Aniruddh D. Patel, *Music, Language and the Brain.* Oxford: Oxford University Press, 2008. ISBN 978-0-19-512375-3 (hardcover) 520 pages $62.95.

Exploring the possible parallels in the origins, structure and function of music and language has been a recurring topic for music philosophers, theorists, performers, anthropologists, psychologists and scientists for centuries. The challenge for all of these previous attempts has been to develop a common set of principles, terminology and definitions that can serve as valid points of comparison in each domain. This book offers a unique perspective on the topic by combining a wealth of empirical knowledge from both linguistic and musical domains with the added contribution of cognitive neuroscience. Written by a first-rate scientist, *Music, Language and the Brain* is the most comprehensive and clear treatment of the sometimes patchwork body of knowledge exploring music and language comparisons within music psychology and neuroscience. Patel's book makes an immediate and important contribution to the vast array of literature in this area by bringing it together in a single source. It is all the more impressive because of the author's ability to present this complex web of scholarship in a very logical and highly readable style.

Perhaps the most notable aspect of the book for those of us engaged primarily in music research is the thorough attention paid to the theories and methods of psycholinguistics. While the book still tilts toward explorations of musical phenomena, Patel contextualizes those discussions by regularly bringing in linguistic models and theories of language as a point of comparison. Few have his command of the research literature in both areas, so the book provides a valuable reference or those of us who have explored some aspect of a music and language comparison, but without the deep background in language research. This results in an economical yet comprehensive treatment of many of the central issues in the field.

Despite the breadth of topic, the author often spends time presenting sophisticated analyses of certain arguments and engages in some internal debates about the strength of various positions. He is always careful to present opposing views from both fields of study, though sometimes one wished for a more thorough fleshing out of the arguments against a music and language connection in order to better understand the strength of the position the author was taking. I had the opportunity to use the book in a graduate seminar I team-taught this year and found that it offers something for readers at many levels of expertise. One benefit for students reading this text was the number of very clear and well-reasoned suggestions Patel makes for future research in the field. His research suggestions are not just general ideas, but proposals worked out to an initial design level so the reader can see how they might provide a critical test of the ideas he is presenting. These ideas generated a lot of discussion and interest in the seminar and provided very specific ideas for the students to grapple with as they tried to assess the validity of the various arguments presented.

Organization

After a brief introductory chapter, the book moves from the fundamental sound elements underlying both music and language to the rhythmic and melodic properties of the two domains and then on to higher-level structures of syntax and meaning. The final chapter discusses the potential evolutionary basis for both forms of human expression. Patel states in the introduction that he plans to approach the comparison of music and language by emphasizing "commonalities over differences" and that the two domains "although having specialized representations…share a number of basic processing mechanisms" (p. 4). This is the central thesis of the book and Patel is successful at making a case through his own work and the work of others for the possible existence of several of these shared mechanisms. This purpose becomes somewhat confounded with another message that runs through the book, that music and language are closely related. Patel provides a two-point summary of his fundamental message in two sentences in the afterward:

> 1. As cognitive and neural systems, music and language are closely related.
> 2. Comparing music and language provides a powerful way to study the mechanisms that the mind uses to make sense out of sound. (p. 417)

A review of the book by Steven Brown published in *Trends of Cognitive Sciences* (2008) suggested that Patel does more to argue for a music of language than a language of music. Brown's point was that Patel was successful in highlighting some of the properties of sound that might underlie both

music and language, but less successful in arguing for shared linguistic aspects of music such as syntax or semantics. I agree with him, but my reading of the book was that Patel isn't arguing for either a music of language or a language of music, at least not directly. His central thesis is that these two important forms of human auditory expression might share some underlying neural architecture. The book is at its best when examining those connections, some of which Patel has explored through his own research, such as linguistic rhythms in instrumental music (Patel & Daniele, 2003). I think that it is possible for the second point of Patel's message to be true without the first statement being true. The two domains could share certain fundamental sound processing mechanisms, which is parsimonious from a cognitive neuroscience standpoint, but with functional differences that are so significant they far outweigh the similarities. Does a shared neural resource equal a close relationship between domains of thought? The answer would seem to be no if we only share resources for basic auditory processing such as timbre or frequency, but could be yes if we share neural resources for processing relationships between more complex information such as that suggested by a musical syntax or metric structure.

