

Aniruddh D. Patel  
*Music, Language, and the Brain*  
 Oxford University Press, 2008: xi + 513 pp.  
 (\$35.00 paper)

## Jeremy Day-O'Connell

### Background

Among the remarkable achievements of the present intellectual age are the momentous inroads that have been made into what is arguably the last great frontier of science: the study of the enigmatic, imponderable workings of the human mind. We live in the wake of what has been called the “cognitive revolution,” a surge of new theoretical concepts and methodologies that arose from a rich interdisciplinary cross-fertilization, one perhaps unequaled in modern times. The cynical behaviorist approach of the early- to mid-twentieth century, which sought to understand mental processes only through their directly observable manifestations (i.e., behavior), was overtaken with a new approach that recognized in the human mind a discoverable (albeit not directly observable) logic and structure. Benefiting from analogies to the digital computer, cognitive science imagined the “black box” of the mind as actively occupied with describable processes of representation and computation and sought to bring those processes to light through experimentation. Decades later, the black box itself would be penetrated with the help of some astounding technological advances that exposed the physical brain to the scrutiny of imaging and mapping techniques, thereby shedding new light on centuries-old questions at the heart of the philosophy of mind.

During that time, in the little corner of the intellectual universe occupied by music scholarship, another revolution of sorts—apparently unrelated to the cognitive revolution, and in any case of rather different consequence—was gathering. The “New Musicology” of the 1980s and 1990s, reacting against the field’s supposed sterility—its insular priorities and positivist methodologies—called for a disciplinary self-scrutiny and a reorientation toward considerations of music’s value and meaning. Borrowing heavily from recent though well-established trends across the humanities, many music scholars answered this call. And while some have questioned the fairness of

the New Musicology's foundational critique, its results have been evident ever since, from the pages of the *Journal of the American Musicological Society* (JAMS), to the entry headings of the *New Grove Dictionary of Music and Musicians*, to the course offerings at our colleges and universities. Even music theory and analysis, which bore a large portion of the New Musicology's revolutionary indignation, seemed to change, broadening in both repertoire and approach.

It is ironic, therefore, that in the midst of these polemical calls for a greater attention to meaning and value, and for the rejection of sterile positivism, a substantial and growing number of scholars were somewhat less stridently applying the insights of the cognitive revolution and the (sterile) scientific methodologies of experimental psychology in pursuit of nothing less than . . . meaning and value in music.

Music psychology, in the broadest sense, has an ancient pedigree, and even its modern incarnation as an empirical psychological science can be traced back nearly 200 years. As an institutional discipline, however, it has only relatively recently, and only relatively awkwardly, found a place at the academic table. For music theorists, Leonard Meyer's groundbreaking *Emotion and Meaning in Music* (1956) represents a crucial landmark, though the development of its ideas was slow and largely confined to the work of Meyer and his students. Journals began to crop up in the 1970s—*Psychology of Music* (1973), *Psychomusicology* (1981), *Music Perception* (1983), and *Musicae Scientiae* (1997)—but have not always received due attention from “mainstream” musicologists and theorists, and these journals have included contributions from scholars affiliated with nonmusical disciplines more frequently than have *JAMS*, *Journal of Music Theory*, or *Music Theory Spectrum*. Most recently, however, the field of music psychology has acquired a greater measure of disciplinary recognition, permanence, and relevance within music studies more generally—as attested by the more psychologically and empirically oriented content of the mainstream journals and mainstream conferences, by the emergence of new professional societies, and, not least of all, by the development of graduate programs and laboratories at a handful of schools. Diana Deutsch's *The Psychology of Music* (1982) underwent a second, substantially revised, edition (1999). And the long-awaited realization of Meyer's highly implicative ideas has emerged triumphantly in David Huron's ambitious and empirically grounded *Sweet Anticipation* (2006). From the perspective of music theory (which itself underwent a turbulent disciplinary self-definition, in American academia anyway), modern music psychology appears to have attained some signs of disciplinary maturity.

