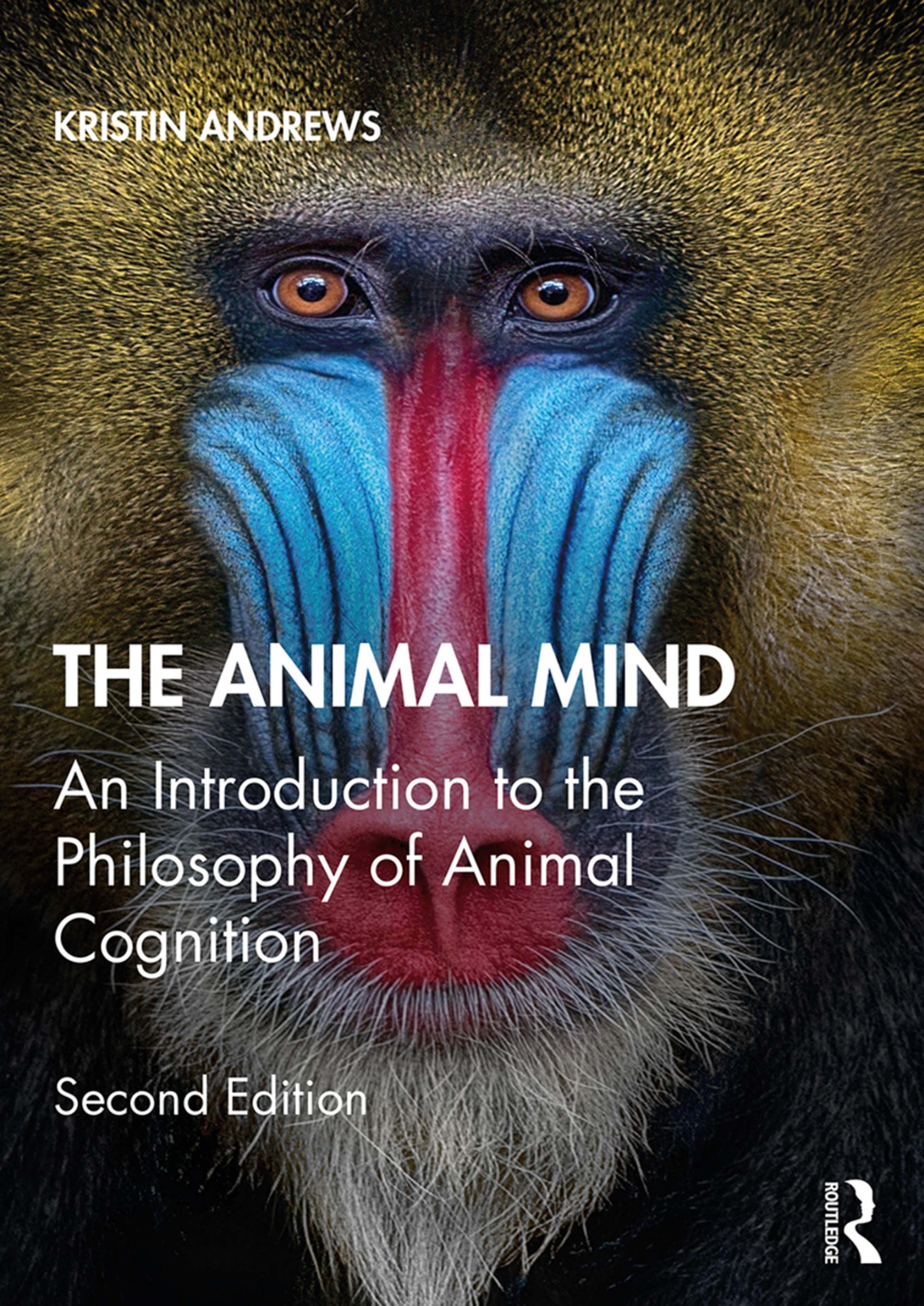
KRISTIN ANDREWS
THE ANIMAL MIND
An Introduction to the Philosophy of Animal Cognition
Second Edition
ROUTLEDGE

The Animal Mind

The philosophy of animal minds addresses profound questions about the nature of mind and the relationships between humans and other animals.

In this fully revised and updated introductory text, Kristin Andrews introduces and assesses the essential topics, problems, and debates as they cut across animal cognition and philosophy of mind, citing historical and cutting-edge empirical data and case studies throughout.

The second edition includes a new chapter on animal culture. There are also new sections on the evolution of consciousness and tool use in animals, as well as substantially revised sections on mental representation, belief, communication, theory of mind, animal ethics, and moral psychology.

Further features such as chapter summaries, annotated further reading, and a glossary make *The Animal Mind* an indispensable introduction to those teaching philosophy of mind, philosophy of animal minds, or animal cognition. It will also be an excellent resource for those in fields such as ethology, biology, and psychology.

Kristin Andrews is Professor and York Research Chair in Animal Minds at York University, Canada. She is editor (with Jacob Beck) of *The Routledge Handbook of Philosophy of Animal Minds* (2017), and is a co-author of *Chimpanzee Rights: The Philosophers' Brief* (2018).

Amy Noseworthy (she/her) is an artist and illustrator in Toronto, Ontario, who draws all manner of strange and nerdy things in between bouts of chasing two small people around the house. She studied drawing and printmaking at the Nova Scotia College of Art and Design and in the fine arts department at York University, Canada. She has a couple of decades of experience doing graphic design and commercial illustration, but her true love is to put pen and pencil to paper. She publishes the webcomic "mamahood" at mamahoodthecomic.tumblr.com. You can see more of her work at hiredhandstudio.com.

“Essential for anyone interested in the philosophy of animal cognition. Andrews expertly combines science and philosophy to show how rich, complex, and varied animal minds can be. She also shows how the study of animal minds can improve our understanding of consciousness, language, reason, culture, morality, human nature, and more. If you want a new appreciation of the many animals you share the world with, as well as of yourself, you should read this book.”

- Jeff Sebo, *New York University, USA*

Praise for the first edition:

“… Andrews explores the philosophy of animal cognition fairly thoroughly and clearly, including ideas, claims, and counterclaims. … *The Animal Mind* is not for skimming; it should be read slowly, a section at a time, digested, and read again. However, the knowledge gained is worth the time invested. … Summing Up: Recommended.”

- *CHOICE*

“Andrews does not merely present the major theories and latest research into animal cognition. She also evaluates the quality of that research and the arguments advanced by notable philosophers, psychologists, ethologists and biologists. For readers unfamiliar with the terminology frequently used by specialists in those fields, Andrews includes a clear glossary. Likewise, the entire book is written in an engaging style, avoiding the mind-numbing tendencies that introductory textbooks can produce.”

- *Philosophy in Review*

“Andrews is terrifically knowledgeable about both the philosophy and science of animal minds and is not above coaxing the rest of us into this notoriously difficult subject with the judicious use of anecdotes and stories. This is the best introduction to the subject currently available.”

- Dale Jamieson, *New York University, USA*

“An outstanding, highly readable, and carefully argued introduction to a variety of increasingly important topics in philosophy. I can think of no better way to get philosophers and cognitive scientists up to speed on the issues, and I look forward to teaching this book in my own courses on animal minds.”

- Bryce Huebner, *Georgetown University, USA*

“This thoughtful and well-informed book is a very useful guide to the philosophical and empirical literatures on animal minds. It is accessibly written and well-pitched for students.”

- José Luis Bermúdez, *Texas A&M University, USA*

“*The Animal Mind* is an ideal text for introductory classes in the growing field of the philosophy of cognitive ethology. It is also an excellent work of philosophy—one that challenges received wisdom and speculates about future lines of research. As interest in animals grows among philosophers and psychologists, this book provides stimulating reading for students and scholars alike.”

- Edward Minar, *University of Arkansas, USA*

The Animal Mind

An Introduction to the Philosophy of Animal Cognition

Second Edition

Kristin Andrews

Routledge
Taylor & Francis Group
LONDON AND NEW YORK

Second edition published 2020
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge
52 Vanderbilt Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

First edition published by Routledge 2015

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
Names: Andrews, Kristin, 1971– author.
Title: The animal mind: an introduction to the philosophy of animal
cognition / Kristin Andrews.
Description: Second edition. | Abingdon, Oxon; New York, NY: Routledge, 2020. |
Includes bibliographical references and index. |
Identifiers: LCCN 2019055759 (print) | LCCN 2019055760 (ebook) |
ISBN 9781138559561 (hbk) | ISBN 9781138559578 (pbk) | ISBN 9780203712511 (ebk)
Subjects: LCSH: Cognition in animals. | Animal behavior. |
Cognition—Philosophy.
Classification: LCC QL785 .A69 2020 (print) | LCC QL785 (ebook) | DDC 591.5/13—dc23
LC record available at https://lccn.loc.gov/2019055759
LC ebook record available at https://lccn.loc.gov/2019055760

ISBN: 978-1-138-55956-1 (hbk)
ISBN: 978-1-138-55957-8 (pbk)
ISBN: 978-0-203-71251-1 (ebk)

Typeset in Franklin Gothic
by codeMantra

For Alex

Contents

Preface to the second edition

The second edition of *The Animal Mind* is more of a renovation than a restoration. I gutted the first edition book but kept the bones and added some fancy new bits. When you move into a house, it can be good to live in it for a while before making any changes. You learn how you use the house, what works and what doesn't. That's what I did with the book. After teaching a few courses with the first edition, and talking to many friends and colleagues about what they liked and didn't like about the first edition, it was time to start the reno.

Chapter 1, Other Minds, introduces those aspects of philosophy of mind used in the book, and Chapter 2, Explaining Animal Behavior, introduces aspects of philosophy of science. These two chapters (which have as their bones the first edition's Chapter 1) are meant to give students with little or no philosophical background a pithy introduction to the questions and theories from the philosophy of mind and philosophy of science that we will be using in the rest of the book. Chapter 3, The Science of Animal Minds, is slightly shortened and cleaned up, with the methodological discussions of anthropomorphism cut out; that discussion now appears in Chapter 2. Chapter 4, Consciousness, is thoroughly revised. I now present three general approaches to answering the question of animal consciousness—through application of a theory of consciousness, through an epistemic approach in the absence of a theory of consciousness, and through a biological function approach. I critique the theory approach as premature, and defend my version of the epistemic approach. Readers of the first edition may be happy to hear that the original chapter on belief, concepts, and rationality has been significantly revised. Chapter 5, Thinking, focuses on three topics: The vehicle of thought, the arguments regarding animal belief, and the philosophy and science of animal rationality and logic. Chapter 6, Communication, is substantially restructured. I also added a more robust discussion of the neo-Gricean account of mindreading and the animal language research program. Chapter 7, Social Cognition, was updated to reflect the flurry of research findings that have come to light since the first edition. The first entirely new chapter is Chapter 8, Culture. Here, I focus on a number of issues of current interest among philosophers, psychologists, and anthropologists having to do with claims of human uniqueness which are built on claims about what animals can and can't do, and how they do what they do. This chapter is a kind of application of the work done in all the previous chapters, using the tools and care with concepts to examine whether we are continuous with animals when it comes to culture, or whether human culture is a thing unto itself. I defend the continuity claim. The last chapter, Chapter 9, Moral Minds, has also been significantly revised. I focus on three topics: Reasons to think animals matter from the perspective of five approaches in ethics and political theory; moral agency (which is updated from the first edition); and moral psychology (which is entirely new).

There are so many people to thank for their help in this process. To all the students who read the first edition and helped me see others ways of explaining some of these concepts, and all the teachers who taught it and gave comments, I thank you. The participants in the 2018 NEH Summer Seminar Animal Minds and Morals I ran at SUNY Potsdam read some of the new chapters and some of the old ones, and offered much in the way of helpful suggestion, especially David Curry and Wendi Haugh who offered me extensive written comments. Thanks to Colin Allen, Jacob Beck, Lauren Edwards, Simon Fitzpatrick, Lori Gruen, Brian Hood, Brian Huss, Alice MacLachlan, Dennis Papadopoulos, Brandon Tinklenberg, Hugh Wilson, and an anonymous reviewer for comments, critiques, and suggestions. I'm so grateful that I was able to work with Amy Noseworthy, who illustrated the book. But most of all thanks to Brian and Poppy for putting up with me while working on another book, and to sweet summer child Riddle, the pup, who came into our lives during the last months of writing.

Acknowledgments, first edition

I've been teaching the Philosophy of Animal Minds at York University for ten years, and I've learned much about how to present this material from all the students who have passed through my classroom. Some of them read draft chapters of this book, some of them saw slides that I turned into text, but they all helped shape the book you are looking at now. First thanks to all of them.

I wasn't planning on turning my class into a textbook until Tony Bruce from Routledge showed up in my office and asked me to write *The Animal Mind*, but it sounded like a great idea. During the next two years, I was lucky enough to have lots of eyes on drafts. In particular, I'd like to thank those who gave me comments on part or all of the manuscript: Laura Adams, Jacob Beck, Rachel Brown, Grant Goodrich, Brian Huss, Imola Ilyes, Georgia Mason, Irina Meketa, Edward Minar, Anne Russon, Sara Shettleworth, Elliott Sober, Olivia Sultanescu, and three anonymous reviewers for Routledge. I'd also like to thank members of the GTA Animal Cognition Group for helpful discussions about many of these issues. Olivia Sultanescu and Brian Huss deserve extra thanks for their work proofreading and writing the glossary, and special thanks to Olivia for cleaning up and putting together the pieces that make up this book.

Thanks to Brian and Poppy, and to Huxley and Mono, for putting up with me working on yet another book project, and all the time and distraction that goes along with that. Thanks to John and the crew at Annex Montessori for teaching Poppy while I worked, and to the cafes in Kensington Market and Bloordale for offering me good places to work. Much of this was written listening to the Smiths at Café Pamenar and Ethiopian jazz at Holy Oak. Thanks to my faculty organization YUFA for giving me the course release needed to write, and thanks to SSHRC for funding the materials and support I needed to put it all together.

I also want to thank all the animals who were used in the research discussed in this book. Many of these individuals died in captivity, including some I had personal relationships with. I appreciate their forced sacrifice.

Introduction

A monkey walks along a wire high above the empty tracks at a train station. As electricity goes through the line, the monkey is shocked and falls onto the tracks, tumbling down into a chasm. Two other monkeys quickly run across the tracks to their companion, but find only a limp body. One of the monkeys hauls the body up out of the pit, shaking the lifeless form. Though the injured monkey looks dead, after a few moments, life returns, and the three monkeys escape the railway tracks. In news reports, the rescuing monkey is called a hero.

A dog gently grasps a sled with their mouth, and pulls the sled up a snowy hill. At the top of the hill, the dog steps onto the sled and rides it down to the bottom. Again, and again, the dog drags the sled to the top of the hill, riding it down like any young human might. A crow sleds down a snowy rooftop on a plastic lid, flapping their wings to control speed and direction, and then carries the sled up to the peak for another run.

An octopus walks along the ocean floor dragging two halves of a coconut shell. At some point, the octopus has had enough, stops, and drops one half on the floor. The octopus eases their body into the shell, and then pulls the other half of the shell on top, making a cozy house.

It's hard to avoid clever and brave animal stories these days. Social media is full of videos of rats running obstacle courses, hippos intervening in crocodile attacks, an adult elephant helping a baby elephant out of a muddy pit, an orangutan rescuing a downing baby bird, and a dog splashing water on a beached fish. We also hear reports about New Caledonian crows bending metal wire into hooks to fish food out of a tube, orangutans using sticks to measure the depth of water in a river, and bumblebees learning how to pull a string to get a sweet treat after watching other bumblebees do so.

It's easy to watch these videos, hear these stories, and take the subjects to be like little humans. The monkey who rescues a hurt companion is a brave hero, the dog and crow are playing, and the octopus wants to carry a house around for protection. We easily *anthropomorphize*—attribute human characteristics—when we hear these stories. This is especially true when we start interpreting *why* the animals act the way they do. When we describe the injured monkey and his cohorts as friends, and the hero as wanting to help a friend, we are offering rich descriptions that may not reflect the kinds of thoughts and feelings actually had by those monkeys. Maybe monkeys don't have relationships that can be described as friendships. Maybe the monkey who shook the injured individual performed a species-typical behavior in the face of death. Maybe the monkey doesn't have thoughts or feelings at all. How can we know what kind of description best captures this incident?

When we hear about crows making tools, orangutans measuring river depth, and bees learning from one another, we might also think that these animals are *smart*. After all, only a smart individual can solve problems, come up with new technologies, and learn. But it is not entirely clear what we mean by "smart." In the past, we used the word to describe a quality of mental capacities, but since we have smart phones and smart cars that presumably lack minds, it isn't clear that we are talking about natural mental capacities. Furthermore, if the animal can't help but perform the behavior, we might not want to call it "smart" even if it looks clever. The starfish's trick of growing back lost legs is a good solution to a problem, but it might not be a *smart* trick because it isn't something the starfish has any control over.

The first motivation for writing this book is to help readers understand what these videos and reports are telling us about animals. In order to better understand what's going on, in any case of animal behavior, we need context for the individual being, information about the species, and scientific and philosophical tools. To understand the context, we can ask about the animal's age and rearing history. Take age, for example. If a three-year-old promises to make you dinner, you're not going to get your hopes up. But if an adult makes you the same promise, you'll naturally expect some kind of nutritious or tasty meal. And, take rearing history. Did the sledding dog observe a child using the sled, and copy the child's behavior? Did the dog accidentally step on a sled at the top of the hill and slide down? Or is the dog merely a reluctant participant in a viral video, sledding only because a human trained him by offering food rewards?

We also need to know what is typical for the species. Do all octopuses carry objects to hide in, or is this a trick that was discovered by one octopus and copied by others? Is it only amazing because we didn't know that octopuses carried their homes? Snails and turtles do this, but we do not marvel at it.

With more information, we can use the tools provided by scientists and philosophers to better understand what animals might be doing, how they might be doing it, and why. And, in turn, by critically examining the mental processes of other animals, we can come to better understand our own mental processes. Questions about animal minds are addressed across academic disciplines, with psychologists, biologists, anthropologists, ecologists, ethologists, primatologists, welfarists, and philosophers—among others—engaged in answering overlapping sets of questions using a variety of methods. The scientific methods are used to develop and test hypotheses related to animal minds, and the findings can help us interpret animal behavior in a scientific, rather than sentimental, way. The philosophical methods are used to clarify the hypotheses, the questions, and the answers by examining the concepts used by scientists, and by critically examining the scientist's methods. It can be tricky for philosophers and scientists to talk to one another, given that they don't use the same methods, don't always share a technical vocabulary, and, worse yet, sometimes use the same words to refer to different concepts. However, the possibility of increasing overall understanding makes it worth the extra effort, and one goal of this book is to bridge the various disciplines of animal cognition so that scientists and philosophers can better work together.

Within the sciences, the study of animals is already interdisciplinary. Scientists work in laboratories, zoos, sanctuaries, wildlife rehabilitation centers, forests, oceans, savannahs, and city streets. Psychologists, neuroscientists, and biologists often work with captive animals, investigating questions about the cognitive mechanisms involved in perception, memory, reasoning, categorization, metacognition, spatial cognition, numerical abilities, learning, future planning, social intelligence, communication, and so forth. Primatologists, biologists, ethologists, and psychologists also work in wild settings and are interested in documenting what different species do, how they learn to do what they do, and whether there are individual or group differences in what they do. Some scientists emphasize the evolutionary history of the species, and seek to understand how the observed behaviors might offer reproductive benefits. Some scientists focus on individual differences, taking a psychometric approach in order to understand how different capacities relate to each other, whether there is some form of general intelligence, and the impact of personality differences. Some scientists take a developmental perspective, studying changes in behavior from infancy until adulthood and looking for the effects of rearing differences in infancy on adult behavior. Some scientists take a comparative perspective, and design experiments in the forms of puzzles that are given to animals of different species (very often, these species are chimpanzees, bonobos, orangutans, and humans). Some scientists focus on the brains of other animals, and test animals' capacities, like perceptual or social, before and after lesioning or during brain stimulation.

Within philosophy, the study of animal minds also crosses traditional boundaries. Some philosophers engage closely with the scientific research on animals within the domain of philosophy of science—examining the methods used by scientists, and the conceptual clarity of their hypotheses and interpretations. Others examine animal minds from a more conceptual perspective. Philosophers of mind may ask about animal consciousness, belief, rationality, metacognition, emotions, social cognition, and memory. Philosophers of language may ask about animal communication, the relationship between language and thought, and the content of concepts. Ethicists might ask about animal empathy, sensitivity to morally relevant features of the world, sociality, emotions, pain, and personhood. Philosophers of biology might investigate issues of animal culture, innateness, consciousness, and evolution of mental capacities.

With more information about the cute videos, and with the tools of science and philosophy, we will be better positioned to understand the minded beings around us. Not all species are the same, so the motivations, mental processes, and actions one species uses to engage in a behavior may be very different from those of another species, even if the behaviors look, to us, to be very similar. And, of course, not all individuals are the same either.

The fact that we're not naturally good at interpreting animal behavior shouldn't surprise us, since humans have a problem interpreting our own behaviors *and* understanding our own motivations. The last decades of research on humans demonstrate a wide variety in human psychological processes, with cross-cultural differences in perception, social thinking, concepts, teaching, commitments to truth and knowledge, morality, and concepts of the self and community, among other things. Social scientists have also found that humans are not as rational, not as transparent, and not as good as we think we are. If 80% of us think we are above average, then something has gone wrong.

The second motivation for writing this book is to help provide people interested in animal ethics relevant information about animal psychologies, given that there are ethical implications for whether or not other animals have mental capacities of various sorts. If, for example, consciously experiencing is enough for moral standing, then if fish are conscious, fish have moral standing. On utilitarian moral theories, any being that can feel in this way is going to be of moral import. Some humans have been keen on identifying what makes humans special, and many of the topics we discuss—*conscious experience*, *rationality*, *communication*, *social understanding, cooperation, teaching, culture, moral agency*—have been touted as capacities that only humans have. As the science has progressed, particular claims of human uniqueness have been dismantled. Back in Darwin's day, for example, a proposed unique human capacity was *mirror self-recognition*. In the 1970s, the psychologist Gordon Gallup reported experimental evidence showing that chimpanzees recognize themselves in mirrors, something that had long been observed in non-experimental contexts. For several years, chimpanzees were the only animals known to pass the test, which helped confirm the common attitude that chimpanzees are special, since they are the species most closely related to humans (humans share 98.7% of their genes with chimpanzees). But now we know that many species will touch a mark on their body after seeing it in a mirror, or, lacking hands, will direct the marked part of the body in front of a mirror—all the great apes, bottlenose dolphins, orcas, Asian elephants, Eurasian magpies, and even ants have all reportedly passed the mirror test. *Tool use* was another early property thought to be uniquely human, but after it was found that chimpanzees use stones as hammers to crack nuts, the criterion was modified from *tool use* to *tool construction*. But that one got dropped after we saw chimpanzees make good ant dipping wands from grass, and even saw them making tools that are used to make new tools. For every proposed uniquely human property so far, we have found some version of the property in another species. The more we learn about other species, the more continuity we find between human animals and nonhuman animals.

Human uniqueness claims sound exciting, as if we are discovering something deeply important about how special we are compared to other animals. I am often asked what makes humans unique if we have so much in common with other species. My response is to wonder *why* we are asking that question. All species have their own special practices and capacities. Eagles fly, frogs catch flies with their tongues, grizzly bears swipe salmon out of fast-moving rivers, birds build intricate nests, and bees make honey. Most humans can't do any of those things. It is just as good a question to ask, "Why do humans build cities out of wood, and stone, and metal, and glass?" then to ask, "Why do bowerbirds build elaborate structures out of sticks and decorate them with found objects?" We can approach these questions in the same way, suggesting that the species engages in that behavior in order to promote the continuation of their biological lineage. Instead, we might try to figure out the social and psychological motivations behind those actions, or the cognitive capacities that support them. Here, we should expect to find similarities as well as differences.

There is a dark side to the obsession with human uniqueness. When psychologists give people newspaper stories claiming to provide evidence of human uniqueness, subjects are more likely to discriminate against vulnerable human groups (Costello and Hodson 2010). However, if people read newspaper stories about psychological continuity of humans with other animals, then they are more likely to respond in an egalitarian way toward other humans, as well as toward other species. There is something in humans that is sensitive to tribal thinking, and when presented with reason to justify tribalism, such as thinking that there is a difference in kind between different groups, exceptionalist thinking gets triggered (such as thinking *humans are special* or *my culture is the best*). But there is also something in humans that is sensitive to communal thinking, and when presented with evidence of cross-species continuity, that side of us comes out. These facts about humans make it all the more important to think critically and carefully about talk of 'human uniqueness,' and to be clear about what it presumes, as well as what motivates the question if you choose to ask it.

Philosophy of animal minds can help us see that animals are the sorts of beings that are morally considerable. It can also help us understand the different interests various species have, given their different psychological profiles. When an individual has moral standing, it doesn't mean that the individual should be treated *just* like you. You might have an interest in learning philosophy or science, you might have interests in setting and planning long-term goals, and you might have an interest in participating in your nation's political system. These are not going to be the same interests that we find in a spider, a dolphin, or a gorilla. Returning to the clever animal videos, it is easy to see the monkeys as having an interest in their companion's survival, or the bird's and dog's interest in enjoying sledding. But we can also be wrong about what an animal wants, simply because we don't understand the species, or the individual. To see this, just sit beside a zoo enclosure for a few hours, and listen to what people say. They can't all be right, because their interpretations of the animal's behaviors are so widely different. This isn't only true of other species; we can also fail badly at interpreting what other humans want, too.

In addition to these moral imperatives for examining animal psychological properties, there is a pragmatic reason for engaging in this investigation. The study of animal minds helps us to better understand the psychological terms we use. We think that humans are conscious, rational, teach and cooperate, punish, and follow norms. And, we think humans have a mind. But what do these claims amount to? What is a mind? If we can't explicate these claims, then what look like statements of knowledge are just empty clichés. It is both an empirical and a conceptual task to better understand what we're talking about when we talk about the mind, and to throw out the useless concepts to improve the communicative function of our language. As an empirical task, it requires that we study subjects. The history of psychology is a short one, and it is the one that has not been very successful at taking a wide-angle approach. The focus of psychology has been primarily on humans, and even more narrowly on white, rich, industrialized, northern, western, and young humans. If the British naturalists had likewise focused on such a narrow subject pool, we would have never got the theory of evolution by natural selection. The proper subject of psychology includes animals and humans in all their diverse expressions.

In this book, I begin by offering you three sets of tools, one in each of the first three chapters. Chapter 1 presents the philosophical tools that are most useful for examining other minds. Here, I present what philosophers variously mean by "mind," make a quick tour through the history of philosophical views about animal minds, and discuss a classic problem of philosophy—*the* *problem of other minds*. After presenting a number of responses to the problem, I conclude that we have good reason to accept the existence of animal minds.

Chapter 2 offers tools derived from the philosophy of science's work on the nature of scientific theories, interpretation, and explanation. Here, we start with a discussion of how to describe animal behavior, and confront worries about folk psychological explanations and anthropomorphic descriptions. I then propose two philosophical methods for studying animal minds: The calibration method for examining concepts and the Sherlock Holmes method for testing concepts against scientific observations. With the problem of other minds dismissed, we can use calibration and seek to offer good explanations and interpretations using these traditional philosophical methods.

Chapter 3 offers a sketch of the different scientific methods that have been used to empirically investigate animal mental capacities. These start with the anecdotal anthropomorphism common until the 19th century, and the development of more rigorous scientific methods in the late 19th and early 20th centuries, which lead to the rise of behaviorism. At the same time, we find the rise of ethology as a new kind of naturalism that combines observational and experimental methods on animals in their typical environment, in contrast to the behaviorist's focus on rats and pigeons in cages.

The cognitive turn of the 1960s in human psychology was slow to reach animal psychology, but now it is a thriving research program, alongside biological and anthropological approaches. These different methods of study have their own strengths and weaknesses, and, in Chapter 3, I defend a pluralist approach as the best way to have a fecund science of animal minds.

The first three chapters are designed to introduce readers to the topic—Chapter 1 introduces readers to concepts and methods from the philosophy of mind, Chapter 2 introduces readers to concepts in the philosophy of science, and Chapter 3 introduces readers to the history of the sciences studying animal minds.

In Chapters 4–9, we confront specific questions about animal minds. In each of these chapters, we have conceptual work to do. Chapter 4 explores how to ask whether animals are conscious, and after clarifying that sentience, or feeling something, is sufficient for consciousness, I argue that we have sufficient reason to accept consciousness widely across species. After having established that animals are minded in Chapter 1, and conscious in Chapter 4, we are now justified to ask additional questions about animal psychology. In Chapter 5, we turn to the question of whether and how animals think. Chapter 6 asks whether and how animals communicate. Chapter 7 asks what sorts of social understanding other animals might have. Chapter 8 asks whether animals have a cultural mind. Chapter 9 starts with a brief introduction to arguments for animal moral standing, and then turns to the question about whether animals have moral minds.

Using the tools introduced in the first three chapters, we can investigate specific questions about what kinds of cognitive capacities different species might have, at the same time investigating what we mean by the concepts. We will then be in a better position to ask new and richer questions, to better understand what other animals want, and how we can best interact with them.

It is my hope that these chapters help you think more deeply about animals and our relationships with them.

1 Other minds

Close your eyes, and reach for an object in front of you. Now open your eyes, and try to identify which object you touched. Easy, right? For human adults, cross-modal perception between the visual and tactile senses is natural. It's even easy for human infants, who at one month can select a picture of a pacifier after having blindly sucked on one. Chimpanzees can also easily match objects they have touched with objects that they see. Dolphins, however, don't appear to use their tactile sense to recognize objects (though it is very important to their social interactions), and so we shouldn't expect dolphins to have such an easy time with this kind of cross-modal perception. Should we conclude then that dolphins lack cross-modal perception? That would be hasty. Dolphins are different from humans and chimpanzees in interesting ways. For one, dolphins use echolocation to perceive the physical world in the water (their echolocation doesn't work in the air). Scientists have found that dolphins who echolocate on a strange shape hidden behind a screen under water will then select that object from an array when it is held in the air so they can see it (Pack and Herman 1995). The lesson is humans, chimpanzees, and dolphins all have cross-modal perception, but scientists need to use different kinds of experiments to show this given the three species' differences in biology and ecology.

Animals clearly think and feel—after all, we are animals, and we think and feel. Members of the human species are minded beings, and if members of other species are minded beings too (and I will soon argue that they are), we should expect to see similarities as well as differences between different species of mind, given our biological and ecological differences. We shouldn't be too surprised to find that other species can do things we can't. For example, elephants can smell differences in quantity (Plotnik et al. 2019). Dogs, who also have excellent olfactory abilities, could be fruitfully tested using the same methods. Humans, who don't, would likely be poor subjects in such a study.

Despite the title of this book, there is no such thing as *the animal mind*. There isn't even such a thing as *the human mind*, given arguments for human neurodiversity and brain plasticity. Neurodiversity is the idea that the differences in neural function between humans reflect a natural variation in the species. For example, having autism is one natural way of being a minded human. Plasticity is the idea that the brain changes during development and in response to trauma, and that the functions of different brain areas can change over time. These observations show us that there is no one, right way of being minded.

Another problem with the title of the book is that there might not even be such an object as the mind. Rather than being a noun, what we identify as mentality might be a property of living systems or of complex machines, or it might be a process—being minded is a doing, not merely a having. To reflect this possibility, I will be speaking of individuals or species as being minded, rather than as having a mind.

Different animal species have different biological, environmental, social, and morphological features, and these differences help shape the different ways animals are minded. Cephalopods such as octopuses with neurons in their tentacles might have cognitive systems that are more distributed than the cognitive systems of some other animals (though the discovery of the human "gut brain"—the neurons in the stomach—and the observation that the nervous system extends throughout the body might lead you to make similar inferences about the human cognitive system). This physiological fact about the octopus can be used to develop hypotheses about how an octopus is minded. For example, maybe an octopus is multiply minded, and can split attention between the central body and the legs when solving certain tasks. Peter Godfrey-Smith describes what an octopus might be doing when navigating a transparent maze to reach food:

> To solve the problem the octopus had to guide its arm through the maze with vision. Although it took a while, all but one of the octopuses in the experiment learned to get an arm through to the food. The study also noted, though, that when octopuses are doing well with this task, the arm finding the food does what looks like its own local exploration at various stages, crawling and feeling around. There may be a mixture of two forms of control here: central control of the arm's general path and fine-tuning of the search by the arm itself. Another possibility is that, by means of attention of some kind, the octopus is exerting control over all the details of movements that might usually be more autonomous.
>
> (Godfrey-Smith 2013)

Cetaceans—whales and dolphins—may have very different mental capacities given their unique sensory modality of echolocation. Given these special abilities, some have argued that cetacean minds are quite different from human minds and cephalopod minds. Thomas White argues that the dolphin's ability to echolocate on other dolphins allows them to observe others dolphins' physiology and to be directly affected by that physiology in a special way that might indicate a kind of group mentality (White 2007). If cetacean groups are minded, that might help us make sense of cetacean behaviors such as group beachings, which happens when multiple whales or dolphins leave the water and become stranded on a beach, often leading to their deaths. The biologists[1] Hal Whitehead and Luke Rendell have observed whales beaching themselves after one of their group members was accidentally beached; they describe this behavior as a kind of group solidarity in which individual interests are subjugated for the group (Whitehead and Rendell 2014). White's hypothesis suggests that the group may comprise a larger minded being, and that the individuals would rather die with the group mind than survive without the rest of their self.

Thomas Nagel famously argued that we can't know what it's like to be a bat because humans are so different from bats both physically and socially, and the best we can do is to imagine what it would be like for us to be *bat-like* (Nagel 1974). However, while animal species are clearly different from one another in some ways, in other ways they are quite similar. For example, we can categorize animals into social and solitary species. Sociality is a difference between some animal species that may impact their cognitive processes. Animals who live in complex social societies have both a social world and an ecological world to navigate. In order to keep track of those complex worlds, social species' cognitive capacities must have evolved in ways that allow them to handle a larger degree of complexity than species who inhabit a primarily ecological world. Consider baboon communities. Most baboon species live in troops with a largely stable female hierarchy, and a more flexible male dominance hierarchy. Because these hierarchies are linear, any change in dominance between two individuals affects the status of the other individuals in the group, and when there is a rank reversal in the female line, the relatives of the baboon who lost status are also demoted, and the entire line is revised. In order to keep track of fluid changes in social status and understand who can do what given their current standing, baboons have to handle quite a bit of information, suggesting that baboons require more complex cognition than if their social lives were more simply structured.

Another way to investigate the similarities and differences between species is to examine individuals' development. We can examine the similarities and differences between the early development of humans and other apes and, for example, find that infant chimpanzees will engage in neonatal imitation just as some human children do (Figure 1.1).

If humans and chimpanzees engage in the same kind of social behavior early in infancy, yet diverge in social behavior later in life, we can examine intervening stages of social development in order to determine what might lead to the differences we see in adults.

Furthermore, while there are differences between species, differences between groups of species, and differences between stages of development, there can also be differences between individuals. Just as humans vary in our cognitive skills, our emotional intelligence, our personalities, etc., we can hypothesize that there are similar kinds of individual differences between individuals in other animal species.

So while we shouldn't expect that there is any such thing as *the* animal mind, there certainly may be a variety of kinds of ways of being minded that are in some ways interestingly similar, and in other ways intriguingly different. To best understand how animals are minded, we need to ask about both similarities and differences between species.

In this chapter, we will cover three topics. First, we will briefly go over different philosophical theories about the nature of mind and mentality. For those of you who have a background in the philosophy of mind, this review should be familiar. For those of you who don't have such a background, it will help to introduce you to the perspectives that philosophers bring to the table when studying animal minds and psychological capacities more generally. Next, we will take a brief stroll through history to see how some of the key figures in philosophy thought about

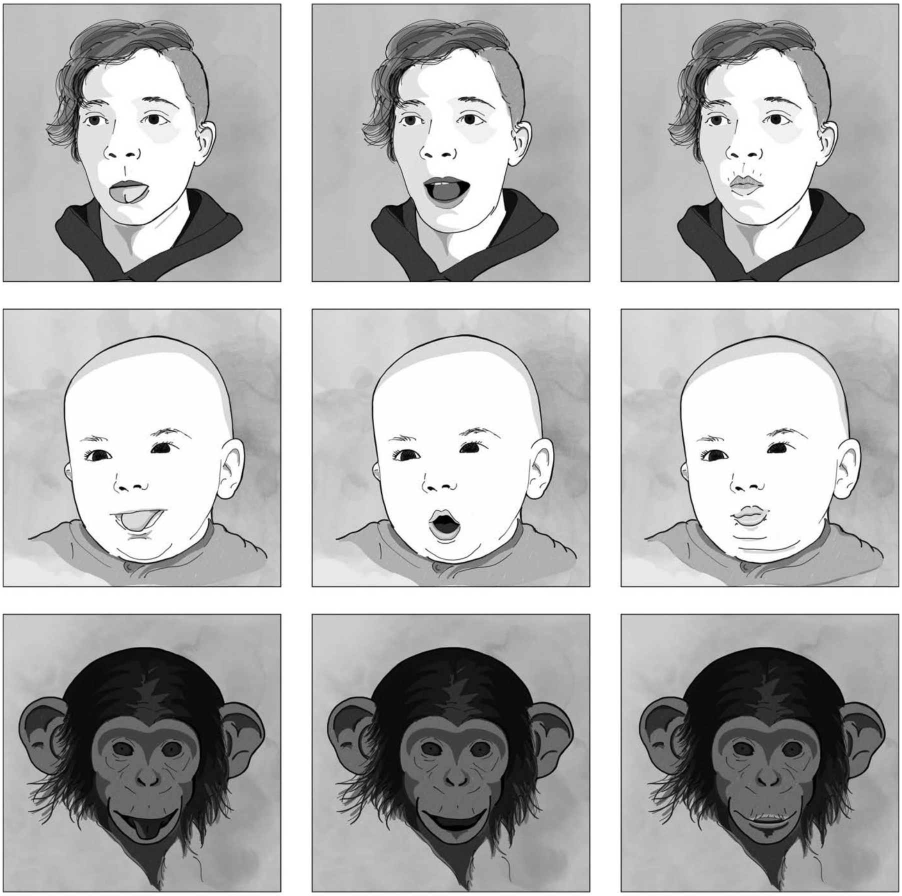

Figure 1.1 A human infant (Meltzoff and Moore 1977) and a chimpanzee infant (Myowa-Yamakoshi et al. 2004) imitate an adult human who is protruding her tongue, opening her mouth, and pursing her lips.

animal minds. Finally, we turn to do some philosophical work and examine a classic problem in philosophy—the problem of other minds. This problem raises the question of whether we are justified in presuming that other humans have minds, since we can only observe others' behaviors. Thankfully, there are multiple justifications for our belief in other human minds. Our work will be to examine whether we are justified in presuming that other animals have minds, too.

1.1 What we talk about when we talk about mind

Before we start investigating animal minds, we should probably try to get a handle on what we're talking about. In one sense, we all know what is meant by mind. When we turn our attention toward our own mental lives, what is perhaps most evident is the phenomenal, or experiential, or sentient, aspect—the experience of the conscious mind which can feel (e.g. itchy), taste (e.g. salty), crave (e.g. affection), and pay attention (e.g., to music). When we look past the phenomenal aspects of mind, we can also see that there is a relationship between being minded and engaging in action—we can mentally do things, visible as behavior and invisible as thought. We remember, analyze, form associations, wonder, learn, perceive, and decide. An amazing feature of our mental processing is that it displays a reason-respecting flow. Even after a long bout of daydreaming, we can retrace our thoughts to figure out how we got to the last idea.

But in another sense, mind is mysterious to us. Mind doesn't seem to be like a tree or a mountain, something we can touch or see—which makes thinking about the mind as an object especially puzzling. We can wonder whether the people around us are really minded, or whether they just act like they are. Furthermore, we don't always have conscious experience of our own reasoning or sensory processes. We engage in automatic driving, tooth brushing, dish washing, and other habitual behaviors without always having any feeling of what is going on. We can't remember whether we turned off the stove before leaving the house. We are often influenced by stimuli that we are unaware of, being generous because of the sunny weather or selfish because we feel rushed; people are more likely to pick up hitchhikers on sunny days than on cloudy days (Guéguen and Stefan 2013), and seminary students not in a rush are more likely to stop and help a person in need (Darley and Batson 1973). Because we don't always realize what influences our actions, we are sometimes wrong about the causes of our own behaviors. We make errors. These are also things we mentally do. Mind is rational and irrational, conscious and unconscious; it remembers and forgets.

In the metaphysics of mind, philosophers investigate the nature of mental states and processes, and form theories about the relationship between mentality and physicality. One way of dividing up these theories is between dualists and monists.

Dualists think that the mental and the physical are two equally real and autonomous domains. We can identify two kinds of dualists. Substance dualists such as René Descartes take the mind to be an object made of mental stuff and the body (including the brain) to be an object made out of physical stuff. Property dualists think that there is only physical stuff, but think that objects can have two different kinds of attributes, physical ones such as shape and extension, and mental ones such as consciousness and rationality. Despite some intuitive plausibility, substance dualist positions are poorly justified and inconsistent with science, as they violate basic causal principles such as the causal closure of the universe, and the idea that every event is caused by a prior event.

Monists think that there is only one domain, and that both mind and matter exist in that domain. While most monists are physicalists, who think that the only domain is the physical world, other monists are idealists, who think that the physical world is only an idea in someone's mind—the domain consists only of ideas. We will leave idealism to the side, as it doesn't have much to offer us here.

The physicalists provide theories of the mind that are consistent with our scientific knowledge. We can mention three kinds of physicalist theories: Identity theorists, functionalists, and enactivists. Identity theorists think that the mind is in some sense identical to the brain. On some accounts they identify mental states with brain states, and on others they identify mental processes with brain processes; there is disagreement about whether the mind is an object like the brain, or a physical process like digestion.

Functionalists take mentality to be a process, but they don't think a brain is required for mind. According to functionalists, mental states are not individuated in terms of what they are made of, but in terms of what they do. Mental states are like states in a computer program, representations that can be multiply realized—made out of different kinds of stuff or implemented on different platforms—as long as they share the same functional role. For example, a fish and a human could both feel pain in response to a bee sting even though fish lack a neocortex and human pain follows a pathway through the neocortex.

Finally, enactivists are physicalists who take mind to be dependent on the body (rather than just the brain) and the environment. Enactivists and advocates of the embodied mind believe that many aspects of cognition depend on the full living organism, and that mind is either caused by or constitutive of this larger biological process. Some philosophers working in this tradition, such as Evan Thompson, take mind and life to be closely intertwined. Mentality is part of a dynamic interaction between living, embodied individuals and their environment, not some particular object or intrinsic property of a thinking brain.

Functionalism is currently the most widely accepted view in the metaphysics of mind, though by no means is the matter settled. Rather than assuming one of these positions in the metaphysics of mind in order to investigate animal minds, we can try to remain open to the various possibilities that are consistent with our science, and use our growing empirical knowledge to help determine the best theories about mentality.

So far we have tried to get a handle on what we're talking about when we talk about mind. Rather than ending up with a definition, we have a set of theories—a possibility space that shows us different ways in which we might think of mind.

Another way to clarify our questions about mind is to narrow the focus on certain elements of mentality. For one, we might investigate conscious experience or sentience—the what-it-is-like phenomenology that is the experience of things like pain and pleasure, hunger and satiety, love and hate. In studying consciousness or sentience, some scientists focus only on pain experience, and others focus on emotions like anger and joy.

We could also focus on cognitive processes, as comparative psychologists tend to do. Cognition is generally understood to refer to the processes that mediate between our sensory inputs and our behavior, which can include things such as memory, problem solving, navigation, reasoning, and language processing. You will often hear cognition defined in terms of information processing or computation. Cognition makes it possible to relive your early childhood memories, to recognize your friend's face, to judge that two lines are the same length, and even to ski down a hill. The cognitive processes underlying these abilities may be described in terms of knowledge or concepts, functional parts, or neural processes in the organism.

Cognition is often taken to be what permits flexible behavior and learning. Having flexible behavior means that you can do different things in similar situations, and learning means that you can change your behavior after certain experiences. Some animal behaviors lack the sort of flexibility assumed to be necessary for learning. The greylag goose, for example, will bring a displaced egg back into her nest by reaching out with her neck and rolling it toward the nest with her beak. If you were to place a golf ball, a doorknob, or a much larger egg on the edge of her nest, she would roll those items into her nest as well (Figure 1.2).

Figure 1.2 The greylag goose rolls a golf ball into her nest.

As the ethologists Nikolaas Tinbergen and Konrad Lorenz showed us, the greylag goose's egg rolling behavior is a fixed action pattern for the species: A motor program that is initiated by anything that closely enough resembles an egg. The goose can't help but retrieve it. She doesn't need a concept of egg, or knowledge that eggs need to be kept safe in her nest, or that goslings will hatch from the egg. All she has is an invariant response to egg-like stimuli.

Some learned behavior turns out to be inflexible as well. Consider *classical conditioning* a form of associative learning that creates an anticipation of an event given a preceding conditioned stimulus. As the 19th century Russian physiologist Ivan Pavlov discovered, dogs who are trained to see a light or hear a bell (the conditioned stimulus) before getting food (the unconditioned stimulus) will start salivating at the sight of the light or sound of the bell, before food appears. This is learning, because the dogs' reactions changed in response to experience. But, once learned, the response is not flexibly chosen—the dogs can't decide not to salivate when the bell rings.

Much of human behavior, however, is quite flexible, and is mediated by concepts and knowledge that allow us to understand the situation. Suchi usually takes the subway to work, but on a warm spring day, she might be moved to ride her bike. She can explain her choice to deviate from her typical behavior by talking about her reasons—she is happy it is finally warm out, and she wants to enjoy the sunshine and get some exercise. We expect people to act flexibly; we don't expect to be able to predict exactly what others are going to do all the time. But, to count as sensible behavior we have to be able to understand someone's reasons for action.

Navigation serves as an example of cognitively flexible behavior. Problem solving serves as another. Humans living in industrialized societies are often trained to use keys to open doors. But sometimes I forget my keys and am stuck outside my locked house. If I were inflexible, I wouldn't have any means of achieving my goal of getting inside. But if I have flexible, problem solving capacities, I can consider other ways of getting into the house—I can climb on the porch roof and push in a window screen.

The idea that the cognitive aspects of mind are reflected in these kinds of rational behaviors offers an inroad into understanding what minds are and how to study them—we can examine the mentality of entities that appear *to learn*, *to solve problems*, and *to behave flexibly*. Once we've identified individuals whose behavior appears flexible, we can start asking more specific questions about instances of flexible behavior in order to better understand the processes or mechanisms involved and the relevant environmental and social variables. We can also examine to what extent the individual is representative of their species, and to what extent the species is like or unlike others in the same family.

1.2 Historical debates about theory and evidence

Interest in the question of animal rational mind has a long history in the Western philosophical tradition, and a number of figures have denied some aspect of mind to nonhuman animals. The Medieval philosopher St. Thomas Aquinas (1225–1274) thought that on this planet humans alone are rational thinking beings who are able to make decisions and choose their own actions (the realm of God and angels is another story). In his *Summa Theologica*, Aquinas examines whether it is wrong to kill, and concludes that killing animals is not immoral, because animals are irrational beings God created for human uses. Aquinas writes:

> Dumb animals and plants are devoid of the life of reason whereby to set themselves in motion; they are moved, as it were by another, by a kind of natural impulse, a sign of which is that they are naturally enslaved and accommodated to the uses of others…He that kills another's ox, sins not through killing the ox, but through injuring another man in his property. Wherefore this is not a species of the sin of murder but of the sin of theft or robbery.
>
> (Article 1, Reply to Objection 2 and 3)

The German philosopher Immanuel Kant (1724–1804) also denied rationality to animals, but he gave different reasons: Animals lack minds due to their inability to consider their reasons for action, and to will their actions. Though Kant thought animals have desires (another mental property), he also thought that they are blindly driven by their desires, like an unrestrained wanton who cannot form desires about their desires, or beliefs about how best to fulfill their desires. Since animals lack rationality, they also lack the ability to step back and consider whether their desires ought to be fulfilled, or how best to fulfill them. For Kant, this means that animals are not persons, they are not valuable as ends in themselves, but are only instrumentally valuable. Kant writes:

> The fact that the human being can have the representation "I" raises him infinitely above all the other beings on earth. By this he is a person… a being altogether different in rank and dignity from things, such as irrational animals, with which one may deal and dispose at one's discretion.
>
> (Kant 1798, 2010, 239; quoted in Gruen 2017)

Despite concluding that animals are not intrinsically valuable, Kant does think that we ought to treat animals well, because "…he who is cruel to animals becomes hard also in his dealings with men" (1784–1785; 1997, 212; quoted in Gruen 2017).

It is perhaps French philosopher René Descartes (1596–1650) who did the most to undermine the view that animals have rational, thinking minds, by arguing that only language users think:

> For it is rather remarkable that there are no men so dull and so stupid (excluding not even the insane), that they are incapable of arranging various words together and of composing from them a discourse by means of which they might make their thoughts understood; and that, on the other hand, there is no other animal at all, however perfect and pedigreed it may be, that does the like. This does not happen because they lack the organs, for one sees that magpies and parrots can utter words just as we can, and yet they cannot speak as we do, that is to say, by testifying to the fact that they are thinking about what they are saying; on the other hand, men born deaf and dumb, who are deprived just as much as or more than, beasts of the organs that aid others in speaking, are wont to invent for themselves various signs by means of which they make themselves understood to those who, being with them on a regular basis, have the time to learn their language. And this attests, not merely to the fact that the beasts have less reason than men but that they have none at all. For it is obvious it does not need much to know how to speak; and since we notice as much inequality among animals of the same species as among men, and that some are easier to train than others, it is unbelievable that a monkey or a parrot that is the most perfect of its species would not equal in this respect one of the most stupid children or at least a child with a disordered brain, if their soul were not of a nature entirely different from our own.
>
> (Descartes 1637/2000, 72)

Descartes didn't realize the benefits that can come with cognitive diversity, and this quote reflects his biases about human cognitive functioning. But he also didn't recognize that language is not necessary for thought, a topic we will cover in Chapter 4. Descartes thought of animals as soulless machines like the automaton toys of his day—lifelike robotic figures that were able to play music, dance, or even draw pictures. On this view, animal movements are the result of simple causal mechanisms, not mentality. Descartes' dualism categorizes animals with dumb machines because their behavior is not complex enough to require anything other than an easily mapped mechanistic explanation. For Descartes, human language provides evidence that the individual is sophisticated enough to be a minded, ensouled rational being.

The skeptics about animal minds were not without their critics. French philosopher Voltaire (1694–1778) thought that Descartes was wrong about the complexity of animal behavior:

> What! that bird which makes its nest in a semi-circle when it is attaching it to a wall, which builds it in a quarter circle when it is in an angle, and in a circle upon a tree; that bird acts always in the same way? That hunting-dog which you have disciplined for

> three months, does it not know more at the end of this time than it knew before your lessons? Does the canary to which you teach a tune repeat it at once? do you not spend a considerable time in teaching it? have you not seen that it has made a mistake and that it corrects itself?
>
> (Voltaire, Philosophical Dictionary)

Voltaire's point here is that other animals engage in rational behavior as well: They learn, solve problems, and correct themselves. Voltaire isn't denying Descartes' claim that rational behaviors are necessary for having a mind, but rather he is disputing Descartes' empirical claims about what animals actually do, and hence undermining Descartes' idea that language is necessary for rationality. We can see two different issues at play in this debate between Voltaire and Descartes. One issue has to do with theoretical commitments about the kinds of capacities required for mentality. The other issue has to do with empirical findings about animal behavior.

Though it might seem simple to distinguish theoretical commitments from empirical findings, these two issues are quite deeply interwoven. By accepting a particular theoretical commitment, one impacts what counts as empirical evidence for whether or not an animal has some capacity. For example, Descartes' theoretical commitment that language is required for mind leads him to reject Voltaire's purported evidence for animal mind. It doesn't matter if the canary learns to compose Irish flute tunes or the bird builds a home out of bricks; if they don't talk then they lack rational mind, given Descartes' theory. As we will see in Section 1.5, there are methodological tools we can use to untangle the threads between theory and evidence.

Like Voltaire, Scottish philosopher David Hume (1711–1776) was dismissive of the idea that animals lack minds. He wrote:

> Next to the ridicule of denying an evident truth, is that of taking much pains to defend it; and no truth appears to me more evident than that beasts are endowed with thought and reason as well as man. The arguments are in this case so obvious, that they never escape the most stupid and ignorant.
>
> (Hume, *Treatise of Human Nature*, 176)

Unlike Voltaire, Hume thought we don't need any arguments to defend the claim that animals have minds, since anyone worth talking to should already know that they do! Hume's position suggests that we can directly see that animals have thought and reason—it is evident to anyone who cares to look, just as it is evident that a child is sad when we see her in tears standing next to an upturned ice cream cone (Figure 1.3).

Given the number of intelligent and knowledgeable philosophers who have denied animals minds, Hume was a bit hasty to conclude that no arguments for animal minds are needed. At this point, let's take some pains and examine four kinds of philosophical arguments for animal minds.

Figure 1.3 See the sadness.

1.3 Arguments for other animal minds

The problem of other animal minds is a version of the more general question of whether anything else has a mind, known as the ‘problem of other minds.’ When the question of other minds is asked about humans, the reasoning often goes like this: Our minds are private and cannot be directly observed by others, so we don’t have access to minds other than our own; our belief that other humans have minds is the result of an inferential process but not direct experience. We infer the existence of other minds rather than seeing them directly, and the skeptic asks whether this inference is legitimate. A solution to the problem of other human minds requires a justification of that inferential process.

Despite the skeptic’s challenge, psychologically there may be no problem when it comes to seeing others as minded creatures. We are not born into a world of *solipsism*, thinking that we are the only minded creatures (despite children’s notorious egoism). Rather, human infants are born into intersubjectivity and appear to have early, if rudimentary, ability to distinguish agential movement from other kinds of movement.

Studies of humans suggest that we are animists; we see agency even where there isn’t any. Early evidence comes from psychological research in the 1940s showing adults’ tendency to ascribe reasons for actions to geometrical shapes moving around a screen (Heider and Simmel 1944). Famously, some subjects told stories about the shapes having to do with two males fighting over a female.[2] Current work in robots and animation identifies the kinds of movements that makes us think an object is a minded agent. From the Pixar lamp to therapeutic robots like Paro the seal, objects can appear to be minded, living beings when humans design them to look that way.

Given the child's and the adult's exuberance when it comes to seeing minds and agents, it may be that our task is to reduce the number of individuals in the class of minded creatures. The current science suggests that the problem of other minds isn't one of combating solipsism, but rather one of combating animism. If that is our problem, maybe we do need arguments justifying the existence of animal minds.

1.3.1 Arguments from analogy

A first attempt to solve the problem of other minds can take the form of an argument style known as the argument from analogy. The argument from analogy for other minds follows this schema:

1 I have some property M and I also have a mind.
2 Other humans also have the property M.
3 Therefore, other humans probably have a mind.

This isn't a valid deductive argument, but rather a very weak inductive argument, where the reference class consists of only one entity (namely, oneself).

> In a *deductive argument* the truth of the premises (the sentences supporting the conclusion) guarantees the truth of the conclusion. When an argument is presented in a numbered list, as above, the conclusion is the last sentence in the list, and the premises are all the sentences before the conclusion. A deductive argument is also described as valid. In an *inductive argument* the truth of the premises offers evidence supporting the conclusion, but it is still possible that the premises are all true and the conclusion is false. Inductive arguments cannot be valid; rather, they are strong (if they offer sufficient evidence for the conclusion) or they are weak (if they don't).

This inductive argument can be made stronger with a complementary argument that provides reason for thinking that some particular reference property M is relevant to having a mind. For example, one of my properties is that I am a woman. But using "woman" as M is extremely problematic, for there is no good reason to think that gender has anything to do with having a mind. In John Stuart Mill's formulation, the argument from analogy for other minds relies on a guiding theory that identifies as the reference property M the causal link between behavior and mind. The analysis, then, turns from the inductive argument for other minds to an argument in defense of some theory about the nature of mind. Given the weakness of the inductive inference, and without independent argument to defend the choice of reference property, it is fair to say that the argument from analogy for human minds cannot, on its own, offer good evidence for other minds. But what about the argument from analogy for animal minds?

When we turn from the traditional problem of other minds to what Colin Allen and Marc Bekoff (1997) call "the other species of mind problem", the argument from analogy is stronger in one sense, but weaker in another. Consider this formulation of the argument:

1 All humans who have minds have some property M.
2 Individuals of species A have property M.
3 Therefore, individuals of species A probably have minds.

While this argument is stronger than the argument for other minds, in the sense that it is an inductive argument with over seven billion entities in its reference class rather than only one, the strength of the argument also relies on the complementary argument about what should count as the reference property M. The reference property M might be a general capacity such as cognitive flexibility, a specific ability such as using language, a biological process such as sexual reproduction, some variety of brain activity, or a conjunction of some of these properties.

Even if we could identify some property or a set of properties for being minded, we would wind up with another problem—how to identify the existence of those properties in other animals. Since animals are organized very differently, we might not always know if a property is shared between, say, an octopus and a bottlenose dolphin. The argument from analogy focuses on similarity, but for most other species we will be able to identify more differences than similarities, thus challenging the strength of the analogy. There is a greater analogical distance between humans and other species than there is between you and other humans. The analogical distance grows with species whose life histories, environment, evolutionary histories, and social structures are quite different from our own. Animals who live deep underwater, fly, perceive through echolocation, live for only a few weeks, are solitary, or eusocial (i.e. form social groups with a division of reproductive labor and cooperative care of offspring, such as honeybee colonies with sterile worker castes) are so different from most humans that the analogy becomes dangerously weak. Thus, the argument from analogy for other animal minds on its own will not provide conclusive justification for a belief in animal minds. However, in combination with other argument styles, analogical arguments can add support.

1.3.2 Arguments from evolutionary parsimony

A more biological approach to the problem of other minds takes mentality, like human eye color or zebra stripes, to be an evolved feature of organisms. Several scholars have appealed to evolutionary parsimony or simplicity to bolster the argument from analogy. The basic idea is that since we have minds, the more closely related other animals are to us, the more evidence we have that the animal is also minded. The most prominent of these arguments defends mentality in our closest living relative, the chimpanzee.

Primatologist Frans de Waal and philosopher Elliott Sober have provided arguments along these lines. De Waal argues that in biology we should accept evolutionary parsimony—a methodological assumption that the causes of similar behavior are similar among closely related organisms (de Waal 1999). If we do not, we are assuming the evolution of many different processes for the production of similar behavior, and since that requires postulating more processes without good reason, it is scientifically suspect. A unitary explanation that appeals to the same cause for similar behaviors is preferable unless the two species are biologically distant and common ancestors do not appear to have the similar behavior. In that case, we can consider convergent evolution—that the two behaviors evolved separately in different lineages, like the wings of the bat and the wings of the bee. But in the case of wolves and coyotes, and in the case of humans and chimpanzees, where we share behavioral patterns and are closely related, the first hypothesis should be that we share the same cause. If the cause in the human case is a mental cause, then we should assume a mental cause in the case of the chimpanzee.

Sober offers a similar argument for chimpanzee mentality based on the likelihood that there is a common cause of the behaviors in chimpanzees, humans, and our now-extinct most recent common ancestor—the hominid ancestor of both humans and chimpanzees (Sober 2015). His argument can be stated like this:

1 We observe humans and chimpanzees perform behavior B.
2 Humans behavior B is caused by mental states.
3 The behavior B could either be caused by mental states M or some non-mental process N.
4 Our most recent common ancestor (MRCA) performed behavior B.
5 The more parsimonious explanation requires the fewest changes between recent common ancestors.
6 It is more parsimonious to conclude that MRCA performed B using M.
7 Therefore, it is more parsimonious to conclude that chimpanzees performed B using M.

The most parsimonious explanation is the one that requires the fewest changes in the phylogenetic tree that maps out the evolutionary relation among species. In short, it is the simplest and so, on this view, the most evolutionarily likely explanation. If we share a close common ancestor with an animal with whom we also share M, then the most parsimonious explanation is that both our common ancestor and the animal are minded. The alternative explanation—that while our mindedness causes M, an entirely different non-mental mechanism causes M in the animal—requires too many changes in evolutionary history.

Sober points out that this argument only offers some evidence for mentality in chimpanzees. Phylogenetic parsimony allows us to make a likelihood comparison, not assign values to probabilities concerning traits. Just because the probability of chimpanzees having M is raised by the presence of M in humans, it still might be that the probability of chimpanzees having M is low. If we had independent evidence that the MRCA had mentality, rather than just the shared behavior, then the probability that chimpanzees had mentality would be higher.

One worry about evolutionary parsimony arguments has to do with what counts as parsimony or simplicity. You might think that it is simpler to presume less complexity in the world. This leads to arguments in favor of cognitive simplicity, such as this one:

1 Complex biological systems evolve by adding new systems on top of simpler old systems.
2 Complex cognition is a complex biological system.
3 Therefore, complex cognition must be built out of older, simpler capacities.

This cognitive simplicity argument suggests that we should think that simpler mechanisms are more likely to be shared across species than cognitive capacities, which are complex. There are a few problems with this line of thinking. Irina Mikhalevich (2014) challenges the first premise, presenting arguments that though ape and corvid brain structures are very different, they are able to engage in the same kinds of tasks. The idea behind her response is an endorsement of *convergent evolution*—the idea that the same capacities can evolve in different lineages.

Another worry with this line of thinking is that it assumes a hierarchical structure to evolutionary processes, with complex humans at the top and increasingly simpler animals below us. This idea that there is a Great Chain of Being or *scala naturae* (Lovejoy [1936] 2001) according to which God is at the top with Man ruling over a hierarchical ordering of Earthly beings has no basis in biological thinking. Charles Darwin's great insight was that the differences between species were the product of evolution through the gradual process of natural selection—biological changes that help individuals survive and reproduce in a changing natural environment, not changes moving toward some ideal (1859). From an evolutionary perspective, it makes no sense to say that some animals are more evolved than others.

The cognitive simplicity arguments do not respect our current biological understanding of either the structures of animal brains or the process of evolution by natural selection. Arguments for parsimony, however, are grounded in biology and while they cannot offer proof of animal minds, they can be used to strengthen our commitment to animal mentality. Taken together with the other arguments, especially inference to the best explanation arguments, the arguments from evolutionary parsimony offer evidence of mind in animals that are closely related to humans, but these arguments are less powerful when it comes to eels, bearded dragons, or octopuses—animals further from us in evolutionary history.

1.3.3 Inference to the best explanation arguments

Another scientific argument for animal minds does not limit itself to animals closely related to humans. An inference to the best explanation argument relies on the scientific method—we can identify a phenomenon to be explained, and then through a process of generating and testing hypotheses, we can conclude which explanation is best. Using this method, we can look at sets of animal behaviors and try to determine what the possible explanations for the behaviors are, and then evaluate each explanation.

The inference to the best explanation argument for other animal minds takes this form:

1 Individuals of species A engage in behaviors B.
2 The best scientific explanation for an individual engaging in behaviors B is that it has a mind.
3 Therefore, it is likely that individuals of species A have minds.

While the inference to the best explanation argument doesn't suffer from the analogical argument's troubles with size of reference class and closeness of analogy, it does require further support. In this case, some justification must be given for premise (2). A certain behavior is best explained in terms of some mental property if that mental property provides more predictive and explanatory power than do other possible explanations. That is, by assuming the explanation that species A have minds because of behaviors B, one can make better predictions about what the animal will do in future circumstances, and the explanation coheres better with other things we already know. For example, we might use what we know about the species' evolutionary history and defend premise (2) by appeal to the evolutionary parsimony argument discussed in the last section.

Of course, since what we mean by 'better' is relative to other competing hypotheses, this argument is stronger when multiple plausible hypotheses have been investigated. If premise (2) is supported merely because the candidate explanations are either (a) the animal has a mind, or (b) the animal is a robot controlled by aliens, then discrediting the implausible hypothesis (b) does very little to support hypothesis (a). When using an inference to the best explanation argument to justify the existence of animal minds, or some particular mental property, one must be charitable and consider other plausible candidate explanations before settling on the mentalistic hypothesis.

Note that this argument can't be used to demonstrate in one go that all other species have minds, but only works on a case-by-case basis. For example, the argument for dolphin minds might refer to their behavior of using sponges to protect their rostrum (the beaky part of their face) when foraging for fish on the ocean floor, but we wouldn't refer to that behavior to support the claim that ants have minds, since ants don't use sponges as tools. But we can't use the lack of evidence that ants use tools as evidence that they don't have minds, either. For one, it might turn out that some ant species do use tools. But more importantly, tool use probably isn't a necessary condition for being minded; there are other behaviors that demonstrate cognitive flexibility and that might be best explained by appealing to minds. The same goes for any one behavior. So, for example, one might try to argue that harvester ants are not minded beings because their behavior is terribly inflexible—as American biologist E.O. Wilson discovered. Harvester ants have a junkyard where they pile their refuse, including dead ants. The harvester ants "know" when another ant is dead because ant corpses produce oleic acid. When Wilson decided to treat live ants with oleic acid, he observed that the ants were carried "alive and kicking" to the junkyard (Gordon 2011). However, flexibility may be found in other contexts, and in different species. Research on the ant species *Ectatomma ruidum* suggests a complex and flexible social structure. The ants spend much of their time in the nest grooming themselves and one another, like apes and monkeys. They also feed one another with the liquid food that serves as the only nourishment for adult ants:

> Droplet-laden foragers returned immediately to the nest tube and, after a few seconds of excitation behavior, either stood still or walked slowly about the nest with [their] mandibles open and mouthparts usually retracted. They were generally approached within a few seconds by unladen workers who gently antennated the clypeus, mandibles, and labium of the drop-carrier, using the tips of their antennae. The carrier then opened its mandibles wide and pulled back its antennae, while the solicitor opened its mandibles, extruded its mouthparts and began to drink. During feeding, the solicitor continued to antennate the donor, who remained motionless. Usually the solicitor also rested one or both front legs on the head or the mandibles of the donor.
>
> (Pratt 1989, 327)

Ectatomma are also sensitive to the levels of food they have in storage, and when supplies are low or merely sufficient, neighboring ants are attacked by guard ants when they attempt to enter the nest. However, when food supplies are abundant, guards allow neighboring ants inside, and let them feed. This sort of behavior is compelling in an inference to the best explanation argument for ant minds if one cannot find other explanations that better account for the observed behavior (like the existence of simple heuristics that illustrate the ant behavior is actually inflexible).

The inference to the best explanation argument relies on specific, testable hypotheses, but as we saw, the claim that a particular animal is minded isn't a well-defined hypothesis, since we are still not exactly sure what we mean by the word "mind." Thus, rather than using the inference to the best explanation argument to answer a question about whether animals are minded, we might be better off using it for specific claims about mentality.

For example, we can use the inference to the best explanation argument to investigate the ability of some dogs to learn the names of many objects. The border collie Rico knew proper names for 200 different objects, and he could fetch each one on command (Kaminski et al. 2004). We can formulate two competing hypotheses about Rico's behavior: (a) He understands that words refer to objects (and thus has some aspect of human language) or (b) he has been reinforced to fetch particular objects when he hears the sound (and he learns new commands via a general learning-by-exclusion mechanism). To distinguish between these two hypotheses, we need to know more about what Rico and other border collies can do. We need to know how flexible Rico's behavior is. As the psychologist Paul Bloom suggests, we can ask whether Rico can learn words for objects that are not fetchable (such as "fire hydrant") (Bloom 2004). Can he appropriately respond to requests not to fetch an object (e.g. to commands such as "Rico, please get anything but the sock")?

The psychologists who tested Rico report anecdotal evidence that he knows the word as a word rather than as a command, because he can do things like put the requested object in a box, or bring the requested object to a different person—he can do things with words like "sock" and "ball" other than bringing them back to the person who uttered the request. But critics point out that the anecdotal evidence isn't sufficient—experiments need to be run. (We'll have more to say about the role of anecdotal evidence in Chapter 2.)

Though Rico died before researchers were able to take up this challenge, another skilled border collie soon appeared in the science journals. Chaser was taught proper names for over 1,000 objects. The psychologists working with Chaser wanted to examine Bloom's questions, and so they also taught her verbs and common nouns.

In formal tests of her language comprehension, Chaser was able to perform novel action/object combinations, demonstrating that she could combine symbols for objects and verbs that she heard paired for the first time, such as, "Nose the ABC" and "Take the lips." She was also able to learn three higher-order categories: Toy, ball, and Frisbee. Chase was able to correctly identify objects as a member of one of these categories. In addition, Chaser was able to learn new proper names through exclusion learning, also called "fast mapping"—if there is a new object in sight, and she is asked to get the "dax" where "dax" is a previously unknown word, she picks up the novel object (Pilley and Reid 2011; Figure 1.4).

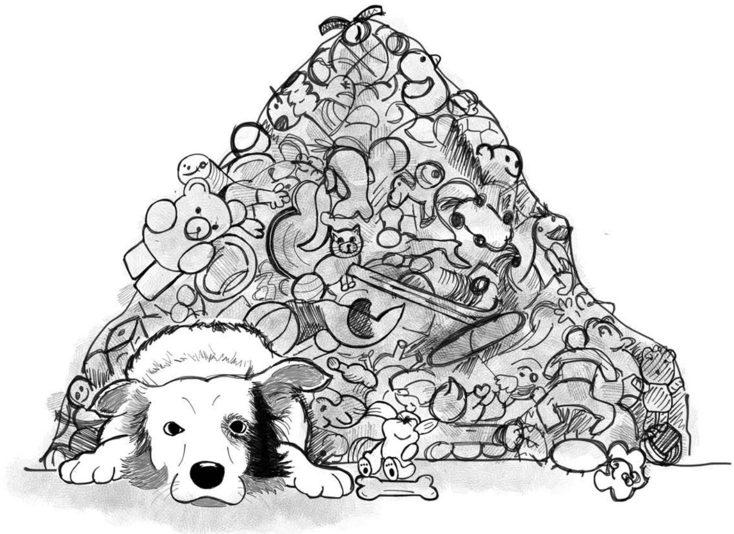

Figure 1.4 Chaser the dog with his named objects.

This formal study of a border collie's word learning demonstrates that the alternative hypothesis offered by Bloom—that the dog understands noun terms as commands to fetch objects—isn't the best explanation for the behavior. The psychologists working with Chaser take her performance on these and other tests to be best explained by the hypothesis that she learns words and knows that they refer to objects and actions in much the way human children do.

A combination of inference to the best explanation argument with argument from analogy offers a powerful justification for our belief in other animal minds, because the inference to the best explanation argument justifies the choice of reference property. We can state that combined argument like this:

1 Humans have minds and some property B.
2 The best explanation for humans having B is that they have minds.
3 Individuals of species A have property B.
4 Therefore, individuals of species A probably have minds.

This argument, while not deductive or conclusive, demonstrates that part of the reason the mentalistic hypothesis is the best one is because we accept that humans have minds. The conclusion that other animals also have minds is justified, because it coheres with the current body of scientific knowledge.

1.3.4 Direct perception arguments

Direct perception arguments (also known as non-inferential arguments) for animal minds are based on the idea that when we interact with a minded creature, we just see that the creature has a mind. Because of this, it is a mistake to even try to justify the existence of other minds, in either humans or animals. Direct perception arguments adopt Hume's view that animal minds are so obvious that it's hard to doubt their existence.

The idea behind direct perception arguments is that humans have an animism detector that we use to perceive minded agents, much like we have a light detector that we use to see objects. Asking us to step back and examine others as objects in order to justify their mindedness is like asking us to close our eyes in order to see. There is no need to infer minds; instead, we directly perceive others as minded.

While this sort of argument reflects what we know about human psychology, it also reflects a different view about the nature of minds. While both arguments from analogy and inference to the best explanation take minds to be unobservable entities that must be inferred, on non-inferential views mind is visible. Dale Jamieson suggests that the problem of other minds is a vestige of an unjustified Cartesian dualism, and that once we reject mind/body dualism, we will in effect dissolve the problem of other minds. Instead, Jamieson thinks we should agree with Hume that there is no need for "heavy philosophical or scientific artillery to prove that animals have thought and reason" (Jamieson 1998, 81). Jamieson's reasoning is that the problem of animal minds is taken to be different from the problem of other human minds, but without any justification. We might state the direct perception argument like this:

1 We reasonably think that some other animals are minded.
2 If we reasonably think that some other animals are minded, then we think so either because we infer that they have minds or because we directly perceive that they have minds.
3 We do not infer that other animals have minds.
4 Therefore, we reasonably think that other animals are minded because we directly perceive their minds.
5 If we directly perceive animal minds, then we know animals have minds.
6 Therefore, we know animals have minds.

The inferential arguments reject premise (3), and presume that when we see other animals—and other humans—we see behaving bodies rather than minds. Jamieson responds that the idea of a behaving body is a "philosophical monster"—something merely conjured up by contrary philosophers. Imagine looking at your baby for the first time, and wondering whether or not it is a mental being. That's a strange idea. We don't tend to ask these philosophical questions when we meet a new infant—especially a new member of our own family. Instead, we start interacting with the baby—we stroke their skin, making faces and cooing sounds. We naturally react to the baby as minded; we are mutually engaged, coordinating our movements, sounds, and gaze. Jamieson thinks that these reactions are irresistible. Seeing the baby as a behaving body whose mind we have to infer is unfathomable to the direct perceptionists.

Just as the folk—and psychologists—need not worry about skepticism when it comes to other human minds, they need not worry about other animal minds. In both cases, we directly perceive others' mental states, and the better we know the individual, their way of life, their relationships, their background, and so forth, the better we are at understanding the individual, regardless of species. Premise (3) is an empirical claim, and Jamieson suggests that we have evidence for it in human psychology.

Critics will also object to premise (5). Even if we directly perceive animal minds, we may not know that animals are minded, if perceiving does not guarantee existence—we may be wrong. A thirsty traveler might think that they perceive water when walking through a desert, but it's really a hallucination. When a stick rests in a glass of water, an illusion causes us to see the stick as bent when it's really straight. In addition to hallucinations and illusions, the human animacy detector may cause more systematic errors that are triggered by geometric objects with googly eyes moving in particular ways. Humans anthropomorphize—we see faces in the clouds and chickens in a church—but we don't think clouds or churches have minds. However, we may have more trouble with robots that look and act like humans. For example, Erica, a robot built by Hiroshi Ishiguro, director of the Intelligent Robotics Laboratory at Osaka University, looks and acts like a 23-year-old human woman. She may even start working as a news anchor in Japan. We likely would respond to Erica in the same way we'd respond to a human reading the news, but that doesn't mean that Erica is minded.

The direct perceptionist might respond by pointing out that if our interactions with Erica are limited to viewing her on a screen, then our animacy detector could be activated. However, if we were to interact with Erica in person, we would quickly realize her limitations. Any robot that managed to engage our animacy detector over a period of time, as the baby does, would likely soon be treated as minded, regardless of any intellectual argument we might have against artificial intelligence.

On the flip side, the direct perception argument might fail to identify mind where it actually exists. Some minded beings may be too small; we're not going to directly perceive any mind in the tardigrade because we can't even directly perceive the tardigrade—they are microscopic. Some minded beings may be too scary; the pelican eel is a deep sea fish with a huge mouth and a snake-like body, and when I look at images of the pelican eel I certainly do not ooh or ahhh, or want to spend much time interacting with it.

While Jamieson says that the non-inferential approach leaves open the possibility that such creatures are minded, he doesn't offer a means for overcoming the difficulties we will certainly encounter when trying to get to know some animals who are very different from ourselves. Thus, while the non-inferential approach may work with dogs, dolphins, and chimpanzees, it may be less useful when it comes to other animals. But, as an evolved method for identifying the kinds of minds that our human ancestors were likely to run across, direct perception of mind probably maps onto a real and salient property of those beings. We take other minded beings to be potential social partners, friends, predators, or competitors. Like other humans, who act and who have similar needs to ours, we engage with other animals as part of our social environment. Even today, and even in the city, humans have to think about other animals who live around them—at my city house, we live with squirrels, raccoons, rats, skunks, spiders, grackles, and sparrows whose actions and interests intersect with my own.

While the non-inferential argument for animal minds may not satisfy a critic who thinks the burden of proof rests with those who accept animal minds, this argument, together with converging evidence from the other argument methods, offers compelling evidence for the minds of animals. As Lewis Carrol taught us in his dialogue "What the Tortoise Said to Achilles," justifications must come to an end somewhere. Taken together—seeing familiar animals as having desires, goals, fears, pains, etc.; knowing that such animals are much like humans when it comes to biology, ecology, and evolutionary history; and finding competing, non-mentalistic hypotheses wanting as explanations for these behaviors—these different sources of evidence for familiar animal minds are all but conclusive. When it comes to other beings—bacteria, sponges, fungi, insects, trees, or robots—more scientific and philosophical work is going to be required, but that investigation can start from the foundation we build by demonstrating mind in familiar animals.

1.4 Chapter summary and conclusions

This chapter introduced us to the nature of the mind and the arguments for animal minds. When we ask whether others have minds, we are asking whether they think and feel. But we are not assuming that the mind is an object (like the brain, the nervous system, the full body, or some nonphysical entity), because mentalizing might be better understood as a process. Identifying mentality with the brain or the nervous system might misidentify the relationship, like identifying digestion with the stomach. The body part is what performs the process, but it is not identical with the process. We also saw that there is variation in mind. There is variation within species depending on any number of factors including developmental stage, environment, social context, neurodiversity, and personality. There is also variation between species because organisms evolve in response to their social and ecological niches, ranging from semi-solitary forest-living orangutans, group-migrating wildebeests, and the solitary eels on the ocean floor. We saw that the mind is not a perfectly logical, computing machine, and that some of our reasons for actions are hidden from us. Not all mind is conscious.

Philosophers have developed a number of theories about the nature of mind. We reviewed four approaches to theorizing about the mind. Dualism takes there to be a nonphysical mental world and the physical world of science. Dualists come in two varieties: Substance dualists who think there are both mental and physical stuff, and property dualists who think there is only physical stuff, but both mental and physical properties. The other three theories reject dualism and the existence of a nonphysical mental domain. Identity theory takes the mind to be identical to the brain. Functionalism takes the mind to be a process, like a program that can be run on different computers. Hence, functionalists think that the mind is multiply realizable, such that different kinds of physical structures, including octopus bodies, human bodies, alien bodies, and robot bodies, may all be able to run the mind program. Enactivist theories take mind to be either caused by or constitutive of the interactions of a living organism in its social and ecological contexts.

Psychologists have been interested in the cognitive capacities of minds. Cognitive capacities such as memory, problem solving, navigation, reasoning, and communication allow organisms to process sensory information in order to flexibly respond to the current situation. Cognition permits us to learn across different contexts, both from the environment and from manipulating the information we already have to make new inferences. For this reason, cognition is often associated with rational thought.

The problem of other minds is an old problem in philosophy. I can directly know that I have a mind, but I can only infer that you have a mind. What sort of evidence do we need to be justified in attributing mind to others? While philosophers don't take the worry about other human minds seriously, they do take the problem seriously when it comes to other animal minds. Historically, philosophers have debated whether animals have minds. Philosophers including Aquinas, Kant, and Descartes have argued that animals don't have rational minds. However, Aristotle, Hume, and Voltaire thought we had reason to ascribe rational minds to animals.

There are four argument types to solve the other species of mind problem. Arguments from analogy have been used both for humans and for other species. They identify a property that I have, or that all humans have, which is explained by attributing mindedness, and use the existence of that property in others to infer that they also have minds. Arguments from evolutionary parsimony have been used to argue that our closest relatives, such as chimpanzees, orangutans, bonobos, and gorillas have minds. These arguments are based on biological principles that closely related species tend to have the same properties, so if we see a similar behavior in two species, the simplest explanation is to conclude that a similar cause is behind the behavior. Inference to the best explanation arguments can be used for all species. These arguments are based on standard scientific approaches to hypothesis testing. We looked at an example of the inference to the best explanation argument at work when we examined whether Chaser the dog understands human words as concepts referring to objects or as commands. Direct perception arguments reject the starting assumption that we have to infer the existence of other minds from behavior. Such views suggest that mentality is something, like color, that can be perceived. Taken together, these four sorts of arguments offer compelling reasons for accepting that some, if not all, nonhuman animals are minded beings.

Notes

1 I think it is helpful to know what field theorists are coming from, so when I first introduce a person in this book, I will indicate their field. Since this is a philosophy book, the default assumption is that the theorists are philosophers, so when no field is indicated, you can assume they are a philosopher.
2 You can watch the stimulus used in the study https://www.youtube.com/watch?v=VTNmLt7QX8E

Further reading

Animal minds and how to study them

Andrews, Kristin, and Jacob Beck. *The Routledge Handbook of the Philosophy of Animal Minds*. New York: Routledge, 2017.

Allen, Colin, and Marc Bekoff. *Species of Mind: The Philosophy and Biology of Cognitive Ethology*. Cambridge, MA: MIT Press, 1997.

Bekoff, Marc, Colin Allen, and Gordon M. Burghardt. *The Cognitive Animal: Empirical and Theoretical Perspectives on Animal Cognition*. Cambridge, MA: MIT Press, 2002.

Sober, Elliott. *Ockham's Razors: A User's Manual* (Chapters 3 and 4). Cambridge: Cambridge University Press, 2015.

On-line resources

The Stanford Encyclopedia of Philosophy is an excellent resource for students of philosophy, and there are a number of entries that are relevant to the topics discussed in this chapter, including Animal Cognition; Other Minds; Dualism; The Mind/Brain Identity Theory; Functionalism; and Embodied Cognition.

The Internet Encyclopedia of Philosophy is another good resource, especially Robert Lurz's entry on Animal Minds.