SOUND ELEMENTS: PITCH AND TIMBRE

This is the most impressive and perhaps intimidating chapter in the book. The author does a masterful job of laying out the sound elements in each domain, the key terminology used and how both have been studied. He then presents careful arguments for linkages between the two systems based on both neurological and behavioral evidence. He avoids the common traps of trying to draw any direct analogies between elements of sound in the two domains (e.g. tones and phonemes) and clarifies the differing importance of timbre and pitch information between the two. He offers specific evidence for possible linkages and cross-modal influences between music and language in the areas of reading development and categorical perception. Two notable features of this chapter that continue throughout the book are a) the use of sound files to augment specific examples via a web interface (http://www.oup.com/us/companion.websites/9780195123753/examples/?view=usa) and b) the use of musical examples from a variety of cultures to illustrate his point. For example in section 2.3.3 on page 62 he discusses the possibility of mapping linguistic timbre onto musical sounds based on tabla strokes and the vocables used to teach them which are presented aurally in sound examples 2.3 and 2.7 respectively. This combination of aural examples and a more global view of music helps to strengthen the argument for any linkages between music and language systems in the brain since any such system needs to function across cultures.

RHYTHM AND MELODY

In both of these chapters, Patel begins by identifying key differences in how rhythm and melody operate in music and language before he gets into to proposing where some common elements may exist. In the rhythm chapter he starts with a definition of rhythm that addresses the role of periodicity as a fundamental aspect of most musical rhythm that is not commonly featured in language rhythm. As he states, "Although all periodic patterns are rhythmic, not all rhythmic patterns are periodic." (p.96) After reviewing important research in each domain, he goes on to present potential connections in relative timing (nPVI) and grouping perception and calls for more direct comparisons of the perception and production of musical and speech rhythm in neuroscientific studies.

The chapter on melody begins by clarifying how the terms are employed in each domain and how they differ. Patel chooses to focus on linguistic intonation as distinct from lexical pitch contrasts found in tone languages (Chapter 2) or affective intonation, which he leaves until the chapter on meaning (Chapter 6). Linguistic intonation refers to the rise and fall of speech melody that reveals structural information by providing accent and boundary information. He introduces some linguistic approaches for analyzing the frequency relationships of linguistic intonation and eventually looks at how such methods could be employed to search for common elements in melodic contour perception. He focuses on the apparent dissociation of musical and linguistic intonation perception in amusics (Peretz, 2001) and offers solid ideas for exploring the nature of that dissociation in ways that may reveal an underlying similarity in processing. This provides another example of the strength of this book. Because of the author's knowledge of research in both areas and his background in neuroscience, he is able to present novel approaches for identifying possible shared processing between the two domains.

SYNTAX AND MEANING

As the book moves from sound elements to higher order relationships of music and speech the differences between music and language seem to become more and more pronounced. I confess some disappointment in the chapter on syntax, an area thought by some to be the most promising point of connection between music and language. Patel does an excellent job of representing the special nature of linguistic syntax, and he has done some interesting research in the area of music syntactic processing. However, he constructs an argument for shared syntactic processing based almost exclusively on music research devoted to Western tonal harmony. While most of the extant music research is in that vein, it has fostered some misleading ideas about the importance of harmonic relationships to the perception of music, which would exclude much of the music from the rest of the world. This is particularly surprising given the care that the author takes to use examples from other cultures throughout the rest of the book. For example in Chapter three he states that, "only a comparison of different cultural traditions can help sift what is universal from what is particular." (p.97). Such crosscultural comparisons would seem to be key to any theory of shared syntactic processing as well. One of the key aspects of linguistic syntax that makes it so powerful from a cognitive standpoint is that every language, not just English or French or German, shares certain underlying syntactic structures. While Western tonal music is certainly prevalent in the world and perhaps the most successful export of our culture (after blue jeans), it is a far from typical example of the majority of world music. If harmonic function is a prerequisite for meaningful comparisons of syntactic processing in music and language, then the argument for a connection between the two domains on a neurological level is severely weakened because the majority of the world's musical systems don't employ functional harmony. Patel makes this very point when discussing tonal language studies that focus on Mandarin because of the number of people who speak it: "A focus on Mandarin might lead one to think that level tones are unusual in language…the truth is in fact the reverse: The great majority of tone languages have *only* level tones," (p. 41). Similarly, research into the cognitive neuroscience of music that focuses on brain responses to functional harmony may not offer much in terms of general principles for how the brain organizes musical information, since most cultures seem to organize their music in other ways. This highlights the danger of confusing a well-known example of a phenomenon with a *typical* example.