The gradual incorporation of explicitly psychological approaches within modern music theory contrasts with the situation in linguistic theory, which was, after all, an important catalyst for the cognitive revolution in the first place. While music studies have been influenced by cognitive science, some of the central subfields of language studies have been virtually defined by it. Language, arguably the most distinctly human product of the human

mind, rightly commands the eager attention of philosophers and psychologists interested in mental processes. But as has often been noted, language shares a great deal with music: outwardly (they are both essentially oral/aural forms), functionally (they are both means of expression), and structurally (they employ phonology and syntax—that is, a culturally prescribed set of discrete elements along with rules or norms for their combination). Indeed, the relationship between music and language, long the inspiration for far-flung speculation and grandiose metaphors (music as a “universal language,” the “language of the soul,” etc.), as well as the source of careful ruminations by great thinkers from Adorno to Agawu, has recently spawned vigorous and widespread theoretical and scientific efforts that build on the foundations of cognitive psychology. This young, hybrid field will be of interest to any music theorist working in the area of music psychology and, more generally, to any music scholar who senses some truth in those aforementioned metaphors (as I suspect most do). Happily, the field of music-language studies has now witnessed a landmark publication of its own: Aniruddh Patel’s prodigious and fascinating *Music, Language, and the Brain*.

Music theorists who read across the disciplines have often raised a bemused eyebrow at erudite writers who nevertheless show themselves to be in over their head when it comes to music. The erudition behind *Music, Language, and the Brain*, on the other hand, is uncommonly deep, and the result is an exemplary interdisciplinary achievement, a commanding view of musical and linguistic structure from the perspective of the brain sciences. Patel presents a cogent and sensitive account of these three highly technical fields and their interrelationships, while assiduously resisting facile or sensational conclusions. The book is organized into deceptively neat topics, each occupying a chapter: pitch and timbre, rhythm, melody, syntax, meaning, and evolution. Along the way, the author calls forth a dizzying panoply of often unfamiliar case studies, the breadth of which is only hinted at through a brief sample: absolute pitch in speech; the vocables of tabla drumming; “perceptual warping” of phoneme space; “sine-wave speech”; pitch realization in tone languages; structural hierarchies both linguistic and musical; the rhythmic consequences of vowel reduction; temporal predictability in speech; the mapping of lexical tone onto musical tone in song; statistical learning of musical and linguistic regularities; cognitive abnormalities both familiar (tone deafness) and fantastic (“pure word deafness”); syntactic “dependency locality theory”; the effect of musical training on the discrimination of vocal affect; songbirds and elephant drummers; and scattered throughout, a legion of valiant babies—unwitting experimental subjects who are sometimes smarter than we think. Importantly, material that is more routine for musicians occupies an equally central role, and on the whole, Patel’s explications are fair and accurate. To be sure, this is a work of high scholarship: the questions are big, the engagement with the literature extensive, and the logic painstaking.

**Basics**

The book begins with an introduction (chapter 1) in which Patel explains his basic motivation: the study of music and language “can deepen our understanding of the mechanisms that underlie our species’ uniquely powerful communicative abilities” (3). He also defines his basic subject of study, which he restricts, quite wisely, to the relationship between “ordinary” speech and instrumental music (i.e., excluding poetry, on the one hand, and texted music, on the other—though as it happens, he does end up addressing both tangentially). The introduction is kept short (a mere two pages), and tellingly so: there is much to be done, and the author is eager to get to it.

