Juliane Bräuer · Juliane Kaminski

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About the Authors

Juliane Kaminski and **Juliane Bräuer** have been studying the cognitive abilities of dogs for 20 years. The authors both studied biology, then completed their doctorates at the Max Planck Institute for Evolutionary Anthropology in Leipzig, and conducted numerous behavioural studies.

Juliane Kaminski is an assistant professor at the University of Portsmouth, where she heads the Dog Cognition Centre. She is interested in communication between humans and dogs and is co-editor of the book, *The Social Dog: Behaviour and Cognition*.

Juliane Bräuer heads *DogStudies* at the Max Planck Institute for the Science of Human History in Jena. She is interested in what abilities dogs have developed over the course of domestication. She is author of the book, *Klüger als wir denken: Wozu Tiere fähig sind.*

1

Why Dogs?

In June 2004, the dog world was abuzz. Rico, a 9-year-old Border collie, had proved under scientific conditions that he could distinguish 200 different objects by name. And not only that, he could also learn new names for toys in a way that had previously only been demonstrated in children. The press spoke of the 'Einstein of the dog world', and a major German newspaper even went so far as to say: 'Finally proven: dogs understand German'. It seemed as if one of the big questions had been solved! Dogs understand us. They understand every word! But is that really so?

What do dogs understand about us humans? Do they understand what we are trying to communicate to them? What do they understand about the world they live in? These are the questions this book is about. It is about *cognition*, specifically, the *cognitive capabilities* of domestic dogs. We are interested in how dogs perceive their environment and what knowledge they can gain about it. On the one hand, it is about what dogs understand about their inanimate environment. For example, do dogs understand simple relationships such as gravity? Do they know that objects that are dropped always land on the earth? On the other hand, it involves the question of what dogs understand about their animate—i.e., social—environment. What do dogs understand about us humans? How do we communicate with them and they with us? In the course of this book you will come to see that this is clearly where our pet's great talent lies. Would you have thought, for example, that your dog can tell whether your eyes are open or not? Or that objects become exciting for it solely because *you* have touched them?

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Why Testing Dogs

But why are we dealing with the cognition of domestic dogs? When we think of cognition, certainly the great apes are the first thing that comes to mind, because they are so closely related to us humans. Or, at the very least, one thinks of animals that have to make it in the wild. Like wolves, for example. But one doesn't tend to think about house pets.

In fact, even in science, dogs have long been regarded somewhat pejoratively as domesticated, as 'imperfect' wolves. They have lost many of the abilities of their wild ancestors. For example, they have smaller brains, and they are also thought to have worse hearing and smell than their wild relatives. Many scientists have rejected research involving dogs because dogs supposedly live in an 'artificial' environment. Results of such experiments would not reflect 'true nature'.

Recently, however, it has become accepted that dogs do not live in an *unnatural* environment, but simply in a *different* environment than wolves (Fig. 1.1). The human environment is the natural environment for dogs. This means that *different* skills are required here than in the wild.

Since dogs have lived together with humans for a very long time, many scientists increasingly see our four-legged friends as an interesting model. Because during this long coexistence they may have developed special abilities to adapt to life with humans. Since the turn of the millennium, this rethinking in the way that dogs are viewed has given rise to numerous new studies.

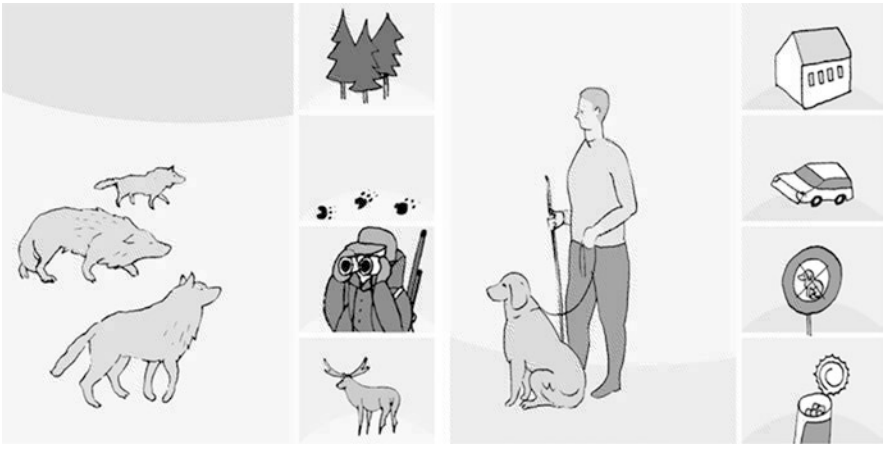

Fig. 1.1 Much has changed in the lives of dogs compared to those of the wolves

About This Book

A lot is written and claimed about dogs. There are a lot of books in which the behaviour of the dog is interpreted and sometimes humanised. In this book we would like to present, in a vivid manner, the latest results from science. All of these findings are based on studies conducted by scientists the world over. Our aim is to explain how such studies are conducted, what their results mean, and how they are interpreted. Thus, what you read here is not our personal assessment or opinion. Of course, this still does not make the book completely objective. We have had to select from many studies, and we may have overlooked some. Others have been left out since we found them unimportant or unconvincing because, in our opinion, they were poorly conducted methodologically. Nevertheless, we have made every effort to give you a very broad overview of what we know about dogs to date.

