Book review: ANIRUDDH PATEL, Music, Language, and the Brain. Oxford: Oxford University Press, 2008. 513pp. ISBN 9780195123753

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ANIRUDDH PATEL, *Music, Language, and the Brain*. Oxford: Oxford University Press, 2008. 513pp. ISBN 9780195123753

Language and music constitute two parallel domains of human achievement which share fundamental cognitive and neural resources. Such is the hypothesis of Patel's book *Music, Language, and the Brain*, a scientific *tour de force* which examines the intersection between these two domains. As the Ester J. Burnham Senior Fellow at The Neurosciences Institute in San Diego, California, and a pioneer in the field of music and neuroscience, Patel brings considerable expertise to this complex inter-disciplinary enterprise.

Monumental in scope and in proportion, the value of this volume as an academic resource is immense. A vast amount of research is packed into its 513 pages and Patel demonstrates perspicacity and clarity of expression throughout. The book divides into seven chapters, each of which focuses on a single topic. The first, a brief introduction, is followed by a discussion of sound elements, rhythm, melody, syntax, meaning, and evolution in subsequent chapters. Each starts with a comprehensive review of music and language relevant to its topic before focusing on some aspect of the shared resource hypothesis. Although each chapter stands independently, the book as a whole could benefit from more dialogue between chapters: It is possible that music and language are not carved at the joints as neatly as this book suggests.

Whilst the notion of overlap in cognitive processing is somewhat controversial – language and music have traditionally been thought to occupy left and right brain hemispheres respectively – Patel is anything but polemic in this discourse. He carefully considers both sides of the argument and is cautious not to overstate his case. Patel also extends the discussion of music and language well beyond the established areas of syntax and meaning into less familiar areas such as pragmatics, phonology, and timbre. What follows is a brief review and critique of selected points from the six main chapters.

The second chapter, 'Sound Elements', explores the acoustic, psychoacoustic, and cognitive processes which shape the auditory representation of music and language. The principal argument is that, whilst pitch and timbre are the central auditory features of music and language respectively, they are both processed *categorically*, and it is on this basis that the two domains overlap. For instance, music which is organized around a tonal system will employ a fixed set of pitches, and pitches which deviate in frequency from this set are heard as less exemplary, not unique, members. Similarly with language, phonemes which deviate from a prototype within a given language are heard as less exemplary members. Furthermore, evidence suggests that sound categories in music and language are acquired, rather

than innate. A Japanese neonate is born with the ability to discriminate all possible speech sounds but soon learns to integrate the phonemes /l/ and /r/ into a single category in accordance with its linguistic environment, and thereafter will have difficulty distinguishing the two. This has important implications for musicologists. The tendency to conceive of Western tonal music as a natural system (i.e. derived from the harmonic series or small integer ratios) is long-standing. Here Patel invites us to think of music as a learned system akin to language, with our ears tuned to the music of our own culture. We hear the musics of other cultures 'with accent' (p. 9), as their tuning systems often do not match our own categories of pitch perception.

Later in the chapter, Patel loosens the distinction between music and language on the basis of pitch and timbre. Pitch variation is an integral feature of tonal languages such as Chinese Mandarin, and conversely, certain percussive systems of music, such as the tabla drums of North India, rely on timbral contrasts similar to the phonemes of human speech, as Patel deftly demonstrates through his empirical handiwork. Thus there is more overlap between music and language as sound systems than we generally suppose, though I would stress that similar sounds still serve separate functions in the two domains. In tonal languages, pitch contrasts achieve a genuine phonemic status as they map directly onto semantic representations, but they do not have a tonal function in the musical sense. Similarly, the spectral content of the tabla drums, though similar to human speech, is probably used to convey, at some level, an abstract representation of movement in space over time, similar to that of other percussion ensembles. However, Patel does cite genuine cases, such as that of the Lokele people of the upper Congo, where drums are used to convey, quite literally, the sounds of human speech.