2 Understanding animal behavior

Once we have decided we have good reason to accept the claim that animals are minded beings, we are faced with a question: How do we characterize what the animals are doing? Is it right to say that the dog is "playing" when we see the dog ride a sled down the hill? Is it right to say that the monkey is "rescuing" a "friend" when we see the monkey pick up another stunned monkey off the train tracks? It might seem like a simple matter to describe what we see animals do, but our choices can have a big impact on how we then explain the behavior. Here's an example; consider a child picking up a dog. This behavior might be described as "The child cuddled the dog" or "The child strangled the dog." The choice between these two descriptions is a choice about how to understand the behavior, including how the child and the dog both felt about it.

In this chapter, we will focus on philosophical questions about the relationship between describing and explaining animal behavior, and consider how to best describe a behavior depending on the kind of explanation we are seeking. This investigation will start with a discussion of folk psychology, the commonsense understanding of other minds, and introduce folk psychology as one kind of explanation we can provide for animal minds. We will also consider worries about the use of folk psychology in animal cognition research that arise in the context of anthropomorphic critiques. We will then turn to two methods for studying animal minds derived from the philosophy of science: The calibration method for examining concepts and the Sherlock Holmes method for testing concepts against scientific observations.

2.1 Folk psychology and interpretation

When the professor shows up to class at 9 am, the students are there waiting. How did the students predict that she would show up at 9 am? It might be natural for us to say that the students understand that the professor *believes* class starts at 9 am, and that the professor has the concepts of CLASS and 9 AM.

Likewise, when Chaser the dog responds to a request to get a Frisbee, it may be natural for us to say that Chaser understands that her human wants her to get one of the Frisbees. We might also conclude that Chaser has a FRISBEE concept, and a FETCH concept. Describing behavior in this way is based on our *folk psychology*. By "folk psychology," we mean the commonsense practice of taking action to be caused or accompanied by mental states like belief and desire, emotions, and understanding that an individual's moods, personality traits, and position in society impact these other mental states.

The term "folk psychology" entered into the common philosophical lexicon with the publication of Paul Churchland's 1981 paper "Eliminative materialism and the propositional attitudes" in which he argued that folk psychology is a theory, like a scientific theory, but it is radically false. Churchland thinks that folk psychology is like astrology or alchemy, a bad theory resting on unscientific concepts that has no role to play in scientific investigation. On this view there are no beliefs or desires, just as there are no vital forces or resurrection stones. Churchland's argument led to an outpouring of support for folk psychology and its concepts, which include all the familiar words we use to describe mentality; it isn't just our beliefs and desires that are threatened by eliminativism, but also our hopes, dreams, and fears. Jerry Fodor, a defender of folk psychology, argued that without folk psychology it would be "the end of the world," since we could no longer understand one another, or predict others' behavior (Fodor 1987).

While Churchland's idea that there are no mental states hasn't gained much support, his view that folk psychology is a theory became very influential. The term "theory of mind" was coined by psychologists David Premack and Guy Woodruff to refer to the ability to understand others in terms of their mental states. They thought that humans have a theory of mind, and wondered whether chimpanzees might have a theory of mind too. Philosophers and psychologists began using the terms "theory of mind" and then "mindreading" to refer to our commonsense understanding of other minds. They focused on one particular part of folk psychology, namely our ability to attribute *propositional attitudes*, or the mental attitudes we have toward propositions. For example, "It is raining" is a proposition, and we can have a variety of attitudes toward that propositional content such as believing it, doubting it, and desiring it.

While people sometimes use the terms "mindreading," "theory of mind," and "folk psychology" interchangeably, it is useful to draw some distinctions:

Folk psychology: A capacity for social cognition and the ability to see others as intentional agents who have goals they act toward; a folk psychologist need not understand what causes the goal-directed behavior. Theory of mind and mindreading are included under the umbrella of folk psychology.

Theory of mind: A theoretical understanding of others, primarily in terms of how beliefs and desires cause behavior.

Mindreading: Attributing mental states to others; because we can distinguish between the content of what is attributed, we can talk of mindreading beliefs, mindreading perceptions, mindreading emotions, and so forth.

The extent to which other animals have a folk psychology that allows them to mindread is the topic of Chapter 7. Our topic here is whether we humans can accurately mindread animal minds. But first, let's see how we mindread human minds.

We use folk psychology when we explain human behavior. For example, we might explain why a friend quit his high-powered job and started a farm in the country by saying that the friend was stressed and wanted some peace and quiet, or believed that he had to escape the rat race to keep his sanity, or was having a mid-life crisis, or even, just got bored and is the kind of person who makes radical changes to his life every few years.

Many philosophers claim that descriptions in terms of folk psychology are like interpretations. We interpret the meaning of observable behavior much the way we interpret acoustic blasts as meaningful sentences. Like the inferential arguments for animal minds discussed in the last chapter, the idea of interpretation starts from an assumption that mental states and meaning are not transparent and directly perceived, but have to be inferred.

The philosopher W.V.O. Quine argued that even when we understand human linguistic behavior, we engage in an act of *radical translation*. He asks us to consider how a linguist goes about translating a newly discovered language. Once a linguist is embedded in a community, they can begin to develop hypotheses about what particular words mean. "A rabbit scurries by, the native says 'Gavagai', and the linguist notes down the sentence 'Rabbit' (or 'Lo, a rabbit') as a tentative translation, subject to testing in further cases" (Quine 1960, 29). Quine argues that even after extensive testing of this hypothesis, the linguist's experience with the linguistic population will not be sufficient to decide between that translation and a variety of other consistent translations, such as "There are undetached rabbit-parts there" or "There is rabbitness there." This goes for all other utterances of the type, and Quine concludes that there can be different but equally consistent good translations of a single language.

Problems with interpretation can be experienced first-hand when interacting with people from different cultures. Bubbly Americans who are constantly telling others to "Have a nice day!" might read more reserved Brits as unfriendly. Talking to someone with your sunglasses on signals disrespect in some cultures, though is acceptable in most of North America. Hiding a giggle behind your hand is polite for a woman in Japan, but was understood to be mean-spirited by my five-year-old Canadian-American daughter.

These cross-cultural problems suggest that more is involved in folk psychology than the attribution of propositional attitudes that cause behavior and that can be correctly interpreted via a process of radical interpretation. Pluralistic approaches to folk psychology are committed to this broader understanding, and endorse the view that folk psychology includes seeing other as intentional agents with their own traits and goals who are embedded in a community of others. Our social interactions create expectations about how other minded beings of various sorts should behave, feel, and think. In humans, when someone violates an expectation, they take on the burden of explaining, justifying, or apologizing. On pluralistic views, a folk psychologist sees others as minded beings with personalities, goals, emotions, relationships—a much richer picture than the one painted by the theory of mind approach (Andrews 2012, 2015; Spaulding 2018).

Pluralistic folk psychology

1 One needs to be a folk psychologist in order to have robust success in predicting, explaining, and interpreting behavior.
2 Folk psychology is a social competence, which includes the ability to identify behavior, predict behavior, explain behavior, justify behavior, normalize behavior, coordinate behavior, etc.
3 The social competences of folk psychology are supported by a number of different cognitive mechanisms.
4 The folk take intentional behavior to be caused by a variety of states or events, including moods, personality traits, dispositions, enabling conditions, propositional attitudes, emotions. . . .
5 The requirement for being a folk psychologist is the ability to recognize that there exist intentional agents, and to fare well in discriminating intentional from nonintentional agents.

(Andrews 2012, 11–12)

If it is sometimes hard to understand the humans we live among, and harder yet to understand humans in different cultural groups, then we should expect even more difficulty understanding other species. A good first step when entering another culture is to watch what people do, and to do that. Do people eat on the subway? Do they walk down the stairs on the right or the left? When they greet, do they kiss, shake hands, hug, or bow? An observant traveler will come up with bare rules to follow, with as little interpretation as possible. Scientists investigating animal minds have to be a bit like a traveler to a new culture. They have to observe what the animals do, and come up with rules that describe typical behaviors. For both the scientist and the traveler, the rules and descriptions are kinds of hypotheses. Constructing rules and descriptions of a new population is only an initial step, and not the end of the matter. If we want to know more about the behavior, the next step is to formulate a hypothesis that helps to situate the behavior into a larger pattern. This allows us to interpret the behavior a part of a meaningful practice, which is needed to generate good explanations of that behavior.

2.2 Explaining behaviors

Once we have described a behavior, we might become curious why someone acted as they did. Answers to *Why?* questions are considered explanations of the behavior. An interesting feature of explanations of behaviors is that there is often not just one true explanation. Ask yourself why you do something you do. Why do you go to the gym or take a yoga class? Because it promotes longevity, because it makes your body feel good, because you like to use the sauna at the gym, because it helps you focus on your work, because it helps you deal with stress, because it increases cerebral blood flow, because it reduces muscle tension, because it increases oxygen consumption, because it is cool, because you get to hang out with your friends, because it helps you lose weight, and because it means you can have a piece of cake later. These can all be explanations for why someone exercises. Arguing about which explanation is the *real* explanation shows a lack of understanding that there are different kinds of accurate explanations for the very same behavior. A full explanation might include all of these, plus reference to the causal chain leading up to the behavior. However, if the causal chain started at the point of the big bang singularity, a full explanation would be impossible! We don't want or need those kinds of explanations. Instead, when we ask for explanations, we are usually wondering "Why this rather than that?" Recognizing the goal of our explanation seeking can help us see what kind of answer we need.

A case from early cognitive science may be instructive to illustrate the point that there are multiple correct explanations for the same phenomenon. The psychologist David Marr introduced the idea that we can identify three levels of explanation for cognitive or perceptual systems: *computational* (the goal of the system), *algorithmic* (the function that achieves the goal), and *implementation* (the physical organization of matter) (Marr 1982). In psychology, the computational level is considered a high level of explanation, and the implementation level is considered a low level of explanation.

To adapt Marr's levels to the exercise case, we might give an explanation on the computational level in terms of promoting longevity. Explanations on the algorithmic level would include feeling good, reducing stress, and helping you focus. Explanations on the implementation level would include increasing oxygen flow and releasing endorphins. Marr's levels don't exhaust the kinds of explanations we have for behavior. Several of the explanations for why you take a yoga class are also folk psychological: Wanting to use the sauna or seeing your friends. Folk psychological explanations offer reason-respecting, story-like details that help others make sense of your behavior. It would be really puzzling if someone explained that they went to yoga class because they hate the annoying teacher and feel terrified after class.

Marr's levels of analysis have been influential in the philosophy of mind and adopted by those who take a functionalist approach to the metaphysics of mind (which is to be distinguished from speak of "function" in biology, where the function of a behavior refers to the ultimate reproductive goal of the organism). Recall that functionalism is the theory that what makes something a mental state is what it does—its causal role—and that the material supporting a mental state is irrelevant. Thus, functionalists assert the doctrine of multiple realizability: The same mental state can be implemented in organisms made of very different material, and with very different physical organization. For example, consider an alarm clock. Many different programs and physical objects can serve the function of an alarm clock: An old-fashioned wind up clock, an iPhone's digital computer, or your very reliable (and hungry) dog can all serve the function of waking you up, even though they have distinct physical structures and causal organizations. For the functionalist, different kinds of systems, with very different kinds of hardware, can run the same mental program.

The move toward functionalism in the philosophy of mind was inspired by research in computation, and especially Alan Turing's work on the theoretical possibility of a Universal Turing Machine, a computer that can solve any well-defined problem. According to Turing, if a Universal Turing Machine can fool a human into thinking it is a human, then the machine *is* minded! This is the Turing Test, which is Turing's solution to the problem of other minds.

On functionalist views, the human mind is analogous to a computer program, and the human brain is analogous to the computer processor. What makes an entity minded depends on whether it is running the right sort of program, a program which corresponds at least generally to human folk psychology (Lewis 1972). Anything that acts according to human folk psychology is minded in the way humans are minded.

Given the commitment to multiple realizability, the functionalist is more interested in explaining behaviors in terms of smaller functional parts, and so looks for explanations at Marr's algorithmic level. Thus, the functionalist approach to animal cognition is unconcerned with whether a behavior is caused by the same matter; instead, the behavior must play the same role. For example, humans and spiny fish have different biological pathways that are involved in tissue damage, but since the same kinds of functional descriptions can be given in both types of organisms, the functionalist must conclude that both humans and spiny fish feel pain.

Unlike functionalists, identity theorists will focus more attention on, and offer explanations at, the implementation level. For example, to study pain on the implementation level we might note that when tissue is damaged in an organism, specialized receptors in the skin called nociceptors send signals to the spinal cord, which are processed in the neocortex, and cause the human body to respond by saying "ouch!" If we want to know whether spiny fish experience pain, we could look for the same pathways, recognize that spiny fish lack a neocortex, and conclude that they do not feel pain. However, a simplistic approach to identity theory like this is problematic because it leads to counterintuitive conclusions. We know that humans have *brain plasticity*, that is, they can come to use different parts of the brain for the same behaviors and functions. After a stroke or injury, humans can relearn certain behaviors by building new pathways in a different part of the brain. If we narrowly identify a particular brain area with a particular behavior, then we would have to deny that the rehabilitated human is engaged in the same behavior as they were before the stroke. A narrow identification of a specific brain activity with some behavior or function would force us to deny that behaviors in humans that play the same functional role are in fact the same. For example, after some brain injuries people have to relearn to walk, using new brain processes. It would be bizarre to claim that the person isn't walking, because they are using a different part of the brain to do so.

All this to say, there are different kinds of explanations for the same behavior, and a scientific explanation of an animal's behavior might involve different levels of explanation. Sometimes it is difficult to identify which level of explanation is being invoked. The study of pain, for example, might involve explanations at all three of Marr's levels. The goal of pain avoidance is to avoid tissue damage, and an irritant response such as pulling away from a heat source is a behavior that fulfills this goal. The biological organization that causes this behavior can be examined in the physical organism. We can also offer folk psychological explanations for pain behavior—we pull away because it hurts.

Because explanations can be given at different levels, when it appears that there are multiple explanations for an animals' behavior, it is important to first determine whether the explanations are competitors or whether they are compatible with one another. It is possible that different explanations that appear to be inconsistent are really consistent explanations at different levels or of different sorts. For example, suppose that we find that Chaser the dog's behavior is explainable in terms of his forming associations between sets of stimuli—must we conclude that Chaser doesn't understand the words? Not unless we have some additional reason for thinking that associations cannot be understood. For example, if children learn language by forming associations between sets of stimuli, and children also understand the meaning of words, we should suspect that the explanation in terms of forming associations is a different kind of explanation than the explanation in terms of Chaser's understanding words. It is especially important to keep in mind that different explanations may not be competing explanations when dealing with inference to the best explanation arguments. Recall that inference to the best explanation arguments are only as good as the number of competing plausible explanations we have developed. If all our plausible explanations are consistent explanations at different levels, then we haven't actually identified any competing explanations.

Animal cognition research is in the business of explaining animal behavior, but as we've seen, there are various ways of explaining behavior. Different scientists focus on different levels and kinds of explanations, which sometimes leads to confusion. Social psychologists are often interested in folk psychological explanations, that is, explanations in terms of beliefs, desires, goals, emotions, personality, and so forth. Cognitive psychologists are often interested in explaining behavior in terms of one's learning history, or in the kinds of representations required. Developmental psychologists are focused on understanding how and when behaviors emerge in childhood and adolescence. Each of these three subdisciplines of psychology might look like they are offering different explanations of the same phenomenon, such as the perception of animacy in the Heider Simmel animation. Animal cognition researchers can explain behavior in a variety of ways too. The take home message of this section is that explanations in folk psychological terms can be consistent with explanations in algorithmic and implementation terms, just as it can be consistent with evolutionary and developmental explanations.

2.3 Worries about folk psychology and anthropomorphism

Describing and explaining animal behavior in folk psychological terms raise worries about anthropomorphism—the attribution of human psychological, social, or normative properties to nonhuman animals "usually with the implication it is done without sound justification" (Shettleworth 2010a, 477). As we will see in the next chapter, scientists have long worried about attributing human properties to animals where they don't apply.

For example, chimpanzees are not little humans, and it is a scientific mistake to treat them as if they were. But is it a mistake to describe a chimpanzee's social relationships in terms of having "friends" or "enemies"? Can we describe a dog as "happy" or "sad" or "depressed," or as having a personality trait such as "brave" or "timid"? The psychologist Clive Wynne says we cannot. He argues that we should not even ask questions about such anthropomorphic properties. To do so is an uncritical use of human folk psychology masquerading as scientific explanation, resulting in unscientific bad analogies (Wynne 2004). Psychologists like Wynne prefer to use neutral, non-anthropomorphic terminology, such as replacing "friends" with "affiliative relations" (Silk 2002).

What we can call *imaginative anthropomorphism* isn't of scientific concern; the talking bears of storybooks and cartoons don't raise scientific hackles. However, scientists and philosophers worry about *interpretive anthropomorphism* when they ask whether a folk psychological term

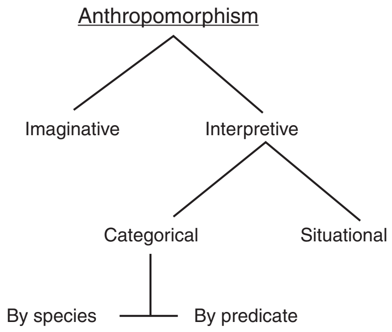

Figure 2.1 Types of anthropomorphism, from Keeley 2004.

is correctly attributed in an explanation of behavior. There are two kinds of skeptics who worry about anthropomorphism: Categorical skeptics who think that animal cognition research cannot be good science, and situational skeptics who think that some of the attributions made by some researchers are unjustified. Categorical skeptics, such as J.S. Kennedy, think that animal cognition research engages in unscientific investigation (Kennedy 1992). The problem arises from the very questions researchers ask, like whether animals have personality traits or a theory of mind. For the categorical skeptics, the charge of anthropomorphism is a pre-empirical one; the argument amounts to the claim that researchers in animal cognition are making a category mistake by asking whether animals have certain properties—it's like asking the color of the number two, or the weight of last night's dream.

Sometimes the categorical skeptics seem particularly concerned about bias in animal cognition research—they worry that if psychologists are allowed to look for some human property in animals, then they will see the animals' behavior through that lens. Kennedy writes that "anthropomorphic thinking about animal behavior is built into us. We could not abandon it even if we wished to" (Kennedy 1992).

The worry about anthropomorphism has led some comparative psychologists to condemn the use of folk psychology in explanations of animal behavior. For example, one group of scientists wrote: "Folk psychology is the linguistic equivalent of giving guns to children and telling them to play carefully: misuse is inevitable" (Jensen et al. 2011, 274). The scholar Derek Penn accuses folk psychology of "ruining" comparative cognition (Penn 2011), and thinks that the "insidious role that introspective intuitions and folk psychology play" in comparative cognition research must be eliminated (Penn and Povinelli 2007, 732). The psychologist Cecilia Heyes thinks that folk psychological explanations may be "simpler for us" to understand (Heyes 1998, 110), but she argues that they have no place in science, since they commit a double error: First they produce an unscientific explanation of human behavior, and then that explanation is applied to nonhuman animals when they engage in superficially similar behavior.

We can state the argument against folk psychology like this:

1 Folk psychology consists of unscientific concepts.
2 Unscientific concepts have no role to play in science.
3 Therefore, folk psychology has no role to play in the science of animal cognition.

In response, we can challenge the first premise. Scientific concepts can be taken to be those concepts that support the development of scientific knowledge. To say that folk psychological concepts are unscientific would be to say that they don't support the development of scientific knowledge. But, they do. The concepts of folk psychology have permitted robust research in cognitive psychology and neuroscience; we don't know how to get that research off the ground without engaging in talk about other's beliefs or desires, for example. While one might reply that the concepts are fine for humans but not for nonverbal animals, we see that these concepts are useful for studying nonverbal human infants as well as older, verbal humans.

Another worry about the first premise is that the class of concepts of folk psychology is very large, and there is no agreement about what counts as a folk psychological or anthropomorphic concept. Are memory, hunger, and fear unscientific concepts? They are part of our commonsense understanding of the mind—no one had to take a psychology course to learn about them—but they are also used in scientific psychology to study both humans and animals. If one replied by saying that the anthropomorphic concepts are those that are uniquely applied to humans, then they are begging the question. We don't know whether some property is unique to humans until we look for it outside of humans.

In defense of the use of folk psychological concepts in animal cognition research, we can point to the continuity of folk and scientific psychology. Scientific psychology began with folk psychology, just as scientific physics began with folk physics. Our folk questions about the mind, like our folk questions about solids, liquids, and gasses, led to the development of the sciences. Some folk concepts get dismissed through scientific study, such as souls, but some scientific concepts get dismissed along the way too, like vital forces. There would be no way to start our sciences without taking our folk concepts as a starting position. With investigation, we can refine our concepts, or discard them if we find that they don't have a role to play.

Another way of formulating the argument against folk psychology in animal cognition research is that it biases us against looking for alternative, "simpler" explanations in terms of associative mechanisms. This argument could be stated like this:

1 Folk psychology presumes sophisticated mental processes where simple associative mechanisms suffice.
2 We should explain behaviors using the simplest mechanism possible, all things considered.
3 Therefore, we should not explain behaviors in terms of folk psychology.

In this argument, we can challenge both premises. Folk psychological explanations may be an explanation at a different level than associative explanations. If folk psychological explanations are explanations at Marr's computational level, and associative explanations are given at Marr's algorithmic level, then they are not competing explanations. Whether one explanation is better than another depends on the goal of the research program. Premise (2) can also be challenged because it isn't clear what it means for one explanation to be simpler than another. Associations can get very complicated, and comparing a folk psychological explanation with an associative explanation in terms of simplicity is a comparison that cuts across categories. It's like comparing apples to oranges.

A slightly more sophisticated version of this argument is inspired by Heyes' worry that we are wrong about human cognition as well as animal cognition. Her argument could go like this:

1 Folk psychology involves appealing to inaccurate causes of human behavior.
2 Inaccurate causes for human behavior cannot serve as good explanations for animal behavior.
3 Folk psychology cannot serve as a good explanation for animal behavior.

This argument is a bit more difficult to analyze, because it is true that folk psychology sometimes provides inaccurate causes of human behavior. We might be wrong about someone's motivation for acting. The problem is amplified when we take a false view about human behavior and use it to explain animal behavior. The philosopher Cameron Buckner has named this error— "anthropofabulation" given that it involves both anthropocentricism and confabulation of our own typical abilities (Buckner 2013). Anthropocentrism is taking humans to be the standard against which all others are judged. Confabulation is making up false psychological explanations or memories. But how do we confabulate our own mental faculties? Psychologists have discovered unconscious processing (such as priming), biases and heuristics (such as discounting the value of future rewards), and core cognitive processes (such as the implicit number system) in humans. These are all processes that we don't seem to have easy conscious access to, and may ignore when explaining our own behavior.

This worry about folk psychology in psychology is a species of a more general worry about making false attributions outside of science. When human behavior is explained without using the scientific methods, we may be very wrong about the mechanisms that led to the behavior.

Consider first seeing gigantic termite mounds that resemble the Gaudi-esque works of a brilliant architect.

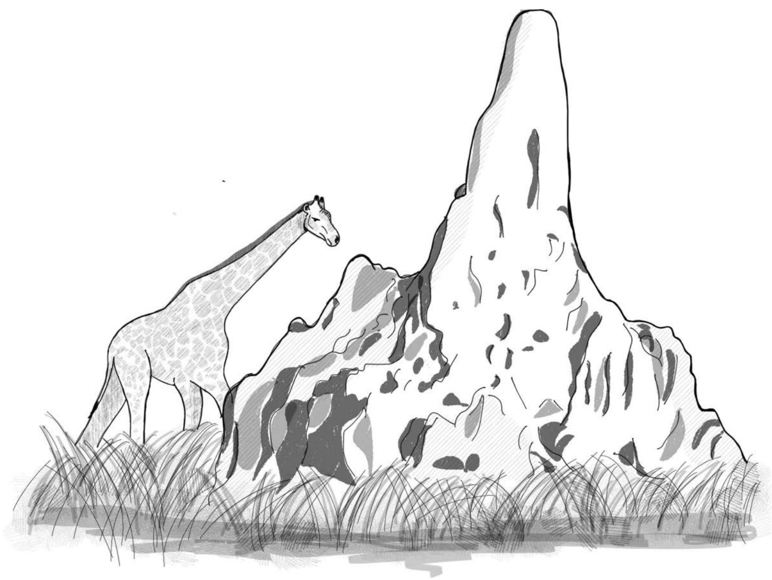

Figure 2.2 A termite mound in the Congo's Miombo Woods thought to be between 680 and 2200 years old.

Your unscientific response might be to see the termite mound as the result of careful planning. However, with a little scientific investigation, scientists discovered that termite nests are built by a group of termites following simple rules. For example, to make an arch the termites first roll up balls of mud that, through their efforts, become infused with a chemical scent. Next, the termites pick up their respective mudballs, and carry them to the location where the chemical scent is the strongest. This means that the largest collection of mudballs attracts more mudballs. This leads the termites to build columns, as the scent is strongest near the top of the pile. When a termite on top of a column gets a whiff of a nearby column, the individual will place the mudball on the side of the column, which over time leads to the construction of an arch. Thus, by way of two rules, apparently sophisticated behavior emerges.

While people sometimes commit the error of anthropofabulation, we also sometimes commit the errors of false attributions. The practice of science helps us avoid false attributions, and there is no reason to think that the use of folk psychological concepts necessarily entails false claims.

These arguments against the use of folk psychology in animal cognition research at best warn us that they can be misused, and that is something we need to keep in mind. However, the arguments also suggest that there is a universal human bias toward attributing mental states to animals. It isn't clear to me whether this is a universal truth about humans. Some humans may be biased *against* attributing mental states to animals.

Sober identified a bias in animal cognition research that is the inverse of anthropomorphism. I call this bias *anthropectomy*—the unjustified denial of human psychological, social, or normative properties to nonhuman animals (Andrews and Huss 2014). Sober points to a methodology in empirical research—null hypothesis testing—as the source of this bias.

The null hypothesis is usually framed as the opposite of the scientist's hypothesis. That is, if I am investigating theory of mind in turtles, my null hypothesis is that turtles don't have a theory of mind. This rule for formulating a null hypothesis is coupled with another methodological rule for psychologists according to which it is better to commit to a false negative than to a false positive. This rule is put in terms of the null hypothesis, and each error is given a bland name:

Type-I Error: Rejecting a null hypothesis when it is in fact true.
Type-II Error: Failing to reject a null hypothesis when it is in fact false.

Sober points out that both anthropomorphism and anthropectomy are problematic biases that say "some hypotheses should be presumed innocent until proven guilty, while others should be regarded as having precisely the opposite status" (Sober 2005, 97). He proposes that we stop worrying about anthropomorphism and anthropectomy, and instead focus on gathering more data that will help support hypotheses.

The comparative psychologist Sarah Shettleworth, who was quoted at the beginning of this section, advises students on how to avoid unwarranted anthropomorphism. She worries that the trend in animal cognition toward examining questions about counting, planning, or insight in animals will lead to unscientific research unless the general questions are deconstructed into sub-questions about sub-processes (Shettleworth 2010b). Shettleworth suggests that when we are open to the idea that some of these sub-processes may be shared widely across species, and that others may be less common, we will be able to do truly *comparative* cognition research at the level of cognitive mechanisms.

The critique of anthropomorphism amounts to the claim that thinking about human properties when examining animal cognition will lead to false claims about animals. However, we do not yet have the full story of human cognition, much less animal cognition. Examining properties we presume to exist in humans in other animals might help us to see that those properties are not needed to explain the animal or the human behavior. Humans and other animals may share more cognitive capacities than we thought not because animals have fancy or sophisticated capacities, but because humans lack them.

Examining whether other animals have human properties is a question, not a mistake. If we can formulate questions about human insight, friendship, morality, or metacognition, we should be able to formulate the same questions when it comes to other animals.

2.4 Methods in the philosophy of animal minds

Once we've accepted that animals are the sorts of things that might have minds, and we have some understanding of the assumptions that might be made when we describe and explain animal behavior, it may seem that we only have to ask more specific questions about animal minds—questions like: Do they have conscious experience? Do they reason? Do they communicate? However, since we are simultaneously investigating the nature of mental phenomena and the nature of animal minds, we cannot directly apply a well-established theory to these questions, because there are no well-established theories in many of these areas. In the philosophy of animal minds, we are simultaneously investigating the theory and the animals. This makes the methods in the philosophy of animal minds a bit different from the methods in animal cognition research. Scientists who study animals are engaged in normal science; they take a theory and a set of methods as given, formulate research questions within that paradigm, and apply the methods to answer research questions. Two methods are particularly helpful for examining theoretical and empirical considerations at the same time: The Sherlock Holmes method and the calibration method.

2.4.1 The Sherlock Holmes method

Daniel Dennett introduced the idea of the Sherlock Holmes method to help us decide between different folk psychological interpretations of an animal's behavior. In 1983, Dennett traveled to Kenya at the invitation of primatologists Dorothy Cheney and Robert Seyfarth, a husband-and-wife research team who were then studying communicative behaviors in a group of vervet monkeys. Earlier observers had noticed that vervet monkeys give different alarm calls for different predators, including snakes, eagles, and leopards. For example, when vervets see a snake, they stand on their hind legs and make a kind of chuttering sound. Each alarm call invokes a distinct behavior in the other vervets in the group. When vervets hear a leopard alarm call, they run up a tree. In response to the eagle alarm call, the vervets run into bushes where they can hide from the eagle, or they look up to the sky.

Cheney and Seyfarth wanted to know whether vervets understand alarm calls as referential, in the sense that the eagle alarm call means "there is an eagle around," or if the calls are more like generalized alerting systems, and mean something like "Take cover!" or express an emotion like "Eeek!" In order to test between the hypothesis that the monkeys use the alarm cries to alert others to danger, but that it isn't specific about the kind of danger (so the monkeys have to look around and see what the problem is and respond appropriately), or whether the calls have more information, Cheney and Seyfarth ran playback experiments, which involved hiding a speaker in the grass near the monkeys and playing an alarm call in the absence of a predator. What they found was that monkeys ran up trees when they heard the leopard alarm call even when there was no leopard around, and likewise responded appropriately to the recordings of the other alarm calls. This led the researchers to conclude that vervet monkeys use the alarm calls as signals with referential properties (a claim which we will examine further when we discuss animal communication in Chapter 6).

Cheney and Seyfarth were also identifying additional vervet vocalizations, and trying to determine what these other calls meant. The philosopher Daniel Dennett was intrigued by this real-life case of Quinean radical translation. Dennett identified three different stances one can take in explaining behavior (Dennett 1987). Each stance involves looking at the actor in a different way. The *intentional stance* involves looking at the system as an agent, so that the behavior can be described in folk psychological terms, as caused by beliefs and desires. An observer who takes the *design stance* sees the system as a designed artifact, and explains behavior in terms of what the system was designed to do. If the system is an artifact like a corkscrew or a chess-playing computer, the design stance would identify the designer's intention for the object; if the system is a biological one, then Dennett says that an evolutionary explanation is appropriate. Finally, an observer who takes the *physical stance* sees the system as an object and explains the behavior in terms of the physical instantiation of the object, just as in Marr's implementation level of analysis. For example, from the design stance, a waiter's corkscrew and a Screwpull would have the same description—to open wine bottles—but on the physical stance, they would have very different descriptions, as they are made of different material, and do the job in different ways.

Dennett's intentional systems theory states that taking the intentional stance, but not the design or the physical stances, allows us to identify minded agents. On his view, anything whose behavior can be reliably and voluminously predicted from the perspective of the intentional stance is an intentional system—an agent whose behavior is accurately described in folk psychological terms (Dennett 2009). When Cheney and Seyfarth claimed that we can interpret the vervet monkey alarm calls as referential signals with particular meanings, they were describing the behavior from the intentional stance. There are two possible challenges to this interpretation. One is that the intentional stance may not be the appropriate stance to take toward the vervets. The other is that their particular intentional explanation may be incorrect. To confront the first challenge, we can apply Dennett's method of disqualification: When we don't get any additional predictive power from taking the intentional stance toward a system, the system isn't an intentional system.

For example, consider trying to determine whether or not a kitchen table is an intentional system. We can take the intentional stance toward the table, attributing the following mental states—the table believes that there are people around and desires to not move when people are around—and predict that the table won't move. But, we already knew the table wouldn't move! Taking the intentional stance toward the table doesn't give us any additional predictive power. So it isn't an intentional system.

If vervet monkeys are intentional systems, we can better predict their behavior from the intentional stance than from the design stance—it is just a matter of attributing the right sort of intentional state description. Dennett writes:

> My proposal, in simplest terms, was this. First, observe their behavior for a while and make a tentative catalogue of their needs—their immediate biological needs as well as their derivative, *informational* needs—what they *need to know* about the world they live in. Then adopt what I call the *intentional stance*: treat the monkeys as if they were—as they may well turn out to be—rational agents with the "right" beliefs and desires. Frame hypotheses about what they believe and desire by figuring out what they *ought* to believe and desire, given their circumstances, and then test these hypotheses by assuming that they are rational enough to do what they ought to do, given those beliefs and desires. The method yields predictions of behavior under various conditions; if the predictions are falsified, something has to give in the set of tentative hypotheses and further tests will sift out what should give.
>
> (Dennett 1988, 207)

Elsewhere, Dennett refers to this proposal as the "Sherlock Holmes method," since it requires creating situations which one thinks will elicit particular behaviors, given what it would be rational for the actor to believe and desire. It gets its name from the hero of Sir Arthur Conan Doyle's detective stories, since Holmes solved his cases using a well-developed folk understanding of human psychology.

For example, in the story "A Scandal in Bohemia," Holmes needs to discover where Irene Adler has hidden a compromising photograph of herself with the King of Bohemia. In order to discover the hiding place, Holmes makes a number of assumptions about Adler's mental states. He expects that she values the photograph more than any of her other possessions, and that she knows where it is hidden. Given those attributions, he predicts that if her home were burning down, and the photograph was hidden in the house, she would retrieve the photo before fleeing. So, to set his trap, Holmes makes Adler believe her house is on fire by setting off a smoke bomb and hiring people to run around shouting "Fire!" As Holmes predicted, Adler retrieves the photo before realizing it is a false alarm, and he recovers the photograph for his client.

The Sherlock Holmes method allows us to ascribe propositional attitudes to others, and when the belief and desire attributions are consistent with an animals' pattern of behavior and offer predictive power, Dennett says we can conclude that the animal has those beliefs and desires. To use the Sherlock Holmes method we have to determine three things about the system: Its presumed belief, its presumed desire, and what would be a rational behavior given that belief and desire. Dennett writes:

> A system's beliefs are those it *ought to have*, given its perceptual capacities, its epistemic needs, and its biography…A system's desires are those it *ought to have*, given its biological needs and the most practical means of satisfying them…A system's behavior will consist of those acts that *it would be rational* for an agent with those beliefs and desires to perform. (Dennett 1987, 49)

Given those rules, we determine what the animal should believe and desire, and then we can set up an experiment—a Holmesian trap—for the animal to determine if our prediction comes out correct. If it does, we have some evidence that the animal has that belief and desire. Our degree of evidence for the attribution is a function of the number of successful predictions we can make.

The Sherlock Holmes method assumes a particular framework of mental state properties. If it doesn't work, we might need to modify the kinds of properties and mental state concepts that we use in our science, or create new ones. When this is the case, we can turn to use the calibration method.

2.4.2 The calibration method

In order to investigate the concepts of mind at the same time we investigate minded beings, we will use what I'm calling the *calibration method*. The calibration method allows us to investigate mental properties without being sure of the meaning of the concepts we apply, and without holding fast to an operationalized definition—an identification of the concept with an observable measure—of the capacity being investigated.

The *calibration method* in animal cognition research is based on the philosophical method as discussed by figures as disparate as Plato, Karl Popper, John Rawls, and Nelson Goodman. It is a form of *reflective equilibrium*, which is a practice of reflecting on and subsequently revising your belief. The calibration method starts with two kinds of information, beliefs and observations, and uses observations to reevaluate our beliefs, and uses our beliefs to reevaluate our observations until we reach a point in which our beliefs and observations settle into equilibrium.

In contrast to the calibration method, the scientific method in *normal science* starts with an accepted theory, and proceeds by applying the theory to the observations, making straightforward inferences. Thomas Kuhn describes normal science as the work of scientists operating within an established paradigm or theoretical framework. The theory that makes up the framework is not open to revision in normal science. Those scientists who use the calibration method are open to tinkering with the framework or working outside the paradigm.

The calibration method requires that we use our folk concepts and theories to get the investigation off the ground. Take a very different use of the calibration method—identifying gold. Gold has a very long history among humans. It has been valued as a glowing metal, used as coin and decoration, and has great symbolic meanings related to excellence and holiness. The Aztec called gold *teocuitlatl*, which translates to "god's excrement." Humans fought wars over gold, have built and destroyed economies over gold, but it wasn't until the chemical structure of gold was discovered that humans were able to distinguish between gold and other minerals such as pyrite, which is superficially similar. The science starts with a view about what counts as gold, as identified by apparent properties of the metal. This class includes metals with different atomic weights and chemical structures. As metal workers and scientists find that some of this supposed gold has different properties than other instances of supposed gold, it makes sense to draw a new distinction, and to make a decision about which of these classes counts as *real* gold, given our interests. We take these differences as reasons to divide the category, and refine our understanding of the very concept GOLD.

Just as we start with our folk understanding of what counts as gold to discover the nature of the element gold, we can use the calibration method to discover the nature of mental phenomenon. First, with our commonsense notions in place, we can *observe* the phenomenon—for example, we see squirrels running around with nuts. Using folk psychology and direct perception, we can then, after a period of observation, *describe* the behavior—we might see squirrels retrieving nuts in the winter that they cached in the fall, and call their behavior "remembering." Notice that by describing the behavior we are also categorizing it as an instance of remembering—a folk psychological mental concept. From this description, we can *formulate a hypothesis*: Squirrels remember where they cached their nuts, which means they will later return to the cache to retrieve the stored nuts. With a testable hypothesis in hand, we can *study* the behavior. For example, one group of scientists asked whether squirrels remember the many locations in which they hide nuts, or do they re-find their caches using smell? By allowing captive squirrels to cache nuts in individual enclosures, and then releasing squirrels into other squirrels' enclosures and measuring the number of nuts retrieved in each condition, scientists found that squirrels are worse at recovering nuts from another's cache site. To explain that result, scientists concluded that squirrels must remember where they hid their nuts—they don't merely rediscover stored nuts by sniffing around (Jacobs and Liman 1991).

After conducting a study, we may need to *recalibrate* our mental state term. Knowing that squirrels can find the nuts they buried demonstrates something, but it doesn't demonstrate that they can relive their past caching behavior the way you can relive your last family celebration. It doesn't demonstrate that squirrels can close their eyes and mentally navigate through their caching territory to count the nuts the way you can close your eyes and mentally navigate through your home to count the windows. Recognizing this can lead us to move beyond folk psychology and draw distinctions between kinds of memory. We might conclude that squirrels demonstrate "semantic memory"—or the recall of facts—but that we don't currently have evidence that squirrels have "episodic memory"—or the reliving of past events. With this distinction in hand, we can return to the study phase to investigate whether squirrels have episodic memory, which, in turn, will help us understand how semantic memory may be related to episodic memory, or whether that distinction turns out to be unwarranted.

Furthermore, we can compare squirrel semantic memory with what we know about human semantic memory, or semantic memory in other animals. Based on how similar the squirrel semantic memory is to our prototype of semantic memory, and how useful it would be to consider squirrels as remembering, we will decide both what we mean by and whether the squirrel's behavior counts as remembering. And that decision can help us to examine additional questions about caching. For example, if we understand the squirrels as remembering the location of their future meals, we can also ask how well they remember, what sort of individual differences there are in memory among squirrels, and whether squirrels only remember when it comes to nut storage, or whether they remember in other domains—for example, do squirrels remember their social partners? And this investigation may lead to another point at which we will want to revisit our notion of memory and the question of whether squirrels remember. If we find that squirrels don't do anything resembling remembering in any other domain, that may serve as evidence against squirrel memory in the domain of nut caching, if we conceive of memory as a domain general process—one that can be used in a number of different kinds of situations.

The calibration method acknowledges that as we describe a behavior, we are beginning to explain it, and starting to offer a hypothesis. It acknowledges that the words we initially use to describe or explain a behavior might have meanings that we find out later are not appropriate. Initial descriptions are tentative, due both to empirical considerations and conceptual ones. As we get deeper into an investigation, the goal is to better understand both the mental concept we use to describe the behavior and the animal whose behavior we are describing.

2.5 Chapter summary

To study animal minds, we have to be able to describe their behavior. Choices about how to describe behavior will impact the kinds of explanations we can generate. Describing behavior in terms of folk psychology involves organizing behaviors together into functional types through the use of familiar mental state terms. Folk psychology is the commonsense understanding of other minds. One's folk psychology might include a theory of mind—a folk theory about how beliefs and desires work together to cause behavior—and it might include the ability to mindread, or attribute mental states such as emotions, perceptions, or beliefs. Pluralistic views of folk psychology hold a richer view about the folk psychological concepts; they include moods, personality traits, dispositions, situations, emotions, social roles or stereotypes, and intentional agency. Interpretation of human behavior permits a rich understanding of others, but it can be difficult. When dealing with humans outside one's cultural group, or animals of other species, we have to observe behaviors in order to start to see patterns before any interpretation is feasible.

When we offer explanations of behavior in terms of folk psychology, we are offering explanations at only one level. There are other levels of explanation that are compatible with folk psychological explanations. Explanations at the computational level focus on the goal of the individual, explanations at the algorithmic level focus on the function that achieves the goal, and explanations at the implementation level focus on the physical organization of matter. The same behavior can be explained in terms of cognitive or neural mechanisms, learning history, or folk psychology, depending on what we want to know.

Worries about anthropomorphism and the use of folk psychology in animal cognition research amount to worries about bias. Anthropomorphism refers to the attribution of human properties to animals with the implication that the attribution is unwarranted. Categorical skeptics think that no attribution of a human folk psychological term is warranted when applied to animals. They offer a variety of reasons for thinking folk psychology has no role to play in science: It consists of unscientific concepts, it presumes sophisticated mental processes where simple ones may exist, and it is inaccurate as a cause even of human behavior. I argued that none of these worries should lead us to reject folk psychological concepts from science, and that some folk psychology concepts (like memory, fear, or hunger) couldn't be rejected even by the most hard-nosed skeptic. We saw that anthropofabulation, a two-step error of first confabulating human abilities and then asking whether animals have those purported abilities, would lead to unscientific thinking, but that it doesn't offer any reason to avoid folk psychology. We also saw that the bias of anthropomorphism—attributing human psychological properties to animals when they lack them—has a kinship with the bias of anthropectomy—denying human psychological properties to animals when they are really there—and that good science should work to avoid both of these biases. To avoid both biases, we need to engage in the practice of science—empiricism.

However, since theory and evidence are interwoven, and we may not be sure about either our theory or our evidence, we need some methods for getting started in our empiricist project. By recognizing that when we describe animal behavior we are already offering a hypothesis, and that there are different levels of possible explanations, we can first decide the level of explanation we are interested in examining. We also need methods for testing and revising a hypothesis. I have offered two different methods.

Using the Sherlock Holmes method, we can formulate folk psychological explanations of an animal's behavior, and then predict what the animal should do in a novel situation, given those beliefs and desires. A successful prediction confirms our attribution, and a failed one causes us to reevaluate it. Using the calibration method, we start with an idea about the nature of some mental property, then we apply that property when observing and studying the animal (or reading about studies and observations of the animal). Given our research, we may tweak our understanding of the property, tweak our commitment to the animal's possession of the property, or both. Using these methods, we have a systematic process for gathering empirical data while respecting the fact that theory and evidence are interconnected.

Further reading

Anthropomorphism

Andrews, Kristin, and Brian Huss. "Anthropomorphism, Anthropectomy, and the Null Hypothesis." *Biology & Philosophy*, *29* (2014): 1–19.

Mikhalevich, Irina. "Experiment and Animal Minds: Why the Choice of the Null Hypothesis Matters." *Philosophy of Science*, *82, 5* (2015): 1059–1069.

Wynn, Clive. "What Are Animals? Why Anthropomorphism Is Still Not a Scientific Approach to Behavior." *Comparative Cognition and Behavior Reviews*, *2* (2007): 125–135.

Folk psychology

Lavelle, Jane Suilin. *The Social Mind: A Philosophical Introduction*. New York: Routledge, 2019.
Marraffa, Massimo. "Theory of Mind" in The Internet Encyclopedia of Philosophy. https://www.iep.utm.edu/theomind/
Spaulding, Shannon. *How We Understand Others: Philosophy and Social Cognition*. New York: Routledge, 2018.

Methodology

Buckner, Cameron. "Understanding Associative and Cognitive Explanations in Comparative Psychology." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 409–419. New York: Routledge, 2017.
Dennett, Daniel. *Brainchildren: Essays on Designing Minds*. Cambridge, MA: MIT Press, 1998.

3 The science of other minds

In *The Descent of Man*, Darwin recounts the following:

> Sir Andrew Smith, a zoologist whose scrupulous accuracy was known to many persons, told me the following story of which he was himself an eye-witness; at the Cape of Good Hope an officer had often plagued a certain baboon, and the animal, seeing him approaching one Sunday for parade, poured water into a hole and hastily made some thick mud, which he skillfully dashed over the officer as he passed by, to the amusement of many bystanders. For long afterwards the baboon rejoiced and triumphed whenever he saw his victim.
>
> (Darwin 1880, 69)

Darwin's story is compelling because we can easily make sense of it. The baboon was tired of being tormented by the officer, so he plotted a muddy revenge. Afterward, the baboon was delighted every time he saw the officer, remembering his success.

It is easy to interpret the story this way, because we would naturally see these sorts of motivations and causes when watching a human act this way. But we have a richer body of information about the causes and motivations of human behavior. We spend lots of time interacting with humans. We can also talk to people in order to gather confirming evidence of our interpretations. In the case of Smith's baboon story, however, we don't have that sort of additional evidence.

In the last chapter, we saw how philosophers confront these sorts of worries about our descriptions and explanations of animal behavior. In this chapter, we will look at empirical approaches to addressing the same issue. We can start with a question: What kind of evidence can help us understand how to interpret stories like Smith's?

To see how difficult it is to answer the question, we can turn to contemporary research in animal cognition. For example, the journal *Current Biology* published a report about a chimpanzee named Santino who lives at the Furuvik Zoo in Sweden. Like Smith's baboon, Santino is known to throw objects, but he targets zoo visitors (Osvath 2009). Rather than making mud pies, Santino likes to throw rocks. What is particularly interesting about this case is that Santino collects the rocks and hides them in different locations near the visitors' area before zoo opens, as though he is preparing the day's ammunition. The report describes Santino's behavior as calm and methodical while he gathers and creates stone projectiles, and agitated or aggressive when he throws the stones. Mathias Osvath, the study's author, claims that Santino's behavior demonstrates foresight and episodic memory. However, both foresight—the ability to plan for the future—and episodic memory—remembering your own past experiences—are capacities that are only controversially attributed to nonhuman species, and sometimes deemed problematically anthropomorphic.

Thus, it isn't surprising that some psychologists were critical of the claim that Santino was planning for the future. In two different papers, psychologists objected to the conclusions of the study by arguing that systematic experimental work would be required before dismissing the possibility that Santino's behavior could be explained in terms of mechanisms that don't require future planning (Shettleworth 2010a; Suddendorf and Corballis 2010). To decide, researchers should compare Santino's behavior in two conditions: When he expects visitors to come and when he doesn't (Suddendorf and Corballis 2010). If Santino is planning, he should only stockpile rocks on the days that he expects visitors. While it might seem very difficult to let Santino know that the zoo would be closed some days but not others, Santino was quite used to Furuvik Zoo's short season—open to the general public only from June through August, and open in May to educational groups. A follow-up study found that when the very first group of visitors arrived in May, Santino picked up pieces of concrete to throw at them, and later, as the visitor season continued, he again began stockpiling rocks and pieces of concrete. Osvath thinks that Santino was not only planning for the future, but also acting to deceive visitors by hiding projectiles in clumps of hay he carried to the edge of the visitors' area (Osvath and Karvonen 2012).

The objecting psychologists were not convinced by this new evidence. As reported by Michael Balter in *Science Now*, Sara Shettleworth wonders: "Did he bring the first hay pile into the arena with the intent of using it to hide projectiles? We cannot know." Shettleworth suggests we conduct tests that involve researchers placing piles of hay into the enclosure in locations not conducive to throwing rocks at visitors, to see if Santino would hide projectiles anyway. And Thomas Suddendorf likewise insists that, "we cannot rule out leaner interpretations [i.e., interpretations that don't involve planning] without experimental study" (Balter 2012).

How are we to adjudicate this debate and determine what evidence is enough evidence, and what kinds of evidence are required to defend different kinds of claims? And what counts as a "leaner interpretation"? What is the role for experimental examination? These questions are at the forefront of many debates about animal cognitive capacities. Questions about episodic memory, planning, and deception that were raised in the Santino studies are among the most controversial in animal cognition research.

The calibration method can be seen as the philosophical method used when answering questions about the nature of mental processes and the distribution of those processes across species. But the calibration method rests on good empirical methods of investigating whether some well-defined process is at use. The focus of this chapter is on the empirical methodologies that have been used to study animal minds. In the study of animal minds, methodological issues themselves become part of the controversy.

3.1 Anecdotal anthropomorphism

Charles Darwin and his contemporaries are often thought to have given birth to the field of animal mind research. Aristotle, however, offered similar insights and methods long before English gentlemen began their inquiries. In *The History of Animals*, Aristotle writes:

> In the great majority of animals there are traces of psychical qualities which are more markedly differentiated in the case of human beings. For just as we pointed out resemblances in the physical organs, so in a number of animals we observe gentleness or fierceness, mildness or cross temper, courage or timidity, fear or confidence, high spirit or low cunning, and, with regard to intelligence, something equivalent to sagacity. Some of these qualities in man, as compared with the corresponding qualities in animals, differ only quantitatively: that is to say, a man has more of this quality, and an animal has more of some other; other qualities in man are represented by analogous qualities: for instance, just as in man we find knowledge, wisdom, and sagacity, so in certain animals there exists some other natural capacity akin to these.
>
> (Aristotle 1984, 921–922)

Darwin takes up Aristotle's commitment to the idea that there are some differences between humans and other animals that are merely differences in degree, as opposed to differences in kind, with the development of his theory of evolution by natural selection. We learned that the emergence of new species happens gradually, over generations, during which time many very subtle changes happen that can lead to large biological differences. Creatures in different places can have different physical needs for flourishing in their respective environments, and over time the differences between two groups build up enough that biologists consider them different species. Given this relationship between organisms, we expect closely related species to share many properties.

Closely related species look similar, they act in similar ways, and so Darwin presumes that they likely have similar psychological properties as well. This line of thinking results in Darwin's Mental Continuity Thesis: There is "no fundamental difference between man and the higher mammals in their mental faculties" (Darwin 1880, 66). Commitment to this thesis leads Darwin and his supporters to interpret animal behavior in the same sorts of ways they would interpret human behavior, and they are not shy about offering explanations of animal behavior in terms of curiosity, imagination, wonder, and misery.

For example, Darwin discusses how dogs may even show a rudimentary sense of religious devotion:

> [The] deep love of a dog for his master … The behavior of a dog when returning to his master after an absence, and, as I may add, of a monkey to his beloved keeper, is widely different from that towards their fellows. In the latter case the transports of joy appear to be somewhat less, and the sense of equality is shewn in every action. Professor Braubach goes so far as to maintain that a dog looks on his master as on a god.
>
> (Darwin 1880, 96)

Despite his commitment to similarities between humans and other animals, Darwin also argues that humans are unique in key ways: "man … is capable of incomparably greater and more rapid improvement than is any other animal … and this is mainly due to his power of speaking and handing down his acquired knowledge" (Darwin 1880, 79). Darwin thinks that language and culture are what distinguish humans from other species, a claim that has been a matter of some debate.

The biologist George Romanes, who was a colleague of Darwin, is often credited with inventing the science of comparative cognition in the 19th century. Following Darwin's commitment to the Mental Continuity Thesis, he developed a method for studying animals that we can term *anecdotal anthropomorphism*. It is anecdotal because the data takes the form of stories about animal behavior, either observed by the author or told to the author, sometimes second- or third-hand. It is anthropomorphic in that the animal behavior illustrated in these anecdotes is explained in terms of human properties.

Darwin's *The Descent of Man* hints at the anecdotal anthropomorphic method. For example, consider his discussion of the sense of beauty. Darwin argues, "the nests of humming-birds, and the playing passages of bowerbirds are tastefully ornamented with gaily-coloured objects; and this shews that they must receive some kind of pleasure from the sight of such things" (Darwin 1880, 92). The reasoning here seems to go like this: Because we would only ornament our homes if we gained pleasure from doing so, the birds must be ornamenting their homes for the same reason. No alternative hypothesis is considered.

Since Darwin, however, we have learned a lot about bower design, and we can now make sense of it without having to rely on introspection about our reasons for interior decoration. Male bowerbirds build bowers that consist of two parallel stick walls with an avenue that spreads out from the structure in a triangular shape. The avenue is constructed with found objects—commonly stones, bones, shells—though some bowerbirds will find and use human artifacts such as bits of plastic, glass, or bottlecaps. The bowerbird places the smaller objects closer to the walls and larger objects further away, so that when the male displays at the end of the avenue to a female standing in the stick walls, he appears bigger (Endler et al. 2010).

Though we don't know whether the bowerbirds receive pleasure from the sight of the nest, we do know that males who build better bowers have more sex. The contemporary research on bowers offers an alternative hypothesis to Darwin's: Female bowerbirds may have evolved to

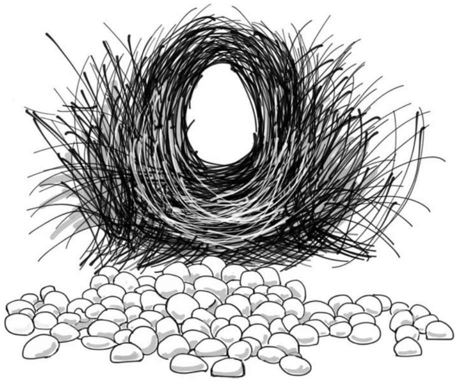

Figure 3.1 The bower of a Great Bowerbird with stones for the avenue.

prefer mates with well-decorated bowers, because they prefer males who look bigger. By moving past the easier-for-us anthropomorphic explanation, we learn more interesting things about the bowerbirds' psychology. The need to successfully reproduce was a problem the male bowerbirds needed to solve, and they solved it by building bowers that created an optical illusion. They may have solved it by a neat trick of considering how their nests appear to females, which would require perspective-taking. However, it is more likely that the bower building behavior emerged over generations, selecting for the disposition to place larger objects further away and smaller objects closer to the structure without understanding how things appear.

For Romanes, an unstructured and indiscriminate set of anecdotes doesn't suffice for science, but the anthropomorphism inherent in the easier-for-us to understand approach remains essential. To raise comparative psychology to the status of a respected science, Romanes uses the science of comparative anatomy as a model. His goal in *Animal Intelligence* is to systematically categorize animals into different levels of intelligence by examining their behavior. There, Romanes articulates the idea behind his anecdotal anthropomorphism method:

> The external indications of mental processes which we observe in animals are trustworthy … so … we are justified in inferring particular mental states from particular bodily actions … It follows that in consistency we must everywhere apply the same criteria. For instance, if we find a dog or a monkey exhibiting marked expressions of affection, sympathy, jealousy, rage, etc., few persons are sceptical enough to doubt that the complete analogy which these expressions afford with those which are manifested by man, sufficiently prove the existence of mental states analogous to those in man of which these expressions are the outward and visible signs.
>
> (Romanes 1912, 8–9)

Romanes' method is not too different from the approach Darwin took to the bowerbirds. There are two steps in any examination of an animal's mind, according to Romanes. First, observe an animal's behavior (or accept someone's anecdote about an animal's behavior). For the second step, use introspection to categorize the behavior and determine what mental state a human engaging in that behavior would have, and then use analogical reasoning to attribute that mental state to the animal.

Romanes identifies a number of problems with this method. He accepts that moving away from collecting anecdotes is required for comparative psychology to become an accepted branch of scientific investigation. But at the same time, Romanes laments that the only method available to him requires that he classifies animal psychology with reference to anecdotes in order to develop general principles of intelligence—his main interest. However, there may be more problems with Romanes' method than he himself saw—and different problems arise at each stage.

3.1.1 Problems with the first step in anecdotal anthropomorphism

One reason Romanes worries about his method is that people sometimes report false anecdotes. The reporter might be untrustworthy, and lie to get attention. Or the person may simply be wrong, or prone to careless thinking. In order to assure that the anecdotes gathered at step one of the method are truthful, Romanes introduces three criteria for accepting an anecdote:

(a) The observer should ideally be a known individual who has some status.
(b) If the observer isn't a person with status, and the claim is of sufficient importance to be entertained, then consider whether there was any considerable opportunity for making a bad observation.
(c) Examine whether there exist independent corroborating observations made by others.

Unfortunately, the scientific methodology of trusting upper-class white men's observations does not remove the worries about the use of anecdotes in science—people with status can be wrong, too! In addition, anecdotes that lack context don't allow for statistical analysis about the frequency of the behavior, and hence make it much more difficult to eliminate alternative explanations for the behavior. They may leave out important details that could be used to offer alternative explanations.

For example, in the early 20th century a Russian trotting horse named Hans amazed crowds with his ability to do mathematical calculations, read German, and recognize musical notes. Hans could respond to a verbal request to add two plus three by tapping his hoof on the ground five times. While the audience was convinced that Clever Hans knew how to add, the early psychologists in Germany were skeptical. Oskar Pfungst investigated Hans' behavior more closely, and found that Hans' owner was inadvertently cuing Hans to start and stop tapping his foot. Hans was clever all right, but not in the way the crowds thought. The horse didn't know how to do math, but he did know how to please his trainer.

A problem with truthful anecdotes is that while they may indeed suggest that an animal acted in an interesting way, they lack information about contexts in which the animal didn't act similarly. When someone tells a story involving a clever animal, we hear about the exciting things without also learning about all the boring things the animal was doing between bouts of “cleverness”; the boring things are just too dull to mention. Humans are biased to notice the unusual and to neglect the uninteresting. But the uninteresting facts are equally valuable when doing science. Thus, there is a selection bias inherent in Romanes’ method because it doesn’t give us means for calculating base rates—the probability that the animal would act in a certain way regardless.

In addition, in many cases reliance on anecdotes results in our neglecting the history of the animal. A clever-looking behavior might be a response to prior training, or some other conditioning earlier in the individual’s life. Taken together, these two worries about truthful anecdotes suggest the following arguments against the first step in anecdotal anthropomorphism:

1 Data that ignores base rates or historical facts doesn’t provide reliable evidence.
2 Anthropomorphic anecdotes about animal behavior tend to ignore base rates and historical facts.
3 Therefore, anthropomorphic anecdotes don’t provide reliable evidence.

While the anecdotal anthropomorphic method has been largely rejected due to these worries, some ethologists and psychologists argue that we can gain valuable evidence of animal behavior from incident reports—anecdotes that don’t ignore base rates or historical facts, and which recognize species-typical behavior. These scientists don’t throw out the baby with the bathwater, they just develop better methods for gathering reports of animals’ natural behaviors (and reject premise (2), that anecdotes ignore base rates and historical facts, in the aforementioned argument). But other psychologists reject any use of anecdotes or incident reports, preferring experimental psychology, which was developed in response to the problems with Romanes’ method. Experimental comparative psychology ideally allows for controllable environmental conditions, knowledge of the individual’s past history, and collections of repeatable behavior that are subject to statistical analysis.

3.1.2 Problems with the second step in anecdotal anthropomorphism

There are two worries about the second step in Romanes’ anecdotal anthropomorphism, which involves categorizing the observed behavior, and using analogical reasoning to determine its psychological cause. First, as we saw, when we categorize an action, we are already interpreting it. Colin Allen and biologist Marc Bekoff draw a distinction between two ways of categorizing animal behavior—we can describe an action *functionally*, in terms of its purpose, or we can describe an action *formally*, in terms of the actual movements of the body (Allen and Bekoff 1997). Allen and Bekoff illustrate this distinction with two different ways of describing a typical dog behavior—the play bow.

Formally, we would describe this posture in purely physical terms, such as the dog’s front end is lowered, and the forepaws are bent and extended, while the hind end, including the tail, is up. A functional description of this behavior would categorize it as a play bow: A signal to other animals that the dog is ready to play. Play bows let other dogs know that the bower is

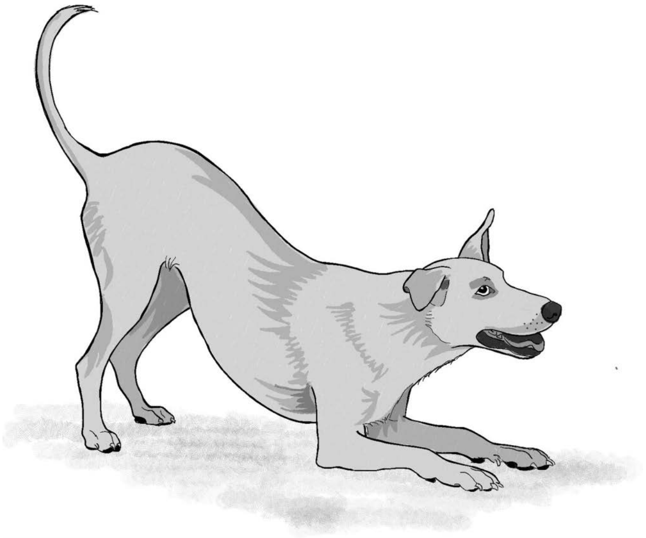

Figure 3.2 A dog's play bow.

not a threat at that time, even if he is also engaged in behavior that can be threatening, such as jaw snapping or head shaking; a play bow modifies the meaning of these other signals. As Allen and Bekoff point out, formal descriptions can miss important aspects of an animal's behavior—describing the dog's posture purely formally will not inform someone naive about dogs that there is no need to be afraid the dog will attack.

However, there are also problems with functional descriptions, insofar as they are subject to over-interpretations due to the same sorts of problems that arose in the Clever Hans case. We may be wrong about the function of the dog's behavior in a way we wouldn't be when describing the dog's bodily movements in purely physical terms. And when we use analogical reasoning from 'why we would act' to 'why an animal would act,' we may be treading on thin ice. If we followed Darwin's reasoning about the bowerbirds building fancy nests for aesthetic pleasure because we build fancy houses for aesthetic pleasure, we might conclude that dogs bow in order to show respect to others, as humans do!

To give a good functional description of a behavior, we need to have a working theory of normal species behavior. Functional descriptions are quite powerful because they allow us to categorize similar behaviors together, even if some element of the formal description is missing (e.g. the dog's tail might not be at full mast, yet the other aspects of his posture and facial expression signal playfulness). Allen and Bekoff argue that the choice between a functional description and a formal one should vary depending on the context, depending on which is more useful, so long as there is also sufficient evidence in favor of the function.

In many cases, functional descriptions will be preferred because of the advantages identified by the ethologist Robert Hinde (1970). For one, behavior described functionally will result in fewer data sets, leading to more robust data analysis. In addition, descriptions in terms of function are more informative than formal ones, given that they include information about the cause of the behavior and/or its consequences. Finally, on a functional description, behavioral changes can be described in terms of environmental changes; for example, a vigilance behavior can be functionally described with reference to the movement of prey into view. This allows us to see the connections between the individual's behavior and other things currently happening in the individual's social and physical surroundings.

While problems arise with categorizing the behaviors, even bigger worries emerge when we turn to Romanes' advice that we should use analogical thinking to uncover the mental state behind the behavior. As we saw in Chapter 1, analogical arguments may be rather weak inductive arguments, depending on how big the reference class is. And as we saw in Chapter 2, the error of anthrpofabulation stems from making mistakes about human cognition and then repeating that mistake in thinking about animal cognition. We saw that introspection about human cognitive capacities is often wrong, and we sometimes confabulate our reasons for action.

In one landmark experiment on human confabulation, the psychologists Richard Nisbett and Timothy Wilson (1977) demonstrate that human subjects attribute to themselves judgments that they clearly never made. Under the impression that they are consumer-subjects in a market survey, subjects are presented with four identical pairs of pantyhose and are asked which one they prefer. The majority of subjects strongly prefer the rightmost pantyhose. When asked to explain their choice, the subjects immediately, confidently, and wrongly declare that their chosen pantyhose are the softest, or have the nicest color. Not one subject notes that the hose they chose were displayed on the right. Instead, they declare that their choice was caused by a psychological state that, because the pantyhose were identical, could not have been the genuine cause of their behavior.

Even when we are right about the causes of our own behavior, there are difficulties with generalizing from our own cognitive capacities to those of other creatures. While Romanes recognizes this, and notes that the warrant for mental attribution is only as strong as the analogy, he also claims that we have no choice:

> Taking it for granted that the external indications of mental processes which we observe in animals are trustworthy, so that we are justified in inferring particular mental states from particular bodily action, it follows that in consistency we must everywhere apply the same criteria. For instance, if we find a dog or a monkey exhibiting marked expressions of affection, sympathy, jealousy, rage, etc., few persons are skeptical enough to doubt that the complete analogy which these expressions afford with those which are manifest by man, sufficiently prove the existence of mental states analogous to those in man of which these expressions are the outward and visible signs. But when we find an ant or a bee apparently exhibiting by its actions these same emotions, few persons are sufficiently non-skeptical not to doubt whether the outward and visible signs are here trustworthy as evidence of analogous or corresponding inward and mental states. The whole organization of such a creature is so different from that of a man that it becomes questionable how far analogy drawn from the activities of the insect is a safe guide to the inferring of mental states—particularly in view of the fact that in many respects, such as in the great preponderance of 'instinct' over 'reason,' the psychology of an insect is demonstrably a widely different

> thing from that of a man. Now it is, of course, perfectly true that the less the resemblance the less is the value of any analogy built upon the resemblance, and therefore that the inference of an ant or a bee feeling sympathy or rage is not so valid as is the similar inference in the case of a dog or a monkey. Still it *is* an inference, and, so far as it goes, a valid one—being, in fact the only inference available. That is to say, if we observe an ant or a bee apparently exhibiting sympathy or rage, we must either conclude that some psychological state resembling that of sympathy or rage is present, or else refuse to think about the subject at all; from the observable facts there is no other inference open.
>
> (Romanes 1912, 8–9)

While I may know how a jealous human acts, I'm not sure how that is going to help me to identify a jealous honeybee that is "apparently exhibiting by its actions these same emotions." It is one thing for someone who knows the species well to interpret the behavior, and another thing altogether for a non-expert to engage in an act of interpretation. For example, the popular portrayal of an open-mouthed bottlenose dolphin suggests a happy and playful creature, ready to help save a sailor or swim with a tourist. The dolphin's open mouth resembles a human smile. But, as anyone who has spent a good deal of time with dolphins knows that treating an open mouth like a smile is a huge mistake; a dolphin's toothy open mouth is an aggressive (or hungry) posture, and when you see it, you should stay away.

The method of anecdotal anthropomorphism as used by Darwin, Romanes, and their contemporaries is flawed not because it relies on folk psychology, but because it amounts to simple interpretation, which is part of our natural, intuitive way of making sense of the behavior around us. However, it lacks any scientific rigor, and it does not include hypothesis testing to support the interpretation. Seeing the bowerbird as decorating his nest to fulfill his desire for beauty, and seeing the dolphin's smile as evidence of a happy emotional state turn out to be bad interpretations. Good interpretation allows us to accurately predict the future, and thinking that the bowerbird is a little artist will lead to false predictions. Science involves more than simple interpretation; it also requires formulating and testing hypotheses about the causes of phenomena and constructing general principles that can be used to predict and explain singular events and general patterns. For this reason, as psychology matured, methodological rigor became more and more important.

3.2 The rise of animal psychology as a science: Morgan's Canon

In order to avoid some of the problems associated with Romanes' comparative psychology, other scientists began developing principles for studying animal minds that avoid the problems associated with anecdotal anthropomorphism. The British biologist and psychologist C. Lloyd Morgan, who is often credited with the rise of contemporary animal cognition methods, points out that animal behaviors that are interesting to us could be caused in various ways. Morgan is interested in what cognitive psychologists today refer to as *mechanisms*.

Consider Morgan's example of Tony, the fox-terrier pup who knew how to escape from the garden into the road. Tony would first snuggle his head under the latch of the gate, then lift the latch, and wait for the gate to swing open. A natural explanation of this behavior, Morgan suggests, is that Tony had a goal and knew how to achieve that goal; in other words, he had a practical reasoning ability. But Morgan points out that there are various ways to interpret this explanation. Perhaps Tony was responding to the properties of the particular situation directly, and saw the latch as liftable without analyzing the structure of the gate or the consequences of lifting the latch. However, Tony might have been using general reasoning principles when opening the gate; if this is the case, he simply applied his general knowledge to this particular situation. It is only the latter interpretation that Morgan categorizes as rational. For Morgan, rational thought is conceptual thought that permits analysis via general principles.

Morgan argues that Tony's behavior ought not to be interpreted as rational, given his famous canon: "in no case is an animal activity to be interpreted in terms of higher psychological processes, if it can be fairly interpreted in terms of processes which stand lower in the scale of psychological evolution and development" (Morgan 1903, 292). Morgan's Canon is an epistemic principle that advises us to explain a behavior in terms of the lowest cognitive capacity possible. Morgan thinks that reasoning in terms of sense experience is a lower process, and that reasoning conceptually in terms of general principles is a higher psychological process. In developing the Canon, Morgan writes, "the principle I adopt is to assume that the [animal's] inferences are perceptual, unless there seem to be well-observed facts which necessitate the analysis of this phenomena … and therefore the employment of reason" (Morgan 1891, 362–363). While there is ample evidence that many species reason, there is no justification for concluding that Tony reasoned rationally, rather than explaining the behavior in terms of sense experience. Morgan argues that the dog could have learned to open the gate without recourse to general principles, and hence we are not justified in concluding that Tony used rational thought in this instance.

Given Morgan's focus on the evolution of mind, he thinks that we need to consider animal minds as well as human minds when doing psychology. He writes in his autobiography:

> [T]hroughout the whole investigation, from first to last, my central interest has been psychological as I understand the meaning of this word. My aim has been to get at the mind of the chick or the dog or another, and to frame generalizations with regard to mental evolution.
>
> (Morgan 1930, 249)

Chicks, dogs, and humans are all minded creatures in Morgan's view, and we wouldn't be doing chick, dog, and human psychology if we didn't think so. Thus, it is unlikely that Morgan intended his Canon to defend nonmentalistic explanations of animal behavior.

Along with his acceptance that there is such a thing as animal psychology and animal minds, it may be surprising to some that Morgan also, reluctantly, accepts the need for anecdotes. What he rejects are the overly romantic interpretations given to anecdotes, and the unsystematic way in which they had been collected in Romanes' work. Morgan also advocates for the attribution of human mental activities to animals using the method of interpretation via introspection. What he cautions us against, however, is automatically thinking that behaviors that appear to be clever, *whether human or animal behaviors*, are really so. In his autobiography, Morgan wrote: "To interpret animal behavior one must learn also to see one's own mentality at levels of development much lower than one's top-level of reflective selfconsciousness. It is not easy, and savors somewhat of paradox" (Morgan 1930, 250). We can call this Morgan's Challenge, because he recognizes how difficult it is for us to follow his advice not to over-intellectualize human cognition. The upshot is that the Canon applies to humans as well as to other species; it does not force a divide between human beings and other animals. And, since Morgan accepts the existence of animal minds, he thinks the lowest explanation that is possible for interesting animal behavior would be an explanation in terms of sensory modalities. Such an explanation, however, still requires interpretation.

Morgan accepts that interpretation must play an essential role in any science of animal minds. This is because the observation of behavior only offers what Morgan calls the "body-story" and never the "mind-story." "Mind-story is always 'imputed' [interpreted] insofar as one can put oneself in the place of another. And this 'imputation,' as I now call it, must always be hazardous" (Morgan 1930, 249). It is this hazard that led Morgan to develop his Canon, yet it is also what led him to see introspection as a necessary part of a science of animal cognition. For Morgan, introspection is the necessary step that permits inference from behavior to mind, and if we want a science of animal minds, introspection must be used.

Morgan's appeal to introspection is the foundation of his belief that others have minds; I do something, I introspect what I think and how I feel, and then I interpret those mental events as the cause of that behavior. The idea that introspection permits us to discover the cause of behavior, is, as we have already seen, a flawed methodology. Nonetheless, introspection was the predominant method of psychology in Europe during Morgan's time, given the influence of Wilhelm Wundt, who is considered the father of experimental psychology.

Despite the contemporary rejection of Morgan's use of introspection as a justified methodology, Morgan's Canon is still taught to today's students of comparative psychology. However, there has been philosophical criticism of its use in comparative psychology. One worry is that Morgan's Canon does not offer any actual advice to scientists, because we don't have a way of interpreting "higher" and "lower" (see, e.g., Sober 1998, 2005; de Waal 1999; Allen-Hermanson 2005; Fitzpatrick 2008, 2009). If we interpret higher as cognitive and lower as associative, we may be mixing two different levels of explanation.

Given such worries, there has been a move toward doing away with Morgan's Canon. Sober suggests substituting Morgan's Canon for empiricism (Sober 2005). Simon Fitzpatrick suggests that we replace it with a principle he calls *evidentialism*:

> in no case should we endorse an explanation of animal behaviour in terms of cognitive process X on the basis of the available evidence if that evidence gives us no reason to prefer it to an alternative explanation in terms of a different cognitive process Y—whether this be lower *or* higher on the 'psychical scale'.
>
> (Fitzpatrick 2008, 242)

Both Sober and Fitzpatrick are calling for scientists to stop worrying about some special problem in studying animal minds, and do science. That is, we should adopt an inference to the best explanation method in the study of animal minds, and remain silent on the correct explanations until we have enough evidence to warrant such an explanation.

3.3 Learning principles: associations and insight

Around the time Morgan was developing his Canon, other experimental psychologists in the United States and Russia were interested in uncovering principles of learning. In 1896, Morgan traveled to the US to give the Lowell Lectures at Harvard. In the audience was a graduate student named Edward Thorndike (1874–1949), who, in his famous research published 15 years later, adopted Morgan's experimental method, but rejected its appeal to introspection. Thorndike worries that introspection is unscientific; because only the person doing the introspection can access the contents of her mind, the information is not publicly available. Due to this lack of observability, he thinks that we cannot test for the reliability or validity of introspection. Behavior, however, can be observed and quantified by numerous observers, so Thorndike retains the behavioral experiment as the method of animal psychology research.

Experiments may be seen as superior to anecdotes, no matter how carefully anecdotes are collected and analyzed, because experiments offer repeatable conditions, a controlled environment, the ability to test a number of individuals, and the opportunity to use statistical analysis to determine typical responses. Thorndike's embrace of the experimental method had him putting animals into situations that he thought to be particularly compelling; most famously, he put hungry cats in puzzle boxes. Thorndike found that even after a successful escape, cats weren't able to immediately escape after being placed back in the box; they had to rediscover the solution. Over many instances of escape, cats gradually decreased the time it took. From this, Thorndike concludes that cat learning is based on trial and error, rather than insight. While it takes several successful escapes for them to learn how to get out of the box, once they've learned how to escape the box, they can use that knowledge to generalize to another, similar box.

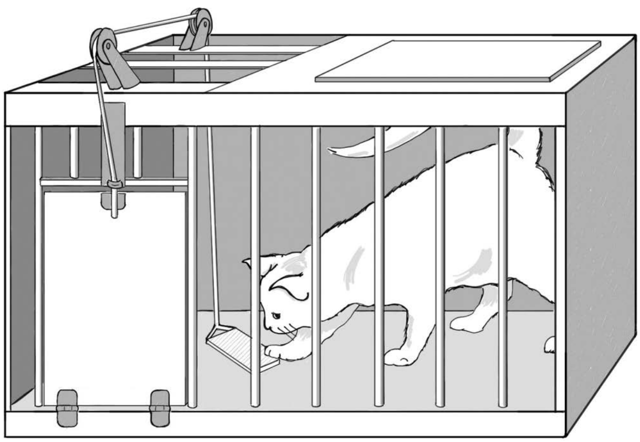

Figure 3.3 A cat in one of Thorndike's puzzle boxes.

Thorndike thinks that we can use experiments to understand what humans and nonhumans do, how they do it, and what they feel while they are doing it. Based on his research on humans and other animals, Thorndike develops the following three laws of learning:

Law of effect: The association between a stimulus and a response is stronger when the response is associated with satisfaction, and weaker when the response is associated with annoyance.

Law of readiness: Satisfaction is the fulfillment of acts an individual is ready to perform, and annoyance is the inability to fulfill an act one is ready to perform, or when forced to perform an act one is not ready to perform.

Law of exercise: The associations between a stimulus and a response are strengthened as they are used, and they are weakened as they are not used.

Thorndike's laws are early examples of principles of *associative learning*. Today, associative learning is defined by comparative psychologists as "learning resulting from the procedures involving contingencies among events," or to put things into more cognitive terms, "the formation of some sort of mental connection between representations of two stimuli" (Shettleworth 2010b, 105). For Thorndike, associative learning involves forming connections between sensory input and behavioral output, and according to his laws, pleasant associations are stronger than unpleasant ones. From his research on humans, Thorndike found that rewards are more effective than punishment, and rewards work best when they are given just after the desired behavior is exhibited. Furthermore, he found that the frequency of the association, while important, is less important than the effect. As he points out, when we first learn to ride a bicycle, we fall off much more frequently than we stay on!

But it is the Russian physiologist Ivan Pavlov (1849–1936) who is usually credited with discovering that animals can form associations; the development of what is now called *classical conditioning* arose directly from his work (as discussed in Chapter 1). While Pavlov was studying the physiology of the gastric system in dogs in the 1890s, he noticed that just before bringing the dogs their food, they would begin to salivate. (Salivation was one variable he was measuring in his study of gastric function, and the dogs had been surgically altered so that their saliva would drip into a tube at the side of their mouths.) Pavlov began to experiment, training dogs by using a conditioned stimulus—such as a light or a bell—just before delivering their food. The dogs initially salivated with the delivery of the food, but over time the conditioned stimulus was enough for them to start to drool. This conditioned response arises as a dog learns to associate a light or bell (the "conditioned stimulus") with food (the "unconditioned stimulus"), which leads to the drooling. In contrast, the "unconditioned response" is the dog's innate tendency to drool at the sight of food.

Classical, or Pavlovian, conditioning (also known as stimulus learning) is a form of associative learning that allows individuals to make predictions about future events. If you have associated event A with event B, then you can predict that event B will occur after experiencing event A. We know that humans are so seized by these sorts of associations that they can be formed even when the subject is unaware of the stimulus (Raio et al. 2012).

A cognitive psychologist is interested in associative learning as a window into the processes of the animal's mind. They ask not just in "under what conditions do animals learn?", but also in "how do they learn?". A cognitivist explanation of how associative learning works has been given in terms of changing strengths of associations between mental representations (Shettleworth 2010b).

In contract, a behaviorist psychologist is interested in classical conditioning not as a means to get at cognition, but rather as a way of studying behavior in order to predict and control what an individual does. For the behaviorists, appeal to introspection as well as any mention of mental entities should be avoided. Any use of a term that is mentalistic (such as thirst, hunger, fear, or desire) has to be operationally defined in terms of measurable, observable qualities (such as time since last having eaten).

Given the hold behaviorism came to have on North American psychology in the 20th century, much of the research associated with Morgan, Thorndike, and Pavlov came to be seen through a behaviorist lens. Psychological behaviorism is the scientific methodology introduced by John B. Watson (1878–1958) and popularized by B.F. Skinner (1904–1990). Watson's goal, like Morgan's, was to make psychology a respectable science, famously stating that, "Psychology as the behaviorist views it is a purely objective experimental branch of natural science" (Watson 1913, 158). On Watson's view, psychology is not only supposed to be concerned with replicable and objective experiments, but the content of psychology should also be limited to observable effects, and so introspective reports, consciousness, as well as postulated entities (like mental representations) and mechanisms (like strengthening the association between mental representations) are excluded from the conversation. Folk psychology is not part of the behaviorist toolbox.

The behaviorist methodology starts with observations of behavior. The behavior, and the environment in which the behavior occurs, is then described using nonmentalistic language and interpreted as little as possible. The psychologist then has to note which aspects of behavior, such as the frequency or duration of behavior, correlate with certain aspects of the environment. That is, the psychologist has to postulate an association between the behavior and the environment. After developing the hypothesis, the psychologist can change one of the environmental variables in order to determine whether or not the behavior remains. Once the psychologist discovers which feature of the environment is necessary for the behavior, we can speak of the behavior as a function of the environment, and the association is confirmed.

Thus, for the behaviorists, behavior is a function of the environmental stimulus alone. All behavior can be explained and is entirely shaped by the punishments and rewards of the environment, and behavior can be studied in a lab where it is easier to control the environmental stimuli. The science of behaviorism can be conducted with any kind of organism, since there are no intrinsic properties of the organism that interact with the stimulus to help produce the behavior. Skinner famously said, "Give me a child and I'll shape him into anything," reflecting the behaviorist's focus on environment and complete lack of interest in anything like innate traits. This focus is also reflected in the behaviorists' choice of research subjects. Though interested primarily in human behavior (especially for Skinner, whose utopian goals led him to describe the ideal human community in his novel *Walden Two*), the behaviorists used rats and pigeons as model organisms, since they were easy to work with in a laboratory setting.

