yields offspring with higher genetic quality, cites a review that finds equivocal evidence for this, and then concludes that social selection must be the real explanation for extra-pair young. Many of the hypotheses for EPC that other authors have proposed are not mentioned.

The concluding chapter lists 26 ways in which social selection and sexual selection give contradictory explanations of reproductive behavior. The caricature of sexual selection is repeated and extended, and false dichotomies, such as nature–nurture, are revived.

This book is not a scholarly review of the wide-ranging topics that it touches upon, nor is it a fair summary of facts from nature. It is a personal essay that quite clearly describes the author's opinions. Thus, the subtitle, "Deconstructing Darwinian Selfishness," is an accurate depiction of the style of critique, which is more literary than scientific. The potential danger of this book was that it could have caused the lay public to believe an untruth (as did the proponents of creationist/intelligent design). However, because the book contains abundant technical discourse and jargon, the lay reader will find it impenetrable. Roughgarden obviously wants the biologists to think more deeply and critically about sexual selection and the natural phenomena that it explains, but her superficial, often misleading scholarship and her scolding tone will win her few converts.

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Evolution of Communicative Flexibility – Complexity, Creativity, and Adaptability in Human and Animal Communication. D. Kimbrough Oller and Ulrike Griebel, editors.

Cambridge, MA: The MIT Press, 2008. 356 pp. ISBN 978-0-262-1121-4 (cloth) $50.00

The editors clearly lay out the goal of this book in the very first sentence of their leadoff chapter: "*This volume is founded on the supposition that evolution of complex communication systems, where human language offers the most extraordinary example, requires a foundation of flexibility in both the form and usage of signals.*" In this way, they throw their hat into the ring of the murky evolution of language debate, claiming that selection for communication, rather than for cognition, is at the core of its evolution. Parsing the two elements of this chicken-and-egg story has spilled much ink, but little of this volume is actually dedicated to the task. Rather, most of the chapters, though not all, describe flexibility within the communication systems of a given species or taxonomic group and offer speculation about how such behavioral variability would be important for the evolution of language. These chapters focus generally on human and nonhuman primates, birds, cetaceans and pinnipeds. Missing, however, is any mention of flexibility outside the species typically discussed in this literature, such as anurans or insects. Examples of these taxonomic groups would have been useful for a broader sense of the patterns of flexibility in communication systems. That being said, the chapters in the book provide a good review of the primary literature in this field. The unique aim and scope of the volume make it a valuable set of papers for researchers of both human and nonhuman animal communication systems.

Following the editor's introductory chapter, which highlights the primary issues related to communicative flexibility, the volume is divided into four main sections, each addressing a different aspect of the topic. The first section of chapters focuses on "Cross-species perspectives on forces and patterns of flexibility in communication." The editors author the first chapter and describe the selective forces under which one might expect communicative flexibility to evolve. This chapter includes a discussion of several central concepts in animal communication, such as signs and signals, and attempts to bridge the gap of how selection for flexibility of these elements could lead to the evolution of language. The following chapter, authored by Shusterman, begins by contrasting the overwhelming evidence for vocal learning in birds with the relative paucity of data on similar behaviors in nonhuman mammals, especially primates. He goes on to describe the evidence supporting such learning abilities in pinnipeds (i.e. seals, sea lions, and walruses), including vocal mimicry and attempts to use operant conditioning to bring vocal responses under stimulus control. The subsequent two chapters present contrasting views of nonhuman primates. The first of these chapters is by Snowdon and describes research, primarily from his laboratory, showing

flexibility in primates' vocal production that appears driven by changes in social context. Surprisingly, most of the robust changes occur in adult primates. The following chapter by Hammerschmidt and Fisher describes work on the neurobiology and behavior of primate vocal production, concluding that these behaviors are largely fixed. These two views of primate vocal production contrast and, as of yet, have not been rectified. In the final chapter of this section, Hausberger reviews work on the presence of contextual "rules," focusing on turn-taking behavior, primarily in European starlings during vocal interactions. Hausberger argues that such contextually sensitive behavior is likely to be one of the hallmarks of behavioral flexibility in systems of social communication in general.

The second section is titled "The role of flexibility and communicative complexity in the evolution of language." In the first chapter, Oller and Griebel utilize data on vocal development in human infants to theorize how communicative complexity could be built up across a successive sequence of simpler stages, the progression of which occurs in a "naturally logical" way. They review data on the emergence of canonical babbling in infants out of earlier, spontaneous vocal productions that are analogous to those produced by nonhuman primates. The authors suggest that these earliest stages of human vocal development can be seen as a model for how the flexibility of human language may have emerged from the relatively fixed vocal signals of primates. Owren and Goldstein in the following chapter focus on vocal production learning and conjecture how it may have emerged from nonhuman primates. The authors speculate that one of the innovations allowing the emergence of production learning and the flexibility of human spoken language is the increased connectivity of cortical areas with subcortical vocal centers over evolutionary time. The subsequent chapter by MacWhinney provides a set of potential cognitive precursors that could have provided a foundation for the evolution of language. In the final chapter of this section, Sterelny presents an insightful argument for the reciprocal interplay between language and its environment. He contends quite accurately that language not only evolved in response to environmental pressures, but that language also provides a mechanism that modifies one's social environment in a number of different ways. He also makes an important point about the relationship between referential signals in animals and in humans' words that I recommend all those working on such issues should read.