The first substantive chapter (chapter 2) considers the basic “sound elements” of musical and linguistic systems: chiefly, contrasts and categories in the realms of pitch and timbre. Patel emphasizes that although music and language favor different sonic dimensions—pitch inventories are primary in music (as scales, intervals, and chords), whereas timbre inventories are primary in speech (as vowels and consonants)—basic learning mechanisms underlie the acquisition of each. This is suggested, for instance, by correlations that have been shown between musical and phonemic abilities, as well as by comparable manifestations of a phenomenon known as the “perceptual magnet effect” in music and language. The presumed learning mechanism shared by the two domains “involves tracking patterns in the environment and acquiring implicit knowledge of their statistical properties, without any direct feedback” (84). This “statistical learning” will be encountered in future chapters as well, as will a basic anthropological conclusion: “our native sound system leaves an imprint on our minds” (9).

As is often the case in this book, the specific results and implications that Patel is after—in this chapter, those having to do with theories of learning and with the purported modularity of mind—might be of secondary interest to many readers compared to the rich and detailed background material that he presents. That background material, again as is typical, involves very many seemingly small but hard-won conclusions. For instance, a detailed and lengthy discussion on pp. 22–28 invokes various perceptual and brain-response studies so as to “provide evidence for intervals as learned sound categories” (22). This fastidiousness might seem overbearing in the case of such a familiar musical concept, but it is indicative of Patel’s epistemological conservatism. And when the terrain becomes less familiar, the reader will appreciate the author’s care and precision.

For music scholars, chapter 2 will serve as an excellent introduction to the basics of articulatory phonetics and to speech perception. It also includes a useful discussion of the musically provocative matter of tone languages (which turn out to be rather intractable from a music-theoretical perspective). And linguistic curiosities (e.g., languages that contrast vowels according to their breathiness or their duration, a language that uses only three vowels,

etc.) are encountered throughout. (In this regard, one wishes that the book's online collection of sound examples were much more generous, as it contains only a small fraction of the many intriguing sounds Patel discusses or alludes to.) Moreover, even his reviews of musically basic concepts of pitch, interval, and scale afford the occasional deep thought, such as the question of why "organized systems of timbral contrasts *within* instruments of a culture are rare" (28). And many important results from music perception are given effective voice here (not least of all in the chapter's appendix, "Theories for the Special Perceptual Qualities of Different Pitch Intervals").

### **Rhythm and Melody**

Chapter 3 concerns rhythm and is the largest chapter here—a fact that may strike some readers as surprising. To a greater extent than is the case with pitch, one might think, linguistic rhythm is relatively unstructured compared to its musical equivalent. But in fact, as Patel demonstrates, the study of rhythm is a well-developed branch of descriptive and laboratory linguistics and one with frequent, promising points of contact with music-theoretical (and even music-historical) concerns. The size of this chapter derives in part from Patel's intent to debunk a certain strand of linguistic theory concerned with isochrony, but there are a number of positive contributions as well. (And, as it happens, it is rhythm that will reemerge in the book's last chapter as Patel's one great hope for biomusicology.)

Patel defines rhythm as "the systematic patterning of sound in terms of timing, accent, and grouping" (96). Rhythmic organization in language can be most easily appreciated by considering the distinct rhythmic styles of different languages (differences that reveal themselves for instance in the speech of nonnative speakers). Indeed, rhythm studies in linguistics were long dominated by typological concerns: such apparently dissimilar languages as English and Thai purportedly share a tendency toward isochrony between stresses, while languages such as Spanish and Hindi purportedly tend toward isochrony between syllables ("stress-timing" versus "syllable-timing," respectively). Although these two rhythmic classes themselves (along with at least one other, an oddball class containing only Japanese) have been upheld in perceptual studies, their foundation in principles of isochrony has been refuted: whatever rhythmic feature(s) might connect or distinguish languages, it is not isochrony. Language, that is, appears not to have anything resembling beat or meter, arguably the defining aspects of rhythmic organization in music. (Nevertheless, something like meter in ordinary speech [Patel self-consciously excludes metrical poetry] has been proposed by practitioners of "metrical phonology," which assigns degrees of prominence to the units of an utterance in a hierarchical fashion—much like the metrical analyses of Grosvenor Cooper and Meyer. The most that can be said about this quasi-metrical structure, however, is that spoken language seems to

employ mechanisms of “stress-clash avoidance,” which results in a very rough alternation between stressed and unstressed units.) The impression one gets is of a very large body of very inconclusive, incomplete work. But duration and grouping—what Patel calls “non-periodic aspects of rhythm”—provide more fruitful points of contact.