Since talk of unobservable mental phenomena is outside of the behaviorist framework, Skinner modified Thorndike's law of effect. Since Thorndike thinks that an association is made more easily when there is satisfaction rather than annoyance, the law of effect can't easily be embraced by a behaviorist. Skinner rejects the reference to satisfaction or annoyance, even as described in the law of readiness, since they are both unobservable mental states that are part of human folk psychology. Instead of talking about mental states, Skinner restates Thorndike's law of effect in behaviorist terms. Skinner defines another type of conditioning, called *operant conditioning* or *instrumental learning*, according to which a behavior that is followed by a reinforcer becomes more frequent, while a behavior that is followed by a punishment becomes less frequent. By removing the mentalistic tinge in talk of satisfaction and annoyance, Skinner rehabilitates Thorndike's findings for the behaviorist age.

For the behaviorist, some variety of associative learning can account for all learned behavior. Because the behaviorist appeals only to associative learning in order to explain behavior, it might seem as though associative learning is a simple way for an organism to learn. This appears to be the reasoning employed when Morgan's Canon is filtered through the lens of behaviorism; it is associative learning that becomes the "lower," and hence simpler, mechanism. While Morgan himself never appeared to make that claim, today psychologists commonly read the Canon in this way: "In contemporary practice 'lower' usually means associative learning, that is, classical and instrumental conditioning or untrained species-specific responses. 'Higher' is reasoning, planning, insight, in short any cognitive process other than associative learning" (Shettleworth 2010b, 17–18). The upshot is that even for the cognitivists, the learning mechanisms that permit classical and instrumental conditioning, along with other associative processes, are largely taken to be cognitively unsophisticated. And the "higher" learning mechanisms are not seen as fundamentally involving associative learning of any sort. Is this view warranted?

As psychologists started regaining interest in cognitive mechanisms in the latter part of the 20th century, associative learning came to be seen as a cognitive process requiring a role for representations of the stimulus and the outcome. For example, in one condition, after being taught an association, the value of the outcome is lowered, at which point the subject is less likely to engage in the response when confronted with the stimulus (Adams and Dickinson 1981). Thinking cognitively, this finding makes sense; if you know that pressing a lever will give you chocolate ice cream, and you just recently developed an aversion to chocolate ice cream, your knowledge about the association between pressing the lever and receiving the treat will cause you to avoid pressing the lever, no matter how many times you pressed the lever before developing the aversion. These findings suggest that associative learning is part of cognitive processing.

Other research on associations points to their complexity. While the initial models reflected Pavlov's discovery of one stimulus per response, subsequent research demonstrated that the stimulus may consist of several parts, and may be the absence of, or the presence of, some entity or event. Take one example, called occasion setting stimuli, which demonstrates the relationships between stimuli leading to an outcome. When a rat is trained that a tone indicates the delivery of food only when accompanied by a light stimulus, the light is called a positive occasion setter (Holland 1992). If, however, a rat is trained that the tone doesn't indicate the delivery of food only when accompanied by a light stimulus, the light is called a negative occasion setter. In the first case, the light and the tone are necessary conditions for the delivery of food, and are jointly sufficient. In the second case, the light is sufficient for the non-delivery of food, and the tone is necessary for food delivery. The introduction of relatively small degrees of complexity into the association relationship points to the possibility that organisms are capable of much more complex, compound associations. Associative learning is not quite so simple as sometimes thought.

The question about the relationship between the so-called higher cognitive capacities, such as insight and reasoning, and associative learning is a complex one. Psychologists often describe insight as an "aha!" moment in reasoning; perhaps it most accurately refers to some inference that isn't made at the personal, conscious, level. The earliest theoretical analysis of insight was given by the psychologist Donald Hebb (1904–1985), who inspired work on artificial neural networks through the development of Hebb's law: "Neurons that fire together wire together." Hebb, thinking that insight is at the core of intelligence, described it as involved in solving tasks that are neither so easy that they are automatically performed, nor so difficult that they can only be performed after lengthy, rote learning. When working through such a task, an individual will often turn from some fruitless effort in one direction to work in a very different direction, and this switch is what Hebb describes as insight. We can understand this change in type of effort as caused by a restructuring of thought or a conceptual change. In other words, insight is the product of the weakening of an association in response to its failure to address the problem at hand, and the strengthening of another association. Hebb himself was an associationist, and he thought that some complex association between the situation and the organization of behavioral structures fundamentally accounted for the phenomenon of insight (Hebb 1949).

In contrast, Gestalt psychologists understood insight simply as looking at a situation in a new way. The German scientist Wolfgang Köhler (1887–1967) took this approach in his research on insight reasoning in chimpanzees. He conducted experiments that required chimpanzees to solve a problem using a creative solution. In the most famous condition, chimpanzees were allowed into an enclosure and saw a bunch of bananas hanging overhead, but out of reach, and three boxes scattered around on the floor. The solution to this problem, which the chimpanzees were able to solve, was to stack the boxes on top of one another beneath the bananas. Köhler claimed that the chimpanzees could not have used associative learning to solve this problem because, according to the theory of the day, an associative solution to a problem derives from either previous experience in the same situation, or trial and error behavior in a new one, neither of which described the chimpanzees' behavior in these studies (Köhler 1925).

But Hebb suggests that Köhler's chimpanzees could have been using both associative learning and insight, given findings about devaluation of the outcome and the complexity of the stimuli in associative learning, which point to the complexity of some associative learning. Further, performance on transfer tests demonstrates that learning in one situation can be transferred to a novel situation, while being accounted for in terms of cognitive associations (Rescorla 1992).

While a full discussion of the current debates about the nature of associative learning isn't possible here, the apparent variety and complexity of associations undermine claims that associative learning is always simpler than reasoning, planning, or insight. Rather, these so-called higher cognitive mechanisms may be fancy versions of associative learning. As Morgan reminded us, the mere fact that we introspect fancy mechanisms for our own behavior doesn't mean

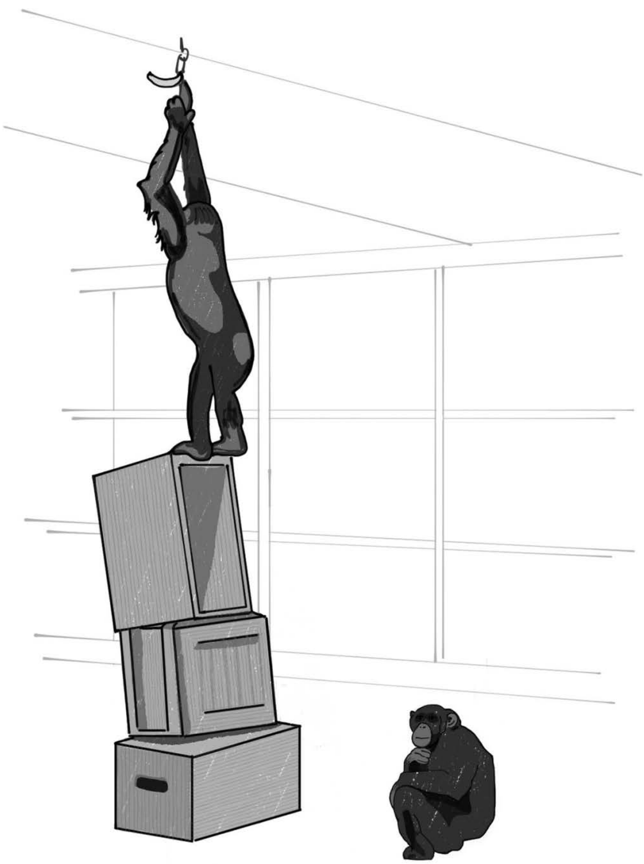

Figure 3.4 A chimpanzee stacks boxes to access out of reach bananas.

that there are fancy mechanisms at work. We should also be wary of any explanation of animal behavior, be they explanations in terms of 'simple' associative learning or insight, without a robust understanding of what we mean by the explanation. The worry is that sometimes an account does nothing more than gesture toward the existence of an explanation, rather than provide one.

Today, experimental research in animal cognition is still typically found in psychology departments, but scientists are interested in studying learning and representational capacities in a much wider range of subjects. At the annual Comparative Cognition Conference meeting in 2019, I heard scientists present their research on dogs, portia spiders, jays, hummingbirds, zebra fish, elephants, dolphins, cephalopods, garden slugs, monkeys, and apes, among other species. The research also examined a wide range of abilities, including susceptibility to visual illusions, willingness to gamble, episodic memory, song learning, prosocial helping, numerical cognition, physical reasoning, social reasoning, animacy detection, and much, much more. Today, the psychology of animal cognition is a vibrant science, and grounds much of what we know, and are learning, about what animals can do.

3.4 The rise of ethology

While behavioral psychologists were focusing on uncovering learning principles via experiments on captive pigeons and rats, in Western Europe, ethologists were learning about animal minds by traipsing through fields, forests, and dunes, raising animals on research stations, and frequenting zoological parks in order to observe the behavior of a wider range of species in more natural settings than the behaviorists' wire and glass cages. Unlike the behaviorists, who took pigeons and rats and humans to be basically interchangeable, the ethologists emphasized species differences, noting that each species evolved in response to particular environments and ecological pressures. In the 19th century, biology consisted mostly of collecting and studying specimens—dead animals that could be kept under glass in display cabinets. The ethologists recognized that there is much more we can learn from living animals, and by observing animals from birth to death as they go about their normal behavior in their natural environments. Though critics worried that ethology would be a return to the subjectivism of the anecdotal method, the ethologists proved to be just as concerned with careful observation and experimentation as the behaviorists, despite the added complexity of studying behavior in a natural setting.

Classical ethology—the biological study of behavior—arose from the "tierpsychologie"—animal psychology—practiced at the turn of the last century in Germany and Austria. This new method was introduced by the zoologist Oskar Heinroth (1871–1945), and developed by his student Konrad Lorenz (1903–1989), Karl von Frisch (1886–1982), and their Dutch collaborator Nikolaas Tinbergen (1907–1988).

Heinroth studied ducks and geese, and observed that hatchlings learn though *imprinting*—a learning mechanism that creates an association after only one exposure. For example, geese will imprint on their mother after hatching, which allows them to follow her rather than other

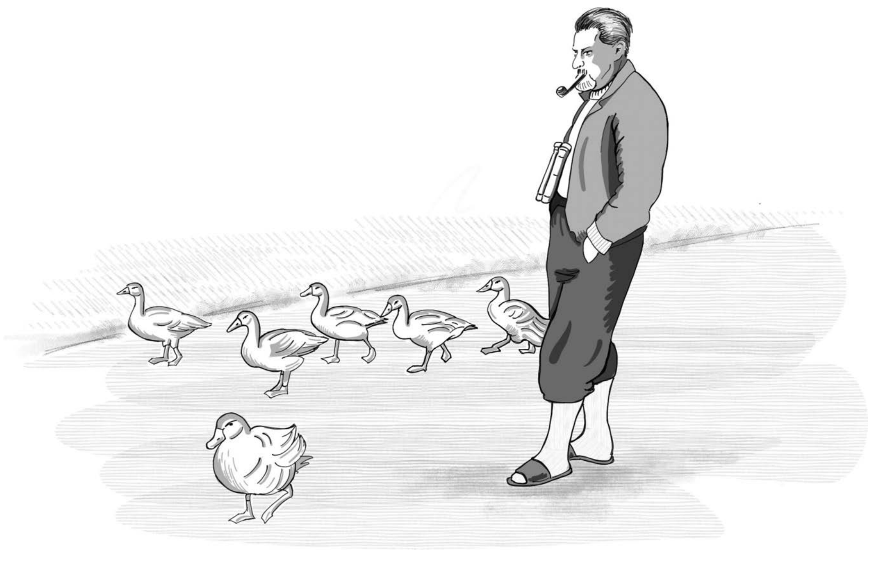

Figure 3.5 Lorenz with his geese following him.

adult geese. Lorenz continued Heinroth's work by handrearing birds such as jackdaws, geese, and ducks at his home/private research station. Because Lorenz was the first individual his hatchlings saw, the chicks imprinted on Lorenz rather than their mother. Famously, Lorenz walked through the countryside with a gaggle of goslings following behind him.

Tinbergen did much to develop the methodology of classical ethology, which he colorfully described as the process of interviewing an animal in its own language. Von Frith is best known for his identification of the honey bee waggle dance. The classical ethologists were interested in species-specific behavior, and in the interaction between biological inheritance and environmental influences.

Lorenz, along with Tinbergen, was interested in the cause of these sorts of behaviors, the purposes of the behaviors, how they developed, and how they were implemented in the physical organism. So, while the ethologists had great interest in species-specific traits, they never ignored the role of environment or the importance of learning in the development of animal behaviors. The ethologists' focus on biology and environment is perfectly illustrated by Tinbergen's famous four questions about animal behavior (Tinbergen 1963):

- i Mechanism: What are the stimuli that cause the behavior?
- ii Ontogeny: How does the behavior develop with age, and are any early experiences necessary for the development of that behavior?
- iii Adaptive value: What is the reproductive and survival function of the behavior?
- iv Phylogeny: How might the behavior have evolved, and what other species share this behavior?

These questions were understood as ingredients for a full understanding of the biology of animal behavior, and as closely related.

Tinbergen realized that most of the work in ethology was focused on uncovering the causal factors of instinctive behaviors and, as he wrote, he was hesitant to cover the topics of ontogeny, function, and evolution. The classical ethologists excelled in the identification of what they called innate behaviors—behaviors that are of particular use to the species, and which arise given an environmental trigger without any need for learning (but, as we will see, which can be honed with practice). For example, when Lorenz and Tinbergen met at Lorenz's home/private research station in Altenberg in lower Austria, they considered the interesting egg-rolling behavior of greylag geese (discussed in Chapter 1). The nesting goose just can't help but retrieve an eggish-object outside of her nest, leading her to engage in a fixed action pattern—a complex behavioral sequence that is indivisible and runs to completion whenever triggered by some external sensory stimulus. Though the term "fixed action pattern" has been largely abandoned, it points to a category of behavior that is associated with species-specific, and largely unlearned, behavior. For example, a squirrel raised in a cage on a liquid diet, will, on first encounter with a nut, hold it properly and try to bite into it. The squirrel has never observed the behavior, so could not have learned it, but there is something about the biology of the squirrel and the trigger of the nut (which ethologists call a releasing stimulus) that leads to the food-processing behavior. However, this squirrel is not very good at opening nuts at first; only after time, after experience with nut-cracking, does the squirrel develop competence in the behavior (Eibl-Eibesfeldt 1975).

In order to determine what in the outside world triggers a particular behavior, ethologists conduct exquisite experiments to determine the causes of behavior. For example, herring gull nestlings will peck at their mother's beak and then gape their mouths open while the mother regurgitates food for the chicks. Tinbergen and Perdeck (1950) used models in order to understand the cause of the chicks' pecking behavior. They wanted to know in more detail the stimulus that causes the chicks to peck, so they made a model of an adult herring gull's head and presented it to the chicks. They found that by changing the color of the red spot on the adult's beak, they could make the chicks peck less frequently.

In another classic experiment in ethology, Karl von Frisch (in the work that won him the Nobel Prize in Physiology in 1973, shared with Lorenz and Tinbergen) discovered that honeybees dance to indicate the location of nectar. To decode the bees' waggle dances, Von Frisch would lead a bee to food, allow it to return to the nest, and then turn the nest 180 degrees, or move the food to another place, or modify the desirability of the food—and then he would observe where the bees would fly when they next left the nest. This manipulation allowed him to conclude that the bees were using the signals of the dancing bee to orient themselves, rather than the actual location of the nectar.

While much of the famous work of ethologists focused on providing answers to Tinbergen's first question by examining the external stimuli that cause behavior, Tinbergen also wanted to know about the physiological mechanisms that lead to species-specific behaviors, and the causal factors associated with the mechanisms. He thought that the answers could be given in terms of hormones or some internal sensory stimuli. Today, the field of neuroethology—the study of the evolution of the nervous system across species—has the tools to experimentally examine the questions of mechanism in field settings. The biologist Robert Sapolsky, for example, studies the anxiety levels of baboons in Kenya as related to social status by examining their behavior and taking cortisol measures from feces samples. Another scientist working in neuroethology, John Wingfield, studies bird migrations by collecting endocrine samples and using hormone implants to uncover the mechanisms associated with migration and other seasonal bird behavior.

Tinbergen's second question—how does the behavior develop with age, and what early experiences are necessary for its development?—has been of central concern to biologists who take an evolutionary developmental (or evo-devo) approach, and emphasize the joint importance of evolution and early environmental experiences. With the recognition that Mendelian genetics is the essential mechanism of biological evolution, scientists began to examine the genetic similarities and differences between organisms, and found that humans share an overwhelming proportion of genetic material with other animals—we share 98.7% of our DNA with chimpanzees, and about 47% with fruit flies. The evo-devo approach is meant to explain how huge differences in species emerge despite great similarities in genetic material, and they are investigating the role of extra-genetic influences, from epigenetics to environmental effects, on how genes are expressed in organisms. As well, the timing of such influences can be very important in development; the stage at which things happen in the life of the organism has large impacts downstream and can lead to the great differences we see between closely related species.

Tinbergen's third and fourth questions, about the evolution of the behavior and its reproductive and survival benefits, were also taken up by classical ethologists. Ethologists interested in looking at the adaptive value of a behavior want to know, in addition, how a behavior aids in the ultimate goal. For example, after gull eggs hatch, the mother disposes of the eggshells from the nest. Why does she do this? Through experimentation, Tinbergen found that the eggshells attract the attention of predators, who quickly eat the newborn fledglings. Thus, there is a certain adaptive value in disposing of the eggshells—it keeps your kids from being eaten.

The interest in the evolution of behavior is alive and well today, with many scientists and philosophers interested in questions about the evolution of various aspects of cognition, including culture and cultural innovations, the evolution of teaching, and, as will be discussed in the next section, the evolution of self-control.

3.5 New directions in animal cognition research

With technological advancements in the sciences, new ways of studying animal behavior have become available. While animal subjects still run mazes and push levers, they are also given computer-generated tests of memory and learning, as well as tests of other aspects of cognition such as individual recognition, uncertainty monitoring, and understanding of number. For example, in one study, chimpanzees and humans play video games, and in some cases, the chimpanzee performance is better than the human performance—Ayumu, a young chimpanzee who learned how to use a joystick by watching his mother, is better able to remember the location of a sequence of numbers than Japanese college students (Inoue and Matsuzawa 2007).[1]

Scientists use neuroimaging techniques to study animal brains, and use this research to uncover the processes behind the behaviors we can more directly observe. They can also use these techniques to discover similarities and differences between human and nonhuman cognitive processes. For example, by using fMRIs to scan dog and human brains as they listened to a variety of dog vocalizations and human words, scientists found that both species share functionally analogous voice-sensitive regions in the cortex, and respond similarly to differences in emotional valence of the vocalizations (Andics et al. 2014). Imaging studies with monkeys are used to help us better understand human vision, and as we will see in the next chapter, neuroscientists rely on monkeys in their search to uncover the neural substrates of conscious experience.

In addition, some scientists use mathematical models to uncover the mechanisms involved in complex animal behaviors. For example, schooling fish appear to engage in group-decision making by considering both individual, personal information and shared, group information, as evidenced by the behavior of other individuals. In order to examine the role played by individual and collective information, along with other factors, scientists have examined whether models can predict the observed behaviors (Miller et al. 2013). When they do, the models illuminate the mechanisms that might be at work.

A recent development in animal cognition research is the creation of large collaborations of scientists across disciplines, and across species, studying the same phenomenon. The goal is to uncover the evolutionary history of cognition more generally by combining the methods of comparative psychology and evolutionary biology. For example, a consortium of researchers has investigated the evolution of self-control by giving the same tasks to various taxa: Primates, rodents, carnivores, elephants, and birds (MacLean et al. 2014). Self-control in humans varies across individuals. In the 1970s, a landmark study on four- to six-year-old children examined their ability to refrain from eating a treat such as a marshmallow. The children were told that they could eat the treat now, or wait 15 minutes and receive two treats. While a few of the children immediately gobbled up the treat, the majority of subjects initially waited. In many cases the children tried to distract themselves by covering their eyes or turning their head and singing a song. About a third of the children were able to wait the full 15 minutes to receive the second treat, and age was a significant predictor, with the older children waiting longer (Mischel and Ebbesen 1970; Mischel et al. 1972).

While the ability to practice self-control has been studied in a number of species, the methods and designs of these studies varied across labs and species. In order to try to make general claims about the evolution of self-control, the same two tasks were given to 36 different species. The researchers found that the ability for self-control as measured by these tasks correlated with absolute brain volume, as well as dietary breadth, but doesn't correlate with group size (MacLean et al. 2014).

These sorts of large-scale consortiums are recent developments in comparative cognition, and the benefits and potential problems associated with them are not unlike the benefits and problems with cross-cultural research on human cognition. The move away from using only WEIRD (Western, Educated, Industrialized, Rich, and Democratic) subjects when doing human psychology is motivated by a desire to find out what may be universal in human cognition (Henrich et al. 2010). However, one might worry whether the same experiment can really be given across human cultures—do gambling tasks mean the same thing to people from capitalistic societies and to people from collectivist societies, for example? Similarly, do tasks given to birds and elephants appear the same to each? The different size of the subjects, the different perceptual acuity, and other species-specific properties might make it difficult to determine whether the subjects are indeed engaged in the same task.

3.6 Chapter summary and conclusions

The science of animal minds is perhaps more appropriately called *the sciences* of animal minds, given how many different disciplines are involved in investigating the cognitive capacities of animals. Early methods for studying animal minds used by Charles Darwin and George Romanes relied on the unsystematic collection of anecdotes. This anecdotal anthropomorphism method was soon challenged by scientists, especially after the Clever Hans incident. In order to avoid some of the problems with anecdotal anthropomorphism, C. Lloyd Morgan introduced what came to be known as Morgan's Canon, a prohibition on interpreting animal behavior in terms of higher cognitive processes if it can be interpreted in terms of lower cognitive processes. However, there is some question whether this principle can be consistently applied.

While Morgan was developing his Canon in England, American and Russian psychologists were starting to build the field of learning theory. Edward Thorndike began experimenting on animal behavior, most famously showing that a cat can learn to escape a puzzle box more quickly after experience. Ivan Pavlov's work demonstrated that animals can form associations through classical conditioning. John Watson and B.F. Skinner continued to experiment with animals and developed instrumental learning methods. The behaviorist interpretation of these learning methods left no room for talk of mental representations, emotions, or cognition. But soon scientists found that animals were able to behave in ways that required appeal to mental representations, and animal cognition research came to ask questions about animal concepts again. Today's comparative cognition research has moved beyond the rats and pigeons—the behaviorists' favorite animal models—and includes experimental studies on a range of species, from spiders and fish, to cats and dogs.

In 20th-century Europe, ethology was the primary science of animal minds, focusing on the biological study of behavior. Konrad Lorenz, Karl von Frisch, and Nikolaas Tinbergen won the Nobel Prize in Physiology in 1973 for their research showing that honeybees will dance to indicate the location of nectar. Only long-term careful field observations permitted this discovery. Tinbergen's four questions about animal behavior helped to shape the science of ethology.

As the study of animal minds continues to change along with new technologies and large-scale interdisciplinary collaborations, we can expect to learn more about what animals can do and how they do it.

Note

1 For very interesting videos of Ayumu's performance on this task, you can visit the Chimpanzee Ai web page.

Further reading

Learning theory

Allen, Colin. "Associative Learning." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews & Jacob Beck, 401–408. New York: Routledge, 2017.

Dacey, Michael. "A New View of Association and Associative Models." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews & Jacob Beck, 419–426. New York: Routledge, 2017.

Morgan's Canon

Buckner, Cameron. "Morgan's Canon, meet Hume's Dictum: avoiding anthropofabulation in cross-species comparisons." *Biology & Philosophy*, *28, 5* (2013): 853–871.

Fitzpatrick, Simon. "Against Morgan's Canon." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews & Jacob Beck, 437–447. New York: Routledge, 2017.

Mikhalevich, Irina. "Simplicity and Cognitive Models: Avoiding Old Mistakes in New Experimental Contexts." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews & Jacob Beck, 427–436. New York: Routledge, 2017.

Morgan, Conwy Lloyd. *Animal life and intelligence*. London: E. Arnold, 1891. http://archive.org/details/animallifeintell00morguoft.

Shettleworth, Sara. "Clever Animals and Killjoy Explanations in Comparative Psychology." *Trends in Cognitive Science*, *14* (2010): 477–481.

Animal cognition textbooks

Shettleworth, Sara. *Cognition, Evolution, and Behavior* (2nd ed.). New York: Oxford. A thorough introduction to the science of animal cognition, 2010.

Shettleworth, Sara. *Fundamentals of Comparative Cognition*. Oxford: Oxford University Press. A succinct introduction to the science of animal cognition, 2012.

Wynne, Clive and Monique Udell. *Animal Cognition: Evolution, Behavior and Cognition* (2 ed.). London: Palgrave Macmillan, 2013.

4 Consciousness

In July 2012, a group of scientists gathered for the Francis Crick Memorial Conference "Consciousness in Humans and Non-human Animals." After a day of lectures, the group of scientists signed *The Cambridge Declaration of Consciousness in Non-human Animals*, according to which:

> Convergent evidence indicates that non-human animals have the neuroanatomical, neurochemical, and neurophysiological substrates of conscious states along with the capacity to exhibit intentional behaviors. Consequently, the weight of evidence indicates that humans are not unique in possessing the neurological substrates that generate consciousness. Non-human animals, including all mammals and birds, and many other creatures, including octopuses, also possess these neurological substrates.

The scientists pointed out that research on consciousness is conducted on nonhuman animal subjects such as monkeys. That is, the research *starts* with the assumption that animals are conscious. Because this assumption led scientists to learn about the brain structures involved in particular conscious experiences, which have been validated using human subjects, we now have even more reason to accept that animals are conscious. If animals *weren't* conscious, we couldn't have used them to find those brain structures. The success of the science vindicates the claim that animals are conscious.

Crick, who famously shared a Nobel Prize for discovering the double helix structure of DNA, used his prestige to make the scientific study of consciousness a respectable endeavor. Teaming up with the computational neuroscientist Christof Koch, they decided to examine consciousness by working in the field of visual perception. Since much visual perception research is done using mammalian research subjects, they decided to accept that such animals are conscious. In their manifesto defending a new methodology for the scientific study of consciousness, they write:

> We shall assume that some species of animals, and in particular the higher mammals, possess some of the essential features of consciousness, but not necessarily all. For this reason, appropriate experiments on such animals may be relevant to finding the mechanisms underlying consciousness.... From this it follows that a language system (of the type found in humans) is not essential for consciousness. That is, one can have the key features of consciousness without language. This is not to say that language may not enrich consciousness considerably.... We consider it is not profitable at this stage to argue about whether 'lower' animals, such as octopus, *Drosophila* or nematodes, are conscious. It is probable, though, that consciousness correlates to some extent with the degree of complexity of any nervous system.
>
> (Crick and Koch 1990, 264)

Crick and Koch's assumption that "higher" mammals (by which they mean primates) are conscious led them to conduct vision research on monkeys. To do comparative neuroscience studies with humans and monkeys, both subjects need a way to report what they see. In one study, monkeys and humans were shown a target image hidden in a field of moving dots that sometimes disappears from visual experience (Crick and Koch 1995). While humans can verbally report whether they see the target, monkeys can report behaviorally; they are trained to push a lever when they see the target. This early research success appeared to vindicate their methodological approach—assume primates are conscious, and use primate models to study consciousness, including human consciousness.

The idea motivating the Cambridge Declaration is that if we don't think that the monkeys are reporting on their conscious experience when they push the lever, then we wouldn't be able to use those studies to create hypotheses and design additional tests which, in turn, help support theories about the biological basis of consciousness in the human brain. We assume that monkeys and other research subjects are conscious when we do studies on them, and those studies have paid off with increased understanding about the parts of the brain that are correlated with conscious experience—the *neural correlates of consciousness*. Identifying the neural correlates of consciousness is only a first step in explaining how consciousness arises in the brain, for correlation need not entail causation, and just because some brain activity is sufficient for conscious experience doesn't mean it is necessary for conscious experience. Multiple realizability of consciousness remains an open possibility.

While animal consciousness is largely accepted among neuroscientists studying consciousness, it is by no means universally accepted that all animals are conscious. Some philosophers argue that certain cognitive capacities, such as metarepresentation, are needed for consciousness, and that most animals lack that capacity (Carruthers 2000, 2005). Some scientists argue that the method for identifying consciousness in animals is based on unscientific introspection and folk psychology (Heyes 2008). A worry about the 'neural correlates of consciousness approach' is that the brain structures in humans and other animals may be correlated with the same kinds of behavior without being associated with the same conscious experiences. If philosophical zombies—individuals who are physically identical yet differ in conscious experience—are possible, then maybe all animals lack experience.

In this chapter, I will present three approaches we can take toward examining animal consciousness, the Theory Approach, the Epistemic Approach, and the Biological Approach. The Theory Approach is the most straightforward. Take a theory of consciousness, and then use it to identify which animals are conscious. While simple, the value of the approach rests on the extent to which we think our theories are true. I will offer some concerns about the Theory Approach by reviewing two types of theories of consciousness. The second approach, the Epistemic Approach, is an attempt to solve a problem currently part of the theory approach—namely, how to identify which subjects to study in any investigation of consciousness. The Epistemic Approach is sympathetic to Crick and Koch's view that we need to start with a presumption of consciousness among a wider variety of species. The third, the Biological Approach, places the question of consciousness alongside the question of life, and shows how we can better understand consciousness by examining how it could have evolved on earth over the last 500 million years. After considering the three approaches, we will end by looking at some work that has been done on the question of self-consciousness in animals.

Before we begin, we should be sure that we are talking about the same thing. Consciousness might be like jazz, as Ned Block put it, quoting Louis Armstrong, "if you gotta ask what it is, you ain't never gonna know." But Armstrong couldn't deny that there are many different kinds of jazz, and a study of jazz could benefit by naming and offering examples of the different musical styles. So let's start that way.

4.1 What is consciousness?

Philosophers often describe conscious experience in terms of qualitative *feeling*. The sweet smell of a spring garden in the morning, the warm prickling of sun on your skin, and the sharp taste of wasabi are all examples of the qualitative nature of consciousness. In his discussion of consciousness, Frank Jackson focuses on visual perception, asking whether one could know the complete science of color vision without having the experience of seeing red (Jackson 1986). Thomas Nagel discusses how we understand other minds by trying to think about "what it is like" to be a bat who flies and perceives the world with echolocation (Nagel 1974). Philosophers are also interested in the cognitive processes that unify our experiences, or the sense we each have of being a whole self with complex experiences, not merely a collection of various bits of qualitative experience (Kant 1781/1998).

Distinctions can be drawn between types of consciousness. One can be *awake-conscious*—that is, aware of your current surroundings because you are awake. But one can also be *asleep-conscious* when dreaming and perhaps in other sleep states. One can be *self-conscious*—able to reflect on our conscious experiences or other mental states. The distinction between consciousness and self-consciousness is important because it may be that one can have conscious experience without being self-conscious of that experience—you might experience pain without reflecting on the pain experience when engaged in a competitive sport or while in deep meditation. As we will see, there is some debate about whether one can be conscious without at least the ability to reflect on one's experiences.

Block (1998) draws a distinction between *access consciousness*—having information that is available to the rest of the cognitive system—and *phenomenal consciousness*—the qualitative nature of experience, feeling, or thinking. You can be phenomenally conscious of the sun on your skin as you sit outside on the first warm day, experiencing a sensation of heat. At the same time, you have access consciousness to information stored in your cognitive system, including the fact that the capital of Kenya is Nairobi. If someone were to ask you the capital of Kenya, you'd access that information (and make it phenomenally conscious) as you report, "Nairobi is the capital." These sorts of reports serve as evidence of phenomenal consciousness to the scientists looking for neural correlates of consciousness.

When Nagel asked, "What is it like to be a bat?" he was interested in the phenomenal sense of consciousness; beings have experience if and only if they *feel something*. Nagel's "what it is like" wording may be somewhat misleading, because it might suggest that we can communicate what is it like to be a bat using language. We might never know what it is like to be a bat, just like we might never know what it is like to be a human from a different culture, with different abilities, a different body, or a different status in society. We might be able to know *that* the bat feels something, but we might still fail to grasp *what it is like* for the bat to feel that way, because we are bringing our human meanings to the bat's sensations.

Phenomenal consciousness refers to these feelings—the experiential nature of the mind. It is what the signers of the Cambridge Declaration of Consciousness were after, with their references to emotions and visual awareness in animals. Words are often insufficient to describe our experiences, though we sometimes try to express our feelings in music, painting, or poetry. Experiences can be caused by any number of things—standing at the top of a steep hill with skis on, sitting in a hospital having your brain stimulated by electric current, or listening to music on your headphones. You can experience flying in a lucid dream, and walking on the moon while hooked up to a virtual reality system—all examples of phenomenal consciousness. Contrast these examples of phenomenal consciousness from states that don't *feel like something*: Being disposed to report that Nairobi is the capital of Kenya, being bombarded by wifi signals, or having an operation under anesthesia.

While it might be nice to have a simple definition of phenomenal consciousness to start the investigation, at best we have these sorts of examples. Eric Schwitzgebel (2016) offers the following definition of consciousness by example. Positive examples of consciousness include sensory and somatic experiences (e.g. afterimages from pushing on your eyeballs, the sound of cupping your hand over your ear, the feeling of your legs in space); emotional experiences (e.g. fear after a near accident); thinking and desiring (e.g. what a sweetie!); dreams (e.g. flying over a green valley); other people (since we regularly take other people to be conscious). Negative examples of consciousness include the growth of your fingernails, your disposition to squint your eyes when you have a good poker hand, or the release of growth hormones in your brain. We can keep these positive and negative examples of consciousness in mind as we address the question of how best to examine animal consciousness.

Consciousness problems

Phenomenal consciousness raises a classic problem in the philosophy of mind, called *the mind-body problem: What kinds of relationships exist between mental events, properties, functioning, etc., and physical events, properties, functioning, etc.?*

Notice that there are different ways to approach this question. One way to answer it would be to use familiar scientific methods to determine the physical neurological correlates to conscious experience in a human or a monkey subject. But at best this method will tell us which brain regions and processes are correlated with conscious experience. Neuroscientists looking for the neural correlates of consciousness are focused on this so-called *easy problem of consciousness*.

Another way to approach this question is to wonder what makes physical material have conscious experience at all. This is known as *the hard problem of consciousness* (Chalmers 1995). Consider that even once we have a full understanding of the function of a human body and brain and know all there is to know about the physical correlates of conscious experience, we can still ask *why are these physical processes accompanied by experience?* Our lack of an answer to this question is referred to as the *explanatory gap*; we have no current explanation for how consciousness depends on physical processing (Levine 1983).

Neurobiological theories attempt to find an answer to the easy problem of consciousness, while some philosophical theories attempt to address the hard problem. While there are a number of theories on the table that seek to address these problems, there is currently no overwhelming consensus.

4.2 Theories of consciousness

The theory approach to consciousness has us answering the question of who has experiences by applying some existing theory about the nature of consciousness to the question of particular species. For example, we could ask: “On Global workspace theory, is a frog conscious?” or we could ask: “On Information Integration Theory, is a frog conscious?”

As may be expected, different theories will provide different answers to the question about whether a frog, an octopus, or a dolphin is conscious. We cannot explore all the theories here, so I will focus on the representationalist theories of consciousness that predominate current philosophical thinking.

Representationalist theories take the ability to represent and manipulate information as key to conscious experience. The fundamental disagreement between these sorts of theories has to do with the types of representations that will be conscious. Having a representational feature is necessary for being conscious, but not sufficient. To be conscious, a state has to be representational and intentional in a particularly mental sense—representational states exhaust mental states. ‘Particularly mental’ disqualifies representations such as photographs and maps, since a subway map can represent the way to get from my home to York University without being conscious.

While theories differ in the details, in general to be representational in a particularly mental sense is to have states that are available to other systems, such as belief-forming or action-taking systems; that is, the representations have to serve the right kind of functional role in the system.

Representational theories of consciousness are usually divided into two classes—one that requires that represented information is subject to *metacognitive processes* (turning one's attention onto their own mental states, such as having thoughts about thoughts), and one that does not. According to higher-order theories, all conscious beings have metacognitive capacities. According to first-order theories, metacognition is not required, but other processes, such as attention or memory, are necessary. We will look at both types of theories to determine whether they can help us answer questions about animal consciousness.

Current neurobiological theories of consciousness

Global Workspace Theory (Baars 1988; Dahaene et al. 2006)

A brain state is conscious if and only if it is present in the global workspace of the brain such that it is accessible to various processing systems, including working memory, long-term memory, perceptual systems, evaluative systems, etc.

Recurrent Processing Theory (Lamme 2006, 2010)

A brain state is conscious if and only if it has been subject to recurrent processing in the brain, such that the information carried by the state has been processed and then reprocessed again by early stages of processing, making a loop.

Information Integration Theory (Tononi 2004, 2008)

A brain state is conscious if and only if it integrates a range of information represented in the system.

Other neural correlates of consciousness accounts

Koch and colleagues' view is that we find correlates of consciousness in a posterior cortical "hot zone" (Koch et al. 2016).

Consciousness arises piecemeal in brain modules given a layering brain architecture (Gazzaniga 2018).

For a detailed discussion of the neuroscience of consciousness, see Wayne Wu's entry for the Stanford Encyclopedia of Philosophy (2018).

4.2.1 First-order representationalist theories

As we saw in the last chapter, scientists have been investigating the role of mental representation in animal cognition, and there is evidence of representations in a wide range of species. Taking that premise from science can help construct a fairly simple argument from a first-order representational theory of consciousness to a conclusion that the animal is conscious. Let's see how that works on two different theories of this type: Michael Tye's (1997) PANIC and Jesse Prinz's (2012) AIR theories.

4.2.1.1 PANIC

According to PANIC, a representational state is conscious if it has four properties: Poised (available to belief-forming cognitive processes), Abstract (no concrete object needs to be involved, thus permitting hallucinations and dreams), Nonconceptual (no concepts are required, such that you can experience analog or coarse-grained features such as the difference between shades of red), and Intentional-Content (the content of the state is represented). Tye claims that animals who demonstrate flexible behavior and the capacity to learn from experience have the kind of representations required for conscious experience. This is because in learning the animal demonstrates that they have a goal, and can respond to contingencies as they seek out their goal. In contrast, a being who has only fixed action patterns, or who invariantly responds to the same stimulus with the same response, does not demonstrate having a represented goal that is flexibly pursued.

The theory entails that many animals, namely those who engage in behavior that depends on evaluations of sense data, are conscious. Tye asks us to consider the example of gray snappers, who usually enjoy eating silverside fish. When researchers injected silverside fish with an unpalatable flavor, and marked the injected fish, gray snappers learned to avoid the marked fish, eating only the unmarked ones. This sort of evidence, combined with observations that various fish species make decisions between better and worse choices (trade-offs), as well as inferences about dominance suggestive of transitive reasoning, leads Tye to conclude that fish have a belief-forming cognitive process, and so they are conscious.

Similarly, Tye cites evidence that honeybees learn the location of food, use landmarks to navigate, learn abstract shapes, and make decisions based on how things look, taste, or feel. Honeybees inform others where food is located using their famous waggle dance. But they can also evaluate the messages they receive, choosing to follow the dancer's instructions or to fly to a food source that they had past experience with (von Frisch 1967). Given PANIC, we should expect that both vertebrates and invertebrates tend to be conscious, since they have beliefs that they use to track the world and modify their future behavior.

Tye thinks that his theory can also provide evidence *against* the consciousness of some species. For example, Tye reports that some fishermen have observed hammerhead sharks feasting on stingrays who appear insensitive to their barbs. He takes this as evidence that sharks are insensitive to noxious stimuli, and hence not conscious. You might worry eating stingray isn't evidence against shark pain, since they may have evolved defenses that permit the behavior. Sharks might feel pain in different contexts. You also might worry that not feeling pain isn't good evidence against consciousness, as the sharks can be perceptually or emotionally conscious in other ways, just as humans with congenital insensitivities to pain are.

Is this observation of the shark's behavior sufficient to conclude that sharks are not conscious? I don't think so. We've only seen evidence that sharks are insensitive to some sorts of tissue damage. Humans can also show a lack of behavioral response to some kinds of tissue damage. Marathon runners describe a variety of ways to manage pain during a run, and humans in intense emotional situations act as if they don't feel pain. An injured father in Georgia saved his baby from a burning building; when the firefighters arrived, the father, who was burned and appeared unable to use a ladder, was standing on the third-floor balcony holding his baby. The firefighter, Capt. Scott Stroup, described what happened:

> I saw the sheer panic in the father when we got there and I knew … that child was coming off that balcony. When I ran up, everything happened so quick. As soon as the child hit my arms, I was like, 'Thank God.' And I was trying to get the child out from the fire because it was hot where we were standing.[1]

Humans can act like they do not feel pain when they are engaged in high stress activities, but we can also report not feeling pain in the face of tissue damage. There are numerous news reports of people who were shot *in the head* who didn't realize it for months. For example, one man had been shot in the back of the head while partying, and he didn't realize it for five years, when he felt a bump on the back of his head![2] In some of these cases, people reported feeling headaches, but nothing serious enough to make them seek immediate medical attention.

Some humans don't feel pain at all, even though they are conscious. This condition, called congenital analgesia, is quite rare, with only 20 cases reported in the scientific literature. People with this condition do not feel burns, cuts, or other damage to their body, and they often unintentionally damage themselves.

Given the variety of responses conscious humans have to tissue damage, it would be hasty to conclude that sharks are unconscious from the observation that they don't behaviorally respond to the sense data resulting from traumatic injury. It would even be hasty to conclude that sharks don't feel pain because they don't respond to tissue damage in this particular context. PANIC could only entail that sharks are unconscious if scientists failed to find *any* instance in which sharks had a representational state of the right kind.

Tye's theory can also be used to *discover* whether some system experiences consciousness. It could also be used to defend the existence of conscious experience in non-biological representational systems. If a robot was designed to have PANIC states, then, on this theory, it would also be conscious. While we don't have conscious robots right now, PANIC theory suggests that we could build them.

One thing to notice about Tye's theory is that it starts with the assumption that we should see consciousness in humans and many other animals. That is, the theory is built on a pretheoretical view about consciousness in animals other than humans. We can then use the theory to examine exactly which species are conscious, whether there are conscious outliers among the animals, and whether there are biological classes or phyla of unconscious animals.

4.2.1.2 AIR

Jesse Prinz's Attended Intermediate-level Representation (AIR) theory of consciousness describes consciousness as requiring hierarchical sensory processing, attention, working memory, and high-frequency neural oscillations (Prinz 2012). The theory, which Prinz describes as synthesizing all the best theories of consciousness, takes consciousness to arise at intermediate levels of abstraction in a sensory system. After an organism takes in sensory information, but before the information is transformed into a categorical representation, there is a sensory state that can be attended to, bringing forth conscious experience. The attention that we bring to the intermediate sensory states creates a change in processing that allows the sensory information access to working memory. We can categorize AIR as a representational theory given that the intermediate level of abstraction is a representation.

On this theory, many species of animals have the neural substrates of consciousness, and so we can formulate the following arguments:

1 The AIR theory of consciousness requires hierarchical sensory processing, attention, working memory, and high-frequency, phase-locked neural oscillations.
2 Many animal species have hierarchical sensory processing, attention, working memory, along with high-frequency, phase-locked neural oscillations.
3 Therefore, many animal species have the requirements for consciousness.

Evidence for consciousness will be strongest in those species in which we have ample evidence of all four features of consciousness. Prinz thinks that we have evidence for consciousness in mammals, birds, fish, cephalopods, and insects, but we can be more skeptical about consciousness in gastropods and reptiles. In the case of reptiles, Prinz admits that this skepticism may be a reflection of the relative lack of neuroscientific study of reptiles.

The evidence for mammalian consciousness is perhaps the strongest, given that what we know about the neurophysiology of human attention and working memory comes largely from studies on monkeys and rats (Prinz 2005). Prinz recognizes that there are limits to drawing conclusions about consciousness in systems very different from us based on AIR theory. Since the theory is based on neuroscience done with mammalian subjects, we don't have a way to apply the theory when it comes to animals with very different neural organization from our own. Prinz offers a description of the neural correlates of consciousness in animals like us, not a theory about the nature of consciousness more generally.

Prinz points out that we are limited in determining whether psychological processes can be phenomenally the same when they are implemented quite differently. How could we ever figure out whether the human processes of attention are the same as the octopuses' processes of attention? We would have to try to keep the psychological state the same while varying the neural mechanisms, but so long as the replacement neural mechanisms have the same functional role, the individual will act the same. However, the octopus isn't able to report on their psychological state, so we won't know whether or not the octopus is conscious as we manipulate their neural structures.

AIR theory is limited in what it can say about beings who appear to act flexibly and learn, but who are completely unlike humans and mammals in brain structures and psychological function—such as a being with no memory or attention. While we might be justified in concluding that any "what it is like" experience for that being is very different from our own, we wouldn't be able to conclude anything about whether or not that being is conscious. Such epistemic worries lead to what Prinz calls "level-headed mysterianism" about the distribution of consciousness across species when applying a theory like AIR to questions of consciousness. More recently, Prinz has turned toward a biological approach to addressing questions of animal consciousness in order to make progress on the mystery (Prinz 2017).

4.2.2 Worries about first-order representationalist theories

Prinz recognizes the difficulties of using theories based only on human studies to answer questions about consciousness in other biological families. The same problem arises for Tye's PANIC theory, and it is a problem that will trouble most of the theories of consciousness on the table. If the theories are focused on addressing the easy problem of consciousness, then they are giving us the neural correlates of conscious experience in their own subjects—be it humans, primates, or mammals. But consciousness might be multiply realizable; very different subjects might have very different correlates of consciousness. Given our definition-by-example of phenomenal consciousness, we have left open the possibility that a being can have sensations or emotions without, for example, the typical memory systems we see in primates.

In addition to worries about the model subjects in first-order representational theories of consciousness, there are also explanatory gap-type worries. Is it conceivable that some kinds of behavior that appears conscious can be performed without the subject having any experience? There are cases that appear to raise problems for first-order representational theories.

A classic example of sensory processing without consciousness is unconscious driving. While driving over a long distance, sometimes the mind wanders. Because long drives can be tedious, we daydream, plan for the future, or otherwise focus attention on something other than the road and the other cars. After driving for some time in the daydreamy state, we might jerk back to the present, and realize that we hadn't been paying attention to the road. But we were not asleep while driving, and were still perfectly able to attend to the other cars, the curves on the highway, and so forth. You might even be able to recall a barn that you just passed after your passenger remarked on it, even though you were not consciously aware of the barn when it was there. Philosophers point to these kinds of experiences—situations in which we seem to lose awareness of our automatized actions in driving, washing the dishes, brushing our teeth—as reasons to think we represent things without consciousness. This leads some philosophers to adopt a view of consciousness that requires metacognitive capacities.

4.2.3 Higher-order theories

Like first-order theories, higher-order theories of consciousness require the existence of representational states for conscious experience. However, such states are not sufficient for consciousness, because, as we saw, humans have representational states that are integrated into other cognitive systems that allow for expert behavior, such as automatic driving, without conscious experience. On these theories, a representation, be it a belief, a sensory state of physical damage, or a memory trace, will not be conscious until it interfaces with a metarepresentational cognitive system—a metacognitive system that is able to represent a representation.

For example, a first-order sensory representation of the taste of a banana might only become conscious when it is subjected to evaluative systems that represent the sensory information as *delicious* or *disgusting.* The thought is that sensory systems can process information and respond to it, like litmus paper responds to an acid or a base, without experiencing anything. When we are driving without awareness, perhaps we are merely *sensing* the world, not consciously *experiencing* it. Such phenomena have been taken as evidence that humans engage in nonconscious sensory processing, and it leads to the following arguments against animal consciousness:

1 The best evidence for animal consciousness is their capacity for sensory processing.
2 Sensory processing does not require consciousness.
3 Therefore, the best evidence for animal consciousness is something that does not require consciousness.
4 If the best evidence for animal consciousness does not require consciousness, it is bad evidence.
5 Therefore, the best evidence for animal consciousness is bad evidence.

This argument suggests that systems can have sense organs without consciousness—systems like ants, fish, and polar bears. Sense organs are needed to gain information that allows us to have a kind of nonconscious sensory-experience of our world, and hence to move about it in coherent ways, but they need not also provide conscious experience.

Premise (2) is key to this argument, and is justified by experiences like unconscious driving. However, one could object that when I am engaged in so-called unconscious driving, I am conscious, just of something else. My focus of attention is elsewhere, but I am monitoring the road and able to shift attention back to it if needed. Much weight has been put on the phenomenology of unconscious human actions. You can evaluate that phenomenological evidence yourself, next time you find yourself automatically doing some task.

One type of higher-order theory takes the representation to be a thought—the Higher-Order Thought (HOT) theory of consciousness (Rosenthal 1986, 1993, 2005). On such a view, a conscious mental state causes a thought, and is the object of the thought. That is, if I am to be conscious of the hot tea, my sensory experience of the hot tea has to be subject to a thought about the hot tea.

Some worry that HOT theories propose an overly demanding criterion for consciousness. For the outcome of a cognitive process to be the object of a thought, a metacognitive ability is required—an ability to think about other mental states. To be aware of your belief, you would have to form a thought about your belief; to be aware of your pain, you would have to form a thought about your pain sensation (which is itself unconscious).

Since it may be that many animal species lack the kind of metacognition needed to form higher-order states, such animals would be deemed unconscious. Indeed, if young children lack this kind of metacognition, which they appear to, then human infants and even toddlers would fail to qualify as conscious beings. As we will see in future chapters, there is recent evidence suggesting that great apes can think about others' mental states, and that many animals including apes, dolphins, monkeys, and rats can form higher-order mental states about their own mental states suggesting that at least some animals may be conscious on HOT theories.

Some HOT theorists have replied to the worry that animals and children would not be conscious by offering a different way of understanding the cognitive requirements. Rocco

Gennaro argues that the cognitive capacities required for higher-order thought are not very sophisticated, and they can be had without the metacognitive concepts of *concept* or *belief* (Gennaro 2004). All that's needed is content of the form "I am in M" where the "I" can be satisfied by any number of selfhood concepts and the "M" can be satisfied by a variety of mental state concepts, without an additional concept of that concept. He thinks that animals plausibly have concepts of "looking red" or "seeing red" and since these concepts are about representations of perceived objects, and allow animals to discriminate red from green objects, such a concept would permit animals to consciously experience colors. In addition, animals plausibly have concepts such as "feeling" and "yearning" that they use to modify their other representations; thus animals could have conscious experiences of things like pains in terms of "this hurt" or "this unpleasant feeling," and these concepts would be sufficient to discriminate painful from painless experiences.

4.2.4 Worries about higher-order theories

Despite attempts to minimize the requirements for HOT, there will be a point in human development at which an individual lacks the proper concepts. The baby crying for milk or a cuddle, laughing with mama, and turn-taking in facial imitation or vocalizations is not going to be feeling anything on such views. While Gennaro thinks that animals and babies can have HOTs by having a selfhood concept, unless these concepts are part of an individual's cognitive architecture at birth, there will be a developmental stage at which the child is not conscious. For many, the idea that infants are born with a self-concept of some kind is implausible, given the utter dependence the infant has on their human mother. It seems that we have the choice of rejecting a commonsense belief that human infants are conscious, or rejecting the theory.

4.2.5 Worries about theory approaches

The problems that arise with both kinds of theories of consciousness point to general problems that will be shared by any theory-first approach to determining whether any nonhuman animal is conscious. For one, when forced to deny an obvious claim or to deny the theory, we will always deny the theory. Suppose a theory of consciousness entails that an individual whom I've been in relationship with for a long time isn't conscious, because the individual lacks some property purportedly required for consciousness. I'm going to immediately reject the theory as ridiculous. Given the problem of other minds, we would end in a stalemate between theory and common sense.

The bigger problem is that in the construction of the theory, we are already starting with a view about who is in the consciousness club. When a theory of consciousness is based on a starting presumption about who is conscious, and then only those organisms are studied, the theory of consciousness that emerges will be shaped by that starting presumption. We can't then directly apply it to answer whether or not some other being is conscious. The choice of theory being applied will beg the question of animal consciousness.

To illustrate, imagine doing a clinical drug study using only 19-year-old American boys as your subject pool. The scientists find that the drug has no side effects, so it is approved for general use in the market. But then women start to get sick from the drug. The problem with this scenario is that the drug researchers assumed that there was no relevant difference between their testing population and everyone else. We know that different subgroups of humans respond differently to drugs, and today clinical studies will include a representative sample in its subject pool.

Likewise, suppose scientists study the neural correlates of consciousness using humans and monkeys, and identify the neural correlates of consciousness. The scientists cannot conclude that those neural correlates are necessary for consciousness, but only sufficient. In order to draw a stronger conclusion, the subject pool would have to model the population of conscious beings. But we don't yet know what makes up the population of conscious beings! And if we don't know who is conscious, we cannot know whether our subject pool is an appropriate model of the target population.

The two limitations of theory approaches—the plausibility of the implications of the theory, and the subject populations used to develop the theory—suggest another way to investigate the question of whether animals are conscious. This alternative is epistemic and methodological, and doesn't offer a theory of consciousness. Rather than first deciding what consciousness is, and then applying a theory, epistemic approaches start with the human practice of treating others as conscious.

4.3 Epistemic approaches to consciousness

Epistemic approaches to consciousness are ways of determining the starting point for the development of a theory of consciousness. They offer justifications for the choice of one subject pool over another in the scientific study of consciousness.

For example, in a recent book Tye advocates an epistemic approach to animal consciousness without having a theory of consciousness. He suggests that we can decide which animals to include through appeal to Newton's Principle, which he extracts from a comment attributed to Sir Isaac Newton: "The causes assigned to natural effects of the same kind must be, as far as possible, the same" (Tye 2017, 72). Tye takes Newton's Principle to tell us that when an animal behaves the same way we behave, and our behavior was caused by conscious sensations, we should assign a conscious sensation cause to the animal's behavior as well. Newton's Principle can be seen as a combination of argument from analogy and inference to the best explanation style argument. The "like causes like" part of the principle relies on analogical reasoning. The "as far as possible" part of the principle relies on inference to the best explanation.

For examples, since humans are consciously experiencing pain that causes them to avoid noxious stimuli, when we see an animal avoid noxious stimuli, we should infer that the behavior is caused by a conscious experience of pain. Since humans are consciously planning when they investigate two different options, we can conclude that animals are consciously planning in similar situations. Thus, if we see animals acting as if they are in pain, making decisions, or planning, we can infer that the animal is consciously in pain, making decisions, or planning.

Tye's epistemic approach reflects much of standard scientific practice. Signatories of the Cambridge Declaration appear to endorse something like Newton's Principle at the neurological level. They take human and animal brains to provide like causes in both behavior and experience, so when we see a human brain process that causes a behavior and an experience, and a homologous brain process in an animal causes a similar behavior, we should assume that the animal has a similar experience as well.

A similar approach was advocated by Donald Griffin, the scientist who revived the question of consciousness in animals in the 1990s. Griffin proposed that there are two types evidence for consciousness in animals: Neural and behavioral. We need to investigate both in order to understand animal consciousness. On the neural side of things, he argued that we have to examine the similarities and differences of neural structure and functioning between the humans and the target animals. On the behavioral side of things, he thought that we have to examine behavioral evidence about the flexibility of the associated behaviors, since flexibility allows an organism to modify behavior without having been preprogrammed by evolution or explicit learning. Behavioral flexibility is evidence for the sort of representational mental states Griffin also thought necessary for consciousness (Griffin 2002).

Both behavioral and neural evidence play a role in what I call the Dynamic Marker Approach (DMA). The DMA includes animals in the class of conscious beings, but it does so via a commitment to the calibration method. It works by first identifying the properties that trigger human judgments or perception of consciousness. This part of the process is purely descriptive—identifying those properties that make us take someone to be conscious. Let's call these *initial markers*. The initial markers will likely include behaviors such as language use, eye contact, bodily interactions, goal-directed action, emotional facial expressions and vocalizations, and pain behavior. This is not to say that all these markers are necessary to trigger perception or judgment of consciousness; an infant's behavior suffices, as will a puppy's. Snuggling, eye contact, cocked heads, exuberant jumps, and yelps of pain in a fluffy 12-week-old puppy trigger an automatic treatment of the pup as conscious, too.

The initial markers will include all the behaviors that play a direct role in our consciousness judgments. What all those markers are remains an open question. In order to do a thorough job identifying initial markers, we can use familiar methods of psychology, including vision science and social psychology, to identify what causes us to take others to be conscious.

The next stage is to use those properties to identify an initial class of subjects who have some number of those markers. Let's suppose this class includes mammals, birds, and some reptiles. We can then investigate subjects from those groups in order to examine whether there are relevant features that are repeatedly found among them—let's call these *derived markers*. The derived markers can result from scientific and philosophical investigation, and may include a range of different marker types: Neurological, computational, cognitive, social, or biological. Some types of derived markers could include learning strategies; responsiveness to drugs such as analgesics (painkillers), anxiolytics (anti-anxiety drugs), or psychedelics; neurological structures and processes; and cognitive mechanisms. The next step is to look outside our initial class to determine whether any derived markers are found in other entities. If they are, then we can add those entities to the study class as we look for yet more markers. We then again look for additional neurological or cognitive similarities held by individuals in this bigger class. If we find a salient difference between some of the members, we will downgrade the degree of belief we have in the consciousness of those creatures. However, given the possibility that consciousness is multiply realized in different kinds of systems, it will be difficult to reach conclusive judgments about which systems don't experience consciousness.

What DMA shares with Newton's Principle is that it relies on analogy and inference to the best explanation argument. However, DMA differs by identifying clusters of markers that go together. A system that had only one marker of consciousness may be deemed conscious through appeal to Newton's Principle, but DMA requires looking at how markers cluster.

For example, consider one kind of marker for consciousness—verbal reports. Typically, if someone is able to talk, we take them to be conscious. However, suppose next year Google's DeepMind creates a chatbot that thoroughly passes the Turing Test. As you talk to this bot, you cannot tell it is a bot. It explains why it made the move it did in Go; it also says it doesn't feel like playing another game right now, but feels like watching a movie. Not another Marvel movie, please, but something Danish … The chatbot's verbal behavior might be impressive, but without a body that can move, without nonverbal expressions of pain or emotion—that is, without any other marker of consciousness—even humans who were first fooled by the bot may be disinclined to take the chatbot as conscious once they realize that it lacks all the other markers. Not having any other markers is reason to doubt its consciousness. The lesson is that language is one marker, but one marker alone is not sufficient for concluding that some being is conscious.

Another difference is that DMA respects the problem of other minds as one that applies to humans as well as to animals. We don't have proof that other humans have minds, just as we will never have proof that other animals have minds. Our commitment to the existence of human minds is based on markers—sets of behaviors and other properties that together we perceive or judge as making a conscious agent.

Markers of consciousness

What is our folk understanding of phenomenal consciousness? This will likely differ a bit between individuals, but more broadly between cultures. You can ask yourself what properties you take to indicate consciousness in some being. Consider running into a new species in some science fiction scenario—what would these creatures have to be like to make you treat them as conscious?

4.3.1 Pain behavior and consciousness

The epistemic approaches to consciousness all share an interest in the relationship between pain behavior and conscious experience, for good reason. Even very young children are responsive to pain behavior as a felt experience—when we see a bloody knee and crying behavior, we see a person in distress. In humans, the pain behavior can be associated with a verbal report—"it hurts!" When we see pain in other animals, such as a limping dog or a cat who screeches when you step on their tail, it is not accompanied by a verbal report. This makes it easier to question whether the animal is really in pain. (It is a bit funny that we give so much epistemic weight to verbal reports of pain, though, since they are just another kind of behavior. Nonetheless, it is usually not a good idea to question someone who claims to be in pain.)

Research in the physiology of human pain finds that the initial stage of pain experience is an unconscious damage detection performed by specialized receptors in the skin called nociceptors. Nociceptors send a signal to the spinal cord, which causes a reflex response, such as pulling one's hand away from a hot stove. The experience of pain is usually understood as an emotional response to the activation of the nociceptors, and scientists have found that the limbic system (a set of brain structures associated with emotional response) and the dopamine system (brain structures which work on dopamine, a neurotransmitter involved with motivation and reward) are associated with pain experience in humans.

We also know that human pain experience is modified by opioids such as morphine, which work by blocking some of the signals from the nociceptors. People on morphine report that the pain is still there, but they don't mind it as much. It doesn't feel the same way. It isn't just the verbal behavior that changes when a person is on morphine; in some cases people are able to function fairly normally, going to work or school as usual while taking morphine for pain. Other pain relievers, such as aspirin, operate on different parts of the pain pathway, with similar results. When the pain is gone, we can continue studying and working as usual.

Since humans act in particular ways when they are experiencing pain, such as withdrawing from a painful stimulus or nursing the damaged area, one way to test for pain in other species is to examine whether behaviors associated with tissue damage are modified when the individuals are given chemicals that work like morphine. In a series of experiments suggesting that trout feel pain, the biologist Victoria Braithwaite and her colleagues examined fish behavior and brains (for a review of their research, see Braithwaite 2010).

To find evidence of pain in fish, Braithwaite thought we need evidence of nociception plus emotional responses to nociception. Braithwaite and her colleagues systematically examined these issues in trout by asking three specific questions: First, do trout have nociceptors; second, are nociceptors active in response to tissue damage; finally, is trout behavior modified when nociceptors are active? After discovering the existence of nociceptors that respond to tissue damage on the face and snout of trout, they tested the receptors using different noxious stimuli by injecting vinegar and bee venom under the skin around the mouth. They found that the fish treated with vinegar or bee venom breathed much more rapidly (as measured by gill beating) than fish in a control group who were injected with a saline solution. They also found that treated fish showed no interest in food long after the control fish began eating. Because increased heart rate and breathing, as well as lack of interest in food, is common among humans who are experiencing pain, Braithwaite and her colleagues took the marked difference in these two measures between the fish treated with the noxious chemical and the control subjects as evidence that fish modify their behavior in response to painful stimuli.

While this evidence was sufficient to conclude that there is nociception in fish, Braithwaite thought more data was needed to defend the claim that fish are consciously experiencing pain. It may be that the trout's appetite was suppressed without their conscious awareness, for example. Corroborative evidence of conscious pain should come from other domains, such as an impact on cognitive behaviors. This led Braithwaite and colleagues to conduct another experiment.

Trout tend to avoid new objects that are placed in their tanks, demonstrating their ability to distinguish new and familiar objects. Braithwaite and her colleagues decided to test whether a trout would still avoid a novel object after having been injected with vinegar. They found that compared with a control group injected with saline, the vinegar-injected fish did not show the usual avoidance responses, swimming quite close to the novel object (a Lego brick). In a follow-up experiment, half the fish were treated with vinegar and half were given a saline injection, and in addition, all were given morphine. The difference between the two groups disappeared: The vinegar-treated fish started showing avoidance responses similar to the control fish. Braithwaite claims that these studies show the following:

> Giving the fish an injection of a noxious substance distracted its attention, but when pain relief was given, the ability to focus its attention increased again. For this to happen the fish must be cognitively aware and experiencing the negative experiences associated with pain. Being cognitively aware of tissue damage is what we mean when we talk about *feeling* pain.
>
> (Braithwaite 2010, 69)

While Braithwaite thinks that the first set of studies offers evidence for fish consciousness, supporting evidence comes from evidence of analogous brain structures in fish and mammals. Since the limbic system is where emotional processing occurs in humans, and pain is understood as an emotion, it follows by analogy that fish would also need something that functions like a limbic system to experience pain. A group of researchers from Spain have suggested that goldfish have areas of the brain functionally equivalent to the hippocampus and amygdala, key players in the human limbic system. For example, they found that goldfish with lesions to the amygdala-like area cannot learn to avoid an electric shock, while typical goldfish can (Portavella et al. 2004; for a review of the research on goldfish, see Salas et al. 2006).

The same sort of evidence Braithwaite provides in favor of fish pain can also be provided for a variety of animals. In his book *Personhood, Ethics, and Animal Cognition*, Gary Varner argues that vertebrates can probably all experience pain, but among the invertebrates, we only have evidence of pain experience in cephalopods (such as octopus, squid, and cuttlefish) (Varner 2012, 113).

Varner suggests that we can identify four features that are sufficient for pain experience:

(a) nociceptors that are connected to the brain
(b) a natural opioid releasing system in the body (i.e. endogenous opioids)
(c) responsiveness to analgesics (i.e. pain medication has predictable effects)
(d) appropriate pain behavior

Those four features are used as reference properties in Varner's argument from analogy for animal pain:

1 Humans who feel pain have nociceptors connected to their brains, respond to damaging stimuli with the release of endogenous opioids and behavioral displays, and such responses are modulated by treatment with analgesics.

2 Cephalopods, fish, salamanders, birds, reptiles, and mammals also display these responses.
3 Therefore, cephalopods, fish, salamanders, birds, reptiles, and mammals also likely feel pain.

While Varner's choice of the four reference properties doesn't depend on a theory of *consciousness*, it does depend on a theory about pain. That pain theory can be itself independently justified via an inference to the best explanation argument. The reason we look for nociceptors, endogenous opioids, responsiveness to analgesics, and pain behavior is that we have a theory of human pain that causally implicates the first element, and includes as effects the other three. Because there are causal relations between the reference properties and the property at issue, according to a theory that enjoys independent justification, a good analogical argument can be scientifically grounded and as warranted as the inference to the best explanation argument that supports the choice of reference properties.

Some object to the argument from analogy based on a lack of sufficient similarity between human brains and some animal brains. For example, the biologists James Rose (2002, 2007) and Brian Key (2016) argue that because the fish brain is much simpler than most vertebrate brains, and there is no obvious neo-cortex, fish cannot feel pain, though mammals can. The argument can be stated as follows:

1 Human pain experiences require specific neural architecture.
2 Fish lack this neural architecture.
3 All pain experience requires that specific neural architecture.
4 Therefore, fish do not feel pain.

While this argument is valid, it is terribly question begging given premise (3), which suffers from anthropocentrism. Premise (3) denies multiple realizability, the idea that the same function can be seen in different kinds of systems. Pain has been the philosophers' standard example of multiple realizability, with Hilary Putnam's insistence that the octopus may feel pain even if they lack the neural properties presumed to be involved in human pain.

There are many clear cases of multiple realizability in the biological world, such as the convergent evolution of wings among birds, insects, and bats, as well as the development of eyes in some mollusks, crustaceans, insects, fish, birds, and mammals. The box jellyfish lacks a brain, but they have two eyes that form images, as well as twenty-two simple eyes. The upper image-forming eye appears to have a single function, always directed up to keep the jellyfish under the mangroves where they find their food (Garm et al. 2011).

Suppose we constructed an argument against jellyfish vision that has the same structure as Key's argument against fish pain:

1 Human vision requires specific neural architecture.
2 Box jellyfish lack this neural architecture.
3 All vision requires this neural architecture.
4 Therefore, box jellyfish do not have vision.

Here, premise (3) is clearly false. From the behavior of the jellyfish, the function of the eye, and the structure of the eye itself, we can conclude that jellyfish vision is a real phenomenon. The upshot is that there are many biological structures that can perform the same function, and just because some organism performs the function one way doesn't mean that all organisms will hit upon the same solution. We should note here that multiple realizability and Newton's Principle do seem to be in tension.

While Varner reviewed evidence for pain primarily in vertebrates, Tye (2017) thinks that we can also find evidence of pain in invertebrates. For example, hermit crabs who were shocked in their shells and then offered other, lower-quality shells moved shells, while hermit crabs who were not shocked remained in their original shells. Tye describes this as a trade-off behavior, which required crabs to determine that the loss of the higher-quality shell was worth avoiding the pain of being shocked. Tye also describes research on shore crabs, who prefer the dark. When placed in a tank with a dark side and a light side, the crabs will usually prefer the dark side. But when they are shocked in the dark side of the tank, the crabs change their preferences and move to the light side. This experiment is an example of a conditioned place preference paradigm.

Tye thinks that these studies are best explained by the animals feeling pain:

> The best explanation seems to be that the hermit crabs that had been shocked remembered it and the painful experience it elicited and chose the new shells, even if they were lesser, because they did not cause them any pain.
>
> (Tye 2017, 157)

Note, however, that Tye's interpretation appeals to other cognitive markers, such as memory and choice, which requires flexible cognitive processing. Plants also engage in trade-offs between growth and defense against insects and pathogens, determining where to direct their energy based on hormone levels (Huot et al. 2014). Should we conclude that they are conscious as well?

This leads us to consider some worries about the appeal to pain behavior as sufficient for concluding that something is conscious. First, if hermit crabs leaving shells in which they were shocked to take up residence in lesser shells that are shock-free looks like evidence of conscious pain, then plants that stop growing and produce an immune response to pathogens should look like evidence of pain too. They both display a system that stops doing something that was beneficial to them, given the introduction of a harmful stimulus, and modification of the system in order to avoid the harm at the cost of losing the benefit. However, to most of us these two events will look different. Is it because there are more consciousness markers in the crab than in the plant? Or is it just because it is slightly easier to anthropomorphize the crabs?

Another worry about pain behavior comes from the existence of pain reflexes. Adam Shriver points out that in humans, nociception can co-occur with increased heart rate, reduced feeding, and even reflex withdrawal, but without the experience of pain. Thus, these sorts of physiological and behavioral responses alone cannot lead to evidence of pain experience. Instead, the sorts of behaviors to focus on when looking for evidence of pain in animals should be those that indicate the existence of an affective component (Shriver 2006).

Humans can distinguish between a sensory component of pain (e.g. throbbing, stabbing, aching) and an affective component (e.g. vaguely annoying, intense, unbearable). If we can find that other animals also draw such distinctions, Shriver thinks this would be stronger evidence that they experience pain. One way we might test for this is by using the conditioned place preference paradigm we saw used with the shore crabs. Rats prefer dark areas to light ones, and in a cage that has a light and dark chamber, rats will spend the majority of their time on the dark side of the cage. But when researchers ligated a pain-related nerve so that rats' left paws were more sensitive to pain, they preferred the light side of the cage (where their right paws were shocked) to the dark side of the cage (where their left paws were shocked). However, once the rats were given a brain lesion in their anterior cingulate cortex, which is associated with the affective component of pain in humans, the rats preferred the dark areas again, even though they continued to be shocked in the same way, and the behavioral responses to the shocks remained the same.

Shriver interprets this study as suggesting that the lesioned rats felt pain (as evidenced by their withdrawal from the shocks) but didn't mind the pain, much like the humans on morphine who sense the pain without minding it (Shriver 2006). The explanation for this experience in humans is that there are two pathways for pain, a sensory and an affective (or unpleasantness) component, and these can be independently manipulated. However, Shriver elsewhere argues that no one task, including the conditioned place preference task, and no particular brain region can be reliably associated with the presence or absence of the affective dimension of pain (Shriver 2017). One worry is that we don't yet have thorough scientific information about pain in humans. Shriver writes, "…the conclusions [about affective pain] that can be reached are currently limited by the absence of crucial information from the sciences" (Shriver 2017, 182).

Shriver is certainly right that our conclusions are limited by current science. Our pain markers could be better than they are. But they are not useless when it comes to offering evidence for pain in animals. Such behaviors offer *some* evidence for animal conscious experience of pain. As always, with more markers, we can gain more evidence.

And, as Varner points out, while arguments from analogy about animal pain can offer evidence *in favor* of animal consciousness, they cannot offer evidence *against* animal consciousness. Like humans with a congenital insensitivity to pain, some animals may be conscious of things other than pain, or may have a very different kind of pain response. This points to the limitations of the argument. As an unapologetic anthropocentric argument, we cannot appeal to the reference properties in order to identify pain that would be very different from human pain. And, contrary to Key and Rose, we cannot appeal to human physiology to conclude that animals who lack that physiology also lack pain, when there is other biological and behavioral evidence that they do experience pain.

Using the calibration method, we can start with a description of pain behavior in those beings we take to be pain experiencers, engage in scientific study and identify the physiology of pain, and then look at other animals to see to what extent they have functional equivalences in their physiology and behavior. If they are close enough, we're going to conclude that they experience pain. If they are too far apart, we will be less sure. Whenever we evaluate the evidence, we will be at some stage in the process of learning about the marker of pain. The evidence currently available does suggest that a wide range of species have one marker of consciousness-pain behavior and processing. What will help bolster an argument for animal consciousness is supporting evidence from other markers. Maybe next scientists studying animal consciousness can turn to studying animal pleasure and joy.

4.3.2 Epistemic approach worries

The example of the epistemic approach with regard to searching for pain markers in animals points to some general weaknesses with epistemic approaches. Clearly, one weakness of the view is that it is anthropocentric. Tye starts with human behavior and looks for similar behavior in other species. I start with human perception of consciousness and use it as a starting point for expanding our understanding of who is conscious. If there are conscious entities that do not behave like humans, and if there is consciousness that we cannot perceive, then those entities will be unjustly excluded. Quite different beings may fail to meet those criteria while still being conscious.

Epistemic approaches also have the opposite problem—they can't be used to definitively exclude beings from the class of conscious beings. Furthermore, the methodological advice for taking the epistemic approach is also rather vague. What counts as a "relevant" feature marking consciousness? How many members of the class must have a feature for it to count as a derived marker? And, how many markers are enough?

These are all appropriate questions. My response is not to offer a straight answer, but to gesture toward future science. The epistemic approach is a methodological one, and the promise is that by following the suggested approach, these sorts of questions will be addressed on the ground in the specific contexts when they arise.

4.4 Biological approaches

Theory approaches attempt to determine the nature of consciousness, and apply a theory to decide who is conscious. Epistemic approaches attempt to determine which animals are conscious by looking for properties we take to indicate consciousness. Biological approaches offer a third way to investigate consciousness. They start with an assumption about the function of consciousness in the evolution of multicellular organism, and such approaches generally imply that consciousness should be widely found in living organisms.[3]

A biological function approach can help us gain an understanding of consciousness by showing how conscious experience makes sense of changes in the evolution of multicellular organisms. These sorts of approaches aim to close the explanatory gap by showing us how conscious experience could have evolved. Rather than trying to close the gap by giving a complete physical, mechanistic description of a conscious human at this moment in time, biological function approaches attempt to deepen our understanding of how consciousness may have evolved in populations over time. The promise is that a historical story of this sort will provide the kind of understanding of consciousness that is lacking in reductivist neurobiological descriptions. A completed neuroscience that knows everything there is to know about the brain may still not offer an explanation for consciousness in the way that a story about the evolutionary pressures that have been shaping life on Earth for 3.5 billion years can.

One advocate of a biological approach to consciousness, Evan Thompson, suggests that the self-organizing nature of cells is the base of conscious mind in life. He identifies three ways in which living cells differ from non-living physical structures:

(a) living cells dynamically produce and maintain themselves (including their boundaries) through metabolic processes;
(b) living cells exist in relation to an environment which they shape into an *umwelt*—an environment of norms and meaning;
(c) living cells must be understood in relation to norms, whereas mere physical structures can be expressed by a law; cells modify their environments according to their norms of activity (just as the environments help shape the actions of the cells) (Thompson 2007, 74).

Like living cells, human organisms are also dynamic systems that are self-organizing and self-maintaining agents that can distinguish between their environment and themselves. But, since human organisms are built out of cells that also have these properties, we can understand the properties of the larger system by understanding the properties of the cells.

Similarly, Peter Godfrey-Smith thinks that we can close the explanatory gap by reimagining the question of consciousness and asking a different kind of question. Rather than asking "why does this matter have consciousness?" we can ask "why do some kinds of physical systems have subjectivity—a point of view—while others do not?" (Godfrey-Smith 2019). This makes the question of consciousness an explicable biological phenomenon. Subjectivity has a collection of biological properties, most importantly agency, that are proper targets for evolutionary explanation. Like Thompson, Godfrey-Smith points out that biological systems are self-maintaining, metabolizing systems that must continuously create their patterns of organization including their boundaries. Through this process, the biological system is maintaining a distinction between itself and its environment. This makes even unicellular organisms subject-like entities with subjective properties, including maintaining and regenerating their organization; maintaining and regenerating the boundaries between system and environment; a sensitivity to the environment that impacts their self-maintaining and regenerating activities.

Godfrey-Smith provides a how-possibly story about the evolution of consciousness in terms of subjectivity, or a point of view. With the evolution of multicellularity, organisms developed perceptual capacities and sentience. Nervous systems that take in and integrate information, perceptual organs that transduce environmental features into proper inputs to the nervous system, and mobility elements such as fins, claws, and spines permit organisms to act on their environment in new ways, and to develop their agency and sensitivity to the environment. The development of perceptual capacities and sentience also requires that an organism can identify those modifications to the environment caused by its own agency as compared to those that are caused by something else. We see the development of a self-boundary/external world distinction into a self-caused/externally-caused distinction.

When an organism can distinguish self and environment, and when that environment is that of the Cambrian Explosion more than 500 million years ago in which the fossil record first shows evidence of multicellular organisms capable of perceiving and engaging with other organisms, the evolution of consciousness is impacted by social constraints. Organisms are both feeders and food, and they develop defenses and weapons. They must also develop some tolerances for other organisms once sexual reproduction becomes typical. The development of these behaviors requires that the organisms can engage in instrumental learning by responding to aversive and positive consequences of their own actions. Felt pain and pleasure can promote learning because these feelings don't just create a momentary change in the organism's behavior, but impact future dispositions to behave as well. Felt pain and pleasure can also help with moment to moment decision making, which is needed for an agent interacting in a complex world of other organisms and other nonagential features, both attractive and aversive.

A third biological approach is advocated by biologists Simona Ginsburg and Eva Jablonka in their book *The Evolution of the Sensitive Soul*, in which they propose an account of how consciousness evolved (Ginsburg and Jablonka 2019). They identify the transition from nonconscious to conscious organisms with the development of a capacity for an open-ended kind of learning they call Unlimited Associative Learning (UAL). This kind of learning, they argue, evolved multiple times, starting during the Cambrian era. UAL permits beings to assign value to new and complex stimuli, to remember the associations with these stimuli, and to use those memories to make decisions in the future. Because UAL has what they take to be all the key features of consciousness, including unification of stimuli and actions, the accessibility to cognitive processing, representations of one's body, the world, and the relationship between them, goal-directed behavior directed by emotion, flexibility, and a rudimentary responsiveness to past and future, Ginsburg and Jablonka propose that we can take UAL to be the marker for phenomenal consciousness. On their account, consciousness and cognition are inexorably intertwined.

All three accounts paint a picture of a world that is rife with experiences and points of view, suggesting there is something it is like to be a sea gull, a sea slug, and even a sea urchin. This approach identifies consciousness as evolutionarily ancient as well as widespread among current animals. By addressing the question of consciousness by examining its function over evolutionary time, the biological approaches suggest that any physiological study of consciousness should not limit its focus to primates or even to mammals. If consciousness is widespread among species, we need to widen the species we study. Rather than ignoring questions about "whether 'lower' animals, such as octopuses, *Drosophila* or nematodes, are conscious" as Koch and Crick initially proposed, the biological approach suggests that we should accept the octopus, *Drosophila* and nematode as conscious, and study these organisms next to the more typical macaque and human research subjects.

4.4.1 Worries about biological approaches

One might worry that biological approaches offer just-so stories for consciousness, not an explanation or theory of consciousness. However, these theories offer examples of how biological sciences can help us to understand consciousness as a feature of life from the very early days of evolution on earth. Just as the neuroscientific theories of consciousness lack a full story, they promote a research program in the hopes of understanding the nature of consciousness. The worry about a neuroscientific approach is that it starts with subjects assumed to be conscious, and then looks at neurological correlates of verbal reports of conscious behavior, thus just examining one kind of conscious experience. The worry about an evolutionary approach is that it starts with a view about the function of sentience, for agency and self-sustenance in an organism. Both approaches have their strengths as well. The neuroscientific approach helps us see how consciousness in humans (and other animals, if they are subjects of study) is organized, and such information can help to bolster an evolutionary story by giving lots of details about one point in the evolutionary process (namely, today). The biological function approach helps us see how very simple kinds of subjectivity could have evolved, through environmental and social pressures, into the human mind with all its variety of experiential capacities.

The neuroscience approach and the evolutionary approach are asking slightly different questions about consciousness. For neuroscientists, the question is “What is it in human or mammalian brains that correlates with conscious experience?” For biologists, the question is “How could conscious experiences of the human sort, including feeling worried about our own thoughts, falling in love, creatively imagining novel ways of living, or reliving past experiences for enjoyment, have evolved from these simple biological systems of the Cambrian Era?”

We have reviewed three ways to address the question of animal consciousness. The Theory Approach involves applying theories of consciousness to animals in order to determine which species would count as conscious. On such views, we need to start with plausibly conscious beings in order to investigate the phenomenon of consciousness. This leads us to the Epistemic Approach, according to which we have to determine how we can decide who is conscious pretheoretically. As we saw, this approach has us presuming consciousness in a wide variety of species. Finally, the Biological Approach identifies the question of animal consciousness as a question about how consciousness evolved, and it too sees consciousness as widespread among organisms. While we still lack a theory of consciousness, we have strong warrant for accepting animals as conscious. What this means is that when we go on to study the cognitive capacities of animals, we should be premising that investigation on the subjects being conscious. It also means that we can examine the kinds of consciousness we might find in different species. For one, it means that we can ask whether other animals might be self-conscious.

4.5 Self-consciousness

While most philosophers and scientists are convinced that we ought to take animal consciousness as a basic assumption (in the way in which we take the existence of human consciousness for granted), there is much less consensus around the question of self-consciousness. Self-consciousness is defined as a metacognitive awareness of one’s own mental states, awareness of one’s existence as a contiguous agent who moves through the world in time, or even as awareness of one’s self narrative.

4.5.1 Mirror self-recognition

Suppose you look at yourself in a mirror and notice a piece of spinach in your teeth. You must be self-conscious if you are able to do that, right? This is the thinking that led the psychologist Gordon Gallup to develop the *mirror self-recognition task*.