Parts of this book were published years ago—but we have now reviewed and updated it in its entirety. The many new studies have changed science's image of dogs a bit in the last 10 years. The focus of research has shifted and new methods have been used, such as magnetic resonance imaging and physiological measurements. This has resulted in completely new chapters in this book—such as the one on cooperation between humans and dogs—whereas others have been completely rewritten or shortened. All in all, our book aims to give you an up-to-date and comprehensive picture of research on dog cognition.

What Do We Need Studies for?

Time and again we are asked by dog owners: why do we need these tests in the first place? Every owner should be in the best position to know about his or her pet. After all, the owner observes it for most of the day. And it is true that such observations always provide good ideas for new tests. The problem lies in how the dogs' behaviour is interpreted. There are dog owners who unhesitatingly attribute a high level of understanding to everything their dog does. They measure each and every behaviour with human yardsticks. This sometimes goes so far that no differences between humans and dogs are even perceived.

We ourselves are dog owners and know from our own experience how quickly an explanation can be found that puts our own dog in the best possible light. However, there are always several possible interpretations for any

given behaviour. The tests serve to find the right explanation for a specific behaviour and to exclude alternative interpretations.

Let's take an example that many of you are probably familiar with. You want to take your dog to the park. Before you can go, however, you need the toy that makes your dog happy outdoors. You look around, but you can't find it. Then you see that your dog is standing in the corner of the room by the wall unit and looking back and forth between you and it. Because you do not react immediately, it becomes even more emphatic and finally jumps up on the wall unit and runs back and forth. Finally, you understand what your dog is trying to 'tell' you. The toy is in the wall unit. You open it up and, lo and behold, there it is.

How can you explain your dog's conspicuous behaviour? Had your dog known exactly what you were looking for and sought to inform you about where the toy was? People communicate in this way. If this communication had taken place between two people, it would certainly have been meant in this way. One person recognises the need of the other and responds by indicating what is needed, helping in this way. It is possible that your dog is behaving in exactly the same way in the situation described above. However, there are other possible explanations for your dog's behaviour. Perhaps your dog knows that the walk is about to start. It notices this, for example, because you have put on your shoes or grabbed the lead.

Your dog may then simply automatically point to the toy because it has a selfish interest in having this toy taken along. Thus, it is not concerned with helping you find it through its communication. It is only concerned with its need to get the toy. Since it cannot get the toy on its own, it needs you as a kind of 'tool' to get the toy for it. This leads to two possible explanations. The first hypothesis would be that dogs communicate to help you search because they recognise your need. The second hypothesis would be that they act solely out of selfish motives to gain an advantage for themselves.

So how can we find out what your dog's behaviour really means? This is the moment at which a test can help. A test is necessary to really know what is behind a dog's behaviour. So-called *controlled* conditions are created. This means that we confront our test dogs with a certain predefined situation. We make sure that the procedure is always the same. Only certain parts of this sequence are changed in a deliberate way. This is what we call the variable conditions. Now we compare the dogs' behaviour under these conditions. This allows us to isolate the reason why the dog behaved the way it did.

It is important in these tests that the experimenter tries to be unbiased. Because you often see what you want to see. In addition, if possible, the behaviour of the dogs in the trials should be recorded with a video camera.

On the one hand, this allows for the material to be evaluated at leisure. On the other hand, this also allows it to then be examined by other, completely unbiased persons. In the best case, by a person who does not even know the question the study seeks to answer. This person should evaluate the behaviour of the dogs according to clear and unambiguously defined criteria. Only if the unbiased observer agrees with the researcher directing the study in his or her evaluation of the behaviour, are the results of the study credible.

But the evaluation of the video does not mark the end of our experiment. Because now comes the statistical evaluation. Rarely are the results completely unequivocal on first sight. Rarely will *all* the dogs in one group behave differently from *all* the dogs in the other group. That is why we need statistical tests. They answer the question: Can our results be explained *by chance*? If so, would the dogs have behaved completely randomly and independently of which test situation they were in? Or are our results *not random*? That would mean the dogs' behaviour really had something to do with the different conditions they were in. If our results are not based on chance, then they are meaningful.

