* is Laland's most personal book to date, taking an almost autobiographical approach. Before delving into questions of style, let's first consider its content.

In *Darwin's Unfinished Symphony*, Laland sets out his take on how and why humans evolved to be so different from all other species. For Laland, the answer is relatively concrete: the uniquely high fidelity of our social learning set in motion a feedback loop between our genes and culture that drove our species into the otherwise uncharted territory of language, widespread cooperation, agriculture, and the arts.

For a book that is so squarely aimed at explaining human evolution, it may seem surprising that the first part of the book (roughly the first third) focuses almost entirely on nonhuman behavior. However, such a comparative approach is characteristic of Laland's career—in attempting to understand the evolution of culture, he has studied the behavior not just of primates, but also of fishes, birds, and rats. In *Darwin's Unfinished Symphony* we learn that nine spined sticklebacks observe the behavior of their conspecifics to infer the richness of food patches, that rats smell each other's breath to learn what is good to eat, and that birds learn migratory routes from their elders. Starting with such a broad focus brings dividends, as it clearly highlights that it is not social learning per se that is unique to humans. Nor can it be strategic use of social information, because, as Laland describes, sticklebacks will increase their reliance of social information when individual learning becomes increasingly risky, such as when female fish are carrying eggs. Instead, Laland argues, whereas other species are social learning *specialists*, restricted to copying only in certain domains, humans, uniquely, are social learning *generalists*, able to learn from others in any context.

Laland begins the second part with a discussion of Allan Wilson's cultural drive hypothesis, which acts as the underlying framework for the rest of the book. Wilson argues that by discovering and sharing difficult-to-learn behaviors, a species can subject itself to novel selection pressures. In many cases, those pressures will

lead to increased cognitive abilities, which help individuals acquire these difficult-to-learn traits. This process can run away with itself, because enhanced cognition not only supports the acquisition of existing traits but can also allow individuals to discover new and even more complex traits, thereby renewing selection for ever more complex cognition. By reviewing meta-analyses of primate brain evolution and behavior, Laland convincingly argues that the ability to learn from others is evolutionarily linked to a range of other traits, such as innovativeness, as required by Wilson's hypothesis. The rest of the second part (the bulk of the book) discusses how such a process could have given rise to human behavior, including teaching, language, cooperation, and even dance.

Laland is not alone in placing such an emphasis on gene–culture interactions, and his theory has considerable concordance with that of Henrich, as noted by both authors in their respective reviews of each other's work (Henrich 2017; Laland and Rendell 2017). Such agreement reflects the growing consensus that human evolution is a story of genes and culture combined, and I strongly suspect Boyd's book reaches a similar conclusion. Yet there are several features that mark Laland's book as a truly unique and valuable contribution. First is Laland's emphatic insistence on taking a comparative approach to human evolution. It has long been recognized that to fully comprehend any trait we must include its evolutionary history and its homologs in other species (Tinbergen 1963). However, all too often human traits, such as culture, are taken as sufficiently unique that a comparative approach is considered pointless. By reviewing the widespread evolutionary roots of culture, Laland demonstrates that humans are not as unique as we might have first thought, but he also uses this comparative data to understand precisely what *is* unique about human behavior and cognition.

A second, and similar, virtue of *Darwin's Unfinished Symphony* is its fearlessness with regard to diving into mathematical theory headfirst. Evolutionary biology and cultural evolution are both highly technical fields grounded in a firm foundation of mathematical theory. Within academic circles this is certainly regarded as a strength, but it rarely features in more accessible texts because it may put unfamiliar readers on the back foot. Despite this, Laland does a highly effective job of not only explaining the value of mathematical models to science, but also in describing the inner workings of the models themselves. Laland dedicates considerable space to discussing a model of transmission fidelity and cumulative cultural evolution (Lewis and Laland 2012) and virtually an entire chapter to the social learning strategies tournament (Rendell et al. 2010). By walking the reader through such technical topics, the curtain is pulled back to show that these approaches are not as intimidating as they first seem, and one can only hope this encourages more scientists, budding or established, to engage with a theoretical approach.