Gallup surreptitiously marked children's foreheads with a colored spot that the children couldn't smell or feel, and then he let them play with a mirror in the room. Gallup found that by two years old, children would more often touch the mark on their forehead when there was a mirror around than when there wasn't, and concluded that human children acquire a sense of self by that age. The same test was run on chimpanzees, who were first anesthetized before being marked. The chimpanzees, like the children, were more often observed to touch the marks when there was a mirror than when there was no mirror around, and Gallup concluded that chimpanzees also have a sense of self.

The mirror self-recognition task became a standard; it seems easy enough to mark an animal and wait to see if they touch the mark more often in the presence of a mirror. But there are some methodological problems. Looking at eyes might be aversive for gorillas. Dirty elephants might not care about marks on their bodies. Bottlenose dolphins don't have any limbs that they can use to touch the mark. Given that there are other explanations for why an animal would fail the mirror self-recognition task, failing it is not evidence that an animal lacks self-consciousness.

Is passing it evidence of self-consciousness? Many species are said to have passed, including Asian elephants (Plotnik et al. 2006), all the great apes (see Anderson and Gallup (2011) for a review), bottlenose dolphins (Reiss and Marino 2001), magpies (Prior et al. 2008), and there is controversial evidence in fish (Kohda et al. 2019). What is the argument that allows us to infer self-consciousness from this sort of behavioral evidence?

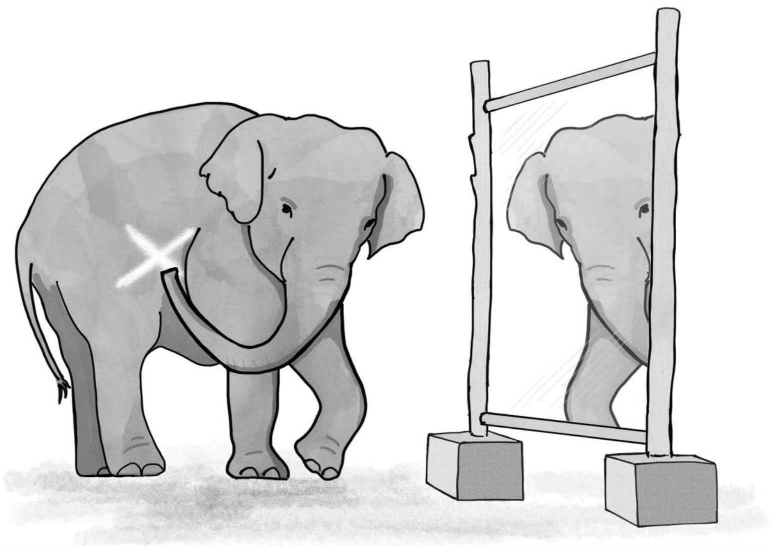

Figure 4.1 An elephant passes the mirror self-recognition task.

Gallup claims that recognizing oneself in a mirror is evidence of self-awareness because it requires that an individual become the object of their own attention, involving a concept of self and the ability to introspect (Gallup 1998). Gallup writes, “If you did not know who you were, how could you possibly know who it was you were confronted with when you saw yourself in a mirror?” (Gallup 1991, 122).

As a critic of the mirror self-recognition research program, Heyes attempts to recreate Gallups’ argument for thinking that mirror self-recognition requires self-consciousness in order to challenge the logic. She writes:

> The reasoning behind these claims has never been articulated, but it seems to be roughly as follows. 1) When I (a human) use my mirror image, I understand the image to represent my ‘self’, and I understand my self to be an entity with thoughts and feelings. 2) This chimpanzee uses his mirror image. 3) Therefore this chimpanzee understands his mirror image to represent his ‘self’, an entity with thoughts and feelings.
>
> (Heyes 2008, 265)

We’ve already seen that there are problems with arguments that rest on introspection about the methods we use to solve a problem, which puts some pressure on premise (1) and the argument form more generally. So, while we can agree with Heyes that this argument is weak, there is probably a most charitable way of reconstructing Gallup’s reasoning. In an earlier paper she gave a different formulation of the reasoning:

> When a primate is confronted with a mirror it receives ‘self-sensation’ (Gallup 1977, page 331); it is, as a matter of fact, sensing itself. If the primate can use a mirror to inspect its own body, then this self-sensation must have given rise to ‘self-perception’ (Gallup 1977, page 331), or, more commonly, ‘self-recognition’ (e.g. Gallup 1977, page 329); the mirror image not only is, but has been perceived by the animal to be, a representation of itself. Self-recognition logically requires a pre-existing ‘self-awareness’ (Gallup 1977, page 330) or ‘self-concept’ (e.g. Gallup 1977, page 329), therefore use of a mirror for body inspection implies the possession of such a concept. The nature of a self-concept or a ‘well-integrated self-concept’ (Gallup 1977, page 329) is largely unspecified.
>
> (Heyes 1994, 910)

Instead of indicating the existence of some unspecified sort of self-concept or self-consciousness, Heyes argues that passing the mirror self-recognition task can only indicate that one has the ability to recognize one’s own body, not one’s own self. So long as an individual can recognize that some sensory inputs originate from one’s own body and that others come from elsewhere, they can pass the test. Heyes claims that an animal needs that ability to learn that the sensory inputs originating from the reflection in the mirror correlate with the sensory inputs originating within one’s own body (Heyes 1994). However, as Heyes also points out, that ability is probably widely present among vertebrates, since the ability to distinguish one’s own body from the rest of the world is needed to successfully move around in the world. This raises a question about this interpretation of the test, given that many species fail it. Heyes doesn’t explain why the great apes and dolphins pass the test, but many other species appear to fail it.

Another suggestion is that passing the test involves the ability to generate and compare two different representations of the same thing. For example, the psychologists Suddendorf and Butler write, “By comparing an expectation about one’s physical appearance with current perceptions of a reflection, inconsistencies, such as the mark, can be noted and motivate exploration” (Suddendorf and Butler 2013, 122). And because they think there is only good evidence for mirror self-recognition among the great apes, and because they think there are no apparent fitness benefits associated with recognizing oneself in a mirror for the common ancestor of the great apes, Suddendorf and Butler conclude that self-recognition probably evolved as a spandrel, a side effect of the common ancestor’s ability to compare multiple representations of the same thing—something which may have profound fitness benefits.

Passing the mirror self-recognition task might serve to raise our credence in the claim that some animal is self-conscious; it gives us some reason to think that the animal, in some sense, understands the reflection is a reflection of oneself or one’s own body. Further evidence for self-awareness could come from evidence that an animal is able to recognize their own thoughts. There are two other research programs that some think offer evidence of self-consciousness in other species, mental monitoring and episodic memory.

4.5.2 Mental monitoring and metacognition

Humans can be uncertain of memories, judgments, and the truth of claims. When we are uncertain of our own mental states, we are experiencing a variety of self-consciousness. When students know they understand the material, they don’t need to study more. When I know that I know how to get to a park in the city, then I won’t check a map before heading out.

If animals are conscious of their own memories and judgments, then they should demonstrate the ability to correctly indicate whether they know what they know, or not. Various uncertainty monitoring tasks have been given to animals in order to determine whether any other species has a similar ability to think about the accuracy of their own thoughts. Positive evidence exists for rhesus macaques (Beran et al. 2006), a dolphin (Smith et al. 1995), and rats (Foote and Crystal 2007).

In one study, the psychologist Robert Hampton devised a memory-monitoring paradigm that he used with macaque monkeys. Knowing that monkeys can perform a simple delayed match to sample task, Hampton added one feature—he allowed monkeys to decide whether to take the test, or to choose not to take the test. If they took the test and passed, they received a valuable treat, but if they failed the task they received nothing. However, if they decided not to take the test, they were given a lesser value food reward. Thus, if monkeys could know when they would pass or fail the test, they could maximize their rewards. Hampton (2001) found that the frequency with which the monkey chose not to take the test increased with the duration of the delay since the original sample was presented.

In a study with dolphins, researchers reported distinctive behaviors around threshold conditions, when the subject was most likely to give the uncertainty response (Smith et al. 1995). This fits with my own experience working with dolphins who would respond to difficult tasks by swimming in a tight circle between the two choices before finally settling on one. I also observed Hiapo, the young male dolphin at the Kewalo Basin Marine Mammal Laboratory, to engage in this kind of uncertainty behavior when learning new tasks.

While Hampton explicitly eschews drawing any conclusions about consciousness from this research (Hampton 2001), a psychologist who did some of the first tests of metacognition in animals, J. David Smith, thinks that the best explanation for the monkeys' performance is that they have "functional analogs to human consciousness" and that uncertainty monitoring research "may be opening an empirical window on animals' cognitive awareness" (Smith 2009, 389). Why? Because the data on human performance on such tasks is strikingly similar to the data on monkeys, and humans report a phenomenological experience of uncertainty when they decline a hard trial. Elsewhere, Smith and colleagues claim that it is "implausible that humans would produce their highly similar graph in a qualitatively different way [from macaques]" (Smith et al. 2012, 1304); if nonhuman primate behavior resembles human behavior, then the most parsimonious conclusion is that the psychological states and processes are similar.

However, humans may have a phenomenological experience when engaging in some behavior that plays no causal role in the behavior itself. The feeling of uncertainty may not *cause* the behavior; rather, the feeling might be a *result* of the behavior.

In addition, the claim that uncertainty monitoring is evidence of metacognition is a matter of some debate. After first taking the rat behavior in uncertainty tasks to be evidence of metacognition, Crystal and Foote later declared that the rats may be learning how to solve the problem by forming associations between the reward and test-specific contingencies, rather than by looking inward at their mental state. They conclude that since associative processes could explain the performance, no metacognition is involved (Crystal and Foote 2009). However, note that this move is only warranted if it isn't possible for the system to be both associative and metacognitive. Further, as Irina Mikhalevich points out, just because a task can be solved in some way doesn't mean that the subject is actually using that method when confronted with it (Meketa 2014).

Another alternative explanation of the uncertainty monitoring performance as evidence of metacognition comes from Carruthers, who argues that animals can solve these sorts of tasks without metacognition, as long as they have beliefs and desires that come in various strengths (Carruthers 2008); moreover, they might even solve these problems in non-representational affective terms (Carruthers and Ritchie 2012). This suggestion is consistent with models psychologists have created to show that the strength of response traces can be used to solve problems thought to be metacognitive (Smith et al. 2008). However, it is a matter of debate whether these models are not properly understood as metacognitive. If metacognition is properly understood as epistemic self-evaluations, then the models are not alternative explanations to metacognitive ones, but they are examples of metacognition.

It is important to remember that the questions we can ask about metacognition might differ, and that answers to these questions that appear to conflict may be answers to slightly different questions, or descriptions at different levels of explanation. With a better understanding of all the mechanisms involved in human metacognition, we could deconstruct the activities we label as metacognitive to see in which ways different species solve these problems. This project has been taken up by Joëlle Proust (2014), who argues that much of what we take as metacognitive in humans requires a kind of cognitive control that is available to nonhuman animals.

4.5.3 Episodic memory

Another type of evidence for self-consciousness is episodic memory, or a kind of mental time travel where we recall personal experiences, such as what happened at a family wedding. The psychologist who introduced the notion of episodic memory, Endel Tulving, describes it this way:

> Episodic memory is a recently evolved, late developing, and early deteriorating brain/mind (neurocognitive) memory system … It makes possible mental time travel through subjective time—past, present, and future. This mental time travel allows one, as an "owner" of episodic memory ("self"), through the medium of autonoetic awareness, to remember one's own previous "thought-about" experiences, as well as to "think about" one's own possible future experiences. The operations of episodic memory require, but go beyond, the semantic memory system … The essence of episodic memory lies in the conjunction of three concepts—self, autonoetic awareness, and subjective time.
>
> (Tulving 2005, 9)

Autonoetic awareness is a kind of self-consciousness in which one thinks about oneself in a particular circumstance, such as a past experience or a hypothetical future one. Since autonoetic awareness is an essential aspect of episodic memory, evidence that some animal has episodic memory would be evidence of self-consciousness. Tulving suggests that the function of episodic memory is actually related to future episodic thinking; once you can replay your past, you can project yourself in the future and better plan for future events (Tulving 2005).

Episodic memory also allows us to return to an earlier event in our life and have a second opportunity to learn from the experience. For example, close your eyes and think of your childhood home. Can you, in your mind's eye, walk through your home and count the number of windows, or the number of faucets, or the number of mirrors? If so, you can gain new information about your home using your episodic memory.

We know that various animals have excellent memories for the location of food sources, shelters, landmarks, etc. (while this knowledge of the world is usually called by psychologists "semantic" or "declarative" memory, there is no linguistic element required for having it). However, some psychologists including Tulving (1983, 2005) suggest that animals lack an episodic memory system.

While direct experimental evidence of the autonoetic consciousness that is key to human episodic memory cannot be directly tested in other species, savvy researchers have found ways to test whether other animals can access information about the *what, where*, and *when* aspect of their past experiences. In the first formal test of episodic-like memory in animals, researchers asked whether scrub jays, who are food storing birds of the corvid family, can remember the what, where, and when of hidden food. Scrub jays cache food for short- and long-term storage, but not all food decays at the same rate. Peanuts are suitable for long-term storage, whereas wax worms need to be eaten relatively quickly. After training the birds to cache peanuts in one section of a sand filled ice cube tray, and wax worms in another section, the birds were allowed to uncache food after various delays. Nicola Clayton and Anthony Dickinson (1998) found that the scrub jays will uncache peanuts after a long delay, and worms after a short delay, thereby suggesting that scrub jays can recall three types of information: What was cached (worm vs. peanut), where each item type was cached, and when the worms were cached.

Clayton and colleagues subsequently tested scrub jays on a variety of versions of this task, with similar results; scrub jays are very good at finding still edible food that they had previously cached. The question, of course, is whether this ability requires the existence of autonoetic consciousness. As Tulving put it, the ability to think what, when, and where may be a property of semantic/declarative memory, without requiring episodic memory.

Clayton and Dickinson acknowledge that their study doesn't offer behavioral evidence of self-consciousness. But this isn't seen as a weakness, because

> autonoetic consciousness … is probably undetectable in many species. In terms of purely behavioural criteria, however, the cache recovery pattern of scrub jays fulfils the three, 'what' 'where' and 'when' criteria for episodic recall and thus provides, to our knowledge, the first conclusive behavioural evidence of episodic-like memory in animals other than humans.
>
> (Clayton and Dickinson 1998, 274)

However, Tulving thinks that the question of episodic memory in animals is empirically tractable. Tulving suggests a test inspired by an Estonian folk tale in which a young girl dreams that she goes to a birthday party where chocolate pudding is served. Unfortunately for the young girl, only children who brought their own spoon can eat it, and she leaves without a taste. The next night, she goes to bed with a spoon in her hand, determined not to lose out again. The "spoon test" that Tulving proposes involves determining whether an animal will plan ahead by acquiring a tool, such as a straw, which would be needed later and in another place for drinking a delicious liquid.

Many animals appear to pass Tulving's test. Recall the discussion in Chapter 3 of Santino, the chimpanzee who is living in a Swedish zoo and appears not to like visitors. His act of gathering chunks of rock and concrete and concealing them under hay seems a natural example of the spoon test, since he uses them later to throw at annoying tourists. However, the interpretation of Santino's behavior as planning for the future was criticized by psychologists who offered alternative explanations. Similar questions are asked when researchers point to wild chimpanzees who carry rocks some distance to where they are needing for cracking nuts (Boesch and Boesch 1984). And, while there have been formal studies showing that apes can carry tools to leave at places they will be later needed (Mulcahy and Call 2006), nonconscious associative learning may explain why the subject carries the tool around. Rather than projecting oneself into the future and imaging the need for the tool, the individual may associate the delicious treat with the tool, and hold onto it given his past experience using the tool to get a treat.

Scrub jays also pass Tulving's spoon test. In one study, scrub jays were taught that they received dog kibble for breakfast in compartment A, and peanuts for breakfast in compartment C. After the jays had learned this association, a food bowl containing both kibble and peanuts was placed in compartment B, and the birds were allowed to cache either food in either compartment. The study authors suggest that a conditioning account would predict that the

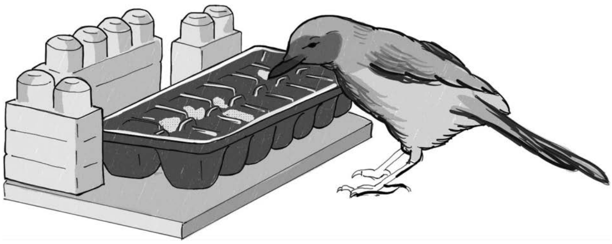

Figure 4.2 Experimental set-up for the scrub jay episodic memory tasks.

birds would cache food in the compartment previously associated with that food, but that a forward planning account would predict that the birds would cache in the opposite pattern, because scrub jays prefer a diversity of foods. In fact, the jays did cache in the opposite pattern, suggesting to the study authors that the birds were anticipating their future motivational states when caching the foods (Raby et al. 2007).

Other studies that try to capture aspects of episodic memory have been performed on the great apes, particularly in language-trained great apes. A gorilla, King, was able to select correct photographs to report on events that he had previously witnessed (Schwartz et al. 2004, 2005). And a chimpanzee, Panzee, was able to correctly select the lexigram token for a food item that had been previously hidden in another location, return to that location with the lexigram token, and trade it for the food (Beran et al. 2012.)

If passing the spoon test or recalling past events requires autonoetic consciousness, then accepting that these studies indicate such abilities in nonhuman animals would also require accepting that these individuals have autonoetic consciousness. The question that remains, of course, is whether such conscious experience is required. The fact that humans have conscious experience while they are solving such tasks isn't sufficient to conclude that humans *must* have conscious experiences when they are solving the tasks. Nonetheless, the corvid study and the apes study, which seems to hold up against Tulving's spoon test, do offer some justification for self-consciousness in animals, and can be used along with other sorts of evidence in an inference to the best explanation argument.

4.6 Chapter summary and conclusions

Phenomenal consciousness (or consciousness for short) refers to the capacity to feel something—the experiential nature of the mind. When we ask whether animals are conscious, we want to know whether they feel something at all, or whether they are unfeeling rocks. There are three ways to address the question of animal consciousness. The Theory Approach has us applying theories of consciousness to animals in order to determine which species would count as conscious. The Epistemic Approach has us identifying prima facie candidates for consciousness pretheoretically, and it is needed as a foundation for any theory of consciousness. The Biological Approach has us identifying the questions about consciousness with the questions about life, and seeks to understand the biological function of consciousness.

Philosophical discussions of consciousness are often centered on two puzzles. The Mind Body Problem asks, *What kinds of relationships exist between mental events, properties, functioning, etc., and physical events, properties, functioning, etc.?* The Hard Problem asks, *In virtue of what is a physical system a conscious system?* These questions are taken up by those who worry about an Explanatory Gap between our understanding of the physical description of events and our understanding of the psychological description of events.

We looked at two varieties of theories of consciousness, Representationalist and Higher-Order Representationalist. We see that advocates of these theories disagree about which species count as conscious. Tye's PANIC and Prinz's AIR theories suggest that consciousness is widely found in the biological world. On Higher-Order views, there is debate about whether or not metarepresentational capacities are required, and the different positions have consequences for which animals would be seen as conscious.

General worries about theory approaches are that the entailments are only as strong as the theory is, and there remains disagreement about the accuracy of any one theory. In addition, the content of the theory will vary depending on who is included in the subject pool as a conscious being worthy of study at the start. That is, there is a worry that the *who is conscious?* question may be begged just as badly if we start with only humans as conscious beings, as it would be if we started with the view that all life is conscious. These worries lead us to look at the Epistemic Approach to animal consciousness, which asks which features cause us to take others as conscious. Tye advocates for the use of behavioral observations and the application of Newton's Principle—that like causes have like effects. I advocate using a Dynamic Marker Approach to answer the who's conscious question. This method starts by identifying the properties that make humans think that the target system is conscious, and then generates a starting class of beings across species that have those properties. This subject group is studied to look for similarities across systems, which can lead to additional markers, including perhaps neural correlates. We can then revisit the starting class, considering whether to remove some types or include others.

Pain behavior is one marker of consciousness that many scientists and philosophers have focused on. We discussed the research on fish pain and the evidence that fish are conscious given consideration of their pain behaviors and neurophysiological structures. Worries about the Epistemic Approach include its anthropocentrism, which may miss some animals that are indeed conscious and include some that are not.

The Biological Approach starts with an assumption about the function of consciousness in the evolution of biological organisms, and implies that consciousness is widely found across species. Evan Thompson argues that the self-organizing nature of living cells is sufficient for consciousness, while Peter Godfrey-Smith, Eva Jablonka, and Simona Ginsburg suggest that consciousness arose with the simple animals living in the Cambrian period who had sensory systems, mobility, sociality (Godfrey-Smith), and the capacity for general associative learning (Ginsburg and Jablonka). The ability to survive and reproduce was made possible by feeling attracted to food and mates, feeling aversion toward bodily damage, and learning how to seek out attractive stimuli and avoid aversive ones. While the Biological Approach offers a how-possibly story about the evolution of consciousness, worries arise that it is simply a speculative just-so story. One may worry that attraction and aversion can occur without consciousness. Furthermore, one might worry that the approach limits consciousness to biological beings, excluding the possibility that non-evolved systems such as androids might be conscious.

When we are faced with difficult questions, it is often helpful to try to answer the question using various methods. The Theory, Epistemic, and Biological Approaches all have their strengths and weaknesses. Our best hope for understanding the nature of consciousness will be for people to take seriously each of these approaches. For now, on the question of whether at least some other animals are conscious, the preponderance of the evidence supports that they are. As the Cambridge Declaration scientists pointed out, the current science of consciousness is based on an assumption of primate consciousness. Our pretheoretical engagement with other animals treats them as conscious, and we have a plausible biological account for why we should expect consciousness to be found widely among agential organisms.

Once we grant animal consciousness, we can turn to ask more specific questions about the kinds of conscious experience animals might enjoy. We ended the chapter by reviewing three sources of evidence for self-consciousness in animals: Mirror self-recognition, mental monitoring, and episodic memory. These three research programs are the ones that are most clearly focused on investigating animal awareness, and while no research program can offer definitive proof, by considering corroborating evidence from different research programs, we have reason to increase our belief in the possibility that other animals are self-conscious.

Notes

1 The interview was recorded for As It Happens on CBC Radio, and aired January 17, 2018.
2 You can read the Associated Press article picked up by the CBC https://www.cbc.ca/news/world/man-shot-in-head-5-years-ago-didn-t-know-it-1.975525.
3 There is a fourth approach—panpsychism—according to which all matter has an experiential element. On panpsychism, animals would also have experiential elements of a sort, but it isn't clear what sort it would be. For a panpsychist, the question changes from whether some being is conscious to whether some being is a seat of self or agency. We won't here delve into how different theories of panpsychism would answer those questions about particular animal species, as there has been little written on the issue, but it is an interesting topic for further exploration.

Further reading

Defining consciousness

Schwitzgebel, Eric. "Phenomenal Consciousness, Defined and Defended as Innocently as I Can Manage." *Journal of Consciousness Studies 23, 11–12* (2016): 224–235.

Theory approaches

Carruthers, Peter. "Comparative Psychology without Consciousness." *Consciousness and Cognition 63* (2018): 47–60.

Gennaro, Rocco. "Animal Consciousness and Higher-Order Thoughts." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews & J. Beck, 196–205. New York: Routledge, 2017.

Prinz, Jesse. "Attention, Working Memory, and Animal Consciousness." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews & J. Beck, 185–195. New York: Routledge, 2017.

Epistemic approaches

Andrews, K. *How to Study Animal Minds*. Cambridge: Cambridge University Press, Forthcoming 2020.
Braithwaite, V. *Do Fish Feel Pain?* (1 edition). New York: Oxford University Press, 2010.
Shriver, Adam. "The Unpleasantness of Pain for Nonhuman Animals." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews & J. Beck, 176–184. New York: Routledge, 2017.
Tye, Michael. "Do Fish Have Feelings?" In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews & J. Beck, 169–175. New York: Routledge, 2017.

Biological approaches

Godfrey-Smith, Peter. "The Evolution of Consciousness in Phylogenetic Context." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews & J. Beck, 216–226. New York: Routledge, 2017.
Godfrey-Smith, Peter. *Other Minds: The Octopus, the Sea, and the Deep Origins of Consciousness*. New York: Farrar, Straus and Giroux, 2016.
Ginsburg, Simona, and Jablonka, Eva. *The Evolution of the Sensitive Soul: Learning and the Origins of Consciousness*. Cambridge, MA: The MIT Press, 2019.
Thompson, E. "Précis of Mind in Life: Biology, Phenomenology, and the Sciences of Mind." *Avant: Trends in Interdisciplinary Studies 2 (T)* (2011): 83–95.
Trestman, Michael. "Minds and Bodies in Animal Evolution." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 206–215. New York: Routledge, 2017.

Metacognition and cognitive control

Beran, Michael. *Self-Control in Animals and People*. London: Academic Press, 2018.
Bermúdez, José. "Can Nonlinguistic Animals Think about Thinking?" In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 119–130. New York: Routledge, 2017.
Proust, Joëlle. *The Philosophy of Metacognition: Mental Agency and Self-Awareness*. Oxford: Oxford University Press, 2014.
Proust, Joëlle. "Nonhuman Metacognition. In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 142–154. New York: Routledge, 2017.
Saidel, Eric. "On Psychological Explanations and Self-concepts (In Some Animals)" In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 131–141. New York: Routledge, 2017.

On-line resources

The Stanford Encyclopedia of Philosophy is an excellent resource for the topics discussed in this chapter, including entries on Animal Consciousness, Consciousness, The Neuroscience of Consciousness, and Representational Theories of Consciousness.

5 Can animals think?

Artemis the dog is chasing a rabbit through a field, but the rabbit is fast and disappears down a path. When Artemis gets to the point where the rabbit disappeared, she sees that there are only three ways the rabbit could have gone. Artemis puts her nose to the ground, sniffs the first path and then the second path, then lifts her nose and rushes down the third.

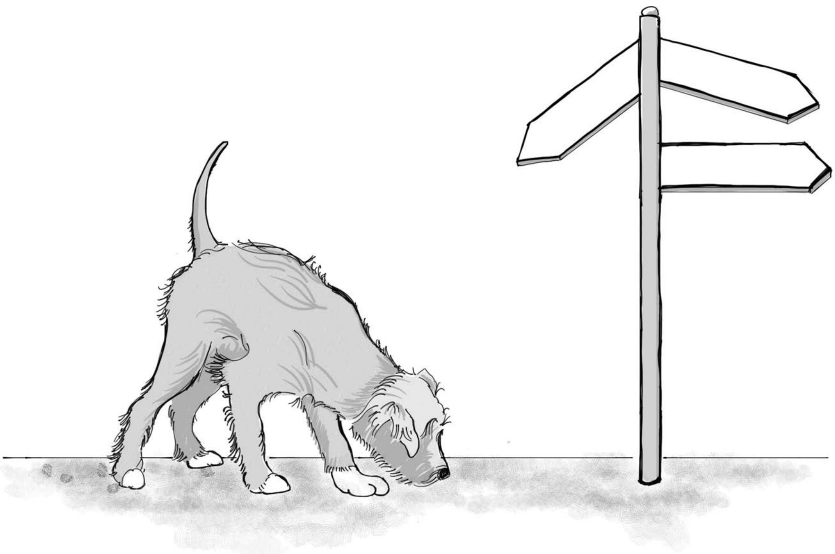

Figure 5.1 A dog infers that the rabbit ran down the third path after sniffing the first two.

More than 2,000 years ago, the Stoic philosopher Chrysippus reported seeing a dog solve this exact problem, and he concluded that the dog could think and reason. It appears that Chrysippus's dog, like Artemis, made a rational inference using the following deductive inference schema:

1 A or B or C.
2 Not A.
3 Not B.
4 Therefore, C.

On this interpretation of the behavior, Artemis believes that the rabbit didn't run down the first two paths. The dog was able to form this belief as the result of her ability to make a logical inference using the above argument schema (which is called the disjunctive syllogism). Artemis' capacity for logical reasoning makes her a rational being.

By now, you should already be wondering if there might be alternative explanations for Aretmis' behavior. Just because we can describe her behavior as the outcome of a logical inference doesn't mean that her cognitive processes are organized according to the rules of logic. Perhaps others methods are also possible. Recall that inference to the best explanation arguments rests on comparing more than one possible explanation.

In this chapter, we will examine philosophical theories and scientific evidence relating to animal thinking. Given what we see animals do, it seems apparent that they think. But if they think, what do they think in—language, pictures, or something else? How do they think? Are they rational? Do they use logical reasoning, causal reasoning, or statistical reasoning? Asking these questions may help us better understand how humans think, and the nature of thought itself.

5.1 What is thinking?

Descartes famously said, "I think, therefore I am," suggesting that he could never doubt his own existence, for the very act of thinking "I might not exist" is an affirmation that I do exist. But by "think," Descartes had something pretty specific in mind. For Descartes, a *thought* is a structured set of elements that can be expressed in another structured set of elements, namely language. *Thinking* is the ability to generate new thoughts through a systematic, formal process. The Cartesian model of thinking makes thought like language, mathematics, or logic, and this view has been of immense influence in philosophy.

In daily life, "think" and "thought" mean something a bit less grandiose. Thinking is the mental process that allows us to understand things in our world, make decisions, solve problems, or develop opinions. We think when we need to figure something out—"Let me think about it." Sometimes, we critique people for not thinking, and just acting on impulse. This commonsense understanding of thought is a functional understanding, given in terms of what it allows us to do. With a functional understanding of thought, according to which thinking is the mental process that permits understanding, decision making, problem solving, and the like, we can attempt to identify instances of thinking by looking at behavior. Artemis demonstrates thought when she figures out that the rabbit must be down the third path. Rats demonstrate thinking when they indicate that they remember a red cross that was presented five minutes earlier on a computer screen. Apes demonstrate thinking when they fill a tube with water in order to acquire a peanut stuck at the bottom. While we observe *that* the animals are thinking, we still don't know *how* they are thinking.

When we consider animal thought, we can use the calibration method, starting with the functional, commonsense understanding of what counts as thinking. As we introduce theories of thinking, we should keep in mind the functional account of thought, and the value of having theories that best explain the range of phenomena that fit the functional definition. If it turns out that a theory of thought only explains a small subset of what appears to be thought on a functional understanding, then we will have reason to reject it as a full account of the nature of thought. That is, while the theory might describe one way in which creatures can think, it may not be comprehensive.

An investigation into thought starting with the functional account of thought and using the calibration method can also lead us to reconsider some behaviors that we took to indicate thought. For example, we might be tempted to see an animal's ability to select a richer resource as an example of thinking—deciding between two patches of food. However, there might be other ways of selecting between resources. For example, plant roots efficiently seek out nutrients in the soil, and if we don't consider plants to think, we may want to consider alternative explanations. Rather than thinking, the animal or the plant might be perceiving one resource as richer than another, or even just sensing rich resources. No thought may be needed.

We can ask several different questions about animal thinking. For one, we can start with theories about the nature of thought, and apply those theories to decide whether animals think. Theories of thought are often framed in terms of what is sometimes called the vehicle of thought—or what we think in. These theories are varieties of *representational theories of thought*, according to which thinking requires representation, and cognition is the manipulation of mental representations. We will look at a few different proposals about the vehicle of thought, and consider both whether we should accept the proposal, and whether it suggests that animals have thought. We will also raise the question of whether framing theories in terms of vehicles of thought is a helpful approach, given its assumption that the mind is a representational system.

A second question is whether animals have beliefs. This question will also be related to theoretical views about the nature of belief, and questions about whether we can use human concepts to describe the content of animal thought. It may be that when we say "Artemis believes that a rabbit ran down the third path," we are using concepts that Artemis cannot grasp. Artemis might not have the concept THIRD, and she might not be able to distinguish a rabbit from a cat. Perhaps Artemis has nonconceptual representations of number. Perhaps Artemis has concepts, but they are very different from ours—and she thinks about SMALL FAST FOOD rather than RABBIT.

A third question is whether the relationships between animal thoughts are rational. We can define *rationality* as successful thought, where successful can be cashed out in different ways. For example, we might think of rational thought structurally when thought processes follow the rules of logic. Or we might think of rational thought as thought that is merely consistent with the rules of logic, even if it follows different rules. Finally, we might think of rationality as behavior that makes sense given the organism's past experience and current situation.

Rationality is commonly seen as logical thought, and humans tend to take ourselves as rational in this sense—though, of course, we are not perfectly logical beings! We will look at a research program investigating logical thought in animals in order to determine how humans and other animals may be similar and different in this regard.

In addressing these questions, we will attempt to get a better understanding of what we are asking—what we really want to know—when we ask whether animals think, whether they have beliefs or concepts, and whether they are rational. We may find that we mean more than one thing, and that is useful to discover.

5.2 What might animals think in?

This question may sound a bit odd, but the idea should be pretty simple. Just as we speak in languages, perhaps we think in some medium. Philosophers over the centuries have proposed that we think in pictures, in words, or in sentences. More contemporary proposals suggest that we may think in a language of thought (LoT), or in nonconceptual formats, while other philosophers think that the idea that we think in anything is unhelpful.

If animals think, and from a functional perspective we have good reason to think that they do, we can then turn to ask what is the medium or vehicle of their thought. We can consider three different possible vehicles of thought: Language, diagrams, and nonconceptual representations.

5.2.1 Language

Since we express our thoughts in language, a first pass at the question "what do we think in?" may have us considering whether we think in language. Some people report thinking in language, and have the ability to retrace the reasoning that led from one thought to the next. Even if you don't *feel* like you think in language, the words and grammatical structure of language could be what allows you to generate new thoughts. By putting familiar words together in new ways, we can get everything from poetry to quantum computing.

There are a number of reasons to reject the view that we actually think in the languages we speak, such as English and Urdu. For one, we seem to have thoughts we don't know how to articulate. Tip of the tongue phenomenon can make this abundantly clear. In addition, I can think in English the same thought that someone else thinks in Urdu, which suggests that there is some third thing that we are both thinking that is the same. Finally, I can express the same thought in two different strings of words; "It's hot out" and "The temperature is high." All these considerations suggest that there is some thought beyond the words we use to express it.

For these reasons, philosophers have largely rejected the idea that we think in language. However, language and thought are still often taken to be closely related. For one, there are subtle views according to which one cannot have beliefs without language. These views typically hinge on the claim that we cannot translate the thoughts of beings without language, and so it doesn't make any sense to say that they have thoughts when we can't say what those thoughts are. These sorts of arguments will be considered in Section 5.3.

Another way that language and thought have been taken to be closely related is in the idea that we think in a kind of LoT—mentalese. According to Jerry Fodor's LoT hypothesis, thought has a language-like structure (Fodor 1975). Fodor's view reflects the cognitive turn in psychology, which takes cognition to be a form of information processing. An argument in favor of the LoT hypothesis comes from the observation that thought, like language, is compositional (there are parts that can be rearranged into different orientations), productive (the system can represent a number of different contents in virtue of different arrangements of parts), and systematic (the ability to think one thought is related to the ability to think another thought using the same concepts). Our grammatical rules allow us to construct new sentences from the concepts in existing sentences in ways that obey the rules of grammar, just as our LoT allows us to construct new thoughts out of old ones, and to combine familiar concepts in new ways.

The LoT hypothesis doesn't require that a thinker has an external language like English or Urdu. On the hypothesis, any animal who thinks has a LoT, even though they don't communicate those thoughts using external language. To explain Artemis' behavior, the LoT hypothesis would have her thinking in a dog mentalese "The rabbit could have only taken one of these three paths. I can tell that the rabbit didn't take this path or that path, so the rabbit must be down the third path."

Scientists and philosophers alike have used the theory to try to show that animals do, or do not, have a LoT. The primatologists Dorothy Cheney and Robert Seyfarth have argued that their research on the baboons of Botswana's Okavango Delta suggests that baboons do have a LoT (Cheney and Seyfarth 2007). Baboons live together in large troops with multiple families of females and their offspring, with adult males supporting the adult females. Female baboons have linear dominance hierarchies that are inherited from their mothers and can be stable for years. The dominant individual is a mother, and next in line are her daughters. Then comes another mother followed by her daughters, and so forth. Female kin live together throughout their lives, and enjoy very close social bonds, grooming one another for hours a day. They also know all the family and dominance relationships between group members. While they do have regular fights over access to food or infants, these sorts of interactions rarely lead to a change in the dominance hierarchy. However, occasionally there is a dominance revolution. Since baboons communicate using vocalizations, and they know who is making a call even when the individual is out of sight, baboons can recognize a dominance revolution just by hearing a formerly dominant female giving a submissive vocalization. Sometimes after the altercation, the winner of the fight will give a reconciliation grunt, which causes the loser to relax; she might stop moving away or cowering. The reconciliation grunt signifies that the fight is over. Third party reconciliation is common; after a fight, the sister or mother of the winner will often grunt, which has the same effect on the loser.

Cheney and Seyfarth suggest that the evidence for a baboon LoT comes from their ability to understand these dominance shifts. For example, the baboons have to make transitive inferences. When you know that Birte is taller than Clara, and that Clara is taller than Denae, you are making a transitive inference when you realize that Birte is taller than Denae, too. The baboons can make transitive inferences about dominance relationships rather than height. The baboons know that, for example, if baboon D12 wins a fight against baboon B4, and B4 gives a subordinate grunt to D12, the entire D family will be promoted over the B and C families in the hierarchy.

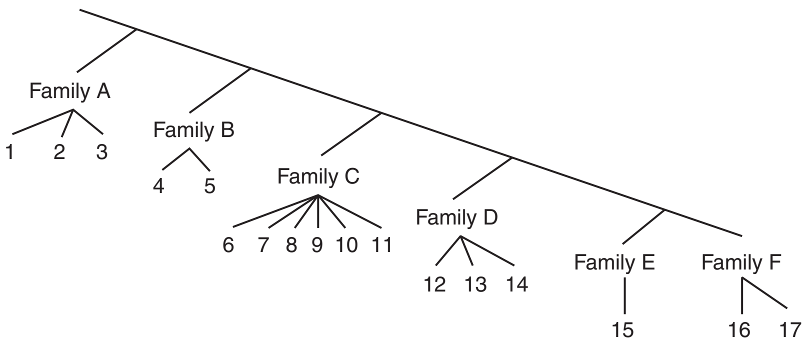

Figure 5.2 Hierarchical dominance relations in baboons.
Source: Cheney and Seyfarth (2007, 107).

The ability to keep track of changing relationships between individuals suggests to Cheney and Seyfarth that baboons have capacities that require the structure of language. Baboons are able to represent discrete individuals, their behaviors and their relationships, which is propositional information. Since baboons do not have language, this ability must be based on structured thinking, which Cheney and Seyfarth propose is a baboon LoT.

The LoT hypothesis remains controversial in philosophy and cognitive science, and while evidence from animals may help to support, or undermine, the hypothesis, we shouldn't take success or failure to find LoT in animals as evidence that animals don't think. They may think in other ways. Furthermore, just because a hypothesis is consistent with behavior isn't enough evidence to conclude that the hypothesis is true. Competing hypotheses should be searched out and examined alongside the hypothesis in question. One competing hypothesis has the baboons thinking in diagrams.

5.2.2 Diagrams and maps

It is common today to accept that some thinking may be accomplished by a medium other than a mental language. For one, we might think in diagrams. Artists and designers, who have to sketch their ideas rather than describing them in language, and the old adage "A picture is worth a thousand words," suggest that there are ways of thinking outside language.

Elisabeth Camp takes up this suggestion by offering an explanation of the baboons' behavior in terms of diagrams (Camp 2009). It's true that the baboon representational system seems to be compositional, since they can represent a number of different individuals. It's also true that the baboon representational system seems to be productive, because baboons can rearrange the individuals into different hierarchies. But these features are not sufficient for LoT, Camp points out. There exist nonlinguistic compositional and productive systems, such as Venn diagrams or city maps. Language and LoT are robust domain general systems, and they may be more sophisticated than needed to keep track of dominance hierarchies.

Camp suggests an alternative hypothesis: Baboons may think in terms of a taxonomic tree, representing relations just like the image Cheney and Seyfarth provide in Figure 5.2. This would make baboon cognition less general and less expressive than language, and explains both what baboons can do and what they can't do. As far as we know, baboons don't make inferences about transitivity outside social relations and they don't produce structured utterances. The LoT hypothesis can't explain why baboons don't do these things, but the taxonomic tree hypothesis can, because it is domain-specific—it is limited to the representation of dominance relations. This explanation is simpler than the LoT hypothesis, and more explanatorily robust because it accounts for what baboons can do, as well as what they cannot do.

Other kinds of diagrams that might support thought include mental or cognitive maps. Like language, maps are systematic and productive. Maps have elements that can be meaningfully rearranged—using the same elements, a map might say "Minneapolis is north of Toronto" or "Toronto is north of Minneapolis." The elements of a map can be rearranged in any number of ways, and so maps can be used to express new beliefs that have propositional formats.

Like taxonomic trees, maps don't have the same expressive power that language does, so what you can think and what you can infer will be limited. Maps are also domain-specific, permitting thought only about geographic features and the relationships between them. Nonetheless, given the type of information mental maps can represent, they could serve as a vehicle for propositional thought.

There is good evidence that humans and animals use something like a mental map. The psychologist Edward Tolman was perhaps the first to suggest that animals use cognitive maps, a mental representation of the geometrical relationship between elements in the environment. Tolman was working with rats in mazes, and he found that his rats were able to take novel shortcuts and detours without training in order to find a food reward. If you can figure out a shortcut, the reasoning goes, you have in mind a representation of the landscape, as opposed to an ability to navigate via landmarks. Scientists have examined cognitive maps in animals by moving them to a strange part of their territory and then releasing them. A variety of species, including honeybees, bats, and pigeons, are able to find their way directly home, or to a known food source from a novel location, thus suggesting they locate their position on a cognitive map, rather than by landmarks, and compute how to best arrive at the desired location.

While maps are a kind of imagistic representation that can support thought, as was already mentioned, they do not support thinking in all domains. They can't be used to think about the laws of logic, for example, or to figure out whether to mate with one individual or another. It isn't clear how a map would be able to support Artemis' apparent inference about the location of the rabbit. Maps can't serve as a complete propositional representational system.

Maps and diagrams are two examples of nonlinguistic systems of thought that support representation, and which can take sentential form. There may also be different kinds of thought systems that cannot take sentential form, because they do not have conceptual components. We will turn to this question next.

5.2.3 Nonconceptual thought

Both LoT and cognitive maps are examples of representational systems that have conceptual elements. A concept is typically considered to be a constituent of thought, akin to a word in a sentence. While images like maps consist of conceptual elements, like places or objects, they also have elements that can be represented nonconceptually, such as the distance between two locations.

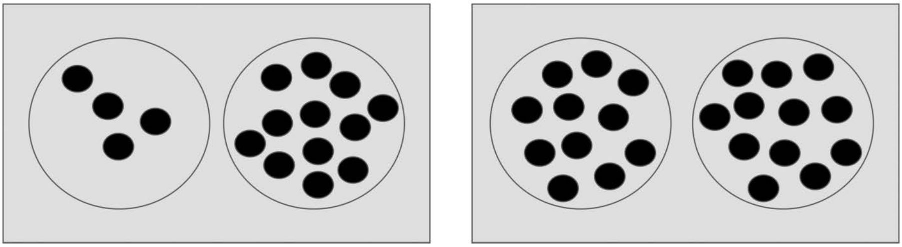

Figure 5.3 If it is easier for you to identify the largest set in the left pair than the right pair, you may be using your analog magnitude system.

One proposed nonconceptual representation that animals have are analog magnitude states, which are postulated to explain animals' and young children's capacities with quantities. Experiments suggest that many animals are able to discriminate between different numbers of objects. Pigeons, rats, monkeys, chimpanzees, orangutans, and dolphins are among the species who show an ability with quantities, but these abilities don't extend to integers. For example, animals find it much more difficult to discriminate between small ratios in number than between large ones; unlike us, the animals don't appear to be counting. This finding is robust across species, and is captured by Weber's law, which says that the ability to discriminate two magnitudes is a function of their ratio. This means that it should be easier to discriminate between 4 and 12 items than between 11 and 12 (see Figure 5.3). We share with animals the ability to make these kinds of approximations without counting, but we can also count. Other species, so far as we know, only have the capacity to make approximations.

The psychologist Susan Carey argued that the correct way of understanding the concepts associated with this capacity is in terms of approximate number representation, so that the orangutan could correctly think there are *approximately six* grapes in an array even if there are really seven (Carey 2009). In that case, we would have a kind of approximate number concept when making analog magnitude judgments. However, Jacob Beck has challenged that interpretation on the grounds that an approximate number concept implies the existence of systematic thought, but the performance of the animals does not support systematicity (Beck 2012). Beck offers the following argument:

1 If approximate number representations have conceptual content, then they satisfy the generality constraint.
2 Approximate number representations do not satisfy the generality constraint.
3 Therefore, approximate number representations do not have conceptual content.

The generality constraint was introduced by Garth Evens as a necessary condition for conceptual thought. According to the generality constraint, thoughts have conceptual content only if they are systematic (Evans 1982). This means that the elements of thought can be recombinable according to rules. For example, in order to have the concept LOVE, you must be able to use it in various well-formed representations—if you can understand the concept LOVE, then you can understand it in the sentence "Luke loves Leia" as well as "Spock loves Kirk" and "I love pizza."

Beck argues that no translation of an analog magnitude state into language reflects the systematicity required to meet the generality constraint. For example, Beck claims that the data shows that pigeons can represent:

40 pecks are fewer than 50 pecks
and
38 pecks are fewer than 47 pecks.

But the data also shows that pigeons cannot represent

38 pecks are fewer than 40 pecks
or
47 pecks are fewer than 50 pecks.

In fact, pigeons are able to discriminate numerical values if their ratios do not exceed 9:10, which is consistent with Weber's law. But the generality constraint tells us that if someone can represent (1) and (2), they should be able to represent (3) or (4). Is there a way of reconciling these? Beck considers several ways of defending the idea that analog magnitude states can meet the generality constraint, but all of them fail. For example, in considering Carey's suggestion that we can translate the sentences into approximates, Beck claims that it violates systematicity, because while the pigeon can represent that *approximately 40* pecks are fewer than *approximately 50* pecks, they can't represent *approximately 38* pecks are fewer than *approximately 40* pecks. Even worse, it may be that the representations in an approximate number system would have no fixed meaning. One might think that pigeons fail to represent (3) because *approximately 38 = approximately 40*, and so (3) is false. But we run into inequivalencies at the ends of the approximates, such that *approximately 38 = approximately 40* AND *approximately 40 = approximately 44* but *approximately 38* doesn't equal *approximately 44*.

While we normally think concepts are required to represent thoughts, the possibility of nonconceptual content offers an alternative way of thinking about animal mental content. The analog magnitudes in humans suggest that human cognition includes both conceptual and nonconceptual content. Given that, evidence of analog magnitude capacities in animals shouldn't be taken as any evidence that animals may not also have conceptual thought.

5.2.4 Vehicles of thought and the assumption of representation

The question about the format that humans and animals might think in remains a live question. It may even turn out to be a bad question. The idea that we think in some format rests on a commitment to representational thought. It's possible thought might not be entirely representational. On non-representational views of thought, having a thought does not require having a mental attitude or doing a calculation on a representation. While this view might seem less interesting to a cognitive scientist, such approaches are of much current interest. Contemporary research in artificial intelligence (AI) and robotics suggests at least a role for non-representationalism. The deep learning systems that have led to the recent developments in AI—from Siri to facial recognition and medical diagnoses—stem from what some theorists understand to be non-representational cognitive systems. The idea that thought need not be done via some kind of a representation has also been explored by psychologists working on animal cognition. For example, the anthropologist Louise Barrett argues that we can make sense of animal action without appeal to complex representations and models of information processing. Following ideas associated with the psychologist J.J. Gibson, she argues that the world and the body together perform the work that is usually attributed to internal representations (Barrett 2011). Barrett suggests that by looking at the intelligent behavior of insects like honeybees or portia spiders, we will come to better understand cognition in terms of action-perception systems that evolved to allow organisms to respond favorably to unpredictable environments. A focus on cognition as a relation between body and world rather a quest to find internal representations, Barrett proposes, will help us to avoid the pitfall of overintellectualizing cognition, for humans and nonhuman animals alike.

It may be that advances in both computer science and animal cognition research will help to answer questions about the vehicles of thought, or lack thereof. Like theories of consciousness, theories of the structure of thought are varied and none yet enjoy dominance. While it is fair to say that cognitive psychologists at this point take the existence of representations as a given, and explain animal behaviors in terms of their representational states, they tend to remain silent on the nature of these representations. Thoughts and their constituents are just taken to be representations of some undetermined sort. As we move on, we can investigate whether we have good reason to accept that animals have concepts or beliefs while leaving questions about the vehicle of thought to the side.

5.3 Do animals have beliefs?

Beliefs are an important type of thought, one that allows us to form accurate thoughts and make good decisions. Beliefs also play a central role in human folk psychology. In Chapter 2, we saw that “mindreading” refers to the ability to ascribe beliefs and desires to predict and explain behavior. Many philosophers think that mindreading works as well as it does because we really have beliefs and desires which work together to cause behavior. We explain Artemis’ rabbit chasing behavior by attributing to her the belief “The rabbit took the third path” and the desire “I want to follow the rabbit.” Having those two mental states causes Artemis to run down the third path.

But what is a belief? In common conversation, we use the term “belief” to describe a degree of uncertainty (“I believe that you need to take a left at the lights”), in contexts of faith (“I believe in an afterlife”), and to express trust (“I believe you”). However, in philosophy and psychology, belief is a different sort of thing—beliefs are what permit truth preserving rational inference.

In philosophy, beliefs are taken to be attitudes toward a proposition that take the proposition to be true. This sets beliefs apart from other types of thoughts, such as hopes, fears, wonderings, or desires. When we believe something, we accept it as true. Given that the best kind of thinking will have us believing true things, belief has a central role to play in questions of animal thought. If we only believed false things, then thinking wouldn't be a very effective way to solve problems or to understand the world. It would also be really hard to recognize a thinker as a thinker if they only thought false things.

According to what we might call the Standard View of belief, which is widely accepted in philosophy and cognitive psychology, a belief is a propositional attitude that is referentially opaque, epistemically endorsed, and inferentially integrated (see the box for a discussion of these concepts). Beliefs participate in causing behaviors, or justifying behaviors. For these reasons, many philosophical discussions of animal thought focus on a more specific question—whether animals have beliefs.

On the Standard View, animals have beliefs if they have representations with the features of belief. If the best explanation for animal behavior is that they have representations with these properties, then we are justified in saying that animals have beliefs. Psychologists routinely ascribe beliefs to humans and to animals to explain their behavior, and the question for them isn't *whether* animals believe but *what* animals believe. Animal belief is a basic premise of comparative cognition.

Properties of belief

Propositional structure refers to the syntax of beliefs, such that they can be stated in a sentence with a subject and a verb. For example, if Artemis believes that the rabbit is fast, we can attribute the proposition THE RABBIT IS FAST to her. Recall that a propositional attitude is a mental attitude toward the content of some proposition. In this case, the attitude is one of belief, and the content is THE RABBIT IS FAST.

Referential opacity refers to a logical property of propositional attitudes, such that if you substitute logically equivalent terms within the proposition, you might change the truth value. That isn't true of propositions themselves. For examples, suppose Zack's friend Sue is also the tooth fairy. Then, all the properties that Sue has, the tooth fairy has as well. If Sue is 23 years old, then it is true that the tooth fairy is 23 years old. But once we attribute the proposition to someone, substitutions are no longer possible. Zack might believe that Sue is 23 years old, but at the same time not believe that the tooth fairy is 23 years old. When we attribute beliefs to Zack, to be correct, we need to capture the *aspect* of his belief—whether he is thinking about Sue *as his friend* or *as the tooth fairy*.

Epistemic endorsement refers to the commitment we have toward our beliefs being true. We can generally say what we believe, and when we are asked if we believe something, we can say so. This verbal endorsement reflects a cognitive endorsement.

Inferential integration refers to the relationship between our beliefs such that they are largely consistent. If our beliefs are a mishmash of inconsistent propositions, they wouldn't be able to support rational thought or behavior.

5.3.1 Can we say what animals believe?

It seems like we can ascribe beliefs to animals we know well. A pet owner may say of their dog "Fido thinks it's time for dinner" or "Puppy knows this is his new home." But are we right when we ascribe beliefs like that? And when we do psychology, can we feel justified in ascribing one belief over another?

There is no small worry about getting it right when we ascribe beliefs to animals. A number of philosophers have offered versions of this argument:

1 If we can't say what animals think, then they don't have beliefs.
2 We can't say what animals think.
3 Therefore, animals don't have beliefs.

The idea here is that it wouldn't make any sense to say of someone that they think if we have no idea *what* they think. The argument suggests that our attributions of thoughts to animals are mistaken anthropomorphic projections, and if we try to think carefully about *what* animals think, we will realize that we just can't say. For that reason, we should conclude that animals actually don't have beliefs.

Consider an example given by Stephen Stich: Fido the dog buries a meaty bone in the backyard of his house. If we watched Fido bury the bone, and later see Fido trying to get back to the spot, we might tell someone "Fido believes there is a meaty bone buried in the backyard." Stich argues that this attribution would be false, because Fido doesn't have the concepts MEATY, BONE, or BACKYARD. Why not? Consider BONE. Fido lacks important knowledge of bones—kinds of bones, what they are for—and he lacks important skills, such as the ability to sort real bones from synthetic ones. In what sense could Fido have anything like our BONE concept? The same worry arises for BACKYARD and MEATY. If we can't say what Fido thinks, then we lose the referential opacity element of belief—we don't capture the aspect of thought.

Stich considers a possible response to this worry: Maybe we should drop the referential opacity element of belief. That way, we could say of Fido something like "Fido believes that this thing [pointing at the bone] is there [pointing at the spot in the yard]." Regardless of how Fido actually represents the meaty bone in dog concepts or pictures or nonconceptually, we can refer to the content of Fido's thought by indicating the objects he is thinking about. Then, we might think it fine to say, "Fido believes there is a meaty bone buried in the yard" because, though he does not have the same concept of meaty bone as we do, his belief is still directed intentionally toward the bone. While Fido doesn't exactly believe *that* the meaty bone is buried in the yard, he does believe *of* the meaty bone and *of* the yard that the former is buried in the latter.

Stich rejects this response for two reasons. First, he is worried that characterizing beliefs this way will result in false inferences. Since one of the hallmarks of belief is referential opacity, we cannot infer from "Lois believes that Clark Kent works for the paper" to "Lois believes that Superman works for the paper," even though Clark Kent and Superman are the same person. If we can attribute to Fido beliefs like "there is a meaty bone buried in the backyard" and "the backyard is my toilet," we can then make inferences that are likely misrepresentative of Fido's informational capacities. Can you derive the inference? (Answer: "There is a meaty bone buried in my toilet.")

Worse yet, Stich thinks such attributions might lead us astray about animal cognition. Suppose researchers study the dog's understanding of bones and learn exactly which conjunction of features causes a dog to sort something into the bone category—say, *hard, white, chewable*, and *larger than 6 cm*. They might then be inclined to say that they understand the dog's BONE concept, which is understood in terms of these properties. However, Stich says, we still don't have any reason to think Fido has the concepts HARD, WHITE, CHEWABLE, and LARGER THAN 6 CM—the problem just repeats itself. The assumption is that we will never reach a level where there are shared human and dog concepts. Stich writes that, "We are comfortable in attributing to a subject a belief with a specific content only if we can assume the subject to have a broad network of related beliefs that is largely isomorphic with our own" (Stich 1979, 22). Since neither Fido's bone beliefs nor his beliefs about the structure of bones are likely to map on to our beliefs, we can't say what Fido believes. And if we can't say *what* Fido believes, we can't say *that* Fido believes.

Taking this as an argument against animal belief relies on the idea that only beings who have mental content that can be translated into human language have beliefs. That view is explicitly anthropocentric—we have to be able to translate someone's thought if they are to have a thought. It isn't just animals who may be difficult to ascribe content to. Unfamiliar humans, people from different language communities, even AIs, and aliens may have concepts that are not isomorphic to our own. Imagine trying to ascribe content to alien life forms who have traveled to Earth from light years away. While we might not share concepts with these technologically advanced aliens, and while we might not be able to say what they believe, we certainly shouldn't conclude that they don't have thoughts!

While these thought experiments raise some concerns about the argument, to offer a full critique we can target each of the two premises. In what follows, I will show that there is good reason to reject both the premise that if we can't say what animals think, they don't have beliefs, and the premise that we can't say what animals think.

5.3.2 The relationship between ascribing content and having beliefs

First take Premise 1, which says that if we can't say what animals think, they don't have beliefs. This premise gets the relationship between language and thought backward. Most theories of language evolution suggest that human language developed from simpler, nonlinguistic communication systems. Consider our hominin ancestors who had to form beliefs about how to make tools, how to coordinate hunts using those tools, how to cook the food, and how to distribute it. While these ancestors had communication systems, at some point they didn't have language. If language evolved to communicate beliefs that were already there, then Premise 1 must be false, for it entails that beliefs come alongside the ability of humans to articulate those beliefs. If we consider human animals, Premise 1 entails that human language could not have evolved to express the beliefs they had before they gained language, because there were no such beliefs.

Being able to say what someone believes is evidence that they have belief. Suppose that SETI (the Search for Extraterrestrial Intelligence project) receives a message from space that linguists translate as "We come in peace," and we infer that there is intelligent, thinking life elsewhere in the universe. That inference is a good one, even if the translation turns out to be wrong. We would be equally justified in inferring that the aliens were intelligent if they sent a message that contained a long list of prime numbers—a nonlinguistic message with no propositional structure. We could attribute to those aliens a belief that they want to communicate to other intelligent species, even though we have no knowledge of whether they even have language.

In another science fiction scenario, we might not have any idea what the aliens believe, but still think that they have beliefs, because technology is a marker of belief. Suppose scientists find a spaceship coming toward Earth, traveling from another solar system. We will presume that there are intelligent beings behind the spaceship, and all of us would be gripped with questions about the aliens' intentions: *Why are they visiting us? Are they peaceful, or do they intend to colonize our planet? Do they think we are worth getting to know, bugs to be exterminated, or livestock to eat?* Thus, while being able to correctly say what someone believes is sufficient evidence of their having beliefs, it is not necessary. We don't need to know *what* someone believes in order to have good reason for thinking *that* they believe something.

Even philosophers who agree that we cannot say what animals believe have rejected Premise 1. Beck offers four ways to make sense of animals' having beliefs though we can't ascribe content to their beliefs (Beck 2013). First, it may be that indeterminism about animal beliefs is only a momentary phenomenon, and with more time, we will be better able to ascribe content to animal beliefs. For example, after years of studying dogs, we may find that our concepts and Fido's concepts do map onto one another. Second, it may be that animals' lack of language is simply an epistemic barrier, since it is hard to know what someone is thinking when they can't tell you what it is. Third, it may be that animals have concepts and contents that are unfamiliar to us, like the aliens whose technological sophistication proves to cause insurmountable communication problems. Finally, and this is the possibility Beck endorses, it may be that we cannot say what an animal thinks because animals think in a nonlinguistic, analog format. Recall that analog formats cannot be divided up into parts the way language can, but like a photograph, they can vary in degree of focus and grain. Beck argues that we can understand some animal representations in this way. Just as we cannot translate a picture into a sentence (he asks us to consider how to translate the *Mona Lisa* into English), we can't translate animal representations. Of course, animals can still *have* representations, just as the *Mona Lisa* can still exist, and relay information despite the fact that it is untranslatable.

Beck's explanation takes the indeterminacy of animal beliefs to really be about using language to express those beliefs—we can't *say* what an animal believes, but we can share a thought with an animal when we are thinking in the same nonlinguistic format as the animal about the same thing. For this reason, we cannot use our difficulty with ascribing content to another being as sufficient for concluding that they lack beliefs. Premise 1 should be rejected.

5.3.3 Ascribing content to animals

The second response to the argument against animal belief is to reject Premise 2, which says that we can't say what animals think. Recall that the reason given in support of this premise is that the concepts we use when ascribing beliefs are human concepts, and since we'll never find a mapping between our concepts and any possible animal concepts, we will never be able to know how animals think about the world. We can consider three replies to this kind of objection. First, empirical science can help us to determine the concepts animals have. Second, having language doesn't remove worries about indeterminacy of content attribution. And finally, there are many proposals for how we can ascribe content. Sometimes, a premise can be undermined simply by showing creative alternate possibilities.

5.3.3.1 Concepts

One way of saying what animals think is to ascribe concepts to them. A concept is often taken to play the same role in thought that a word plays in language. However, concepts can be had without language. Psychologists and philosophers take concepts as necessary for a number of psychological processes such as categorization, logical reasoning, memory, and learning.

Theories of concepts

Classical view of concepts: representations of necessary and sufficient conditions for class membership.

Example: BACHELOR is an unmarried male.

Exemplar view of concepts: representations of a set of instances of that concept.

Example: CHAIR = {dining chair, beanbag chair, stool, grandma's easy chair, desk chair, wing chair, deck chair…}

Prototype view of concepts: the ideal exemplar of the set.

Example: FRUIT is most strongly associated with apples and oranges, less strongly associated with durian or jackfruit.

Concepts are often seen as the currency of thought, as they provide content to thought. When I think about a birdfeeder, I have a concept BIRDFEEDER that permits me to discriminate birdfeeders from other things that may superficially resemble them, I can recognize novel things as birdfeeders, and I can group together platform feeders, tube feeders, suet bags, hummingbird feeders, oriel feeders, and funny little houses as all being instances of the concept. While philosophers first suggested that to have a concept is to have a set of necessary and sufficient conditions, too many concepts seem to be fuzzy. Like the birdfeeders, many instances of a concept only share a family resemblance. Ludwig Wittgenstein provided the example of GAME, and pointed out that there are no necessary and sufficient conditions for satisfying that concept—consider that soccer, Jeopardy, and skipping rope are all games, but they don't really have much in common. Skipping rope is not typically competitive, Jeopardy is not typically athletic, and of the three, only soccer involves a ball.

Today, concepts are typically understood as a way we mentally group instances together into a category without invoking language. We might have a picture of an ideal member of the concept in mind, or we might have in mind images of typical exemplars. While psychologists and philosophers continue to discuss the nature of concepts and our conceptual capacities, that hasn't stopped cognitive psychology from using concepts in their understanding of human cognition. For this reason, Colin Allen argues that the science of animal cognition should, like the science of human cognition, operationalize cognition in terms of concepts (Allen 1999). If we reject animal concepts, we would be unable to make comparisons between human and animal cognitive abilities; this would make it harder to understand the evolution of human concepts. Furthermore, since concepts are what make up beliefs and other intentional states such as desires, without concepts it is hard to see how we could develop a theory of content for the intentional states of animals.

Because we don't want to give up the idea of animal concepts, and we don't yet have a settled theory of concepts, we can't just apply theories to see if animals have concepts. Instead, we might construct experiments to see whether introducing what we take to be a purely conceptual change in a stimulus causes a behavioral change. For example, suppose we want to know whether or not vervet monkeys have the concept DEATH (Allen and Hauser 1991). Vervet females look toward a mother when they hear the mother's infant making a contact call, and the mother looks toward the cry. But what happens if the infant dies, and then the group hears the infant contact call? Allen and Hauser suggest that if the female stops looking at the mother, and the mother stops looking toward the location of the call, we'd have an example of a conceptual change resulting in a behavioral change to the very same stimulus. We see the work of concepts at play when someone responds differently to an identical stimulus, because the only thing that can cause the difference in the response is the conceptual change. Of course, for ethical reasons we can't run that experiment, but the structure could be imported into other types of situations.

Another type of evidence that animals have concepts would come from concept learning, and learning from past mistakes. For example, if an animal initially treated all nuts as food, but later learned that one type of nut was inedible, and so avoided eating only that kind of nut, then we would have some evidence that the animal has a *food* concept. Many species can classify objects into different categories; for example, pigeons are great at discrimination, even distinguishing paintings by Picasso and Monet. The question remains whether these capacities permit the kind of generalization we expect to find in conceptual understanding, or whether pigeons who are able to recognize their errors come to better discriminate between the paintings. Furthermore, we have to examine the human concept PICASSO PAINTING to determine whether there is enough overlap between the human concept and the pigeon concept in order to determine if they should count as the same. Plausibly, in this case, we wouldn't say that pigeons have the concept. But many other concepts, like TREE, may have enough in the way of overlap. Consider how we ascribe content to young children even when their concepts are not as rich as the adult version. Kids who like to climb trees may fail to know things about roots, home insurance, death by falling limbs, or photosynthesis, but we wouldn't be wrong to say of a child "He thinks that tree is good for climbing."

In order for our attributions to be accurate, the concepts we ascribe to others must match our own to a degree, but our web of concepts need not be fully isomorphic. If it were, then everyone would share exactly the same associations between concepts. However, sharing all the same associations between concepts is sharing all the same beliefs! And if we all shared the same beliefs, there would be no disagreement. To take an example, political disagreements are partially constituted by disagreements about how concepts are related to one another: Is state-sanctioned killing of murderers itself murder? Is limiting gun ownership a violation of liberty? The question that arises is how close is close enough to think that we share the same concept.

We shouldn't be pessimistic about determining the kinds of concepts other animals have. There are ways we can come to ascribe content to beings who lack language, through careful experiment and observation of their learning patterns. Our concepts don't need to be fully isomorphic with those of another being in order to understand them. Understanding, after all, comes in degrees.

5.3.3.2 Belief requires language

The idea that belief and language go hand in hand has a long history in philosophy. So far, we examined one argument along those lines, that if we can't say what animals think, they don't have beliefs. Now we can turn to a more direct argument relating language and belief, namely that to have belief one has to have language. Let us look at a version of this argument, in order to undermine the worry that belief requires language more generally.

A well-known argument against animal belief based on animals' lack of language comes from Donald Davidson. According to Davidson, we ascribe beliefs to others by adopting a principle of charity and assuming that others are rational—that their beliefs will be largely consistent. If someone's behavior doesn't meet this requirement, then she doesn't have beliefs. Beliefs exist insofar as there is a community of attributors whose behavior meets this minimal criterion. Thus, beliefs exist in a community in which the members ascribe beliefs to another. For this reason, Davidson thinks that "a creature cannot have thoughts unless it is an interpreter of the speech of another" (Davidson 1975, 9).

Davidson motivates this idea by suggesting that to have a belief one must have a concept of belief, which includes understanding that beliefs are the sorts of things that are true or false. After all, you can't believe that P without also believing that P is true, which requires having the concept of *truth*. And when you use the principle of charity, you have to consider which beliefs would be true and which would be false. Since sentences (and propositions) are the only sorts of things that can be true or false, the believers in the community must use sentences—language—and hence all believers will be language users who have the metacognitive ability to think about their own, and others', thought.

Once I have the concept of belief, I can be surprised, which means that I can realize I was wrong about a proposition I used to believe. While animals can be startled, can discriminate between stimuli in their environment, and can learn and engage in flexible behavior, Davidson says that this isn't sufficient to demonstrate belief. An animal can adjust their behavior after being startled without considering that he had a belief that was false.

Davidson thinks that an understanding of error can be arrived at only by acquiring a language, and offers what is known as the triangulation argument to defend this view. It is only with language that we can escape the tyranny of subjectivity, and realize that there are multiple ways of conceiving of the same state of affairs. The understanding of objectivity requires two individuals communicating with one another about some object in the world. It is through triangulation of this sort that the concept of truth arises.

There have been a variety of responses to Davidson's position. A central weakness of Davidson's argument is with the claim that to have a belief, one needs a concept of belief. One challenge to that premise comes from the possible existence of individuals who can speak yet cannot attribute beliefs to themselves or others. That is, there is reason to think that some speakers have beliefs but don't have the concept of belief. Young children would be one example of such a speaker. Davidson has to say that either the children who fail metacognitive and theory of mind tasks actually do have the concept BELIEF or that they are not thinkers and don't mean anything by their utterances. Neither option sits well with the empirical facts.

Another challenge to the idea that having a belief requires having the concept of belief comes from Hans-Johann Glock (2000). Consider Davidson's argument as presented by Glock:

1 A belief is something that can be true or false.
2 To believe that p requires being able to be mistaken in believing that p.
3 To believe that p requires being able to recognize that one is mistaken.
4 To believe that p requires having the concept of a mistake.
5 Therefore, to have a belief one must have the concept of belief (because the concept of a mistake requires the concept of a belief).

Glock (2000, 54)

Glock worries about the third and fourth premises of this argument. In response to the third premise, Glock argues that the claim is too strong, and that, to be mistaken, one only needs to change one's belief and does not have to have an additional metacognitive belief about the prior false belief. For example, when my daughter isn't at the park at the agreed upon time, I might come to believe that she got lost or hurt. In response to that belief, I call my partner who tells me our daughter is at home with him. I can update my belief about my daughter without needing to reflect on the falsity of my prior belief.

The fourth premise is also problematic, thinks Glock, because we can be capable of recognizing a mistake, and hence understand the possibility of being mistaken, without having the concept MISTAKE. For example, it is sufficient to recognize that this object that you initially thought was edible isn't edible after all. Glock uses the analogy of singing in the key of C: One can be capable of singing in the key of C, and recognize that one isn't singing in the key of C, without ever having the concept KEY OF C.

Finally, Glock also suggests that there are examples of nonlinguistic creatures who have beliefs about the beliefs of others. He points to chimpanzees' ability to recognize mistaken beliefs in others, and to take advantage of others' mistaken beliefs in deception, as evidence of a kind of nonverbal triangulation.

Davidson's arguments also raise questions about the development of language, communication, and belief in human children. Since these capacities all require one another, and as research in developmental psychology suggests, there doesn't seem to be room for a stage-wise development of the concept of belief, much less the development of language.

The claim that belief requires language is often presented as a solution to the problem of indeterminacy of belief. That is, the idea seems to be that if someone speaks a language, then we should be able to say what they think. But does having language absolve us of worries regarding accurate attributions? As we saw in Chapter 2, radical translation between human languages always rests on a degree of uncertainty. Thus, if we are worried about correctly ascribing content to Fido, perhaps we should also be worried about ascribing content to a human with whom we don't share a language.

We might not even have to go as far as other language users to find problems about indeterminacy in content ascription. Perhaps even within a language our words can only approximate our cognitive states. Allen makes this argument—the grain of our language is much coarser than the grain of thought, so verbal utterances will never exactly describe our mental states (Allen 2013). He provides the example of thinking the same thought in two different contexts: "I like bicycling." It means one thing when he says it in a dinner party, and something rather different while he is grinding up a steep hill. Likewise, when we attribute beliefs to others in language, we will always be imprecise.

Allen argues that the imprecision in these attributions doesn't entail that the attributions shouldn't be part of scientific analysis; rather, it shows that we need a method to determine whether an attribution is similar and relevant enough to the subject's cognitive states. He suggests a helpful metaphor: Just as we can transform geometric objects into less precise or idealized objects using transformational rules such as applying a smoothing filter, we can transform our own and others' cognitive states into language that is less precise. In both cases, the result of the transformation is a function of the original object or process. This way we can say that two individuals think the same thing, because both thoughts can be transformed into the same proposition, even though the original representations may be different, and may have different associations.

Language is a helpful tool in coming to understand others, but it is different from telepathy, and it still requires interpretation. Sharing and using the same language as another isn't enough to solve the problem of understanding what they think.

5.3.3.3 How to ascribe propositional content

In response to worries that we cannot ascribe content to creatures without language, philosophers have developed a number of suggestions. Allen and Glock have provided two suggestions about how to attribute content to animals. We can now look at two additional methods that may be used to say what animals think.

The first method is proposed by José Bermúdez. He suggests that we can attribute beliefs to animals and other mute minds via a form of success semantics, such that the content of a belief is that which would satisfy the animal's desire by causing the appropriate action (Bermúdez 2003). Bermúdez thinks that researchers have done a fair job in differentiating between the objects that nonverbal beliefs are about. For example, in experiments examining what makes infants surprised, psychologists have discovered how prelinguistic infants organize the world. Bermúdez's review of the infant cognition research suggests that prelinguistic infants, like nonhuman animals, are able to perceive the world in a structured way.

Furthermore, Bermúdez thinks that we have learned quite a bit about animal beliefs through different sorts of experimentation. For example, rats are able to successfully recall the location of food in a cross-shaped maze. How do they do this? Well, the rat desires food, and has a belief about the location of the food. But what is the content of the rat's belief? Bermúdez suggests that there are four possibilities:

(1a) Food is located at the end-point of a set of behaviors.
(1b) Food is located at coordinates (x, y) in space referenced egocentrically.
(1c) Food is located at coordinates (x', y') in space referenced by points in maze space.
(1d) Food is located at coordinates (x", y") in space referenced by points in the distal environmental space (e.g. wall color).

By designing and running a variety of experiments, psychologists came to realize that (1c) correctly describes the rat's belief. They reasoned in the following manner: (1a) and (1b) are disqualified because the rat finds the food even when starting at a different place in the maze, and (1d) is disqualified because when the maze is shifted so that the distal environmental stimuli are different, the rat is still able to find the food. Thus, Bermúdez shows us that careful experimentation permits accurate ascription of content to an animal, which will, in turn, allow us to make accurate predictions of that animal's future behavior.

The second proposal is inspired by the work of Daniel Dennett. Though Dennett thinks that language is required for someone to be a believer proper, his views about belief are naturally suited to determining what animals may believe (2009). According to Dennett's Intentional Systems theory, a believer is someone whose behavior is reliably and voluminously predictable by attributing beliefs, desires, and rationality. (Recall our discussion of Dennett's intentional stance from Chapter 2.)

It is plausible that describing behavior in terms of mental states can aid in prediction and offer satisfying explanations. When my dog Riddle rings the bell on the back door, he is doing something meaningful. He has come to use the bell to tell me that he wants to go outside. I intended him to use the bell to tell me when he had to use his toilet area, but he had other ideas. Riddle believes that if he rings the door I will let him out, and he desires to go outside, so I can explain his behavior through reference to his belief and desire. I can also use them to predict that if I open the door in response, he will run outside. Dennett calls this strategy of attributing beliefs and desires 'taking the intentional stance' (1989). While attributing propositional attitudes like belief and desire isn't necessary for predicting behavior, it can help.

It's important to note that Dennett doesn't accept what we've called the standard view of belief. He doesn't think that belief is a representational cognitive state. Rather, beliefs, desires, and all other propositional attitudes are interpretive devices, rather than descriptions of causally efficacious cognitive states or sentences in a LoT. Because of this, there is no deep mystery about what one *really* believes. Recall from Chapter 2 that Dennett gives us straightforward directions for determining what others believe and desire.

An intentional system believes what they *should* believe, given their world, their perceptual capacities, their past experiences, and their biological goals to stay alive and promote their genes. An intentional system desires what they *should* desire, given those same biological needs and the available means for satisfying them. Given their beliefs and desires, an intentional system will do what it is rational to do. Thinking this way, we can predict what others will do by thinking about the beliefs and desires they ought to have.

For Dennett, rationality of this sort is essential for being a believer. We saw earlier that Davidson also took rationality to be necessary for belief. For those who take a more traditional approach to belief and thought, rationality is also a key element. It might not come as any surprise, though, that what counts as evidence for rationality, and how theorists understand rationality, is not an entirely settled matter. We will turn to examine the question of animal rationality shortly.

5.3.4 Conclusions on animal belief

The argument against animal belief based on worries about correctly attributing beliefs doesn't hold up to scrutiny. We have seen that there exist methods that permit justified attributions of thought to animals. We can observe behavior and construct experiments in order to say what animals believe and desire, and what kinds of concepts they have. The mere fact that animals lack human language doesn't create an insurmountable barrier to understanding thought, beliefs, and desires. Our knowledge of other humans' beliefs and desires is given to us by human behavior, just as our knowledge of other animals' beliefs and desires is given to us by their behavior. It's just that humans also have linguistic behavior that can help us—or sometimes deceive us—when we are ascribing beliefs.

Much like the conclusions we drew in the last chapter regarding animal consciousness, when it comes to animal belief we have a situation in which the theories of belief and concepts are not settled, but the practice of thinking of animals as having beliefs and concepts is part of commonsense thinking. Unlike consciousness, the existence of beliefs and concepts is widely accepted among cognitive psychologists, and is a topic of fruitful psychological investigation. If we were to reject animal beliefs and concepts, we wouldn't just be undermining common opinion, but we would be undermining the practice of science. When we are in a position where the postulation of some entity explains more than the rejection of it can, we should accept its existence until we have reason to reject it. Right now, the evidence supports animal beliefs and concepts, and accepting that animals have such things will provide more evidence for philosophers who hope to offer and defend theoretical accounts of thinking, and the elements and aspects of thought. To use the calibration method at this point in the science is to call for more in the way of observations. At this point, given a functional account of thought, we are pretty sure that many nonhuman species are thinkers.

5.4 Animal rationality

One last question remains for us in this chapter—are animals rational? As we've seen, animal behavior often appears rational. Artemis seemed to solve a logic problem, Thorndike's cats learned how to escape from their puzzle boxes, and Köhler's chimpanzees solved the problem of how to grasp out-of-reach bananas by stacking boxes to stand on.

While Artemis appeared to engage in a logical inference, she may have used some other means to reach her conclusion. Could Artemis still be rational? Is logical inference necessary for rationality? Not surprisingly, your answer to that question depends on your theory of rationality. Ruth Millikan puts it well. If one understands rationality as "the ability to make trials and errors in one's head rather than in overt behavior" (Millikan 2006, 117), then animals probably do have rationality. But if it involves "the capacity to form subject-predicate judgments sensitive to a negation transformation, hence subject to the law of non-contradiction" (Millikan 2006, 117), then it becomes much less clear whether other animals are rational. Rather than suggesting that one of these descriptions is the true description of rationality, we might take them to be different ways of describing rational thought. By taking a functional approach, and thinking of rationality as a way of solving problems in one's head, empirical science will likely show us a pluralism of ways in which beings solve problems—using logical reasoning, causal reasoning, and statistical reasoning. Some beings, like adult humans, have all three methods of reasoning. It may be that these three reasoning styles don't always hang together, and that in some species we will see only one or two of the three.

Taking a functional approach, Fred Dretske suggests that rationality is widespread among species. He asks us to consider the example of monarch butterflies, who are poisonous to birds and mice, and viceroys, who closely resemble monarchs but who are not poisonous. Butterfly predators are not born avoiding monarchs, but they learn to do so after eating one and vomiting. The predators' learning generalizes to the viceroys, too, given their similarity. Dretske points out that this similarity makes it rational for the predators to avoid eating viceroys. The predators' avoidance of monarchs and viceroys is explained by their *reason*, making them minimally rational agents (Dretske 1988, 2006).

Dretske offers another example: We can say that a frog believes there is a bug in front of him when he grabs a fly with his tongue, because natural selection likely selected for tongue protrusion when stimulated with the visual percepts associated with flies. Given the evolution of this reliable mechanism, it is impossible to fool the frog; a visual percept of a certain kind *just is* a visual percept of that kind, and so the frog forms a belief about the existence of a bug in front of him, due to the evolution of this reliable mechanism. Dretske argues further that the frog has knowledge that the bug is in front of him, because believing requires picking up the right kind of information, which is a kind of knowing.

The functional approach to rationality offers up a host of cases like these that we can examine in order to uncover the mechanisms of rationality. Bermúdez thinks that cases like these do not require logical thought, but can be understood as a kind of causal reasoning. As you will recall, Bermúdez suggests that we can use experimentation to determine the content of animal beliefs, and he thinks that many animals demonstrate a kind of rationality. Bermúdez develops a perceptual account of reasoning that is non-propositional and nonlinguistic, does not permit generalizability or future planning, and is tied to a particular context. This style of thinking can be understood as a kind of behavioral skill rather than a structured belief; for example, using Dretske's case we can speak of the frog's thought as knowing how to catch this fly here and now, rather than knowing that a fly is in front of his face, or having general information about how to catch a fly. Bermúdez's proto-thinking is a simple capacity to respond appropriately to the environment.

Bermúdez argues that such minimalist conceptions of thought cannot account for all animal behavior because there are some behaviors that can only be explained in terms of propositional attitudes, informational states, or generalizations that go beyond the here and now. For example, chimpanzees naturally construct tools from vine stems by stripping off leaves and neatly biting the end before carrying it as far as 200 meters to fish for termites. In captivity, chimpanzee subjects choose a tool needed by another chimpanzee and pass it to their partner, demonstrating that they knew which action their partner needed to perform. New Caledonian crows manufacture different kinds of hooks to catch prey. Hooked-twig tools are stripped of leaves and bark and have a hook on the wide end; stepped-cut tools are made from sturdy leafs and are cut so that the birds can use the sharp barbs along the leaf edge. Scientists now know that fabricating tools is a capacity humans share with other species.

Figure 5.4 New Caledonian crow uses a twig tool to access food.

Navigation is another example of behavior that requires something more than minimalist rationality according to Bermúdez. If an animal can learn from experience (for example, if they can come to recognize landmarks over time), then the animal must have a more objective way of representing the environment than the minimalist account allows. As we already discussed, animals as diverse as bees and orangutans successfully navigate their environments, appearing to use landmarks as part of their mental maps.

In addition, since some nonlinguistic animals can learn a symbolic communication system, these animals must have something more than minimal rationality. Bottlenose dolphins can respond to gestures representing actions, modifiers, and objects. Great apes raised in a symbolic environment can come to use lexigrams or elements from American Sign Language to make requests for play or food, and they show enough comprehension of spoken English that they can respond appropriately to requests to do something strange, like putting pine needles in a microwave oven. Behaviors such as these seem hard to explain in terms of the minimalist conception.

