Richard Parncutt, *Psychoacoustic foundations of major-minor tonality*. Cambridge, Massachusetts: MIT Press, 2024, ISBN: 9780262547352 (paperback) $65.00 – ISBN: 9780262377379 (eBook) $64.99.

Richard Parncutt's (2024) latest book, *Psychoacoustic foundations of major-minor tonality*, offers an interdisciplinary exploration of the underlying principles that shape the perception and structure of major-minor tonality (MmT) in Western music. The book covers all of the concepts and issues that have been deemed relevant for musical harmony since its origins in Greek Antiquity to modern-day, lab-based research on the topic. Investigating the psychoacoustic mechanisms behind chord perception, scale construction, and tonal hierarchies, the book seeks to answer fundamental questions about why certain tonal structures and progressions have been developed, and how they have been transformed throughout musical practice. At the same time, Parncutt's book addresses broader cultural and philosophical issues, thus offering a novel approach to understanding the universality and specificity of MmT.

Overall approach and structure of the book

The book is organized into 23 chapters across 6 parts: (I) "Interdisciplinary Introduction," (II) "Extramusical Foundations," (III) "Musical Foundations," (IV) "Perception of Sonority," (V) "Perception of Progression," and (VI) "The Big Picture." In the first part, Parncutt dedicates about 30 pages to defining key concepts. This is particularly helpful for readers with basic knowledge of music theory and cognition (see the sections on "Definition" and "Rudiments"). The volume concludes with an extensive 30-page index and includes nearly 700 references, providing a strong foundation in the existing literature. Throughout, the reader is offered numerous musical examples from a wide repertoire (including jazz, pop/rock, classical, and non-Western traditions), which serve to illustrate theoretical concepts in a more concrete way. For example, the second movement from Johannes Brahms' *Requiem* ("Denn alles Fleisch, es ist wie Gras") and Roy Orbison's 1964 hit "Oh, Pretty Woman" are cited just a few lines apart to exemplify prolonged dominants (see p. 326). This and many other similar examples showcase the book's eclectic approach. Despite its cohesive structure, the book can also be fruitfully approached through individual chapters or sections, which may function as standalone reference materials. For instance, Parts IV and V include comprehensive chapters on topics such as "Pitch," "Consonance and Dissonance," "The Root of a Chord," "Jazz Harmony," "Pitch Commonality," "Tonality," "Progression and Modulation." These chapters can serve as excellent resources for specific areas of interest. An overview of each part follows below.

SUMMARY OF THE MAIN PARTS

Part I, "Interdisciplinary Introduction," establishes foundational concepts, beginning with definitions related to music, tonality, and psychoacoustics. Parncutt outlines the core questions, including the historical and cultural context of tonality and the debate between positivism and relativism, the former conceived as the confidence that central questions have discoverable and universal answers, the latter conceived as the doubt that universalist claims are impossible or problematic, also due to enculturation. The introduction also emphasizes the importance of interdisciplinary research, blending music theory, psychology, and psychoacoustics. The aim is to integrate insights from both the humanities and sciences to create a comprehensive framework for understanding major-minor tonality (MmT) and its perceptual and cognitive foundations.

Part II, "Extramusical Foundations," explores the philosophical underpinnings of music perception. Delving into traditional metaphysical issues like objectivity, subjectivity, and the distinction between physical, psychological, and abstract realities, Parncutt discusses the nature of sound and music and their relation to human perception. He also introduces key concepts from auditory scene analysis and psychophysical scaling. Discussions follow on how we perceive sound in complex environments and how music differs from environmental sound in terms of human auditory sensitivity.

Part III, "Musical Foundations," provides an overview of some relevant historical and theoretical perspectives on musical structure. Discussing theorizations by key figures such as Matthew Shirlaw and Hugo Riemann, the author explores how musical structures—such as triads, intervals, and scales—relate to our auditory perception and cognition of harmony, particularly in the context of MmT.

In Part IV, "Perception of Sonority," Parncutt discusses how humans perceive sonority, a core element of musical texture, which relates to tone simultaneities in MmT but more broadly refers to the overall quality of auditory experience and sounds as auditory percepts. This section focuses on key topics in tone perception, such as pitch and the consonance-dissonance dichotomy. The author examines how psychoacoustic principles, such as roughness and consonance, influence our perception of complex tones, and he connects these findings to broader theories of musical structure.

Part V, "Perception of Progression," explores how listeners perceive chord progressions and modulations in Western tonal music. Parncutt delves into the psychoacoustic and cognitive principles that govern how chord progressions are processed, focusing on pitch commonality, harmonic directionality, and voice leading. Using examples from classical and popular music, he carefully analyses the combination of auditory and cultural factors that might explain the perceptual effects of chord progressions and modulations.