But how do we interpret the behaviour of our four-legged friends? If, for instance, a dog does *not* 'pass' a test, there may be several possible reasons for this. Perhaps the test design was not sensible. Maybe there was something that distracted the dog? Was it motivated? Is it capable, in purely physical terms, of solving this problem? If you have eliminated such flaws and the dog still fails, it is probably the dog's lack of understanding that keeps it from solving the problem. And if the dogs can solve the problem? Does that mean they understand as much as we do? Or do they perhaps use a completely different strategy and arrive at the same result? Did the animals perhaps learn the solution in the course of the experiment? We have to check this too, because we are more interested in the dogs' spontaneous behaviour and less in their learned behaviour. These are all questions that need to be answered before a statement can be made about the dogs' abilities.

Fun for Dogs or Animal Experiment

Dog owners tell us what they have gone through with their pets. These observations, as well as our own, provide the ideas for studies. However, the overriding principle in this kind of work with dogs is that everything is done on a voluntary basis. It should be fun for everyone involved. Only then can the dog attain its best results. The situations created for the purpose of the study are usually very playful.

In most experiments, a problem of some kind must be solved. The stimulus is either food or toys (Fig. 1.2). For example, a ball has to be found. Or a lever has to be pressed to get food. When the dogs have solved the problem, they are allowed to eat the food. Or they play a round. These motivational phases in-between help to keep the dog in a good mood.

For this type of study, it is important that the dogs do not lose their motivation. This could falsify the results. In such a case, the animal might be able to solve the problem, but it 'no longer feels' like doing anything. So it is in the interest of all involved that the dogs never stop having 'fun' at their 'work'. Most of the dogs seem to like our tests very much. No matter whether in Leipzig, Jena, or Portsmouth…

Dog owners are always telling us that their pets turn off on their own toward the dog testing rooms on their way to the park. So it seems that a new test is better than a familiar walk. In the testing rooms the dogs get to play, search for food, and—if desired—make contact with their own kind. And above all, there is a human being there who is only concerned with them.

Depending on the question asked in the test, the owners are sometimes part of the study and sometimes not. To keep the general conditions of our tests as constant as possible, many studies are carried out without the dogs' owners. This is because dogs are extremely sensitive to the slightest cues from their owners. Thus, it is our aim to keep owners from giving their animals these small forms of assistance. An assistance that can even take place unconsciously. After all, it is almost impossible to suppress the desire to have one's

Fig. 1.2 Both are good motivators: toys and food

own dog master the task at hand. But what interests us most is how the dogs can solve the problem on their own!

However, there are studies that are dependent on the participation of the owner. For example, if you want to know how a dog and its owner communicate with each other or whether dogs prefer to assist people they know over those that they don't. Then, of course, the owner is very important for the test. Sometimes he or she is given very precise instructions on how to behave in the test—depending on the conditions in the particular study. In other cases, the owner is allowed to move freely with his or her dog and behave as he or she would if he or she were unobserved. Here the free interaction between dog and owner is recorded and analysed.

Some of the experiments described in this book can be easily replicated at home. You will therefore always be encouraged to try one or the other with your dog. Such a test may provide you with more than a few new insights into your own pet. It may also ensure that your four-legged friend has an interesting afternoon.

The Comparison

You might be surprised to discover that this dog book is not only about dogs. It often includes work with children, monkeys, and even goats (Fig. 1.3). It is not that dogs alone do not provide enough to talk about. It is because this comparative approach plays an important part in cognitive research. This raises the question about the evolution (i.e., the development) of cognitive abilities.

There is no doubt that humans have developed a very high level of cognitive ability. This applies both to their acute understanding of the inanimate world (quantities, colours, shapes, etc.) and to their sophisticated understanding of the social environment in which they operate. We know in some

Fig. 1.3 Making comparisons between species is important for understanding how cognitive abilities have developed in the course of evolution

situations what others can or cannot see. We understand what they are trying to tell us. In certain cases, we can even discern the aims and intentions of the person (or animal) opposite us. We make use of this knowledge on a daily basis. This means that we humans are able to perceive others as autonomous agents with their own thoughts, feelings, and ideas. Comparative cognition research asks the question whether other species are also able to do this. Studies with apes seem to be the obvious choice in this context. Great apes are the closest living relatives of humans. So if we were to find comparable abilities, it would be here.

But dogs? How could dogs fit into such investigations, apart from the fact that, as a dog lover, one naturally likes to work with these animals? There are two things that make dogs interesting. First, they are mammals. They belong to the same systematic group as humans and apes. However, they are more distantly related to humans than apes are. This makes them interesting for comparative studies. If you compare different animal species with each other, you can see how widespread certain abilities are in the animal kingdom. This comparison is not only important with species closely related to us, but also with those more distantly related.

