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Introduction

The Science–Music Borderlands is a new critical contribution to the field of interdisciplinary music research, promising intellectual synthesis of cutting-edge music research that has been enabled by the convening power of the Society for Music Perception and Cognition (SMPC). Served primarily by North American constituencies, this international organization represents the intellectual and professional interests of an international music science community. While the majority of contributors are affiliated with universities and elite research institutions in the USA (18) and Canada (6), the volume editors (Northeastern University and Princeton, USA) have included numerous contributions from Europe and the UK (11) and East Asia (4); institutional affiliations also feature from India, Australia, New Zealand, Nigeria, and the Republic of South Africa. The geographical range is important, for reasons that the editors themselves foreground: that “despite the unique opportunities for confluence afforded by the more than century-long existence of humanistic and scientific inquiry into music, and despite the potential offered by the decades-long existence of a society [SMPC] that strives to foster interdisciplinary collaboration, rifts between the approaches persist... [yet] researchers have been steadily working toward new paradigms informed by developments across disciplinary boundaries and the global conditions of the twenty-first century.” (p.2). The institutional and global conditions in which music research takes place matter a great deal. The influence of politics and policy at such wider levels facilitates – and constrains – both the knowledge conditions and the practical opportunities that are available to access music’s multidisciplinary expressions.

The list of academic disciplines and sub-disciplines relevant to the study of music is extensive and fluid, encompassing, for example, historical musicology, ethnomusicology, composition, analysis, popular music studies, aesthetics, semiotics, psychology, sociology, linguistics,

anthropology, archaeology, acoustics, information science, and mathematics. SMPC has sought to support interdisciplinary music research since its inception in 1990, recognizing two distinct modes of music scholarship in the speculative and subjective approach of the humanities, contrasted with the systematic, experimental and positivist approach of the sciences. Similarly longstanding institutions and societies have also contributed to the contemporary, international field represented in the current volume, all motivated by the imperative of interdisciplinary dialogue between communities who practice the scholarship of art, and those who practice science. European societies including SEMPRE (1972) and ESCOM (1991) have been instrumental in sustaining productive dialogue among music researchers for many decades, alongside hubs such as the Centre for Music and Science in Cambridge, UK since 2001; and conference series such as the Conference for Interdisciplinary Musicology since 2004. In the UK, various longstanding postgraduate degrees have trained generations of new researchers through explicitly interdisciplinary programs, such as the MSc in Music, Mind and Brain at Goldsmith’s University of London, or the University of Sheffield’s postgraduate Music Psychology programs.

Institutional infrastructure has been designed, historically, to accommodate disciplines as distinct units, and this prefigures the communicative prospects of interdisciplinary research. Interdisciplinary research is often expensive: it requires additional labor to establish the productive dialogue necessary for both the generation and dissemination of new concepts, theory, and data. Work that falls between or across established research communities is also more likely to challenge orthodoxy, and this is also costly. But, as anticipated by Georgina Born and collaborators (Barry & Born, 2013; Born, 2010), and as recognized in the current volume, the digital and global conditions of contemporary knowledge cultures have already disrupted and reconfigured traditional disciplinary networks, and they also profoundly impact what we know about music, and how we come to know it.

Contents and Organization

Four distinct sections offer up chapters that are grouped thematically in order to map out current boundaries of knowledge and imagination: Part I – “Beyond Nature vs.



Nurture,” Part II – “Beyond Music as a Window to the Mind,” Part III – “Beyond Reductionism,” and Part IV – “Beyond Musicians and Non-musicians.” Each section is elegantly contextualized with an introduction from the editors, and interspersed with colorful and personal writing on and about music, musicality, creativity, and science.

To understand how future music research may better reconcile the insights arising through the “divergent branches” of the sciences and humanities, the volume editors identify questions “at the core of how knowledge is produced” (p. 9). Institutional organizations and resources polarize the humanities and sciences in systemic ways that affect knowledge production. This issue is addressed in the final section of the volume, including chapters by Alexander W. Cowan (“The musical mind is the normal mind”) and by Patrick E. Savage et al. (“Building sustainable global collaborative networks: Recommendations from music studies and the social sciences”). Cowan warns that the problematic universalism now recognized within music science could be superseded by an equally flawed “epistemology of differences.” His chapter highlights the inescapable elision of the scientific and the political, pointing to research on the work of Seashore (Koza, 2021).

Such politically engaged music research can, of course, be generated only through mutually comprehensible dialogue, and must face outwards beyond academic institutions. Yet, as the editors explain, more productive dialogue is needed even within academic institutions: “Humanities and scientific approaches to music *must* interact for new and potentially transformative insights to occur within their own domains, let alone insights that transcend them” (p. 3). The editors explain how this requires researchers to go “beyond imagining that humanities expertise exists either to serve science or to critique it” (ibid.).

