

MUSIC AS BIOLOGY: THE TONES WE LIKE AND WHY.

By Dale Purves. Cambridge (Massachusetts): Harvard University Press. \$29.95. x + 165 p.; ill.; index. ISBN: 978-0-674-54515-1. 2017.

Since Darwin, many theorists have pointed to vocal communication as a significant factor in the structure and evolution of music, but Dale Purves' *Music as Biology* summarizes fairly recent work that has brought this approach to a new level. Anyone seriously interested in questions regarding the origins of music needs to become familiar with the work of Purves and his colleagues—this concise and eloquent book is an excellent way to do that.

Scholars across a variety of disciplines have long recognized relationships between prosodic patterns in affective signals and emotional features of music. But these observations, although interesting, do not typically explain the more intricate characteristics of musical structure. According to Purves, widespread consistencies across the world's musical systems are due, in large part, to perceptual mechanisms shaped by evolution to extract meaningful information from naturally occurring periodic sound stimuli, including most notably, vocalizations.

From this perspective, the author covers the perception of consonance and dissonance in musical intervals, universal predilections for certain musical scales over others, the relationship between intervals and vocal emotions, and tonal preferences across cultures. For example, analyses of spectral slices of spoken utterances, normalized and examined in octave bands, reveal amplitude peaks in spectral distributions that map quite nicely to the frequency ratios of most intervals in the chromatic scale. This strikes me as some of the best evidence ever presented regarding the structural origins of musical systems. It is certainly not the entire story, but likely a major theme. Overall, the chapters are crisp and succinct—in fact perhaps too succinct at times, as the explanations might require some technical understanding beyond average readers. That said, I found the volume to be very well written and definitely to the point.

The approach described in these pages could be central to a pure byproduct account of the evolution of this complex capacity, but Purves addresses neither phylogenetic nor adaptationist issues at all—a little curious for a book about the biology of music. He does provide an interesting final chapter titled Implications that delves into the sometimes thorny philosophical issues concerning unconscious inference, naïve realism, and the role of evolution in designing perceptual systems. But I am not sure he quite makes the connection to music that he intends. I also felt the brief discussion regarding culture did not do justice to the enormous role that cultural evolution plays in the shaping of musical phenomena. It

is simply not enough to argue that our preferences are due purely to neurocognitive predispositions. People are highly motivated to create communicative music, often in groups, in elaborate cultural contexts; and across most societies, musical aesthetics interact with people's social lives within and across generations. Consequently, music evolves in ways that require explanations beyond proximate generalizations. I doubt Purves would disagree but, in the end, scholars who approach music from a cultural or historical perspective might be unfortunately put off by the apparent reductionism. I would encourage such thinkers to give Purves the benefit of the doubt, as he is sticking to what he knows, and that is cognitive neuroscience. Understanding the nature of music is a long-term, interdisciplinary enterprise—I believe the work described in *Music as Biology* contributes in a very important way.

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VOICE LEADING: THE SCIENCE BEHIND A MUSICAL ART.

By David Huron. Cambridge (Massachusetts): MIT Press. \$38.00. viii + 263 p.; ill.; index. ISBN: 978-0-262-03485-2. 2016.

Students and masters of musical composition follow a core set of principles in arranging musical ensembles. In this volume David Huron provides the science of why certain core principles of composition result in the qualitative experiences of music listeners. The author systematically takes readers through the core sets of voice leading rules: for each he provides the expectations for how the rule influences perception, generates testable hypotheses for how our sensory system processes music shaped by the rule, predictions for those hypotheses, and summarizes research testing those predictions, with discussion and interpretation. Although we generally take for granted that music sounds good because of compositional approaches, *Voice Leading* brings a new appreciation to the complexity of our sensory system and the care with which strong composers play to the rules of human auditory perception.