The chapter on meaning begins by differentiating between translatability and significance as Patel tries to clarify issues around the use of the term meaning in both domains even delving into a discourse on "what does one mean by meaning" (p.303). He suggests that music's ability to cross cultural boundaries more easily than language rests not in a shared understanding between cultural insiders and outsiders, a view confirmed in my own research (Demorest et al., 2008), but in an ability to perceive structure and significance from a musical utterance even if the interpretation is "wrong" from an insider's point of view. In this way, he seeks to establish a different set of criteria for the meaning of music. He then delineates eleven ways in which musical meaning has been discussed historically by scholars from many fields of music with a focus on music's ability to engender emotional responses and studies of imagery and identity. In order to draw parallels to language, he separates linguistic meaning into semantics (the meanings of words and propositions) and pragmatics (meanings constructed through contextual information and inferencing). He first presents some of the literature that has attempted to find connections between the semantic meaning of music and language including recent event-related research work exploring N400 responses (Koelsch et al., 2004). N400 responses have been observed when subjects are engaged in semantic processing of language and vary in magnitude based on the semantic predictability of a word. Patel points out potential challenges with proposed semantic connections in music, including the observation that "to date there are no published studies showing that music alone can elicit an N400" (p. 335). Patel instead focuses attention on potential connections between musical meaning and pragmatic meaning in language based on the perception of coherence in linguistic discourse. This provides another example of how the author's understanding of research in both domains leads to more nuanced arguments regarding potential connections between them rather than relying on more traditional (and less musical) views of linguistic meaning.

EVOLUTION

The strength of this chapter is Patel's ability to again bring together a wide variety of linguistic and musical sources in discussing the possible evolutionary basis for the two domains. He concludes on the basis of a lengthy and well-organized review that the evidence for language as a biological adaptation is overwhelming while the case for music is significantly weaker. His overall conclusions are in line with

many scholars in both fields, though there are still significant arguments about language as a biological versus cultural phenomenon. Given the careful presentation of the component elements of each domain in the first six chapters, it was surprising to hear them discussed as more global monolithic structures with regard to evolution. As Patel points out for language evolution "'natural selection for language' really refers to selection for the ability to acquire language." (p. 358). This chapter would seem like an excellent opportunity to circle back to some of the fundamental processing mechanisms described in chapters 2-4 and posit possible evolutionary ties in terms of the survival value of superior auditory processing that may have served as a source for the ability to acquire both forms of human expression regardless of whether biological or cultural factors ultimately drove their development. One real strength of the chapter is his careful reading of and counterarguments for the music literature in support of an adaptationist perspective. He offers several propositions or predictions that would need empirical support before the case for music as an adaptation could be made.

Conclusions

When we began our seminar this term, my colleague in psychology offered a relatively clear list of the properties that define certain sounds as language and conversely exclude other forms of auditory expression as non-linguistic. He asked if we might provide a corresponding definition to delimit music. Suffice it to say, we were unable to come up with a clear set of defining terms. Patel acknowledges this difficulty and agrees with Nettl (2000) that there are no true sonic universals in music. We might go on to say that there appear to be no universal relationships or structures that can clearly distinguish musical sounds from non-musical ones and we are left with definitions like those cited by Patel (p. 12) that focus on intended or perceived aesthetic effect. This difficulty in constructing a clear definition of what constitutes music may be at the root of why comparisons between the two domains are such a challenge. Even if we acknowledge the rich history of language research and the primacy of its position in psychology and cognitive neuroscience relative to music cognition research, we must consider that a careful scientific study of music needs to be able to define more carefully what phenomenon is under study.

I came away from the book with two strong impressions. One impression is that, based on what Patel has presented here, music as it is currently practiced by humans can never be considered a language, at least not in any traditional sense. While both domains are rule-driven and may rely on some similar cortical resources for sound processing and pattern detection, they seem fundamentally different in terms of the way their constituent elements relate to each other in cognition. While we may continue to use linguistic terms like syntax and semantics to describe certain musical relationships, it is clear that those relationships do not operate in remotely the same way in musical thinking and organization. In chapter six Patel states, "At a very general level, one can view different languages as different ways of achieving the same thing: the transmission of certain basic types of meanings between individuals."…"Music does not bear these kinds of meanings. Furthermore ethnomusicological research suggests it is unlikely that different musics are different ways of transmitting *any* basic common set of meanings." (p.301). A second impression is that it makes sense that our brains evolved with sound processing capabilities that are not entirely domain specific, or put another way, that these two forms of human expression did not evolve out of entirely separate neural resources. The challenge comes in identifying the points at which they intersect or diverge within our thought processes and what that tells us about the nature of each domain and about the functional architecture of the brain. This book provides an important first step in laying out the issues central to such research in a clear, concise and accessible way. I am certain I will find myself returning to this resource many times.

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