The challenge goes deeper still. For such dialogue to progress within and communicate beyond niche academic and research environments, research processes need to be both participatory and representational. These structural changes require both individual- and institutional-level commitments to counter complex and entrenched forms of systematic discrimination. Savage et al. take up the baton, with a list of recommendations to address problems of diversity, logistics, comparative research, and incentives for sustained and sustainable change. The list only begins to articulate and therefore challenge discriminatory institutional and knowledge-production structures; if such changes seem like a “revolution,” Cowan (p. 326) suggests that this might be what it takes to begin “to catch up with the intellectual and political demands of modern life” (ibid.).

Of course, polarization of the field cannot be attributed solely to institutional cultures and resources. In the service of learning and discovery through knowledge-based practices, different methods are afforded by different disciplines. But these are not generated simply to pursue the “same thing” with alternative tools. Rather, the remit of artistic, humanistic, and scientific modes of enquiry cast their own objects of investigation. In the organization of this volume, the editors have

devised various strategies to avoid the perils of uncommunicative juxtaposition between disparate disciplines.

The first organizing principle is to headline a series of powerful folk-beliefs – myths – about the nature and manifestation of musical experience. Chapters within each section reflect on inconsistencies, falsehoods, and solutions by engaging in a different mode of critique. The result is that each section in turn presents an incremental journey across a spectrum of epistemic reasoning, exploring the history, current status, and future of the given scientificism. Second, the editors have interleaved thematic sections of scholarly discourse with transcribed interviews and some more personal, reflective styles of writing. For example, luminary Diana Deutsch offers her personal perspective on over thirty decades of “Music theory and experimental science”; and an interlude called “Conversations with Pamela Z” is vivid and joyful, effortlessly explaining the artist-musician’s lived experience of their craft. This editorial decision allows researcher subjectivities to emerge clearly, bringing a welcome and humanizing transparency to the volume, and bringing the site of debate into the eponymic borderlands. While some chapters have the feel of “interludes” (and it is not always so clear why other interludes are not chapters), the overall result of the editors’ organizational choices – to me, at least – has the effect of highlighting the subjective shifts of perspective, which in turn supports the communication of complex ideas as expressed by disparate disciplines.

The volume includes a substantial single index that combines both authors and subjects, and this produces some incongruous imagery: “tree diagrams (Lerdahl)” is followed by “tree-hole frogs (*Metaphrynella sundana*), instrumental music by”; later, “Nietzsche, Friedrich” follows “Niche construction (radical),” then, “nightingale.” The space given over to birds is quite unexpected. Subsections for each of “birdsong” and “songbird,” for example, duplicate entries alongside the appearance of many individual species. Some other features of the index also feel a little surprising; for example, the rather disjointed inclusion of “variability” has multiple citations, yet the entry for “bias” appears slender. This could surely have yielded a much more productive index subsection because one of the most important contributions this volume makes is in surfacing and naming bias as it arises across music science: anthropocentrism, logocentrism and linguo-centrism, positivism, avian bias (biomusicology), ableism, racism, state bias (neuroscience), and so on. I noticed also that both “sound” and “sound studies” elude the index; this is a topic that I will come back to.

The editors and contributors traverse significant terrain in this book. In choosing to directly address certain “myths” of music science, they engage in important and bold critique of many core concepts normally accepted across the music sciences and humanities. The first section, “Beyond Nature vs. Nurture,” includes four chapters that collectively challenge the persistent view that exclusive mechanisms of biology and culture should compete to explain musical phenomena.

Anticipated by Cross (2003), gene–culture coevolution now offers the strongest account by which to understand the emergence of human musicality. The significance of this for future research in music science is made very clear within the contemporary global context of “big data,” where the accelerated power and capacity to model the interaction between genes and cultural traits offers new possibilities to understand musical behavior (Mehr et al., 2019; Savage et al., 2015).

Chapter 1, “Human musicality and gene-culture coevolution: 10 concepts to guide productive exploration” by neuroscientist Aniruddh D. Patel, sets out a guide for interdisciplinary adventurers and establishes the first definitions: *Music* is a socially constructed category (one for the humanities); *human musicality* describes “spontaneously developing cognitive, sensorimotor, and affective capacities supporting human musical behavior” (p. 19), as a definition for the cognitive sciences. Patel takes care to distinguish “human musicality” from colloquial use of the term “musicality,” the latter understood to connote a special interest or talent.