Grouping principles, so celebrated in music theory and analysis, are perhaps even more essential to the processing of spoken sound: not only sentences and phrases but words themselves are unintelligible to a hearer without some immediate and intuitive parsing of what is, after all, a largely continuous sound stream. These principles constitute part of the competence of native speakers—they are part of the particular rhythmic systems of individual languages. In both language and music, phrase boundaries are perceptually salient and are cued by similar things (changes in pitch, loudness, and duration). Linguistic segmenting strategies at the word level—such as the preference rule, used by native English speakers, that associates stress with the beginning of a meaningful segment—appear to govern the segmenting of nonlinguistic sound as well, prompting the question of whether music might likewise be segmented in culture-specific ways. Recent work, not surprisingly, affirms this possibility, and one of the points of the chapter is a sort of conceptual refrain in the book: what we learn from our culture shapes how we process both musical and linguistic stimuli.

The most musicological strand of this chapter, as it were, deals with the question of the possible interactions between a culture’s musical and its linguistic durational patterns. Two separate studies have demonstrated a correlation between music and speech in this way, using a particular measure borrowed from studies of linguistic typology (such as those mentioned above). The “normalized pairwise variability index” (nPVI) registers the amount of syllable-to-syllable durational variability in an utterance (it was originally developed as a reliable descriptor of rhythmic class: “syllable-timed,” “stress-timed,” etc.). Applied to music, this index has revealed systematic differences in the melodic style of European composers of various nationalities: thus the higher nPVI of spoken English as compared to French corresponds to the higher nPVI of the melodies of certain turn-of-the-twentieth-century English composers (e.g., Elgar, Delius, Vaughan Williams) as compared to the melodies of their French counterparts (e.g., Debussy, Poulenc, Saint-Saëns). More generally, European composers’ melodic nPVI, averaged over several centuries, is higher in those nations associated with stress-timed languages than those associated with syllable-timed languages. Only one case does not fit the model: German composers’ melodic nPVI is abnormally low, contrary to what would be predicted for these stress-timed speakers. But this anomaly prompts a provocative and ingenious explanation. Taking a historical perspective, the question of Italian influence on German music was considered, and indeed, a longitudinal trace of nPVI in German music suggests an effect of Italianate (i.e., essentially syllable-timed) melody, which is most

noticeable in the eighteenth century and which gradually wanes over the next two hundred years.<sup>1</sup> This explanation is not only elegant but virtually unimaginable without the tools of empirical linguistics.

In chapter 4, Patel takes up the matter of melody, “an organized sequence of pitches that conveys a rich variety of information to the listener” (182). Music theorists, accustomed as we are to dealing systematically with (discrete) musical pitch, will find nothing in language analogous to the concept of scale, and hence we might reasonably throw up our hands when confronted with the continuous, microtonal pitch space of speech melody. Such ambitious efforts as Leoš Janáček’s attempts to commit speech to musical notation are curiosities to be sure—exceptions that affirm the inherent difficulty of theorizing linguistic pitch. Nevertheless, most linguists accept that there is a “phonology” of intonation—that is, a reasonable mapping from the continuous pitch of speech onto an abstract categorical framework. Patel introduces one widespread theory (the “autosegmental-metrical theory” of intonation), which assigns melodic events to “high” and “low” tones (and further qualifications of those); this framework allows for a discussion of a number of similarities and differences between musical and linguistic melody.