Bermúdez argues that while not minimalist, these behaviors are still not indicative of logical reasoning, which he thinks requires metarepresentation—thinking about thoughts. He asks us to take the case of gazelles who see a lion and then run away. This looks like a logical inference: If you see a lion, then you should run; you see a lion; therefore, you should run. However, Bermúdez thinks that we can just as easily explain the behavior in terms of causal reasoning. Causal understanding is based on sensitivity to the regularities one encounters in the environment, and while animals may not have a full understanding of causality, they have a good enough understanding to permit this sort of rational-looking behavior.

However, it isn't clear that Bermúdez's account can help us understand the behaviors that are better candidates for rational behavior. Gazelles running from lions aren't exactly the most compelling case for rational inference in animals. As we saw at the beginning of the chapter, Chrysippus thought that his dog was rational because he made an inference about where the rabbit was after learning where the rabbit wasn't. Let's see how Bermúdez's account helps us understand Chrysippus' story.

According to the causal interpretation, Artemis may have perceived a causal relation between the lack of smells on the first two paths and the existence of the rabbit on the third, based on regularities encountered in the past. Artemis thinks that smells cause the existence of rabbits, or some such thing, and so she avoids the path that lacks the smell, seeking instead the path that has it.

But how does this explain why Artemis would have run down the third path without first sniffing the third path? Does *no smell on A* cause *no smell on B* which causes *smell on C* which causes *rabbit on C*? It is hard to imagine what sort of experience would lead the dog to make that kind of a causal inference. As this case illustrates, it isn't clear that what looks like logical reasoning in an animal can always be explained in terms of causal reasoning.

Even if Bermúdez's account doesn't offer a compelling explanation for the Chrysippus problem, it is still premature to conclude that the dog did engage in logical reasoning, for there are other possible explanations. Michael Rescorla suggests one; instead of causal or logical reasoning, the dog may be engaged in a kind of statistical reasoning. He suggests that we can explain the dog's action by appeal to her ability to unconsciously form and update probability formulas over mental maps given changes in perceptual information (Rescorla 2009a). When the dog first sees the three paths, each has a 33.3% probability of being the correct path. However, after checking the first path, Artemis updates the possibilities so the first path now has a 0% probability of being correct, and the two remaining paths have a 50% chance of being correct. The probabilities get updated again after sniffing the second path, leading to a 100% probability for path three being correct. This probability assessment is sufficient to cause Artemis to run down that path. From the outside, the reasoning looking like logical reasoning, but from the inside the cognitive mechanism might take a probabilistic rather than deductive structure.

There's good evidence that human infants and nonhuman animals alike engage in statistical reasoning. Humans show intuitive statistical reasoning in infancy. We know that babies prefer to make a selection from containers that have a higher ratio of preferred to unpreferred items. Capuchin monkeys and great apes also show this type of statistical reasoning, and while the ability has not yet been widely studied, older research finds that pigeons and fish will *probability match*—they will choose an option with a frequency that represents the likelihood of that option being the best choice. This independent evidence that animals engage in statistical reasoning supports the statistical reasoning hypothesis. Can we find supporting evidence that animals engage in logical reasoning?

While causal reasoning, probabilistic reasoning, and logical reasoning may all be forms of rationality, theoretical considerations lead some to think that logical reasoning is the pinnacle of rationality. If we want to find out whether animals are rational in this sense, we have to ask a more specific question. Luckily, in this case we know what we are asking—deductive logic is well-defined. How to study logical thought in nonlinguistic beings is less of a settled issue, however. We will conclude this chapter with a review of some current empirical research on animal logical reasoning abilities.

5.4.1 Animal logic

If beliefs are propositions, and propositions obey logical constraints, then we should be able to examine propositional thought in animals by examining their logical reasoning abilities. At Lou Herman's dolphin cognition lab in Honolulu, four bottlenose dolphins learned to understand a gestural system of communication. The dolphins knew verbs, nouns, and modifiers such as *left* and *right*. When I was working as an intern at the dolphin lab in the early 1990s, the dolphins were being taught to add two new symbols to their communicative system: *and* and *erase*. The *and* sign was supposed to have the same function as "and" in English, and *erase* served the same function as negation, or "not." Akeakamai was taught to respond to the *and* symbol by performing two actions in a row; for example, when the trainer gestured *surfboard tailtouch and hoop under*, Akeakamai would perform each action. And when the trainer gestured *surfboard tailtouch erase*, Akeakamai would do nothing. While Akeakamai did well responding to these commands, it wasn't clear how she understood them. Because Akeakamai usually responded to the second conjunct first in the *and* gestures, perhaps she took it to be an ordering relation rather than a conjunctive one.

I was particularly interested in the introduction of what might be seen as logical connectives to the dolphins' communicative system, because using *and* and *erase* (understood as "not"), we could test the dolphin's ability to recognize that two syntactically distinct strings of symbols are semantically equivalent. For example, in the semantics as the researchers understood it, *surfboard tailtouch* is logically equivalent to *hoop under erase and surfboard tailtouch*. Because Akeakamai was also competent at marking object pairs as same or different, I thought that we could examine Akeakamai's ability to recognize that two different strings of symbols had the same meaning. Unfortunately, so far as I know, that study was never carried out.

While "language trained" animals offer particularly enticing opportunities to test logical reasoning abilities, researchers have also devised clever experiments to uncover whether animals can engage in different kinds of reasoning, such as *transitive inference* or *reasoning from exclusion*. As we saw earlier in this chapter, baboons show transitive inference reasoning when they keep track of dominance relations and update dominance relations in a way sensitive to the transitive properties of the dominance relationship. There is a large body of research investigating whether other species can engage in transitive reasoning in controlled laboratory tasks. Rats, pigeons, pinyon jays, scrub jays, hooded crows, fish, and monkeys have been trained on versions of the five-element transitive inference task, in which they are trained that A is rewarded over B, B is rewarded over C, C is rewarded over D, and D is rewarded over E (see Vasconcelos 2008 for a review of the findings). Once they have mastered each of these pairs, the subjects are then tested to see how they respond to a choice between B and D. Subjects reliably chose B, even though in training B was rewarded the same number of times as D was rewarded, thus suggesting that the subjects formed a representation of a transitive relationship between the elements of the set. Of course, there may be other ways of solving the task that don't require transitive inference. For example, it may be that an appeal to the kind of error-correcting rules that connectionist networks use in learning would be sufficient for solving these transitive inference tasks without needing any kind of inference reasoning (De Lillo et al. 2001). In his discussion of how best to understand transitive inference reasoning in animals, Allen suggests that the better evidence for transitive inference reasoning would come from ecological versions of the task, which wouldn't require such an elaborate training regime to begin with (Allen 2006).

Another area in which researchers have been focused on logical reasoning in animals has been in the exclusion reasoning task—which gives subjects a problem like the one Chrysippus' dog solved. Exclusion reasoning requires reasoning in terms of the disjunctive syllogism:

1 A or B.
2 Not A.
3 Therefore, B.

It turns out that dogs might be able to act in the way Chrysippus described. Exclusion reasoning abilities have also been found in great apes, parrots, and corvids.

One sort of experiment involves hiding food in or under cups, like the old shell game. The animal sees that food has been placed in one of two cups, but they don't know which one. Then they are shown that one of the cups is empty. When given a choice between the two cups, subjects will choose the one that isn't empty.

This exclusion reasoning ability has many benefits to animals in their natural lives, and it may help to explain the fast mapping of new toy names demonstrated by Chaser the dog discussed in Chapter 1. But does it demonstrate deductive thinking?

An alternative explanation for successful performance on the two-cup task is that subjects use the rule of thumb “Avoid the empty cup.” This solution doesn’t involve logical reasoning, but it is also limited in its usefulness. Another experiment is needed to test between these possibilities. In the four-cup task, two sets of two cups are presented to subjects, set A and set B. One cup in each set gets baited, but the subject doesn’t know which cup. Then the subject is shown that one of the four cups is empty—let’s say a cup in set B. Finally, the subject gets to choose one cup. Which set should the subject choose from? If the subject is using an “Avoid the empty cup” rule, then they should randomly select from the remaining three cups. But if the subject is using a disjunctive syllogism, they should choose the other cup from set B.

While we don’t yet know how apes would succeed on a task like this, we do know that toddlers find it more difficult than the two-cup task. However, an African Grey Parrot has demonstrated success on the task (Pepperberg et al. 2018). While the science is ongoing, we can continue to look at alternative explanations for successful performance. In particular, we can ask whether a probabilistic explanation could explain success, and see that it could.

Successful subjects would start by assigning probabilities of 50% per cup when each set of cups gets baited. When they see that a cup in set B is empty, they update their probabilities for the B set, but not for the A set. Now, for the B set, the revealed cup is assigned 0% and the unrevealed cup is assigned 100%. Since 100% is higher than 50%, subjects choose the correct cup.

Experiments with cups may be of limited use in trying to decide between the logical and probabilistic reasoning hypotheses. Clever experimenters continue to explore new ways of examining logical reasoning abilities in animals.

Research on animal logic is still new, and there haven’t been a lot of studies on logical abilities in other species. Comparative research that looks to compare children’s developing logical abilities with the different kinds of logical abilities we see in other species can help us come to see in what ways various species might enjoy logical reasoning ability, and if logical reasoning requires having belief, such work will offer evidence of animal belief as well.

5.5 Chapter summary and conclusions

In our investigation of animal thought, we saw that there are a number of related questions. First, we looked at theories of thought that make claims about what we think in—the vehicle of thought. The three vehicles we examined include a language of thought (LoT), diagrams with conceptual and nonconceptual content, and fully nonconceptual content such as analog magnitude states. While the evidence for LoT in humans and animals alike is controversial, there is evidence of diagrammatic thinking in humans and other animals, such as mental maps, as well as nonconceptual content such as analog magnitude states. Since humans have multiple vehicles of thought, we have to be careful not to take evidence of animal nonconceptual content as evidence *against* conceptual content in animals. What we’ve seen is that the vehicles of thought may be many, and pluralism about the structures of thought may be true of other animals as well.

We then turned to consider a challenge to animal thinking that takes the form of arguing that since animals lack language, they cannot have beliefs. If belief is necessary for thought, as many take it to be, then the lack of language would result in a lack of thought. This is a tricky issue, because it rests on definitions of “belief” and “concept” that are not wholly agreed upon. Because of this, one way to answer the question “Do animals have beliefs?” is with another question—“What do you want to know?” If you want to know whether animals have representations that obey systematicity or logical constraints, you can answer this question by doing research on the structure of animal reasoning. If you want to know whether folk psychological ascriptions permit a robust predictive power that you didn’t antecedently have, you can spend a lot of time experimenting with an animal and interpret their behavior. Belief appears to be an umbrella concept, and without clarifying the aspect of belief that we are interested in, both empirical research and philosophical investigation into the question of animal belief will suffer.

These definitional issues to the side, when we take a functional approach to belief—as that which permits us to engage in rational inference—we can construct arguments in favor of thought without language. We can think of these arguments as developmental: How infants appear to think before they are able to speak; as evolutionary: How human language appears to have evolved from simpler nonsystematic communication systems; and as exobiological: How intelligent aliens may have thought without anything like human linguistic structures. Language can help support the development of new thoughts, but it is implausible that this sophisticated communication system evolved without any selective pressure to communicate preexisting thoughts. For these reasons, the observation that an animal doesn’t use language shouldn’t be reason enough to conclude that they are not believers or thinkers more generally.

Our last topic raised the issue of rationality. Thought and rationality are widely considered to be intertwined capacities. This offers another avenue into investigating animal thought, by looking at their rational capacities. We saw that animals, like very young humans, engage in causal and statistical reasoning. The question that remains is whether they engage in logical reasoning as well. This brought us back to the question of Chrysippus’ dog, and whether she was engaged in disjunctive syllogism reasoning when she realized the rabbit must have run down the last path. We saw that there are alternative explanations for the dog’s behavior in terms of statistical reasoning. Looking at the current experimental evidence for logical reasoning in animals and infants, we also saw that statistical explanations can describe those performances as well. Developing experiments that could test between statistical and logical cognitive capacities is a current challenge. This difficulty raises a final question to ponder: Is there a real difference between logical and statistical reasoning in cognitive systems?

Further reading

Mental representations and vehicles of thought

Beck, Jacob. “The Generality Constraint and the Structure of Thought.” *Mind*, *483* (2012): 563–600.

Beck, Jacob. “Do Nonhuman Animals Have a Language of Thought?” In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 46–55. New York: Routledge, 2018.

Bermudez, José Luis. *Thinking Without Words*. Cambridge, MA: MIT Press, 2003.

Camp, Elisabeth. “Thinking with maps.” *Philosophical Perspectives*, *21* (2007): 145–182.

Camp, Elisabeth. “A Language of Baboon Thought?” In *Philosophy of Animal Minds*, edited by Robert W. Lurz, 108–127. New York: Cambridge University Press, 2009.
Pitt, David. “Mental Representation.” *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta. (Winter 2018 ed.). https://plato.stanford.edu/archives/win2018/entries/mental-representation/.
Rescorla, Michael. “Maps in the Head?” In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 34–45. New York: Routledge, 2018.

Belief

Dennett, Daniel. “Do Animals Have Belief?” In *Brainchildren: Essays on Designing Minds*. Cambridge, MA: MIT Press, 1998: 323–332.
Glock, Hans-Johann. “Animal Rationality and Belief” ” In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 89–99. New York: Routledge, 2018.
Lesson, Sarah Beth, Brandon Tinklenberg, and Kristin Andrews (forthcoming). “Belief and Representation in Nonhuman Animals.” In *The Routledge Handbook of Philosophy and Psychology*, 2nd ed., edited by S. Robbins, P. Calvo, J. Symons, 370–383,. New York: Routledge.
Schwitzgebel, Eric. “Belief.” *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta (Summer 2019 ed.). https://plato.stanford.edu/archives/sum2019/entries/belief/.

Against animal belief

Davidson, Donald. “Rational Animals.” *Dialectica*, *36* (1982): 317–327.
Stich, Stephen. “Do Animals Have Beliefs?” *Australasian Journal of Philosophy*, *57* (1979): 15–28.

Rationality and reasoning

Camp, Elisabeth, and Eli Shupe. “Instrumental Reasoning in Nonhuman Animals.” In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 100–108. New York: Routledge, 2018.
Hurley, Susan, and Matthew Nudds. *Rational Animals?* 1st ed. Oxford; New York: Oxford University Press, 2006.

Studies of reasoning in infants and animals

Call, Josep. “Inferences by Exclusion in the Great Apes: The Effect of Age and Species.” *Animal Cognition*, *9, 4* (2006): 393–403.
Erdőhegyi, Ágnes, József Topál, Zsófia Virányi, and Ádám Miklósi. “Dog-logic: Inferential Reasoning in a Two-Way Choice Task and Its Restricted Use.” *Animal Behaviour*, *74*, *4*, (2007): 725–737.
Marsh, Heidi L., and Suzanne E. MacDonald. “Information Seeking by Orangutans: A Generalized Search Strategy?” *Animal Cognition*, *15, 3*, (2012): 293–304.
Mody, Shilpa, and Susan Carey. “The Emergence of Reasoning by the Disjunctive Syllogism in Early Childhood.” *Cognition*, 154 (2016): 40–48.
Pepperberg, Irene M., Suzanne L. Gray, Shilpa Mody, Francesca M. Cornero, and Susan Carey. “Logical Reasoning by a Grey Parrot (*Psittacus erithacus*)? A Case Study of the Disjunctive Syllogism.” *Behaviour* (2018). doi: 10.1163/1568539X-00003528.

6 Communication

Cecep ambles over to Anne and plops down in front of her. He is filthy from wrestling in the dirt with his buddies, leaf dust and twigs sticking out of his hair. Sitting across from Anne, he picks a fresh green leaf from a tree and hands it to her. Anne looks at the leaf and drops it on the ground. Cecep picks another leaf, briefly rubs the leaf back and forth on top of his own head, and then hands it to Anne. This time Anne uses the leaf to clean the dirt from Cecep's head.

Anne took Cecep to be communicating—letting her know he wanted her to clean his head. Sometimes, our messages are simple gestures. A pat on the couch can mean "come sit with me" and an extended thumb and pinkie finger by the ear can mean "call me." Cecep started this communication exchange with a simple action of giving Anne the leaf. In this community, caregivers often clean infants' heads with leaves. But because this was science, Anne pretended she didn't understand what Cecep meant. If you pretended you didn't know what my pat on the couch meant, I'd probably elaborate using speech "C'mon over here!" Cecep can't talk, but he can still elaborate. He elaborated his message using pantomime.

This story, and this interpretation of this story, might sound normal enough until you find out that Cecep is an orangutan and Anne is a human. Cecep's behavior, and the behavior of other orangutans who pantomime what they want done to them, was the topic of a paper I wrote with psychologist Anne Russon, the Anne of the story above (Russon and Andrews 2011a). We argued that these orangutans are engaged in communicative acts, and that they use gestures to communicate. But others were not convinced. Some scientists suggested that the orangutan's actions were accidental, and were just interpreted as a request. Russon and I are convinced that Cecep's actions were not accidental, given the quality of his behavior, the fact that it happened within a social scene that involved eye contact and turn taking. Russon's 25 years of observing orangutans help form the interpretation; she has seen a large number of communicative orangutan behaviors, and interpreting these behaviors as communicative permitted successful

Figure 6.1 Cecep pantomimes cleaning his head with a leaf before handing the leaf to Anne.

predictions. Russon and I were taking a functional approach to understanding communication, as permitting certain kinds of coordinated behaviors and relaxed interactions when the message is successfully communicated, and uncoordinated behaviors and agitated interactions when the message fails. Cecep and the other orangutans in his group frequently acted out what they wanted, and we saw them react in frustration when their requests were not granted. Inspired by these observations, we decided to "play dumb" in order to elicit pantomime behavior, using a version of the Sherlock Holmes method. Our prediction that pretending to not understand would cause the organutans to elaborate their message came true. These infant orangutans, who had lost their mothers early in life and who were living in a rehabilitation center, had to make up a way of communicating with their human caregivers in order to get what they wanted.

If Cecep were a human infant and Russon were his mother, I suspect there would be fewer skeptics about Cecep's communicative intent. Since human infants turn into language users, and language users are the paradigmatic communicators, it may be easier for us to see them communicating. But is the fact that a child will be a language user in the future genuinely relevant to the question of whether she is now communicating? We can't take that line of reasoning too far, because a six-month-old human fetus will also typically turn into a language user, yet someone who claims that they can communicate with a fetus would be looked upon with skepticism. Rather, in both the cases of the human infant and the orangutan infant, it is the pattern of behaviors that justifies our interpretation that they are acting with communicative intent.

While the example with Cecep and Anne is a rather unusual case of communication between members of two different species, communication of some sort appears to be common in many animal species. We see it in the social insects. Honeybees who come back from foraging will waggle dance to indicate the location of a food source to other members of the hive (von Frisch 1967). Ant foragers will lay a pheromone trail from a food source back to the nest, which is followed by other ants (Aron et al. 1993). Golden shiner fish are able to arrive at consensus about which of two paths to take even though none of the individuals have a preference for either path (Miller et al. 2013). Male cuttlefish change their coloring when courting a female, but can deceive rival males by displaying female coloring on the side of their body nearest the rival while continuing to present the courting color to the female (Brown et al. 2012). Chickens give different calls in the presence of food (Evans and Evans 1999). Ravens will gesture with their beaks and use eye contact to coordinate interactions with non-food items such as twigs or moss (Pika and Bugnyar 2011). Baboons have at least 14 different vocalizations verified by playback experiments, including alarm calls, reconciliation grunts, fear barks, contact barks, and threat grunts (Cheney and Seyfarth 2007). Prairie dogs (Kiriazis and Slobodchikoff 2006) and meerkats (Manser 2001) also have distinct alarm calls they use to warn group members about the appearance of various predators.

Are these all actually cases of communication? They all involve two or more organisms coordinating their behaviors. But what else do they have in common? And how do they differ? While linguistic communication is the variety of communication we are most familiar with, we likely share other means of communication with animals.

We will start by examining accounts of communication in order to understand the question that we are asking when we ask whether animals communicate. It shouldn't be surprising by now to know that there is no great agreement about the nature of communication, and that different people mean different things by the same word. After setting the scene with the discussion of theories of communication, we will then look at some empirical research on natural communication systems in animals in order to understand how animals are communicating and what animals are communicating about. Can animals refer to objects, or are they merely expressing emotion? Do they vocalize in order to get others to pay attention to what's going on, or are they expressing content? Are animal signals merely imperatives, or do they use declaratives too? As we will see, there is evidence that animals can do all these things with their vocal and gestural communicative behaviors. Finally, we will turn to the issue of cultural communication systems—language. While there is no evidence that animals have language with the formal properties of human language, animals may have the precursors to human language. In the last section of this chapter, we will look at views on the evolution of language and examine the work of scientists teaching animals human languages and other symbolic communication systems.

6.1 What is communication?

Humans obviously communicate using language, through spoken word, writing, and gesture. Humans also communicate in subtler ways. We communicate through body language, with a smile, or a touch. We also sometimes communicate things without even knowing it, by modulating our standing distance, or by how often we touch someone. Are these purposeful and unconscious ways of communicating both the same kind of communication? If you think about how many ways we use the word "communication," we can find even more kinds of cases. Your phone communicates your location to your friend's phone when you use Find My Friend. In a network, one computer will communicate data to another computer. There is an entire journal dedicated to computer communication. Are we talking about the same thing when we talk about Cecep and Anne, animal alarm calls, honeybee waggle dances, human conversation, and computer information exchange?

It will help to distinguish three types communication: Biological, information processing, and intentional. As may already be obvious from the examples of purported communication presented so far, depending on the type, there will be stronger and weaker constraints on what counts as communication. The biological approach to communication, which calls the behavior of ants and bees communicative, is the most minimal when it comes to cognitive requirements, whereas intentional accounts of communication can be very demanding. We will look at each account in turn.

6.1.1 Biological accounts

Biologists describe communication as a relationship between two organisms such that a change in the state of one organism causes a change in the state of the other organism. More precisely, biologists tend to define communication along these lines: "any act or structure which alters the behaviors of other organisms, which evolved because of that effect, and which is effective because the receiver's response has also evolved" (Maynard-Smith and Harper 2003, 3). This gives us three conditions necessary for communication. Note right away that given the requirement that communication is a biological adaptation, non-evolved systems, such as your iPhone, would not be a proper communicator.

What would count as communication on this definition? A courting cuttlefish communicates to a female by changing color, because his coloring causes the female to approach, the courting color evolved in order to attract females, and it benefits the male to attract females.

This account of communication applies to human linguistic communication too. For example, since one person's utterance of a sentence causes a change of belief in the communicative partner, and given the assumption that language evolved to change people's beliefs, language fits the criteria. But so do many simpler interactions. Consider the case of bean plants that are infested with aphids. The presence of the aphids causes the plant to produce a chemical that attracts wasps, who come and eat the aphids, and to send signals through fungus threads that connect to the roots of neighboring plants and cause those plants to produce the wasp-attracting chemical too (Babikova et al. 2013). It looks like bean plants are telling wasps to come and eat dangerous bugs, and warning other bean plants that pests are near. This case fulfills the criteria of biological communication. Take another example: A fertilized egg will only be successfully implanted in a uterus if the uterus first sends the correct signals (Mohamed et al. 2005). Systems biology is rife with examples of cell signaling and communication.

Biological communication can also be deceptive. If the signaler derives some fitness benefit from signaling false information and causing another organism to engage in some behavior, then the signaler is deceptively communicating. Some plants are able to deceive in this way. For example, orchid species attract male wasps by looking like, and smelling like, female wasps. The males are attracted to the flower because of its appearance and its production of a chemical that smells like the mating pheromone of females, and the wasps try to mate with the flower. While the attempt at copulation fails for the wasp, it is extremely beneficial to the flower, because when the wasp flies off to try to mate with the next flower, he carries the flower's pollen on his head and deposits it on the new flower's stigma.

Since biological communication is pretty common in biological systems, on this account it isn't an open question whether animals communicate. They do. So let us leave this view, and turn to examine animal communication from the perspective of informational accounts.

6.1.2 Informational accounts

Computer scientists, linguists, mathematicians, and some philosophers have offered an alternative definition of communication as the exchange of information from one party to another. More precisely, we can define communication as the act of a sender transmitting a signal through some medium to a receiver who then decodes the signal to extract the information (Shannon and Weaver 1949). The message itself is the information that is encoded by the sender and decoded by the receiver.

What counts as communication on this account? Starting with the example of the cuttlefish, we can call the interaction communication, since the sender's color change serves as information for the receivers about whether the sender is a potential mate or competitor. We would also be able to describe the bean plant as communicating, since it encodes information about the presence of aphids and sends that information to the other bean plants. Cecep and Anne's interaction would count as communication too, as would honeybee dances. A dancing bee who encodes the location and quality of a potential new hive site, and conveys it via a dance, transmits information which is decoded by the other bees who fly to the location and then return to the swarm to begin their own dances. When all (or most) of the scouts dance for the same hive site, the scouts together communicate to the bees in the rest of the swarm that it is time to take off and fly to the new site (Seeley and Visscher 2003).

Unlike on the biological account, on the informational account non-evolved entities could also communicate. The computer network examples are perfect models of communication on an information exchange account. Other non-biological natural examples might also fit this definition. Consider a natural signal, like the bright sky at night that tells sailors there will be smooth weather tomorrow. Is the sky a sender who is communicating a message to the sailors?

In order to answer that question, we can step back a moment and ask what counts as information. Not just any signal can be informative, since information signals are often accompanied by irrelevant noise. When someone speaks to you in a crowded coffee shop, the words and body language are part of the medium of the information being transferred, and the others chatting around the speaker are mere noise in the auditory signal. One proposal is that to count as information, the signal has to reduce uncertainty in the receiver (Dretske 1981). That way, the signal counts as additional information, and can cause a stronger belief in what the signal indicates. However, information can also serve to undermine our confidence and increase uncertainty—you may have been confident in a scientific theory until you read a new study that undermines it.

Another way of thinking about information is that it is action-guiding. After a receiver decodes a signal their actions will vary as a function of the information. If the signal increases certainty in some belief, the receiver may be motivated to act. If the signal decreases certainty in that belief, the likelihood of acting on that belief will be lowered.

While this way of understanding information would likely include Cecep and Anne's exchange, it is more questionable whether the bees or cuttlefish are intentionally acting, and hence communicating. We can be pretty sure that the computers are not acting, and so networked computers, the very thing that the informational account was supposed to explain, would be excluded.

This shows us how important an account of information is for us to understand the informational account of communication. If we understand information nonintentionally, we can describe quite a bit of animal interaction as communicative without understanding anything about the mechanisms involved. But if we understand information intentionally, then the information account loses some of its unique power and blurs into intentional accounts.

The information exchange model of communication is accepted by some animal cognition researchers. When, like the biological model, the information model is understood non-cognitively, it permits researchers to talk about animal communication without making any assumptions about the cognitive mechanism involved in the act. However, insofar as we are interested in animals *wanting* to communicate, we would need something more like the action-guiding account of information. We need an account of intentional communication.

On a biological account of communication, Cecep and Anne may be communicating, if gestures evolved. On an information account of communication, they would also likely count as communicating. But when Russon and I say that we are communicating with Cecep, we don't have the biological or the informational senses of communication in mind. We mean something more—we think that Cecep has a message he *wanted* to communicate to us. These other notions of communication are silent on mentality and intentionality—the ability of minds to be directed toward the things they think about. Because we are interested in whether animals can communicate their thoughts, we are interested in intentional communication.

6.1.3 Intentional accounts

Philosophical accounts of intentional communication have largely focused on human communication—through language, gesture, facial expressions, or body language. While we can use all these vehicles for intentional communication, not every instance of their use will be an instance of intentional communication. Our slips of the tongue may be linguistic utterances that are nonintentional. Our body language may reveal more about our minds that we wanted.

Intentional communication is typically thought to have two features: The communicative signals are flexible, and the sender expects that the message will impact the receiver. The first condition, that the signal is flexible, means that the sender can decide whether or not to send the message. Unlike blushing, which is a signal that isn't under voluntary control for most of us, a flexible signal is one that we can choose to offer or not.

The second condition, that the sender expects that the message will impact the receiver, is a bit more difficult to spell out. Most generally, it refers to the sender's desire that the receiver knows both the content of the message and that the message comes from the sender. When I communicate to you that there is a dangerous elephant behind you, I want you to grasp the content of what I'm communicating—that there is a dangerous elephant behind you—and I want you to know that I am the one giving you that information (because I am trustworthy when it comes to how dangerous elephants are, and someone else may be playing a joke or just be wrong).

The discussion that follows will focus on various ways of cashing out the second condition for intentional communication. There are three main approaches: Gricean accounts that require having a theory of mind to communicate; weaker Gricean accounts such as intentional-semantics which require some understanding that other minds exist; and dynamical systems accounts, which are silent on cognitive mechanism, and instead stress co-regulation and behavior coordination between communicative partners.

Let us now look at how these accounts have been applied to nonhuman primates.

6.1.3.1 Gricean communication

An influential account of intentional communication comes from the work of H.P. Grice, who analyzes speaker meaning in terms of the speaker's communicative intentions. Grice suggests that when we communicate with one another, we need to think about what others are thinking in order to understand what they mean; the words alone do not have meaning. For example, if I utter "The cat is on the mat" with the intention that you realize that I know that the cat is on the mat, and we had earlier agreed that you would keep the cat *off* the mat, then my utterance might mean "Please get the cat off the mat."

For Grice, a speaker means something by an utterance if and only if the speaker also has the intention that (1) the utterance produces a response in the intended audience; (2) the audience recognizes the speaker's first intention; and (3) the audience's recognition of the speaker's first intention serves as a reason for the audience responding as it does (Grice 1957). Communication is the result of meaningful utterances.

The Gricean account of communication takes apparently communicative interactions, like the one between Anne and Cecep, and says that unless Anne and Cecep are making meaningful utterances (or gestures), they are not really communicating. Grice's account of meaning places a cognitive requirement on communication. Any creature who fails to recognize others' intentions fails to communicate. What kind of cognitive capacities are needed to recognize others' intentions? What kind of being can fulfill Grice's three conditions?

On standard interpretations, Gricean communication minimally requires a theory of mind. Recall that a theory of mind is the ability to mindread, or to attribute propositional attitudes to another person. Grice's second condition, that the speaker intends that the audience recognizes the speaker's intention, entails both that the audience needs to represent the speaker's reason for uttering, and the speaker needs to represent the audience's belief about the speaker. For example, suppose the speaker meaningfully says, "The cat is on the mat." The audience must represent the speaker's belief: The speaker wants me to believe that the cat is on the mat. Furthermore, the speaker must represent the audience's belief: The audience knows that I want them to believe the cat is on the mat. Notice that these representations of propositional attitudes are pretty sophisticated. Simple mindreading only requires one propositional attitude, for example: The cat believes the mat is nice for sitting. On Gricean accounts, communicative partners need to be able to embed multiple propositional attitudes, requiring third- or fourth-order intentionality.

Orders of intentionality

Theory of mind, *mindreading*, and *mentalizing* all refer to the ability to think about another's mental state. These are a form of metacognition, when the cognitive state is about the mental state of another person. Recursive understanding of others' mental states is possible to an extent. First-order thought is a non-mentalizing thought; it is a thought about something other than a mental state. Second-order mental states are sufficient for theory of mind.

First order: The cat is on the mat.
Second order: Alex believes the cat is on the mat.
Third order: Franny believes that Alex believes the cat is on the mat.
Fourth order: Alex believes that Franny believes that Alex believes the cat is on the mat.

How many orders of intentionality can you keep track of?

On Grice's requirements for meaning, it appears that only mindreaders are able to communicate. This should immediately raise some concerns for the Gricean approach if we are using the calibration method and starting with a functional account of communication. The Gricean account leads us to reject some of our starting assumptions about communication, such as communication facilitates coordination of behaviors between communicating individuals, and results in a relaxed interaction. Worse yet, the Gricean account would have us reject an even more basic assumption about communication—that all language users are communicators. Why is that? Because children develop language capacities before they are able to represent second, third, and forth orders of intentionality.

A number of apparently communicative interactions would be disqualified on a Gricean account of this sort. The interaction between Anne and Cecep wouldn't be classified as communication, because Cecep almost certainly lacks fourth-order intentionality, and as an infant orangutan, he may not even have second-order intentionality. Individuals with theory of mind deficits—which some think includes white, middle-class, Westerners younger than four (Wellman et al. 2001), Tainae speakers from Papua New Guinea younger than 14 years (Vinden 1999), and some people on the autistic spectrum (Ozonoff et al. 1991)—would not count as communicators. Babies may coo while looking in your eyes, they may call out "Mama" or "Dada," and they may point and yell out, "ba! ba!" every time they see a ball. But on this view, these babies don't communicate anything at all. Young children starting to string words together still lack the second- or third-order intentionality the Gricean view requires.

Even worse, if every instance of communication requires considering others' mental states, then much of adult human language use isn't communicative, either. Adults often use language without thinking about the thoughts of a communicative partner, such as the pleasantries we give to strangers on the street, or the distracted conversations we have while looking at our phones. The Gricean account describes something that adult humans sometimes do when we talk, gesture, and offer facial expressions. But the view excludes too much of what we want to understand as communication—baby's first words, toddlers cries of protest, the language capacities of those with deficits in social cognition, and the distracted conversations of multitasking adults. To accept a Gricean view of communication, we'd have to move very far from our starting point in the calibration method without much reason. Such a counterintuitive consequence should lead us to question the strong Gricean account of communication, and seek alternatives.

6.1.3.2 Intentional communication without mindreading

The Gricean account captures something of our commonsense understanding of communication, namely that we have to understand that the signal is coming from a communicative partner. Where it goes astray is by offering a description of the cognitive mechanisms required for this knowledge. Rather than starting with the cognitive, we can start with the functional. We can understand communication as a relaying of a message such that the sender and receiver understand each of their roles in the exchange. This counts as intentional communication because the sender has the goal of offering a message and the receiver knows that the sender has this goal. Part of what is required for intentional communication is knowing that one's communicative partner is an intentional agent who has goals and can recognize others' goals—someone you can communicate with.

One account of communication, given in the spirit of Grice but without the high cognitive requirement, is offered by Richard Moore. He suggests that we analyze a speaker's communicative intention as consisting of two related actions: The speaker produces a signal that elicits a behavioral response from the audience and produces an "act of address" that serves to get the attention of the audience (Moore 2016). The act of address is a phenomenon long studied in child development as part of ostensive communication.

Ostensive communication consists of two parts, a message and a signal that the message is intended. When we point at an apple, we direct attention to that apple. But the point might not have been intended for anyone in particular, and it may have merely been some kind of truncated reaching for the apple. Like a well-worn path directing anyone who walks by that the lake is to the left, the signal doesn't count as communicative since it does not signal that the message is intended. In order to turn a path or a reach into communication, we need to add an ostensive cue to signal that the message is intended to be received by the receiver. When adults signal intention to young children, they use ostensive cues such as eye contact, using the child's name, or speaking in a higher pitched voice. Those cues signal to the child that the adult is talking to them.

Moore points out that while the speaker may act with communicative intent, the audience might not pick up on that intent. An intentional audience would be sensitive to the speaker's intent. This doesn't require understanding that the speaker has beliefs or knowing the speaker's reasons for action, but can simply consist of thinking of the speaker as having a goal. I might know that you intend to get on the subway, because of the way you are walking toward the open subway door, without knowing why you are getting on the subway. We often understand more about people's goals than we do about their intentions. Even young children can understand communicative intent, as demonstrated by the development of joint attention around nine months of age.

Ostensive communication and joint attention in human and ape infants

Human infants start engaging in ostensive communication in the first year of life, making eye contact with and reaching toward caregivers. By the time infants reach their ninth month, they are engaged in what developmental psychologists call *joint attention*, or the shared attention of two individuals on the same object or event. These infants are able to point and make eye contact with a communicative partner, which allows them to coordinate their behavior and engage in new types of cooperative play sometimes called *triadic interactions*.

Before nine months, human infants are either engaged with an agent or with an object, but not both at the same time. After nine months, infants' triadic interactions are accompanied by new motivations for cooperation. The psychologist Colwyn Trevarthen describes the move from what he calls primary intersubjectivity (before nine months) to secondary intersubjectivity (after nine months) as a development in play from simple actions, like offering a rattle to Mommy after trying and failing to manipulate it oneself, to more complex ones, like digging a hole together in a sandbox or pretending to serve tea (Trevarthen 1979). Around nine months, Trevarthen thinks that children have a rudimentary understanding of persons that allows them to participate in joint cooperative actions (Trevarthen and Hubley 1978).

While Trevarthen and many contemporary psychologists think that the cooperative interactions we see in human infants are uniquely human, the primatologist Juan-Carlos Gómez finds similar behavior among other great apes, including chimpanzees and gorillas. Gómez used Trevarethan's criteria for secondary intersubjectivity to analyze the behavior

(*Continued*)

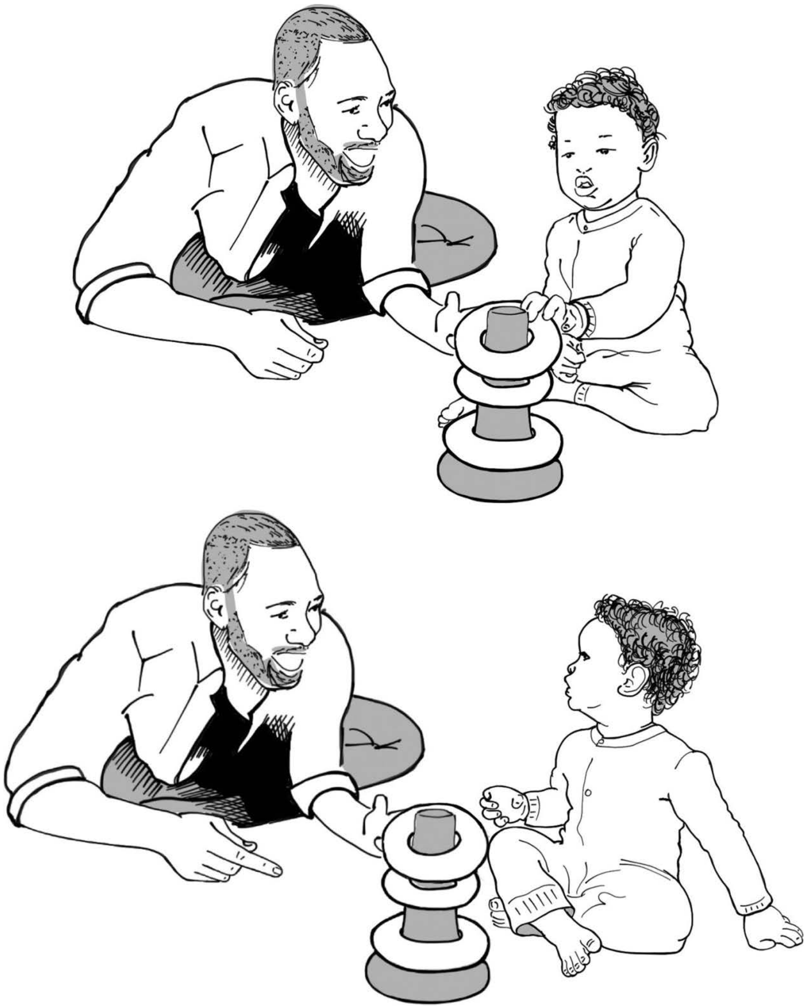

Figure 6.2 Ostensive communication and joint attention. A father and child jointly attend to a toy.

of a captive infant gorilla named Muni, who was raised by humans at the Madrid Zoo in the early 1980s (Gómez 2010). By following Muni's behavior during the period of 6 to 36 months, Gómez was able to compare Muni's behavior with the typical behavior of human infants using the same categories Trevarthen used. While children demonstrate a revolutionary change at nine months, when they move from primary to secondary intersubjectivity, the gorilla demonstrated two revolutionary changes. At 18 months, Muni started engaging in cooperative behaviors much more frequently, and at 30 months, the complexity of the interactions also increased. To get a taste of Muni's development, we can look at how her intersubjective abilities developed:

> OBSERVATION 2: (10 months; 11-10-80). H shows Muni how to put pebbles through a hole in a big hollow plastic rectangular block. H then offers the block and the pebbles to Muni, who picks them up and laboriously tries to put the pebbles through the hole, first unsuccessfully with her hand, then successfully with her mouth [IMITATION]. MUNI then turns over the block and tries to retrieve the pebbles; H helps her by holding and moving the block together with her, which Muni accepts [ACCEPTS ASSISTANCE].
>
> (Gómez 2010, 361)

> OBSERVATION 5: (20 months; 5–8–81). While Muni watches, a human makes an object (the pointed half of a plastic egg) spin on the floor like a spinning top by giving it an initial rotating impulse with both hands. Muni watches the initial action and its result for a few seconds, then jumps upon the object catching it [FOLLOW MANIP]. H retrieves the egg and repeats the same action, which Muni again watches. She picks up the egg, watching it and handling it in a variety of ways [FOLLOW MANIP]; eventually she offers the egg to H, extending it towards H's chin but without touching it [OFFER], while making eye contact [EYE CONTACT]. H picks up the egg and makes it spin again. Muni catches it once more and offers it again to H as before [OFFER + EYE CONTACT]. The same is repeated twice more.
>
> (Gómez 2010, 362)

> OBSERVATION 20: (32 months; 4–8–82). Muni is hitting the floor with a fragment of red brick. H notices that the brick leaves marks on the floor, he takes the object from Muni [ACCEPTS ASSISTANCE], and shows her how to trace lines on the floor with the brick piece. H gives the brick back to Muni who takes it in her hand [TAKE]. However, she looks at him [EYE CONTACT], takes his hand [TOUCHES] and places it on the floor marks he had just made [TAKES HAND TO OBJECT], lets go of the hand and then places the brick just by H's hand [OFFERS], and watches both hand and brick waiting (no look at eyes). H repeats the tracing. H offers back the brick, and Muni takes it [TAKES OBJ]; Muni then moves it on the existing marks and manages to add a few herself [IMITATES].
>
> (Gómez 2010, 364)

The eye contact as well as the more intricate interactions that emerge around 18 months lead to rather complex interactions between Muni and her human caregivers. Gómez takes this study as evidence that a gorilla follows the developmental trajectory of a human infant; it's just that the gorilla develops the capacities along a different timeline.

On an ostensive communicative account like Moore's, we would be able to accommodate many more of our starting assumptions about what counts as communication. Young children would be able to communicate and, Moore suggests, so would nonhuman animals. He points out that we see many cases of primates showing—sending a signal in order to evoke a response, from sex solicitations to threat displays. We also see many cases of primates producing acts of address, including fleeting eye contact and pats on the back. Because the message and the act of address can come apart—the same message might have been directed to someone else—we can experimentally test whether an animal has both abilities necessary for intentional communication. To make this point, Moore asks us to consider not primates, but grouper fish and moray eels (Moore 2017).

Grouper fish and moray eels engage in cooperative hunting; the eels can fit into crevices in the coral that are too small for the grouper to enter. Grouper offer information; they indicate the hiding location of prey by standing on their heads and pointing. Grouper also have another gesture, a body shimmy used to recruit partners. Scientists have observed a number of instances in which headstanding groupers are ignored by nearby eels. In response, the grouper fish approaches the eel and gives the shimmy signal. This gets the eel's attention so the grouper can go back to the headstand and signal the location of the prey. Moore suggests that these gestures may be of the two types required for intentional communication. The headstand indicates the content and the desired behavior of the audience, and the shimmy serves as the act of address. Once these two types of signals have been identified, scientists can construct an experiment in which the behavior of the eel is unexpected. Depending on how it is unexpected, we would predict an intentionally communicating grouper to give a particular signal. For example, if the eel responded to the shimmy but swam into the wrong crevice, we should expect a communicating grouper to repeat or elaborate on the headstand gesture. If the eel failed to approach the grouper at all, we should expect a communicating grouper to repeat or elaborate on the shimmy behavior.

Similarly, if we wanted to test whether the kind of interaction we saw between Anne and Cecep was a case of intentional communication, we could add a condition to our experiment. Recall that we came to know that the infant orangutans expected to be cleaned when they handed a leaf to a caregiver human. Anne pretended not to understand the message, which led to Cecep elaborating on the message by briefly cleaning his head before repeating the message by giving Anne the leaf. Here, Cecep responded appropriately to the wrong reply to the signal. To this experiment, we could add a condition in which we ignored Cecep's signal altogether. Suppose Cecep tries to hand Anne the leaf and she doesn't take it, but looks to the side. If we see Cecep engage in an attention-getting signal before handing Anne the leaf, like tugging on her arm, then we would have evidence that Cecep is sensitive to both parts needed for ostensive communication.

Independent research suggests that great apes are sensitive to these two different types of signals. We know that apes have attention-getting signals as well as content signals. Captive apes will use clapping, spitting, and cage banging as attention-getting signals, and wild apes use vocalizations and touch. As we will see, apes have a range of gestures with contentful meaning. There is also evidence that captive apes will vary their signals given the attention of the audience, using more attention-getting signals to a human who is looking away from them than a human who is looking toward them (Leavens et al. 2010).

In our paper, Russon and I recount a pantomime incident that included both an act of address and content. While collecting data on the natural behavior of infant rehabilitant orangutans, the primatologist Agnes Ferisa noticed that an orangutan named Kikan was favoring her foot. Ferisa examined Kikan's foot (with some trepidation, because Kikan hasn't been very friendly to Ferisa recently) and noticed that there was a sliver of rock embedded in the sole of her foot. Ferisa used a pencil to remove the stone and then daubed latex from a fig leaf stem on the wound to help seal it. A week later, Kikan pulled on Ferisa's leg to get her attention (the act of address), then picked a leaf and poked its stem at the sole of her now healed foot, just as Ferisa had done while doctoring her (the content). Ferisa interpreted Kikan as thanking her; the message is something like, "Remember that thing you did? It worked. My foot is better now."

On Moore's ostensive communicative account, there can be special kinds of signals that develop as a means to communicate "pay attention—I'm about to give you a message." This account is open to there being many different kinds of message contents and, as such, it serves as a general theory of communication. Is there reason to think that apes have communication in this sense?

The psychologist Michael Tomasello thinks that some ape signals are examples of intentional communication, taking a position that may be seen as a subspecies of Moore's ostensive communicative account. Tomasello describes communicative signals as those that

> are chosen and produced by individual organisms flexibly and strategically for particular social goals, adjusted in various ways for particular circumstances. These signals are intentional in the sense that the individual controls their use flexibly toward the goal of influencing others.
>
> (Tomasello 2008, 14).

Tomasello's functional account of communication led him to look at gestures, which he considers to be under greater intentional control than vocalizations (though it should be noted that other primatologists, including Cheney and Seyfarth (2018), think that vocal signals are also used flexibly). Ape gestures, Tomasello thinks, are flexibly and deliberately produced and are intended to change the psychological state of a recipient. Evidence comes from observations that apes will use different gestures to achieve the same goal, will persist or elaborate if the message doesn't result in the desired outcome, and will move into the line of sight of communicative partners before gesturing. Unlike vocalizations, Tomasello thinks, gestures are aimed at a particular individual, and, unlike a worn-down path leading to the lake, gestures indicate a communicative goal directed at a social partner.

Tomasello identifies two kinds of gestures, those that serve to get the attention of a social partner, and those that indicate what the signaler wants the recipient to do. Attention-getting signals are a specific variety of Moore's acts of address because they are behaviors from the animals' typical repertoire that can also elicit attention, such as throwing objects or chomping on a leaf. A signaler who has the audience's attention can then provide a message, which Tomasello thinks always takes an imperative structure. Apes ask others to do things—to play, to have sex, to be carried—and Tomasello thinks that the signals that they use to ask for these things are all individually created, and not socially learned via imitation. The reason why apes end up having the same gesture for the same action is that the gestures are ontogenetically ritualized, that is, they are shortcuts of the actual behavior that the ape wants to engage in. For example, an infant's request to climb on mom starts from the action of climbing on mom, and later transforms into touching mom's back in a certain way. Mom learns to respond more quickly to the infant, pulling the baby up on her back. The signal can continue to simplify, so the infant learns that raising two arms and looking at mom is all that is needed to signal the imperative message "Carry me."

The exchange between Anne and Cecep conforms with Tomasello's view, in that Cecep moved in front of Anne so she could see him—attention getting—before handing her the leaf—the imperative message. But the exchange between Agnes and Kikan does not. Kikan used an attention-getting signal that may have been devised to work well with humans, tugging on the leg of a much taller primate, but it wasn't from a repertoire of species-specific behaviors used for other purposes. In addition, Kikan's message had no imperative intent; it was a declarative, communicating to Agnes that Kikan's foot had healed. This suggests that Tomasello's account of ape communication may be limited in focus, and miss some instances of intentional exchanges that should qualify as communicative.

Whether the empirical evidence indicates that declarative and imperative contents are part of apes' communication systems will be discussed later. For now, we have seen that there are ways of taking a Gricean-inspired intentionality account and lowering the cognitive requirements so that an intentional communicator does not need the capacity to consider higher orders of intentionality. However, they do need voluntary control.

Our last account of communication is not Gricean inspired at all, but is a functional account that remains silent on cognitive capacity and downplays the role of voluntary control.

6.1.3.3 Dynamical systems account of communication

A different approach to intentional communication comes from Stuart Shanker and the anthropologist Barbara King. King and Shanker refer to communicative interactions as a dance, because a small move by the first party has effects on the second party, which, in turn, effects the first party, and so it goes until the dance is broken off (Shanker and King 2002; King and Shanker 2003). Like Trevarthen and Gómez, King and Shanker take as inspiration the very early interactions between young infants and their caregivers, which they take to be a case of co-regulation—a process of continual adjustment to suit the partner. Since a signal will often be, in part, the consequence of a prior social interaction, these sorts of accounts do not emphasize voluntary control. Rather than stressing the individualism of voluntary action, they take the communicative pair to be the unit of analysis.

In a successful communicative interaction, information is created between communicative partners, rather than exchanged, and mutual understanding is the result. One consequence of this view is that the larger context is essential to interpreting a signal; one gesture or sentence isn't independently meaningful. Because meaning is created by interactions across many sensory modalities, an exclusive focus on one modality will be misleading. Spoken human language can be perceived through auditory sensory modalities, but we also watch people's facial expressions and body language in order to actually understand what our communicative partner means. When humans lack cues, misunderstandings can result. For example, in the early days of texting and emailing, people got into many fights and disagreements that were based on misunderstandings, because the sparse medium of typed text wasn't conveying the feeling that is apparent in a face-to-face communication, which can be seen, heard, and probably smelled. The invention of emoticons and emojis allowed us to replace the missing signals and improve electronic communication.

While the other accounts of communication tend to focus on sequential transmission of information and turn taking, the dynamical model focuses on coordination of simultaneous movements between the communicative partners (Shanker and King 2002). In their defense of the dynamical systems approach to studying ape communication, Shanker and King endorse the psychologist Alan Fogel's definition of communication as a "continuous unfolding of individual action that is susceptible to being continuously modified by the continuously changing actions of the partner" (Fogel 1993, 29).

King and Shanker offer the following examples of communication among members of a captive bonobo family:

> Event 1. Female Elikya, two months of age, sits with her mother Matata. Her mother hands her over to her older sister Neema sitting nearby. From Elikya's facial pout, it is clear that she is distressed by this transfer. Three times in succession, she extends her arm and hand, palm up, back towards her mother. She is near enough to her mother to touch her, but she gestures instead. After the third gesture, her mother takes Elikya back. As Elikya relaxes against her mother, her sister pats her gently.
>
> Event 2. Elikya, eight months old, moves toward her sister Neema; she may lightly touch Neema's outstretched leg, but it is hard to be certain. Neema lowers her leg, then begins to stomp her feet on a platform as Elikya stands bipedally facing her. Elikya has a playface and raises her arms. Immediately Neema moves to Elikya and hugs her, covering her with her whole body, then quickly moves back and resumes her previous position.
>
> (King and Shanker 2003, 11).

King and Shanker think that these two interactions show how the kind of gesture Elikya offers, along with her facial expression and body posture, helps to shape the behavior of her sister and mother. Communication occurs when there is mutual understanding that "emerges as both partners converge on some shared feeling, thought, action, intention, and so forth" (2003, 608).

The dynamic model is an embodied approach to communication. While eye contact, vocalizations, and gestures are part of the story, other elements are also important parts of communication. For example, humans as well as other great apes use touch to get attention, as well as to offer comfort and support. Neema patting Elikya after returning her to her mother has a communicative function. Chimpanzees who touch and hug their friend who just lost a fight is another example of communication. An embodied approach opens up the ways in which communication can be studied. For example, joint attention is often described as requiring mutual gaze. This prioritizes one modality, vision. Maria Botero argues that some species' joint attention will be better understood if we look for it in other modalities, such as touch (Botero 2018). This will be especially true of species who do not primarily rely on visual modalities, such as dolphins.

A fan of intentional communication might welcome the suggestions offered by the dynamic dance model as a complement to their theory of communication. The dynamic and embodied approach may be better understood as a way of recognizing potential instances of communication, rather than as a theory of communication.

For example, both the dynamic approach and the ostensive intentional approach may be illustrated by the creation of meaning in a new interspecies relationship between a human and a dolphin. The biologist Diana Reiss describes her experiences communicating with a newly captured bottlenose dolphin named Circe during her PhD research. Reiss was teaching Circe to eat dead fish and respond to basic husbandry commands. Part of the process of training dolphins often involves giving them a "time-out" when they don't do as the trainer desires. Reiss would give Circe a time-out when she broke a rule, such as leaving the training station before being dismissed. To give a time-out, Reiss would break social contact for a brief time by stepping back and silently waiting a few moments. Circe quickly learned to stay at the station until released, because obeying the rule meant social interaction and fish, while breaking a rule meant that there would be no more good stuff.

Soon enough Reiss noticed that Circe didn't like to eat the untrimmed fish tails, and so she started trimming the tails to make the fish more palatable. Circe came to expect that Reiss would trim the fish tails, creating a new rule—you trim the fishtails, and I will eat the dead fish. But then Reiss broke the rule:

> One day during a feeding I accidentally gave her an untrimmed tail. She immediately looked up at me, waved her head from side to side with wide-open eyes, and spat out the fish. Then she quickly left the station, swam to the other side of the pool, and positioned herself vertically in the water. She stayed there against the opposite wall and just looked at me from across the pool. This vertical position was an unusual posture for her to maintain…I could hardly believe it. I felt that Circe was giving me a time-out!
>
> (Reiss 2011, 75)

Reiss decided to do an experiment to determine if the behavior would be repeated whenever the tails were not trimmed, and, as she reported in her dissertation, Circe always gave Reiss a time-out when fed untrimmed fish tails (Reiss 1983). Though Reiss doesn't offer and test alternative hypotheses, and didn't do transfer tests to determine whether Circe would give her a time-out in other contexts, her report does serve as preliminary evidence that Circe was using a particular behavior that she learned from Reiss in order to communicate that Reiss violated her expectation.

While other models of communication set an upper limit for what communication can be, the dynamical approach to communication emphasizes the emergence of communicative ability. The dynamical approach is silent on the cognitive capacities that are required for communication, suggesting instead that we start with a behavioral account of communication, and use that to examine what is needed for the complex coordination and co-regulation of behavior that we see in some animals. In this way, we can see it as a complement to intentional accounts of communication, and an invitation to think differently about how to study communication using a variety of modalities and contexts.

6.2 Natural communication systems

So far, we have spent a lot of time considering examples of communication in great apes. Comparing the development of great ape infants to human infants is a methodology that works as well as it does because the two species use shared sensory modalities, have a similar morphology, and live in similar social situations. However, the method has its limits, because the apes studied are typically adults, not infants, and they have adult knowledge, experiences, and motivations that will be quite different from an infant.

To study communication in other species requires some understanding of their unique social, biological, and ecological contexts. Elephants make and respond to sounds that travel miles; electric fish use pulses of electric charges in water. Psychologists working with humans point to cues we can use to identify communication between human infants and adults, such as eye gaze and child-directed speech. All these cues are species-specific, and it wouldn't do to look for them in all species. In species with poor eyesight, or species that do not use vision as a primary sensory modality, eye contact may be less important than touch or smell. Likewise, in species like us who do not hear low-frequency sounds or sense electricity or magnetism in subtle ways, we shouldn't expect such modalities to be part of human communication.

As an example, consider dolphins, who do not rely on their eyesight to see underwater. Instead, they use a kind of sonar called echolocation. Dolphins can't see others echolocating, but they can hear others' echolocation clicks. There is evidence that dolphins can eavesdrop on each others' echolocation clicks and click echoes in order to gain information about the dolphin and the environment (Gregg et al. 2007). Dolphins also use tactile signals in communication by touching non-kin with their pectoral fins to signal affiliation (Dudzinski and Ribic 2017). Finally, there are coordination cues. Male dolphins synchronize their behaviors, swimming and surfacing in unison during social interactions, and especially in intense situations in which the males are chasing after and trying to herd a female (Connor et al. 2006). Dolphin mothers and infants synchronize their movements for the first three months. Some scientists suggest that this mirroring helps dolphins learn to actively synchronize and later to imitate behaviors, which, in turn, promotes social learning of actions such as sponge fishing (Fellner et al. 2006). For dolphins, eye contact is likely not as important as auditory, tactile, or coordination cues.

Study of intentional communication in various species will have to be sensitive to the modalities that are salient and under voluntary control for that species. This suggests that knowing the species well is essential to identifying which cues might signal intentional communication for that species.

When we look at natural animal behavior in order to find evidence of intentional communication, we can look for three things. First, we can look for the content of the message—what the signal means. Second, we can look for the function of the message—what the signaler wants as a result of the signal. Finally, as we are looking at the meaning and the target of the message, we should make sure that the signal is voluntary, since all agree that an intentional act of communication should be under the control of the sender.

6.2.1 What do signals mean?

Some of the earliest work in animal communication started by asking whether animal signals refer to objects such as predators, group members, or food items. The biologist Peter Marler introduced the idea of functionally referential utterances, which are utterances that have all the behavioral characteristics of a referential signal, without implying anything about the cognitive mechanisms underlying the behavior. There are two criteria for a signal to be functionally referential: Its production must be caused by the same kind of stimuli, and hearing or seeing the signal must cause the same effect as does hearing or seeing the object the signal refers to (Marler et al. 1992). For example, because vervet monkeys give the same signal to all perceptions of an eagle, and because vervets respond to both the eagle alarm cry and the appearance of an eagle in the sky by hiding in a bush, the vervets' eagle alarm call counts as a functionally referential signal.

Many species will turn out to have referential calls if we apply Marler's criteria. For example, bantam chickens give different alarm calls in response to aerial predators, such as hawks, and ground predators, such as foxes (Evans et al. 1993; Evans and Marler 1995). As well, they exhibit different behaviors in response to hawks and foxes, but will take the same evasive action at the sight of a hawk and the sound of the aerial predator alarm call. Dogs are more likely to avoid taking a bone when they hear a recording of a growl made by a dog guarding his food than when they hear a recording of a dog growling at a stranger (Faragó et al. 2010). Prairie dogs have alarm calls for hawks, humans, dogs, and coyotes, and respond to the alarm calls the same way they respond to seeing members of those species (Kiriazis and Slobodchikoff 2006). Alarm calls may be modified depending on the individual properties of the predator (Slobodchikoff et al. 2009). Meerkats have alarm calls that simultaneously indicate predator type and the degree of danger presented by the predator (Manser 2001).

Other animal calls thought to be functionally referential include food calls and social calls. When chimpanzees find food, their calls can indicate both that there is food available, and also how good a food source it is (Slocombe and Zuberbühler 2005, 2006). Chickens (Evans and Evans 2007), ravens (Bugnyar et al. 2001), and various other primate species (Hauser and Marler 1993; Kitzmann and Caine 2009) also have food calls that have been identified as functionally referential.

Contact calls are also taken as having referential properties, and in some cases they may function as names representing particular individuals. Contact calls are given to indicate the presence of individuals, and some species have specific calls for specific individuals. Across many species mothers can discriminate their offspring's contact calls from those of unrelated individuals. For example, bat mothers discriminate between the isolation calls of their own offspring and those of other young bats, and experienced mothers are better at making this discrimination than new mothers (Knörnschild et al. 2013). Dwarf mongooses identify individual adults by their contact calls; in a playback experiment, mongooses who had acquired a desirable food item were more vigilant after hearing the contact call of higher ranking individuals than when they heard the calls of lower ranking individuals (Sharpe et al. 2013).

Baboons recognize alarm calls as well as reconciliation calls as coming from particular individuals (Cheney and Seyfarth 2007). Baboons can determine who is making a call, regardless of the type of call, and they respond differently depending on who is doing the calling. Cheney and Seyfarth write:

> Individual recognition occurs in so many contexts, with so many vocalizations, that it is hard to escape the impression that listeners have a mental representation, or concept, of Sylvia [a baboon] as an individual. If monkeys were human, we would call this a concept of a person.
>
> (2007, 262)

In a playback experiment, their research team presented recordings simulating a threat and fight between two females. When the fighting was consistent with the dominance ranks, observers were relatively uninterested. But when the recordings simulated a threat by a subordinate baboon to a dominant one, the other baboons looked longer at the direction of the vocalizations. Cheney and Seyfarth take this as evidence that the baboons are aware of individual identity and family membership, as well as linear ranking between families.

Bottlenose dolphins also have a sophisticated system of individual identifiers based on the signature whistle. Bottlenose dolphins create a unique signal that broadcasts their individual identity (by modifying calls heard around them early in life), and other dolphins learn to identify that signal with the individual (Janik et al. 2006). While females have a relatively stable signature whistle, males will modify their signature whistle to resemble the whistle of other males they have formed coalitions with (Watwood et al. 2004). Signature whistles are used to indicate one's approach to the group, which is useful given that dolphins often leave the group and return after some absence. Dolphins will also sometimes copy another's signature whistle, and this elicits a response in the named individual, who responds with his signature whistle (King and Janik 2013).

A case can be made for all these examples that they fulfill Marler's two criteria for functionally referential calls. However, given that Marler's criteria are silent on cognitive capacity, we can still worry that the calls are not made with referential intent. Consider that many machines can fulfill Marler's two criteria as well, by being reliable signalers of something (such as smoke) that causes receivers to respond in the same way they would respond to the object of reference itself (for example, both seeing the smoke or hearing the smoke detector go off would cause you to leave the building). Despite this, smoke detectors are not intentional communicators. In order to determine whether signalers are intentional communicators, we can ask whether the kinds of signals we see in natural communication systems are under voluntary control or not.

A second worry about Marler's criteria is that they blur the distinction between declarative and imperative communicative signals. A declarative statement does not by itself have motivational force. I can tell you that there is a lion behind you and you might run, or you might turn to look for the lion. An imperative statement is wholly motivational. If I yell, "RUN" (and you trust me), you will run. We should be able to draw a distinction between signals used to refer to an object and signals used to get others to do something.

6.2.2 Are animal signals voluntary?

Darwin thought that animal signals are largely expressions of emotions, and that recipients use this information about the signaler's state (Darwin, 1973/2007). The cat with the arched back who hisses at a dog is expressing her fear and anger toward the dog, and the dog with rump and tail up, and with head and paws on the ground is expressing her desire to play. These animal signals were long thought to be species specific and inflexible.

Scientists continue to examine the extent to which animal signals are under voluntary control. One suggestion is that some kinds of signals are under voluntary control, whereas others are not. We can see this in human signals. Human verbal behavior is typically under voluntary control, but blushing and grunting when picking up a heavy object isn't. Blushing and grunting can also serve as information even though they are not examples of intentional communication.

Tomasello and psychologist Josep Call have suggested that in the case of primates, vocalizations are not under voluntary control, but gestures are (Tomasello and Call 2018). They think that primate calls don't appear to be sensitive to audience effects, but look like automatic responses to highly salient events such as the presence of a predator or the location of food. This is a difficult claim to defend, because it isn't clear what counts as evidence of voluntary control. Flexibility is one marker of voluntariness, but it isn't necessary for voluntariness. You might utter the exact same string of words, such as a prayer, at a certain time every single day, but your utterance would still be voluntary. In addition, the claim that primate vocalizations are not voluntary because they are not flexible rests on the fact that we haven't yet observed such flexibility (or much of it—they do note that there are a few observations of flexibility in ape and monkey calls). To find evidence of absence requires a lot of time, more time than needed to find evidence of presence.

Other scientists are quick to point to evidence of flexibility in animal vocalizations. One source of evidence is that many animal vocalizations don't appear to be species-specific fixed action patterns, but learned. Chimpanzee infants acquire the vocalizations that their mothers produce, whereas chimpanzees raised by humans in a nursery fail to acquire the same vocalizations (Taglialatela et al. 2012). In addition, wild chimpanzees living in adjacent communities have very different pant hoots, such that they are more different from one another than they are from far-off communities, suggesting that the adjacent communities varied their calls to better distinguish in-group from out-group calls (Crockford et al. 2004).

Other species also learn to make sounds that serve as signals, such as the male zebra finch who normally will imitate his father's song, but who will develop a different song if exposed to another song model during the sensitive period for song learning (Eales 1985), or the bottlenose dolphin who will modify his signature whistle to resemble the whistle of a coalition partner, and who will produce a partner's whistle to get the partner's attention (King et al. 2013).

In addition to learning signals as evidence of flexibility, there is evidence that many species display audience effects. In a review paper, Cheney and Seyfarth describe a host of studies showing audience effects, including chimpanzees being more likely to signal the presence of food when they think a friend is coming compared to a nonfriend, vervet monkeys being more likely to utter alarm calls when others are around than they are when alone, and baboons being more likely to grunt when they approach someone they don't know well (Cheney and Seyfarth 2018).

Finally, a third kind of evidence of flexibility in primate calls comes from studies that show apes are sensitive to others' informational states. In one study, chimpanzees were exposed to a rubber snake on a path, and over the course of the day scientists observed that the chimpanzees would only alarm call when other chimpanzees who were ignorant about the presence of the snake approached. When chimpanzees approached the setting who already saw the snake, or had been close enough to hear a prior alarm call, no one bothered to warn them again (Crockford et al. 2012).

As with humans, some vocalizations appear to be under voluntary control, but that doesn't mean that all of them are. Being flexibly produced, learned, and showing sensitivity to communicative partners are all evidence of being under voluntary control. At the same time, such vocalizations will be influenced by one's history and current context. When examining the voluntariness of vocalizations, we can ask the philosophical question about how voluntary our actions are in general. Our words and our deeds are both influenced, and caused, by events that precede them. In a natural world where every event is caused by events that precede it, what counts as voluntary will have to be something less than 'could have done otherwise.'

6.2.3 Are animal signals declarative, imperative, or expressive?

Early debates among ethologists centered around whether animals' signals are referential or expressive. These two properties were taken to consist of an exclusive disjunction; a signal can either be expressive or referential, but not both. For example, the vervet eagle alarm cry couldn't mean "There is an eagle and I am terrified!" Referential signals have declarative content, providing information about some object or state of affairs. Expressive signals can be imperative, telling others what they should do, or they can be a sharing of mental experience. However, as we will see, it may not be as easy to disentangle referential, imperative, and expressive intent in animal signals—or in human linguistic practice. When "the cat is on the mat" can also mean "Please get the cat off the mat," declarative information (where the cat is), imperative commands (move the cat), and expressive attitudes (irritation about the cat hair on the mat) may be intertwined.

The kind of voluntary signals we've been discussing—alarm calls, contact calls, and food calls—are often understood as having some declarative content. They refer to the predator, a conspecific, or the location of food. In addition to vocalizations, gestures may be used to refer to objects.

Gestural communication has been observed in a number of species, including ravens who have been observed to use head and beak to indicate objects such as moss or twigs to their partner (Pika and Bugnyar 2011). Ravens show—pick up a non-food item by the beak and hold it for a few moments—or offer—pick up a non-food item by the beak and move the head up and down—items that have no obvious functional purpose for eating or nest building. Pika and Bugnyar think that the gestures serve to promote or test the bond between raven partners, given that ravens bond for life and rely on their partners to raise young, making finding the right partner a high-stakes activity.

Elephants have also been observed to use a number of gestures with one another; for example they orient their body to indicate where they want to go next (Poole and Granli 2011).

And some elephants understand human pointing (Smet and Byrne 2013). While controlled studies of these species' gestural communication have not been done, observations of failed communications can help to illuminate the intentional nature of these other animal gestures.

In particular, pointing is a behavior that may indicate reference to the object pointed at. As a deictic gesture—one that is only understood in a context—pointing occurs spontaneously in children and is interpreted as referential and triadic. The pointer indicates to the partner the existence of some referent in the environment. Because children begin pointing around nine months, and apes are not often observed pointing in natural contexts, one might be excused for thinking that pointing is unique to human beings. However, great apes in captivity are often observed pointing to indicate objects to a human caregiver, and there are also a few observations of apes pointing for other apes (de Waal 1982; Savage-Rumbaugh 1986; Pelé et al. 2009). Formal studies confirm that chimpanzees point in the presence of a human observer, but not when alone (Leavens et al. 1996), and that they are produced with sensitivity to the attentional state of the recipient (Liebal et al. 2004). The psychologist David Leavens argues that pointing is a natural communicative behavior for chimpanzees who are enculturated—who live in non-institutionalized captive settings in which they enjoy daily interactions with human caregivers (Leavens, 2014). Where studies fail to find evidence of pointing behavior in captive chimpanzees, it is because the subjects are living in an institutionalized context and don't have the opportunity to learn to point.

Compelling studies of apes pointing show how they respond to a failed message. It may be that a gesture is just an accident, and has no meaning, if it isn't repeated or elaborated on when the purported communicative partner doesn't respond in the right way. But if the gesture is repeated or elaborated on, a good explanation for the behavior is that it is an instance of intentional communication.

Leavens and colleagues report that chimpanzees respond to failed messages by persisting, and elaborating their gestures (Leavens et al. 2005b, 2010). In one study, researchers pretended not to understand chimpanzees pointing behavior in order to elicit additional communicative behavior (Leavens et al. 2005a). When the researchers failed to give a whole banana to chimpanzees pointing at a banana, the chimpanzees either persisted by repeating the gesture, or elaborated on the gesture until they received the desired food.

Similarly, in another study, the psychologists Erica Cartmill and Richard Byrne (2007) found that captive orangutans continued to gesture until they received some requested food, but that they varied the types of gesture depending on the response of the caretaker. If the orangutans only received part of the food they were requesting, they would continue repeating the original gesture. However, if the caretaker engaged in an incorrect behavior, such as bringing the wrong food, the orangutans changed their gesture, or elaborated on the original one.

Apes elaborate, repeat signals, and substitute gestures when their message fails. The flexibility of the responses is comparable to that of human children, and such patterns of behavior, like the behavior of human children coming to learn human language, can be interpreted as intentional communication. If the apes were merely responding with frustration, we would expect them to respond to failures with species-typical frustration responses, but they do not. Instead, the apes act as though there is an appropriate way of responding to the request and the human fails to do so, and so they help get the message across by either giving the same signal with more vigor or changing the signal entirely.

Figure 6.3 A person lip-pointing.

In addition to these formal studies of ape pointing, there is evidence of apes pointing, or using pointing-like gestures, in natural settings. For one, there are rare reports of pointing in wild bonobos (Veà and Sabater-Pi 1998) and chimpanzees (Hobaiter et al. 2013). Further, it may be that great apes, like humans in some cultures, use gestures other than an outstretched arm and index finger for pointing. For example, the Mohawks and Ojibway of North America point with their noses and chins. Lip-pointing, which is a deictic gesture that involves protruding the lips, orienting the gaze, and sometimes raising an eyebrow, is common in Laos (Enfield 2001).

In a similar sort of gesture, rehabilitant orangutans have been observed to show caregivers small fruits by presenting the fruits on their extended lower lip; the caregivers are allowed to examine the fruits, but if they fail to return them the orangutans become agitated. These orangutans appear to be showing, not offering (Andrews, unpublished data).

Tomasello has proposed that what looks like pointing and indicating an object is instead an attention-getting signal. As we saw in the discussion of intentional communication, an attention-getting signal is one that doesn't have referential content, but serves as an ostensive cue to the intended recipient of the signal. Attention-getting gestures are intentional, because they are a reflection of the communicator's desire that the receiver engage in some action. But they aren't referential, given that the sender expects that if the recipient looks where the sender indicates, the recipient will do what is wanted—such as provide the object pointed at. For Tomasello, only human pointing is genuinely referential, because it is cooperative, and can involve sharing information for the receiver's sake. Ape pointing, he thinks, is merely a request serving the signaler's selfish motives (Tomasello 2008).

Tomasello argues that it isn't just chimpanzee pointing that lacks referential content, but that none of the many great ape gestures refer. Chimpanzees have gestures that indicate requests, like groom me, scratch me, chase me, and pick me up. Tomasello suggests that these gestures are individually created as abbreviations of the performance of the behavior—ontogenetic ritualizations. As with an infant chimpanzee touching the mother's back in the right way, a human child's raising of arms at a caregiver signals that they want to be picked up. The arms up signal is a natural shortcut that has meaning as an imperative, but no referential content.

These shortcut signals might be better understood as attention-getting cues rather than messages with referential content, Tomasello argues. When an ape points, the recipient looks at what is pointed at and, so long as the message is well received, gives the object to the signaler. Tomasello says that apes do not respond well to points, because they are not used to giving objects. If all points are directives, a human who points at an object might be understood as asking the ape to give them the object, but unhelpful apes aren't motivated to give objects. In order to demonstrate reference in a gesture, an ape would have to use the same gesture in different contexts in order to accomplish different things. Tomasello thinks that nothing apes do in their natural environments amounts to referential behavior, and that is what distinguishes ape and human communication systems.

In addition to thinking no ape signals are referential, as we've seen, Tomasello thinks that ape vocalizations are not under voluntary control. The idea that vocalizations are not under voluntary control is consistent with the signals being purely expressive, displaying the emotional state of the signaler in an automatic fashion. Observations that some signals correlate intensity of vocalization with degree of emotion suggest that the signals are expressive in this way, indicating things like how scared the caller is, or with what urgency the receiver should respond.

When it comes to alarm calls, we might want to ask whether they are referential or expressive. Some observations suggest that alarm calls might not be referential, because adults sometimes give alarm calls to falling trees or non-predators (Arnold and Zuberbühler 2006), which suggests that there may be an emotive quality rather than merely a referential one. Many species give food calls in higher frequency when food is abundant (Hauser et al. 1993; Di Bitetti 2005), or of a high quality including fowl (Marler et al. 1986), cotton-top tamarins (Elowson et al. 1991), red-bellied tamarins (Caine et al. 1995), and spider monkeys (Chapman and Lefebvre 1990). These sorts of findings suggest to some that animal signals are just expressions of the sender's emotion, which, in turn, causes an emotion in the receiver, who then behaves appropriately given that emotion.

However, both interpretations assume a dichotomy between expressive signals and referential ones. Rather, we can take this sort of evidence to understand signals as providing information both about one's mental state and external objects. Like human sentences that mean different things depending on how they are said and the context that they are said in, some animal alarm calls can provide a variety of information. There may be a pragmatics of animal calls.

When presented with a luscious slice of cake, you might say, "That cake looks delicious!" But if you were worried about the empty calories, you might pronounce the sentence with despair in your voice rather than joy. Similar cases are seen in some animal calls. For example, suricates give different alarm calls to mammalian, avian, and reptilian predators, and they respond differently to the calls depending on the degree of urgency the call demonstrates

(Manser et al. 2001). In response to a low urgency snake alarm recording, suricates will raise their tails, approach the loudspeaker, and sniff the area around it, but they will quickly resume their previous activity. However, if a high urgency alarm call is played, the suricates will continue searching for the snake for a significantly longer time.

Given this dual role for some alarm calls, Dorit Bar-On argues that animal alarm calls are best understood as neo-expressive avowals that are self-reports of one's current mental states that have both an action component and a semantic component (Bar-On 2013). Expressivism in the philosophy of language is the view that our utterances do not refer, but merely express. Neo-expressivism was developed by Bar-On, and it combines the traditional expressive element with semantic content, such that an avowal is both an expression of a current mental state and a token with semantic properties (Bar-On 2004).

Andrew McAnnich and colleagues have applied neo-expressivism to argue that not only do animal calls have both referential and expressive elements, but they can be understood as having truth-evaluable propositional content (McAninch et al. 2009). Evidence of content comes from the fact that the alarm calls fit Marler's criteria for functional reference, conjoined with what is called "force-independence"—the idea that the same signal can cause different acts depending on the context. Because animals respond differently to an alarm call depending on the context, there is a kind of force independence to the call; an eagle alarm call doesn't make you run into a bush if you are already hidden. Even in honeybee dances we see some degree of force independence, since scout bees who have found a candidate site for a new hive will often fail to bring all the other scout bees to the site; the bee's private experience with a different site is a relevant factor in her response to a scout's dance (Grüter et al. 2008). The idea that the same signal can mean something different based on the context of that signal gets at the heart of pragmatics. For example, when there are different responses to an infant and an adult giving the same signal, or a dominant and a submissive, there is evidence that the messages mean something different depending on whom they come from. As we've already seen, depending on who gives the signal, it can mean different things.

One might worry that animal signals cannot have full-blown propositional content because the signals do not have compositionality—smaller parts do not determine the meaning of the utterance as a whole. However, there is evidence that something like compositionality may be present in animal signals, and that is the repetition of a message in order to change the meaning. Honeybees dance longer to indicate better nest sites (Seeley and Buhrman 2001) and suricates indicate the level or urgency of an alarm call through a graded change in harmonics to a noisy structure (Manser 2001). Gunnison's prairie dogs have alarm calls for different predators and features of predators, and some scientists think that these modifiers indicate a communication system with correlates to nouns and adjectives (Slobodchikoff 2002). McAninch and colleagues think that there may be some animal correlates to compositionality.

Finally, propositional content seems to require what is called cognitive significance—such that the meaning of a signal is related to the parties' mental state about the content of the meaning. McAninch and colleagues suggest that vervet monkeys fulfill this requirement. A monkey may be seen by other monkeys as an unreliable signaler of one predator, but still reliable when it comes to other predators. When researchers reveal a monkey as unreliable about eagle alarm calls by playing back recordings of that individual's eagle alarm call in the absence of an eagle, conspecifics will begin to ignore his eagle alarm call. However, they will continue to respond to his alarm call for other predators (Cheney and Seyfarth 1990).

Animal signals, like human utterances, may express feelings, present semantic content, and make imperatives all at the same time. There is no need to assume a dichotomy between these elements. Many empirical questions remain. Understanding that the same signal may have these different elements complicates the study of animal communication, but it promises to gain us greater understanding of the sorts of things animals can do with their signals.

6.3 Language and communication

Studies of the baboons of Botswana's Okavango Delta found that baboons have around 14 discrete vocalizations with different meanings. These vocalizations are learned and voluntary. However, unlike human vocalizations, the baboons do not combine these vocalizations to make new meanings. In this sense, there is no syntax or grammar in the baboon communicative system. Despite the complexity of the baboon communication system, Cheney and Seyfarth don't call what the baboons have a language. In order to understand why they don't, we need to understand how psychologists and linguists use the term "language."

The English word "language" derives from the Latin "lingua," which literally translates as "tongue." And while we use the term to refer to systems of codes we use to program computers, few students have the opportunity to meet their language requirement by studying C++. Narrowly understood, "language" refers to the systems of communication demonstrated in humans, and the questions of whether animals have similar systems and how these systems evolved are based on premises about the properties shared by all natural human languages.

The linguist Noam Chomsky famously claimed that only humans have language. While Chomsky thought it "obviously true" that animals have systems of communication (Chomsky 1980, 430), these are nothing like human language. According to Chomsky, all human languages share a set of implicit rules that allow us to form sentences according to the hierarchical grammars of our natural languages (Chomsky 1965). While the grammars of natural languages differ, at a more abstract level, they all share the same rules. They all share a set of properties that animal communication systems were thought to lack: Structural principles, physical mechanisms, manner of use, ontogenetic development, phylogenetic development, and integration into cognitive systems. While in subsequent years we have learned about the physical mechanisms, manner of use, ontogenetic development, and integration of animal signaling, Chomsky insists that structural principles are necessary for having a language. He thinks that animal communication systems lack a grammatical structure, lack a productive capacity (they don't allow a denumerably infinite number of distinct expressions), do not involve distinct elements, but are continuous, and do not exhibit recursion (the embedding of phrases inside other phrases to construct new phrases). Furthermore, the manner of use of animal communication systems and human languages is very different. Animals don't tell stories, don't write poetry, don't request information for clarification, can't give monologues, or engage in casual conversation about the weather. They can't talk about the past or discuss plans for the future. What they can do is indicate things like whether they are ready to mate, whether there is a predator around, or whether they will behave in a friendly or aggressive manner.

If the question "Do animals have language?" is understood to be the question of whether animal communication systems are like human language systems, then Chomsky concludes, it is clear that the differences are so great as to undermine the usefulness of the metaphor. Animals don't use language just as humans don't fly, even though humans can jump off tables and sail through the air for a second or two. Chomsky also argues that recursion might be the only structural feature that distinguishes human language from animal communication systems (Hauser et al. 2002). If we understand language to require recursion, which all human languages have, Chomsky concludes, no other species has language.

As linguistic anthropologists learn more about the diversity of human languages, and as animal cognition researchers learn more about how animals communicate, the claim that all humans and no animals engage in recursive signaling has been challenged. Research on European starlings demonstrates that we can train birds to discriminate a recursive grammar from among strings of starling sounds (Gentner et al. 2006). Research has shown similarities between human language and bird song along cognitive, neurological, genomic, and behavioral dimensions (Bolhuis et al. 2010). Because human children and baby birds both have to learn their communication systems through exposure to experts in those systems, and because both species go through a babbling phase, it may be that learning recursion is simply a part of learning a complex set of vocalizations. However, there is a difference between human children's easy acquisition of recursive forms and the intensive training of the starlings. Furthermore, while the children quickly generalized their recursive skills, the starlings did not. One study seeking to teach cotton-top tamarins to understand recursion failed to do so, suggesting to the authors that this species may not be able to recognize embedded grammars (Fitch and Hauser 2004). However, we should be careful in drawing conclusions from one study that fails to find an effect.

