

BOOK REVIEW

Speaking about music and the music of speech

As Einstein is often misquoted as saying, explanations in science should be made as simple as possible but no simpler. Aniruddh Patel's book, *Music, Language and the Brain*, manages to be both admirably readable and also scholarly. Whilst there are other books dealing rigorously with the perceptual and cognitive aspects of language and music as separate topics, few, if any, authors have successfully tackled the task of exploring the overlap between the cognitive and neural mechanisms of these two uniquely human domains. Patel takes on the challenge of providing not only accurate coverage of existing research in the fields of language and music, but also a much needed synthesis that throws new light on the links between the two.

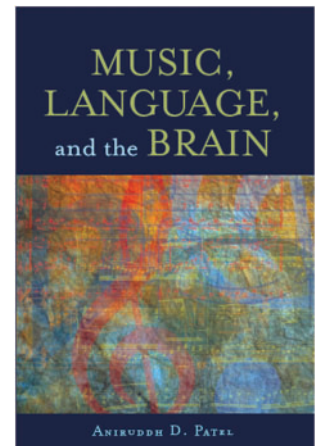
In most areas of science, there is some consensus on the outstanding problems, and a range of rival explanations or solutions corresponding to them. This consensus provides a framework within which the exploration of rival theories can take place, and from which advances can be made. The difficulty in tackling the interdisciplinary aspects of music treated in the present book is that no such consensus exists, because few, if any, experts are equipped to take a fully synoptic view of the subject matter. Musicologists, linguists and psychologists have tended to speak in different languages, and to examine different problems. So whilst much has been learned about language and music, it has been inaccessible to most people. However, during the last two decades, the pioneering efforts of researchers such as John Sloboda, Robert Zatorre, Isabel Peretz and Steven Mithen have caused a sea change in the way that psychologists think about music and language, and a body of scientifically rigorous, cross-domain work has emerged. As a result, it is now possible to stand back and take a broad perspective of the issues arising from the study of music and language.

The central question that Patel addresses is: 'what are the underlying neurological and cognitive mechanisms that music and language have in common, and in what respects do they differ?' A subsidiary question is: 'how can the study of human abilities and disabilities in one or both of these areas throw light on these cognitive and neural mechanisms?' He approaches the task of addressing these questions by analysing and synthesizing results from studies using an extraordinarily wide range of methodologies. Dr Patel is familiar with the work of past and present generations of musicologists and with cross-cultural

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studies in music; he also understands the sometimes rather confusing theories of pre- and post-Chomskian linguists. He is fully conversant with behavioural and neurological methods in psychology. He appreciates the importance of both function and physiology, without dogmatically insisting on the superiority of one or the other. He is, moreover, familiar with newer approaches to perception and cognition, such as statistical learning models.

One fruitful method used in this book is that of applying definitions common within one domain to phenomena in the other. For example, how should one apply the term 'meaning', widely used in linguistics, to the study of music? If music is 'untranslatable', how can it possess meaning, in the sense that language possesses meaning? If it does have meaning, how should this be defined, and what links, or relationships, can there be between musical and linguistic meaning? In tackling this issue, Patel makes a clear distinction between the two components of meaning in speech: semantics and pragmatics. This distinction is important, as Patel concludes that meaning in music will be most fruitfully discussed in the context of pragmatic, rather than semantic, meaning in language. The most interesting aspect of Patel's discussion is his claim that the key link between linguistic and musical meaning is via the expression and appraisal of emotion. To say that music is the language of the emotions may be a cliché; but clichés are sometimes true, and there is evidence for cross-cultural similarities between acoustic cues to emotions in both speech and music.

One of the problems with analysing emotion in music is that the whole area is riddled with inconsistencies as to how emotions are to be described, how many dimensions are there in 'emotion space', how to measure those emotions, and even whether the important emotions are those which appear to be perceived in the music, or to be those evoked by the music. Given that researchers often begin with a different set of preconceptions about what they should be looking for, it is hardly surprising that their results are so often inconsistent. It therefore seems constructive of Patel to propose a study of brain-damaged patients who cannot detect emotions in speech, to see whether they can detect emotion in music. If individuals with such 'pure' deficits can be found, this might well produce results that are robust to differences in models or methodologies.