The highlight of this chapter is utterly nonphonological, however, and returns once again to the concept of “statistical learning.” Melodic statistics of both speech and music reveal a preference for small intervallic motion, for which Patel offers two possible explanations: a “constraint-based” explanation reflecting physiological and perceptual limitations, and a “cross-domain” explanation involving a direct influence of speech norms on music. A search for cross-cultural *difference* with regard to intervallic statistics stands to favor the “cross-domain” explanation. In particular, Patel returns to his English/French musicolinguistic corpus, revealing a lower “pitch interval variability” (i.e., a set of more uniformly sized intervals) in French speech compared to English speech, and likewise for the respective musics.

Melody also provides fertile ground for the study of the concept of modularity—a central topic of cognitive science concerning the organization and interrelationships of the mind’s faculties, in particular, the degree to which these can be thought of as independent modules. Several studies of musically tone-deaf individuals (mTDIs) by Patel, his collaborators, and other colleagues have clarified the perceptual associations and dissociations between melodic processing in speech and music. For instance, mTDIs have been shown to perform normally in many tests of the perception of speech intonation. Nevertheless, Patel challenges the apparent conclusion (reached by others) that the mental processing of melody and of speech is therefore modular. Instead, he proposes the “melodic contour deafness hypothesis,” which accounts for all relevant results: mTDIs do in fact have specific deficits

<sup>1</sup> One has to consult the original study to uncover the details, which are even more surprising, even unintuitive: among composers from syllable-timed language cultures,

Brahms sports a melodic nPVI well below the mean, and yet one could scarcely imagine a less Italianate figure than this composer of *Ein deutsches Requiem*.

in the processing of speech melody, but these deficits go unnoticed in real life and in the most common experimental paradigms. The deficit in question, common to both music and language, seems to be one affecting the detection of pitch change *direction* (but not the sheer presence of pitch change, which mTDIs detect reasonably well). In language, this deficit either is irrelevant or can be overcome by redundancies of syntax and the like. In music, on the other hand, a deficit in this domain, Patel insists, would interfere with the very acquisition of pitch schemata during musical development, leading to the profound difficulties associated with musical tone deafness. Patel offers this as an illustration that “a behavioral dissociation is not necessarily the same as a neural dissociation” (238).

### **Syntax and Semantics**

The question of modularity is addressed again in chapter 5, now with respect to syntax—that most crucial and provocative of the commonalities between music and language. Syntax is often touted as the most distinctive feature of human communication: while other animals may use melody, rhythm, and even arbitrary sound/meaning pairings, only human language involves syntax. It is thus arguably the most human aspect of the most human aspect of human culture. From Patel’s report, however, it appears to be the least developed area of music-language studies, and some of the few lapses of the book appear in this crucial chapter.

Patel’s understanding of syntax (on which everything in this chapter depends—and a topic about which substantial controversy exists, even among linguists) is reasonable enough, and suitably general: “the principles governing the combination of discrete structural elements into sequences” (241). This definition, however, comes in and out of focus. For instance, as an example of a syntactic universal in music, Patel cites “organization of pitch in terms of musical scales with (typically) 5 to 7 tones per octave” (242): do scales really constitute syntax per se or, rather, phonology, as seems to be more the understanding in chapter 2? He explains the concept of chordal root, ostensibly as an element of musical syntax, without emphasizing that such a concept is strictly a theoretical (i.e., not necessarily a true syntactic) construct. And his analogies here are at times imperfect, for instance, those between chord categories (that is, Roman numerals) and grammatical categories (e.g., noun, verb), and between chord *functions* (e.g., tonic, dominant) and grammatical functions (e.g., subject, object). (It should be pointed out that Patel proposes these analogies at the level of “logical structure,” not at the level of specifics; he ardently, and quite rightly, rejects any direct correspondence between, say, particular chords and particular grammatical categories.)

