

Aniruddh D. Patel (2008). *Music, language, and the brain*. Oxford: Oxford University Press. Pp. xi + 513.

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Parallels in the sound patterns, structure and origins of language and music have fascinated intellectuals for centuries, but empirical study of connections between these two domains has only recently been undertaken in earnest. *Music, language, and the brain* provides a fascinating synopsis of the current, young state of scientific research in cross-domain language–music comparative study. The book traverses with ease the disciplinary lines of linguistics, music and neuroscience. This impressive work of scholarship will serve as a reference on the topic for years to come.

For any linguist with a primary research interest in, or desire to understand, speech prosody, this book is a must-read. The work will also be of great interest to laboratory phonologists, regardless of their specific research area, due to its impressive synthesis of a broad base of empirical literatures across phonetics, phonology, psycholinguistics and neurolinguistics. Linguists from any area of specialisation who wish to understand points where language and music do, and do not, intersect, will find this book useful, and it will be a tremendous resource for the student inquiring about comparative language–music topics. Finally, students stand to benefit particularly from the book, which is chock-full of out-of-the-box research and dissertation ideas.

The book is organised into seven chapters, which can largely be read on their own and are accessible to anyone with training in linguistics (or music). Chapter 1 lays some groundwork, for example establishing that both music and language are universals: both appear in every human society, regardless of what other aspects of culture are absent (Nettl 2000, Everett 2005). Two aspects of the book's orientation are also laid plain. First, it focuses on the relationship between purely instrumental music and ordinary spoken language, rather than e.g. poetry. Second, the book avowedly seeks commonalities between music and language, rather than emphasising differences; nevertheless, it seems nowhere to exaggerate these shared aspects, and in some cases may actually underestimate them (see comments below).

The chapters that are most directly relevant to phonology are Chapters 2 (on pitch and timbre), 3 (on rhythm) and 4 (on melody). Chapter 2 compares sound elements in music and language, focusing on the roles of pitch and timbre in each. Both speech and music are noted to be 'particulate' systems, in which a set of discrete elements of little inherent meaning are combined to form structures with a great diversity of meanings. The chapter highlights an important difference between the two domains, namely that timbre (cf. spectral contrast) is the primary dimension for organised sound distinctions in language (cf. phonemic contrast), whereas sequences of organised timbral contrasts are quite rare in music. Conversely, the chapter highlights a hypothesised central link between domains, namely, shared mechanisms for sound-category learning via statistical learning of acoustic exemplars, which is thought to underlie the

formation of category representations both in language (Kuhl *et al.* 1992, Saffran *et al.* 1996, Maye *et al.* 2002) and in music (Krumhansl 1990, Huron 2006).

Chapter 3 focuses on rhythm in music and language. By way of introduction, the term 'rhythm' is first described as 'the systematic patterning of sound in terms of timing, accent, and grouping' (p. 96), a definition that deliberately leaves out periodicity. Indeed, the chapter takes great pains to downplay periodicity in language, likely due to adverse initial reactions some will have due to its associations with acoustic isochrony (equal intervals) in speech, which figured prominently in the genesis of historically important characterisations of languages as stress-timed, syllable-timed or mora-timed (Pike 1945, Abercrombie 1967), but which has since been disproved as such (e.g. Beckman 1982, Roach 1982, Dauer 1983). Next, four key attributes of (most) musical rhythms are identified: multiple levels of periodicity (i.e. metre), grouping, durational patterning and the presence of a beat. Transitioning to formal phonology, potential connections are considered between musical grouping and prosodic hierarchy theory (e.g. Nespor & Vogel 2007), and between musical metre and metrical phonology (Lieberman 1975, Selkirk 1984, Halle & Vergnaud 1987, Halle & Idsardi 1995). Patel expresses some scepticism concerning the validity of connections based on the latter approach, noting that the premise of stress periodicity underlying much work in metrical phonology has roots in musical intuitions (cf. Liberman 1975), rather than hard measurements. He argues instead for focusing on comparisons of *non-periodic* aspects of rhythm across language and music, and for pursuing these comparisons using laboratory phonology methods. In support of this proposed focus, Patel cites a number of examples of musical traditions that lack an isochronous beat or pulse (e.g. Ghanaian drumming, Balkan folk music), in contrast to most Western music. He also cites non-periodic attributes which have been fruitfully compared across both linguistic and musical rhythmic domains, which include estimates of temporal contrast or variation as captured in the normalised pairwise variability index, for example (Low *et al.* 2000, Patel & Daniele 2003; see also Ramus *et al.* 1999), and perceived grouping of non-linguistic tone sequences as a function of linguistic experience (Kusumoto & Moreton 1997, Iversen *et al.* 2008; cf. Jakobson *et al.* 1952). With respect to the periodicity issue, the evidence is clear that normal, spoken language does lack acoustic isochrony (e.g. Beckman 1982, Dauer 1983). However, Patel suggests on pages 143–144 that there may be a productive role in spoken language for *perceptual* isochrony (cf. Lehiste 1977), a proposal supported by recent work (Dilley & McAuley 2008).