In chapter 2, “Musical meaning in transspecies perspective: a semiotic model,” Gary Tomlinson articulates “the problem of our abiding linguocentrism” (p. 39), illustrating this with reference to the complex combinatoriality of birdsong. Birdsong, explains Tomlinson, is not compositional. It is not symbolic – its meaning is not dependent on its play within arrays – rather, it is *hyperindexical*: It has combinatorial syntax, but its meaning arises in situated, niche-constructive processes (p. 49). This indexicality, argues Tomlinson, is the type of semiotic that is pervasive in music. “The specifically human outgrowths of semiotics manifested in language,” explains Tomlinson, “have been taken as the major transition (Szathmáry & Smith, 1995), when it is the far broader advent of meta-relation, signs and interpretant, today spanning thousands of species, that deserves the name” (p. 52). Such original, exemplary interdisciplinary research counters both anthropocentrism and the linguocentrism that is rife in music science’s historical preoccupation with computational, musical grammars of tonal harmony. This is an important point revisited in a later chapter in this volume by Jonathan De Souza, citing the work of Nicholas Cook (2007) and Philip Ewell (2021) to identify the legacy of Henrich Schenker’s anti-democratic worldview and its association between musical, social, and racial hierarchies (p. 139).

Rachel Mundy’s chapter, “Humane treatment, sound experiments,” contextualizes the historical legacy of science that surrounds and shapes our current understanding of the music of animals. Explaining how today’s notion of research ethics is connected to a complex history of racial science (p. 102), Mundy’s research explores the legacy of a “postwar division of music into human culture, on the side of the humanities, and animal bodies, on the side of the sciences” (p. 105). Mundy further observes how “humanists [...] have become so skilled in mapping our ignorance, and scientists [...] excel at mapping what we can know” (p. 107). It is the case that, supported through editorial

decisions, the contributions in this section do help to shine light into a number of voids within music research.

Mundy’s words also bring to my attention an area of the borderlands at which this insightful and progressive volume only glances. The absence of “sound” or “sound studies” in the index confirms the sense that there is little direct attempt here to explore directly and critically what connections exist between musicality, art, and aesthetics more broadly – beyond sound. The excellent closing chapter, “Conversations with Steven Feld” (comprising transcriptions of interview-type dialogue) provides an exception to this critique. Feld uses both “sound” and “music” precisely, distinctly, and purposely, rendering vividly the particular types of question that his anthropological, experiential knowledge motivates. The first section taken as a whole, however, does not apply similar critical attention; “music” elides with “sonics” and “sound” without comment. As a result, sound and music are presented either as self-evidently synonymous or as self-evidently distinct. For example, a chapter on cross-species research (“Cross-species research in biomusicality: methods, pitfalls and prospects” by Diandra Duengen, Mariannem Sarfati, and Andrea Ravignani), is notable for its rich and informative survey and for how robustly the authors address the complex anthropocentric legacy of biomusicological research. However, there is no explanatory comment on their use of “music” at the outset, moving to “sound” in the later part of the chapter.

The section altogether articulates and challenges important assumptions, yet the impression remains that one common object of musical enquiry – namely, music as the sonic form of art – is pervasive across interdisciplinary divides. Carmel Raz’s subsequent interlude, “Of Sound Minds and Tuning Forks: Neuroscience’s Vibratory Histories” emphasizes the lasting legacy of early theories on sonic effect on the development of modern neuroscience and the conflation of electrical and acoustical nerve stimulation. Raz calls out the eighteenth-century “well-known fact” about music’s powerful affectivity, as “consisting, physically, of nothing more than sonorous vibrations” (p. 122) – but neither Raz nor the editors quite call into question the deep association of this assumption with a persistent belief in music’s primary value as one of auditory aesthetic transcendence.

The second section, “Beyond Music as a Window into the Mind,” includes chapters by Jonathan De Souza (“Music, mind, body and world”); Maria Witek (“Rhythmic entrainment and embodied cognition”); Haley Kragness, Erin E. Hannon, and Laura K. Cirelli (“The musical mind: Perspectives from developmental science”); and Jim Sykes (“The science of music is about relations”). Introducing this section, the editors highlight the persistent myth of music’s vaunted position as a pure, transparent medium via which cognitive science should be able to read the workings of the human mind.

Within this section, Witek’s chapter, “Rhythmic entrainment and embodied cognition” includes the volume’s only reference to sound studies as a relevant extant field of study. Clarifying the possibilities for antirepresentationalism in music and sound studies, Witek advocates for an enactivist

approach that can redefine mind “as equally distributed among neural, corporeal, and environmental systems” (p. 162). The primary reason for taking this view is to bring theory into better alignment with lived experience, potentially providing clearer routes for interdisciplinary research. I would note, too, that this has the further advantage of a more inclusive basis to recognize and value music’s aesthetic function within social and situated multimodal communicative contexts (see, for example, the work of Ruth Finnegan (Finnegan, 2014)).