Throughout the chapter, Patel’s discussion of musical syntax focuses self-consciously on European tonal music (indeed, on the very matter of tonality itself) and invokes Fred Lerdahl and Ray Jackendoff’s generative

theory. He provides a good introduction to that theory and an admirable description of the multilevel syntactic organization of pitch in music (at the level of note, chord, and key). Some of the experimental designs that he cites, however, suffer from an asymmetry in their treatment of music versus language. For instance, the following set of sentences was ingeniously constructed as controlled exemplars of “easy, difficult, or impossible” syntax (272):

- Some of the senators had promoted an old idea of justice.
- Some of the senators endorsed promoted an old idea of justice.
- Some of the senators endorsed the promoted an old idea of justice.

The corresponding musical stimuli, however (see Example 1), are comparatively unimaginative and lack the graded complexity exemplified by the sentences. Indeed, while Patel’s exposition of musical syntax is rich and musically sensitive, the experimental results under discussion seem largely to reduce musical syntax to the quality of *rightness* versus *wrongness*. Judging from recent discussions on the SMT-talk regarding recursion, many music theorists will be interested in these studies and, one hopes, in pursuing their own improved experimental designs.

Example 1. Patel, figure 5.12

Patel once again questions mainstream results from neuroscience, which propose special, separate pathways for musical and linguistic syntax. His “shared syntactic integration resource hypothesis” holds that there are specific and separate representations of syntactic items in the two domains, whereas there is partial overlap in the neural resources that carry out the processing of those items, particularly those resources “that serve to rapidly and selectively bring low-activation items in ‘representation networks’ up to the activation threshold needed for integration to take place” (283). This hypothesis is consistent with previously irreconcilable results from neuroimaging and neuropsychology vis-à-vis the modularity of linguistic and musical syntax. It has found support, moreover, in deficit studies and in a small number of studies that specifically manipulate musical and linguistic syntactic

stimuli together (e.g., studies of event-related potentials using sung or musically accompanied sentences). These studies are enlightening but extremely limited; one only hopes that we are witnessing the beginnings of a new research program.

The last music-language connection Patel considers is meaning (chapter 6). Patel skillfully enumerates several types of musical meaning in turn, from the most abstract formal qualities of a particular piece (those celebrated by Eduard Hanslick, Peter Kivy, and others) to the most general resonances between musical styles and the values of the cultures that create and perpetuate them. (Patel discusses this latter notion in a tentative, self-conscious way, as if it were a new and speculative idea. The omission of any reference to Susan McClary here and elsewhere is regrettable.) What Patel recounts of the scientific perspectives on music's meanings, however, is a bit rudimentary. Studies appear to simply confirm (as science of course must!) what we generally take for granted: that listeners associate broadly referential and emotional meanings with various musical stimuli, with some degree of consistency. (Patel offers these results as counterevidence to Kivy's extreme view of musical meaning, though he perhaps reads Kivy too narrowly.) Of course, one of the great questions of musical aesthetics concerns the mechanics of musical emotion, and this question provides an important locus for music-language studies. Patel reviews several important cross-cultural and metastudies connecting vocal emotional expression and musical cues of emotional qualities, citing this as a "key link."

One unusually evocative approach described in this chapter does not concern semantics per se but rather the inferential strategies that listeners use in constructing a coherent message from a series of utterances—the strategies postulated by "discourse theory." Certain basic epistemological principles (first proposed by Hume as "connections among ideas") have been offered as the basis for these strategies: resemblance, causation, and contiguity (each of which encompasses a number of individual "coherence relations"). Patel only hints at the potential application of these principles to music, and without noting the like-minded insights of Baroque rhetoric theory; discourse theory, as described by Patel, seems to represent a twenty-first-century version of Mattheson, Kircher, and Mersenne. Patel gives no examples nor cites any specific studies, implying that musical discourse theory is up for grabs; the concocting of suitable experimental materials will benefit from the insights and dispositions of theorists and composers (at least as much as was the case for syntax).

### **Origins**

This wide-ranging, ambitious book closes with a consideration of what is arguably the most far-reaching and provocative branch of modern cognitive science: evolutionary psychology. In gradually bridging the gap between spirit and matter—between mind and brain—cognitive neuroscience has

begun to render intelligible a commonplace but epistemologically thorny intuition: that behavior itself is at least in part genetically determined. Such an idea represents a formidable challenge to a “blank slate” view of human nature and therefore has profound and politically fraught implications for the nature-nurture debate.