The first three of the book's 17 chapters provide a comprehensive overview, briefly covering: the main principles of voice leading, the operation and limitations of our auditory system, definitions of sound and how it is produced (although Huron focuses on only airborne sound), the formation of sound images and sound localization, the psychology behind the pleasing nature of music, and acoustic versus auditory phenomena. Chapters 4–6 focus on a core set of voice leading principles for Baroque part-writing, and discuss auditory image formation,

perception of the quality of sounds, auditory masking, and the perceptions of melody. Chapters 7 and 8 provide guidance on Baroque composition and part-writing, Chapters 9 and 10 explore embellishments and the sense of music leading somewhere, and Chapters 11 through 14 present additional considerations for composition, such as the perception of harmony and how we analyze auditory scenes and experience musical texture. Chapter 15 discusses how learning and experience influence sound perception, and Chapter 16 focuses on experiments on why music is pleasing. Chapter 17 comprehensively summarizes the book.

For readers who tire of marching through each principle, Huron has incorporated an explicit roadmap for reading *Voice Leading* in Chapters 1 and 17. He also implements parallel formatting for ease of reading: each chapter starts with a concise plan, a tangible and common example to illustrate the ideas discussed, technical exploration of the concept with key ideas italicized, extensive background to explore the ideas, and an excellent summary in a chapter reprise. Although each chapter is dense with scientific information, and the information can be quite technical at times, the explanations are easy to grasp. At the end of each chapter it will be a pleasant surprise to discover how much you have learned.

You do not have to be a musician or composer interested in the cognition of music to appreciate this book. For bioacousticians, the author's navigation of human auditory perception invokes shadows of signal analysis, peripheral nervous system constraints, central nervous system processing, multicomponent signals, and signal composition that can be applied across the animal kingdom. Huron's neuroethological approach to understanding the perception of music will bring new appreciation to consideration of the aesthetics of sound in other animals. Furthermore, the historical commentary on musical composition throughout anchors the volume within a social context. Perhaps Huron's next book he could consider how auditory perception in other animals contrasts with humans to provide context for how unique—or not—human perception of music really is.

Overall, *Voice Leading* provides a framework not just for understanding why musical compositions are perceived the way they are (or which rules musicians should follow to meet specific goals), but paints a picture of the complexity of the neurophysiological and psychological aspects of the impressive human auditory system.

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THE RATIONALITY QUOTIENT: TOWARD A TEST OF RATIONAL THINKING.

By Keith E. Stanovich, Richard F. West, and Maggie E. Toplak. Cambridge (Massachusetts): MIT Press. \$39.00. xvii + 459 p.; ill.; author and subject indexes. ISBN: 978-0-262-03484-5. 2016.

The great Arthur Conan Doyle, author of the timeless Sherlock Holmes novels, was fooled into believing that fairies exist by two teenage girls armed with a camera and a few cardboard cutouts of fairies. How could the brilliant intellectual father of the hypercritical and discerning Sherlock Holmes take on such an extravagant conviction on such meager evidence? The reason, Stanovich et al. would tell us, is that—contrary to common belief—rationality has very little to do with intelligence. RQ (Rationality Quotient) is only weakly correlated with IQ. So what underlies rational thinking? This important question is at the core of *The Rationality Quotient*.

In addition to providing a comprehensive overview of the major findings of four decades of research in the heuristics and biases tradition instigated by the great Kahneman and Tversky, this volume delivers a standardized test to assess rationality in individuals. The importance of the book lies both in the comprehensive overview of the research on (ir)rationality and the psychometric system it proposes to gauge rationality in individuals.

For far too long, IQ has been getting all of the attention. Although IQ is an important metric and a good predictor of an individual's occupational level and performance, RQ—as the authors point out—is both more encompassing and important. In an increasingly hostile cognitive environment (i.e., an environment that differs from the environment of evolutionary adaptedness to which our innate intuitive modes of reasoning are attuned) forming rational beliefs and taking rational decisions becomes ever more challenging. At the same time, in a world where we are constantly bombarded with informational snippets that diverge widely with respect to their trustworthiness, rationality becomes ever more important. The modern world, as the authors point out, puts a premium on rational thinking.

But the importance of rational thinking on an individual level is overshadowed by its importance on a societal level. From overconfidence leading to war and financial crises to the affect heuristic making us overreact on terrorism and remain dangerously impassive to the threat of climate change, the woes of society are the result of a lack of rationality. One can only hope that putting RQ on the map will produce a Flynn effect as has been the case for IQ, where average IQ has been steadily on the rise since the test was first introduced in the beginning of the 20th century.