The rhythms of speech and music would appear to provide fertile grounds for comparative research, with the possibility that specific cultures might share similar rhythmic patterns across the two domains. In the third chapter, 'Rhythm', Patel argues that this is indeed the case, although identifying the overlap is no straightforward matter. Despite the widespread belief that languages exhibit periodicity at the level of either the stress or syllable – English and French being examples of stress-timed and syllable-timed languages respectively – very little empirical evidence has emerged to support this. Thus, as a point of comparison, Patel opts for a more abstract statistical measure, one of contrast between successive durations in an utterance, known as the *normalized pairwise variability index* (nPVI). In applying this measure to the French and English languages, Patel shows how they belong to two distinct rhythmic classes, albeit not the stress- and syllable-timed categories cited above. The same measure is then applied to French and English music, revealing a significant correlation between the nPVI of the language and music of each culture and leading to the intriguing suggestion that certain rhythmic features of a nation's language are captured in its music. This innovative research demonstrates the power of statistical measures to find relations where none are otherwise apparent.

The value of this chapter as a resource for musicologists interested in the rhythms of speech is not to be underestimated. Patel provides excellent summaries of highly technical linguistic methodologies, leaving this as perhaps the only source to date which is easily accessible to non-linguists. I would treat aspects of the theoretical

discussion of musical rhythm with more reserve. The discussion contains numerous references to strong and weak beats, the psychological validity of which has been called into question (cf. Hasty, 1997). Likewise, the grid conception of metre as hierarchically related levels of periodicity (Lerdahl & Jackendoff, 1983) represents the temporal experience of music in analytical repose, not necessarily as it is perceived. These small reservations aside, there is much in this chapter which is of real value.

In the following chapter on melody, Patel uses a similar statistical measure to gauge hidden similarities between prosody, the 'melody' of speech, and that of music. By combining the rhythmic nVPI with an index of melodic interval variability (MIV), Patel forges an abstract measure of 'rhythmic-melodic space'. Sure enough, English and French are shown to occupy distinct positions within this space, and the music of these cultures is located near their respective languages. This work is ingenious and the research here is as meticulous as any other chapter, but it brings into focus a broader concern.

The degree of abstraction required to find common ground for melody and for rhythm suggests that the areas with which we traditionally parse music and language as independent domains are not necessarily the best basis for their comparison. Melody and rhythm in music do not have direct analogues in language, just as syntax and semantics are not clearly defined systems in music. Applying these categories too strictly could affect the way we view the subject matter. The study of melody as tonal stability, movement, thematic content, prosodic gesture, and affect is in essence the study of meaning, yet melody and meaning are dealt with here in separate chapters with little reference to one another. Relaxing the boundaries between these topics might be a more efficient approach to comparative research, enabling a clearer picture of overlap and dissociation to emerge.

The notion that music, like language, is hierarchically structured and exhibits non-adjacent relations, functional harmonic categories, and syntactically governed chord progressions, has been the topic of discussion since Lerdahl and Jackendoff's pivotal *A Generative Theory of Tonal Music* (Lerdahl & Jackendoff, 1983). Patel discusses all of these in depth in the chapter on syntax, but his main contribution comes by way of the *shared syntactic integration resource hypothesis*, in which it is argued that music and language share neural resources involved in syntactic processing. This position opposes the received notion in neuropsychology that music and language are processed independently (Peretz & Hébert, 2000; Peretz et al., 1994). Patel cites compelling empirical evidence from neuroimaging studies comparing neural responses to syntactic irregularities in language and music – a syntactic irregularity in music consisting of the presence of a chord from a distant key at an unexpected point (Koelsch & Mulder, 2002; Patel et al., 1998). Patel lends his theoretical acumen to reconciling differences between results that support his hypothesis and neuropsychological results that support dissociation by suggesting that the representation of linguistic and musical syntactic structures are stored separately but are processed in shared networks during perception.

At the outset of the chapter, Patel defines syntax as 'the principles governing the combination of discrete structural elements into sequences' (p. 241), a definition which encompasses almost every theoretical entity there is in music. For instance, Patel classifies the principles of chord construction in tertial harmony as

syntactic. However, the principles of chord construction might be better classified as morphology, since they deal with the internal structure of elements – chords – rather than the sequential ordering of those elements. Patel also construes the systems which generate tonal tension and stability between both pitches and chords as syntactic. But surely a system which generates varying degrees of tension and stability among pitches or chords is a semantic system, given that tension and stability are *states* which the music *represents*. It is the principles by which those chords are related in time that are syntactic (Rohrmeier, 2007). It is possible that music, whose meaning is often said to reside in its structure, is not as easily differentiated in terms of syntactic and semantic function as is language. Nevertheless, the fascinating findings presented in this chapter make it a major highlight of the book.