Not only individual behavior but also collective behaviors and aesthetic dispositions (which is to say, the elements of *culture*) have recently been accounted for in biological terms, as products of selection. Many music scholars will have first encountered this approach in the edited volume *Origins of Music* (Wallin, Merker, and Brown 1999), but the idea of music as adaptation goes back to Darwin himself, who also (like his contemporary Herbert Spencer, and like Rousseau before him) imagined a close connection between the origins of music and of language. Those origins—and in particular their possible explanation as biological adaptations—are of course the stuff of speculation (and presumably forever so), since sound leaves behind no artifacts. But a good deal of research has been brought to bear on the question, and it is this research that occupies Patel in this final chapter.

To be clear, the adaptations in question are best thought of as mental *faculties*: no one supposes that humans are biologically programmed to actually make specific music or specific language, as certain birds are programmed to make certain songs. The role of example and emulation is still necessary, in a way that it presumably is not in the case of, say, learning to walk. The question, then, is whether a particular cultural behavior might have been adaptive in a particular prehistoric ecological context and whether the skills and capacities central to that behavior might have been selected for. The argument for linguistic adaptationism is relatively straightforward: the utility of formulating, communicating, and understanding messages, especially within the context of a highly social species, can be readily imagined. Nevertheless, the adaptationist view is far from unanimous, and even among adaptationists, the precise explanation—in terms of a hypothetical ecological scenario that would have selected for a language faculty—can take a number of different forms. Patel is less interested in the ultimate explanation(s) than in the prior question: adaptation or not?

Consequently, Patel offers ten bits of evidence that the language faculty is indeed an adaptation. This evidence encompasses issues of anatomy (an unusually sophisticated vocal tract among primates), development (infant babbling; critical periods for language acquisition; vocal learning, including “poverty of the stimulus” arguments), language change (the ability of language to “jump modalities”; the rapid emergence of grammaticalization in new or compromised languages), genetics (the recently discovered *FOXP2* gene, damage to which causes severe and nonlocalized language deficits), and sheer survival (the “biological cost of failure to acquire language”). Patel also mentions a handful of further observations that he deems too weak to include as relevant to the question. Nevertheless, even his top-ten list has its weak points: spontaneous grammaticalization could be taken as evidence

that robust language can develop out of purely pragmatic interspeaker constraints on communication, and the matter of “biological cost,” which as it happens goes utterly unexplained by Patel, essentially begs the original question. Most of the evidence for a language instinct, nevertheless, does seem compelling.

In the case of analogous evidence for music, on the other hand, Patel is more hesitant: music compares unfavorably to the robustness of language. For instance, music is generally unable to transfer to other, nonaural modalities, and musical competence is much more variable from individual to individual than is linguistic competence. Furthermore, musical abilities and proclivities can themselves largely be thought of as subsumed within the language faculty. In the end, what Patel requires of an adaptive explanation of music is some evidence of a domain-specific skill that develops “precociously and spontaneously” in humans but not in other animals (402). He consequently calls for research into human “beat-based processing,” what he feels is the strongest candidate: with the exception of isolated, anecdotal examples, no animal other than humans can spontaneously and flexibly synchronize to a beat (and human infants’ poor abilities at beat synchronization may only indicate a lag in motor skills, analogous to the corresponding well-known lag in speech production).<sup>2</sup> In closing, Patel insists that even if music is not an adaptation, neither is it a “frill”; rather, music should be thought of as one example “of technologies invented by humans that have become intimately integrated into the fabric of our life, transforming the lives of individuals and groups” (401).