The volume editors explain how such approaches within cognitive science draw on systems dynamics, and emphasize interaction and emergence. This is seen by advocates as an important counterpart to “the modern paradigm of experimentation as hypothesis testing [...] where ability to produce results exceeds the ability to explain them” (p. 130). Indeed, this central portion of the edition provides substance and coherence to the volume overall. De Souza’s historical account of music in material, situated practice reveals both over-representation and also misrepresentation of musicking in scholarly and scientific discourse, and the subsequent chapter (“The musical mind: Perspectives from developmental science”) recalls and substantiates Witek’s arguments. This contribution by Kragness, Hannon, and Cirelli situates evidence for the developmental emergence of engagement in musical behaviors within current scientific contexts: “Development occurs across multiple domains, it is not simply the unfolding of continuous or static capabilities, and individuals shape their own musical experiences” (p. 193). All told, the contributions here communicate emphatically how researchers need to be proactive in moving beyond the spectatorial approach to music science, by recognizing the need to integrate and reconcile the findings of distinctly reductionist and ecological approaches.

And thus, to the third section, “Beyond Reductionism,” including chapters by Jamal Williams and Matthew Sachs (“Combating reductionism in music neuroscience with ecologically valid paradigms: What can (and cannot) be gained?”); Grace Leslie (“Composing at the border of experimental music and music experiment”); and Sarah Faber and Randy McIntosh (“Hidden repertoires in the brain accessed by music in aging and neurodegeneration”). Taken together, these chapters articulate both the power and the limitations effected by the prestigious essentialism of neuroscience as a field. Faber and McIntosh report on the development of neuroscientific measures that move beyond neuroessentialism to understand the brain as a complex and adaptive system. Identifying the particular implications of a complex systems framework for music neuroscience, they note the possibilities of multiscale entropy and hidden Markov modeling. Musical experience can similarly be understood as a temporal complex system, simultaneously recruiting multiple systems that include not only perceptual and motor networks but also “linguistic, social and emotional components” (p. 274). Williams and Sachs open with the observation that “methodologies,

tasks, and stimuli” are separate components that may lie differentially on the continuum of ecological validity and experimenter control (p. 241). Situating the powerful project of neuroscience and its materials firmly in a pragmatic reality, they show how the ultimate power and utility of research evidence for music science rests on conceptual decisions that people make about study design.

The fourth and final section, “Beyond Musicians and Non-musicians,” explores the myth with perhaps the most impact on the way that music science appears and operates today. As the editors explain, music science’s “reliance on a dichotomy between musicians and non-musicians, and the misunderstandings that accrue as a consequence, exemplify the need for an interdisciplinary dialogue” (p.311). Beatriz Ilari and Assal Habibi contribute the chapter, “The musician–non-musician conundrum and developmental music research.” Alongside Cowan’s contextualization of Seashore’s musician-ship revision project, Ilari and Habibi’s contribution provides this volume with an outstanding contextualization of scenarios that affect the business and outcomes of music science. The pursuit of a categorical distinction between musician and non-musician, Ilari and Habibi explain, is driven by research design that requires operationalized measures of individual difference, which are reduced from a complex array of skills and experiences. Solipsistic reductionism may enable research output production, but it seems unlikely to increase knowledge and understanding of the crucial, current view of musical experience identified by the editors, that of “musicality as an emergent property of the developing mind and body” (p. 4).

Conclusion

Overall, this forward-looking volume conjures a fantastically thought-provoking vision of music scholarship and science, with the editors’s organizational decisions inviting readers to manoeuvre between one vantage point and another. The editors rightly note concern about the risks of “forswear[ing] vast fields of inquiry because of particular problems or challenges” (p. 3), emphasizing how important this is given the polarizing effects of short-form social media where so much academic discourse may now be played out. The important inclusion in this volume of science and technology studies research, however, illuminates disconcerting critical shortfalls in the status quo. It is now well understood that music research benefits from the mutual acceptance of positivist and interpretivist approaches. But on the basis of such contributions as chapters by Cowan, Mundy, and Savage et al., it seems clear that the value of future music research rests on further conceptual and methodological recalibration, in order for the interdisciplinary field to connect on issues about music which claim global relevance and impact.

This book’s imaginary view of the science–music borderlands brings to my mind the astronaut William Ander’s 1968 photograph, “Earthrise” (Poole, 2008). The image shows us a deep, dark expanse and an illuminated gibbous body. At first, the image feels comforting and familiar. But what we are looking at is not the moon in

the night sky, but a tiny, fragile, green-blue planet. That precarious place, those invisible specks: That's you, and me, and eight billion other humans, among eight million other species. A reminder that the study of music is a collective enterprise, nourished by scientific, and humanistic, and aesthetic modes of expertise originating from a multitude of lives and experiences.

Action Editor

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