Chapter 4 is on melody in speech and music. The chapter starts by highlighting obvious differences between musical and spoken melodies, namely that the former are built around a stable set of pitch intervals, whereas the latter are not. Nine properties of musical melody (e.g. grouping structure, motivic similarity, pitch hierarchy) are then reviewed; it is clear from the discussion that some, but not all, of these can be related to aspects of linguistic melody. Next, two approaches to speech melody are considered, chosen for their relevance to comparative speech-music research. The first is autosegmental-metrical (AM) theory (cf. Bruce 1977, Pierrehumbert 1980); a concise, but perhaps too brief, overview of the theory is given, which may leave some unsatisfied, but readers are referred elsewhere for details. Patel takes a positive approach to describing

potential connections between AM theory and music, citing the underlying notion of a 'pitch-event hierarchy' in AM theory as the central link that might be made; for a more thorough treatment of possible connections between AM theory and aspects of musical structure, see Dilley (2005) and Dilley & Brown (2007). The second theory is that of the Institute for Perception Research (IPO) in the Netherlands ('t Hart *et al.* 1990). This is a phonological approach (cf. Ladd 2008), but one which is based in perception; it is suggested that this could be an especially fruitful approach to music–language research. Patel is aware of the controversy concerning whether intonational primitives are movements or discrete tones (cf. Dilley *et al.* 2005), suggesting that AM theory and the IPO approach are not irreconcilable. This is likely true, but no reconciliation of views has yet appeared in the literature. Finally, he cites statistical learning of melodic intervals and melodic contour (i.e. pitch up–down patterns) as key links between music and language, identifying a number of promising areas for future comparative language–music research.

Chapter 5 focuses on syntax in language and music. The chapter first briefly mentions the famous lectures on the topic given by Leonard Bernstein at Harvard in 1973, the arguments of which ultimately have not been convincing to scholars. That said, 'musical syntax', as defined in the chapter, refers to the principles governing the combination of discrete structural elements into sequences. The vast majority of the world's music is syntactic, in the sense that it is comprised of perceptually distinct elements (e.g. tones with distinct pitches) with norms for combination of these elements into sequences. Syntactic combinatorial rules (e.g. scale, chord and key structure) that enter into the sequential construction of Western tonal music are then described, followed by a discussion of similarities and differences in syntactic properties of music and language. The most obvious difference is the presence of grammatical categories in languages (e.g. nouns and verbs), which have no counterparts in music, while similarities concern the fact that the formal structure of both musical and linguistic syntax is both hierarchical and logical. The final part of the chapter focuses on neurolinguistic evidence concerning syntactic processing in language and music, discussed with respect to the 'shared syntactic integration resource hypothesis'. The hypothesis proposes that there is overlap in the neural areas and operations that provide the resources for difficult syntactic integrations in music (e.g. processing sequences of chords that violate normal harmonic expectations) and in language (e.g. processing reduced relative clauses).

Chapter 6 focuses on meaning in (instrumental) music and (ordinary spoken) language. It is here that the links between language and music seem most tenuous compared with topics in other chapters, due exclusively to the early stage of research in this area. Certain challenges to making connections are clear. First, unlike language, music does not allow a way to refer to specific entities or concepts (e.g. 'sister', 'love'), or to enable the asking of questions or expression of wishes. Furthermore, it is unlikely that there will be a consensus on a common set of meanings across musical genres or cultures, e.g. the assertion that music is 'always about emotion'. The links that seem most compelling come near the end of the chapter, when empirical work on perception and neural correlates of emotion and affect in both language and music is reviewed; Patel convincingly argues that this is probably the most promising point of contact between musical and linguistic meaning. It is clear there is still much to be understood about this topic.

Chapter 7, the final chapter, concerns evolution. Fascinating questions abound in this section: why are both language and music universal, and why are they apparently unique to our species? Is music an evolutionary adaptation? Is there a direct role for natural selection in shaping human brains and bodies to acquire and use language (cf. Pinker & Jackendoff 2005)? Or are the effects of natural selection on language indirect (cf. Tomasello *et al.* 2005)? A topic which is cited as being of particular importance for future research is whether there is evidence of direct natural selection for music. Based on his review, Patel cautiously asserts that music does not seem to be a biological adaptation. He hastens to add that it is not simply a hedonic ‘frill’, as famously suggested by Pinker (1997), but that instead the dichotomy between ‘adaptation’ and ‘frill’ is probably a false one: music is likely a reflection of human ingenuity, such as written language and aircraft. Furthermore, Patel offers a challenge to those who might argue for music as an evolutionary adaptation: establish the (auditory) domain-specificity of some aspect of music cognition, its uniqueness to humans and its *lack* of a relationship to language. He suggests that a widespread aspect of musical rhythm that might qualify in this regard: beat-based rhythm processing, i.e. perception and production of a rhythmic, periodic pulse. To wit, every culture affords some form of music with a regular beat (cf. Nettl 2000), but there is little evidence of beat-based rhythm processing in language. At the time of the book’s publication, the evidence was equivocal whether beat-based rhythm processing could reflect selective adaptation for music, but Patel and colleagues have subsequently reported evidence to the contrary (Iversen *et al.* 2009, Patel *et al.* 2009).

In sum, *Music, language, and the brain* provides a fascinating review of empirical evidence for, and against, music–language connections, crossing major disciplinary divides and significantly advancing research in this area through its impressive synthesis. In my opinion, this book belongs in every linguistic library and in most linguists’ personal collections. For those with at least a passing interest in music–language connections, this book will significantly broaden horizons. For those with a serious research interest in this topic, the book will be an invaluable reference to return to time and again.

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