

A chick (the first to hatch) quickly establishes dominance over the B chick, and most of the fighting involves the B chick attacking its C sibling. Mock describes these fights so effectively that a reader can almost see the chicks jabbing at each other and also trying to dodge their nestmate's jabs, which Mock likens to boxers alternately throwing and dodging punches. In a counterintuitive turn, B-on-C aggression is not dependent on current food levels or degree of satiation, because even experimental augmentation of feeding does not turn it off. But reducing a brood of three chicks to two does turn off aggression. Although food is all-important, Mock argues persuasively that the proximate stimulus for aggression is brood size, not current food levels, and that B chicks try to kill off C chicks to maximize their own chances of surviving should food availability decline. In other words, even when there is currently plenty of food, the B chick is still tries to kill off its younger sibling in a pre-emptive strike. Remarkably, when food is experimentally augmented, there is at least a weak trend for B chicks to increase aggression because, it seems, their extra energy enables them to devote even more effort to pre-emptive strikes. Mock candidly admits that he expected his egrets to show declining sib-sib aggression with increasing food.

All readers, even the most experienced ones, will find many fascinating examples of sibling competition and of the valuable conceptual lessons that these demonstrate. For example, sibling murder is not limited to animals; many plants have mechanisms that allow a developing seed to kill off its siblings, and some means of sibling competition are remarkably bizarre. It is one thing to kill off smaller siblings by the relentless aggression that egrets and many other birds show; it is quite another to consider the way pronghorns accomplish siblicide: the tail of one embryo grows through the head and body of another embryo, which is an effective insurance against the former being unviable.

Because their basic paradigm assumes that behaviour is adaptive, a heuristically useful approach, behavioural ecologists have a tendency to try and explain everything. But sometimes this leads us astray, and I found only one glaring example of this in Mock's book. Citing the finding that American toad tadpoles prefer to associate with kin rather with unrelated conspecific tadpoles, Mock points out that this result seemed enigmatic at first, because it raised the question of how kin recognition could possibly be adaptive to animals as seemingly simplistic as tadpoles. To provide a potential explanation, Mock then discusses the cannibalistic nature of some anuran larvae, such those of the spadefoot toads, and points out that such tadpoles would benefit by preferentially eating unrelated tadpoles. Although this conclusion is true, it is not relevant to the kin recognition of American toads and other anurans in which kin recognition has been demonstrated, but in which cannibalism never occurs. This is one case in which readers would have been better served by a simple admission that what we have here is a biological phenomenon, kin recognition by tadpoles, for which there is no simple adaptive explanation.

Some general insights in the book are of value to all behavioural ecologists, particularly Mock's discussions of

how preconceived notions can retard the adoption of new ideas. For example, it was very hard to get behavioural ecologists to believe the idea that an extra egg, i.e. one that would raise brood size beyond the number that can normally be reared, can be insurance against hatching failure, because there was such widespread acceptance of David Lack's (1947) elegant hypothesis that extra eggs serve a resource-tracking role. Mock also describes his own assumption that siblicide would reduce parental fitness and how this assumption led him to further assume that parents would not tolerate deadly sibling competition, which in turn led him to pursue several incorrect expectations, even when all of his initial observations were contrary to his assumptions. In an even more striking example, Mock describes how a possible rare example of brood adjustment by a parent, a black stork that threw one its own nestlings from its nest, went unreported for 24 years, until research showed that infanticide was a logical expectation for some species. And this occurred even though the infanticide had been irrefutably documented by photographic evidence!

The book closes with an elegantly written epilogue that is more a statement of the nature of the scientific process than a summation of what we know about strife versus cooperation within families. Mock describes the scientific value of being wrong and how it is often much more exciting to get results that one did not expect than to get results that support one's predictions. He points out the danger of believing hypotheses simply because they seem neat and new and provides an entertaining explanation of how the word empiricism is derived from a group of 13th century physicians who had the revolutionary idea that it is better to base actions on facts and observations than on intuitions. I encourage everyone to read at least this short part of the book, especially graduate students, because Mock gives valuable insights that normally come only after a scientist is well into a successful career in research. Although the entire book is a real gem for what I have suggested is its most appropriate audience, there are many individual gems, such as the epilogue, for all readers.

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The Behavior of Animals: Mechanisms, Function and Evolution. Edited by JOHAN J. BOLHUIS & LUC-ALAIN GIRALDEAU. Oxford: Blackwell (2005). Pp. xvii + 515. Price \$69.95 paper.