The third section titled "Underpinnings of communicative control foundations for flexible communication" is comprised of only two chapters. In the first, Call uses the gestural system of apes to show how these animals can use intentional communicative acts in very flexible ways. A single gesture, for example, can be used in multiple contexts to achieve different goals, while multiple gestures can all be used in the same context to achieve a similar goal. Animals also appear to decide whether to gesture, and also adjust their choice of gesture, based on the attentional state of the recipient. The significance of this flexibility for the evolution of language is more fully expounded by Tomasello (2008). The second chapter in this section, authored by Kuczaj and Makecha, focuses on the potential role of play in the evolution of language. These authors focus primarily on the significance of vocal play in cetaceans, but other taxonomic groups are discussed, including human infants.

The fourth and final section consists of a set of chapters on "Modeling of the mergence of complexity and flexibility in communication." McCowan and colleagues use dolphin communication in an information-theory model to compare the patterns of juveniles' and adults' whistle production. They show greater repetition in adults' whistling behavior, suggesting a potential "syntactic" structure in the organization and timing of this communication system. In the second chapter, Lachlan addresses the potential forces behind the evolution of vocal learning in songbirds. Suggesting that vocal learning emerges out of the need for a flexible system of communication, he examines how different physiological constraints, perceptual predispositions, and ecological and geographic niches may have driven some species of birds toward more flexible signaling systems. In the final chapter of this section, Westermann describes how both hearing and producing the sounds of one's native language is crucial to the process of learning a language. He summarizes recent work showing that auditory experience with one's native language serves to shape and calibrate the perceptual space of the infant. A detailed neural network model of sensorimotor integration that describes a possible mechanism underlying the development of this perception–production link is also described.

The editors have skillfully compiled an excellent volume detailing the range of flexibility in animal communication systems with an eye to factors that may have contributed to the evolution of language. The breadth of topics covered in the book makes it useful for a diverse range of scholars. We recommend

this book to anyone working on communication, as it would be beneficial to those interested in both human and nonhuman animal systems. Although communicative flexibility is often mentioned in the literature, the range of issues is rarely compiled in a single volume of papers. As such, this unique book is likely to be a useful resource for years to come.

Reference

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Evolution, Second Edition. Douglas J. Futuyma.

Sunderland, MA: Sinauer Associates, 2009. 633 pp. ISBN 978-0-87893-223-8 (hardcover), $108.95.

> *We can to a certain extent understand how it is that there is so much beauty throughout nature; for this may be largely attributed to the agency of selection.*
>
> Charles Darwin, *On the Origin of Species*

Darwin's opus continues to be inspiration and catalyst for discovery of the myriad patterns and processes that distinguish life on Earth. So much has happened in the past 200 years to advance a science already standing on a sturdy foundation that evolution cannot be considered a modest topic to cover in a textbook, even one more than 600 pages long. Given the truth in Dobzhansky's assertion that nothing in biology makes sense except in the light of evolution, a writer of a textbook on this subject is basically up against trying to present to students a work dealing with practically all of biology.

Doug Futuyma has done precisely that in ways that almost make me want to be an undergraduate again, so that I can dedicate more hours to poring over the pages of his wonderful text. There is such a wealth of information in these pages that only a full-on course would come close to doing it justice—it is really a one-stop-shop for up-to-date assessments of what we do and do not know about evolution. There are chapters and sections on just about everything. The mainstays of Darwin's triumph are all there, of course: phylogenetics, natural selection, variation, adaptation, the fossil record. . . . But to this pantheon have been added pieces that Darwin did not have at hand: the synthesis, heterochrony, allometry, tectonics, radiometric dating, and especially genetics and evo-devo—not to mention lucid armories for the fight against creationism and other anti-intellectual forces that would find the scholarly mass of the rest of the book an affront to their misguided sensitivities. Futuyma deftly covers the issues of why "creation science" is oxymoronic, and how it squeezes itself into new shapes to confound and confuse those not yet equipped to evaluate the difference between fact, theory, science and ideological obfuscation. The book is worth every penny for this alone and as a bonus, you get one of the most on-point Doonesbury cartoons in the history of the funny pages.

Speaking of the comics, many figures are further illuminated by little "cartoon speech balloons" that spring from pieces of the illustration that might require parenthetical explanation. I found these extremely eye-catching, useful, and actually charming in cases in which the diagrams and the subjects therein seem to be speaking to the reader like the characters from some evolutionary funny pages (the cetaceans on p. 86 were great in this regard). There is hardly a page of this book lacking in skillfully chosen and crafted imagery. That there is indeed "so much beauty throughout nature" comes through not only in the aesthetic joy of things like "*Anomalocaris*", but in the theoretical appeal of the colorfully coded maps and graphs that reveal their inner beauty in educational messages of great impact.

In attempting to teach phylogenetics to undergraduates engaged in our own programs at the California Academy of Sciences, I have had to try and find a suitable book that covers the basics of evolutionary biology but that also emphasizes cladistics. I have gone to various specialized texts on phylogenetic theory, but I am starting to rethink that approach in favor of a book such as Futuyma's.