

public that the parts list doesn't give us the key to life. The genome initiative has taught us the value of sharing. We need to learn this lesson. Cell biologists are generating huge data sets. As one peruses the poster sessions at any major meeting, it is inescapable that more data are being generated than a single person or even small laboratory can fully analyse. Each investigator typically analyses one or two aspects of their own data set. It would be interesting if one could download (for example) images of fluorescent chromosome spots in mitosis from a laboratory that has the images and apply their analysis tools. While this may seem a bit heretical, this is exactly where the genome was circa 1975. An investigator would not dream of sending their sequence to a colleague before publication. And don't we all remember attending meetings and being frustrated when a colleague would not disclose the gene name? (Colleagues were very protective of their A, G, C, and T's just a decade ago). While the data sharing model opens up a Pandora's Box of questions, this is the direction things are going. There are laboratories that are great at imaging and others that are great at analysis. Wouldn't it be wonderful to create a web site, like the genome sites, where investigators with analytical skill sets could go for data! Unlike the genomes, image sets are not strings of AGCT, but 0's and 1's in different formats, time scales and operating systems. We should think of the cell biologist's data set as an 'imaginome', figure out how to share these data sets in the spirit of the genome world and develop strategies for the developers of analysis tools to have free reign of a reliable database. Physicists, mathematicians, astronomers, engineers, and computer scientists have amazing ways of analyzing digital data and pulling out patterns from complex arrays. Let's figure out how to pool resources for the next generation to explore.

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## Book review

### The dog: a biologist's best friend

Brian Hare

*Dog behaviour, evolution and cognition* — Adam Miklosi. Oxford University Press, Oxford, UK, 2008. ISBN 978-0-19-929585-2

In your interactions with dogs you have likely wondered: do dogs recognize each other and different people? How sensitive is a dog's nose and what is their vision like? How good are dogs at finding their way home? What can a dog learn from another dog? Do dogs know what you are trying to say? Do they know what you are thinking? When did dogs start living with humans and why? Where did dogs originate? What are the differences between breeds? Whether one is a behavior geneticist, a population biologist, a psychologist, an anthropologist or just a dog lover, you cannot help but wonder about the lives of dogs and our lives together with them. But even though Darwin began the *Origin of Species* with examples of dog domestication, and Pavlov's dogs were the first to reveal to us classical conditioning, until now there has been no place to obtain answers to questions such as these that are based on rigorous scientific research. Adam Miklosi's new book aims to fill this gap and will be a landmark contribution to the study of animal behaviour, evolution and cognition. Over the past decade there has been an explosion of interest in dogs and it is this work that Miklosi uses to provide us with the first modern scholarly review of all there is to know about dogs — and the first review of scientific research on dogs since Scott and Fuller's pioneering book *Genetics and Social Behavior of Dogs* published in 1974.

Miklosi himself has been at the center of the surge in research interest on dogs over the past decade. So there is no one in a better position to write the first modern review of dog behavior, cognition and evolution. He has played a leading role in the work of the largest research laboratory working exclusively

on dog behavior and cognition, at Eotvos University in Budapest, Hungary. In many ways this book is also a tribute to the hard work of his colleagues. Miklosi and his team have published scores of empirical papers on all aspects of dog behavior and cognition that test phylogenetic, ontogenetic, and even functional explanations of behavior. All of the best experimental work starts with careful observation of the population or species under study. Miklosi and colleagues have taken this dual approach to their own work with dogs. In some cases they have gone to extremes to understand dog behavior before they attempt to tease apart the mechanisms that guide the behavior they observe. As an example, Miklosi and colleagues dedicated countless hours to personally raising a group of wolf and dog pups in identical rearing environments to allow powerful direct comparisons. They have studied the behavior of hundreds of dogs from dozens of breeds in dozens of different cutting-edge tasks that they developed specifically for examining dogs. This means for the first time you will find in this book a review by a dog expert who is explaining their behavior and cognitive skills through the lens of a careful observer and scientist, as opposed to a dog trainer or untrained enthusiast.

Miklosi's review is authoritative and exhaustive. The book is organized into eleven chapters covering the very latest research findings and are chock full of fun facts. For example, did you know the wolf was the smallest of eleven related predators at the time it first evolved? Or that dogs can see yellow and blue but not red and green. The first two chapters discuss the history of dog research and conceptual and methodological issues regarding the study of behavior in any species. The next eight chapters each focus on a theme, including: dogs in human society; dogs in comparison to other canids; the genetic and archaeological evidence for domestication; the perceptual world of dogs; dog cognition regarding the physical world; dog social cognition; behavioral development in dogs; and temperament and personality in dogs. No other author has attempted to review such a range of topics about dogs in one volume. One of the major devices that Miklosi uses to succeed are break out boxes; these include additional illustrations, original figures and detailed explanations that allow

Miklosi to go into further detail on a particular point without interrupting the main text. The break out boxes are easy to locate and read as you are using this book as a reference guide on dog research. Overall, with the broad coverage of topics and the organization of the book, it will interest and be accessible to expert and dog lover alike.