We have already mentioned the second reason why dogs make an interesting comparison. It has to do with their long and intensive coexistence with humans. It is assumed that dogs have developed special abilities in this relationship. When we hear, for example, that the Border collie Rico learns names of objects by matching, we may not be that surprised. However, when we learn that this ability has otherwise only been shown to exist in humans, a completely different picture emerges. This book would like to draw your attention to these distinctive features of our dogs' abilities.

When looking at the behaviour of dogs, the comparison with their closest relative, the wolf, is of particular interest. Especially when the question arises about the extent of influence that the process of domestication had on dogs' abilities. An entire chapter of this book is devoted to this comparison. Similarities between dogs and wolves tell us something about the abilities of their species in general. Differences show what has changed in the long period of dogs' domestication.

In comparison with other species, we see that dogs can do some things particularly well and other things not as well. This raises the question of *why* this is so. It is related to the skills that their environment calls for. This is where their 'talents' lie. The studies are basically designed to require skills that are also relevant to dogs. Accordingly, we don't test whether dogs can talk. Or whether they can divide a number by 17. Instead, we try to give test dogs tasks that are relevant to them in their everyday environments.

We are, of course, often asked the question: How smart are dogs? If you compare their abilities with those of small children, how smart are they? As smart as 2-year-old children or as smart as 5-year-olds? Clearly, it is not that easy to answer this question. It all depends on the task. As you will see when reading this book, there are areas in which dogs perform as well as 3-year-old children. In other areas, they can't even hold a candle to a 10-month-old child. And in one area they probably do even better than humans—due to their extremely sensitive noses. Dogs may well understand more about the world of smell—and what is connected with it—than we humans do. But we don't know much about that yet.

You may notice that we never speak of 'intelligence' in the following pages. This is not to say that dogs are not intelligent. But we prefer to speak of cognitive abilities. Because this expression allows for a differentiated view. Dogs are not intelligent or stupid. It is just that they can do some things and not others.

2

How Wolves Became Dogs

A scene at the dog run: A golden retriever is tussling with a German shepherd. A St. Bernard stands calmly nearby. It weighs in at a hefty 85 kg. Its head alone is bigger than the entire dwarf dachshund that lifts its leg a few metres away. In between, graceful greyhounds flit back and forth, chasing and catching each other. A Labrador never tires of fetching, again and again, the ball thrown by its owner. A Puli joins in. Its face can only be intuited under its long coat.

It is hard to believe that all these different animals are closely related and are supposed to share the same progenitor: the wolf. For a long time, this resulted in speculation whether other canids, such as golden jackals or coyotes, could be the closest relatives of dogs. However, it has also been known for a long time that dogs very rarely—if ever—mate with coyotes or jackals, neither in the wild nor in crossbreeding experiments. They do, however, mate with wolves. All recent studies also speak against coyotes or jackals playing a role as dog ancestors. Geneticists, morphologists, and behavioural scientists agree: wolves are the closest living relatives of our present-day domestic dogs (Fig. 2.1). There is some debate among anatomists as to whether dogs represent a species of their own (*Canis familiaris*) or a subspecies of wolves (*Canis lupus familiaris*). But that need not concern us here.

When It Began

In the following, it is important for us to distinguish between the progenitor wolf and the wolf of today. For today's wolf is not the direct ancestor of our dog, but its cousin. Thus, both dogs and present-day wolves are descended

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Fig. 2.1 Clearly proven: dogs and wolves share a common ancestor

from a common ancestor, just as two cousins have grandparents in common. When we look at the differences between dogs and wolves, we have to bear this in mind: we cannot compare the dogs in our studies today with the progenitor, the 'primeval wolf', but only with its cousin, who lives today. And, of course, this cousin has also evolved over the last 40,000 years. The wolf has, for instance, been subject to intense hunting in many parts of the world. So you can imagine that only the most reclusive wolves have survived and reproduced. Among dogs, on the other hand, those that were particularly good at getting along with people prevailed.

As far as dogs are concerned, everything suggests that they all—from the miniature pinscher to the Great Dane—are descended from the 'primeval wolf'. It is also certain that dogs are the oldest domesticated animals. They have lived with us much longer than, for example, goats, which were the next animal to be domesticated. But when exactly did it happen, when did wolves become dogs? When did they develop floppy ears and start barking? It is not so easy to answer this question from the genetic material. It is possible to look at how closely dogs and wolves are related to each other. But we can only guess when the split between the species took place. Biologists still do not agree here, because different genetic methods have led to different results. In the meantime, agreement has been reached that domestication of the dog began about 35,000–40,000 years ago.

Archaeologists can confirm this. Since the Ice Age, bones of wolves have been found close to those of early humans. This may be because both species