Another challenge comes from the linguist Daniel Everett, who claims that the language spoken by the Pirahã of Amazonian Brazil fails to demonstrate recursive properties (Everett 2005). Everett, one of the few to translate the language, also claims that there is a limit to how long sentences can be and so the language is finite. These claims, if true, would further undermine a clean distinction between animal systems and human systems of communication.

A final worry about recursion offering a difference in kind between human language and animal communication systems comes from neuroscience research showing that brain areas analogous with those associated with speech production in humans are associated with bird song in zebra finches. Humans with a mutation of the FOXP2 gene have impaired speech production, and some claim that this gene was key to the evolution of human speech and language (MacDermot et al. 2005). However, the FOXP2 gene is expressed in the same part of the brain in finches, and finches with damaged FOXP2 genes are also impaired in their song production (Haesler et al. 2007). Finch songs and human language may be more similar than they at first appear.

Human and nonhuman communication systems might be continuous with one another, with animal systems having simpler aspects of many properties of human communication language. However, human language may be discontinuous with animal systems of communication, such that language is something entirely new under the sun. In order to gain a better understanding of how animal communication may be continuous with or different from human language, we can consider theories about the evolution of language.

6.3.1 Gestural origins of language evolution

When we think about language, we generally think about talking. The voices that surround us are the most salient aspects of our linguistic processes. This makes it unsurprising that many first thoughts about the evolution of language propose that our first steps would be vocalizations, such as grunts and clicks and song. While this is probably the dominant view of language evolution, and the reason why vocal imitation is emphasized in some accounts of language evolution (Fitch 2005), an alternative idea is that human language evolved from body movements, like gesture, miming, and dance. Given the view that gestures are under voluntary cortical control to a greater extent than are vocalizations, some theorists propose that human language stemmed from communicative bodily movements, rather than vocally produced sounds.

The psychologists Michael Corballis (1992, 2002) and Merlin Donald (1991) both promoted versions of this theory beginning in the early 1990s, though the idea has been around for hundreds of years. Early European traders who were able to communicate with foreign people through gesture helped promote the idea that languages of the hand may have preceded languages of the mouth (Corballis 2009). That experience continues today for travelers to foreign countries; my sister and I spent an afternoon in Saharan Morocco with a family with whom we shared but a word, though we were still able to offer a ride to the matriarch, accept an invitation into her home, and take tea with her family. Gesture-first advocates consider several properties of pantomime as critical stepping stones to language: It is productive (enables creation of novel messages), and because it can communicate meaning with propositional content, it serves as an entryway to syntax, declaratives, and narrative (Arbib 2002; Arbib et al. 2008).

Donald saw the beginnings of modern human language as stemming from what he calls “mimetic skill,” which consists in the ability to control behavioral movements, rehearse them, and use them for communicative purposes (Donald 1991). Our ancestors were able to communicate by acting out what they wanted to say; by relying on pantomime they were able to communicate complex thoughts. Although Donald agrees that apes have a complex set of cognitive abilities, he thinks that their ability to store and use memories is quite limited, and so they “remain locked into an episodic lifestyle” (1993, 739). The ability for mimetic skill, which is the origin of language, he thinks, is unique to humans. Perhaps unsurprisingly, given his view about the relative voluntariness of gestures over vocalizations, Tomasello also endorses a version of the gestural theory of language evolution (Tomasello 2008).

Corballis argues that contemporary human language not only has its source in gestures, but remains, in fact, a gestural system, where the gestures are those of our articulatory organs including the lips, tongue, and larynx (Corballis 2009). Contemporary support for the theory comes from the research of neuroscientist Michal Arbib, another prominent supporter of gesture-first theories (Arbib 2005). Arbib and Corballis think that the gestural system is based on the existence of the mirror system, which is a neural system found in humans and other primates that is active both when witnessing another engage in an action and when one engages in that action oneself (Rizzolatti and Craighero 2004). The mirror neuron system overlaps Broca's area in humans—a brain area associated with the production of speech, as well as with observing or imagining meaningful gestures. And in monkeys, the mirror neuron system is thought to involve a brain area homologous with Broca's area in humans (Rizzolatti and Arbib 1998).

Animal cognition researchers have continued pursuing this interest in gestural theories of language evolution by examining gestural communication in other species. There has been special interest in the great apes, whose gestures are individually variable in terms of their repertoires (Call and Tomasello 2007), flexibly used (Gentry et al. 2009), involve multi-modal communicative combinations (Tanner et al. 2006; Pollick and de Waal 2007; Leavens et al. 2010), are used in sequences (Tanner 2004; Genty and Byrne 2010), and are part of negotiation or co-regulation within communicative interactions, including elaborations of failed messages (Leavens et al. 2005b, 2010; Cartmill and Byrne 2007).

Perhaps most controversially, great apes have been reported to engage in pantomime, which involves more elaborate acting out of desired ends in an idiosyncratic way (Russon and Andrews 2011a, 2011b). When Cecep showed Anne what he wanted her to do with the leaf, he was pantomiming. Pantomime consists of a gesture or series of gestures in which meaning is acted out; in humans, it can be as simple as twirling a finger to indicate a vortex or as complex as a Balinese dance recounting the story of the Ramayana. Pantomime can be representational, symbolic, narrative in form, and fictional (McNeill 2000). There are a number of anecdotes about pantomime in captive great apes. For example, Koko, a language-trained gorilla, mimed rolling a ball of clay between her hands to express "clay" (Tanner et al. 2006). Chantek, a language-trained orangutan, placed his thumb and index finger together and placed his lips on them, blowing, to indicate his desire for a balloon (Miles et al. 1996). The primatologist Christoph Boesch reports observing a wild chimpanzee acting out how best to crack a nut for her daughter (Boesch 1993). Wild chimpanzees also have been observed using a gesture called a "directed scratch" which involves an exaggerated scratching of a part of one's own body as a request to another chimpanzee to scratch that spot (Pika and Mitani 2006).

While critics argue that pantomimes and other great ape iconic gestures exist only in the eye of the beholder (Tomasello and Zuberbühler 2002; Guldberg 2010), the aforementioned observations indicate the need for testing in experimental settings. Pointing, iconic gestures, and pantomime may be important keys to understanding great apes' gestures given great apes' remarkable motor flexibility and the opportunities we have for observing their production and comprehension.

Evidence of pantomime in other species offers a window into how language could have evolved in humans. It may be that complex pantomimes that express propositional content existed before verbal language, which was required only after early hominids started multitasking. If you are stalking animals, readying your weapon, and communicating with your hunting partners at the same time, the new tool of verbal language would sure come in handy.

Another possibility is that both gesture and vocalization were integral to the evolution of human language. The chimpanzee homologue to Broca's area is active when the chimpanzee intentionally gestures and intentionally vocalizes, but not during nonintentional vocalizations (Taglialatela et al. 2011). Taglialatela and colleagues suggest that this neurological evidence is evidence for a multi-modal theory of language evolution, one that involved our hominid ancestors both gesturing and making vocalizations in order to communicate.

6.3.2 Teaching animals language

We can't end our discussion of animal communication without saying something about the 20th-century fascination with trying to teach language to other species. The cross-fostering experiments in the first half of the last century involved humans bringing baby chimpanzees into their homes, treating them like human infants, and hoping that they would begin to speak (Kellogg and Kellogg 1933; Hayes 1951). Unlike parrots, however, chimpanzees don't have the vocal apparatus needed for making human sounds, so this research program was doomed to fail. Researchers shifted to teaching apes American Sign Language (ASL) or other symbolic communication systems created in the lab. Early attempts with these projects appeared to be a success. The juvenile chimpanzee Washoe learned over 100 signs in ASL, after laborious training by his researcher caregivers Beatrix and Allen Gardner. While they wanted Washoe to learn language like a human, his acquisition of symbols required shaping, molding, and modeling the appropriate gestures (Gardner and Gardner 1978). Washoe's training shifted when Roger Fouts was hired to serve as Washoe's primary caregiver and language teacher when he was a young PhD student in psychology. Over time, Fouts was able to teach Washoe more than 350 ASL signs by introducing gestures within the context of daily activities the way a child learns language (Fouts 1997). Washoe subsequently taught her adopted son Loulis to communicate in sign language, and videotapes of Washoe's family show that they used signs to refer to attractive men in magazines, lipstick, and Christmas—all with no humans present.

Around the same time, the psychologist David Premack introduced several chimpanzees, including Sarah, to a lexical communication system using plastic tokens for nouns, verbs, and logical connectives, in order to produce strings of symbols that obey syntactic rules (Premack 1971), and the animal language researcher Francine Patterson introduced a modified form of ASL to Koko, a gorilla who learned over 100 signs and combined multiple signs to make new ones (Patterson 1978). However, when the psychologist Herbert Terrace tried to replicate the findings of some of these studies, he failed, thus starting the "ape language wars" of the 1960s and 1970s.

After acquiring an infant chimpanzee he named Nim Chimpsky, Terrace hired a series of caregivers to look after Nim and teach him ASL. The context was at first a laboratory setting in New York City, then a mansion in the country; the trainers came and went, and they had better and worse relationships with Nim. Nim didn't acquire much in the way of signing, and those signs he did seem to learn appeared to Terrace to be imitations of signs just given by a caregiver. After reviewing videos of Washoe's signing, Terrace concluded that Washoe's performance was best explained as simply copying (Terrace et al. 1979).

Subsequent ape language research controlled for alternative interpretations of results. Premack used transfer tests as evidence that the chimpanzee Sarah understands the symbols she was taught, showing that she could use symbols appropriately in a context different from the context in which she learned them (Premack 1971). Sue Savage-Rumbaugh was trying to teach Matata, a female bonobo, a lexical communication system when Matata's adopted son, Kanzi, spontaneously began using the lexicons (Savage-Rumbaugh 1986). Kanzi and other bonobos in Savage-Rumbaugh's care also came to comprehend spoken English, and in a formal study of comprehension of novel utterances Kanzi performed as well as a two-year-old human child (Savage-Rumbaugh et al. 1993). The psychologist Tetsuro Matsuzawa taught the female chimpanzee Ai to use numerals, and showed intergenerational transmission of this ability between Ai and her son Ayumu (Matsuzawa 2002).

Given what the apes were able to accomplish, some researchers started to look at other species. The psychologist Lou Herman taught a gestural communication system to four bottlenose dolphins, who were able to comprehend nouns, verbs, modifiers, and (perhaps) some logical connectives (Herman 2010).

The psychologist Irene Pepperberg taught spoken English to an African grey parrot, Alex, who was able to label objects by name, color, shape, and matter (Pepperberg 1999), and studies of other parrots' vocalizations suggest appropriate contextual use of words and phrases (Colbert-White et al. 2011) and semantic structure such as synonymy (Kaufmann et al. 2013). Studies of dogs' word learning suggest that border collies, like Chaser and Rico, understand that words refer to objects in the world (Kaminski et al. 2004; Pilley and Reid 2011).

Among the claims made about how other animals can come to use symbols for communicative purposes, we see evidence for semantics and syntax. Philosophical questions arise about what these studies tell us about the relationship between language and mind. Are there cognitive operations that an animal can do with a symbolic system and cannot do without it?

There is some suggestive evidence that having a symbol helps animals pass certain tasks. Chimpanzees in a reverse contingency task (in which what you pick goes to another, and you get what you don't pick) failed to maximize their own reward when they were presented with candies, but were able to maximize when they were given numerals rather than objects (Boysen et al. 1996, 1999). Capuchin monkeys are also reported to do better on this task when using tokens rather than food (Addessi and Rossi 2011). It seems that symbols may help animals control impulses. But what about other tasks? We use symbols to help us remember grocery lists or to do math problems, among other things. But these animals don't have the ability to use the symbols for themselves, for the most part. When a researcher provides them, the subjects can respond appropriately, and they are used to make requests for trips or treats. But if the full range of symbols is not available to the individual, they cannot come to rely on them or use them to develop novel solutions to other seemingly unrelated tasks. Dolphins and dogs who can comprehend symbols given to them by humans but have no means to produce symbolic communication are not going to be able to recruit such symbols for other purposes. Without the ability to use the system to communicate with other members of one's species, and without intergenerational transfer of the system to offspring in the group, it is unlikely that the system will develop. Consider the evolution of creoles from pidgins, as illustrated in the creation of a new sign language in Nicaragua in the late 20th century. In a short period of time, a group of deaf children who were brought together created a language, by modifying elements of various home signs they brought with them to the school. As younger children joined the school, the system continued to change and increase in complexity, with grammatical structures like noun–verb agreement soon emerging (Senghas and Coppola 2001).

There are reports of great apes using their symbolic systems to communicate with one another. The ASL study that began with Washoe also included other apes, including Loulis, Washoe's adopted son, who learned signs from her. We've already seen that the apes used signs to communicate with one another when no humans were around. In addition, Loulis used his signs to communicate about play with his young friend Dar. When the play got too rough, Loulis would sign to Washoe to get comfort. He also appeared to blame Dar for starting a fight, by signing "good good me" to Washoe and then pointing and screaming at Dar (Fouts and Fouts 1993).

Savage-Rumbaugh has conducted formal tests that indicate the chimpanzees Sherman and Austin can use lexigrams to communicate to one another; when one chimpanzee needed a tool that the other chimpanzee had access to, he could use the correct lexigram to request the appropriate tool, which would then be provided (Savage-Rumbaugh 1986). The real promise of the artificial animal language research program would be the development of communication systems by groups of individuals who, like the deaf Nicaraguan children, modify what they are given to create a new language. While you might think we could try to create a parrot community to observe whether language abilities would evolve, since parrots can autonomously use the symbols they acquire, such a project may be difficult to set up; Pepperberg reports that Alex didn't like the other parrots she brought into his community.

There is some evidence that groups of zebra finches who learned nonstandard songs will, over a few generations, develop a wild-type song in much the same way humans create creoles (Fehér et al. 2009), but unlike the symbol-trained apes, humans know little about what zebra finch songs might mean to the birds. We have as of yet seen nothing like creolization in artificial animal language systems. Since these projects on apes and dolphins are largely in the past, and ethical issues regarding the cross-fostering studies loom large, it is likely that a multigenerational project on animal language will not be forthcoming.

There are at least two ways in which having a symbolic language can be related to thought. One we already examined and discarded in the last chapter—the claim that language is required for thought. The second, less controversial, claim is that language and symbolic representational systems more generally, while not being a requirement for thought, do allow for a significant expansion of thought and cognitive processes because they permit a way of offloading cognitive work from the brain into the linguistic environment, and a means for integrating information from different domains. With speech, language allows us to share tasks and solve problems through dynamic interaction, linking brains together. With written symbols, language allows us to make lists to help our memories, to prioritize and schedule our tasks, and to make inferences about complex relationships. Symbols allow us to better interact with others, to explain our actions and share our plans.

While there are ethical reasons for avoiding studies that take infant apes from their mothers to raise in human homes, there also may be ethical imperatives for teaching some symbols to animals. For example, horses are often blanketed, even in the summer, as a part of normal husbandry practice. Researchers taught horses three symbols, one meaning "blanket on," the other meaning "blanket off," and the third meaning "no change" (Mejdell et al. 2016). Horses learned to communicate their preferences, leading to increased welfare in these animals. If we can teach domestic animals some symbols that will help them thrive, perhaps we should turn our attention to teaching useful communicative symbols to the domestic and other captive animals in our care.

6.4 Chapter summary and conclusions

Like the question "Do animals have beliefs?" the question of whether animals communicate requires clarification in order to be answered properly. We considered three general types of communication: Biological, information processing, and intentional. Biological communication can be understood as a signal that effects the behaviors of another organism, which evolved because of that effect, and which is effective because the receiver's response has also evolved. On this view, plants might communicate, but computers would not. Communication as information processing can be understood as a signal sent by a sender to a receiver who decodes the signal to extract the information. On this view, plants and computers could be communicators. Neither biological nor information processing accounts get at communicating thoughts and feelings, which is what humans are able to do.

Intentional communication is communication between agents, but some accounts have unreasonably high cognitive requirements. Gricean accounts of intentional communication require that communication partners can mindread by attributing mental states to one another. On some readings, a fourth-order intentionality is required, such that communicators can think thoughts like, Alex believes that Franny believes that Alex believes the cat is on the mat. Many humans, including me, have a hard time wrapping our heads around sentences like these! Since our investigation into the cognitive requirements for intentional communication starts with our assumptions that human children communicate at an early age, and children don't show mindreading abilities until around being four years old, the calibration method suggests that there are problems with the Gricean account of communication.

Philosophers and primatologists alike have introduced intentional accounts of communication inspired by Grice but without requiring mindreading at all. On these accounts, communication consists of relaying a message such that the sender and receiver understand each of their roles in the exchange. This counts as intentional communication because the sender has the goal of offering a message and the receiver knows that the sender has this goal. One way to develop this account is in terms of ostensive communication, which requires both a message and an "act of address" that signified that the message is intended for the receiver. Richard Moore's ostensive communicative account of intentional communication requires that communicative partners can understand that others have goals, but don't require understanding other's beliefs. He thinks that we may find evidence of intentional communication of this sort in animals from fish to apes. Michael Tomasello's view of ape intentional communication suggests that only ape gestures are intentionally communicative, because gestures, and not vocalizations, are under voluntary control. The last intentional account is a dynamical systems account, according to which communication is a kind of embodied co-regulation. Communicators will be agents, but their communicative signals cannot be fully voluntary, as they are at least partially the result of prior social interactions. Communicators will also use many sensory modalities, including touch, in their meaning-making practices. While the dynamical systems approach to communication doesn't offer a psychological theory of communication, it does help us identify instances of communication that don't fit into the information exchange models that still dominate thinking even in intentional theories.

While most people working in this area agree that at least some species engage in intentional communication, they disagree on what is communicated. Contact calls, food calls, alarm calls, whistles, presentations of body parts, dances, points, generating noises by stomping or biting leaves, touches, eye contact, and more are all kinds of communicative signals. Some of these might be attention-getting signals. Others might be signals expressing the sender's emotions. Some signals might be referential, and others might be imperatives. We saw that the same signal might offer content of different sorts, given pragmatics. The way we say a sentence can express how we feel about what we are saying, and the same might be true of some animal signals.

We finally looked at issues related to language and communication. Language is thought by many to be different in kind from animal communication systems, because it has a grammatical structure permitting new meanings to be created from familiar symbols, and animal natural communication systems all appear to lack such properties. We examined whether gestural communication might be able to provide syntax and productivity in communication, and considered that pantomime may have been how humans first developed language. Given evidence of pantomime in great apes, the difference between human language and ape communication systems might be one of degree. We also saw that attempts to teach language to other animals resulted in animals learning a number of symbols that they could use or comprehend, but very little in the way of grammatical structure. While some infants learned symbols from their conspecifics, for the most part transmission was from human to animal. However, these experiments have been limited by the ethical and practical constraints of keeping animals in captivity and taking young infants from their parents.

Since a key element of communication is the ability to identify a communicative partner, social cognitive abilities are going to be necessary for any communicator. In the next chapter, we will step back to look at the research on social cognition, folk psychology, and theory of mind/mindreading in other species.

Further reading

Intentional communication theories

Bar-On, Dorit. "Communicative Intentions, Expressive Communication, and Origins of Meaning." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 301–312. New York: Routledge, 2018.

Dretske, Fred I. *Knowledge and the Flow of Information*. Oxford: Blackwell, 1981; reprinted, Stanford, CA: CSLI Publications, 1999.

Grice, H. Paul. "Utterer's Meaning and Intention." *The Philosophical Review*, 78 (1969): 147–177.

Millikan, Ruth. *Varieties of Meaning*. Cambridge: MIT Press, 2004.

Moore, Richard. "Convergent Minds: Ostension, Inference and Grice's Third Clause." *Interface Focus*, 7 (2017): 20160107. doi: 10.1098/rsfs.2016.0107

Flexibility in ape gestures or vocalizations

Cheney, Dorothy, and Seyfarth, Richard. "Flexible Usage and Social Function in Primate Vocalizations." *Proceedings of the National Academy of Sciences*, *115, 9* (2018): 1974–1979.

Tomasello, Michael, and Josep Call. "Thirty Years of Great Ape Gestures". *Animal Cognition, 22* (2018: (461–469)). doi: 10.1007/s10071-018-1167-1.

Animal communication

King, Barbara. *The Dynamic Dance: Nonvocal Communication in African Great Apes* (1st ed.). Cambridge, MA: Harvard University Press, 2004.

Sievers, Christine, Markus Wild and Thibaud Gruber. "Intentionality and Flexibility in Animal Communication." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 333–342. New York: Routledge, 2018.

Stegmann, Ulrich. "John Maynard Smith's Notion of Animal Signals." *Biology and Philosophy*, *20, 5* (2005): 1011–1025.

Stegmann, Ulrich. *Animal Communication Theory: Information and Influence* (1st ed.). Cambridge and New York: Cambridge University Press, 2013.

Stegmann, Ulrich. "The Content of Animal Signals" In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 324–332. New York: Routledge, 2018.

Tomasello, Michael. *Origins of Human Communication*. Cambridge, Mass: MIT Press, 2010.

Animal language projects

Fouts, Roger. *Next of Kin: My Conversations with Chimpanzees*. New York: William Morrow Paperbacks, 1998.

Hess, Elizabeth. *Nim Chimpsky: The Chimp Who Would Be Human*. London: Bantam, 2008. (The documentary film *Project Nim* covers the material in the book.)

Pepperberg, Irene. *Alex & Me: How a Scientist and a Parrot Discovered a Hidden World of Animal Intelligence-and Formed a Deep Bond in the Process*. New York: Harper Perennial, 2009.

Savage-Rumbaugh, Sue, and Roger Lewin. *Kanzi: The Ape at the Brink of the Human Mind*. Somerset, NJ: Wiley, 1994.

7 Social knowledge

Gelada baboons live in small communities in which a dominant male has exclusive mating rights with all adult females. The subordinate males of the group aren't allowed sex with females, and so they typically leave their natal group and try to take over a group of their own. Despite this norm, about a quarter of the babies born in a gelada group are not the dominant's offspring. Clearly, the baboons are up to something. Indeed, a controlled study of gelada mating behavior found that when baboons have unsanctioned sexual relations, they keep quiet, but when females mate with the dominant male they vocalize loudly. Researchers think that cheaters take the dominant male's perspective into account, and make sure that he can't see or hear them (Le Roux et al. 2013).

What's going on here? Are the cheating baboons thinking about how best to deceive the dominant? Do they think the dominant will be angry if he knew they are mating? Humans can think these kinds of thoughts. Are we alone in the ability to think about others' emotions, perceptions, desires, or beliefs? Does an animal need to think about all these mental states in order to have some kind of social understanding? These questions are not easy to answer. On the one hand, since animals don't use language, they don't give their reasons for action or name their feelings. On the other hand, humans use language to describe what we take to be our reasons and our feelings, but we might be making it up as we go along. Language can also provide a misleading window into others' minds.

Social animals, including humans, are excellent at predicting and coordinating behavior with other individuals—predators, prey, friends, enemies, co-workers, or strangers on the street. We know that humans can think about other people's minds, because we can talk about what Mavis thinks is the best TV show, or how Alessia feels when it rains (thus providing evidence that we use mentalistic concepts). The central question for this chapter is whether animals also think about other individuals' *minds*, or whether they only need to think about individuals' *behavior*. We want to know whether animals think of others as agents with mental lives.

Let's take stock about what we've established so far. We're justified in thinking animals can be conscious, rational thinkers who communicate with others. However, we need to acknowledge that it is possible that thinking, communicating, conscious beings know nothing about others as agents. A thinker and communicator thinks and communicates specific content, but there are limits to the kinds of things we can think about. Some people think about iambic parameter; most people never do. In the last chapter, we discussed mentalizing—thinking about others' mental states—in the context of the orders of intentionality required for Gricean communication. Here, we will directly confront the question of whether animals understand one another's emotions, perceptions, desires, or beliefs—that is, whether they think about mental content.

While the recent focus in animal social cognition has been on this question of whether animals can mentalize, and in particular, on the question of whether animals understand that others have beliefs, there are other ways in which we can examine animals' social knowledge. Just as animals may be able to communicate without having second-order intentionality, they may be able to understand one another without it, too. Not even all human social interactions consist of thoughts about others' reasons for actions, motivations, or feelings. We also understand people, and can coordinate with them and predict their behavior, by considering their role in the society—by thinking about their personality traits, or by thinking about what they should do. Pluralism in folk psychology makes the point that both humans and other species use methods other than attributing mental states in order to understand one another.

Drawing on the work we did in the previous chapters, coupled with a more nuanced view about how humans understand other humans, we can examine both what we know about animal social cognition, and the kind of science and philosophy—and the philosophy of science—we need in order to gain a deeper understanding of how animals understand one another.

7.1 Mindreading or theory of mind

Whichever term you use (philosophers tend to prefer "mindreading," while psychologists use "theory of mind"), the topic is roughly the same. The focus is on mentalizing, or thinking about the minds of others. We all assume that adult humans mentalize, and we have introspective evidence that we do it ourselves. Drawing on that observation, the psychologists David Premack and Guy Woodruff asked whether chimpanzees do it too. In their 1978 paper "Does the chimpanzee have a theory of mind?" they reported showing a 14-year-old chimpanzee named Sarah short videos of her trainers beginning to engage in some familiar act like acquiring out-of-reach bananas, unlocking a lock, or warming up a cold room with a heater. Sarah was then shown two photographs, one of which demonstrated the goal of the action, and she did a good job picking the correct photograph for her preferred trainer (interestingly, Sarah tended to choose photos depicting mishaps when shown pictures of a trainer she didn't like very much) (Premack and Woodruff 1978).

Premack and Woodruff claim that Sarah's performance shows that she understands that the actor has an *intention*. They suggest that the best interpretation of their findings is that Sarah does have what they called a *theory of mind*, because "In looking at the video, [s]he imputes at least two states of mind to the human actor, namely, intention or purpose on the one hand, and knowledge or belief on the other" (Premack and Woodruff 1978, 518). To be fair, they say that additional research is necessary, but that their study offers preliminary evidence that chimpanzees think about others' beliefs, and desires or goals. They reason as follows: Belief alone, like purpose alone, may not be enough to make a correct prediction because cognitive states and motivational states are jointly necessary for behavior. A person might *want* to acquire the bananas, but without *knowing* where they are there's nothing she can do about it. Similarly, I may *want* to acquire a million dollars, but this desire alone isn't going to cause me to do anything in the absence of some belief about how to achieve that goal; if I *believe* that playing the lottery will help me gain a million dollars, and I desire to have a million dollars, I will play the lottery. Since Sarah is predicting what the human is going to do next, she must be thinking of both his belief and his goal/desire. The only other option, as they see it, would be that Sarah is reasoning about behavior. But that would require knowledge of a huge number of regularities unmediated by any unifying theory, and they think it is unlikely that that's what Sarah is doing. As they put it, "The ape could only be a mentalist. Unless we are badly mistaken, [s]he is not intelligent enough to be a behaviorist" (Premack and Woodruff 1978, 526).

This report was just the beginning of what has turned into a huge debate about mentalizing in other species. Premack and Woodruff failed to convince many that Sarah has a theory of mind. In his commentary on the article, the anthropologist Ben Beck pointed out that chimpanzees and humans alike do not need a theory of mind to be good at predicting behavior. Tyler Burge agreed, remarking that he can see a beetle stymied by an obstacle in their path and immediately understand the problem without attributing mental states to the beetle. While these insights were largely ignored, other commentaries played a central role in shaping future research. Daniel Dennett worried that Sarah's behavior could be explained via associative reasoning, and suggested an alternative experiment based on asking whether chimpanzees can think that others have *false* beliefs. He writes:

> Very young children watching a Punch and Judy show squeal in anticipatory delight as Punch prepares to throw the box over the cliff. Why? Because *they know Punch thinks Judy is still in the box*. They know better; they saw Judy escape while Punch's back was turned. We take the children's excitement as overwhelmingly good evidence that they understand the situation – they understand that Punch is acting on a mistaken belief (although they are not sophisticated enough to put it that way). Would chimpanzees exhibit similar excitement if presented with a similar bit of play acting (in a drama that spoke directly to their "interests")? I do not know, and think it would be worth finding out, for if they didn't react, the hypothesis that they impute beliefs and desires to others would be dealt a severe blow, even if all the P&W tests turn out positively, just because it can be made so obvious – obvious enough for four-year-old children – that Punch believes (falsely) that Judy is in the box.
>
> (Dennett 1978, 569)

Dennett's idea, which was shared by two other philosophers who wrote commentary on the study (Bennett 1978; Harman 1978), stemmed from a discussion in the philosophy of mind about the nature of belief and its role in mentality. Premack and Woodruff endorsed the idea that belief and desire together cause action, and thus there is a tight relationship between the two. However, their study didn't take up another philosophical point about the nature of belief, namely the idea that was referred to in Chapter 5 as epistemic endorsement—that beliefs are taken to be true by the believer. If we didn't actually take belief to be the sort of thing that can be true or false, we wouldn't need to talk about beliefs at all. Instead, we could speak of knowledge, or just the state of affairs in the world that the belief is about.

Gilbert Harman appears to be working from the insight that error is what gives belief its purpose when he offers a test to determine whether chimpanzees attribute beliefs:

> Suppose that a subject chimpanzee sees a second chimpanzee watch a banana being placed into one of two opaque pots. The second chimpanzee is then distracted while the banana is removed from the first pot and placed in the second. If the subject chimpanzee expects the second chimpanzee to reach into the pot which originally contained the banana, that would seem to show that it has a conception of mere belief.
>
> (Harman 1978, 576–578)

And thus the idea for the false belief task was born. Harman's proposal was taken up by developmental psychologists Hans Wimmer and Josef Perner who tested theory of mind in children (Wimmer and Perner 1983). Children watched a puppet show in which Maxi puts away a piece of chocolate before leaving the room. While Maxi is out, his mother finds the chocolate and moves it to another location. Maxi returns to the scene, the show is stopped, and children are asked to predict where Maxi will go to look for his chocolate. If children predict that Maxi will look for the chocolate where he left it, then they are thought to demonstrate their ability to attribute false beliefs to others. The child who predicts Maxi will look for the chocolate where it really is doesn't demonstrate an ability to attribute different beliefs to others, and so they might lack the concept of belief. In this original study, most children younger than four predict that Maxi will search for the chocolate in its current location. Older children appear to realize that Maxi doesn't know that his chocolate has been moved, so he will go look for it where he left it (Wimmer and Perner 1983). This test is sometimes called the Sally-Anne task, after a version of the same story given to children on the autistic spectrum (Baron-Cohen et al. 1995). After hundreds of tests, it seems pretty clear that typically developing children pass this test around four years of age (Wellman et al. 2001).

While the false belief task became a popular research program in child development, the inability to tell such stories to animals made it difficult to use it as a test for mindreading in other species. While there have been many studies purporting to show some understanding of intentionality, goals, desires, perceptions, and beliefs in other species, Premack and Woodruff's question raises more questions than have been answered so far. Let us look at a few of those questions.

7.1.1 Can we test for animal mentalizing?

Dozens of empirical studies of mindreading in great apes, monkeys, dogs, dolphins, and elephants have been performed already. It may seem that we just need to find the right test in order to determine whether another species thinks about mental states. However, some philosophers have argued that empirical research is the wrong way to proceed on this issue. As we saw in Chapter 5, José Bermúdez thinks that nonlinguistic animals cannot engage in logical thought because they cannot think about thought. If animals can't think about thought, then they certainly can't mindread. Bermúdez contends that mindreading isn't possible without language. This isn't an empirical claim; rather, it rests on the idea that in order to think about thought, thoughts need to be represented in some format that permits metacognition, and, he claims, only public language can do that.

The overall line of reasoning starts with what Bermúdez calls the argument from intentional ascent (or thinking about thoughts), which can be stated as follows:

1 For a thought to be the object of a second-order thought, it must be represented.
2 Representations are either symbolic (requiring the use of natural language) or pictorial.
3 In order for a thought to have an inferential role it must be composed of elements that play a role in other related thoughts.
4 Symbolic representations are composed of elements that play a role in other related thoughts.
5 Pictorial representations are not composed of elements that play a role in other related thoughts.
6 Therefore, for a thought to have an inferential role, it must be a symbolic representation, involving elements of a natural language.
7 Second-order thoughts require thoughts to have an inferential role.
8 Animals do not have language.
9 Therefore, animals do not have second-order thoughts.

The upshot of this argument is that thoughts can be the object of thoughts only if they take a linguistic form. Bermúdez concludes that intentional ascent, or thinking about thoughts, requires semantic ascent, or thinking about words.

Premises (2) and (5) are key to this argument. In premise (2), Bermúdez assumes that natural language is the only symbolic system. He also considers two different mechanisms that would permit metacognition and logical thought, and then goes about showing how one of them cannot do the job. That work is done in premise (5), which he defends by arguing that there is no structure to pictures, no joints at which to divide them, and so they cannot offer the structure needed for truth-evaluability and inferential roles.

However as we saw in Chapter 5, pictorial representations such as maps or diagrams offer a richer structure than Bermúdez gives them credit for, and they can account for some degree of rational inference. Imagistic map-like representations can take the place of mental sentences. But can maps support logical inference? Recall Elisabeth Camp's discussion of maps. Camp thinks maps can express negation, disjunction, the conditional, and tense (Camp 2007). She suggests that negation would be represented pictorially with colored icons that represent positive or negative information. Dynamic maps might represent disjunction and conditional via flashing lights; tense could be represented by italics. One could even represent some existential quantifiers, such as "There exists a school right here." However, she doesn't think maps can account for non-specific existentials such as "I know that the right guy is out there, I just need to find him!" or universal generalizations. Camp concludes that although maps have fewer expressive limitations than one might suppose, and they cannot account for the full expressive power of language, they still can be composed of elements that play a role in other thoughts.

If symbolic representation can occur without language, or pictorial systems can be composed of elements that play roles in other thoughts, then Bermúdez's argument doesn't hold and scientists are free to continue studying animal mindreading. However, if Bermúdez is right, then the empirical research program dedicated to answering Premack and Woodruff's question is misguided, because the question is already answered.

Bermúdez provides a theory-first approach to examining animal mindreading. Like in some theory-first approaches to consciousness, we find that the theory excludes the possibility that animals have the property in question. The worry that emerges is that the theory may have been developed without sufficient evidence about the range of behaviors and capacities in other species. The theory may have been built from a faulty foundation. Rather than pre-emptively concluding that no theory is possible to explain second-order intentionality without language, we would be better off starting with more in the way of empirical evidence. Before we do that, we need to confront another preliminary challenge to the study of animal mentalizing.

7.1.2 The "logical problem"

In order to design experiments on animal mindreading, we need to ask the epistemic question: What sort of evidence do we need to conclude that a nonhuman animal is a mindreader? Researchers inspired by the philosophical analysis of belief devised experiments that sought to determine whether chimpanzees can understand others' false mental states. Among all candidates, false perception has been of particular interest. But these studies have all been challenged by what the psychologists Daniel Povinelli and Jennifer Vonk refer to as involving "logical problems" (Povinelli and Vonk 2003, 160), which leads to what Susan Hurley and Matthew Nudds dubbed "the logical problem" (Hurley and Nudds 2006b). The problem arises when trying to decide between two kinds of hypotheses—mindreading and behavior reading. Povinelli and Vonk claim that because our mental state attributions are largely due to our observations of the person's behavior, whenever we are predicting behavior, we might just as likely be relying on associations between behaviors as we are relying on associations between mental states and behavior.

Povinelli and Vonk introduce this puzzle as a critique of a study that purports to show that chimpanzees know what other chimpanzees can see. The psychologists Brian Hare, Josep Call, and Michael Tomasello investigated this question in the context of food competition between a dominant and subordinate chimpanzee. In one of the experimental conditions, they set up a room with a door at each end, and positioned a chimpanzee at each door. In all cases, one of the chimpanzees was dominant over the other. This is an important part of the experiment, because subordinate chimpanzees know that they are not allowed to take food from a dominant chimpanzee. The experimenters set up the room so that there were two cloth bags in the middle of the room, and they placed a piece of banana or apple on the subordinate's side of the bag. The subordinate was allowed to watch the room set up in all conditions, but the dominant was

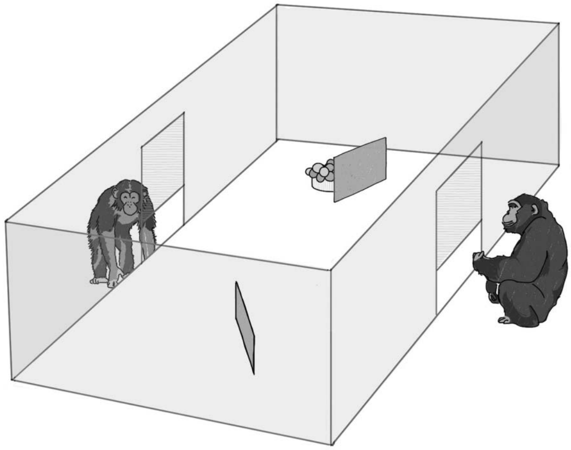

Figure 7.1 Chimpanzee food competition set-up. The subordinate only seeks the food the dominant cannot see. Redrawn from Hare et al. 2001.

only allowed to watch the placement of the food in the informed condition; otherwise, the food was placed while the dominant chimpanzee was behind a door. The subordinate chimpanzee was very good at avoiding the food the dominant saw being hidden, and seeking out the food that the dominant didn't see being hidden. The researchers concluded from these findings that chimpanzees understand the mental state of seeing (Hare et al. 2001).

However, Povinelli and Vonk have a different interpretation of what's going on in this study. Chimpanzees have lots of opportunities to watch other chimpanzees move toward food, and so they had ample opportunity to notice connections between behaviors. For example, the subordinate might notice that when a dominant turns his head toward food, next he heads over to the food and eats it. The subordinate doesn't have to also think about what the dominant sees. Povinelli and Vonk think that any mentalizing study that rests on what they call behavioral invariants (behaviors that are tied to other behaviors) cannot distinguish between whether the chimpanzee is predicting based on the invariant or on a mental understanding.

Povineli and Vonk call the predictive method that relies on behavioral invariants *behavior reading*. To avoid a behavior reading explanation, they think that mindreading tests need to be devised so that the task can't be solved by reference to past experience with others' behavior. The task should be set in an unfamiliar context that requires the chimpanzee to draw inferences in order to predict a new behavior, one that isn't associated with some behavioral invariant. They endorse a version of "the goggles experiment," an experiment first proposed by Heyes (1998). Rather than wearing goggles, the apes wore buckets with opaque or translucent windows in them:

> Subjects would first be exposed to the subjective experience of wearing two buckets containing visors which look identical from the outside, but one of which is see-through, the other of which is opaque. The buckets would be of different colors and/or shapes in order

> to provide the arbitrary cue to their different experiential qualities. Then, at test, subjects are given the opportunity to use their begging gesture to request food from one of two experimenters, one wearing the <seeing> bucket and the other wearing the <not seeing> bucket … By definition, S_b [a behavior reader] has no information that would lead the subjects to generate this response. In contrast, a system that first codes the first person mental experience, and then attributes an analog of this experience to the other agent (in other words, S_b+_{ms}) could have relevant information upon which to base a response.
>
> (Povinelli and Vonk 2004, 14)

The idea is that the apes have to engage in experience projection—understanding that a certain kind of situation caused in them a certain mental experience, and realizing that others in that same situation will have that same mental experience. This experiment seems promising, because the chimpanzee subjects would not have the prior experience of seeing humans wearing buckets. But would the success of this study really avoid the logical problem? I think not. The chimpanzee who successfully begs from the experimenter wearing the <seeing> bucket could have, *from his own experience*, made the connection between wearing the see-through bucket and being able to do things—like walking around without bumping into things, or acquiring food items in the enclosure (Andrews 2005). Rather than generalizing from one's own *mental* experience, the chimpanzee could be generalizing from his own *physical* experience. One can solve this task by making the behavioral connection between wearing the opaque bucket and *not being able to do things*, and from that decide to beg from the person who can do things.

While the logical problem wasn't intended to suggest that empirical research on ape mindreading is impossible, it may be that no experiment can in principle avoid these alternative interpretations. Robert Lurz agrees that the bucket on the head experiment can't decide the issue, but proposes that we can overcome the logical problem by designing an experiment where the chimpanzee's behavior isn't subject to a *complementary* behavior reading hypothesis—a hypothesis that refers to the very features of the situation that provide evidence of the mental state (Lurz 2011). To develop diagnostic tests, we can consider the adaptive function of mindreading. Lurz thinks that mindreading evolved to help predict the behavior of conspecifics who were looking at ambiguous stimuli, such as camouflaged predators or prey.

Drawing on this idea, Lurz proposes a modified version of the food competition study. First, researchers train a subordinate and a dominant chimpanzee that orange bananas are not real bananas. After training, the subordinate is exposed to translucent red barriers that make real yellow bananas look like fake orange ones. Once the subordinate understands how the barriers work, a naive dominant is invited in for the test. The room is baited with two yellow bananas on the subordinate chimpanzee's side of two barriers. Because one barrier is transparent and the other is translucent red, the subordinate who can perceptually mindread will seek out the banana behind the red barrier, because the dominant will think it is a fake orange banana, and will go for the yellow treat behind the transparent barrier.

Lurz criticizes the original food competition task, which can be explained in terms of the complementary behavior reading hypothesis by appealing to a direct line of gaze (a facial/bodily orientation of the chimpanzee toward the object). Because the dominant has always eaten food to which he has a direct line of gaze, the subordinate can infer that the dominant will not seek the food that is not in their line of gaze; hence, the food behind the barrier is safe. Because in his task the subordinate chimpanzee has never observed anyone interact with a red barrier, Lurz claims that there is no complementary behavior reading hypothesis about direct line of gaze through translucent red barriers. However, such an interpretation is available (Andrews 2012b). Because the subordinate might see the transparent barriers as offering a direct line of gaze and the red translucent barriers as strange blockers or modifiers of direct line of gaze, the subordinate could predict that the dominant would move toward the banana to which the dominant has a direct line of gaze, rather than toward the banana to which the dominant's gaze is obstructed by an odd barrier. This doesn't require that the subordinate think anything about how the bananas *appear* to the dominant chimpanzee.

Lurz and the psychologist Carla Krachun proposed a different test of chimpanzee mindreading based on Lurz's evolutionary account (Lurz and Krachun 2011). Krachun has found that chimpanzees are able to learn about the affordances of minimizing and magnifying glasses to choose the largest grape, even when it is under a minimizing lens and looks small (Krachun et al. 2009). They propose using a violation of expectation task, in which a chimpanzee is watching a human competitor choose a grape that the chimpanzee alone saw placed in a minimizing or maximizing box. The chimpanzee expects that the human will try to get the largest grape, and so should be surprised if, for example, the human reaches for the grape that looks smaller but is actually bigger. While Lurz and Krachun think that there is no complementary behavior reading hypothesis available to interpret success on this task, the training trials would teach the chimpanzee that the human reaches for objects with a relative size difference. The chimpanzee can use this experience with the human's past behavior to expect that the human will continue reaching for the large-looking grape, even though the chimpanzee himself would prefer the other grape (the chimpanzee could do this because he would have a past experience of the actual size that he could use to set his own goal, but he need not know *why* he was able to solve the task). The logical problem appears to remain unsolved.

7.1.3 Do we need to solve the logical problem?

The challenge to come up with an experiment that avoids the logical problem is one that I think we should set aside. To understand why the logical problem isn't a real problem for the investigation into animal mindreading, we need to make a brief detour into some classic philosophy of science. Science doesn't usually proceed by relying on a single groundbreaking experiment. Instead, research programs progress by running many different kinds of experiments that come out of different research groups, including those that differ in their theoretical and methodological approaches.

How science progresses has been a matter of debate among philosophers of science—from Karl Popper's view that science proceeds by attempting to falsify theories and rejecting those theories whose predictions are not supported by experimental results, to Thomas Kuhn's view that scientific change only happens after too many problems arise with a theory, leading to a paradigm shift, to Imre Lakatos' view that science progresses through the construction of auxiliary hypotheses to explain false predictions, which permit new and more precise predictions.

On all these views, scientific progress isn't a deductive practice; the evidence for a hypothesis cannot *guarantee* the truth of the hypothesis. Rather, the evidence offers support.

In order to gain support for a hypothesis, we may seek to confirm it. Confirmation, however, isn't as straightforward as it might seem. There exist various accounts of what it is to confirm a hypothesis. For example, according to the hypothetico-deductive model, we can confirm a hypothesis when it, plus any necessary auxiliary hypotheses, entails the observable evidence. Experimentalists use this method when they form predictions based on their hypotheses, and test whether their predictions come true. A successful prediction then offers some evidence for the theory that, along with auxiliary hypotheses, entails it. However, on this view, a false prediction isn't able to disconfirm a theory. As Lakatos points out, what often happens in science is that either the theories are modified to take into account the new predictions or different auxiliary hypotheses are constructed. For example, when Newton's theory of celestial mechanics made a false prediction about the orbit of Uranus, scientists didn't reject Newton's theory. Instead, they questioned some of the auxiliary hypotheses, including the hypothesis that the solar system had only seven planets. This move led astronomers to discover the planet Neptune. When we turn to hypotheses dealing with entities that are not directly observable, like particles, waves, or mental states, any empirical finding is going to be consistent with multiple hypotheses, because hypotheses dealing with unobservables are even more deeply entrenched in a set of auxiliary hypotheses that led to the postulation of the entity in the first place. All this means that we shouldn't be surprised by the fact that when examining chimpanzee theory of mind using the hypothetico-deductive method, researchers are faced with competing hypotheses. Quine suggests that when we deal with competing hypotheses, we should reject the hypothesis that is less entrenched in our web of belief. If the hypothesis has lots of other hypotheses resting on it—such as our hypothesis that there exists an external world—then we shouldn't reject it if we can instead reject a hypothesis that plays a less crucial role in the system.

Another account of confirmation comes from probability theory. Bayesian approaches to confirmation share the idea that evidence increases the probability that a hypothesis is true. In an attempt to examine claims about the chimpanzee's mental capacities more generally, Sober examines the evidence for mental continuity between humans and chimpanzees from a Bayesian confirmation approach (Sober 2012). The hypothesis he investigates is:

> if human beings and a closely related species (e.g. chimpanzees) both exhibit behavior *B*, and if human beings produce *B* by occupying mental state M, then this is *evidence* that *M* is also the proximate mechanism that chimpanzees deploy in producing B.
>
> (2012, 230)

That is, given that both chimpanzees and humans engage in the same behavior, we can examine which probability is greater: That the chimpanzee behavior is caused by a mental state given that humans have that mental cause, or that humans have that mental cause alone. From the fact that humans and other apes share a common ancestor, we can examine whether the two effects trace back to a common cause. Unfortunately, Sober concludes, we don't yet have enough evidence to draw a good conclusion about the truth of the hypothesis. What do we need? More evidence, which means more empirical study, of both behavior and biology.

Whatever your account of confirmation is, when doing science you will always have competing hypotheses, but scientists need not worry that there are alternative hypotheses explaining a phenomenon. Instead, they need only to defend the claim that their chosen hypothesis best accounts for the *overall* body of data. As we know, inference to the best explanation arguments rely on the existence of alternative hypotheses. But they also rely on having plenty of data. When we are deciding between competing hypotheses, we appeal to the body of data at hand, and can use Quine's test to decide which one to accept for now. The fact that each piece of evidence has its own, different alternative interpretation need not be of much significance. So while we need not worry about solving the logical problem, we do need to have the right kind of data in order to draw conclusions between competing hypotheses. Given that at this point there is quite a bit of experimental data on chimpanzee social cognition, we can now turn to the question of whether the studies show that other animals have a theory of mind.

7.1.4 Apes pass the false belief task, but do they have a theory of mind?

Premack and Woodruff's paper led to a robust research program in child development, but it was 20 years after their paper before we saw another paper on ape mindreading, and another 20 years after that before researchers were able to report apes successfully passing a false belief task. How do you design a nonverbal false belief task?

The first attempt compared apes and human children in a task that involved a Hider hiding a piece of food in a box (Call and Tomasello 1999). The apes and children weren't able to tell which box the Hider placed the food, but they would tell that another experimenter, the Communicator, could see the food's location. The Communicator marked the box that contained the food by placing a token on it. The apes and kids learned to use the Communicator's token, choosing the marked box that had the food in it. Once subjects got good at using the token, they were given a false belief task. In this case, the Hider hid the food, the Communicator left the room, and then the Hider switched the food to a different box, in view of all the subjects. While the apes and kids didn't know where the food was, they should have been able to infer that the Communicator didn't know where the food was either. When the Communicator came back into the room, he marked the original location of the food. If you are following the events, you should choose to look in the box that isn't marked, because you know the Communicator is wrong. But the apes continued to choose the marked box, unlike five-year-old children who started choosing the unmarked box. The researchers concluded that the ability to attribute beliefs might be unique to humans.

Over the years, apes were given versions of this task and continued to fail, while human children continued to pass them. Many researchers cautiously concluded that chimpanzees don't understand false belief. In their review of 30 years of research on chimpanzee mindreading, Call and Tomasello wrote:

> chimpanzees probably do not understand others in terms of a fully human-like belief–desire psychology in which they appreciate that others have mental representations of the world that drive their actions even when those do not correspond to reality. And so in a more

> narrow definition of theory of mind as an understanding of false beliefs, the answer to Premack and Woodruff's question might be no, they do not.
>
> (Call and Tomasello 2008, 191)

A number of alternative explanations for apes' failing these nonverbal false belief tasks have been offered. One of the most prominent explanations, coming from Tomasello and his colleagues, is that apes might mindread, but not in cooperative contexts. Perhaps apes only think about others' minds in competitive contexts. Another set of worries comes from primatologist Christophe Boesch, who identifies five reasons for thinking that we cannot directly compare ape and human subjects:

> (a) Human subjects are selected from free-ranging individuals living in natural social groups, whereas ape subjects are selected from captive individuals living in deprived social groups.
> (b) Human subjects are tested with conspecifics, whereas ape subjects are tested with members of another species (normally humans).
> (c) Humans subjects are tested in the same room as the experimenters, whereas ape subjects are separated by physical barriers from the experimenters.
> (d) Infant human subjects are in close proximity to one of their parents during testing, whereas infant ape subjects are separated from their biological mothers during testing.
> (e) Human subjects are tested about conspecific tasks with conspecific materials, whereas ape subjects are tested about human tasks with human materials.
>
> (Boesch 2007, 233–234)

The last reason may be particularly relevant in the false belief task. Children who are used to playing games that involve hiding objects and trying to find them may have learned a skill that apes were not in a position to learn. Apes might not be motived to play a food finding game like the ones used to test false belief.

Around the same time, infant researchers were developing nonverbal false belief tasks. In the first published study of infant mindreading, researchers measured how long infants looked at a person acting according to her false belief about the location of an object compared with how long they looked at a person acting inconsistently with her false belief (Onishi and Baillargeon 2005). At 15 months, infants showed sensitivity to people's false beliefs. Among the studies building on this discovery was one by Victoria Southgate and colleagues that used eyetracking technology (Southgate et al. 2007). Infants observed a person who wanted to obtain a ball hidden by a puppet. The false belief conditions involved the puppet moving the ball between two boxes, leaving it in the right-hand box, and exiting the scene. Then the agent turned away, the puppet returned, opened the right-hand box, and took the ball with him out of the scene. When the agent turned back, the infant expected that the agent was about to seek the ball, and looked at the right-hand box even though the ball was no longer inside, and even though the ball had spent the same amount of time in both boxes. The authors conclude, "The data presented in this article strongly suggest that 25 month-old infants correctly attribute a false belief to another person and anticipate that person's behavior in accord with this false belief" (Southgate et al. 2007, 590).

Southgate's study was used as a model in a nonverbal test of mindreading in apes. Krupenye and colleagues (2016) adapted the materials so they were more likely to catch the apes' interest. Based on the premise that apes are more interested in competitive than cooperative scenes, the researchers designed an antagonistic scenario that followed the pattern of the more traditional Sally-Anne task. In one condition, apes watched a movie showing a human who was attacked by someone in a gorilla suit (King Kong). The apes first saw King Kong attack the human, and then run into one of two haystacks to hide. The human grabbed a stick and hit the haystack where King Kong was hiding. In the false belief conditions, the human had to leave the scene to get the stick, at which point King Kong changed position and left the scene. When the human came back, the apes looked at the haystack in which King Kong hid before the human left, anticipating that the human would beat that haystack with the stick.

Soon after, an active false belief task with chimpanzees was published, claiming to corroborate the finding that great apes attribute false belief (Buttelmann et al. 2017). The task was also modeled on a test first given to human children, in this case 18-month-old infants (Buttelmann et al. 2009). In the original task, toddlers were able to help the experimenter open a box, and they were able to determine which box he wanted to open even when he had a false belief. The set-up involved a blue box and a yellow box and an object that the experimenter was playing with. In the false belief condition, the researcher placed the object in the blue box and locked the box, giving the key to the child, and then leaving the room. While the experimenter was gone, another adult unlocked the box and moved the object to the yellow box, locking both boxes. When the experimenter came back into the room, he tried to open the blue box. The children

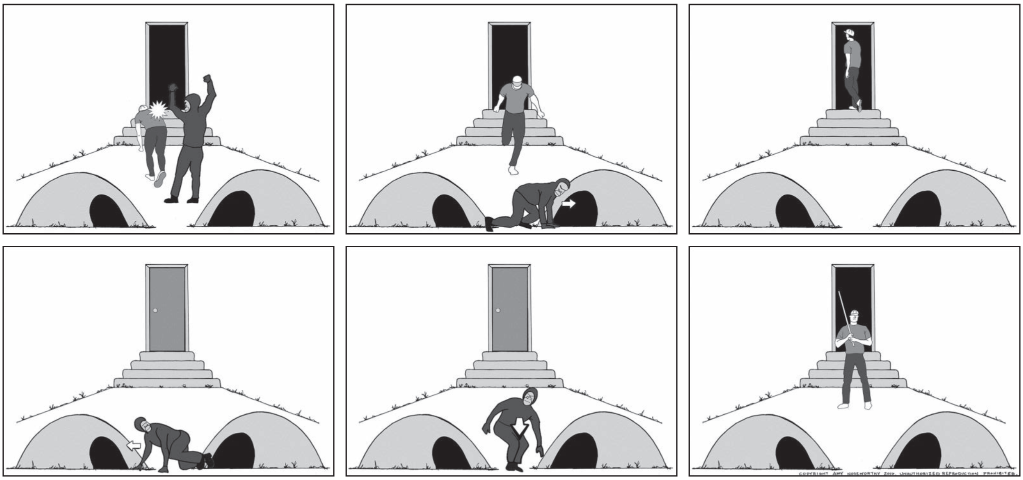

Figure 7.2 False belief 2 condition from Krupeyne et al.'s experiment 1. The ape watches as the human sees King Kong hide in the right haystack, and then goes inside to get a stick, closing the door behind him. While the human isn't watching, King Kong moves from the right haystack to the left, and then leaves the scene. Then, the door opens, the human comes out with the stick raised over his head, and the chimpanzee subjects look more at the right most haystack, where the human last saw King Kong. These looks are interpreted as a prediction that the human will hit the rightmost haystack, and an attribution of a false belief that King Kong is hiding in the right haystack.

with the key tended to open the yellow box for him, revealing the desired object. Importantly, in the true belief condition, which involved the same movements except that the other adult didn't move the object, when the researcher came back into the room and tried to open the (empty) yellow box, the children helped him open that box. The children seemed to understand the researcher's goal in the two conditions, and this was interpreted as evidence that they know the content of the researcher's belief about the location of the object in each condition.

The ape version of this task found the same kind of difference between the true and false belief conditions (but interestingly, the apes were worse than the children in the true belief condition). Both tasks show that great apes, like human infants, are able to track a person's behavior and goals when they have a false belief. But do they show that apes understand false belief? The researchers think so:

> …our results, in concert with existing data, suggest that apes solved the task by ascribing a false belief to the actor, challenging the view that the ability to attribute reality-incongruent mental states is specific to humans.
>
> (Krupenye et al. 2016, 113)

> Great apes thus may possess at least some basic understanding that an agent's actions are based on her beliefs about reality. Hence, such understanding might not be the exclusive province of the human species.
>
> (Buttelmann et al. 2017, 1)

I'm not so sure. Recall that what motivated the false belief task was a particular view of belief, as a propositional attitude that the believer takes to be true—epistemic endorsement. To attribute a false belief to another in this sense is to have a concept of belief. While the false belief test tells us that apes can track others' false beliefs, we need to know more before we can decide how they do it. Does mindreading really have the function of helping us predict behavior when people have a false belief? Can we make such predictions using other methods? We can address these questions by looking at the different possible functions of mindreading.

7.2 Functions of mindreading

One way to examine mindreading in other species is to examine its adaptive benefits in humans. What does mindreading help us do? The usual answer is that mindreading helps us to predict people's behavior that hasn't yet happened, and to explain why people acted as they did. Given that scientific theories are also thought to predict and explain, it shouldn't be surprising that we sometimes talk of a "theory of mind." While many other functions of mindreading have also been proposed, let us start by looking at these two—prediction and explanation.

The predictive function of mindreading is a central part of the Social Intelligence Hypothesis, according to which the reason why humans and other primates are so smart is because they are so social. Complex cognitive capacities arose due to the pressures associated with living in large social groups, not due to other, more ecological pressures such as foraging or avoiding predators. For example, the gelada baboons who have sneaky sex developed their capacity to think about the dominant's mind because they live in complex societies full of flexible agents, and to thrive in a world like that requires thinking about others' minds.

The Machiavellian version of the Social Intelligence Hypothesis is based on the idea that group members are in competition with one another for food, mates, dominance, and learning how to outwit competitors is a valuable skill (Whiten and Byrne 1988). The story goes like this: As individuals gain a more sophisticated understanding of others' mental states, they become better at coming out on top of the competition. They might sneak around, pretend, cheat, or otherwise deceive their competitors once they understand others are minded. Introducing deception of this sort into a community creates an even more complex social situation. It makes it necessary that other individuals in the community develop the same skills, which creates a pressure to develop better and better competitive strategies—an evolutionary arms race. Since attributing propositional attitudes is needed for making more accurate predictions of behavior, so they say, individuals came to postulate mental states and gain facility with concepts such as BELIEF, and they developed a theory of how beliefs and desires cause behavior. Thus sophistication social cognition was born.

This story suggests that the place to look for mindreading in other animals is in their ability to predict, compete, and deceive. However, it turns out that mindreading isn't necessary for deceiving, so tests for deception won't serve as reliable tests for mindreading. How can we deceive without thinking about mental states? Here's one story about how the ability could arise: Suppose an early human, let's call her Lucy, noticed that every time someone found food, they made a particular exclamation. Lucy also noticed that shortly after making the exclamation, other group members would come to join the caller. Lucy didn't want to share food. She wanted to know what caused the group members to come to her whenever she found food. Realizing that among the things she did when she found food was make this exclamation, she decided to try to be silent. The next time she found food, she didn't call, and no one came. She got to keep all the food for herself. Lucy was reinforced to avoid calling whenever she wants the food for herself. Lucy might know that there is a regularity between calling and others coming, and she might be using a sophisticated causal reasoning. But she isn't thinking about others' mental states at all. We can deceive in a case like this by formulating a hypothesis about what causes behaviors when the cause is an observable feature of the situation—the exclamation.

While the Machiavellian version of the Social Intelligence Hypothesis offers one story about the function of mental state attribution, the Mengzian version of the hypothesis offers a very different tale (Andrews 2018). According to the Mengzian version of the Social Intelligence Hypothesis, humans think about one another's beliefs and desires—and reasons for action—in order to solve our social living problems through cooperation. Our hominid ancestors didn't just compete with one another, but they worked together to build the foundations of today's society. The competition existed only on a background of cooperation. Early humans lived in communities, built shelters, innovated tools, shared their knowledge with others, and engaged in joint activities such as child rearing, foraging, and hunting. In a cooperative society, the ability to explain the behaviors of group members in terms of their reasons for action could offer a significant advantage, for it permits the spread of new behaviors that may be beneficial.

A Mengzian story about the evolution of mental state attribution shows the value that comes from explaining people's reasons for acting oddly. Today's odd behaviors are tomorrow's innovations. Consider the invention of cooking meat (Andrews 2012a). Because cooked meat provides more nutrients than raw meat, it was a real innovation in human culture. However, imagine how people responded to the first humans who put meat in the fire after a difficult hunt. A campfire might seem like a bad place to put your valuables, since fire tends to consume and destroy what you put into it. The community members might have been pretty upset to see the person put the hard-won carcass into the fire. The first chef may have been shunned or even exiled. The behavior may have been prohibited. But if the community could come to see the reasons for this unusual behavior, namely that cooked meat tastes better, the chef wouldn't have been shunned, but celebrated. When the community tastes the burnt meat, and realize it tastes better than the raw stuff, they begin to understand the chef's reasons for the unusual action. Then more people start to throw carcasses on the campfire before eating them, creating the cultural practice of cooking. Knowing that people act from mental states allows us to understand that there may be opaque reasons to engage in the behavior, no matter how strange the behavior might seem. Stories like this suggest that mindreading might have evolved to promote cooperation through explaining odd and sometimes innovative behaviors.

Mindreading for explanation-seeking makes sense of the large number of cooperative social behaviors we see in humans and other species. Animals learn socially. Social learning, or coming to perform actions that you see demonstrated by others, and tolerating naive individuals' attention to your skilled performances, is seen in many species from rats, guppies, and cowbirds, to monkeys, dolphins, and elephants, as we will see in Chapter 8. Animals work together. We now know that species routinely engage in collaborative behaviors, from honeybees who collectively look for a new hive site, meerkats who babysit communally and take turns serving as sentries to warn of predators, marmosets' cooperative breeding, to zebra fish who decide together where to forage.

When social cognition is understood as predicting what others will do after being deceived, the false belief task will look like a good way of learning about social cognition. But when social cognition is also understood as facilitating coordination and cooperation, the false belief task seems less relevant. These considerations suggest that we can do a better job learning about how animals understand other minds by examining naturalistic behaviors, including social learning, cooperation, and collective action. We can also seek to understand how animals respond in unusual situations and to unusual behaviors. Using those observations, researchers can devise experiments that study social cognition by looking at functions other than behavior prediction. Animals may mindread to learn, to satisfy their curiosity, and to understand how to help others, in addition to using it to cheat and deceive. Mindreading might help explain why adult chimpanzees at the Lincoln Park Zoo don't put on their usual dominance displays toward Knuckles, a juvenile male who has cerebral palsy. Rather than screaming at him when he approaches, the dominant male tolerates Knuckles, and even grooms him. Frans de Waal reports that physically disabled chimpanzees have lived to adulthood in the wild, as evidenced by the discovery of skeletons. He suggests that these individuals could only have lived that long if they had been fed by group members who were able to understand their needs and abilities (2009). Mindreading by knowing what others want and need could have assisted there too.

By looking at these other examples of where and how mindreading could be beneficial for social animals, we are confronted with a more basic question about animal social understanding than that which Premack and Woodruff were addressing, namely, whether animals think that other animals are agents, and if so, how they think about their minds. In order to think about someone's beliefs, we first need to realize that they are the right sort of thing to ascribe beliefs to. Which other species can identify agents, and how do they do it? When we look at animal social cognition and folk psychology through a wider lens, we can ask questions about other species' understanding of various aspects of the mind. With a more robust understanding of the sorts of capacities animals have, we will be well placed to develop plausible alternative explanations for how apes—and human infants—are able to pass the false belief task without having the concept of belief.

7.3 Do animals understand intentional agency?

David Hume could sit in front of his fire alone at home and question causality, but as soon as he got up to eat dinner he accepted causal powers. The same goes for other mind skeptics—as soon as the skeptic is in a social environment, she can't help but act as if there are minds—or intentional agents. We see other people as self-propelled, as goal-oriented, and as able to flexibly change their goals and their paths toward their goals given changes in their environment. For most humans, it is easy to sort agents from non-agents. Here we differ from the ants who will carry their folic-acid-painted nestmate to the graveyard alive and kicking. The ants have one cue for death, and don't take the behavior of other ants as evidence for life or intentionality. A human, however, would probably open a coffin if she heard someone knocking.

Humans generally take others as having minds, intentional actions, personality traits, emotions, and moods, and we do it from an early age—maybe as early as two months (Trevarthen 1977, 1979). By 12 months, human infants are pretty good at identifying agency—in people and animals, as well as in inanimate objects of the right sort. For example, the psychologists György Gergely and Gergely Csibra showed infants a video of a small circle first pulse, then move toward and jump over a wall, and then continue to a big circle and pulse again. The video was shown repeatedly until the infant lost interest in it (Gergely and Csibra 2003).

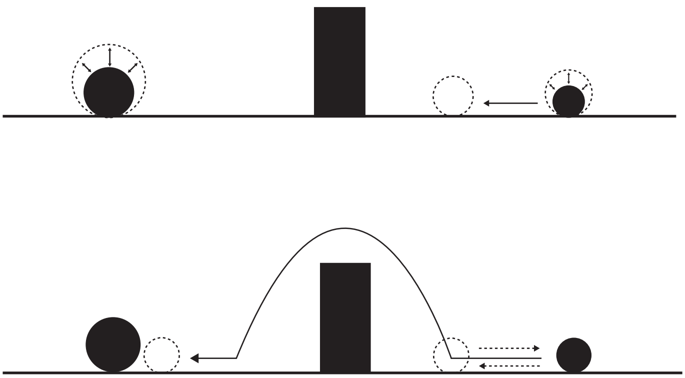

Figure 7.3 Stimuli shown to infants in the teleology study.
Source: Gergely and Csibra (2003).

Then the child was shown a new video, either a New Action video or Old Action video. In both videos, the two circles remain, but the wall has been removed. Infants who watch the Old Action video, in which the small ball continues to hop even though the wall is gone, show renewed interest. Infants who watch the New Action video, in which the small ball now moves in a straight line to the large ball, are still bored. It seems that the infants think that the little ball wants to get to the big ball, and so they predict that the little ball will take the most direct path to the big ball—an attribution of intentionality to the little ball.

If we take these sorts of behavior as evidence that infants understand intentionality, then we must agree that there is evidence that great apes also understand other apes as intentional agents. As we saw in the last chapter, chimpanzees engage in primary intersubjectivity behaviors with human and chimpanzee caregivers. In addition, infant chimpanzees pass the Gergely and Csibra test (Uller 2004).

Other studies purport to show that chimpanzees understand intentionality. Some of these come from the studies on elaboration after a failed message that we saw in the previous chapter, but other research comes from studies in which humans fail to meet a chimpanzee's expectation. For example, chimpanzees are more likely to protest when a person is unwilling to give them food compared with a person who is unable to give them food (Call et al. 2004). And when a human caregiver needs help retrieving a dropped or out of reach object, chimpanzees will help out by retrieving the object for the caregiver (Warneken and Tomasello 2006).

The logic of the arguments here is based on analogy: Human infants who pass tests P and Q demonstrate that they see others as agents, so chimpanzees who pass chimpanzee versions of tests P and Q likewise demonstrate that they see others as agents. But as we have seen, it isn't clear that we can give chimpanzees the same task we can give to human children, because it might not strike the subjects as the same task. We can't test animals on their sensitivity to human signals if those animals are not at all interested in humans, or are frightened of humans, or cannot even interact with humans at all. The species that have been tested along these lines are those who do enjoy some social relationships with humans, and those who have a rich social structure. But not all species will be able to take the same test off the shelf in order to demonstrate understanding of intentionality.

Take, for example, the ability to follow points. In the last chapter we discussed chimpanzee pointing, which some chimpanzees who live with humans come to do, as well as perhaps some wild chimpanzees. Comprehending points, something one-year-old human infants can do, might suggest understanding of intentionality, in that it is a response to directing one's attention to something of interest. In object choice tasks, where a human informant points to indicate where food is hidden, many chimpanzees have problems using the cues to correctly locate food (Call and Tomasello 1994; Kirchhofer et al. 2012). Leavens notes, however, that the chimpanzees who fail these tasks are the ones who have not lived with humans. The fact that domestic dogs (Kirchhofer et al. 2012), human-habituated wolves (Udell et al. 2008), and captive bottlenose dolphins (Tschudin et al. 2001) can respond appropriately to human pointing gestures supports the claim that understanding points comes from living with humans who point.

To conclude from these studies that chimpanzees don't understand intentionality because they fail the object choice task is to draw too hasty a conclusion. The problem arises when we focus on a single behavior, and ignore evidence from other domains. Just as a chimpanzee's failure to follow points doesn't undermine his sensitivity to agency, dolphins' and dogs' success in so doing doesn't alone show that they are sensitive to agency. To defend claims such as those, we would need to look at the whole body of evidence on dog or dolphin behavior.

If we have evidence that an animal understands agency, we already have preliminary evidence that the individual understands goals. Since an agent is someone who acts, the evidence for agency is *goal-directed behavior*. Therefore, if we show that members of a species can attribute goals, we establish that they can recognize agency. Explicit tests of goal attribution have been done with several species including chimpanzees. In fact, the original test for theory of mind in chimpanzees was actually a test to see if a chimpanzee could identify a human's goal.

7.4 Do animals understand emotions?

When we understand that another person is in an emotional state, we know how they feel, but not necessarily what they think. Emotions are affective states that may or may not be intentional. They may not be about something in particular. When I am afraid of a bear, my fear is about the bear, but when I wake up sad, my sadness might not be about anything in particular.

Emotions have a physiological grounding and are associated with specific bodily movements. The psychologist Paul Ekman discovered the subtle muscle movements associated with different emotions, and he argues that these are innate to humans, found cross culturally, and occur without training (Ekman 1992). Lisa Parr, a psychologist who studies emotion in chimpanzees, found that primate facial muscles are very similar across species, and that chimpanzees' facial muscles are almost identical to those of humans. From this she infers that we can make direct comparisons between chimpanzee and human facial expressions in terms of the emotions they indicate. Using this information, and following Ekman's research, Parr has developed a catalog of chimpanzee facial expressions and the emotions they express.

Parr reported that chimpanzees can identify computer-generated chimpanzee emotional facial expressions with photographs of chimpanzees displaying the same emotion (Parr 2003; Parr et al. 2007). This suggests to her that chimpanzees recognize basic emotions, such as friendliness, aggression, fear, pouting—wanting something that you're not getting—and that other chimpanzees respond appropriately to others based on the emotions they are expressing. Given the conservation in musculature between humans and chimpanzees, the fact that chimpanzees display facial expressions in emotional settings, and that other chimpanzees respond appropriately given those displays, we have some behavioral evidence that chimpanzees track others' emotions.

In addition to seeing other's emotions, there is evidence that we can smell them as well. Humans, with our relatively poor olfactory senses, are able to distinguish between the sweat of a boxer and a bike rider, demonstrating higher levels of anxiety after sniffing the sweat of an aggressive boxer (Mutic et al. 2016). The lead author hypothesizes that animals with better olfaction, such as dogs, may be much more sensitive to such negative emotions. Taking up that suggestion, a team of researchers asked humans to watch videos that either elicited fear, happiness, or no emotion and they collected samples of their sweat. Then a group of dogs were given the samples of the sweat to sniff. The dogs who were given fear samples showed more anxiety, more fearfulness of strangers, higher heart rates, and they spent more time with their owners. After smelling the happy sweat, the dogs were more interested in the stranger (D'Aniello et al. 2018).

Given such connection between expressing the emotion and feeling an emotion, some philosophers and psychologists have suggested that our ability to recognize emotions in others is associated with our feeling the same emotion when we see their body movements. Some philosophers who think we understand other minds by simulating what it is like to be that person in that situation suggest that seeing others in a particular emotional state causes us to come into that state as well. For example, Alvin Goldman suggests that we understand others' emotions by subtly imitating their facial expressions, and then experiencing the emotion ourselves, realizing that emotion is shared with the observed other (Goldman 2006; Goldman and Sripada 2005). Evidence for this claim comes from studies of face-based emotion recognition; people with certain neurological deficits are impaired in both feeling an emotion and attributing the emotion to others. This mirroring of emotional states is part of a larger mirroring system found in humans and other animals, which activates the same neural pathways whether one is observing another engage in an action or engaging in that action oneself (Gallese et al. 1996; Rizzolatti et al. 2001.) Because those who have impairments in the areas of the brain that experience fear cannot use those parts of the brain to mirror others' experience of fear, they cannot recognize fear in others.

That other species share the biology, chemistry, and behavior associated with human emotional states is evidence that those animals also experience emotions. Since Darwin's book *The Expression of the Emotions in Man and Animals* (1873/2007), scientists have investigated emotions, including pain, in different species. Stress associated with the release of cortisol, bonding and pleasurable love feelings associated with oxytocin, and brain activity associated with fear or anger have all been found in other species.

The analogical reasoning used in these sorts of studies showing similarity in physiology and behavior to humans in various emotional states provides evidence that particular species experience particular emotions. Claims regarding the existence of specific emotions experienced by animals can be controversial, especially when it comes to complex emotions such as grief. However, in light of all the evidence, the claim that animals experience emotions of *some* sort seems indisputable. Granting that premise, we can then ask whether or not animals understand others' emotions.

In order to determine whether animals understand others' emotions, we might examine whether seeing a highly charged emotional state in another affects an animal's behavior, brain activity, or hormones. Much of the current research on animal understanding of others' emotions comes from the literature on empathy in animals. We will have a discussion of the empathy literature in Chapter 9.

As we will see, behavioral studies, neurological observations and lesion studies, and chemical studies all suggest that animals are sensitive to others' emotional states. Like humans who can smell others' anger and respond appropriately without realizing it, other animals might be reacting to emotion without attributing it. To mindread emotions, however, requires more than tracking emotions, if mindreading requires attributing a mental state. That noted, it may be that humans track emotions more often than they mindread them. Sometimes we perceive emotions, rather than infer them.

7.5 Do animals understand perceptions?

Like emotions, there is evidence that animals track others' perceptual states. For example, we saw that chimpanzees can track perceptual states well enough to only approach food that a dominant cannot see. But do the chimpanzees have the concept SEE? Can they attribute visual perceptual states?

One way to test whether an animal is able to attribute a perceptual state is to ask if an animal is able to think another's inaccurate perception. Just as truth is what gives belief its point, accuracy is what gives perception its point. Perspective, by its very nature, is contrastive, and implies the existence of multiple different ways of seeing the world. When I wonder about someone's perspective on a landscape or an abstract problem, I am wondering how it appears to the other, and whether it appears differently than it does to me. When I say that Frank perceives the red fruit, I mean that there is red fruit, and that Frank understands that there is red fruit, because he sees it.

Compare this with the cognitive requirements needed for attributing emotions. While we see normative constraints on the kind of emotions people should have in particular circumstances—you should be happy that your sister won the prize, you should be sad that your cat died—in no sense can someone have a false or illusory emotion the way they can have a false belief or an illusory perception. You might be wrong about what's causing the emotion, you might apply labels to your emotions in non-standard ways, but what you are feeling is what you are feeling, and many think that we have private and privileged access to our own emotions. If that's the case, then there are no correctness conditions for emotions in the same way there are for beliefs.

While beliefs take propositions as their content, perception takes as its object things in the world, as well as states of affairs (and perhaps mental states too, as direct perception accounts of mindreading suggest). While we can perceive an object, we cannot believe an object. Belief differs from perception because only beliefs are epistemically endorsed, or taken to be true. A perception can be accurate, but not true.

In developing the idea that perceptual mindreading is a less complex type of mindreading than belief mindreading, Bermúdez suggests that perceptual mindreading takes the form of representing: (i) A particular individual; (ii) perceiving; (iii) a particular state of affairs. On this view, we can only perceive states of affairs, not mental states or propositions (Bermúdez 2011). While the perceptual mindreader has to represent an individual perceiving a state of affairs, she doesn't represent the individual perceiving anything representational. Because a perceptual mindreader typically already perceives what she can think someone else perceives, to make the move from perceiving to mindreading perceptions is simply to add to her representation of the state of affairs a relation between the perceiver and the state of affairs. The perceptual mindreader can reason like this: I see the ripe fruit, and Putri is facing the ripe fruit, so Putri sees the ripe fruit too. But the perceptual mindreader isn't able to take into account that Putri might not see *that* the fruit is ripe, for example. She doesn't understand that things can appear differently to different individuals. On Bermúdez's account, perceptual mindreading does not have correctness conditions, and does not involve metarepresentation. (One might question Bermúdez's choice of calling this kind of understanding mindreading!)

However, there are other ways of understanding perceptual mindreading such that it has some, but not all, of the logical properties of belief mindreading. Lurz introduces a distinction between two kinds of perceptual mindreading—attributions of *seeing*, and attributions of *seeing-as* (Lurz 2011). An attribution of a simple seeing may go very much like Bermúdez describes, but an attribution of a seeing-as state is more complex. Seeing-as is taken to be an intentional state, and attributing a seeing-as, such as in the case of an illusory perception, requires that one attributes to another the perception of an object/event *as* F when the attributor himself does not believe that the object/event *is* F. The seeing-as mindreader can attribute to Putri that she sees the fruit as unripe, even though it is ripe, for example.

Though they involve a more complex state than simple seeing, seeing-as attributions differ from belief attributions in that the former are not revisable in light of additional information the way that belief attributions are. Lurz suggests that even the most sophisticated perceptual mindreader would be unable to predict that an animal who saw what appeared to be a bent stick in a glass of water would treat the stick as whole given that he observed the stick being lowered into the water. In order to calibrate attributions in this way, belief attribution is needed. The reasoning is that only with belief attributions can one make the logical inferences needed to update attributions.

However, we may be able to do quite a bit of reasoning about others without attributing beliefs to them. An attempt to find some middle ground between belief mindreading and behavior reading has been developed by the psychologists Ian Apperly and Stephen Butterfill. They introduce the notion of minimal mindreading, which has some of the properties of belief attribution, such as correctness conditions and goal-directed causal powers, and two relations: Encountering and registration. The encountering relationship holds between an individual and an object in a location within the individual's field (Apperly and Butterfill 2009; Butterfill and Apperly 2013). When we attribute encountering an object to another, we are not appealing to any other psychological states; the attribution is a proxy for "perceiving." Registration, however, serves as a proxy for belief. A registration is an encountering relationship that remains even once the object is no longer in the agent's field. "One stands in the registering relation to an object and location if one encountered it at that location and if one has not since encountered it somewhere else" (Apperly and Butterfill 2009, 962). While there are no truth conditions for registration attributions, there are correctness conditions. Registration attribution allows one to respond to changing perceptual information in ways that track the behavior of the target. But what it doesn't allow one to do is to robustly track all kinds of false belief and false perception. Rather, there may be signature limits such that someone with a minimal theory of mind cannot understand modes of presentation or pass level-2 mindreading tasks, but can track behavior in a Sally-Anne task. For example, they suggest that a minimal mindreader, but not a full-blown mindreader, would make the following invalid inference:

1 Mitch believes that Charly is in Baltimore.
2 Charly is Samantha.
3 Therefore, Mitch believes that Samantha is in Baltimore.

The minimal mindreader makes this inference because she uses a registration relation to reason:

1 Mitch registers <Charly, Baltimore>.
2 Charly is Samantha.
3 Therefore, Mitch registers <Samantha, Baltimore> (Butterfill and Apperly 2013, 622).

Chimpanzees can pass the food competition task using the encountering relation, by realizing that the dominant chimpanzee doesn't encounter the food, and because of that he will not approach it. While most chimpanzees pass this task, they tend to fail in the misinformed condition, where the subordinate watches as the dominant sees food being hidden, then sees the dominant's view blocked while the food is moved to a new location. When released into the enclosure, the subordinates avoid the location of the food, even though the dominant doesn't know its current location. Here the dominant encounters the food, but doesn't correctly register it.

Whether or not human children or nonhuman animals are in registration relations to others or attribute beliefs to others (or neither!) is a matter for ongoing empirical research and theoretical debate. But it is important to be skeptical of any claim that some tasks can only be solved by attributing beliefs to others. Our ability to think of alternative explanations for behaviors is limited to a greater extent by our own lack of imagination than by physical or psychological constraints on the subjects. Belief is easy for us to think of, but the human interest in others' beliefs may act as blinders that hide the true cognitive mechanisms behind our actions, and the actions of other animals.

7.5.1 Research on perceptual mindreading in animals

We've already discussed some evidence that chimpanzees understand what others see, based on the food competition study. Additional evidence comes from naturalistic observations that chimpanzees routinely track others' perceptual states (Plooij 1978; Byrne and Whiten 1988; Whiten and Byrne 1997). Experimental work confirms that great apes will follow human gaze around barriers and past distractors, and will use such cues to find food in hiding places (Itakura et al. 1999; Bräuer et al. 2005). As early as 13 months chimpanzee infants are already tracking eye direction in a human experimenter (Okamoto et al. 2002).

Chimpanzees have also passed a version of the goggles task that the skeptics have proposed as compelling evidence for experience projection (Karg et al. 2015, also Kano et al. 2019). Subjects are exposed to food boxes having lids with differences in opacity and transparency, and they are allowed to learn that a lid that looks opaque is, in fact, transparent from another perspective. Next, chimpanzees have to compete with humans for food hidden in these boxes. Chimpanzees prefer taking food from opaque boxes over transparent boxes, and from boxes that are opaque over boxes that merely appear to be opaque. This suggests that the chimpanzees understand that the merely opaque boxes are transparent from the human's point of view.

Ravens have also passed a version of the goggles task (Bugnyar et al. 2016). Subjects get to look through a peephole to watch another bird caching food, and are later given access to the room where they retrieve the food they saw hidden. Next, the subjects are asked to cache food themselves in the same chamber. They found that ravens' caching behavior was different when there was a peephole looking into the chamber from when there was no way to be observed.