To start, one of the book's highlights has to be the review of all of Miklosi and colleagues' work in one place. For example, we learn from their comparisons of wolves and dogs how the two species develop physically and behaviorally at very different rates; that dog puppies are more attracted and more comfortable around humans than wolves throughout their development; that, while dogs puppies are immediately able to use social information provided by humans, wolf puppies do not spontaneously use this same information; and that dogs actively look to humans for solutions to unsolvable problems while wolves look for solutions on their own. Together this work makes a convincing case that the process of domestication has had a profound effect on not just the morphology but also the psychology of dogs. Crucially, it seems that dog psychology has evolved such that dogs bond with humans in a way that wolves cannot. Miklosi stays appropriately close to the data and emphasizes the need for future research to tease apart various models of how selection during domestication may have shaped the dog, but in doing so points to future avenues of research.

There are many other surprising finds reviewed in this book. You will learn about work testing the ability of dogs to learn from humans and other dogs through various forms of social learning — including imitation. And studies examining whether the bark of the dog varies in its structure, such that both dogs and humans can discriminate different types of bark with different types of meaning. But there is more here than just behavioral work. You will also learn how researchers are harnessing the unmatched morphological variance in dogs to test hypotheses at the intersection of neurophysiology and cognition. For example, Miklosi explains how it was discovered that the width of the dog skull in relation to its length correlates with how the area in a dog's eye allowing for high acuity (where there is a high density population of ganglion

cells in the retina) is shaped. Miklosi then outlines how he and colleagues used this neurophysiological finding to test whether Brachiocephalic (short-nosed) dogs were more skilled than Dolichocephalic (long-nosed) dogs at using gestural cues provided by humans. Consistent with the neurophysiological finding, short-nosed dogs such as pugs were more skilled at comprehending human gestures than long-nosed dogs such as collies. You will also learn how neuroendocrine techniques are helping to reveal individual differences in the stress reaction of dogs. When measuring the changes in cortisol when confronted with a strange human, neither bold nor shy dogs experience dramatic changes in cortisol levels when threatened by a strange human; instead, dogs that are not categorized in either extreme show the strongest physiological reaction to a stranger. This suggests that stress for dogs is caused by ambivalence in deciding how to react in the presence of a stranger.

This new book is a testament to the bright future of research on dogs. Miklosi has made the case for how important the dog is becoming in the study of animal psychology. The days of dogs being considered artificially created animals for use in conditioning studies have given way to the recognition of the dog's rich social life requiring it to adapt to the most complex primate of all. With the increasing costs and ethical dilemma often created by keeping nonhuman primates in laboratories, dogs may provide a particularly attractive option in the future for psychologists interested in studying the cognitive processes in nonhuman animals (pet dogs are recruited for non-invasive research as in studies of humans). Miklosi's new book will be a central fixture in all future work on dogs, as it will be the first place that students and experts alike will go to review unfamiliar topics or search for new research ideas. And it is not just researchers who will benefit. The book will be essential reading for all those using dogs as helpers for the handicapped, assistants to law enforcement, or just those who want to understand their best friend a little better.

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## Quick guide

# Elephant cognition

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### **Why study elephant cognition?**

Elephants have the largest absolute brain size of any land animal: 5.5 kg in Asian elephants and up to 6.5 kg in African savannah elephants. Larger brains should provide greater information processing power, but the high metabolic cost of brain tissue requires that animals only invest in large brains if they need to overcome some serious cognitive challenges. As a non-specialist browser, too large to be much threatened by predators, an elephant's biggest cognitive challenge is most likely to be social. All species of elephants form large social networks, with hierarchical, multi-level organisation, implying that elephants can deal with a degree of social complexity. Flexible problem solving would help, and elephants have the necessary brainpower. It is hardly surprising, then, that more and more researchers are becoming interested in the cognitive skills of these enigmatic animals.

For cognitive scientists, there is an additional reason to study elephants. Most research on animal minds has concentrated on species that are phylogenetically close to humans, such as the primates. Although this a natural starting point, such anthropocentrism has sometimes led to a bias in our understanding of animal cognition, with animals that are physically able to perform similar tasks to humans, such as tool making or keyboard use, being perceived as more 'intelligent'. Now, cognitive research on animals is increasingly conducted in ecologically valid ways on a wider range of domestic animals, birds, fish, and even invertebrates. Broadening the range of taxa examined and the types of question asked holds the promise of a truly comparative picture of animal mental skills. Elephants form part of the *Afrotheria*, more closely related to the small-brained aardvarks and manatees than to primates, so represent an obvious challenge for cognitive researchers.