One aspect of emotion in music not covered in Patel's book is the issue of musical emotion perception in autism. It has been claimed elsewhere, on the basis of anecdotal stories bolstered by flimsy arguments from evolutionary psychology, that people with autism should be insensitive to the emotional content of music. Whilst the findings from several empirical studies show that children with autism can make appropriate conventional pairings between musical extracts and visual depictions of emotions, recent research carried out by Rory Allen has identified subtle differences between typical listeners and those with autism. Consistent with other findings identifying type 2 alexithymia, or difficulties in describing but not experiencing emotions, in autism, Allen's work suggests that music-induced physiological arousal maps onto emotion categories atypically in adults with this disorder. Whilst autistic adults are clearly moved by music, they do not describe their responses to it in conventional emotional terms. This suggests a stage in the processing of musical emotions involving some kind of generalized arousal that intermediates between the physical perception of the sound, and the emotional significance that the listener finally attributes to it. For the typical listener, this intermediate response interacts with his or her perception of the sounds and a range of emotion categories. In Allen's study, the participants with autism appeared to map physiological arousal and perception of the sound on two dimensions, those of tension and excitement.

Another interesting area of music research that has included groups of individuals with disabilities has investigated the uses of pitch in music and language. Pitch is important in both domains: this is self-evident for music, but in language too, pitch has important functions. Patel hypothesizes that perception of the way pitch changes over time—melodic contour—has a shared neural mechanism in speech and music. One objection to this interpretation is that people with a certain type of amusia, which involves a reduced ability to detect the direction of pitch change in music, understand pitch-mediated pragmatic and semantic cues in language. Patel gets round this contradiction rather neatly, by positing the 'melodic contour deafness hypothesis'. This suggests that people with this type of amusia can detect the existence, but not the direction, of pitch change in both speech and music. In the language domain, these reduced abilities may be sufficient for the modest demands which language makes on pitch contour perception. However, an inability to perceive directional information cripples any serious appreciation of music.

A related question, not addressed in Patel's book, is what happens when pitch processing is too good? Hypersensitivity to pitch information in music has been demonstrated in several studies of autism, and more recent findings have shown that this generalizes to pitch in speech. Whilst the implications of these findings have yet to be fully realized, findings showing that autistic children can make discrimination judgements about differences in pairs of pitch contours from different domains (prosody and melody) as easily as pairs of pitch contours from the same domain (melody and melody/prosody and prosody) do appear to present a challenge to domain-specific models of pitch perception. The co-occurrence of difficulties in understanding pitch-mediated pragmatic cues in language and hypersensitivity to pitch in autism presents an interesting contrast with amusia, which may well be explored in future studies.

The concept of statistical learning is of interest to researchers working in music and language, and Patel draws links between the two by discussing the presence of a perceptual magnet effect in both domains. This phenomenon refers to perceptual distortion resulting from early exposure to culture-specific information. In language, perceptual magnet effects are manifested in a loss of discrimination of non-native phoneme contrasts by the end of the first year. In music, magnet effects influence perception of musical scales. According to Patel, this suggests that the same statistical learning processes operate across the music and language domains. If this is true, and Patel suggests some interesting ways in which his hypothesis might be tested, one must conclude that statistical learning mechanisms are characterized by extraordinary versatility in dealing with diverse sensory inputs.

The acoustic cues given by single voices uttering phonemes in language strings seem very different to those of single tones in melodies or sequences of chords in musical sequences, which suggests that statistical learning is not limited to inputs of a particular, pre-determined kind. But certain evidence suggests the contrary. For example, musical savants can be highly sensitive to musical style. They find it easier to memorize music written by familiar than by unfamiliar composers, and are sometimes able to improvise in particular styles, for example, classical and baroque. Some of these individuals do not possess any functional language skills. If, as seems likely, statistical learning mechanisms enable them to acquire musical knowledge, it appears that these mechanisms can be highly domain specific. This is an anomaly which has yet to receive an explanation from supporters of the statistical learning model.

'Syntax' refers to the rules governing the combination of structural elements into sequences. Syntactic rules, in both music and language, are internalized by listeners and determine their expectations about likely upcoming events. Whilst Patel highlights many similarities in musical and linguistic syntax, he also acknowledges important differences in detail. For example, whilst music and language are both characterized by hierarchical complexity, there are qualitative differences in the way this is perceived. My own view is that humans' ability to understand recursive complexity in language is rather limited, a fact readily apparent to anyone trying to make sense of the average legal document. It seems that hierarchical richness is both more abundant and more easily appreciated in music. In language, excessive hierarchy,

with multiple levels and references, places severe burdens on processing systems. Music seems far less effortful. So whilst a passage from a Mozart symphony or a Bach fugue may be no less demanding in terms of syntactical analysis than a single sentence by Marcel Proust or Henry James, it certainly feels much easier to listen to the music. Research aimed at identifying neural overlap between music and syntax processing has yielded somewhat mixed findings, and Patel has outlined what he calls a 'shared syntactic integration resource hypothesis' to account for this. He also makes some useful suggestions about how this might be tested in the future, and it will be interesting to see how this important issue is resolved.