Finally, Part VI, "The Big Picture," provides a more general perspective on MmT, and music cognition in general, as both a cultural construct and a product of psychoacoustic principles. Parncutt emphasises the interdisciplinary nature

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of research in systematic musicology and calls for a deeper integration of humanities and sciences. He highlights the limitations of some traditional approaches to music theory and suggests that insights from cognitive psychology and psychoacoustics can offer a more comprehensive understanding of MmT.

THE PHILOSOPHICAL STANCE

From the very first pages, the book presents itself as a passionate exploration of what could be referred to as "music beyond music," touching on scientific practice and mission, culture, prejudices and, ultimately, humanity. The author takes a strong philosophical stance toward the issues at hand. His attention to seemingly peripheral, yet critical, problems—such as observations on the circular nature of commonly accepted definitions of music (p. 4) or the lack of academic consensus about apparently trivial issues (Preface, p. ix)—reveals this sensitivity. Readers will also notice the author's sociological and anthropological awareness. This is evident since the Preface, where Parncutt combines the role of the researcher in music cognition with a commitment to universal concerns, such as climate change and biodiversity (Preface, p. xvii), or in his evaluation of the music theorist Heinrich Schenker's "dark side" (p. 140). One may correctly feel that music is sometimes used as an entry point for broader discussions on topics like science, art, and philosophy, with historical analysis carefully intertwined with theoretical and psychological insights.

The emphasis Parncutt places on extramusical issues is likely to impress readers. In the tradition of Western scholars like Augustine of Hippo and Anicius Manlius Severinus Boethius, Parncutt recognizes that the foundations of music raise philosophical questions. He tackles one of the most enduring dilemmas in Western (and perhaps Eastern) thought—the millennia-old debate between monism and dualism as it relates to musical objects and subjects, which can also be framed in terms of realism versus anti-realism. Parncutt takes a nuanced stance in this debate, stating: "This book aims for a middle path. I acknowledge the validity of the monist position, but I argue that the central questions posed in this book are too complex to answer within a monist framework. For practical reasons, we are forced to adopt a dualist perspective. The question of whether the dualist perspective is correct may ultimately be unanswerable" (p. 80). To my knowledge, this is one of the few sources in music cognition that takes philosophical issues so seriously (see also the discussion on subjectivity and Parncutt's distinction between interpersonal, observational, and metaphysical subjectivity, p. 68).

A key philosophical distinction in the book is based on Karl Popper's (1977) concept of three worlds:

> In an attempt to clarify arguments about the nature and origin of musical structures, this book has repeatedly invoked Karl Popper's three worlds. World 1 is the physical world of sound, including frequencies in hertz. World 2 is the experiential world of sensations and emotions, including perceived pitch, or how high tones seem to us, both absolutely and relative to each other. World 3 is the abstract world of thoughts and information, including musical scores—whether printed on paper, stored in computers, or memorized in the mind of a musician. (p. 358)

Popper's three worlds are then connected to different approaches to music perception and cognition:

> There is an interesting connection between the psychoacoustic–cognitive dichotomy and Popper's worlds. Psychoacoustic approaches focus on the relationship between Worlds 1 and 2, as measured and quantified in psychoacoustic experiments and models. In that case, World 1 is represented by temporal and spectral representations of musical sounds (waveforms, spectra), whereas World 2 comprises patterns of perceived pitch, loudness, timbre, rhythm, and so on. By contrast, cognitive approaches investigate information processing in the mind/brain—that is, World 3. (p. 358)

Parncutt raises thought-provoking questions, such as "Are physical tones, perceived pitches, and musical notes different things, or are they different representations or perspectives of the same thing?" (p. 65) and "Do the two worlds in question—the physical world and the world of subjective experience—actually exist?" (p. 69). Pursuing the answers to such questions, he explores a range of philosophical sources across aesthetics and philosophy of mind. These intellectually stimulating detours take curious readers beyond narrowly conceived music theory. By following these deviations, readers will gain a deeper understanding of the broader philosophical ramifications and implications of music discourse.

MmT between nature and culture

One of the most prominent themes throughout the book, which could even serve as a fitting subtitle, is the interplay between nature and culture. Music provides an ideal medium to explore this duality, and the author skilfully demonstrates how this interaction manifests in numerous historical and practical examples. Readers will easily grasp how music theory and practice are deeply rooted in both the biological "hardware" and cultural "software" of humans, blending arithmetic with tradition. A key area where the nature-culture debate is embodied is in the concept of musical intervals, and related notions of consonance and dissonance. As Parncutt extensively discusses and exemplifies, musical intervals are culturally

learned entities. Readers may recall Parncutt's earlier work (e.g., Parncutt & Hair, 2011, 2018), where he argued that musical intervals are not precise pitch ratios based on small integers, but approximate pitch distances learned through cultural exposure. As he notes: "In musical practice, major-third intervals are neither pure/Just (386 cents) nor Pythagorean (408 cents), but they do vary across and even outside that range" (p. 48). This aligns with a solid tradition of cultural interpretations of musical intervals, as well as consonance and dissonance, stretching from Aristoxenus to Enlightenment thinkers like Jean le Rond D'Alembert and Jean-Jacques Rousseau (see, e.g., Cazden, 1945; Di Stefano, 2024, for a review).

