**From ants to music and language**

Language and music are integral aspects of human life and culture. Although precursors of music and language can be found in other species, such as in songbirds, the complexity and variety of these skills are uniquely human. It is, therefore, very likely that human evolution has equipped our brains with a neural infrastructure that is particularly suited for the acquisition of language and music. It is exactly the interface of music, language and the brain that is at the heart of this wonderful and scolarly book by Aniruddh Patel.

The book provides the best and most thorough overview of experimental research on music in relation to language and the brain that is currently available. Dr. Patel discusses the central aspects of music and language. These include the sound systems in both modalities, the rhythm, melody and syntax that are core features of both language and music. He also discusses to what degree meaning can be found in music and where it might overlap with language. Although certainly the propositional content of a linguistic expression is not available in (instrumental) music, it might bring about similar semiotic consequences in the mind of the listener. An example is the expression and appraisal of emotion. Both language and music can evoke powerful emotional responses, and can even strenghthen each others cognitive and emotional effects, as in song.

In a final chapter, Dr. Patel discusses the evolution of language and music. Here remarkable findings have surfaced in recent years. It turns out that similarities with species more distant on the phylogenetic tree are stronger than with our nearest phylogenetic neighbours. For instance, next to humans only vocal learning species (e.g., parrots) are capable of synchronizing with a musical beat. In contrast, species that are genetically closest to humans, namely non-human primates, cannot learn to tap to a metronome, despite substantial efforts to teach them to do so. Vocal learning is not only crucial for acquiring language, but also seems to be a prerequisite for the perception of musical structures. This raises the issue of how interdependent linguistic and musical skills are.

Although in the past, perspectives on language and music have often stressed the differences, Dr. Patel has introduced and strongly promotes the alternative view. This is the view that at many levels the similarities between music and language are more striking than the differences. Clearly, the differences are undeniable. For instance, there are pitch intervals in music that we don’t have in language, while on the other hand nouns and verbs are part of the linguistic system without a concomitant in music. This points to differences in the representational structures that are domain-specific and laid down in memory during acquisition. However, the processing mechanisms and the neurobiological infrastructure to retrieve and combine domain-specific representations might be shared to a large extent. This idea has been made explicit in Dr. Patel’s ‘shared syntactic integration resource hypothesis’ (SSIRH in short). According to this hypothesis linguistic and musical syntax have in common mechanisms of sequencing, which are instantiated in overlapping frontal brain areas that operate on different domain-specific syntactic representations in posterior brain regions.

Here I cannot avoid noticing a striking similarity with my own view on the distribution of labour within the perisylvian language cortex. As I have argued in a number of papers, in language (as in music) building blocks are available in long-term memory, that in the field of psycholinguistics is often referred to as the mental lexicon. These building blocks include form properties (phonology), syntactic properties (e.g. grammatical gender, word class, syntactic frames), and knowledge about word concepts. Temporal cortex seems to be especially involved in providing the neuronal ensembles that code for these different types of lexical information. However, in both language and music the stored building blocks can be combined and appreciated in endless new combinations. These combinations are not prestored in memory, and hence necessitates neural machinery that allows them to be unified into larger structures. Here the inferior frontal cortex, especially in the left hemisphere, plays an important role. In a dynamic interaction with the domain-specific memory areas in temporal cortex it supports the unification of domain-specific representations into larger structures. This unification component of the network is, however, itself not domain-specific. It might be shared between language and music, and moreover can integrate information from multiple domains, such as language and music, or language and gestures, etc. It is clear that this proposal is fully compatible with the views that Dr. Patel has proposed. It also predicts that lesions affecting the unification network in patients with Broca’s aphasics should also impair their unification capacity for music. In fact, this is exactly what we have found in a collaborative research project between Dr. Patel’s and my research group.

Another remarkable finding about the interrelation between language and music is Patel’s finding that composers are influenced in their musical compositions by the rhythmic structures of their native language. We, or at least the composers among us, seem to be able to abstract pure relative duration patterns from speech and generalize this to the

domain of music.

If the relationship between language and music is that strong, one might wonder in a society in which language is so dominant, what benefit one might have from developing musical skills. The answer seems to be that one might benefit quite a bit. Music has been found to increase the pro-social behaviour in 4 year olds. Moreover training your rhythmic skills in music might help children in developing their reading skills. As a final example, a certain form of musical therapy in patients has been found to strengthen the Arcuate Fasciculus in the right hemisphere. This is a major fiber bundle connecting inferior frontal and temporal cortex. Since music and language seem to share processing mechanisms and neuronal resources, one might benefit from training in either domain for developing skills in the other domain.

Ani Patel has an interesting biography. He studied biology at the University of Virginia. He received his PhD from the University of Harvard, where he was supervised by E.O Wilson, one of the greatest living biologists and the world’s leading expert on ants. Ani Patel’s first publications were on ants. However, ants are not known for their musical skills. Since music is the passion of his life, Patel shifted gears and wrote a PhD thesis with the title “A biological study of the relationship between language and music. After he finished his PhD at Harvard University, Patel became a postdoctoral fellow at the Neuroscience Institute in La Jolla, California. This institute is directed by Nobel laureate Gerald Edelman, who has among many other interests, a great interest in music. It is at this institute that Dr. Patel developed his research program on music, language and the brain. He is still at this institute, currently as Esther J. Burnham Senior Fellow in Theoretical Neurobiology. The inspiring environment of the institute also created the opportunity to write this book.

*Music, Language, and the Brain* is a rich source of information on the fascinating topic of the relation between music and language. It reviews the field as a whole, and the work that Dr. Patels was involved in himself. When reading this book, one realizes that Dr. Patel’s scholarship extends far beyond the areas that he works on himself most directly. Undoubtedly this book is your best guide if you are interested in the intricate relationship between music, language and the brain.

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