In addition to great apes, researchers have investigated perceptual mindreading in corvids (Emery and Clayton 2001; Dally et al. 2006; Clayton et al. 2007), monkeys (Flombaum and Santos 2005; Santos et al. 2006), dogs (Hare et al. 1998; Hare and Tomasello 1999; Miklósi et al. 2004; Bräuer et al. 2006), and wolves (Udell et al. 2008).

The raven study builds on earlier findings that corvids are sensitive to what others can see. Corvids store food to eat later, and their food caches are subject to plundering by other birds. To handle the pilfering, corvids have developed a strategy of rehiding food if their original caching behavior is observed by another. It looks like the bird is pretending to hide its food, knowing a competitor is watching, and then when no one is around, hides it again, for real this time. In an experimental test, scientists found that only those scrub jays with previous experience *stealing* food would recache their food store (Clayton et al. 2007). Clayton and colleagues suggest that the scrub jays may be simulating, or thinking about what they would do if they were the observing bird, and so they hide their food again when being observed. This experiment is taken to be evidence that corvids engage in experience projection.

Rhesus macaques also show evidence of some sort of perceptual mindreading. Free-ranging monkeys on the island of Cayo Santiago were faced with human competitors in a foraging task. In one study, two experimenters approached a lone monkey, but in such a way that only one of the humans could see the monkey. Both humans had a grape, and the monkeys would tend to steal the grape from the human who couldn't see them (Flombaum and Santos 2005). The monkeys were also good at passing auditory versions of the task, preferring to steal a grape from a quiet box than from a box that made a lot of noise when a human wasn't watching them. However, when a human was obviously looking at the monkey, he would take the grape and run, without worrying about whether he'd make a noise (Santos et al. 2006).

Canids have also been subject to a number of perceptual mindreading tasks. Scientists have confirmed what dog lovers have long known, that dogs use human gaze to locate objects, and they often make eye contact before initiating play (Hare et al. 1998; Hare and Tomasello 1999; Miklósi et al. 2004; Bräuer et al. 2006). Wolves who have been raised with humans also show a sophisticated ability to follow human social cues (Udell et al. 2008), as do coyotes (Udell et al. 2012). The tests of perceptual mindreading in canids typically take the form of preferential begging tasks—and many individual canids prefer to seek food from a human who can see the subject rather than a human who cannot see him, though there are wide individual differences within species (see Gácsi et al. 2004; Udell et al. 2011). One worries that these tests show that canids can learn to use behavioral cues to determine how best to get food from a human. However, other studies that find that dogs misbehave only when a human cannot see them offer some converging evidence that canids can generalize from their experiences with humans across situations, which serves as evidence of perceptual mindreading.

In one such deceptive situation, dogs were given a command to do something, such as lie down, or to refrain from doing something, such as eating food. Researchers found that the dogs obeyed the commands better when the human looked at the dog than when the human was distracted or looking away (Gácsi et al. 2004). And like the rhesus macaques, dogs preferred to take food from a silent container than a noisy one when humans were not looking (Kundey et al. 2010). And when dogs are explicitly commanded to leave the food alone, they also prefer to make a silent approach to steal the food, even when they cannot see the human (Bräuer et al. 2013).

In cooperative situations, too, dogs engage in behaviors that show sensitivity to human perspective. When a human asked a dog to fetch a toy, and the human could only see one toy and the dog could see two, the dogs were more likely to fetch the toy that the human could see (Kaminski et al. 2009).

7.6 Do animals understand personality traits?

Researchers in animal personality have used the same factoring analysis used in human psychology in order to identify individual differences in a variety of species, from great tits (Amy et al. 2010) and octopuses (Mather and Anderson 1993), to dogs (Gosling and John 1998) and orangutans (Weiss et al. 2006; see Freeman and Gosling 2010 for a review of personality research in primates). As in human personality research, the nonhuman animal personality research uses instruments such as the Five-Factor Personality Inventory (FFPI) to rank subjects on properties such as extraversion, agreeableness, and neuroticism.

While the goal of the personality research is to determine whether there are personality differences in other species, researchers can also look at whether conspecifics seem to understand personality differences among individuals. The psychologist Francys Subiaul arguably started the research program in social evaluation in his study of whether chimpanzees can learn the traits of unfamiliar humans by watching them interacting with another chimpanzee (Subiaul et al. 2008). It turns out that they can. Further work shows that orangutans can also formulate reputation judgments by observing a human interacting either nicely or meanly with another orangutan (Herrmann et al. 2013).

There are now a number of studies finding positive results of social evaluation or reputation in nonhuman animals, including dogs (Kundey et al. 2011; Chijiiwa et al. 2015; Carballo et al. 2017), great apes (Hermann et al. 2012; Hermann et al. 2013), and capuchin monkeys (Anderson et al. 2013). Interestingly, while adult dogs demonstrate social evaluation, preferring to interact with generous over selfish humans, puppies show no preference (Carballo et al. 2017). This suggests that understanding others' personality traits may be something that develops over time, with experience.

7.7 Chapter summary and conclusions

Humans can understand other people in a myriad of ways, in terms of their emotions, their reasons for action consisting of beliefs and desires, their goals, their perceptual states, their personality traits, their position in society, and so on. The philosophical interest in animal social cognition has primarily been focused on the literature related to theory of mind, perhaps because philosophers were instrumental in getting that research program going. But theory of mind doesn't even scratch the surface when it comes to social cognition. Social animals typically have to learn their group typical behavior. They may have to understand individual differences, so they can focus on a good model to learn form. Social animals often have to work together, and so having reason to choose one individual over another would be an adaptive skill. The sociality of many animal species may include abilities to recognize individual personality traits, status in the group, sex role, level of maturity or development, as well as others' goals, emotions, and perceptual states. A good way to understand what animals need to know about one another is to look and see what animals do in a natural context. Wild animals are relatively fit to their environments as opposed to captive animals. In the next chapter, we will turn to look at another recent research program in animal cognition that has focused on the natural behaviors of wild animals—the investigation into animal culture.

This chapter raised the question of how animals understand other animals. A question that has gripped the minds of philosophers is the question of whether animals understand that other animals have mental lives. But we need to ask these other questions to understand the range of ways in which animals may, or may not, take others as minded social agents.

We discussed the research into animal theory of mind or mindreading. Philosophers have been involved in this research program since it was introduced in the 1970s. Given theories of belief, philosophers proposed the false belief task as a test for whether chimpanzees understand that others have mental states. Since beliefs and desires are said to cause intentional action, and beliefs are endorsed by the believer, the suggestion was to create a situation in which a chimpanzee has to figure out what someone will do given their goals when they have a false belief. The false belief task was adopted for children for years before an ape-friendly version was designed. Though we now know that apes can pass the false belief task, it isn't clear that they, or young children, need to attribute belief in order to do so.

We examined a number of worries about animal theory of mind. First, we considered a priori worries based on the idea that language is necessary for metarepresentation, and that theory of mind requires metarepresentation. While some theories express this entailment, other theories of mindreading don't require metarepresentation, and yet others do require metarepresentation, but think it is possible without language. As with other debates stemming from a theory-first approach, we put aside the a priori worries about the need for language.

We then turned to consider methodological worries about testing for theory of mind/ mindreading in animals. We considered the logical problem critique, according to which it is difficult to distinguish between mindreading and behavior reading explanations of animals' performance on these tasks. Behavior reading involves anticipating what someone will do based on behavioral cues that predict actions. The logical problem critique arises because the same stimuli that cause the mental states could be used as a cue to predict the behavior. For example, if a predator lunges at a deer, the deer will run. Sure, the deer might also be afraid, have the belief that there is a predator, and the desire not to be eaten. But the presence of the predator is sufficient to make the prediction. For some time, philosophers and psychologists worked to find a single experiment that would overcome the logical problem constraints. One type of experiment involved asking subjects to engage in experience projection, and to predict a behavior they had never observed before, but only after having been the actor in that same situation. These sorts of experiments came to be known as "the goggles task." The attempt to find one experiment that would serve to decide the question came under attack from methodological grounds as well as conceptual ones. It turns out that in experience projection situations, the scientist cannot tell if the animal is predicting based on their own mentalistic experience that they then attribute to others, or on the affordances they had in the situation—the ability to perform certain actions. As well, philosophers of science suggested that the hope for a litmus test for theory of mind fails to understand how scientific theories are developed and confirmed. Best practices for studying theory of mind would involve creating a host of different kinds of tasks, not just additional versions of the false belief task.

Since apes have been found to pass a nonverbal false belief task, we returned to the question of what passing this test actually shows by examining the functions of belief attribution and the methods for predicting behavior. A popular version of the Social Intelligence Hypothesis suggests that humans developed the ability to think about mental states in order to deceive and manipulate competitors. However, we saw that deception and manipulation could be done without considering mental states. Another role for mental state attribution is to explain behavior, and especially explain people's reasons for action. Supporting a cooperative Mengzian version of the Social Intelligence Hypothesis, I proposed that thinking about reasons for action helps to support technological innovations.

Finally, we turned to consider other kinds of social understanding. Social cognition at its core involves taking others to be agents, self-propelled beings who are goal-oriented. We saw empirical evidence supporting agential understanding in a number of different species. We then turned to consider whether there is evidence of emotion understanding, which will be a topic we return to in Chapter 9. We returned to discuss in more detail evidence that other animals can engage in perceptual mindreading. Finally, we introduced research from a more recent area of investigation within animal cognition, namely social evaluation. Evidence from this work suggests that some species are able to use personality traits to decide how to interact with others. We concluded by encouraging future research on these other ways in which animals may understand one another, moving toward a richer, and more pluralistic understanding of social cognition.

Further reading

Mindreading and the logical problem

Buckner, C. "The Semantic Problem(s) with Research on Animal Mind-Reading." *Mind & Language 29*, *5* (2014): 566–589.

Clatterbuck, Hayley. "Using Causal Models to Think About Mindreading." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 247–257. New York: Routledge, 2018.

Halina, Marta. "What Apes Know About Seeing." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 238–246. New York: Routledge, 2018.

Lurz, Robert. "Animal Mindreading: The Problem and How It Can Be Solved." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 229–237. New York: Routledge, 2018.

Predicting behavior without mindreading

Andrews, Kristin. "Do Chimpanzees Reason About Belief?" In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 258–268. New York: Routledge, 2018.

Butterfill, Stephen. "Tracking and Representing Others' Mental States." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 269–279. New York: Routledge, 2018.

Vincent, Sarah and Shaun Gallagher. "From False Beliefs to True Interactions: Are Chimpanzees Socially Enactive?" In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 280–288. New York: Routledge, 2018.

Pluralistic folk psychology in apes

Andrews, K. "Pluralistic Folk Psychology in Humans and Other Apes." In *The Routledge Handbook of Philosophy of the Social Mind*, edited by J. Kiverstein, 117–138. New York: Routledge, 2017.

8 Culture

In 1979, a three-year-old killer whale was captured in Icelandic waters and sold to an aquarium. The whale, who came to be known as Keiko, was the star of the Free Willie movies—the first movie is about a young boy who befriends a whale living in a theme park and decides to release him into the wild. The movie was a hit, but audiences started wondering why the whale actor who played Willie had to live in captivity when the whale he portrayed was freed, thus spurring a movement to release Keiko. Many years and 20 million dollars later, the campaign ended in tragedy (Simon et al. 2009). After being released into Icelandic waters, Keiko couldn't integrate into wild social groups. The one time he approached a wild pod, the other whales rebuffed him, and Keiko returned to the research vessel tracking his movements. He was unable to feed himself, and was sustained by human provisioning. Keiko was in such bad health that he was returned to captivity a number of times before the attempt to release him was finally given up. He died at a facility in Norway in 2003.

The attempts to release Keiko were bolstered by the best scientific research at the time, and funding didn't appear to be an issue. Why didn't Keiko make it? Why couldn't he learn to thrive in the environment he evolved in live in? We need an answer to this to successfully release a captured or injured and rehabilitated killer whale. The answer comes from successful release programs; while Keiko had the proper genetic inheritance for living in the sea, he lacked the proper cultural inheritance. On his own, Keiko wasn't able to figure out what to eat, where to go, or who to interact with. These are things killer whales have to learn. For example, in British Columbia there are two populations of killer whales that specialize in different prey. The fish specialists, called "residents," engage in different hunting techniques and have different social structures and practices than do the mammalian specialists, called "transients" (Rendell and Whitehead 2015). If Keiko never got the chance to learn how to be a whale from other whales, and he was unable to figure it out on his own, then no wonder he didn't make it. Whales that retain cultural knowledge have shown much better outcomes when they are released back into their communities.

The idea of culture in animals might sound funny at first. By culture, we're not talking about what you might think of as "high culture" or "cultured" practices such as going to the opera or an art museum. Instead, we are understanding culture in an anthropological sense. We know that there are differences between human groups in terms of what and how they eat, greet, show respect, create artifacts, or dress. The study of animal culture is the study of what sorts of differences there are between animal groups of the same species. In this chapter, we will begin by considering accounts of culture and the differences between degrees of culture. We will then look at the kinds of practices that support culture, and the kinds of cognitive capacities that are involved in those practices.

8.1 What is culture?

The study of culture in human societies is typically found within anthropology departments, but even anthropologists can't agree on what counts as culture. In our investigation of culture in animals, we can start by identifying the three threads that run through the different definitions. First, culture is what produces certain kinds of products and practices. This thread was introduced by Edward B. Tylor, the first Professor of Anthropology at Oxford University, back in 1871, when he wrote that culture is "that complex whole which includes knowledge, belief, art, law, morals, custom, and any other capabilities and habits acquired by man as a member of society" (Tylor 1871). Tylor's list of products is fairly intellectually complex, and looking for art, law, or morals in animals might be akin to looking for evidence of communication in animals by looking to see if they compose lyric poetry. Since he also includes any practice that is acquired by virtue of being a member of a society, Tylor's list could well include those pieces of knowledge that Keiko lacked, such as what to eat, where to travel, who to interact with, and how to interact with others. In the animal culture literature, the kinds of cultural products we will be talking about are less highbrow, but no less acquired, such as tool construction and use, communicative signals, travel routes, food processing techniques, and social norms.

However, you might wonder what kind of product counts as a cultural one. I mentioned travel routes and ways of processing food as cultural products, but not all travel or all food processing seems cultural. Take, for example, the way sea turtles move en masse into the sea after hatching. This is a travel route, and scientists have discovered the variables that trigger the turtle's movement, including the downward slope of the beach and the reflection of the moon on the water (which is why many beaches have a lights-out policy during turtle nesting season). The sea turtle's travel route probably doesn't strike you as a cultural behavior, because it is part of a fixed-action pattern. It likely requires no learning and no cognition. The sea turtle didn't acquire this ability by virtue of living in a society.

The sea turtle example suggests that we need another thread to our definition of culture that focuses on how the practice is acquired. By virtue of living in a society, people socially learn certain ways of doing things. The view that culture requires *social learning* is the second thread in anthropologists' definitions of culture.

The two threads taken together give us an account of culture as practices or products that are socially learned, but we may wonder whether anything that is socially learned counts as culture. What kinds of things can we socially learn? I can learn from my sister that our parents will be visiting tomorrow, but that doesn't strike me as a cultural product, just information. Those kinds of observations lead to a third thread in definitions of culture, focusing on the type of information used to create cultural projects. The anthropologist Clifford Geertz wrote that

> Culture is best seen not as complexes of concrete behavior patterns—customs, usages, traditions, habit clusters—as has, by and large, been the case up to now, but a set of control mechanisms—plans, recipes, rules, instructions (what computer engineers call 'programs')—for the governing of behavior.
>
> (Geertz 1973, 44)

When my sister tells me that our parents are visiting, I am not learning rules about how to act. When my sister tells me that greeting practices in Nashville include hugging, or when she and other locals demonstrate that practice, however, I am learning rules about how to act in that culture.

These three threads—products, social learning, and rules that govern behavior—have been woven together to provide definitions that will be useful for studying culture in animals. For example, the biologists Kevin Laland and Vincent Janik propose understanding animals' culture as, "all group-typical behavior patterns, shared by members of animal communities, that are to some degree reliant on socially learned and transmitted information" (Laland and Janik 2006, 524) and the philosopher Grant Ramsey proposes that, "Culture is information transmitted between individuals or groups, where this information flows through and brings about the reproduction of, and a lasting change in, the behavioral trait" (Ramsey 2013).

Definitions of culture that combine the three threads allow us to identify a phenomenon that is of interest, that exists in humans across cultures, and that can be examined in other animals. They also support the idea that culture is something that we might look for in those species that have the kinds of psychological capacities we have discussed so far in this book. A cultural species will likely be conscious, rational, communicative, and social, because culture is a feature of agents acting rationally together. This doesn't mean that all cultural practices are rational in some causally necessary sense. For example, singing at a ball game is a cultural practice, but not something you need to do in the way you need to eat nutritious food or avoid being bitten by snakes. However, joining in on the fun makes you one of the gang, so singing along can bring a person a sense of belonging and security.

The first hints of culture in animals came from observing behaviors in groups of animals that appear to be unique to that group, and not due to the specific ecological conditions the animals were living in. Just as humans who live in similar environments but who eat different foods implies cultural differences, animals of the same species who live in similar environments but who eat differently also implies cultural differences. Thus, when the Japanese primatologist Kinji Imanishi observed that one group of Japanese macaques on Koshima Island wash sweet potatoes in the water before eating them, he suggested that the monkeys were engaged in a cultural practice (Imanishi 1957). The observation of this group's unusual behavior led the primatologists to investigate other macaque communities across Japan. Imanishi and his colleagues found other differences in social behaviors and food processing among these macaque communities. Though they were careful to distinguish the monkey behavior from human cultural products such as religion and music, Imanishi was convinced that animal cultural practices are evolutionarily continuous with these products of human culture. When Imanishi brought his ideas about animal culture to the United States in the 1960s, he was mocked by American scientists. In de Waal's article about Imanishi's visit, he describes the backlash as racist, with some scientists deriding Imanishi's claim as "Japanese in its unreality" (quoted in de Waal 2003, 293). De Waal also points out that Imanishi had asked whether animals might have culture even before observing the potato washing on Koshima Island:

> As far back as 1952, when European ethologists were working on instinct theories and American behaviorists were rewarding rats for pressing levers, Imanishi wrote a paper that criticized established views of animals (Imanishi 1941, 1952). He inserted a debate between a wasp, a monkey, an evolutionist, and a layman, in which the possibility was raised that animals other than ourselves might have culture. Hirata et al. (2001) provide a translation of a portion of this imaginary debate. The proposed definition was simple: if individuals learn from one another, their behavior may, over time, become different from that in other groups, thus creating a characteristic culture (Itani and Nishimura 1973; Nishida 1987).
>
> (de Waal 2003, 296)

This early text proposed a definition of culture that was suitable for scientists examining animal culture, and with that definition in hand, the scientists who saw the potato washing were able to identify it as cultural.

Among scientists in Europe and North America, culture didn't become a topic of much discussion until 1999 with the publication in *Nature* of an article about culture in chimpanzees. Seven groups of researchers working with different chimpanzee communities across Africa identified differences in behavioral patterns that they could not attribute to differences in genetic or ecological factors (Whiten et al. 1999). In the article, Whiten and colleagues addressed the issue of defining culture, and pointed out that anthropologists often define culture as requiring linguistic transmission, which is unhelpful for a study of animal culture. They proposed a definition that sounds quite a lot like Imanishi's: "a cultural behavior is one that is transmitted repeatedly through social or observational learning to become a population-level characteristic" (Whiten et al. 1999, 682).

Since the *Nature* paper, research into culture in animals has exploded. Cultural traditions are now thought to be widespread in animals, including rats learning what to eat from sniffing the breath of other rats, guppies choosing mates that other guppies have selected, song learning in birds and cetaceans, and travel routes in elephants.

Such research raises the question about whether there are types of culture, or differences between the practices and products identified as cultural in different species. It also raises questions about whether there is something unique about human culture that needs to be identified. Have we moved too quickly by accepting culture in animals? If the distinction between the kind of culture humans have and other animals have is quite stark, we might have reason to retain the word “culture” for what humans do, and when it comes to animals use some other term, such as “traditions” (as some theorists do).

We humans live in thoroughly cultural worlds. Our entire lives are supported by cultural products, both material (e.g. roads, toilet paper, and smartphones) and nonmaterial (educational systems, slang, and social norms). We depend on culturally acquired information and products for our very survival—a human naked alone in the forest wouldn’t last very long. One suggestion is that the difference between culture in humans and in other animals is that humans need culture for survival. Other species don’t need to be actively taught how to live, but can rediscover solutions to subsistence problems on their own. Another suggestion, which has become common since the acceptance of animal culture, is that only humans enjoy some process of cultural evolution. Given the prominence of cultural evolution, we can spend some time unpacking what that means.

8.1.1 Cultural evolution

Cultural evolution is a theory of how humans change over generational time. The dual inheritance or gene-culture co-evolution model of human evolution suggests that genetic inheritance and cultural inheritance can interact to support changes in biology over generational time (Richerson and Boyd 2005). Both of these systems create effects that the other is sensitive to, and so they create a dynamically interacting system of inheritance. Common examples of how genetic and cultural inheritances work together include how herding societies gained adaptations for tolerating cow’s milk, how agricultural groups gained anti-malarial adaptations, and how societies dependent on rice agriculture gained adaptations for alcohol aversion.

While cultural evolution remains a controversial theory, it has played a significant role in discussions of culture in humans and animals. For one, cultural evolution has helped to identify a number of cognitive mechanisms that have been proposed to support culture; we will look at those in Section 8.2. But in addition, cultural evolution has given us some concepts that are useful in identifying aspects of culture that we may look for in other animals.

One element of cultural evolution is called niche construction, which refers to species’ ability to change their environment such that there are long-term effects on future selection pressures in the species. Humans have modified our environments so much that some geologists have proposed that we are living in a new geological epoch—the Anthropocene. Animals also modify their environments in ways that shape selection pressures. One of the best examples is beavers, whose dam construction creates lakes and changes the water quality and subsequent ecosystem in their environment. Likewise, humans engage in social niche construction, changing the social structures and expectations in society.

Another element discussed in the context of cultural evolution is the notion of cumulative culture, a kind of evolution in which cultural practices improve over generational time as others refine them. Tomasello and colleagues call this the ratchet effect: Innovations remain stable in a community as they are learned by the next generation with a high degree of fidelity until an improvement is introduced, which ratchets up the behavior (Tomasello et al. 1993).

The modified behavior remains stable with little backward slippage because of the high fidelity of transmission. For example, consider the development of the broom. The first brooms were likely handfuls of grasses that were used to sweep away debris. The first refinement might have been tying one end of the grasses so they didn't have to be held as carefully. Next may have come a short wooden handle. With the innovation of a long handle, sweepers no longer had to bend to the ground to clear space, making it a more comfortable task. It could have taken hundreds of generations to get from handfuls of grasses to the long-handed broom. We know that humans are able to refine cultural products in this way, but are other species? Many theorists think not, presenting cumulative culture as that which makes humans unique among animals.

The search for what makes humans unique has long gripped the human imagination, but all the past attempts to find some property that is unique to humans, from Aristotle's "rational animal" to Oakley's "man the toolmaker," have been undermined by new scientific discoveries. Today some version of culture evolution is often taken to be what makes humans unique (Tennie et al. 2009; Galef 2012; Sterelny 2012; Henrich 2016; Tomasello 2016; Dennett 2017; Heyes 2018). The anthropologist Joe Henrich provides an example of the importance of cultural evolution when he describes how a group of Western explorers lost in Australia died of malnutrition because they were unable to process native cassava. The explorers observed local people harvesting and eating cassava, and so they started eating it too. However, what they didn't know is that unless the cassava was pounded, grated, and steeped, it would kill them. The explorers who were unwilling to seek help from the local population cooked cassava in their own way, and died. The local population evolved practices to make cassava safe to eat, practices that the explorers couldn't discover on their own.

The cultural view of human uniqueness rests on current sciences of both animal and human cognition. In Section 8.2, we will look at some general cognitive capacities involved in cultural transmission of information. Section 8.3 will turn to look at the cognitive capacities that are involved in the material and nonmaterial products of animal culture, which will lead us to examine some work in the science of animal culture. Finally, in Section 8.4, we will return to the question of human uniqueness when it comes to cultural evolution.

8.2 Cultural cognitive capacities

We can start by distinguishing two types of cognitive capacities that support culture. One fulfills the second thread from our definition of culture, namely the transmission of information from one individual to another. Psychologists usually refer to this thread under the heading of social learning. There are a number of methods of social learning, some as simple as picking up someone's discarded tool and playing with it, and others as complex as receiving and considering linguistic instruction about how to use a new social media app. We will return shortly to the topic of social learning capacities.

The second type of cognitive capacities that support culture will be specific to the cultural product in question. Humans have a wide range of cultural products—including language, dance, music, drama, clothing, food, tools, vessels, architecture, games, religion—and particular cognitive capacities may also be required to support the creation, as well as the dissemination, of types of cultural products. For example, to have a culture that supports language requires a capacity to think in propositions, to have a culture that supports architecture requires a capacity to think about structural engineering, and to have a culture that supports drama requires a capacity to tell stories.

The same will be true when we turn to look at specific products of animal culture. Topics of interest in the animal culture literature include the creation and use of tools, and food processing. In the case of the Japanese macaque sweet potato washing, it was all started by a single individual, a female named Imo. The other monkeys in her group began to copy her, and so the behavior spread. A few years later Imo innovated another method of food processing—she started cleaning the sand off wheat by throwing handfuls of sandy wheat into water and picking out the floating grains. Imo's group members also copied this behavior. We can consider both the capacities needed to innovate the behaviors, and those needed to learn the behaviors. The potato washing might have come about via a fortuitous accident; Imo may have dropped a potato in the water and found it tasted better afterward, requiring nothing more than associative reasoning. Or she may have perceived a problem with gritty potatoes and thought about how she might solve the problem. We don't know which, if either, of these explanations is correct. On the transmission side of things, a monkey who observes another monkey dunk a potato in the water may need only simple physical reasoning to engage in the same behavior; the obvious result of the behavior might make the goal transparent. However, the monkey might not even know what the goal of potato washing is, but is motivated to engage in the practices just because Imo did. In this case, little more than a drive for conformity would be required.

The animal culture literature has also reported on behavioral patterns whose functions are less transparent. For example, in one group of capuchin monkeys living in Costa Rica, a young adult male called Guapo innovated a number of games that spread through the group, including tail-sucking, finger-in-mouth, and hair passing games. These games always involve two individuals, and Guapo successfully recruited other group members to engage in these odd behaviors with him. Anthropologist Susan Perry and her colleagues describe the hair passing game as

> Monkey A bites a tuft of hair out of the face or shoulder of monkey B. Then monkey B attempts to extract the hair from A's mouth, using the same techniques described for the finger-in-mouth game. Once monkey B succeeds in recovering the hair, A tries to get the hair back from B's mouth. The game continues, with A and B reluctantly passing the hair from mouth to mouth, until all the hair has been accidentally swallowed or dropped. Then A bites another tuft of hair out of B to start the game anew.
>
> (Perry et al. 2003, 251)

In other games, monkeys stick their fingers in one another's mouths, nostrils, or eye sockets.

The authors suggest that games like these may be rituals used to signal commitment to the social relationship and to improve social bonding. Because the monkeys have to coordinate with one another to touch in ways that involve physical risk, and in ways that are not extendable to just anyone in the community, such behaviors are not unlike human bonding rituals such as open-mouth kissing.

Figure 8.1 Guapo and a juvenile playing the finger-in-mouth game. Redrawn from Perry et al. 2003.

The cognitive tools needed to learn sweet potato washing are likely different from those needed to learn the hair passing game. Physical reasoning and experience with water, sand, and sweet potatoes may make it fairly transparent what a potato washer is doing. The capuchin games are a different matter. Observing the behavior, it isn't clear what the animals are doing. There is no obvious reason for it. Rather than having capacities of physical reasoning, a hair passer likely needs to have social cognitive capacities that permits them to interact with others in the right kind of way.

Both potato washing and the hair passing game are innovations, new behaviors that were not previously present in the communities. An innovation doesn't need to be transmitted to other members of the society, but can just be a solution to a problem. Experimental research found that Betty, a New Caledonian crow, spontaneously bent a piece of wire to make a hook she used to pick up a bucket of meat that was inaccessible inside a bottle (Weir et al. 2002). In a version of that test with human children, even eight-year-olds had a difficult time innovating a solution to retrieve a bucket containing a sticker inside a transparent tube, but they quickly learned how to make a hook by watching a demonstrator (Beck 2016).

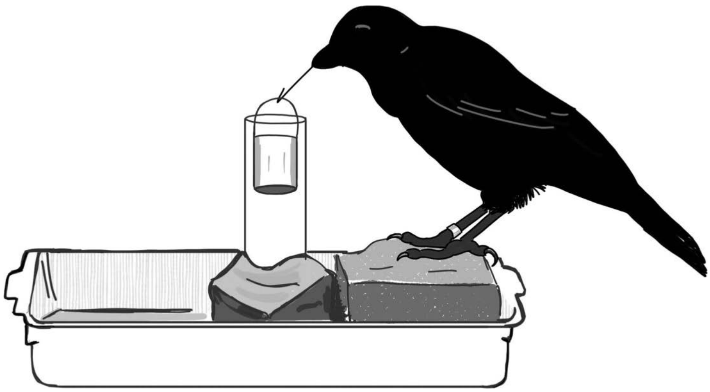

Figure 8.2 Betty uses a wire she just bent to extract food from a bucket. Redrawn from Weir et al. 2002.

The cognitive capacities involved in innovation are varied, and can include products that are produced through insight, trial and error, exploration, refinement, recombination, or reuse in a new context (exaptation). For example, when the report on Betty the crow was first published, some hailed her as an insightful innovator, whose a-ha! moment led to a new behavior never seen before. However, it was already well known that that New Caledonian crows make tools out of twigs, and in a follow-up study, scientists captured 18 crows on New Caledonia to examine their tool-making abilities. The scientist observed that the crows used their beaks to break off small branches from a shrub and fashioned one end into a tiny hook by biting it. But ten of the birds then bent the shaft of the tool into a curve—a larger hook by sticking it into a hole or holding it down with a foot while pulling on the other end, just as Betty did (Rutz et al. 2016). The finding that New Caledonian crows make hooks out of twigs suggests that Betty wasn't using insight to solve the problem, but something more like recombination—using existing practices on new materials in a different kind of context. While it isn't genius, it also isn't robotic behavior.

Just as not all cultural innovations involve insight, not all cultural products are the result of innovations. Some products themselves evolve and their causal structure may be opaque to the practitioners. Ritual behaviors and food processing are good examples of these sorts of cultural products. For example, Henrich gives an example of a Mapuche man who was preparing mote, a traditional corn dish: "He showed me how you have to scoop fresh ash out of the wood stove and put it into the corn mix for soaking, before heating it. I thought that was curious, so I asked him why he mixed the wood ash in with the corn. His answer was, "It's our custom" (Henrich 2017, 102). That custom keeps the Mapuche alive, because adding ash to the corn releases niacin, which is needed to avoid the fatal disease of pellagra. Likely, it was not a moment of innovation when ash was first mixed with corn, and the same goes for the cassava eaters in Henrich's earlier example. Human food processing practices, including using spicy chili peppers to preserve food, the pounding, grating, and boiling of cassava, and adding ash to corn, probably evolved little-by-little over time in much the same way biological adaptations do. People who enjoyed chili, soaked corn next to ashy fires, or preferred pounded cassava lived longer than their group members who didn't, and their children inherited these practices through social learning.

Whether different cultural product types are a result of innovations or not, and whatever cognitive capacities are involved, they are all transmitted through some form of social learning. This makes social learning capacities key to having a culture. Because social learning leads an individual to copy group members, different behaviors can arise in different groups in the same species, even when the groups share a similar environment.

Social learning involves learning through other agents either directly or indirectly in order to gain some knowledge or skill. We can see social learning in young orangutans who acquire the ability to suck termites from rotten wood by peering at (that is, watching very, very closely) skilled orangutans performing the behavior. A wide variety of social learning types have been identified, some requiring more in the way of cognitive capacities than others. Social learning is contrasted with individual learning, which can be done by a single agent interacting with their natural environment. An example of individual learning would be a monkey discovering that a washed sweet potato tastes better after accidentally dropping it in the sea. The same kinds of cognitive capacities supporting innovations support individual learning (insight, trial and error, exploration, refinement, recombination, or reuse in a new context (exaptation)).

A number of theorists have suggested that we can identify a third kind of learning specific to culture. Cultural learning is a type of social learning that is required for the kind of culture humans alone are thought to have. Cecilia Heyes suggests that there are five types of learning that cultural evolutionists typically refer to as cultural learning: Selective social learning/ learning biases; imitation; teaching; mindreading; and language (Heyes 2018). All five of these capacities are thought to exist in humans across cultures, but Heyes suggests that all but selective social learning appear to be unique to humans.

Learning strategies

Individual learning

Trial and error: Manipulation of elements in the world in a relatively random way, not guided by the manipulation of mental representations in the head.

Insight: A sudden realization about how to solve a problem, without requiring trial and error.

Exploration: Active examination of objects, individuals, or spatial locations without any obvious reinforcement other than the novelty.

Social learning

Local (or stimulus) enhancement: Observing another individual interacting with an object or location causing the observer to interact with the object or explore the location.

Conformity or copying: Doing the same thing as a demonstrator. The mechanisms are unspecified.

Emulation: Low-fidelity copying only some elements of a behavior; goal emulation refers to copying only those parts of the action that appear relevant to achieving a goal.

Cultural learning

Selective social learning/learning biases: Learning strategies that shape how knowledge and skills spread through a community. Strategies include information about who to copy, including generic biases such as *copy older individuals* or *copy prestigious individuals* and domain-specific biases such as *copy digital natives*. Strategies also include information about when to copy, such as *copy when uncertain*.

Imitation: High-fidelity copying of all elements of an observed behavior.

Teaching: Effort on the part of a demonstrator that results in the learning of new information or skills on the part of the observer.

Mindreading: Attributing mental states to others so as to understand their intentions.

Language: Formal communicative system with a syntactic structure.

If there is a set of learning strategies that are necessary for cumulative culture, and only humans have those capacities, we would have an answer to the question what makes humans unique. However, things are a bit more complicated. The claims of human uniqueness rest on claims about what kinds of cognitive capacities humans and other animals use, and as we have seen so far in this book, that is often difficult to determine. In addition, the claims of human uniqueness rest on a shared understanding of the nature of the learning strategies, and we have seen that there is disagreement even in how people use terms such as "mindreading" and "language." The same is true for "teaching" and "imitation." While we saw evidence about the social cognitive capacities of animals in Chapter 7, and evidence about the communicative capacities of animals in Chapter 6, we also saw that there is currently no evidence that animals have the same concept BELIEF that philosophers use when they are discussing mindreading. However, we aren't sure whether children or even adults who pass the false belief task have the same concept BELIEF. And while grammatical structure in spoken language appears to be unique to humans, we can investigate the relative importance of language compared to other communication systems for transmitting cultural information. While children can learn that you add ash to mote by being told to do so, they could also learn it through nonverbal active teaching, such as a model exaggerating the important moves when making the dish as the children watch.

Questions remain about whether the cultural learning strategies are necessary for cultural evolution or cumulative culture, and whether they are human-unique. Because this is a big topic, we can only look at a small part of the debate here. First, we will look at the question of whether animals imitate others, or whether they only emulate. Next, we will look at whether animals have any learning biases that would count as selective social learning. And finally, we will look at the question of animal teaching. In all three cases, there is some evidence that some species engage in behaviors that may be best understood as continuous with what humans do in imitation, selective learning, and teaching. While the differences between culture and learning in humans and other animals remain vast, the difference may not be best attributable to a deficit in these learning strategies.

8.2.1 Imitation and emulation

From birds learning proper songs only when hearing others sing, to orangutans learning how to paddle a boat by watching humans, to "do as I do" dog training methods, it might seem obvious that other animals imitate. However, until around the 1990s, there was little in the way of formal investigation on animal imitation. Since then, a host of experiments, many of them comparing apes with children, have raised questions about whether apes, in fact, ape. While it might seem that animals do imitate, a challenge arose: Maybe animals just emulate, or copy some elements of a behavior in order to achieve a goal. Imitation requires a high-fidelity copy of all the elements of an observed behavior. It doesn't merely facilitate realizing a goal.

The psychologist Andrew Whiten has been examining imitation in apes and children by developing tests that are easily given to both subjects. One of his approaches has been to develop "artificial fruits" that can be opened in multiple ways. In one of the first tests, researchers used a transparent plastic box containing a treat that could be opened by either poking out or twisting bolts (Whiten et al. 1996). Subjects were allowed to observe an adult human open the box using one of the two methods, and then were given the same kind of box to interact with. Both species were more likely to use the demonstrated method to open the box, but the four-year-old children copied with higher fidelity and precision than younger children and apes.

In order to examine whether imitation of this sort could support a cultural tradition, scientists used diffusion studies to test whether using the artificial fruit in a demonstrated way would spread through a community (Whiten et al. 2007). While these tests have been conducted in a variety of ways, a common strategy looks like this: First, a high-ranking female is taken from the group, and a human demonstrates how to open the artificial fruit. After this individual learns the behavior, a second individual is allowed to observe the first one open the fruit. Then, the second one is given the fruit, successfully opens it, and yet a third individual is allowed to watch the second. That is, a particular behavior is seeded into the group by demonstrating it to one individual and through a daisy-chain series of observations it spreads to the group as a whole. Even when the other method is discovered through free play, the innovator tends to revert to the seeded method.

While chimpanzees do copy behaviors in this way, some scientists have raised questions about whether the fidelity of transmission is high enough to count as imitation rather than emulation (Tomasello 1990, 1999). For example, when the apes saw humans poking bolts in a puzzle box, they may have learned how the box worked in the same way they might have had the box fallen on the ground and the bolts fell out. That is, the demonstrator may not have offered any special facilitation for learning the box's affordances. The apes may not be imitating the actor's movements, but emulating the end goal given their knowledge about how the box works.

Scientists have tried to answer the question about imitation vs. emulation by using two kinds of experiments: Ghost condition studies and overimitation studies. In the ghost condition studies, scientists compare how well subjects pick up a behavior when it was performed by an actual agent model or by a ghost (such as transparent fishing wire that moves the object). Chimpanzees find it more difficult to learn a new behavior such as sliding a door to access food in the ghost conditions (Hopper et al. 2007), and when they do, their behaviors have lower fidelity than when copying a chimpanzee model (Hopper et al. 2008). This suggests that the model can be very important for the chimpanzee.

In the overimitation studies, scientists examine whether subjects will imitate causally irrelevant actions. This is taken to be very important because much cultural behavior is opaque. We cook, perform rituals, eat certain foods during certain times of year, etc., just because others do so, not because we know how things work or what the goal might be.

Children as young as 14 months will overimitate unnecessary action to achieve a goal. In the first study of overimitation, the developmental psychology Andrew Meltzoff invited children to play with an adult who showed the child that she could turn on a light box by touching it with her head. A week later, the children were given the opportunity to interact with the light box, and they turned it on more often with their heads rather than with their hands. The result is somewhat surprising, because it is strange to turn on a light with your head, and the children only saw the adult demonstrate the behavior once before; they were never instructed to copy the demonstrator (Meltzoff 1988).

However, unlike human children, wild-born sanctuary chimpanzees do not tend to overimitate obviously causally irrelevant behaviors modeled by experimenters (Horner and Whiten 2005). When the model demonstrated on an opaque puzzle box, the chimpanzees copied every action demonstrated to them, but when the box was transparent, and it was apparent how to extract the food, the chimpanzees skipped the unnecessary behavior. Children, however, tend to overimitate actions they know are causally irrelevant, even when warned not to imitate the "silly" actions (Lyons et al. 2007). There is also a report that domestic dogs will overimitate their human caregiver (Huber et al. 2018).

While some interpret the failure of the sanctuary chimpanzees to overimitate as evidence that chimpanzees do not engage in high-fidelity imitation, the null result could be due to other elements of the experimental context. As we saw in the work on ghost conditions, the model appears to matter. This raises the possibility that the sanctuary chimpanzees do not take humans to be good models. Like wild chimpanzees who don't imitate the novel behavior of recent immigrants, and like the action of "ghosts," the sanctuary chimpanzees may have seen the unfamiliar humans as the wrong kind of model.

Given the theory that overimitation functions to help children learn cultural norms (Rakoczy et al. 2008; Allen and Bickhard 2011), we would expect that chimpanzees lack the motivation to overimitate such models. The humans may not have been in-group members, and so they shouldn't be imitated. Children also fail to overimitate out-group members, such as adult humans who speak a foreign language (Buttelmann et al. 2013). Furthermore, evidence that chimpanzees will overimitate in-group humans comes from Kyoto, where Tetsuro Matsuzawa, who has a lifetime research relationship with Chimpanzee Ai, reports that she overimitates his irrelevant tool use (Myowa-Yamakoshi and Matsuzawa 2000).

Another possible explanation for the failure of sanctuary chimpanzees to overimitate is that they are rational imitators. In a modified version of the lightbox task, children played with a human who performed the same action of turning on a lightbox with her head, but she was also holding a blanket around her body and let the children know that she was chilly (Gergely et al. 2002). A week later, the children used their hands to turn on the lightbox, suggesting that children rationally imitate—they only imitate odd behaviors when there isn't another reason for the demonstrator to perform in that way. The children may be implicitly reasoning that a person who is feeling cold has to hold a blanket around them, and so cannot use their hands to turn on the light. Since humans are limited compared to chimpanzees—we can't travel through the trees, we can't catch and kill monkeys with our bare hands, we can't bite open prickly fruit—it may not be rational for a chimpanzee to imitate a human who is trying to open a box with food in it.

Observations of natural behavior have offered additional evidence of imitation in apes as well as monkeys. Wild chimpanzees are more likely to imitate dominant individuals than lower-ranking ones, even if the low-ranking chimpanzee behavior is more efficient (Kendal 2014). Immigrant chimpanzees tend to conform to the behavioral patterns of their new group, and will change their tool use even when the new tradition is less effective than their original one

(Luncz et al. 2012; Luncz and Boesch 2014). A female chimpanzee living in a sanctuary started wearing a straw-like blade of grass in her ear, and other chimpanzees began to do the same (van Leeuwen et al. 2014). Wild vervet monkeys, brought up eating pink corn and avoiding blue corn, who immigrate to a community that eats blue and avoids pink, will switch their behavior (Erica van de Waal et al. 2013). The game-playing capuchins, grass-wearing chimpanzees, and colored-corn-eating vervets all provide evidence of arbitrary conventions in other animals.

While some theorists such as Tomasello and Heyes think that chimpanzees learn cultural behaviors via emulation, this evidence suggests that apes and monkeys, and perhaps other species, may also be imitating with a high degree of fidelity. In studies of imitation, researchers need to be mindful that learning biases may be at work. Just as humans don't copy just anyone at any time (and thank goodness for that), we shouldn't expect that an animal should copy anything that a random human wants them to do. Rather, we should examine the kinds of selective social learning strategies that the species have.

8.2.2 Selective social learning

In studies of human children, psychologists have come to realize the important role of selective social learning. Children won't learn from just anyone. They are less likely to imitate individuals who speak a different language (Buttelmann et al. 2013), or low-status individuals (Chudek et al. 2012), or unreliable individuals (Poulin-Dubois et al. 2011). Such findings provide an alternative explanation for an animal's failure to learn from another person—perhaps they have biases against learning from that sort of person in that particular context.

As an adaptive learning strategy, the rule *copy anyone anytime* would be terrible. We don't tend to copy people we judge to be immoral or unsafe. Adults don't tend to copy children. Advertisers think that we copy attractive and successful people, which is why they hire traditionally attractive people as models in their campaigns. If all humans copied everyone all the time, then we would all be doing the same thing. Given what an ineffective rule *copy anyone anytime* is, we can infer that animals don't use the rule either.

The evidence suggests that primates engage in selective social learning. Apes prefer to imitate high-ranking individuals (Bonnie et al. 2007). Rehabilitant orangutans prefer to imitate some humans over others (Russon and Galdikas 1995). Vervet monkeys prefer to imitate females over males, which makes sense given that vervet males immigrate, and females are local experts (van de Waal et al. 2010). These observations—that primates are only selective social learners—emphasize the methodological problems with the imitations studies. The use of out-group human demonstrators in imitation tasks may explain why apes fail to imitate in those cases.

The earliest work on selective social learning in animals was not done with primates, but with fish. The biologist Kevin Laland and his students first discovered evidence of selective social learning in the stickleback fish in the 1990s. They found that the ninespine stickleback and the threespine stickleback have different social learning strategies. The ninespine but not the threespine tend to copy behavior when they don't have prior experience in a situation, or when their experience with the situation was long ago (van Bergen et al. 2004). Selective social learning strategies are found across species, including rats and guppies who follow a *copy when uncertain* strategy, pigeons who follow a *copy when current behavior is unproductive* strategy, male European marsh warblers who follow a *copy rare vocalizations* strategy, and bats who follow a *copy successful individuals* strategy (for a review, see Laland 2004).

The finding that animals selectively learn has methodological significance, since experiments typically ask subjects to learn how to do something. Null results shouldn't be too quickly interpreted as an inability to perform some task, or as evidence that some cognitive capacity is lacking. Instead, the experimenters have to consider whether the animal might have a learning bias that would keep them from performing because of the way the information is presented.

8.2.3 Teaching

When we speak of teaching, the image that springs to mind may be your 4th-grade classroom, with rows of desks and a teacher standing up front. However, before there were schoolhouses, there was teaching, and there remains a great deal of teaching that has nothing to do with institutionalized schools. When animal cognition researchers speak of teaching, they are often adopting an operationalized definition introduced by Caro and Hauser (1992, p. 153), who provide three criteria for teaching: (1) An individual, A, modifies their behavior only in the presence of a naive observer, B; (2) A incurs some cost or derives no immediate benefit; and (3) as a result of A's behavior, B acquires knowledge or skills more rapidly or efficiently than they would otherwise. With this understanding, teaching is an act performed by a knowledgeable agent that promotes the transfer of knowledge or skill to a naïve one. The cognitive capacities required for teaching are unspecified in this functional account.

A teacher will minimally need to know that the learner is naïve, and that the teacher has the skill or knowledge that the naïve individual lacks. While this might suggest that the teacher needs a theory of mind to think about what others know, it may merely require that teachers are sensitive to what others can and cannot do. A teacher will also need to be able to communicate information or skill to the learner. While this might suggest that the teacher needs language to instruct the student, it may merely require that the teacher creates a stimulus enhancement learning context. For example, there is a kind of teaching called facilitative teaching, which only involves giving the learner some opportunities for learning without giving explicit instructions. Facilitative teaching is widespread in human cultures where children have to learn to hunt and make tools. In many hunter-gatherer societies, facilitative teaching includes practices such as allowing children to accompany adults on hunting trips and allowing them to handle tools, including weapons, from an early age.

One kind of facilitative teaching is apprentice learning. Kim Sterelny's apprenticeship learning hypothesis offers a model of teaching in humans that is useful for examining animal teaching (Sterelny 2012). Sterelny suggests that humans create an organized environment for learning, without explicit teaching. Adults allow children to closely watch what they are doing, and they live among and interact with the cultural items that they will need as adults. Adults are sensitive to the child's degree of competence, and they prepare gradual learning steps for children; they deconstruct tasks so that children scaffold up to learning complex skills, like learning to build and use complex tools, and gain other types of cultural knowledge efficiently and faithfully.

While reports of teaching in animals are fairly limited, there are some observations of behaviors that fit an apprenticeship model of teaching. In meerkats, for example, adults help young individuals learn how to kill and process deadly scorpions using task deconstruction (Thornton and McAuliffe 2006). First, the young are only allowed to interact with dead scorpions, and then they are given injured scorpions who have been rendered less dangerous. The meerkat task deconstruction fulfills all three of the criteria for teaching. The teacher modifies their behavior by bringing dead or disabled scorpions to the young, with no direct benefit to the teacher, and the young learn how to kill and eat scorpions.

Two other species' practices have also been largely accepted as fulfilling the three criteria for teaching. In the *Temnothorax albipennis* ants, individuals who know the route to a food source will run more slowly when accompanied by a naïve ant. The knowledgeable ant makes detours that allow the naïve ant to examine the landmarks along the route, and will continue to run only when the naïve ant taps the leader with their antennae (Franks and Richardson 2006). The three conditions are fulfilled in this case as well; the knowledgeable ant modifies their behavior and takes on a cost of reduced speed and efficiency, and the naïve ant learns the efficient route, without the detours.

A third example of teaching is found in pied babblers, a species of group-living birds. Adults condition nestlings to associate a specific purr call with food. The nestlings respond by begging, and when they become fledglings, they will approach an adult who purr calls. Adults also use this call with their offspring once they begin to fly to lead them away from danger and toward food patches (Raihani and Ridley 2008). This behavior fulfills the three conditions because the adults do not gain any benefit from making the calls, and the young birds learn the beneficial and harmful parts of their environment.

More recent observations of tool construction and tolerated theft in chimpanzees have led some researchers to claim that chimpanzees also teach; mothers have been observed to make and offer tools to infants who use them to practice termite fishing (Musgrave et al. 2016). In a review article, biologists Alex Thornton and Nichola Raihani offer guidance to scientists looking for evidence of teaching in animals, and they propose that there are promising candidate-teaching practices in many species, such as allowing young to come on hunts in killer whales and lions, or breaking contact with offspring to teach them to travel on their own in primates (Thornton and Raihani 2010).

While future research may find more evidence of teaching in animals that fits the three criteria, we might wonder whether those criteria permit the kind of teaching that is needed for cultural evolution. Humans are immersed in a cultural context such that our teaching and learning is high fidelity, frequent, long-lasting, and multifaceted. We don't just learn routes or food processing, but etiquette, morality, religion, law, rituals, and language. There sometimes seems like there is very little that is not cultural in human practices, including our most private acts. While other animals may learn, have some cultural traditions, and while they may practice teaching in a few areas, they may not be immersed in an environment of teaching and learning sufficient for cultural evolution.

8.3 Cultural practices

Some advocates of culture as what separates humans from other animals emphasize the kind of cultural practices we see in humans as compared to other animals. An early proposal was that humans alone make and use tools. When Jane Goodall went into the forest of Gombe to observe chimpanzees, "man the toolmaker" was accepted science. One day, she was astonished to realize that the chimpanzee she saw poking what looked like grass into a hole and then into his mouth was actually using a termite-fishing tool he made from a leafy twig. After Jane Goodall discovered tool-making in chimpanzees, she wrote to the anthropologist Louis Leakey, who was funding her research, and he famously replied: "Now we must redefine tool, redefine Man, or accept chimpanzees as humans."

Today, our knowledge of animal material culture is vast, with numerous articles and books on animal tool use and construction. As we saw already, New Caledonian crows learn how to make hook tools by breaking off twigs and fashioning them into a curved shape with a notch on the end, and chimpanzees make tools for termite fishing and ant-dipping, and use stones as hammers, anvils, and wedges when cracking nuts. As we continue to observe wild chimpanzees, our knowledge of their material culture is growing. Chimpanzee females living in the savannah of Fongoli, Senegal make spears they use to hunt bushbabies, small primates who sleep in tree hollows during the day (Pruetz and Bertolani 2007). The spears are made by breaking off strong branches, trimming the side branches and leaves off, and sometimes also trimming the length or removing the bark. The chimpanzees sharpen the spear by biting it into a tip using their incisors. The completed spear is used by jabbing it into a tree hollow with great force, sometimes killing a bushbaby that they then eat. In a very different behavior, chimpanzee males at four different research sites were observed throwing rocks at particular trees, resulting in a cairn—a pile of large stone. The authors interpret this behavior as a possible ritual or form of communication (Kühl et al. 2016).

Animal archeology is a new research field dedicated to uncovering the history of animal tool use. In a recent study, scientists found evidence that a community of capuchin monkeys in Brazil have been using stone tools for at least 3,000 years, and they documented how their tool use evolved twice during that time (Falótico et al. 2019). Sea otters, monkeys, and fish use stones to open shells, octopuses use coconut shells as mobile homes, orangutans use giant leaves as umbrellas, dolphins use sponges as protective clothing, elephants use branches to swat flies, and ants use stones to block their rivals' exit tunnels. Material culture of these sorts is widespread in animals, but we are only beginning to learn about these practices.

Nonmaterial cultural practices are even less well studied. The third thread of the definition of culture emphasizes the learning of rules. Material culture has rules about how to use objects. But humans also have rules about how to behave. Nonmaterial cultural practices in animals are still quite controversial, and underexplored. There are at least two current proposals supporting human uniqueness that relate to nonmaterial cultural practices. One idea is that only humans have social, and ultimately, moral norms. Another idea is that only humans are enthusiastic cooperators. We will look at each of these ideas in turn.

8.3.1 Social norms

In our discussion of the cognitive capacities that support culture, we saw many examples of cultural products. Traditional travel routes, tools, information about the location of resources and hazards, and food processing techniques are the most common types of cultural products. But we also saw evidence of nonfunctional cultural products, such as the vervet monkey immigrants who switched their corn-eating preferences to match that of their new group. This behavior is nonfunctional from an evolutionary perspective, because the monkeys know that the blue corn is good to eat and there is no competition for the blue corn, but they start to avoid it anyway and compete for the pink corn after moving to the pink-corn-eating community. This vervet behavior is reminiscent of the annoying behavior of a human tween who comes home from a new school to tell her parents that all her perfectly good T-shirts are unwearable, because everyone else is wearing tank tops. Human culture is rife with nonfunctional cultural products, practices that are adopted just because we want to be like the other people who engage in them.

There is some evidence of nonfunctional cultural products in primates. In addition to the vervet corn-eating and the chimpanzee grass-in-ear behavior, a number of the practices identified in the first ever animal culture paper are nonfunctional. For example, a chimpanzee behavior that is seen in some communities but not others is called handclasp grooming. While all chimpanzees groom, in only some groups do chimpanzees hold one arm in the air and grasp one another's forearms while grooming with the other hand. Like human greeting practices, which might consist of a handshake, a hug, a bow, a kiss or two or three, or an outstretched tongue, chimpanzee communities show cultural differences in how they interact with others. If apes also have different grooming practices, do they also have other types of nonmaterial cultural products, such as social norms? This is a question that is just beginning to be investigated.

Social norms undergird normative behavior in humans, and we might think of them as the foundation for moral behavior as well. As such, asking about social norms in animals is asking whether they, like us, view some behaviors as acceptable while others not. In the next chapter, we will look a bit at the research on moral practice in animals, but in this chapter, we will focus on the possibility of social norms.

There are three general ways that philosophers think about social norms. One approach is to take norms to be rules or principles of actions accepted by a community. Another approach is to take norms to be community-wide attitudes toward certain actions or properties. A third approach synthesizes the first two.

In their rule-based account, Chandra Sripada and Stephen Stich define a social norm as "a rule or principle that specifies actions which are required, permissible or forbidden independently of any legal or social institution" (Sripada and Stich 2007, 281). Another advocate of rules, Joe Heath, writes that "most social norms have an overtly deontic structure. They constrain agents by imposing specific duties on them. Rules usually classify actions as permissible or impermissible; they do not specify which outcomes are more or less desirable" (Heath 2008, 66). On these views of norms, a norm expresses content that tells one what is permissible and what is obligatory.

The second way to account for norms is to take them to be attitudes, rather than rules. Edouard Machery and Ron Mallon describe this approach:

> Norms are attitudes toward types of actions, emotions, thoughts, or other traits. These norms are typically shared by many members of a given group and regulate people's behaviors, thoughts, emotions, characters, and so on. Their content essentially involves deontic concepts, such as SHOULD or OUGHT. Such norms can prescribe or forbid a thought, behavior, or any other characteristic, and may be associated with a disposition to punish those individuals who do not comply with the norms.
>
> (Machery and Mallon 2010, 12)

Yet, other accounts of norms combine rules and attitudes. On Cristina Bicchieri's account, social norms are rules of behavior that individuals choose to follow because they believe two things: (a) That others in their community follow the rule and (b) that others also believe that community members ought to follow the rule (Bicchieri 2017). These two beliefs comprise a requirement that individuals have a particular attitude toward normative behaviors.

The range of thinking about social norms extends beyond the ones presented here, but these views are representative. The views differ when it comes to the structure of norms, the content of norms, and, by implication, the cognitive capacities required for normative thinking—from the metacognitive ability to represent and follow rules in the case of Heath, to the mindreading ability to attribute to others beliefs about rule-following in the case of Bicchieri.

All these accounts of social norms require intellectualist cognitive capacities that many species may lack. Instead of adopting a definition of social norms that presupposes the mechanism, we can follow the tradition of the psychologists and biologists who are investigating the capacities of culture by offering an operational definition of social norm that is silent on mechanism. I have proposed that we can keep the spirit of the philosophical way of thinking about social norms but operationalize it as such: A social norm is to be identified by the existence of three elements: (a) There is a pattern of behavior demonstrated by community members; (b) individuals are free to conform to the pattern of behavior or not (the behavior is voluntary); and (c) individuals expect that community members will also conform, and will sanction those who do not conform (Andrews 2020). The pattern of behavior can be taken as a rule, given that individuals choose to conform and expect others to conform. The expectation that others conform can be taken as an attitude toward the pattern of behavior, as can sanctions in response to nonconformists. This account of what I call "animal social norms" is offered in the spirit of Bicchieri's account, but it lowers the cognitive requirements for participating in social norms, since it does not require the capacity to attribute mental states to others. This lowering of the cognitive bar is necessary if we are to examine how our kind of normative participation may have evolved from less cognitively demanding processes.

With such a definition in place, we can examine what sorts of social norms may exist in animal communities. Researchers have suggested that chimpanzees may have social norms dealing with infanticide (Rudolf von Rohr et al. 2011, 2015), treatment of infants (de Waal 2014), and distribution of resources (Brosnan et al. 2005, 2010).

Take infanticide, which, though rare among chimpanzees, sometimes occurs. Male chimpanzees might kill a female's infant in order to make the female fertile again, so the male can impregnate her with his own infant. Researchers have observed even unrelated females protesting by screaming, barking, and intervening when a male acts aggressively toward an infant.

Another example may be the treatment of infants, who are typically given a lot of freedom. Even high-ranking adult males will endure infants climbing on them, and stealing tools and food, and will self-handicap when playing with infants. While infants have this freedom, juveniles do not. De Waal describes the difficult transition:

> Youngsters go virtually unpunished for the first four years of life. They can do nothing wrong, such as using the back of a dominant male as a trampoline, stealing food out of the hands of others, or hitting an older juvenile as hard as they can. One can imagine the shock when a youngster is rejected or punished for the first time. The most dramatic punishments are those of young males who have ventured too closely to a sexually attractive female … Young males need only one or two such lessons. From then on, every adult male can make them jump away from a female by a mere glance or step forward. Youngsters thus learn to control their sexual urges, or at least become more circumspect about acting upon them.
>
> (de Waal 2014, 189)

Given the three criteria for identifying a social norm, infanticide avoidance and treatment of infants both appear to count. There is a pattern of behavior in place when it comes to what infants are permitted to do, and how adult males are permitted to interact with them, thus fulfilling the first condition. The behaviors are cognitively flexible actions, so they fulfill the second condition. Finally, violations of the pattern result in sanctions. In the case of males mistreating infants, the females will intervene to stop a possible infanticide incident. In the case of the infants, when they start growing up, they have to learn the new behavior pattern, and they are sanctioned for improper behaviors.

Another possible social norm may be found in communities of captive chimpanzees, who expect that human caregivers follow particular norms about feeding. Chimpanzees are able to understand whether a person is unable or unwilling to give them food, and will protest when a person who is able to give them food fails to do so, yet will not protest when the person is unable (Call et al. 2004). For example, if a person holds up a grape toward a chimpanzee and moves to offer it to the chimpanzee through a hole in a Plexiglass window, but then takes it away, the chimpanzee protests by banging on the window and then leaving the testing chamber. If the person leaves the room while the chimpanzee is still protesting, the chimpanzee reduces his protest display, suggesting that the behavior is dependent on the actor's presence. When an actor tries to put the grape through the hole but cannot because the hole is too small, the chimpanzee is comparatively calm.

The inequity aversion studies with chimpanzees and monkeys provide evidence that chimpanzees have developed norms regarding the distribution of food rewards, something like "equal pay for equal work" (de Waal and Brosnan 2003; Brosnan et al. 2005). In these studies, a pair of monkeys or chimpanzees are separated but can see one another, and an experimenter alternates giving each subject the same task (to return a stone). Each subject is rewarded for performing this easy task, but one receives a delicious grape for the work and the other receives a less valuable cucumber slice. For monkeys, the individual who receives the cucumber will protest and then stop working, but the partner monkey happily carries on working for grapes. For chimpanzees, the responses are more complicated. Depending on the relationship the chimpanzees have with their partner, they will behave differently. In some cases, the chimpanzee who gets the grape will also stop working, as if in solidarity.

Candidate chimpanzee social norms

In an examination of chimpanzee behavioral patterns that may qualify as social norms, Susana Monsó and I proposed the following list:

- Infanticide avoidance—chimpanzee females protest infanticide (Rudolf von Rohr et al. 2011, 2015; see Nishie and Nakamura 2018 for a description of the first observed case of a wild chimpanzee killing and eating an infant chimpanzee).
- Treatment of infants—chimpanzee infants enjoy permissive parenting for the first years of life, and are not punished by community members for any behavior. "They can do nothing wrong, such as using the back of a dominant male as a trampoline, stealing food out of the hands of others, or hitting an older juvenile as hard as they can" (de Waal 2014, 189).
- Helping—chimpanzees help conspecifics even when there is no direct benefit to self (Yamamoto et al. 2009). Male and dominant chimpanzees aid females and youth in road crossing (Hockings et al. 2006). Chimpanzees destroy hunting snares that can injure group members (Ohashi and Matsuzawa 2011). Gorillas have also been observed dismantling snares, and in one observation, juveniles worked together to destroy two snares just days after a snare had captured an infant member of their group. This report appeared in National Geographic:

> [T]racker John Ndayambaje spotted a trap very close to the Kuryama gorilla clan. He moved in to deactivate the snare, but a silverback named Vubu grunted, cautioning Ndayambaje to stay away, Vecellio said. Suddenly two juveniles—Rwema, a male; and Dukore, a female; both about four years old—ran toward the trap. As Ndayambaje and a few tourists watched, Rwema jumped on the bent tree branch and broke it, while Dukore freed the noose. The pair then spied another snare nearby—one the tracker himself had missed—and raced for it. Joined by a third gorilla, a teenager named Tetero, Rwema and Dukore destroyed that trap as well.
>
> (Than 2012)

- Food—chimpanzees share food with friends but not with non-friends (Engelmann and Herrmann 2016). Chimpanzees as well as other species have calls indicating the presence of food. Withholding such calls so as to monopolize the food resource has been observed in rhesus monkeys (Hauser 1992), capuchin monkeys (Di Bitetti 2005), and in chimpanzees (Hauser and Wrangham 1987). Violators of food call practices may be sanctioned by group members.
- Copulation rules—primates have strict rules about who copulates with whom. Juvenile chimpanzee males who venture too close to an estrus female risk being attacked by adult males (de Waal 2014); macaques will have sex more often when bystanders are not around, especially the alpha males (Overduin-de Vries et al. 2013); geladas engaging in extra-pair copulations are less likely to vocalize and more likely to copulate when the other pair-member is some distance away (le Roux 2013).
- Immigrant conformity—immigrant chimpanzees have been observed to modify their tool use to conform to the practices of their new community, even though the adopted practice is less functional than their original practice (Luncz et al. 2012; Luncz and Boesch 2014); vervet monkeys modify their food choices to conform to their new community, leaving untouched the food source they grew up with that is not subject to competition (van de Waal 2013).
- Arbitrary conventions—a female chimpanzee started wearing a straw-like blade of grass in her ear, and other chimpanzees began to do the same (van Leeuwen et al. 2014); a male capuchin monkey introduced hand-sniffing (mutual inserting of fingers in one another's nostrils or eye sockets) and tail-biting games, which spread through the community (Perry et al. 2003); chimpanzees prefer to open a puzzle box in the way demonstrated by higher-ranking group members (Horner et al. 2006).
- Inequity avoidance—preference for fairness or resistance to inequalities, such as gaining the same reward for the same work. Chimpanzees and monkeys refuse to participate in tasks upon witnessing another receiving a higher-valued reward (Brosnan et al. 2005, 2010; de Waal and Brosnan 2003). Chimpanzees in an ultimatum game make more equitable divisions after partner protests (Proctor et al. 2013).
- Cooperation—working together to achieve a joint goal, such as cooperative hunting in chimpanzees (Boesch 1994).
- Consolation—chimpanzees engage in higher levels of affiliation with a social partner after a conflict. They have been observed to console those who lose fights, reconcile after fights, and facilitate reconciliation between fighting parties (de Waal and van Roosmalen 1979; Kutsukake and Castles 2004; de Waal 2009).
- In-group preference—chimpanzees patrol boundaries between neighboring communities, sometimes invading and killing adult males and infants and kidnapping adult females (Watts and Mitani 2001; Watts et al. 2006).

(Monsó and Andrews, forthcoming)

8.3.2 Cooperation

Another recent proposal supported by a number of scientists is that human uniqueness stems from our hyper-cooperative nature. While chimpanzees and other animals may be able to work together upon occasion when their interests align, humans display a proactive sort of sociality such that we prefer cooperation over individual action. Even when we are alone, we are connected by agreements on how to act, laws and regulations. Typically, humans have been able to gather together in large masses without incident, on subways at rush hour, at busy airports, or parades.

Tomasello thinks that animals lack a distinctive sort of cooperation that humans have, namely that which involves joint intentionality (2005, 2016). On his account, true cooperation requires that the individuals working together share the same intention, understand that the other has the same intention, and have the intention *because* the other has it. Some behaviors might look like cooperation, such as when two individuals both want to acquire out of reach food and they have to coordinate rope pulling to access it, which apes and elephants will do. However, Tomasello suggests that this behavior may be more like two people showing up at the train station at the same time because they both want to get on the 3 pm train. They aren't doing it together; they just happen to have the same goal.

Michael Bratman offers a theory of joint intentionality that Tomasello has adopted in his own work (Bratman 1992). Bratman suggests that shared cooperative activity involves multiple agents supporting one another as they perform their role in the joint activity, and they all understand how to help one another so everyone fulfills their role.

Tomasello interprets Bratman as proposing that two individuals jointly intend only if they can understand that their perspective is just one possible perspective, and that another might share their perspective or have a different one. This ability allows cooperating individuals to take a third-personal perspective on the task, and see what needs to be done from a variety of perspectives. As Tomasello puts it, cooperation requires "[a]n understanding of role interchangeability suggest[ing] that the participating individuals conceptualize the collaborative activity as a whole from a 'bird's eye view…'" (Tomasello 2016, 53). From a bird's eye view, individuals are able to break the cooperative act into roles, and to understand that a variety of individuals could fulfill the same role. When two individuals both have this third-personal perspective, they can create a shared intention to fulfill some goal.

At this point, I suspect the reader will recognize that this account of joint intentionality, like the philosophical accounts of social norms, has high cognitive requirements. To understand one's own perspective *as a perspective* requires metacognition. To understand another's perspective requires a theory of mind or mindreading. As we've seen again and again throughout this book, mindreading and metacognition are commonly invoked as necessary conditions for some practices, including communication, teaching, predicting behavior, and now, cooperation. Yet, we are not sure that humans are using metacognition and mindreading when we are engaged in many of these same actions, and there remains debate about what exactly we mean by metacognition and mindreading. If humans need to take a third-personal perspective on the task to count as cooperation, then the three-year-old twins who plot to steal cookies from the kitchen are not cooperating, nor are the 89 authors on a physics paper. An application of the calibration method would have us refine our definition of cooperation at this point, rather than throwing out many of our starting views of cooperation.

Dennis Papadopoulos suggests that rather than require complex intellectual abilities, we might consider another account of cooperation offered by Margaret Gilbert (2009). On Gilbert's view, joint intentionality is grounded in establishing a normative commitment to act together based on a mutual communication of willingness to do so. Joint intentionality, and hence cooperation, requires a commitment that is communicated to one another such that we both expect each other to act toward some goal. The cognitive requirements for this account include the ability to communicate and understand one's own and other's goals, rather than their mental states. This account would also exclude two people showing up at the train station for the 3 pm train, unless they had previously had a conversation and arranged to meet there at 3 pm. The children who plan to steal cookies, and the 89 authors can all count as cooperating on Gilbert's account because communication creates expectations that we can rely on each other in order to achieve a shared goal. How about nonhuman animals?

Papadopoulos proposes that we take the natural behavior of apes to display joint intentionality along the lines of how Gilbert sees it (Papadopoulos in preparation). He offers the example of how bonobos are able to share territory with different groups. Unlike chimpanzees, who often war with neighboring communities, bonobo groups who cross paths while foraging may at first display apprehension, but they then begin a process of negotiation. The primatologist Gen'ichi Idani reports that female bonobos from one group will move toward the females of the other group, and engage in grooming and genital-genital rubbing. The interaction between females leads the males to relax as well, and the group members tolerate one another as they continue to forage together. Papadopoulos proposes that this case of the males following the females' lead in preserving a peaceful foraging situation serves as an example of joint intention. The males of both groups adopt an attitude of tolerance because the females are tolerant, and everyone has the goal of continuing to eat rather than to fight or flee.

These two ways of thinking about joint intentionality can help us to explain the debate between field researchers who report that chimpanzees cooperate and lab researchers who say they do not. The primatologist Christophe Boesch reports that chimpanzees will spend years learning how to work together to hunt monkeys (Boesch 1994, 2002, 2005). Tomasello argues that even when chimpanzees work together to secure food, they do not do it given a shared sense of "us" (Tomasello 2016). Sometimes the debate appears to be one about definitions more so than about cognitive mechanisms.

Even the data used to support the claim that chimpanzees lack shared goals can be questioned. Tomasello points out that when chimpanzees are given the opportunity to either work alone or with another chimpanzee, they choose to work alone while young children choose to work together (Rekers et al. 2011). Because children prefer to work together, Tomasello thinks that they are motivated by a shared goal. Because chimpanzees prefer to work alone, Tomasello thinks that they are not motivated by a shared goal, but rather by the reward.

One thing to notice is that human adults who prefer to work alone can still cooperate, and the chimpanzees in the study are primarily adults. It is hard to know what we should conclude from this study. Human cooperation comes in many varieties. It is also selective; we don't cooperate with just anyone, and we won't cooperate on any sort of task. Some humans will refuse to cooperate with out-group members. Some humans have a strong sense of autonomy and like to do things themselves no matter who the potential partner is. And there are some practices that do not lend themselves to cooperation—regular tooth brushing is one example.

An operational definition of "cooperation" is silent on mechanism and is the way we talk about human cooperation. Given that there are vast differences in kinds of human cooperation, from two children digging a hole together, to a criminal trading testimony for a reduced sentence, to scientific collaborators co-authoring a paper when they have never even met—a definition of "cooperation" in terms of mechanism is likely premature. At this stage of the investigation we can look to see whether animals act together to achieve a goal, to what extent they communicate and encourage one another, and whether they are careful in choosing partners.

With an understanding of cooperation in terms of realizing that another has a goal, and communicating one's goal, cooperation will be more common in animals than may have been thought.

Cooperative behaviors in apes and cetaceans

Chimpanzee infants coordinate rope pulling to access food (Crawford 1937; Hirata and Fuwa 2007).

Chimpanzees share food gained after hunting monkeys proportional to effort (Boesch 1994).

Chimpanzee dyads with strong social bonds cooperate to get food in an experimental setting (Melis et al. 2006).

Dominant male and infant chimpanzees coordinate lever pulling to access food, but others fail to work with dominant (Chalmeau 1994; Chalmeau and Gallo 1996a, b).

Chimpanzees share and coordinate tool use in order to gain access to food (Melis and Tomasello 2013).

Chimpanzees in long-term relationships share food and engage in grooming (Jaeggi et al. 2013).

Chimpanzees keep track of and tend to support past supporters (de Waal and Luttrell 1988).

Chimpanzee adults more likely to share food with individuals who have groomed them (Brosnan and de Waal 2002).

Chimpanzees, bonobos, and orangutans distinguish between true and false beliefs in their helping behavior; they infer a human's goal and help them achieve it (Buttelmann et al. 2017).

Two dominant male dolphins, but not subordinates, coordinate rope pulling to access and share food, and then synchronously interact with an emptied container (Kucsaj II et al. 2015).

Orcas share prey non-aggressively: Each takes a piece of prey and swims in opposite directions, tearing the meat (Guinet et al. 2000).

Male bottlenose dolphins form alliances that collaborate in securing consortships of females, competing with other groups to do so (Connor et al. 2000).

(From Vincent et al. 2018)

8.4 Culture and human uniqueness

At this point, it seems clear that it would be premature to conclude that cultural evolution is what makes humans unique. As we saw, the cognitive capacities supporting imitation, selective social learning, and teaching are apparent in other animals, and there is evidence for the kinds of cultural products that support learning rules for behavior, including social norms, and cooperation. Furthermore, there is evidence that other animals engage in high-fidelity social learning, niche construction, and that gene-culture co-evolution is apparent in other species.

For the three social learning strategies discussed earlier, it may be that we see them widely in animals—some animals imitate, they are selective about who to imitate and when to imitate, and in some cases models will make efforts to transmit knowledge and skill to naïve individuals. The difference between social learning in humans and all other animals might not be that they lack something that differs in kind, but that we have a greater variety of ways of teaching and things to teach than do other animals. But what does not follow from this difference in degree is the claim that animals are not also cultural species who rely on social knowledge to survive. In case after case, we have evidence that animals suffer from a lack of social learning opportunities just as many humans do. Like humans, many species of animals need socially transmitted information and skills in order to survive.

Keiko the killer whale was never able to be freed like the Willie he portrayed in the movies, because Keiko didn't grow up in his cultural community and he didn't learn what a young killer whale needs to know in order to survive. Similarly, an orangutan taken from their mother at three months and raised in an apartment building will not last long if released unprepared into a Bornean forest as an adult. Given the large number of orangutans orphaned due to human disruption, the Borneo Orangutan Society and other NGOs have created reintroduction programs that give orphans social learning opportunities in forest schools, so that young orangutans can learn how to be orangutans. Even with these efforts, rehabilitated orangutans frequently die from starvation or ingestion of toxic fruits (Russon 2009).

As scientists are discovering how many animal species rely on cultural knowledge, conservationists recognize how important this knowledge is for the survival of a species. For example, elephant herds who lose their matriarchs sometimes also loose cultural knowledge as to where important resources are, like waterholes that are only visited during times of drought. In a study that compared herds of elephants in Tanzania's Tarangire National Park, scientists found that the groups led by older females left the park during a year of extreme drought, and those led by younger females did not. The death rates were lower in the groups that left the park. The lead researcher of this study, biologist Charles Foley, told *The Telegraph*:

> Understanding how elephants and other animal populations react to droughts will be a central component of wildlife management and conservation … Our findings seem to support the hypothesis that older females with knowledge of distant resources become crucial to the survival of herds during periods of extreme climatic events…. It's enticing to think that these old females and their memories of previous periods of trauma and survival

> would have meant all the difference. The data seem to support the speculation that the matriarchs with the necessary experience of such events were able to lead their groups to drought refugia.
>
> (Eccleston 2008)

Similarly, South Africa's decision to cull elephant herds by killing adults in the 1980s and 1990s led to a disintegration of the herd's typical practices, so that they behaved in completely random ways when confronted with strange elephants or other species. The psychologist Karen McComb, who collected data on the different practices in these herds, told BBC news that her study "suggests that the breakdown in their social fabric, even though it occurred decades ago, has had a real effect on their decision-making processes" (Gill 2013).

In cultural species, it can take years to acquire the full range of cultural traits, requiring long-term transmission, especially from older individuals. Like the elephants, killer whales rely on knowledge and expertise of matriarchs who can live up to 90 years, which is 50 years after they stop reproducing. These females hold knowledge of salmon hunting grounds, and will lead their pods to unfrequented and far away food sources in times of scarcity; thus the presence of these females impacts the likelihood of survival of their adult offspring (Brent et al. 2015; Mann and Karniski 2017).

Like human explorers who died because they never learned how to process cassava, many animals also need cultural knowledge to survive. One question that remains is whether other animals, like humans, have created niches that have generated new contexts for biological adaptation. It may still be that only humans have the kind of genetic inheritance that is so durable that it has impacted the genetic structure of the species. Recall that in humans the examples of gene-culture co-evolution include developing an adaptation to milk in herding societies and anti-malarial adaptations in farming societies. In a review of the data on great apes, cetaceans, and canids, the psychologists Adam Bebko, Krista Phillips, and I found evidence of processes similar to these adaptations in other species (Bebko et al. in preparation). For example, there are a number of groups of Canadian wolves who have different prey specializations, and these differences reflect genetic differences presumed to be a result of the prey selection. For example, marine-specialized wolves in British Columbia have a genetic tendency to be smaller and have misaligned teeth compared to other Canadian wolves; this is thought to be due to their reliance on smaller prey such as salmon and snails rather than large prey such as moose. However, wolves who eat salmon are at risk of salmon-poisoning disease, which can be fatal. To protect against the disease, the marine-specialized wolves only eat the salmon heads, and avoid the body despite its high nutritious value given that the risk of infection is greater when eating the kidney and muscle tissue (Darimont et al. 2003). Wolves from other communities do not share this practice, and salmon-poisoning disease is blamed for the loss of wolves from the state of Oregon (Darimoxnt et al. 2003).

Similarly, Bebko et al. discuss how the fish-specialized and the mammal-specialized killer whales in coastal British Colombia engage in different practices related to their prey specializations which appear to have had a genetic impact. The two have different genetic adaptations relating to their methionine cycle, which reflect the different amounts and consistency of dietary protein due to cultural specializations (Foote et al. 2016). We argue that this genetic difference is like the genetic difference due to herding practices and milk consumption in some human populations.

Rather than taking cultural practices as something unique to humans, we have seen that all the elements of culture are seen to some extent in other species. Human culture is different from animal cultures in many ways. We have an advanced technological culture unlike any other species. We likely have a greater number of cultural practices than other animals. We have cultural practices that stay the same over long periods of time, but also cultural practices that change continuously and rapidly. We have meta-cultural practices of short-term trends for certain clothes, ways of speaking, toys, music, etc. While it may be that we also have a unique set of capacities that permits the generation of novel cultural practices, current evidence doesn't support that conclusion. While these are areas for further investigation, I suspect that we will continue to find differences in degree rather than differences in kind when it comes to human and animal cultures. Perhaps the degree of cultural entrenchment humans have is due to something as simple as the length of time we've had cultural practices, and if we allow other animals to continue to evolve unimpeded by human development and interference, we will see other animal cultures evolve into societies with more cumulative cultural products and a greater degree of gene-culture co-mingling.

8.5 Chapter summary and conclusions

In this chapter, we examined the concepts and science related to culture in animals. A cultural community is one in which individuals learn from each other, resulting in behavioral patterns that differ from those of other groups. At the same time as scientists have started finding evidence of culture in animals, theorists have proposed that culture is what makes humans unique. This suggests that there are different ways of thinking about culture. One proposal is that only humans have cumulative culture, or the incremental improvement of cultural products over generations. Another proposal is that only humans have gene-culture co-evolution, such that our cultural practices create new niches that cause new selection pressures and ultimately impact genetic evolution. These proposals have been supported by examining the cognitive mechanisms involved in cultural transmission, as well as by examining the sorts of practices and products we see in human cultures compared with animal cultures.

It is widely agreed that culture requires social learning, and learning theorists have identified a number of different types of social learning. We considered three types of social learning: Imitation, selective social learning, and teaching. Imitation in animals has been controversial, despite the popular notion that many species like to copy what others do, and that apes ape. This might be due to the way imitation is defined by scientists, such that it requires a careful and precise copying of the way an actor performs an action. Imitation is compared to emulation, which refers to using information from a model to find out how an object works, and has lower fidelity than imitation. While there remain debates about whether other animals imitate or emulate, experiments using ghost conditions in which an invisible actor serves as the "model" have found that apes are slower at learning to open a puzzle box in the absence of a real demonstrator. However, experiments on overimitation have largely failed to find evidence that chimpanzees and bonobos will copy irrelevant actions if demonstrated by a human. This is in contrast to young children, who tend to copy silly actions that are demonstrated to them. However, I suggested that the claim that apes do not overimitate is premature, given the second cognitive capacity discussed, namely selective social learning. Humans won't learn from just anyone, and children won't copy just anyone. There is evidence of learning strategies in many species of animals. We considered the possibility that apes may not overimitate humans because they are not the right kind of model. Because selective social learning is widespread, methodological challenges for scientists conducting research arise; if a subject doesn't learn some task, it might be that the task wasn't taught by the right person or in the right kind of way. Humans are selective about who they learn from, when they learn, and what they learn. We have reason to think animals are also selective in at least these ways.

Teaching is another kind of social learning that has been a topic of much interest. We used the standard definition of teaching as a practice with three conditions: (1) An individual, A, modifies their behavior only in the presence of a naive observer, B; (2) A incurs some cost or derives no immediate benefit; and (3) as a result of A's behavior, B acquires knowledge or skills more rapidly or efficiently than they would otherwise. While there are no formal educational systems in animal communities, we do find evidence of facilitative teaching, or teaching by apprenticeship, in which a knowledgeable member of the community breaks down the task, or otherwise alters the difficulty level, to help naïve individuals scale up to the full behavior. Meerkat scorpion processing and tandem ant running are two oft-cited examples of teaching in animals, and while teaching does not appear to be a widespread practice, with further investigation scientists may find it to be more common than presently thought. Given that many of these behaviors should express themselves more in natural communities than in lab settings, and field research is time-consuming and the science moves more slowly, more time is needed before we draw conclusions about the relative frequencies of teaching in other species.