Another feature that should make *Darwin's Unfinished Symphony* effective as outreach for science is Laland's autobiographical approach. Many undergraduates, graduate students, and early career researchers describe the feeling of being unable to live up to the success of more established professors. This "imposter syndrome" can lead to gifted researchers leaving academia. By taking a personal approach in his writing, Laland gives the reader a look into the inner workings of science that may help calm some of these fears. We peek behind the published articles to see that the design of the social learning strategies tournament needed to be started from scratch three times before all parties were confident it would provide meaningful data. We learn that the discovery of species-specific social-learning adaptations in sticklebacks hinged on a researcher, unable to tell closely related species apart, accidentally collecting members of two species. Finally, and perhaps most importantly, we see that science is never carried out in isolation. Throughout the book,

although Laland emphasizes work he was a part of, he continually and graciously cites those he was working with, whether an international team of experts in the case of the tournament or, more often, individual graduate students and postdocs. In this way, we see that far from a cutthroat competition, science is most successful when groups of individuals from all points in their careers work together.

I think the book overall benefits from this personal approach, but it, necessarily, has drawbacks. By emphasizing projects he was a part of, Laland falls into the habit of presenting individual papers as providing the solution to scientific questions, rather than forming part of an often messy and contested literature. In part, this is a genuine reflection of how scientists think: we have a theory, we use theory and/or experiment to test it, and we tend to be more influenced by our own findings than those of other research groups. However, I don't suppose this is the ideal of how science *should* work.

Laland's personal approach also influences the context in which theories are described. For instance, Laland brings a unique insight into the role that niche construction (organismal modification of the selective environment) has played in human evolution, a theory that he uses particularly effectively in discussing the origins of agriculture. However, Laland's personal influences occasionally obscure the rich histories of the theories he discusses. For instance, I don't doubt that Wilson's work on cultural drive was hugely influential on Laland's thinking; nonetheless, the ideas in this theory go back far beyond Wilson. I tend to trace them (just as arbitrarily) to nineteenth-century figures like J. M. Baldwin (Morgan and Harris 2015). In this way, framing the book around cultural drive is effective and honest in terms of Laland's individual thinking, but it also masks the intellectual history of these ideas.

As much as the autobiographical approach strengthens the early chapters in which Laland discusses at length the projects in which he was at the forefront, it also weakens the later chapters in which Laland applies his theory more speculatively to topics he has not personally worked on as much. Although this change in perspective is a little jarring, and it takes away from the reader the pleasant feeling of being a scientific Sherlock Holmes, this does not mean these chapters are without merit. I found the chapter on language evolution, strengthened by Laland's comparative approach, to be particularly invigorating. The checklist of features needed by a successful theory of language brings useful structure to a field that tends towards the vague. Moreover, there is something delightfully mischievous in Laland's suggestion that language, which is often regarded almost reverentially, evolved initially as a cost-saving measure to reduce the burden of teaching. However, the final chapters on cooperation and the arts are notably weaker than the others.

From a scientific perspective, I am inclined to agree with Laland's general outlook that human evolution for hundreds of thousands, if not millions, of years has been dominated by the interactions of culture and genes. I think the weak point in Laland's argument, and in all similar arguments, is in identifying why the evolutionary feedbacks that drove humans down such an unusual evolutionary pathway didn't take over the evolution of other species too. Laland suggests that this is because only human ancestors evolved sufficiently high-fidelity social learning mechanisms, but this then begs the question of why our ancestors alone evolved such high-fidelity social learning. The response may be that our ancestors inhabited an environment that, uniquely, demanded they learn behaviors that were both highly fitness-relevant and difficult to acquire through low-fidelity social-learning and asocial-learning mechanisms. But until the relevant features of the environment can be identified and a strong argument for why this was unique to human ancestors can be put forward, arguments such as these must remain somewhat unsatisfying. More generally, I worry that Laland's identification of transmission fidelity as the key factor

artificially privileges one part of a coevolutionary process involving many separate players. A full understanding of human evolution requires research programs addressing the full range of human and nonhuman cognition.

With all this in mind, I see Laland's book as a valuable and important contribution to the consideration of human evolution. *Darwin's Unfinished Symphony* presents an argument broadly similar to that in Henrich's *The Secret of Our Success*, but by taking a broad-ranging comparative approach, emphasizing the role of mathematical theory and presenting the ups and downs of a scientist's working life, *Darwin's Unfinished Symphony* carves out a niche of its own. I often consider the publication of accessible books to be an indication of the maturity of a field, and the publication of three in quick succession is not just a coming-of-age for gene–culture approaches to human evolution, but also a good sign for the continued success of the field.

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