### Conclusion

Patel freely admits that the question of music and evolution is “not yet settled” (400), and this sentiment, encountered more than a handful of times throughout the book, emerges almost as a motto—and a welcome one. The book is chiefly a summary and assessment of the state of scientific music-language studies. Its whopping sixty-seven-page works cited list gives some indication of the vastness of the field and of Patel’s superhuman achievement in presenting and critiquing that field, which he carries out not only cogently and commandingly but also with sensitivity, imagination, and even flair. The author is himself an engaged and ambitious researcher in the field, so the book is also something of a vehicle for his own cutting-edge (and therefore at times speculative and controversial) theories. (That latter fact makes the balance and even-handedness of the writing all the more notable.) And at the same time, Patel’s narrative represents an ardent *invitation* into that field, with an eye firmly on the future. Virtually every section of the book includes an

<sup>2</sup> More recent work by Patel, however, suggests that parrots also have an ability to flexibly coordinate physical movement with musical stimuli (Patel et al. 2009).

appeal for the replication, generalization, or refinement of the reported experimental results, and proposals for specific experimental designs are offered frequently and graciously. This spirit of a collective pursuit of truth bespeaks a disciplinary perspective unfortunately foreign to the humanities, and one that is both refreshing and exciting.<sup>3</sup>

A field that previously existed in the form of hundreds of articles across a diverse range of journals now exists in the virtuosic synthesis of *Music, Language, and the Brain*. That synthesis is an imposing one, and those intent on digesting the whole book will not do so easily, despite the clarity and grace of the writing. The sheer volume of material covered and its meticulous treatment make for a challenging journey, and the organization often makes great demands on the reader: an inevitable consequence of Patel's exhaustiveness is the sometimes labyrinthine arrangement of often colliding topics, an arrangement he has handled as well as could be expected. Frequent pit stops and map checks are necessary along the way but are aided by detailed outlines at the beginning of each chapter. These outlines will especially help readers who use the book more selectively (as many will, and profitably so), whether as a reference source or as a collection of discrete, topic-focused chapters. (Less helpful to such readers is the rather stingy index.) Both types of reader will be greatly rewarded for their efforts. The impact of this book within music-language studies promises to be profound and will surely necessitate a second edition before too long. A second edition would also provide a welcome opportunity to address the alarming—and for so reputable a press, embarrassing—profusion of copyediting errors.

For music scholars generally, *Music, Language, and the Brain* is a unique gift, and its appearance is timely. Music theory in the early twenty-first century bears an affinity with ethnomusicology, though not necessarily in ways that would be recognized as such by ethnomusicologists. At the very least, theory's current openness to noncanonic repertoires, to oral traditions and oral "texts," and to issues of subjectivity suggests a very different field than that critiqued (more or less accurately) by the New Musicology twenty years ago. Importantly, some of the most interesting recent work in music theory has combined a psychological approach with a broad perspective that takes seriously music's integration into the whole fabric of human experience.<sup>4</sup> A deeper understanding of the great mysteries of music will require a music theory animated by such a perspective. In this regard, Patel's book will be indispensable.

**3** Other habits of scientific scholarship, however, will strike many in our field as awkward. Citation practice is a case in point. On the one hand, we find bibliographic support given for seemingly obvious, uncontroversial aspects of human experience: "Infants are frequently rocked or bounced to music (Papousek, 1996)" (405). On the other hand, we find the weighty principles at the heart of an entire discipline summarized matter-of-factly and cited with neat

(indeed, with arbitrary) precision: "In tonal music, there are norms for how chords follow one another (Piston, 1987; Huron 2006)" (249), and "Central to the experience of tonal music is a listener's sense of tension and resolution as a piece unfolds in time (Swain, 1997)" (256).

**4** Huron 2006 and Zbikowski 2002 are two notable examples.

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**Jeremy Day-O'Connell** is assistant professor of music at Knox College, where he coordinates and teaches the music theory sequence. In 2009–10 he was a Fulbright Distinguished Scholar in residence at the University of Edinburgh's Department of Linguistics and English Language. 