Rhythm is an area of intense activity in music research, and Patel explores it in some depth. Neuropsychological studies have identified a coupling between the auditory and motor areas of the brain in response to rhythm. Music is culturally universal, and rhythm may represent the most primitive sort of intentional sound-making, from which music first developed. In contrast to music, speech appears to display little that we can identify with rhythm in the strict sense. However, in accordance with the theme of the book, Patel finds a possible commonality between the two. He suggests that speech researchers have taken too narrow a view of rhythm in speech, and that 'grouping processes', organizing rhythm, play an important role in speech too. He claims that this grouping process may use a common cognitive mechanism. As evidence, he adduces studies showing a correlation between rhythmic patterns in languages and in their culturally associated music, and suggests that the way forward is to conduct neurological studies to see whether a common mechanism can be identified. Without necessarily sharing his enthusiasm for the posited mechanism, I think Patel has put forward some helpful suggestions, and his provocative claim that rhythm in speech is more prevalent than we had thought seems worthy of investigation.

During the last couple of decades, views about music's pre-historic origins have polarized. In response to Stephen Pinker's claim that music is simply 'auditory cheesecake', music-loving scientists have proposed, with varying degrees of success, alternative theoretical accounts. Whilst these intellectual exercises are often stimulating and occasionally enlightening, they are seldom in any strict sense scientific. Moreover, the debate is limited by the implicit assumption that one must belong to one camp or the other, believing either that music is the product of the same types of evolutionary processes as led to the opposable thumb, or subscribing to Pinker's opinions. True to form, Patel brings a new approach to these tricky questions, by pointing out that these two accounts of the origins of music represent a false dichotomy. He argues that music is not a useless 'spandrel', like nipples on men. Music has been important historically and cross-culturally because humans value the way it transforms their lives. But neither is it, he argues, the product of blind evolutionary forces.

Whilst I am absolutely convinced by Patel's account of why music has been so pervasive in human cultures, I am less convinced by the parallels he draws between music, fire and writing. This is because it could be argued that fire and writing

serve specific uses and purposes that have survival value. A better parallel might be the drive to self-ornamentation. Archaeological evidence for music and self-ornamentation go back around the same length of time, some 30 thousand years, so the parallel is less absurd than it may appear. Both activities have no apparent 'use', yet both are universal. And, perhaps significantly, both have been the target for persecution by puritans through the ages.

So, how well does Patel succeed in his overall aim for this book—throwing light on the similarities and differences between music and language? It is clear from his account that there is as yet no unitary explanation that links the perceptual, cognitive and neural bases of music, or of language, much less one that accounts holistically for both domains. We are still at the stage of studying areas such as syntax, melody, semantics and rhythm as distinct aspects of the whole. It may be that a future science of music and language will unite these facets, but that time has not yet come.

Meanwhile, this book undoubtedly provides the best attempt so far to synthesize theory and research findings, and in doing so highlights the many advantages of applying a holistic approach to the study of music and language. It also provides readers with a scholarly analysis of the links between perceptual, cognitive and neurological phenomena within individual subject areas, where such information is available. But it does much more than this. Throughout his book, Patel summarizes both established findings and areas of ignorance, and suggests new studies which could test rival hypotheses about existing data. Every chapter, indeed almost every page, contains suggestions for some '*experimentum crucis*' which might advance knowledge in a significant direction. Patel's research ideas could keep a battalion of investigators busy for the next decade.

For readers whose background is in neuroscience, Patel's knowledge of the work of musicologists and linguists will provide insights that may inform and even humanize research conducted mainly through the use of clinical and scanning techniques. Those with a greater interest in the cognitive and behavioural aspects will perhaps realize how much they can learn from properly directed imaging studies, as well as from their colleagues in the humanities. By the same token, one would hope that the book would also be read by linguists, musicologists and philosophers of language, who might welcome the opportunity to acquire a better understanding of how a more empirical, scientific approach can be applied to their disciplines.

This book could be understood by a dedicated and persevering general reader, though it is more likely to be of interest to specialists. It should certainly be studied by anyone claiming expertise in the areas of either musical or linguistic neuropsychology, and it will be invaluable as a source of ideas, and good intellectual habits, to fledgling academics. Last, but not least, it sets a gold standard for authors aiming to write a wide-ranging, yet not over-technical book which is comprehensible and without having sacrificed intellectual integrity in the search for glib generalizations.

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