



Book Reviews

The Design of Animal Communication. Edited by MARC D. HAUSER & MARK KONISHI. Cambridge, Massachusetts: MIT Press (2000). Pp. xi+702. Price \$65.00.

This book arose out of a symposium in honour of Peter Marler, held at the University of California, Davis in 1997 and several of the contributors are (former) students or colleagues of Marler's. The quality and breadth of coverage of the chapters are testament to the enormous impact that Marler has had, and still has, in the field that for the sake of producing a coherent book has been labelled 'animal communication'. In the Preface, Mark Konishi rightly suggests, however, that Marler's inspiring influence reaches beyond communication per se, to fields such as behavioural development, evolution and neuroethology. This is also reflected in the organization of the book, in which the 24 chapters are distributed over three main sections on mechanisms, ontogeny and evolution of communication. That Marler is still an active force in the scientific study of communication is exemplified by the fact that he also contributed a chapter to this volume. Most of the book (20 chapters) deals with acoustic communication, whereas three chapters consider visual communication, and one electric communication.

An important research paradigm in which Marler has been a leading figure ever since his own Ph.D. work with Bill Thorpe in Cambridge is that of bird song learning. It is no surprise, then, that several chapters are concerned with the behavioural analysis of song learning (Kroodasma, Mundinger, Marler, Searcy & Nowicki). Bird song has become a prominent paradigm in behavioural neuroscience, which is also reflected in four different chapters dealing with this subject (Nottebohm, Ball, Doupe & Solis, Mundinger). The chapter by Nottebohm, a student of Marler's, is an impressive, thorough review of the current knowledge of the neural mechanisms of song learning. This is a fast-moving field, and the author has done an extremely good job integrating the wealth of data on the various brain loops and pathways involved. Nottebohm acknowledges that we do not know yet where in the brain vocal memories are stored 'but it is tempting to suppose that the higher reaches of [the ascending auditory pathway], such as the caudomedial neostriatum (Ncm), the caudomedial and caudolateral hyperstriatum ventrale (cmHV and cIHV), and the neostriatal Shelf under HVC play a role in the storage of this memory' (page 75). This would appear to be a plausible supposition, and, in keeping with his role as a leading figure in the field, it is one that Marler has discussed recently (Marler & Doupe 2000). Ball provides an interesting review of seasonal changes in vocal behaviour in songbirds and the accompanying neural and endocrine changes. The songbird's 'brain for all seasons' is also an approach pioneered by Nottebohm. Curiously, this fascinating phenomenon has long been a mechanism looking for a function, as it was not obvious which aspects of song were associated with the changes in volume of certain

brain nuclei. Ball follows Brenowitz's suggestions that the neural changes may be related to changes in song stereotypy (e.g. Tramontin & Brenowitz 2000).

Another important chapter in this book is that by Suthers, who gives an excellent overview of his classic work on the mechanisms of vocal production in birds. Suthers has provided direct evidence for a longer held hypothesis that the bipartite sound-producing organ of songbirds, the syrinx, in fact accommodates two independent sound generators. When vocalizing, songbirds can alternate between two sound sources, and even use them simultaneously. It is fascinating to read Suthers's account of cases of lateral differentiation in which the separate sides of the syrinx each covers a different frequency range, or in which one side specializes in amplitude- or frequency-modulated notes. In some birds, most of the song appears to be produced by one side, while the other is used for taking 'minibreaths' between song syllables. Such differences in motor patterns underlie diverse vocal strategies, such as extreme spectral complexity or very high syllable repetition rates, which enable different bird groups to achieve their own distinctive kind of vocal virtuosity. Suthers's chapter is highly recommended reading for anyone interested in the mechanisms of communication.

Michelsen addresses recent developments in a key paradigm in animal communication: the dance language of honeybees. Since the renowned experiments of Karl von Frisch, it has become clear that forager bees lead recruits to food sources by odours and dances. It remained a mystery, however, exactly how follower bees in a dark hive perceive the message carried by the dance, and which components of the dance are perceived as signals by follower bees. Two suggestions for the former question had already been given by von Frisch: substrate-borne vibrations and touch. Michelsen suggested a third mechanism, air currents, after he and his coworkers discovered a three-dimensional field of oscillating air around dancing bees. Several hypotheses and experiments, including Michelsen's experiments with a fantastic dancing bee robot, are reviewed in this chapter, which reads like a detective story. In the end, it is still undecided which hypothesis is correct. As Michelsen himself puts it: 'It seems fair to conclude that we are still confused, but at a slightly higher level'.

