# Neuroscience of birdsong: Cambridge University Press, Cambridge, H Philip Zeigler and Peter Marler

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The title *Neuroscience of Birdsong* hardly does justice to the contents of this treasure of a book. While birdsong has been studied extensively in the context of behavioural ecology and evolution, the physiological, genetic and molecular aspects have been studied less widely. Birdwatching (or 'twitching') has played an important role in the youth of many eminent ecologists or evolutionary biologists, [1] and this may have played a small part in the emphasis that has been placed on the role of birdsong in behavioural ecology. Arch-twitchers, if they have not seen a bird but have only heard it, will often count it towards their tally of birds 'experienced'. But, just as male birds tend to be more flamboyantly coloured, it tends to be the males who do all the singing - or so I thought, prior to reading the chapters in this wonderfully edited book.

Birdsong has many more facets than perhaps conventionally acknowledged: the repertoire of songbirds depends on a multitude of factors which feed back onto the birds' brain structure. These factors include breeding patterns and social structures of birds, territoriality, dependence on environmental cues such as seasonality outside of the tropics, and much more complicated combinations of factors inside tropical latitudes. In many of the best-studied species, typically from temperate regions of the Northern Hemisphere, singing is closely related to sexual dimorphism, where males sing in order to attract females or to mark their territory. This dimorphism is, as many articles amply demonstrate, reflected in the neuronal architecture of the bird brain. In the best-studied systems, where the Northern Hemisphere

species are joined by the Australian zebra finch, the central auditory system in the male birds' brains is significantly larger than that of the females of the species.

It is in the wider discussion of this and related points where the book really scores highly, and this is why it merits the attention of a wider audience. One of the main reasons why the analysis of birdsong is interesting lies in the perceived or actual relationships to human language. Birdsong, like human language, is acquired from role models; but nature, in addition to nurture, also plays its part. Moreover, as discussed widely throughout the chapters, some of the neuronal circuitry shows strong similarity to the auditory and language-processing regions in the human brain. In other chapters, this level of physiological homology [2] is extended to the genetic level, in a discussion of the relative role which the gene *Foxp2* appears to play both in human language processing and in birdsong.

Unlike human language, however, patterns of birdsong in the important model species show seasonality, waxing and waning with the mating and breeding periods. Furthermore, use of language is not limited to human males. In one of my personal highlight chapters, however, Gisela Kaplan shows that in many bird species - her particular focus is on the Australian magpie - birdsong is common to both sexes. It is therefore largely independent of mating or breeding behaviour, and, encouragingly, the auditory systems of males and females appear to be indistinguishable. In many other respects, the Australian magpie's singing differs further from that of previously closely studied model songbird species. Precisely because of such differences, the magpie (and other, especially tropical songbird species in which both sexes sing equally) may be a much better organism in which to investigate links between birdsong and human language. It also serves as a useful reminder of the role that species choice can play in comparative biology.

In this context, but also throughout the book, the authors (and editors) draw up a complex picture of the neurological, physiological, anatomical, cognitive, ecological and evolutionary factors influencing birdsong. While this complexity may at times appear bewildering, the different chapters do an excellent job in enticing the reader to think further about these topics - for example, when discussing the links between the singing and the anatomical features required to sing. Here and elsewhere in the book, the temptation to anthropomorphise is, at least for me, always present; this, in fact, appears to be frequently actively encouraged by many of the authors when stressing the relationship between birdsong and human language. What clearly emerges from the 37 different chapters is the complexity of birdsong; there appear to be no simple answers as to its origin or the neurophysiological machinery underlying it. This, of course, is also becoming more apparent in other areas of the modern life sciences [3]. But birdsong may indeed be a good model system for studying the neurophysiology of human language. I was therefore surprised by the lack (until recently; see http://www.ncbi.nlm.nih.gov/genome/guide/finch/) of a completely sequenced songbird genome; the genomic (or post-genomic) perspective has thus far contributed little to our understanding of this phenomenon. In the interest of comparative biology, perhaps more songbird species' (eg the

Australian magpie) genomes should be sequenced.

I found the book thoroughly enjoyable. The editors have managed to collate a set of consistently high-quality articles. The chapters have been grouped into seven sections, which cover the depth and breadth of birdsong production, acquisition and the genomic analysis of songbirds. A final section provides personal historical perspectives by some of the leading scientists in the field (the volume is dedicated to the memory William H. Thorpe, the pioneer of the study of birdsong). The editors are to be especially congratulated for their superb synoptic introductions to the seven sections of the book. These introductions provide valuable orientation and help to the reader unfamiliar with this topic.

The book deserves a wide audience; even now, I frequently find myself dipping into chapters, marvelling at the complexity of the problem, the ingenuity of the researchers in this area and the scope for future insights into fundamental neurobiological processes.

# References

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