The penultimate chapter, 'Meaning', presents a cogent review of philosophical, ethnomusicological, and scientific discourse on musical semantics, and sets forth a compelling case for the application of pragmatic discourse coherence theory to music. Discourse coherence deals with the concepts which make clauses and sentences meaningful in relation to each other – the study of meaning at the next level up from syntax and semantics. Thus the utterance 'John took a train from Paris to Istanbul. He likes spinach' is semantically correct but nonsensical as discourse, because no coherent relation holds between the two sentences (Kehler, 2002, p. 2). Coherent relations are defined as those which exhibit cause and effect, resemblance, and contiguity. 'John took a train from Paris to Istanbul. His friend lives in Turkey' is coherent because it exhibits a causal relation. Patel argues that musical phrases exhibit the same relations, stating that musical phrases cohere because they exhibit cause and effect, resemblance and contiguity at a suitable abstract level. If this is the case, it is possible that music and language share neural resources in the processing of linguistic and musical coherence. Although this section of the chapter remains speculative, it promises a rich vein for future theoretical and empirical exploration.

What is possibly missing in this chapter is a broader philosophical discussion of meaning in relation to music and language. A naturalist conception of meaning dealing with intentionality, representation, and content would help unify the diverse approaches presented and filter out less tenable ones (Millikan, 2004). Patel does not differentiate between natural meaning (signs which are not designed to convey meaning, such as the black cloud which signifies rain) and intentional meaning (signs which are designed to convey meaning, as in the utterance 'It's going to rain'). He suggests instead that meaning lies on a continuum of complexity: Inferring the neighbour's presence from the sound of the piano being played is a less complex meaning than the psychological experience of the music itself. However, the epistemic distinction here is one of natural versus intentional meaning, not simple versus complex meaning, and natural signs can be as complex as we care to make them.[1]

The closing chapter deals with evolution: The question of whether or not music and language are the result of natural and/or sexual selection. Patel notes that research in this area is complicated by several factors. The humans species is the only one that exhibits these complex behaviours, thus precluding any direct comparative study across species. As forms of behaviour, language and music do not

leave explicit traces in the fossil record; evidence for music only surfaces in the archaeological record approximately 35,000 years ago, and archaeological evidence of speech does not exist. However, more profitable areas discussed by Patel include the ontogenetic development of these behavioural forms, genetic research, and the biological and neural mechanisms involved in music and speech.

Having weighed up the evidence on both sides, Patel concludes that language is an adaptation, whilst music relies on cognitive mechanisms selected for other effects. Hence Patel describes music as 'something we invented that transforms human life' (p. 401). This stance invariably recalls Pinker's infamous comment that music is nothing but 'auditory cheesecake' (Pinker, 1998, p. 534), an assertion which has fuelled even more debate on the subject than the remarks of Darwin himself (Darwin, 2004/1871).[2] That this assertion should prove so provocative is testimony to the investment we have in music as a distinctly human activity, something which, like language, defines us as a species. Patel respects this view, and cites what he terms Pinker's false dichotomy: That music was either selected for, and is thus innately human, or it employs mechanisms selected for other purposes, and is thus entirely dispensable. For Patel, music is a quintessentially human activity, albeit one which is not genetically defined. Regardless of one's own views on this issue, Patel's arguments require careful consideration, and the amount of evidence amassed both for and against makes this chapter an ideal reference for one's own investigation.

Music, Language, and the Brain makes a profound scientific contribution to the study of music and language. Patel extends the discussion beyond the traditional domains of syntax and meaning, presents powerful and innovative hypotheses, and summarizes a mass of technical literature in a clear and easily accessible manner. Patel acknowledges that the interdisciplinary enterprise of music and language is at an early stage, and that much remains to be explored. Indeed this is the case, but no other single source equips readers more thoroughly to explore the cognitive intersection between these two domains.

NOTES

1. The sound of a piano being played next door is a natural sign because the musician does not intend to convey his or her presence; if this was intended, the sign would be classified as a non-cooperative intentional sign – a sign which is intentionally produced, but perceived by the listener as a natural sign (Millikan, 2004).
2. 'As neither the enjoyment nor the capacity of producing musical notes are faculties of the least use to man in reference to his daily habits of life, they must be ranked among the most mysterious with which he is endowed' (p. 636).

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