One theme that keeps popping up in this book, especially in Part II on ontogeny, is that of 'nature versus nurture'. Certainly, several of the contributors freely use the label 'innate' when they discuss, for example, the development of human language or bird song, with three authors even using the 'i-word' in the title of their chapter (Kuhl, Mundinger and Marler). In the Introduction to Part II, Hauser discusses the thorny debate, and comes up with the not entirely satisfactory conclusion that 'To move beyond such academic wars, many researchers have taken the position that developmental change involves an interaction between genes and the environment'. It would have been nice to have gone a little further than that, and to make it clear that

development is more complex than just an interaction between genes and environment, which surely is a prerequisite for life itself. It is surprising that in a book where the word 'innate' is used so much, there is no reference to [Lehrman \(1970\)](#), who should be required reading for anyone interested in the development of behaviour. Eventually, Marler himself comes to the rescue when he states about the use of nature–nurture type dichotomies: 'I will use data on song development in birds to question the logic behind all of these pairs of terms, if used as antithetical categories for classifying behavior. I believe that they are ultimately a hindrance to progress in the study of behavioral development'.

Only about half of the chapters in the third section are actually about evolution of communication, but all of them are of high quality. We particularly liked the chapter by Gerhardt, who discusses reproductive character displacement of acoustic signals, including his own studies using treefrogs as a model system.

This is a wonderful book that is required reading for anyone interested in animal communication and beyond. At times the book lacks coherence, but that is perhaps inevitable in a volume such as this. We would hope that the publishers would produce a paperback version to put this important book within the reach of students. This beautifully produced book is a fitting tribute to Peter Marler. In collecting and editing these different contributions, the editors have done him proud.

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Promiscuity: An Evolutionary History of Sperm Competition and Sexual Conflict. By TIM BIRKHEAD. London: Faber & Faber (2000). Pp. xiii+272. Price £9.99 paperback.

Tim Birkhead has spent much of the last 15 years exploring what turned out to be very fertile ground at the interface of behavioural ecology and reproductive physiology. His studies of the evolutionary consequences and the mechanisms of sperm competition in birds have been instrumental in pushing this field of research to the forefront of modern behavioural ecology. It is with high expectations, therefore, that one picks up this book, a mixture of research memoir and personal view of the state-of-the-art of the field. I am happy to report that my expectations were fulfilled. This is a whirlwind tour of the latest research in comparative reproductive

physiology, cryptic female choice, genetic mating systems and sexual conflict that can easily be read in a sitting. It is enlivened throughout by personal anecdotes (not all research-related) and snippets of information about other major players in the field. (Anyone reading the book will surely look with even more awe at Geoff Parker on learning that he is not only the founding father of sperm competition theory but also a champion chicken-breeder.)

We are taken through chapters outlining evolutionary arguments for competition, choice and conflict via description of patterns of paternity and ways in which animals protect their paternity, the evolution of genitalia, sperm and ova. Plenty of space is given to Birkhead's forte, describing how mechanisms of sperm competition and sperm choice can potentially explain variation in fertilization. Finally, after taking in recent exciting work on sexual conflict the book concludes with a discussion of the benefits of multiple mating for females. Extensive (but discreet, and highly current) references support the majority of statements and there are also numerous historical notes of interest. A selection of superb photographs also adds considerably to the overall impact. In particular, an extraordinary set of images depicting interactions between sperm and egg nuclei in a comb jelly is almost worth the cover price alone.

Although this is a work of popular science, anyone working within the field will almost certainly learn a lot from reading this book. Few professionals have as broad a knowledge of the issues discussed as Birkhead does, so there will almost certainly be some areas covered that will represent fresh ground. Does it work as popular science? I think it does admirably, although one guinea-pig expressed difficulty in following the logic of arguments that are usually taken for granted by evolutionary ecologists. Perhaps it is hard to remember just how much knowledge of genetics, selection and natural history is concealed within such familiar expressions as 'adaptive significance' or 'sexual conflict', particularly when it applies to behaviour. On the other hand, the best way to grasp these concepts is probably by exposure to them, and this book contains examples of most of the most exciting ideas in modern evolutionary ecology.

If I have one minor criticism it is that, to me, the treatment of human sexual behaviour and sperm competition felt like something that had been added or embellished, possibly to satisfy an editor's demands. Much of this material is very good, and involves fascinating portraits of the protagonists in some controversies (particularly over Robin Baker and Mark Bellis's work). On the whole though, it still seems very difficult to combine discussions of selection on animal sexual behaviour with discussion of selection (or its lack) on human sexual behaviour, without first taking elaborate care over statements of just what one can and cannot conclude from any similarities between the two. On the other hand, it is hard to imagine a book on this subject omitting humans entirely, and perhaps we have to risk occasional misunderstandings to communicate work as interesting and exciting as this to broader audiences.

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