The debate about the biological/universal vs. cultural/relativist nature of musical intervals, and consonance and dissonance, has garnered a lot of attention in recent years, with several publications appearing in highly-ranked scientific journals (McDermott et al., 2016; Bowling & Purves, 2015; see Di Stefano et al., 2022, for a review). In what follows, I will delve deeper into the cultural argument, by breaking it into two parts. First, if no interval is consistently represented as a stable integer ratio, then integer ratios would play no definitive role in defining intervals. Second, if no arithmetical ratio is fundamental, musical intervals must be considered cultural constructs.

The first part of the argument is a matter of fact: culturally, perfect fifths are not always tuned to a 2:3 ratio, nor are perfect fourths always tuned to 3:4 (Parncutt & Hair, 2018; Thompson, 2013). Different tuning systems exist even within the same musical traditions. However, the fact that intervals are tuned to frequencies that approximate certain ratios across systems is another matter of fact. Now, what conclusion is to be drawn from these pieces of evidence? One might conclude, with Parncutt, to rule out integer ratios entirely from intervals theory. Alternatively, one could conclude that certain ratios act as "fundamental attractors in the space of all possible tone relationships in human musical tonality" (Bowling, 2023, p. 46). How to decide which conclusion fits best with empirical evidence?

It seems to me that the question turns out to be an epistemological one, as it relates to how we conceive scientific theories and, relatedly, their objects of study. I will start by considering alternative conceptions of scientific theories. To put it roughly, the alternative is between Popperian falsificationism and more refined accounts, such as the Lakatosian, view of scientific progress. If we follow Popper, scientific theories are yes/no claims about the world. When a "no" answer is empirically obtained, the theory is falsified and should be rejected. This contrasts with other accounts of scientific theories, such as Lakatos' notion of "research programme." This holds that a scientific theory is a dynamic entity comprising a firm core surrounded by a protective belt of auxiliary hypotheses that safeguard the core. The latter approach significantly revises the Popperian idea of falsification based on several examples from the history of science showing that "falsification in the sense of naïve falsificationism (corroborated counterevidence) is not a sufficient condition for eliminating a specific theory: In spite of hundreds of known anomalies we do not regard it as falsified (that is, eliminated)" (Lakatos, 1970, p. 121).[1]

In Lakatosian terms, the simplicity of integers ratios could represent the scientific core with several auxiliary pieces of evidence that defend the core (Lakatos, 1970). Examples of this auxiliary evidence might stem from neurophysiological findings that the auditory system tolerates small deviations from perfect-integer relationships (Tramo et al., 2001), or that neural processing of equal-temperament intervals is influenced by the degree of consonance, despite the complex ratios present in equal temperament (e.g., Bones et al., 2014; Itoh et al., 2003, 2010).[2] In such an approach, therefore, the evidence showing the influence of historical, individual, and cultural factors on consonance perception should not be hastily dismissed as a refutation of the core, but as part of the normal life course of a progressive research programme (Lakatos, 1970).

Turning to the nature of scientific objects, we encounter another dilemma. One might conceive of musical intervals as single, stable metaphysical entities. If so, they would likely align with Parncutt (2024) when he asks whether a major third is 4:5 or 64:81 (p. 127). Parncutt frames this as two yes/no questions, and his answer to both of these is a firm "no":

> Our musical intuition tells us that there is only one major 3rd, for if there were two, at least some composers would have distinguished them in their notated compositions. But with a few rare modernist exceptions (Harry Partch springs to mind), no one did that. If an interval was a ratio, we would repeatedly have to choose between Just and Pythagorean versions of the same interval—but there is no clear criterion for such a choice, nor is there evidence for it happening in musical practice (p. 127).

Integer ratios do, in other words, not represent stable entities, and thus they play no role in defining musical intervals or consonance and dissonance.

