Invention and innovation

Are novel actions important in the evolution of behaviour?

Animal Innovations
edited by Simon M. Reader & Kevin N. Laland
Oxford University Press: 2003. 344 pp. £55, $85 (hbk); £19.99, $34.50 (pbk)

W. C. McGrew

B. BEVAN/ARDEA LONDON

A thirst for the new? Blue tits in Britain learnt from one another how to open milk bottles.

Innovation is the raw material of evolution, whether it be genetic mutation or the invention of behaviours. No one doubts the former's role in life on Earth through organic evolution, but many doubt that the latter occurs outside human cultural evolution. This book addresses this latter problem, as it is about the "psychological bases, natural ecology, evolution, and adaptive function of behavioral innovation in animals".

The editors — two biologists with research experience ranging from fish to primates — have assembled a volume of 15 chapters based on a symposium held at the 2001 International Ethological Congress in Tübingen, Germany. The authors of the chapters range across animal behaviour, from laboratory-based comparative psychologists such as Hilary Box to fieldworking ethologists (Richard Byrne, for instance). They cover taxa from fish (in the case of Kevin Laland) to great apes (Anne Russon). Not surprisingly, given their big brains and well-studied habits, primates are the focus of seven of the chapters.

Reader and Laland believe that innovation by non-human species is widespread, important and distinctive. In a provocative 35-page introduction, they pose some key questions. Who invents new behavioural patterns? What ecological variables influence innovation? What psychological processes underlie it? And does innovation drive evolution?

Unfortunately, the answers are not straightforward. Novelty is often not clear. Innovation can be idiosyncratic (that is, it never spreads beyond the inventor). Broad definitions equate initiative (for example, the first guppy to learn a new route through a maze) with creativity (such as the composition of new songs by humpback whales). Narrow definitions exclude key elements; for example, if we insist on only totally new patterns, we may exclude interesting modifications of existing behaviour. Innovations can range from mindless serendipity to clever insights. Given these issues, it is not surprising that the editors sometimes contradict themselves and the authors use different definitions for the phenomenon.

One of the chapters, by Hans Kummer and Jane Goodall, is a reprint of an article published nearly 20 years ago (*Phil. Trans. R. Soc. Lond.* **308,** 203–214; 1985), included presumably because of its landmark status in the field. Its make-up provides a starting point and gives us a benchmark: three pages of pregnant theory from Kummer, followed by nine pages of compelling storytelling about chimpanzees by Goodall. The remainder of the book shows how far the study of innovation has come in the past 20 years.

Pride of place goes to systematic, empirical, comparative analyses that seek to correlate 'innovativeness' with basic key variables. There are reassuring convergences: both Louis Lefebvre and Johan Bolhuis for birds, and Reader and Katherine MacDonald for primates, show a positive correlation between innovation frequency and the size of the neocortex, even when other possibly confounding variables have been controlled for. Byrne shows that much of the deception in non-human primates, especially the novel use of existing behavioural patterns out of context, may be innovative. Russon provides an astonishing array of examples of innovation by free-ranging orang-utans that are being rehabilitated from captivity. Many relate to human activities to which they may have been exposed, but many more cannot be, as humans do not do such things as dissemble palm crowns by hand.

Three chapters are given over to birds, which almost always provide bigger and better data sets than do mammals. Russell Greenberg contends that a preference for the familiar over the novel provides the key distinction that makes sense in terms of ecological analyses. Peter Slater and Robert Lachlan focus on bird song and distinguish among four alternative sources of novelty: immigration (new-comers and diffusion), innovation (modification of existing elements), invention (really new and underived) and improvisation (extemporaneous and transient). The best experimental work continues to be done on birds, a point that blinkered primatologists sometimes fail to acknowledge.

What to make of the claims of innovation by reptiles and fish? Laland and his students have produced a series of elegant experiments with guppies which may well exceed in quality of design any comparable studies of primates, for obvious logistical reasons. However, to be frank, it has yet to be shown that guppies do anything interesting, and if solving a simple maze task counts as innovation, it is hard to know how to compare it meaningfully with, say, elementary technology in apes or the riff-like singing of song birds, to quote Marc Hauser.

The editors have succeeded in putting innovation well and truly on the map as a phenomenon to be reckoned with. They provide a series of outstanding questions that demand answers, and the book will stimulate further research efforts. In that sense, Reader and Laland's volume can be compared to Benjamin Beck's *Animal Tool Behaviour* (Garland, 1980) or *Machiavellian Deception* by Richard Byrne and Andrew Whiten (Oxford University Press, 1988), two seminal tracts that set high standards. ■

W. C. McGrew is professor of anthropology and zoology at Miami University, Oxford, Ohio 45056, USA. His latest book, The Cultured Chimpanzee: Reflections on Cultural Primatology *(Cambridge University Press,), will be published later this year.*