In their preface to *The Behavior of Animals: Mechanisms Functions and Evolution*, Bolhuis & Giraldeau argue that there is need for a new textbook in animal behaviour with

several distinctive features. First, the text should cover the entire spectrum of contemporary subdisciplines from animal cognition and behavioural neuroscience to conservation biology, animal welfare and evolutionary psychology. Second, the text should provide balanced treatment of causal and functional/evolutionary issues. Third, it should reflect the diversity of perspectives on the field from those of classic ethologists and learning theorists to 21st century behavioural ecologists and students of the phylogeny of behaviour. Last, Bolhuis & Giraldeau suggest that, because of the great progress that has been made in the many subdisciplines of animal behaviour in recent decades, the breadth of the field exceeds the ability of any individual to review it adequately. Consequently, a collection of chapters by experts in various areas is required to provide students with coverage that is both up-to-date and comprehensive.

Reading *The Behaviour of Animals* leads to the conclusion that Bolhuis & Giraldeau are very much on the right track. Of course, the volume suffers from weaknesses common to any multi-authored text: inconsistencies in style and depth of discussion, repetition of some material and absence of some important information that no contributor happens to cover. And the authors' goals vary considerably. Some take the invitation to participate in the volume as an opportunity to showcase their work and that of their students; others barely mention their own substantial contributions. Some provide comprehensive reviews of an area; others work through a few carefully chosen examples in depth. Still, taken as a whole, the volume is a great success, integrating material of historical interest with the latest studies of animal behaviour and considering in greater or lesser depth each of Tinbergen's four questions.

The volume is divided in three parts: the first, consisting of seven chapters, is concerned with mechanisms of behaviour and ranges over topics including perception (Ewert) and motivation (Hogan), biological rhythms (Mistlberger & Rusak), brain and behaviour (Sherry), development (Bolhuis), learning and memory (Kirkpatrick & Hall) and animal cognition (Emory & Clayton). Sherry's chapter on the relation between brain and behaviour and Kirkpatrick & Hall's review of learning are particularly compelling.

The second, and strongest, section, comprising six chapters, discusses the function and evolution of behaviour. There are some very impressive chapters here: Giraldeau's introduction to the whys and hows of mathematical modeling in behavioural ecology, McGregor on animal communication, Ryan on the evolution of behaviour, Elgar on sperm competition and sexual conflict, and Pusey on social systems, as well as a dense chapter on mate choice, mating systems and sexual selection by Møller.

The third section, 50 pages and three chapters in length, is devoted to applications of animal behaviour to other areas of inquiry, and is the most unusual for an animal behaviour text. It includes an interesting contribution by

Caro & Eadie on possibilities and problems in applying basic research in animal behaviour to conservation biology as well as an insightful discussion and defence by Daly & Wilson of the methods of evolutionary psychology as they relate to animal behaviour more generally. Fraser & Weary provide illustrations of the application of animal behaviour research to problems in animal welfare. A useful glossary of terms and both subject and author indexes complete the volume.

I found the first section on mechanism and development the least exciting of the three. I sorely missed a chapter on hormonal control of behaviour of the sort that John Wingfield, Hubert Schwabl or Ellen Ketterson might have written. There seemed to be undue emphasis on mid-twentieth-century issues (e.g. more space devoted to the question of the irreversibility of imprinting than to bird-song learning). Consequently, some chapters in the first section did not make as much contact with chapters in the second and third sections as they might have.

One problem common to edited volumes was largely avoided. An outstanding effort was made to cross-reference the various chapters, adding considerably to the integration of the volume's various parts. If the indexes had been prepared with similar care, the text would have been easier to use. Inevitably, more than one author discussed a number of issues and examples, and much could be learned by comparing approaches to common problems. The indexes were only occasionally helpful in allowing the interested reader to find all the locations in which repeated material was to be found.

Quibbles aside, Bolhuis & Giraldeau's edited volume is a fine addition to the current crop of animal behaviour texts. It would be my choice for teaching either advanced undergraduate students with a background in the life sciences and an interest in animal behaviour or a graduate-level seminar course. *The Behaviour of Animals* is, however, not suitable either as an introductory classroom text or for general audiences. The authors of various chapters assume that readers have already mastered modern evolutionary theory, are capable of understanding simple algebra and have at least a rudimentary knowledge of physics, neuroanatomy, phylogeny and molecular biology. Consequently, the text would not be suitable for the several-hundred-strong introductory classes in animal behaviour that are typical at my university, populated as they are by a mix of science and social-science students who cannot be assumed to have any relevant expertise at all. On the other hand, for students with a background in and commitment to the life sciences, *The Behavior of Animals* should prove an engaging and challenging compendium, providing a comprehensive and up-to-date overview of a very diverse discipline.

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