Alternatively, one might conceive of musical intervals as somewhat flexible regions within musical space, suggesting that frequency ratios of 4:5 and 64:81 can both represent a major third.[3] This view aligns with Pfordresher and Brown's (2017) conceptualization of musical intervals as "islands" of frequency ratios, rather than fixed points defined by specific harmonic ratios. Additionally, it resonates with the "sensorimotor hypothesis" proposed by Sato and colleagues (2019), which posits that the structure of musical scales is shaped by a balance between optimizing interval sizes for accurate production and optimizing ratios between scale degrees to maximize consonance in group music-making.[4]

While the reflections above cannot resolve the issue at hand, they exemplify the rich interdisciplinary implications of Parncutt's approach to MmT. The nature of musical intervals, as well as consonance and dissonance, will likely remain a central focus in future music cognition research. Insights into these topics could emerge from further

cross-cultural studies that investigate how non-Western listeners perceive and rate Western musical sounds. Similarly, protocols could be developed to test Western listeners with unfamiliar musical scales, addressing the role of exposure in interval perception (see, e g., Friedman et al., 2021).

Although it is relatively straightforward to empirically assess whether non-Western listeners (e.g., indigenous populations of minimally-Westernized cultures) can perceptually distinguish between different classes of sounds, such as consonant and dissonant stimuli, assessing their aesthetic preferences or appreciation poses a greater challenge, especially when using cross-cultural stimuli. Aesthetic appreciation is a complex, often ambiguous psychological construct, shaped by a dynamic interplay of biology, culture, and individual experience (see, e.g., Jacobsen, 2006, 2010; and Bowling et al., 2017, for consonance/dissonance). As such, any differences observed in the judgments of Western and non-Western participants are difficult to attribute to a single cause. Further research is needed to develop reliable, less Western-focused experimental protocols that can reduce bias and offer clearer cross-cultural insights.

Another question that arises from Parncutt's volume is whether it is even appropriate to speak of a single MmT, or whether we should instead refer to MmT*s*. After all, a minor third in hip-hop or electronic dance music is hardly the same musical, perceptual, or metaphysical entity as it is in Palestrina's compositions. Similarly, we might more radically question whether the distinction between nature and culture can be clearly defined at all. People often ascribe a universally clear meaning to "nature," while viewing "culture" as a more relative and ambiguous concept. Yet "nature" itself is a cultural construct—our understanding of it has evolved over centuries through theorization and reflection.

Conclusion

When I first started reading Parncutt's (2024) book, I was struck by the vast range of topics covered and the level of detail. More than once, I found myself thinking I was not sufficiently qualified to write a review. While I still believe that to be true, I am also convinced I am not alone—very few people, if any, could claim the expertise to cover all these topics comprehensively. I found comfort in Parncutt's own words: "Today, no one can claim to be an expert in more than one such discipline, but everyone has the opportunity to read widely and incorporate as much material as is reasonably possible when considering interdisciplinary questions" (p. 356). This sentiment seems to reflect not only Parncutt's academic journey but also his intellectual biography and honesty.

To conclude, I would like to share a quote that, in my view, captures the essence of the book's attitude and approach: "A century ago, an educated liberal European might innocently have asked whether MmT (and, in the same breath, grammar in English or European languages) corresponds to the universal workings of the human mind. Today, given the obvious diversity of the world's musics and languages, such a question seems arrogant, colonialist, and possibly racist" (p. 368). The emphasis on "musics," still too rarely used in its plural form, is telling—and as such flagged as incorrect by my grammar check. There is still a long way to go, and Parncutt's fascinating book will certainly serve as an inspiring and thought-provoking guide on this journey.

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Notes

[1] This might partially correspond to Parncutt's (2024) observation regarding the fact that "ratio theory continues to thrive, despite the clear empirical counterevidence" (p. 161).

[2] Regarding the explanatory power of neurophysiological evidence for the perceptual experience of music, Parncutt (2024) prudently, if not sceptically, observes: "Highly complex physical correlates in the brain can be identified. These correlates can and should be studied in detail in order to understand the anatomic structures and their biological functions better, both within and between neurons. But the observations of neuroscientists are limited to the physical world. Regardless of unpredictable future technological developments, and despite the fascinating fantasies of science fiction, neuroscientists will never directly observe the subjective experience of live subjects within their brains" (p. 226). This relates to Parncutt's relevant observations about causality and correlation in scientific research, such as: "Correlation does not imply causality. Just because something that we experience is correlated with something happening in the physical world does not mean that the physical states or changes are causing the experience" (p. 225).

[3] In this sense, musical intervals would be no different from other perceptual qualities, such as colours. No one would argue that because we perceive slightly different hues as red, "red" does not exist.

[4] Parncutt is well-aware of this idea, when he wrote: "A ratio theorist might argue that idealized ratios are distorted when transformed in music performance— for reasons to do with physical constraints, musical contexts, or expression. Such distortions exist, of course—but relative to which of the two ratios? The question seems to be unanswerable. So, a theory of that kind is unfalsifiable (Parncutt and Hair 2018)" (pp. 157-158). However, the point here might be that there are no single ratios, but rather more or less extended "islands."

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