When we turned to look at the kinds of cultural products we see in animal cultural practices, we noted first of all that material culture, such as tools and methods of food processing, is quite common. Nonmaterial cultural products, including nonfunctional behaviors (i.e. those that don't directly impact biological fitness) and social norms, are less studied, though there is preliminary evidence of these in nonhuman animals. Furthermore, there are questions about whether any other animal engages in the specific cultural practice of cooperation. Among those who propose culture as a way of understanding what makes humans unique, social norms and cooperation are two key proposals.

We saw that by "social norms," philosophers have tended to provide definitions that specify cognitive mechanisms. We adopted a definition of social norms that lowers the cognitive requirements substantially by identifying an animal social norm as: (a) A pattern of behavior demonstrated by community members; (b) individuals are free to conform to the pattern of behavior or not; and (c) individuals expect that community members will also conform, and will sanction those who do not conform. We looked then at three possible social norms in chimpanzees: Prohibition against infanticide, permissiveness toward infants, and fairness.

Next, looking at cooperation, we saw that definitions of cooperation given in terms of joint intentionality, which requires metacognition and theory of mind, might also place too high of a cognitive requirement on the concept. It would exclude many human behaviors as cooperative. Instead, we considered an account of cooperation in terms of joint intentionality and the ability to communicate a commitment to working together on a shared goal. Given this definition, we are able to include many animal practices as cooperative, such as joint hunting. We also noted that there are many kinds of cooperation among humans, and future research might be facilitated by thinking about these varieties of cooperation.

We returned to the question of human uniqueness at the end of the chapter. The way I have presented the culture literature and animal data supports the view that we cannot identify a difference in kind when it comes to culture or cultural evolution. Like humans, many species rely on cultural knowledge and social learning in order to survive. Animal technologies that are learned, from nest building to singing to knowing where to find water in times of drought, are all cultural products that evolved over generations, and exist today only because of the successes of their ancestors. It is not only humans who can see further by standing on the shoulders of giants.

Further reading

Social learning

Heyes, Cecilia. *Cognitive Gadgets*. Cambridge: Belnap Harvard, 2018.
Laland, Kevin. "Social Learning Strategies." *Animal Learning & Behavior 32, 1* (2004): 4–14.
Sterelny, Kim. *The Evolved Apprentice: How Evolution Made Humans Unique*. Cambridge: MIT Press, 2012.
Thornton, Alex, and Nichola J. Raihani. "Identifying Teaching in Wild Animals." *Learning & Behavior 38, 3* (2010): 297–309.

Animal cultures and innovation

Brown, Rachael. "Animal Traditions: What They Are, and Why They Matter." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 362–371. New York: Routledge, 2018.
Goodrich, Grant. "Varieties of Culture." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 354–361. New York: Routledge, 2018.
Laland, Kevin, and Vincent M. Janik. "The Animal Cultures Debate." *Trends in Ecology & Evolution 21, 10* (2006): 542–547.
Laland, Kevin, and Bennet G. Galef. *The Question of Animal Culture*. Cambridge: Harvard University Press, 2009.
Ramsey, Grant. "Culture in Humans and Other Animals." *Biology & Philosophy 28* (2013): 457–479.
Ramsey, Grant. "What is Animal Culture?" In *The Routledge Handbook of Philosophy of Animal Minds*, edited by K. Andrews and J. Beck, 345–353. New York: Routledge, 2018.
Reader, Simon, and Kevin Laland. *Animal Innovation*. New York: Oxford University Press, 2003.
Whitehead, Hal, and Luke Rendell. *The Cultural Lives of Whales and Dolphins*. Chicago: University of Chicago Press, 2014.

Cultural evolution

Henrich, Joseph. *The Secret of Our Success: How Culture Is Driving Human Evolution, Domesticating Our Species, and Making Us Smarter*. Princeton: Princeton University Press.
Jablonka, Eva, and Marion J. Lamb. *Evolution in Four Dimensions, Revised Edition: Genetic, Epigenetic, Behavioral, and Symbolic Variation in the History of Life*. Cambridge: MIT Press, 2014.
Laland, Keith. *Darwin's Unfinished Symphony*. Princeton: Princeton University Press, 2017.
Richerson, Peter, and Richard Boyd. *Not By Genes Alone*. Chicago: University of Chicago Press, 2004.

9 Moral minds

In December 2013, the Nonhuman Rights Project filed a petition for a common-law writ of habeas corpus in the New York State Supreme Court on behalf of Tommy, a 26-year-old chimpanzee living alone in a cage in a shed in rural New York. Tommy had been a child actor, but was living out his retirement in solitary confinement. While this might sound like a terrible situation for Tommy, no laws were broken, so the Nonhuman Rights Project couldn't appeal to animal welfare considerations to have him released. Instead, they used the legal tool of habeas corpus, which offers protection for persons who are confined arbitrarily. A successful petition would bring the confined person to court and allow the judge to decide if the confinement was justified or not. Soon after filing the petition on behalf of Tommy, petitions were also filed for Kiko, another chimpanzee housed alone in Niagara Falls, and Hercules and Leo, two chimpanzees held in research facilities at Stony Brook University. Since the initial petition, many judges and courts have heard the argument that Tommy, Kiko, Hercules, and Leo should be granted a habeas corpus hearing because they are persons. Time after time, the judges decided that chimpanzees cannot be bearers of legal rights because they are not persons. Since every being has a legal status of either a person or a thing, these chimpanzees have been deemed mere things.

Since the petitions were unsuccessful in getting a hearing for a chimpanzee, the Nonhuman Rights Project decided to appeal to the New York Court of Appeals. I was part of a team of 17 philosophers who wrote an amicus brief in support of legal personhood for animals (Andrews et al. 2018a). While the appeal was unsuccessful, one of the judges, Judge Eugene M. Fahey, wrote, in a consenting opinion, on the moral injustice inherent in the situation:

> The better approach…is to ask not whether a chimpanzee fits the definition of a person or whether a chimpanzee has the same rights and duties as a human being, but instead whether he or she has the right to liberty protected by habeas corpus…Does an intelligent

> nonhuman animal who thinks and plans and appreciates life as human beings do have the right to the protection of the law against arbitrary cruelties and enforced detentions visited on him or her? This is not merely a definitional question, but a deep dilemma of ethics and policy that demands our attention. To treat a chimpanzee as if he or she had no right to liberty protected by habeas corpus is to regard the chimpanzee as entirely lacking independent worth, as a mere resource for human use, a thing the value of which consists exclusively in its usefulness to others. Instead, we should consider whether a chimpanzee is an individual with inherent value who has the right to be treated with respect… The reliance on a paradigm that determines entitlement to a court decision based on whether the party is considered a "person" or relegated to the category of a "thing" amounts to a refusal to confront a manifest injustice. Whether a being has the right to seek freedom from confinement through the writ of habeas corpus should not be treated as a simple either/or proposition. The evolving nature of life makes clear that chimpanzees and humans exist on a continuum of living beings. Chimpanzees share at least 96% of their DNA with humans. They are autonomous, intelligent creatures. To solve this dilemma, we have to recognize its complexity and confront it…The issue whether a nonhuman animal has a fundamental right to liberty protected by the writ of habeas corpus is profound and far-reaching. It speaks to our relationship with all the life around us. Ultimately, we will not be able to ignore it. While it may be arguable that a chimpanzee is not a "person," there is no doubt that it is not merely a thing.
>
> (Fahey 2019)

Fahey's opinion raises the question of whether chimpanzees have inherent value, whether they deserve respect, and whether they should be protected against being treated as mere resources. If they do, then chimpanzees *matter*; they have value and should be considered *moral patients*. Any being that matters in this sense is owed moral consideration by *moral agents*, those who can be held morally responsible for their actions. Fahey suggests that while one way of arguing that animals matter is to have them deemed persons, there are other ways.

In this chapter, we will turn to the questions of how animals matter, and whether animals are moral agents, or something like it. Both questions can be illuminated by the issues discussed so far in the book. When we see that other animals are conscious, rational beings with social relationships, we are confronted with the possibilities that animals matter, and that they might be moral agents themselves.

The issue of animals as considerable, as individuals who are moral patients or who matter, is a traditional subject in animal ethics, and of growing interest in political philosophy. First, I will introduce some of the ways in which philosophers have argued that animals matter morally and politically. One set of approaches involve looking at the particular capacities of animals. This way of thinking is often divided into utilitarian views that emphasize animals' ability to feel pain, and deontological views that emphasize animals' status as rational beings. Utilitarians argue that animals matter because they are sentient and can feel pain. What matters morally on this view is the ability to suffer—experience negative affective sensation. On deontological views, we can argue that animals matter because of the cognitive capacities they have. What matters morally on these views is being a certain kind of individual, such as a person or a subject-of-a-life.

Both utilitarian and deontological approaches are anthropocentric, and take as a starting position the fact that humans are valuable. Another way to approach the issue of what matters is to consider how relationships create value, and to develop and use moral imagination to see how different kinds of beings participate in lives of significance, even if they are very different from our own. Relationships can be the source of value, and beings in relationship merit respect. Such approaches are used to show that we have moral and political obligations toward other animals.

I hope this whirlwind tour will inspire students to read more deeply into these and other theories about the value of animals. Here, we will focus on the kinds of psychological and social properties these approaches propose as sufficient for mattering.

We will then turn to look at different sorts of questions about animals and ethics, namely whether animals might also be moral agents, or something like it. Much of this discussion rests on whether animals have the capacities necessary for making moral judgments or engaging in moral practices. In recent years, number of philosophers have argued that moral participation is not human-unique. For example, Mark Rowlands argues that animals can track moral truths and hence be moral subjects—a kind of intermediary between moral patients and moral agents (Rowlands 2012). Susana Monsó argues that the cognitive requirements for being a moral agent are much lower than typically thought, and that a moral agent needs only the capacity to recognize and respond to the behavioral manifestations of another's negative emotion; one doesn't need to be a mindreader to comfort someone in distress (Monsó 2015). In contrast, other philosophers offer arguments against moral agency in nonhuman animals. These arguments, which tend to focus on a familiar requirement for moral agency, namely being able to represent and consider the morality of the rules that one follows, require metacognitive and conceptual capacities that are likely beyond the abilities of any animal. Christine Korsgaard (2006, 2018) and Philip Kitcher (2011) offer arguments along these lines. We will review a sample of these arguments.

Simon Fitzpatrick argues that the debate between these two camps is largely terminological and non-substantive (Fitzpatrick 2017), and that focusing on the nature of moral agency is likely to be unproductive if our hope is to understand how animals are similar to and different from us. I am largely sympathetic to Fitzpatrick's analysis, and have argued that while having moral agency and acting in accordance with the moral facts describes one way of participating in a normative world, having social norms and normative cognition describes another, more fundamental way (Andrews 2020).

Normative cognition is required on all approaches to the practice of morality because it is the capacity to think about *oughts.* Though normative cognition is likely not sufficient for moral participation, it is necessary; to take a moral stance toward the world, whether one is calculating likely outcomes or following laws, is to have a kind of ought-thought. To better understand the evolution of moral practice, we can first uncover the elements of normative thinking and then examine how widespread those elements might be in the animal kingdom.

At the end of the chapter, we will look specifically at questions of moral psychology in animals, and in particular whether animals have moral emotions such as empathy, and moral concepts such as fairness. We will also look at properties found in human moral practices across cultures and ask whether such properties are also found in animal practices. I conclude that our current knowledge of animal social and psychology properties suggests that there is no clear line between humans and other animals when it comes to moral participation.

9.1 Why animals matter

To say that someone matters is to say that they are of value in and of themselves, not merely because someone else values them. When we say that animals matter, we mean that they merit attention; we need to consider and appreciate animals when deciding how to act.

Knowing that someone matters doesn't entail we know how to treat them. Humans matter, but it is an open question whether we should give all humans free medical care, or whether it is acceptable to allow terminally ill people to end their lives. The conclusion that animals matter only tells us that we are obligated to think about how our actions impact them, for their own sake.

We will look at three arguments that can be made for animals mattering, in terms of their sentience, their personhood, and their participation in relationships. The first two of these arguments focus on the individual properties of animals, and they are associated with traditional ethical theories of utilitarianism and deontology. The last argument focuses on relational properties of animals and versions are found within feminist ethics and political theory.

9.1.1 Sentience

Sentience is deemed sufficient for mattering morally on a number of ethical approaches. Perhaps most famously, sentience is of primary concern for utilitarians. Utilitarianism is an ethical theory that instructs us to maximize pleasure and minimize pain for all sentient beings, that is, beings capable of feeling pleasure and pain. For a utilitarian, insofar as animals are sentient, they matter.

From the beginning, utilitarians argued that animals are morally considerable. In the 19th century, Jeremy Bentham, who first proposed the theory, argued that animals matter:

> The day *may* come when the rest of the animal creation may acquire those rights which never could have been witholden from them but by the hand of tyranny… It may one day come to be recognised that the number of the legs, the villosity of the skin, or the termination of the *os sacrum* are reasons equally insufficient for abandoning a sensitive being to the same fate. What else is it that should trace the insuperable line? Is it the faculty of reason or perhaps the faculty of discourse? But a full-grown horse or dog, is beyond comparison a more rational, as well as a more conversable animal, than an infant of a day or a week or even a month, old. But suppose the case were otherwise, what would it avail? The question is not, Can they *reason*? nor, Can they *talk*? but, Can they *suffer*?
>
> (Bentham 1879, Ch 17)

Bentham thinks that it is the capacity to feel pain (and pleasure) that is required for moral standing, and since animals can suffer, they are morally considerable. What follows is that when we act, we have to consider how our actions might cause pleasure and pain not only in other humans, but also in the cats and dogs, and cows and pigs, and pigeons and rats who may be impacted. The suffering of a rat dying from dehydration after getting stuck in a glue trap is morally relevant, as is the suffering of a human who has rats living in the garden. From this, it doesn't follow automatically that we cannot kill the rats. Rather, in order to determine whether *in this instance* it is morally acceptable to kill rats, we have to do the utilitarian calculation and take into account the pleasure and pain of all impacted sentient beings. For example, one may argue that a painless poison is morally acceptable on a utilitarian calculus, but glue traps are not.

To be morally considerable on Bentham's classical utilitarian account, then, is to be a conscious or sentient being who can feel pleasure and pain. As we saw in Chapter 4, it is likely that many species of animals feel pleasure and pain, so they all would matter morally.

In modern times, utilitarians have offered a variety of views about what counts as good consequences. For example, Peter Singer, whose book *Animal Liberation* is credited with initiating the animal rights movement, has defended a version of utilitarianism called "preference utilitarianism" according to which desire, or preference satisfaction, is the end goal. We are happy when we fulfill our preferences, and we suffer when we fail to do so. Preference utilitarianism adds morally relevant cognitive capacities to the classical utilitarian view, namely the mental states of preference or desire. An implication of this view is that an animal who can only feel pain and pleasure, but who does not have desires may well have a lower score on the preference utilitarian's scale than an animal who can feel pain and pleasure, and who also has preferences (even if they are preferences that cannot impact their happiness, such as the preference to be burned rather than buried after death). However, what remains relevant for the preference utilitarian is the capacity for sentience. That's what matters.

Why does being sentient make one matter? One of the earliest presentations of the argument for sentience mattering comes from the 8th-century Buddhist philosopher Śāntideva, who wrote in *The Bodhicaryāvatāra*:

> VIII.94. I should dispel the suffering of others because it is suffering like my own suffering. I should help others too because of their nature as beings, which is like my own being.
> 95. When happiness is dear to me and others equally, what is so special about me that I strive after happiness only for myself?
> 96. When fear and suffering are disliked by me and others equally, what is so special about me that I protect myself and not the other?
>
> (Goodman 2016)

Here, Śāntideva presents his view that we ought to consider others' suffering and happiness because, just as my suffering and happiness matter to me, your suffering and happiness matter to you. Furthermore, since there is no difference in the nature of being between me and you, on pain of contradiction, your suffering and happiness should matter to me, too (Śāntideva 1995).

Buddhists like Śāntideva apply this reasoning not just to other humans, but to animals as well. We all care about our suffering and happiness, and we are all in this together.

The first argument for animals mattering can be stated as such:

1 All sentient beings matter.
2 Animals are sentient.
3 Therefore, animals matter.

9.1.2 Persons or subjects-of-a-life

Being a person is sufficient for mattering morally on a number of views. Persons matter, if anything does. The term "person" is imbued with normativity, which raises the question of what counts as a person.

A quick first response might be to say that a person is a human. However, science fiction challenges us to think of nonhuman persons such as Luke Skywalker, half-human persons such as Spock, and mutant persons such as Iceman, Angel, and Beast. Science also challenges the view that "person" means "human," because while the Neanderthals were ancestors to many humans, they were not humans, but they were persons. PERSON and HUMAN are two very different concepts. "Human"—*homo sapiens*—is a biological term that helps us to identify populations. "Persons" is a normative term. Persons—those who have feelings, work toward achieving goals, enjoy good and bad relationships, make plans, and think about what to do next—matter, even if they are not humans, and even if they lack some of our biological and psychological characteristics.

While we can draw a distinction between the concept PERSON and HUMAN, some philosophers have found it useful to try to understand what makes humans matter in order to understand what makes anything matter. We can consider human rights, the familiar idea that certain protections are afforded to all humans regardless of their race, gender, sexuality, ethnicity, and also regardless of their cognitive or physical capacities. Starting with this understanding, Tom Regan asks the following question: What justifies giving all humans these rights? (Regan 2004). It can't be rational agency, because we grant human rights to humans who lack full-blown rational agency, such as children, and adults with dementia or certain cognitive deficits. We can't justify human rights on the basis of biology, because that would be an arbitrary way of drawing the line, and a blatant example of speciesism, which is as unjustifiable as racism or sexism. Rather, Regan thinks that what grounds rights for all humans is that they are subjects-of-a-life.

Subjects-of-a-life are individuals who have inherent value and as such are due respect. In contrast to utilitarian views, according to which individuals are merely creators of positive and negative emotions that have value, Regan argues that humans and all other subjects-of-a-life are themselves valuable. The kind of value that subjects-of-a-life have requires that they have rights that are commensurate with their cognitive capacities. It also requires that they have rights not to be used as a mere resource for others. For example, I have the right not to be killed, even if killing me would save five other people.

While Regan tells us that a subject-of-a-life is what has moral value, what counts as being a subject-of-a-life remains a bit unclear. A subject-of-a-life has to have some kinds of cognitive capacities, but which ones? Using Regan's methodology of starting with what makes humans valuable, we might conclude that one needs typical human cognitive capacities, including beliefs and desires, rationality, episodic memory, theory of mind, and metacognition. If subjects-of-a-life need the ability to see themselves as a subject-of-a-life, with a past and a future, and with preferences and plans, then many animals likely don't count. However, given such a high bar, many humans wouldn't count either. Not all of us are typical.

A subject-of-a-life may turn out to be a synonym for a person, which leaves us with the question we started with. What makes someone a person? This is an old question in philosophy, and philosophers have generated many proposals. In our amicus brief supporting the Nonhuman Rights Project, my colleagues and I identified ten capacities that often show up in the literature (Andrews et al. 2018b). These are:

Sentience—consciousness or basic awareness
Emotions—such as happiness, empathy, sadness, anger, and fear
Autonomy—the ability to act on one's own behalf, to exercise control over creating goals and achieving them
Self-awareness—the ability to reflect on one's own mental life
Sociality—the ability to be in relation with others
Language—the ability to communicate with others and to put one's own thoughts into words
Rationality—the ability to engage in means-end reasoning or logical thought
Narrative self-constitution—the ability to create oneself in terms of the subject of a story with a past and a future
Morality—the ability to understand what is good, right, or virtuous
Meaning-making—the ability to create a vision of a life worth living

What does it mean to say that these capacities are relevant to personhood? It could mean that they are all jointly necessary for personhood. That requirement would exclude many humans as well as animals from being morally considerable, since from birth to death humans tend to gain and loose some of these capacities, and some humans never gain some of them. It would also be difficult to judge because many of these capacities come in degrees or exist in only limited domains. For example, an animal may only act rationally in tool use, but not in social contexts. Is that enough to count as rational?

Another possibility is that each of these capacities is alone sufficient for moral standing. That requirement would be very inclusive, given that every social animal would qualify, any conscious robot, and any solitary creature who experiences emotion. But it might include too much. If anything that is in relation with another is a person, then perhaps a beloved stuffed animal would count too.

In light of these considerations, my colleagues and I defend a cluster conception of personhood, according to which personhood comes from having some of these traits, but no single one is required. Any number of subsets of capacities would be sufficient for moral standing. What follows is that there are different personhood profiles. Cluster conceptions of social kinds are pretty familiar. We think that there are different ways of being a man, a woman, a teacher, or a student. Likewise, there are different ways of being a person.

For example, the personhood profile of a three-year-old child may rate low on morality, language, and autonomy, but high on sociality and emotions. The personhood profile of an adult chimpanzee, in contrast, would rate high on emotions, autonomy, sociality, and rationality, but even though they pass the mirror self-recognition task, we don't have evidence that chimpanzees form the kind of self-conceptions that typical adult humans do. Likewise, while chimpanzees have communication systems that include gestures and vocalizations, there is no evidence that any of these systems has a grammatical structure or the kind of productivity we see in human languages. Thus, chimpanzees would score lower in these two dimensions.

Cluster conceptions of personhood capacities are also quite inclusive. Among persons, we will find all humans and many different species of animals. As our cluster conception is not limited by biological requirements, persons might include a future generation of robots like Erica, the Japanese aspiring newscaster we met in Chapter 1. The cluster conception also makes sense of our intuition that a message picked up from space, even if its content is just a very long list of prime numbers, was sent by some alien person.

The cluster conception of personhood is unapologetically anthropocentric. Like Regan's approach, our approach was to take the properties deemed relevant to human personhood, and then ask to what extent these properties exist in other species. We take personhood to be sufficient for moral standing, but not necessary. There may be other kinds of beings who lack personhood but who are still morally considerable. The analysis does give us another argument for the moral considerability of at least some animals:

1 [Some] animals are persons.
2 All persons matter.
3 Therefore, [some] animals matter.

9.1.3 Relationships

A different approach to see how animals matter looks at the kinds of relationships they enjoy. All sexually reproducing animal species are social, and some have relationships with both conspecifics and heterospecifics. If you have ever gone diving or snorkeling on a reef, you may have noticed how many different species of fish interact with one another—young parrotfish swim with a school of grunts, cleaner fish nibble on the teeth of groupers or the backs of turtles.

Just as animals have relationships with one another, we have relationships with other animals. Whether they are the cats, dogs, rats, and snakes who live with us as pets, or the feral cats, dogs, rats, and snakes who share our property, the birds we feed, the raccoons we try to keep out of our garbage, the deer who eat the lettuce in our garden, the farm animals we raise for food, the entertainers who perform in Hollywood or in circuses, or the wild animals whose habitats we actively protect or cut down, we are in relationships with the animals around us.

For some philosophers, these relationships challenge the individualism and anthropocentrism inherent in the capacities approaches to mattering, which all share an expanding circle approach. The idea of the expanding circle is that at the center is a set of people already deemed valuable, be it oneself or members of a certain group, and then others get to be included via an expansive exercise of seeing how others are similar to those at the center. What remains in the center is the undisputed value, and the sameness to the center is what makes others matter. Lori Gruen argues that there are two main limitations with these approaches: Such reasoning misses out on what is distinctively valuable about the differences, and it fails to recognize that individuals are co-constituted by their relationships (Gruen 2015). Learning the skill of moral perception permits us to practice what Gruen calls *entangled empathy*, which means we respond to another's condition and engage in acts of imagination to try to discover what it is for that individual to be in that condition, all the while keeping track of our similarities and differences.

These kinds of relationships permit another way of seeing what makes beings matter. For example, Elizabeth Anderson argues that "Moral considerability is not an intrinsic property of any creature, nor is it supervenient on only its intrinsic properties, such as its capacities. It depends, deeply, on the kind of relations they can have with us" (Anderson 2004, 289). What matters is being in relationship, and the observation that we are already in relation with other animals shows how they matter.

Sue Donaldson and Will Kymlicka examine our relationships with animals from the perspective of political theory (2011). Our actions impact other animals, just as their actions impact us, and so we are engaged in different kinds of political relationships with other animals. Domesticated animals, who we created by capturing wild animals and breeding them for hundreds or thousands of years, should be given citizenship status and a right to share the benefits of citizenship. Wild animals should be granted sovereignty over their habitats and bodies. And the non-domesticated animals that live in our cities and among our homes should be granted denizen status, which gives them the right to live among us without risking extermination. While on this view, animals' psychological features must be taken into account in order to determine how to treat them as either a citizen, a sovereign, or as a denizen, it is their relationship to us, not their psychological makeup, which grants them the rights under these categories. What these rights will be depends on the various species' interests, needs, or preferences.

The idea that animals' moral standing comes from our relationships with other animals asks us to take a step back from thinking of humans as the paradigmatic moral being, and instead to look at the world with fresh eyes that permit us to see how things matter in ways very different from what we learned at our parents' knees. This reimagining can lead us to see animals not just as mattering morally, but as themselves engaged in moral practice of their own sort, and we will turn to that topic next. But first let us state the final argument for why animals matter based on being in relationship:

1 Animals are in relationship.
2 Any being in a relationship matters.
3 Therefore, animals matter.

Being in a relationship matters, because you matter to the other and they matter to you. To be in a relationship is to be the kind of being that creates mattering, and hence value.

The aforementioned three arguments present reasons for thinking that animals matter. Together, they offer overwhelming evidence that we need to be concerned with animals and how our actions impact them. Once we conclude that animals matter, it would be immoral to conclude that we don't have to worry about our treatment of animals because they are not human. Speciesism, or discriminating against individuals based solely on their species membership, is a moral failing. How we should morally relate to our fellow creatures is beyond the scope of this book. If you have questions about what might follow from animals being morally considerable, such as whether it is ever morally permissible to eat animals or their products, raise them on factory farms, keep them in zoos, build roads through their territories, develop their land, or use them in medical experiments, you will find rich discussions of these topics in the texts listed at the end of this chapter.

9.2 Animal moral participation

Newspaper headlines will sometimes describe animals as heroes. In May 2014, when CCTV cameras in California captured a four-year-old child attacked by a neighborhood dog and rescued by the child's family cat, newspapers praised the cat's act.[1] Across the world a few months later, a monkey was observed saving the life of another monkey who had been electrocuted after walking on electric wires at an Indian train station. You can see a video of the monkey trying to revive the unconscious monkey by rubbing, hitting, biting, and dipping them in water until, the victim finally showed signs of life.[2]

Between videos like these and growing scientific evidence about animal cognition, emotion, and culture, people have started to ask whether animals, like us, might be participants in a moral system. Some philosophers explicitly argue that morality is unique to humans, because moral agency requires capacities that are only demonstrated in our species, such as self-awareness, reflective scrutiny, the capacity to construct and act according to rules, normative self-government, or moral concepts (Dixon 2005; Kitcher 2006; Korsgaard 2006, 2018). Others argue that some animals can participate in morality because they have a rudimentary form of these capacities (DeGrazia 1996), or because they are moral subjects whose emotional reactions reliably track objective moral facts (Rowlands 2012).

We will approach the question of animal morality in two kinds of ways. First, in Section 9.2.1, we will look at the question of whether animals might be moral agents from within the perspective of moral theories. While this discussion may be helpful, the approach suffers from a lack of agreement on the correct moral theory.

We will then turn to take another approach in Section 9.2.2, which I think is more helpful for discovering the varieties of ways in which humans and perhaps other animals may be participating in a normative world. Normative cognition, or thinking in terms of oughts, is necessary for moral practices such as critiquing or justifying group norms. Just as a study of the evolution of language will not fruitfully begin with an analysis of hip hop, a study of the evolution of morality should not begin with an analysis of whether animals are moral agents on different moral theories. To understand the evolution of morality, and where animals might be in the practice of morality, we can look to see what are the capacities of normative cognition, and what evidence there is that animals have those capacities.

After providing evidence that animals have naïve normativity, we can turn to look at three additional ways of approaching animal moral participation from the perspective of moral psychology. In Section 9.2.3, we will look at moral emotions of care, and in particular empathy.

In Section 9.2.4, we will look at moral concepts of fairness and norms, and in Section 9.2.5, we will ask whether other animals also demonstrate evidence of a set of dimensions of morality that have been identified in humans across cultures. While we only have time for a brief introduction of these topics here, I hope to have at least made plausible the idea that there is a continuity of moral practice between humans and other animals.

9.2.1 Moral agency

As usually understood, a moral agent is someone who can be held responsible for their behavior, and whose behavior can appropriately be judged morally acceptable or not. But good behavior does not make a moral agent; a robot programmed to be good is not going to count. Consider a robot programmed according to the science fiction author Isaac Asimov's three laws of robotics:

i A robot may not injure a human being or, through inaction, allow a human being to come to harm.
ii A robot must obey the orders given to it by human beings, except where such orders would conflict with the First Law.
iii A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Such a robot may exhibit seemingly moral behavior quite consistently, but we might hesitate to call it a moral agent. The robot need not know why it shouldn't injure a human, it need not feel any emotions or moral outrage when it sees a human being injured, and it need not feel empathy when seeing a living being in pain in order to exhibit its encoded "moral" behavior. If the robot is programmed to deterministically follow the rules stated earlier, it cannot make a choice to follow them or not; it can only determine how best to implement them.

Good behavior isn't enough because a moral agent is an agent who is able to respond to the demands of morality. What counts are responding to the demands of morality will vary on different theories. Corresponding to the major ethical theories found in Western philosophy, we have the following cognitive requirements: Consciousness and metacognition (Kantianism), empathy or other-regarding emotions (sentimentalism and utilitarianism), personality traits and ability to improve them (virtue ethics), and social relations (feminist ethics).

Slogans for the popular moral theories

Utilitarianism: the greatest good for the greatest number
Kantianism: treat all rational agents as ends in themselves
Virtue ethics: act to develop your virtues and you will do good acts and flourish
Sentimentalism: right and wrong are founded on our good and bad feelings
Feminist ethics: right and wrong are founded on our good and bad feelings, our situations, and our relationships

The psychological requirement for morality that has been discussed the most in the context of animal morality has been metacognition, which Kantians think is required for an individual to have autonomy. The conscious metacognitive requirement is needed according to ethical views in which an agent needs to be an autonomous being that considers their own reasons for action. To act from reasons is different than acting according to reasons, says Kant, and a moral being does the right thing for the right reason. Therefore, they have to know their reason for acting, and they have to be able to evaluate their reasons. Korsgaard uses this approach to argue against animal moral agency. Because animals can't mindread, they cannot decide whether or not some behavior is justified and act from that judgment. Instead, she suspects that animals just act from their desires. Korsgaard writes:

> What it [normative self-government] requires is a certain form of self-consciousness: namely, consciousness of the grounds on which you propose to act *as grounds*. What I mean is this: a nonhuman agent may be conscious of it as *fearful* or *desirable*, and so as something to be avoided or to be sought. This is the ground of his action. But a rational animal is, in addition, conscious *that* she fears or desires the object, and *that* she is inclined to act in a certain way as a result. That's what I mean by being conscious of the ground *as a ground*. She does not just think about the object that she fears or even about its fearfulness but about her fears and desires themselves.
>
> (Korsgaard 2006, 113)

I worry that the conscious metacognitive requirement for morality is too intellectually demanding to capture our full practice of holding others responsible. On this view, a child isn't moral until they acquire metacognition and the ability to evaluate their reasons for action. Even adolescents struggle at evaluating their reasons for action. While we do not hold adolescents fully legally responsible for their actions, as part of children's moral education we do hold them morally responsible for their actions. For example, if a nine-year-old child burns a cat, they won't go to jail, but we still morally condemn this behavior and hold the child responsible. However, on Korsgaard's view, it isn't clear that we can.

Worse yet for a requirement like this is that research on adult moral reasoning suggests that adults do not generally consider their reasons when making moral judgments (Haidt 2001; Cushman et al. 2006). Human moral judgments are often based on an initial emotional response—it feels wrong and so we think it is wrong. This is true even when we can't come up with any reason to think that the behavior is harmful. In a seminal experiment on what is called moral dumbfounding—thinking some action is right or wrong without being able to give reasons for that judgment—subjects were told a number of stories and asked to make moral judgments. One story goes like this:

> Julie and Mark are brother and sister. They are traveling together in France on summer vacation from college. One night they are staying alone in a cabin near the beach. They decide that it would be interesting and fun if they tried making love. At the very least it would be a new experience for each of them. Julie was already taking birth control pills, but Mark uses a condom too, just to be safe. They both enjoy making love, but they decide not

> to do it again. They keep that night as a special secret, which makes them feel even closer to each other. What do you think about that? Was it OK for them to make love?
>
> (Haidt 2001, 814)

Subjects tend to think that it was wrong for the siblings to have sex, but when they start giving their reasons, the experimenter points out that the bad consequences have been ruled out by the vignette. There are no bad consequences here, and there were no reasons to think there would be. There was no disrespect of other agents—no one was coerced. So there is no reason to think that the act is wrong, yet people tend to persist in their initial moral judgment.

Other reasons for thinking that humans can act morally without understanding that they are endorsing a moral rule come from a famous passage in Mark Twain's novel *The Adventures of Huckleberry Finn*:

> They went off and I got aboard the raft, feeling bad and low, because I knowed very well I had done wrong, and I see it wasn't no use for me to try to learn to do right; a body that don't get STARTED right when he's little ain't got no show—when the pinch comes there ain't nothing to back him up and keep him to his work, and so he gets beat. Then I thought a minute, and says to myself, hold on; s'pose you'd a done right and give Jim up, would you felt better than what you do now? No, says I, I'd feel bad—I'd feel just the same way I do now. Well, then, says I, what's the use you learning to do right when it's troublesome to do right and ain't no trouble to do wrong, and the wages is just the same? I was stuck. I couldn't answer that. So I reckoned I wouldn't bother no more about it, but after this always do whichever come handiest at the time.
>
> (Twain 1992, 237)

Huck implicitly tracks the moral norms that slavery is wrong, even though he also knows that the legal principles of his society were in conflict with his intuitions, and so he lies that he didn't see Jim, the enslaved man he's sharing a raft with. Just as Huck Finn can track norms that he isn't explicitly aware of, other animals may also be able to follow norms without metacognitive awareness.

It may be more helpful to identify other kinds of moral participation. Considering moral rules and acting on them because they are moral rules might be one kind of moral participation; tracking the moral rules because you have the right kinds of emotions might be another. This sort of view can be seen in the work of Mark Rowlands (2012), who argues that animals have moral emotions, and the content of these emotions provides moral reasons for an animal's actions. As Rowlands puts it, animals can be *sensitive* to morally salient features of their environments given that they have a reliable mechanism to produce the appropriate emotion in the appropriate circumstance. Rowlands suggests that this capacity makes animals moral subjects who are able to act for moral reasons, but not moral agents who are responsible for their actions.

As an example of a moral subject, Rowlands describes his dog Hugo and Hugo's interaction with Rowlands' five-year-old son. Hugo is a German Shepherd who is trained in protection, and as part of his training, he will bite a kevlar sleeve that Rowlands puts on his arm. But when his son puts on the bite sleeve, Hugo will only gently chew on it. This different treatment of different individuals in the same circumstance, coupled with Hugo's strong desire to bite the sleeve at any opportunity, leads Rowlands to conclude that Hugo is a moral subject.

> Hugo exhibits concern for my son, and as a result inhibits his desires when doing so is necessary. This is enough for him to qualify as a moral subject: one motivated to act by moral reasons. The concern he exhibits is bequeathed him both by natural history and by form of life. And the latter comes by way of the deed.
>
> (Rowlands 2012, 213)

Moral subjects feel emotions such as happiness or sadness because the situation is good or bad. For example, a moral subject can feel happy in the face of others' happiness, and sad in the face of others' suffering. And when a moral subject feels sad, their sadness is about the suffering of others, such that the content of the subject's belief is what the emotion is intentionally directed at. While her response is reliable, she can get it wrong. This is what gives the emotion normative force—e.g. if a dog bit a small child and was happy about it, he got it wrong, and we need to do more to train the dog to respond appropriately to others. According to Rowlands, moral agents have more than this—they understand *that* they track the moral features of the world, they can evaluate their actions and their consequences—but since moral subjects already have normativity, they are already within the domain of the moral, and their behaviors can be good or bad.

Korsgaard is working within a Kantian moral theory. Rowlands is working within a sentimentalist moral theory. A very different approach is seen in the work of biologist Marc Bekoff and philosopher Jessica Pierce, who take a relativist approach to morality. They argue that moral agency should be understood as relative to species, and that we shouldn't expect that animal moral agency is some precursor to human moral agency (Bekoff and Pierce 2009). Given that they understand "morality" to mean "a suite of other-regarding behaviors that cultivate and regulate complex interactions within social groups" (Bekoff and Pierce 2009, 82), many ethicists would be unmoved by this account. The definition misses something that is typically taken to be the key to the normativity of ethics, namely that there is some force to acting in one way rather than another. On Bekoff and Pierce's definition of morality, there is no requirement that one acts from the demands of morality.

Bekoff and Pierce identify three clusters of moral behavior—cooperation, empathy, and justice—and they argue that many species engage in behaviors that fall into one or more of these categories. Central to the view is that different species have different norms, and that this makes animal morality species-relative. Despite the differences found between species, they think that many species have the capacities for empathy, altruism, cooperation, and a sense of fairness.

There are many her examples of the sorts of behaviors illustrating the capacities. For example, vampire bats cooperate by sharing blood, and dogs and wolves punish those who violate social norms by giving false signals. Bekoff and Pierce's idea is that since we can see behaviors that fall into these categories, we have evidence of morality in these species, and by observing these behaviors in other animals, we can learn more about their own systems of morality.

Bekoff and Pierce highlight some behaviors that may be relevant to morality, but I worry that their account of morality is too inclusive, and the empirical evidence they provide for these capacities is too thin. Pretty much all social beings would be moral on this view, since social beings have to regulate complex interactions with group members. While it is helpful to point out the kinds of behaviors that regulate social life, I think there is a missing middle ground between Korsgaard's intellectualist account of moral agency that requires acting for reasons that are endorsed, and Bekoff and Pierce's permissive account of moral agency that requires only engaging in other-regarding behaviors. To find that middle ground, we need to leave the debates about moral agency and instead turn to the discussion of moral psychology.

9.2.2 Normative cognition

Normative cognition refers to the ability to think about oughts, what one should and shouldn't do, whether that ought is a practical or moral ought. One kind of normative cognition allows individuals to act from social norms. Recall in the last chapter I presented an account of animal social norms according to which (a) there is a pattern of behavior demonstrated by community members; (b) individuals are free to conform to the pattern of behavior or not; (c) individuals expect that community members will also conform, and will sanction those who do not conform. At this point, we can ask what sort of cognitive capacities are required for acting according to animal social norms, and whether animals have those capacities.

A lot of cognitive capacities are packed into these three criteria for social norms. An individual has to recognize patterns, recognize others as group members, be able to engage in autonomous action, predict the behavior of others, recognize violations of the pattern, and be motivated to sanction violators. I have identified a core set of cognitive capacities necessary fulfilling these criteria that I call *naïve-normativity*: Identification of agents, sensitivity to in-group/out-group differences, social learning of group traditions, and responsiveness to appropriateness. Let us look at each of these, in turn.

To identify others as agents is core to being a folk psychologist, as we saw in Chapter 7. Agents are potential social partners who are cognitively flexible, self-propelled beings who act to achieve their goals. We saw evidence that human children and great apes recognize agency early in life, and I expect that this capacity will be widespread among social species who have to be able to recognize friends and foes. This criterion doesn't set a very high bar.

Sensitivity to in-group/out-group differences is slightly more sophisticated, but the capacity is also likely widespread among species. Individuals in many social species need to know who they belong to, and one way evolution solved the belonging problem was through imprinting. Recall the goslings who imprinted on Lorenz because he was the first thing they saw after hatching. Many species lack imprinting, but are still able to discriminate their people from strangers. Since the relevant social norms are those shown by members of one's own community, a norm follower will need to be able to distinguish in-group from out-group members in order to recognize the relevant patterns of behavior among community members.

Social learning of group traditions is most clearly required for having social norms. As we saw in the last chapter, many species engage in selective social learning which results in conforming to the traditions of one's own group. This capacity also supports social cognition, because the similarity in practices between yourself and others makes it easier to predict what others will do by thinking about what you would do. Social learning of community behaviors also offers additional predictive power in terms of understanding what others will do in particular situations—for example, a chimpanzee might expect that others will build a nest when sleepy and make a food call when food is discovered.

The final capacity of naïve normativity is what I call responsiveness to appropriateness, which is an affective response to violations of social norms. Evidence for emotions in animals requires that we make inferences from behavior and biology. In the last chapter, we saw some behavioral evidence of chimpanzees responding to candidate norm violations in the case of infanticide, treatment of infants, and distribution of resources. Punishment is taken to be another type of behavioral evidence for consciousness of appropriateness, given its role as a tool for encouraging conformity and retribution in response to norm violations. But not everyone has the power to punish, so absence of punishment isn't evidence against consciousness of appropriateness. Other sanctions include avoiding the individual, or emotional responses of stress or anger. Jane Goodall described a practice of shunning in the chimpanzees of Gombe—when an individual violated a norm, the others stopped interacting with him (Goodall 1986).

What we have so far learned about animal psychology suggests that many species have the first three capacities of naïve normativity. As was already hinted at in the last chapter, more research on social norms will be needed to determine whether animals do indeed sanction those who violate social norms. If we find good evidence that they do, then we should accept that animals, like humans, act from the demands of normativity, moral or not.

9.2.3 Caring emotions

Emotions are another aspect of moral psychology. A cold follower of social norms who feels emotionally unmoved by their actions strikes many as a kind of moral monster despite their good actions—the charge "you don't care about other people" is profound moral criticism. Given the intuitive plausibility of care as a moral emotion, and the widespread acceptance of care as relevant in many moral theories, here we can focus on emotions of care such as empathy, sympathy, and concern. Empathy has been much discussed in the animal literature, and while there are (unsurprisingly at this point) disagreements about what empathy is, everyone seems to accept that it is part of morality.

Empathy definitions

Empathy as an affective state: feeling what another individual is feeling

Emotional contagion: immediate response to another's emotional expression that takes the form of acquiring that same emotion; an example is how when one baby starts to cry, the other babies do too

Empathy as an epistemic state: knowing what another individual is feeling

Empathy as perspective taking: taking the perspective of another in order to understand what that other is experiencing

Empathy as perception/action state: perceiving and responding compassionately to another's distress

Entangled empathy: responding compassionately and caring for and about another in a way that involves reflectively imagining being in their position.

Figure 9.1 Consolation in young bonobos.

One of the first people to discuss care in animals was Frans de Waal, who argues that morality and empathy are deeply entrenched in humans, and that moral emotions such as empathy are evolutionarily ancient (de Waal 2006). The first form of care de Waal focused on was consolation behavior in chimpanzees—comforting behavior directed at an individual in distress, often in the aftermath of a conflict or a fight. De Waal observed this behavior in chimpanzees and described it in his first book, which led to an immense amount of popular and scientific work on consolation in animals.

After his initial work on consolation, de Waal turned his attention to the emotion of empathy. In one of his most evocative examples of empathy in apes, de Waal describes the behavior of a bonobo in an English zoo:

> One day Kuni captured a starling. Out of fear that she might molest the stunned bird, which appeared undamaged, the keeper urged the ape to let it go … Kuni picked up the starling with one hand and climbed to the highest point of the highest tree where she wrapped her legs around the trunk so that she had both hands free to hold the bird. She then carefully unfolded its wings and spread them wide open, one wing in each hand, before throwing the bird as hard as she could towards the barrier of the enclosure. Unfortunately, it fell short and landed onto the bank of the moat where Kuni guarded it for a long time against a curious juvenile.
>
> (de Waal 2006, 55)

While the first discussions of care focused on the great apes, more recently scientists have been asking whether rats have empathy. To perform these tests, scientists house rats together in a case to build affiliation. Then, in the testing condition, one rat is put in a restrainer, a tube that is locked from the outside. The restrainer and the other rat are both placed in a cage, so that the free rat can release the trapped rat. Rats tend to release their cagemate, but if there is no rat in the restrainer, or only a stuffed animal rat, they don't usually open the restrainer (Bartal et al. 2011). When a second restrainer full of chocolate was also placed in the cage, the free rat would first release the trapped rat before eating the chocolate. The researchers took this behavior to be evidence of altruism, since the free rat then had to share the chocolate with the trapped rat.

A number of variations of this task have been run as well. Rats will free a trapped rat even when it means the trapped rat moves to a different compartment, and the free rat is then alone. (Rats are quite social and prefer companions.) Rats will rescue cagemates who are in compartments half-full of water, and they will do it even more quickly when the savior-rat had already experienced the aversive watery compartment first-hand (Sato et al. 2015). The authors of this study concluded that the rats demonstrated empathy that was supported by experience projection, or the ability to understand that another individual feels what you felt in a similar situation.

Given the variety of definitions of empathy, it should be expected that critics challenge the interpretations of the rat studies in terms of empathy. One objection is that none of the accounts of empathy are needed to explain the rats' behaviors, because, as the psychologist Alex Kacelnik argues,

> The reproductive benefits of this kind of behavior are relatively well understood as, in nature, they are helping individuals to which they are likely to be genetically related or whose survival is otherwise beneficial to the actor… To prove empathy any experiment must show an individual understands another's feelings and is driven by the psychological goal of improving another's wellbeing. Our view is that, so far, there is no proof of this outside of humans.
>
> (Kacelnik 2012)

While Kacelnik here is adopting one of the more sophisticated accounts of empathy, which requires perspective taking, one might worry that there isn't even evidence that the rats are feeling any emotion, thus ruling out even the definition of empathy as feeling the emotion of another. Can the rats be acting this way without feeling anything toward their cagemate?

An argument in favor of that interpretation comes from looking at a similar rescue behavior in another species, the desert ant. When foraging, ants sometimes get caught in spider webs, and nestmates free them by biting off the threads. They also sometimes get trapped in sandpits, and nestmates will dig them out. In a series of studies, researchers found that sister ants will free a trapped group member if they are caught, but will not free ants from other groups or other species, fake ants, or anesthetized nestmates (see Hollis and Nowbahari 2013 for a review).

The ant behavior looks quite a bit like the rat behavior that has been described as empathy; yet, the media hasn't picked up on these stories proclaiming that ants have empathy the way they did with the rats. Why not? One possibility is that people are likely biased against ants even more than rats, and think it is unlikely that ants have anything like moral capacities. Helping behaviors like those displayed by the rats and the ants are found across species, and it has long been a question for evolutionary biologists why animals engage in such altruistic behaviors—behaviors in which one accepts some cost in order to improve the fitness of another.

There are two different biological explanations for the ubiquity of helping behaviors. One explanation is given in terms of inclusive fitness, according to which the behavior of the altruist increases one's own fitness by promoting the genes of related individuals (which we see in the case of the ants). The other explanation is in terms of reciprocal altruism, according to which an altruist's help will be reciprocated by the partner or other group member at a later date, thus improving their fitness—this may explain the rats who are quicker to help after they have been helped. In a natural setting, we would also expect inclusive fitness to be at work in a rat colony, given how closely related individuals are.

While these are biological explanations for helping, we should worry that they are not in conflict with the explanations in terms of moral emotions. The biological explanations are being given at one level of explanation, and the psychological explanations in terms of empathy are being given at another. (Recall our discussion of levels of explanation from Chapter 2.) It may well be that biologists have it right that we understand the reproductive benefits of helping behavior, as Kacelnik says. But that doesn't mean we understand the psychological mechanism, and that is what the psychologists are trying to uncover in the rats.

The question at issue here is whether the rats, the ants, or the chimpanzees, or any other animals have the right kind of emotion. If we are starting from scratch, we have a big job in front of us. Criticisms of rat empathy studies can be made by those who even doubt that rats are conscious. Given the arguments we saw in Chapter 1 providing justification for accepting other animal minds, and the arguments we saw in Chapter 4 providing justification for accepting animal consciousness, we already have a solid foundation for asking the question about rat empathy. If we can assume that rats have conscious experience, then we might be able to get at rat emotion by adopting a functionalist methodology. We can ask whether rats engage in a fuller range of behaviors related to empathy, not just freeing cagemates from tubes. And we can ask whether the same brain regions and neurochemicals are at play when the rats are acting empathically.

While different kinds of behavioral studies remain to be done, we do have corroborating evidence of rat empathy from neurobiology. In a physical intervention study, researchers lesioned rats' amygdalae, a part of the brain association with emotion and social cognition in humans. These rats failed to act prosocially, and the authors think their results show that typical rats are sensitive to the affective state of other rats, but that by damaging the amygdala, the rats are unable to process the social information emotionally (Hernandez-Lallement et al. 2016). In a series of chemical intervention studies, researchers administer anti-anxiety drugs to rats, which caused their helping behavior to be reduced (Bartal et al. 2016). These rats would still open a restrainer to get chocolate, but they didn't free the trapped rat. The authors suggest that rats are motivated to help others given their emotional responses, and when their emotions are muted by drugs, it impacts their behavior.

The behavioral and neurobiological evidence should raise our confidence that rats experience empathy, though different kinds of research can help to bolster our confidence in that conclusion even more. For a deeper discussion of the topic of empathy in apes and rats, you can look at three papers that this section has drawn on greatly (Andrews and Gruen 2014; Gruen 2018; Monsó and Andrews forthcoming). However, given the considerations from Section 9.1, as scientists move forward studying empathy in animals, I hope they are mindful of the ethics of their experiments.

9.2.4 Fairness and norms

While emotions like empathy are one part of moral psychology, moral concepts are another part. One aspect of morality that is often stressed is the aspect of reciprocity—that we take care of one another, that we are fair and don't cheat, that we cooperate, and that we help and expect others to help us. In the last chapter, we saw that the question of cooperation in animals is a topic of debate, but that in at least some senses of the term, we have evidence that animals do cooperate. We also saw that monkeys and chimpanzees might have an aversion to inequity in payment for the same work. These studies suggest that animals might have a concept FAIRNESS. So far, the fairness research is primarily conducted with primate subjects, and much of it relies on familiar economic games performed with humans.

For example, in the ultimatum game, designed by the economist Werner Güth and colleagues, two individuals are randomly assigned the roles of proposer and responder. The proposer is offered a sum of money and can decide to offer some portion of it to the responder. If the responder accepts the offer, both parties keep the money. However, if the responder does not accept the offer, then neither player gets anything (Güth et al. 1982). While a rational maximizer should accept any offer given, Güth and colleagues found that humans tended to reject offers if they were too low. This finding is often interpreted as evidence that humans value the norm of fairness in the distribution of resources over their own personal gain. It seems that humans will make personal sacrifices to punish those who don't follow social norms about fair distributions of resources.

In the first chimpanzee version of this test, the chimpanzees acted as rational maximizers, accepting any offer given, no matter how small (Jensen et al. 2007). The authors of this study conclude that chimpanzees are not concerned with fairness: "These results support the hypothesis that other-regarding preferences and aversion to inequitable outcomes, which play key roles in human social organization, distinguish us from our closest living relatives" (Jensen 2007, 107).

However, showing that chimpanzees don't object when food isn't distributed in a way we think is fair doesn't demonstrate that chimpanzees lack the concept. For one, consider that the cross-cultural data on the ultimatum game shows a great diversity of responses. For example, in non-industrialized human communities that lack a market economy, people will accept much smaller offers than in the West, and in larger communities we see greater rates of punishment. Given such findings, Henrich and colleagues suggest that the norms associated with what we consider fair division of goods coevolved with market economies and sedentary populations (Henrich et al. 2010). Anthropologists are sensitive to how different cultures might approach what appears to be the same game, making comparisons across cultures difficult. In commenting on Henrich's article, Baumard and Sperber suggest that:

> Behavioural differences observed in economic games are not due to deep psychological differences per se, but rather due to different interpretations of the situation … For example, Henrich et al.'s (2005) study in 15 small-scale societies reveals a striking difference between the Lamalera, who make very generous offers in the ultimatum game, and the Tsimane and the Machigenga, who make very low offers in the very same game. But the game is likely to be construed very differently within these societies. The Lamalera, being collective hunters, may indeed see the money as jointly owned by the proposer and the recipient. By contrast, the Tsimane and the Machigenga, who are solitary horticulturalists, may see the money as their

> own property and therefore feel entitled to keep it. In the same way, Westerners may appear as outliers not because they have a different moral psychology, but rather because, living in very large, democratic and capitalist societies, they make different assumptions in economic games (e.g., that, not knowing the other participant – a situation of anonymity that is common in large-scale urban societies – they have no particular duty to share the stake with her).
>
> (Baumard and Sperber 2010, 85)

Just as different cultures honor relatives in different ways—in North America people will sometimes put their visiting family members in a hotel, while in other cultures not sharing your home with your parents would be a huge insult—different cultures display their other-regarding sentiments in different ways. And just as different cultures display their other-regarding sentiments in different ways, different species can as well. To claim that the chimpanzees do not have a sense of fairness because they fail a test based on cultural human norms is based on an anthropomorphic, and perhaps a Western-centric, assumption about what fairness looks like.

In order to examine the question of whether chimpanzees have other-regarding tendencies that we might consider a sense of fairness, we need to look at species-specific behavior. For chimpanzees, the ultimatum game does not reflect any chimpanzee norm about sharing jointly earned resources. Research based on an understanding of wild chimpanzee behaviors would likely not have been designed around whether chimpanzees have a concept of fairness regarding inequitable distributions of food items. It is like testing humans on their sense of fairness by asking them to share their toothbrush with a classmate. If you won't share your toothbrush, you must not have any other-regarding preferences!

This is tricky, because as we already saw in our discussion of cooperation in the last chapter, it can be hard to compare humans and other species on the same task and be sure that the task is getting at the same psychological mechanisms, because the tasks, as embedded in the distinct cultures of the participants, may have very different meanings.

What might fairness look like for a chimpanzee? To understand that, it is worth spending a moment thinking about what fairness is. In the ultimatum game, fairness is operationalized as equal distribution of resources. However, especially among market capitalist humans, we do not really have a norm in favor of equal distribution of resources! Some people are very rich, and some people are very poor, and these people live in the same towns and cities.

A different way of understanding fairness is to see it as the consistent application of a rule. If we have a rule that people have to share their resources to such an extent that everyone has healthcare, as is the norm in Canada, then it would be unfair if one person of means didn't have to pay taxes into the health care system.

In a second study looking at chimpanzee performance on the ultimatum game, researchers found that after two individuals had played the game together many times, the proposing chimpanzee would respond to verbal protests at selfish offers by making a fair offer (Proctor et al. 2013). This finding suggests that chimpanzees can develop a food sharing norm in the right kind of context. Once the norm is developed, fairness requires equal application of the rule to all involved parties. The inequity aversion studies presented in the last chapter, in which monkeys and chimpanzees protest getting a cucumber when their partner gets a grape for the same task, offer another example of a norm that gets developed in a lab, such that a violation of it results in a violation of fairness.

In their normal habitat, chimpanzees live in fission-fusion societies, which means that there are small subgroups of chimpanzees who come together to form a larger community on a regular basis. Lori Gruen and I argue that in such large groups, and especially with a species as volatile as chimpanzees, having social norms would best facilitate the ability to share resources, exchange information, and manage social interactions, and the complex behaviors we see among chimpanzees are best explained in terms of their having social norms (Andrews and Gruen 2014). As we have seen, there are a number of candidate animal social norms among chimpanzees, and evidence in favor of normative thinking in apes is growing. While there is some evidence that other animals have a concept of FAIRNESS, we still need a robust research program, and the best evidence will come from first identifying the norms that the animals actually have, and then examining responses to norm violations.

9.2.5 Moral foundations

As our final approach to studying animal moral psychology, we can consider the extent to which cross-cultural moral practices are found in other species. A framework for comparing human moral systems is seen in Jonathan Haidt and colleagues' Moral Foundations Theory, which identifies between five and six dimensions that serve as the psychological foundations of human morality across cultures. These dimensions are harm/care, fairness/reciprocity, in-group/loyalty, authority/respect, purity/sanctity, liberty/oppression (Haidt et al. 2009; Haidt and Graham 2011; Iyer et al. 2012).

Haidt and colleagues are sympathetic to the possibility that we will find some of these foundations in other animals; they write that there is "some evidence of continuity with the social psychology of other primates" (Haidt et al. 2009, 111). In a review of the existing literature with Sarah Vincent and Rebecca Ring, we discussed the extent to which great apes and cetaceans exhibit these moral foundations (Vincent et al. 2019). We focused on five categories of moral norms (obedience norms, reciprocity norms, care-based and altruistic norms, social responsibility norms, and norms of solidarity) and identified behaviors that would fall under each category.

Categories of moral norms found across cultures

O*bedience norms* include social hierarchies, punishment, and teaching.
Reciprocity norms include fairness and cheating, cooperation, mutualism, proportionality, and preference for individuals.
Care norms include consolation, targeted helping/hurting, grief, and emotion recognition.
Social responsibility norms include loyalty/betrayal, aversion or protesting, distribution of labor based on skill, and indirect reciprocity or cooperation for the benefit of the group.
Solidarity norms include sanctity/degradation, liberty/oppression, group identity or culture, and self-sacrifice.

You can see the chart we constructed listing the evidence of these moral foundations in apes and cetaceans in Appendix A. Given that these issues have been studied more in chimpanzees than in any other species at this point, we were able to find evidence that chimpanzees exhibit each of these norm types. Studying whales and dolphins is much more difficult, given their aquatic environment, and there are fewer research programs looking at dolphin social behavior. Nonetheless, we also found evidence of most of these norm types among cetaceans.

For example, cetaceans are known for occasional instances of mass stranding, when groups of animals end up on a beach, often dying as a result. This odd behavior may be understood as the performance of a solidarity norm. In one report of sperm whale beaching in South Australia, observers noticed a tightly packed group of whales offshore, mostly females and their offspring (Evans et al. 2002). One whale separated from the group and started swimming parallel to the shore. The whale then started swimming erratically, moving toward shore and stranding on the beach. The other whales began moving toward the shore where the first whale had been beached in small groups of two or three, seeming to let the surf strand them. The last two whales in the group swam parallel to the beach, then turned and swam back past all the stranded whales. Then, they turned toward the shore and appeared to strand themselves by swimming onto the beach a bit away from the rest of the group. None of these whales survived.

Orcas coordinate hunting and share food, dolphins midwife the birth of their allies' babies and are famous for helping to rescue drowning humans, humpback whales have been observed rescuing seals from orca attacks, and orcas and dolphins alike have been observed carrying their dead offspring, a behavior some scientists are happy to describe as mourning (see Vincent et al. 2019 for a discussion).

The observation that the human moral foundations may be shared with other species suggests that there may be a deep structure to moral psychology that is widely conserved across species. Insofar as moral practice and cognition evolved to help us solve our social living problems, it should not be too surprising that the core practice types underlying a variety of solutions to social living are similar in this way.

9.3 Chapter summary

Where different animals fit into the moral sphere may depend on their psychological properties, such as their ability to feel pleasure and pain, to develop positive personality traits, to respond emotionally to moral stimuli, or to think about their reasons for action. Or it may depend on the relationships they enter into with others. Objections to animals fitting somewhere in the moral sphere are typically based on their lack of some cognitive requirement—they aren't smart enough to have morality, or they only have simple emotions but lack the moral emotions, they can't empathize, aren't rational, and so forth. The issue then becomes the sort of capacity required to make the moral-looking behavior into truly moral behavior.

In this chapter, we drew on the familiar ethical distinction between *moral patients*—individuals who matter morally and have moral standing, and *moral agents*—those who can be held morally responsible for their actions. First, we looked at three arguments supporting animal moral standing. The first argument defends the claim that anything that is conscious matters morally, and that animals are sentient—they can feel good and bad. The second argument considers whether animals are persons, individuals with certain properties who might be said to have moral rights. Finally, we saw arguments that animals can matter morally because of their participation in relationships. Taken together, these arguments offer strong reasons to accept that animals deserve moral considerability.

Next, we turned to look at ways in which animals might participate in morality. We considered whether animals might be moral agents, or something like that. We reviewed Korsgaard's argument against animal moral agency, Rowland's argument for a middle ground of moral participation he called *moral subject*, and Bekoff and Pierce's relativist view of moral agency. Given that these views are all based on particular moral theories, and in light of the common view that humans across cultures participate in moral practice, I suggested it may be more productive to look at moral psychology than to focus on moral agency in order to understand whether animals have properties akin to ours in the domain of morality.

A focus on normative cognition is a useful starting point for studying moral cognition. We saw that naïve normativity is such a framework, and it includes four cognitive capacities: Identification of agents, sensitivity to in-group/out-group differences, social learning of group traditions, and the conscious awareness of responsiveness to appropriateness. I think that looking for norms in other animals is a valuable first step toward making arguments that animals are participants in moral practice.

Next we turned to the question of moral emotions. We focused on empathy, reviewing both evidence for empathy in great apes and the more recent empirical research program looking for evidence of empathy in rats. I concluded that while we have some evidence of empathy in rats and other animals, this research program is still in its infancy.

We also looked at the question of moral concepts, and in particular focused on the question of whether animals have a sense of fairness, and considered that what counts as fairness will differ depending on the norms of the group or the species. Fairness should not be understood as requiring an equal distribution of resources, as it sometimes has been in the scientific literature.

Finally, we considered another approach to studying morality in animals by starting with a framework from human psychology. Moral Foundations Theory identifies dimensions of morality that are found across cultures: Harm/care, fairness/reciprocity, in-group/loyalty, authority/respect, purity/sanctity, liberty/oppression. I offered preliminary evidence that other animals share these psychological dimensions of morality with humans, and reasons to think that the framework can offer a useful organizing tool for future work in animal moral participation.

As we learn more about animals, their lives free from human encroachment, their cognitive capacities, their emotions, and their needs, we will also learn more about the scope of our moral concepts of agency, empathy, and fairness. The calibration method will be essential as this work continues, and as we consider how best to organize our shared lives with other animals. The outcomes of these moral decisions depend greatly on the work of philosophers and psychologists who study moral psychology and the nature of normativity, as well as on the more general research into the cognitive capacities of other animals.

Appendix A. Norm types in apes and cetaceans (from Vincent et al. 2019)

Table 9A.1 Obedience norms: regarding relationships of authority or dominance

Obedience norms		
Behaviors	**Examples in chimps**	**Examples in cetaceans**
Authority and subversion	Hierarchical societies in which the dominant male must be deferred to (de Waal 1982)	Male bottlenose dolphins establish hierarchical dominance relationships (Connor and Norris 1982; Connor et al. 2000)
Punishment	Destroy food stolen from them, but not food given to the other (Jensen, Call and Tomasello 2007)	After being trained by "time-outs," dolphin gives a "time-out" to researcher whenever offered food has unwanted parts (Reiss 2011)
	Lack of evidence of third party punishment in an experimental captive setting (Riedl et al. 2012)	
Teaching and obedience	Demonstration teaching, with correction (Boesch 1991, 1993; Pruetz and Bertolani 2007)	Dolphin mothers teach calves to produce and manipulate bubbles which are used in hunting (Kuczaj II and Walker 2006)
	Teach by inhibition, preventing another individual from acting (e.g., mothers pull infants away from plants not normally in diet) (Hiraiwa-Hasegawa 1990); mothers intervene when infants play with unusual or dangerous objects (Hirata 2009)	Dolphin mothers teach foraging tactics to calves: pursue prey longer, make more referential body-orienting movements, and manipulate prey longer while calves observe (Bender et al. 2008)
	Adults tolerate youngsters closely watching them perform tasks and permit touching or taking tools (see Van Schaik 2003 for a review)	Orca mothers teach hunting techniques to calves: push them on and off beach and orient them toward prey (Whitehead and Rendell 2015)

Table 9A.2 Reciprocity norms: regarding relationships of support or mutual benefit

Reciprocity norms		
Behaviors	**Examples in chimps**	**Examples in cetaceans**
Fairness and cheating	Share food that is easily divided (Hare et al. 2007)	
	Refuse to participate in tasks upon witnessing another receive a higher-valued reward (Brosnan et al. 2005, 2010)	
	Accept all offers and fail to reject unfair offers in ultimatum game (Jensen et al. 2007a)	
Direct reciprocity, cooperation, mutualism, and proportionality	Coordinate rope pulling to access food (Crawford 1937; Hirata and Fuwa 2007)	Two dominant male dolphins, but not subordinates, coordinate rope-pulling to access and share food, and then synchronously interacted with emptied container (Kucsaj II et al. 2015)

(*Continued*)

Reciprocity norms		
Behaviors	**Examples in chimps**	**Examples in cetaceans**
	Share food gained after hunting monkeys proportional to effort (Boesch 1994)	Orcas share prey non-aggressively: each takes a piece of prey and swims in opposite directions, tearing the meat (Guinet et al. 2000)
	Dyads with strong social bonds cooperate to get food in an experimental setting (Melis et al. 2006) Dominant male and infant coordinate lever pulling to access food, but others fail to work with dominant (Chalmeau 1994; Chalmeau and Gallo 1996a, 1996b) Share and coordinate tool use in order to gain access to food (Melis and Tomasello 2013) Chimpanzees in long-term relationships share food and engage in grooming (Jaeggi et al. 2013) Keep track of and tend to support past supporters (de Waal and Luttrell 1988) Adults more likely to share food with individuals who had groomed them (Brosnan and de Waal 2002) Chimpanzees, bonobos, and orangutans distinguish between true and false beliefs in their helping behavior; they infer a human's goal and help them achieve it (Buttelmann et al. 2017)	Male bottlenose dolphins form alliances that collaborate in securing consortships of females, competing with other groups to do so (Connor et al. 2000)
Preference for individuals; discrimination	Prefer to beg from a generous human donor over a selfish one (Subiaul et al. 2008) Prefer to select more skillful collaborators in a rope pulling cooperation task (Melis et al. 2006; Hirata and Fuwa 2007) Juveniles self-handicap when playing with weaker individuals; also evidence of role reversal (Hayaki 1985) Remember who attacked them and are more likely to attack former attackers (de Waal and Luttrell 1988) Prefer to cooperate with partners who share rewards more equitably (Melis et al. 2009)	Bonded male dolphins perform specific affiliative behaviors with each other: synchronous swimming, petting, and adjusting signal whistles to match (Tyack 2000; Stanton and Mann 2014)

Table 9A.3 Care norms: regarding the wellbeing of others

Care norms		
Behaviors	**Examples in chimps**	**Examples in cetaceans**
Caring and consolation	Console those who lose fights and reconcile after fights (de Waal and van Roosmalen 1979; Kutsukake and Castles 2004; deWaal 2009) Console bonded individuals in distress (Fraser et al. 2008)	Cetaceans "stand by" others in distress, staying close but not offering aid, often in dangerous situations such as whaling (Connor and Norris 1982)

(*Continued*)

Care norms

Behaviors	Examples in chimps	Examples in cetaceans
Targeted helping/ hurting	No preference for food delivery method that also delivered food to a conspecific (Silk et al. 2005)	Cetaceans "support" others in distress, pressing them to the surface until the supported recovers or dies; observed intra- and inter-specifically (Connor and Norris 1982; Williams 2013)
	Help a human obtain out of reach objects (Warneken et al. 2007)	Cetaceans help others deliver infants and help raise newborns to surface (Connor and Norris 1982; McKenna 2015; Whitehead and Rendell 2015)
	Prefer to use a token that supplied food to self and conspecific, rather than only to self (Horner et al. 2011); note Skoyle's (2011) interpretation of this behavior as mean-spirited, not pro-social (but still normative)	Cetaceans approach injured individuals, show violent or excited behavior, come between captors and the injured, bite or attack capture vessels, and push the injured away from captors; observed intra- and inter-specifically (Connor and Norris 1982)
	Help another chimpanzee even when there is no direct benefit to self (Yamamoto et al. 2009)	Dolphins approached a sailor who fell overboard, then approached search boats, going back and forth, thereby leading human rescuers to the sailor (Whitehead and Rendell 2015)
	Target individuals to kill, castrate, and disembowel (Peterson and Wrangham 2003; Boesch et al. 2008; Wilson et al. 2014)	Orcas guided lost researchers by surrounding and staying with the boat until they reached home, then swam away in opposite direction (Morton 2002)
	Males and dominants aid females and youth in road crossing (Hockings et al. 2006)	Humpback whales interfere with orca whale predatory attacks on various species, sometimes rescuing the prey (Pitman and Durban 2009; Pitman et al. 2016)
		A bottlenose dolphin guided a mother/calf pygmy sperm whale pair out of an area of sandbars upon which they were repeatedly stranding (Lilley 2008)
		A captive orca attacked and killed a human trainer at Seaworld, holding the trainer underwater too long (Kirby 2012; Neiwert 2015)
Response to loss (grief)	Mothers carry dead infants until they are mummified (Biro et al. 2010)	Adult cetaceans carry dead calves and juveniles, sometimes until they decompose (Connor and Norris 1982; Reggente et al. 2016)
	Responses to dying and death include caring for dying individual, examining for signs of life, male aggression to the corpse, all-night attendance by adult daughter, cleaning the corpse, and subsequent avoidance of the place of death (Anderson et al. 2010)	Captive orca Bjossa remained with her dead calf for days, touching her and preventing humans from approaching (http://www.apnewsarchive.com/1995/Killer-Whale-Calf-Loses-Fight-for-Life/id-0a2a8961200d44de89389632 60ce058b); captive orca Corky made specific distress vocalizations and refused food for days after calf died (Morton 2002)
Emotion recognition	Recognize basic emotions in facial expressions (Parr et al. 2007)	

Table 9A.4 Social responsibility norms: regarding social roles and duties that benefit the group

Social responsibility norms		
Behaviors	**Examples in chimps**	**Examples in cetaceans**
Loyalty/betrayal	Trust friends but not non-friends to share food (Engelmann and Herrmann 2016)	When transient orcas are detected nearby, resident orca groups move into and hold a defensive formation and vocalize in low grunts (Morton 2002)
	Form alliances with intragroup support (de Waal 1982)	Resident orca group aggressively chased and attacked a transient group, driving them into a harbor toward the beach (Ford and Ellis 1999)
Aversion and protesting	In an ultimatum game, make more equitable divisions after partner protests (Proctor 2013)	Neither sex disperses from resident orca natal groups; with no inbreeding, mating occurs within community and sometimes clan, but never the same pod (Barrett-Lennard 2000)
	Protest infanticide (Rudolf von Rohr et al. 2011) Bonobos protest unexpected social violations (Clay et al. 2016)	After a human approached a dolphin calf, the mother approached the familiar tour group leader, rather than the trespasser, and tail slapped the water; authors interpret as protesting norm violations (White 2007; Whitehead and Rendell 2015)
Distribution of labor-based on skill	Cooperatively hunt monkeys in groups of four after years of training (Boesch 1994)	One dolphin (“the driver”) herds fish against a wall of conspecifics; the same individual in each group repeatedly serves as driver (Gazda et al. 2005)
		One dolphin swims in circles around shoal of fish, strikes muddy bottom with tail, creating a mud-ring around fish; the rest of the group gathers outside of the ring, catching jumping fish (Torres and Read 2009)
		Humpback whales specialize in different elements of cooperative foraging; particular individuals are bubble-blowers or trumpeters (Whitehead and Rendell 2015)
Indirect reciprocity; cooperation for the benefit of the group	Break hunting snares, thereby protecting group members (Ohashi and Matsuzawa 2011)	Transient orcas coordinate hunting and share prey (Saulitis et al. 2000)
		Both orca and dolphin groups herd fish into balls and take turns feeding (Similä and Urgarte 1993)
		Humpback whales cooperate to corral herring, blowing encircling bubble nets, blasting herring with sound, and using their flippers (Whitehead and Rendell 2015)
		Sperm whale females take turns babysitting each other’s calves while mothers dive to hunt (Whitehead and Rendell 2015)

Table 9A.5 Solidarity norms: regarding social cohesion, group identity, and belonging

Solidarity norms		
Behaviors	**Examples in chimps**	**Examples in cetaceans**
Sanctity/ degradation	Throw feces and wet food at humans (Hopkins et al. 2012)	
Liberty/ oppression	Police conspecifics by intervening to stop fights (de Waal 1982; Rudolf von Rohr et al. 2012)	
	Look longer at images of infanticide; interpreted as bystander effect by authors (Rudolf von Rohr et al. 2015)	
Group identity/ culture	Demonstrate 39 patterns of behavior that differ between communities in tool usage, food processing, grooming, and courtship; differences not due to ecological features (McGrew and Tutin 1978; Whiten et al. 1999)	Greeting ceremony: southern resident pods each forms a rank, swim toward each other, come to a halt and face each other, pause, then dive and swim together in tight sub-groups, with lots of vocalization, social excitement, and no hostility (Whitehead and Rendell 2015)
	Patrol boundaries between chimpanzee communities, sometimes invading and killing adult males and infants and stealing females (Mitani and Watts 2001; Watts et al. 2006)	Sympatric orca social groups are differentiated by dialects and diets (Barrett-Lennard 2000; Ford 2002); sympatric sperm whale social groups are differentiated by dialect (Whitehead and Rendell 2015)
	Throw rocks in particular trees, resulting in a cairn-like structure; authors interpret as ritual or communication behavior (Kühl et al. 2016)	Humpback whale communities have specific songs, synchronously performed by males; songs change between and within generations and over distance as innovations are introduced (Whitehead and Rendell 2015)
		Signature whistles, petting, and synchronous swimming differentiate stable social units of Bottlenose dolphins from more loosely associated community members (Conner et al. 2000; Pack 2010)
		Northern resident orcas rub their bodies on particular underwater-pebble beaches, whereas other resident communities or sympatric transients do not; the same beaches are revisited throughout generations (Ford et al. 2000; Whitehead and Rendell 2015)
		A subgroup of the larger Shark Bay dolphin community uses sponges as foraging tools and attaches sponges to their rostrums to forage amongst sharp rocks; others sharing same habitat do not exhibit this socially learned behavior (Mann et al. 2012)
Self-sacrifice	Lack of evidence of self-sacrifice accounted for by a lack of cultural systems of reward; otherwise warfare is a good model of early human warfare (Wrangham and Glowacki 2012)	Some highly socially structured cetacean groups beach themselves in mass strandings, following each other onto the beach in a deliberate manner; typically won't leave the beach by themselves (Connor and Norris 1982; Simmonds 1997; Evans et al. 2002; Whitehead and Rendell 2015)

Notes

1 www.theguardian.com/world/video/2014/may/15/cat-saves-boy-from-dog-attack-video
2 www.youtube.com/watch?v=ulg1Imcavew

Further reading

Lori Gruen's textbook *Ethics and Animals: An Introduction* (2011) is highly recommended; she confronts the applied issues like factory farming, extinction, and experimentation that I was able to avoid in this chapter.

Animal moral standing

Andrews, Kristin, Gary Comstock, G.K.D. Crozier, Sue Donaldson, Andrew Fenton, Tyler M. John, L. Syd M Johnson, Robert C. Jones, Will Kymlica, Letitia Meynell, Nathan Nobis, David M. Peña-Guzmán and Jeff Sebo. *Chimpanzee Rights: The Philosophers' Brief*. New York: Routledge, 2018.

DeGrazia, David. *Taking Animals Seriously: Mental Life and Moral Status*. New York: Cambridge University Press, 1996.

Hursthouse, Rosalind. *Ethics, Humans and Other Animals*. New York: Routledge, 2000.

Regan, Tom. *The Case for Animal Rights*. Berkeley and Los Angeles: University of California Press, 1983.

Singer, Peter. *Animal Liberation*. New York: Harper Collins, 1975.

Animal moral agency

Bekoff, Mark and Jessica Pierce. *Wild Justice: The Moral Lives of Animals*. Chicago, IL: University of Chicago Press, 2009.

de Waal, Frans. *Primates and Philosophers: How Morality Evolved*. Princeton, NJ: Princeton University Press, 2006.

Rowlands, Mark. *Can Animals Be Moral?* New York: Oxford University Press. 2012.

Animal moral psychology

Andrews, Kristin. "Naïve Normativity: The Social Foundation of Moral Cognition." *Journal of the American Philosophical Association.* 6(1) (2020): 36–56.

Gruen, Lori. "Empathy in Mind." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 485–490. New York: Routledge, 2018.

Monsó, Susana, and Andrews, Kristin. Forthcoming "Animal Moral Psychology." In *The Moral Psychology Handbook*, 2nd ed., edited by John Doris and Manuel Vargas.

Vincent, Sarah, Ring, Rebecca, and Andres, Kristin. "Normative Practices of Other Animals." In *The Routledge Handbook of Moral Epistemology*, edited by A. Zimmerman, K. Jones, and M. Timmons, 57–83. New York: Routledge, 2019.

Glossary

Access consciousness A type of consciousness that characterizes mental states that are available to the individual, and that does not require a qualitatively distinct aspect. The distinction between access consciousness and phenomenal consciousness was introduced by Ned Block.

Affordances Perceptions that are inextricably tied to actions. J.J. Gibson introduced this term.

Analogy An analogy is a relationship of similarity between entities. There are two factors relevant to the strength of an analogy—(a) the number of properties that are thought to be similar and (b) the level of similarity between those properties. The higher the number of similar properties and the higher the level of similarity between them, the stronger the analogy.

Anecdotal anthropomorphism A scientific method using stories about animal behavior explained in terms of human properties as data to empirically investigate animal mental capacities. This method was developed by George Romanes, a colleague of Charles Darwin, and was common until the 19th century.

Anthropectomy (Gk. anthropos—human; ektomia—to cut out). The denial of human properties to nonhuman animals, usually with the suggestion that the denial isn't justified.

Anthropofabulation The confabulation of human abilities, a false view about human behavior, applied to questions about animal behaviors.

Anthropomorphism The attribution of a human psychological, social, or normative property to a nonhuman animal, usually with the suggestion that the attribution isn't justified.

Associative learning A type of learning that involves associating two objects, properties, or events, which is involved in classical and instrumental conditioning. Associative learning is sometimes given as an example of a low-level cognitive process.

Behaviorism A school of thought that takes the objective evidence of behavior as the only concern of its research and the only basis of its theory without reference to mental experience.

Belief The propositional attitude that one has whenever one takes something to be true.

Biological approach An approach to understanding consciousness that identifies the questions about consciousness with the questions about life, and seeks to understand the function of consciousness.

Biological learning A signal that effects the behaviors of another organism, which evolved because of that effect, and which is effective because the receiver's response has also evolved.

Calibration method Start with a hypothesis, interpret and investigate observations in light of the hypothesis, and then, given the research, tweak the hypothesis and repeat.

Cartesian dualism The doctrine, articulated by René Descartes, that there are two kinds of substance—mental, non-material substance, and physical substance.

Classical conditioning A type of learning that takes place when an unconditioned stimulus is paired with a conditioned stimulus. It is also referred to as Pavlovian conditioning and is a form of associative learning.

Concept A constituent of thought, usually taken to be necessary for a number of psychological processes such as categorization, logical reasoning, memory, and learning.

Content Intentional mental states have content; they are about things. The thing that an intentional mental state is about is referred to as the content of that mental state. While content is usually taken to be propositional, in recent years non-propositional notions of content have been articulated.

Cooperation Working together to achieve a goal.

Cultural learning Learning strategies critical for the development of cultures.

Culture Long-lasting group behavioral patterns or informational resources that are transmitted via social learning.

Direct perception arguments These arguments reject the starting assumption that the existence of other minds is something that needs to be inferred from behavior. Instead, it argues that mentality is something, like color, that can be perceived.

Dispositionalism Dispositionalist accounts explain phenomena in terms of dispositions—ready tendencies of objects to do certain things. The dispositionalist view of belief takes belief to be a disposition of an individual to act or feel in certain ways.

Dynamical systems account A communication account according to which communication is a kind of embodied co-regulation.

Dynamic marker approach An approach to understanding consciousness that starts by identifying the properties that make humans think that the target system is conscious, then generates a starting class of beings across species that have those properties, studies those beings, and as a result modifies the markers and generates a new class of beings that have those properties.

Empathy Feeling what another feels.

Emulation A type of learning involving low fidelity copying of only some elements of a behavior; goal emulation refers to copying only those parts of the action that appear relevant to achieving a goal.

Enactivism Enactivist theories take mind to be either caused by or constitutive of the interactions of a living organism in its social and ecological context.

Epiphenomenalism The view of the relationship between the mental and the physical according to which physical things can cause other physical things, and they can cause mental things, but mental things can't cause anything.

Episodic memory Memory for specific episodes belonging to one's past. It is usually contrasted with semantic memory, understood as memory of concepts or propositions.

Epistemic approach An approach to understanding consciousness that identifies prima facie candidates for consciousness pretheoretically, and takes this as the foundation for any theory of consciousness.

Ethology A branch of biology that investigates the natural behaviors of animals.

Evolutionary parsimony A principle that suggests that evolutionary explanations that postulate fewer entities or processes are superior to those that postulate more entities or processes.

Explanandum A phenomenon that requires an explanation. The explanation is called *explanans*.

Exploration A type of individual learning involving active examination of objects, individuals, or spatial locations without any obvious reinforcement other than the novelty.

False belief task A type of task that is thought to require the attribution of a false belief to pass such that the subject has to infer that another does not possess information that they themself possess.

Folk psychology The commonsense understanding of other minds. For example, describing behavior in terms of folk psychology involves organizing behaviors together into functional types though the use of familiar mental state terms.

Fixed action pattern A sequence of behaviors that cannot be altered and that is carried through to completion once initiated by a stimulus. One classical example is the egg retrieval response of the greylag goose.

Functionalism The view of the mind according to which the nature of mental states is to be explained in terms of their causal roles, and in particular an input–output relationship that holds in virtue of the mental state.

Gene-culture co-evolution Cultural practices create new niches that cause genetic changes that are passed on to future generations.

Global workspace theory Takes consciousness to require information to be widely broadcast to different cognitive systems.

Goggles task A type of experiment where subjects are asked to engage in experience projection and to predict behavior they have never observed before, but only after the subject has been the actor in that same situation.

Hard problem Asks, in virtue of what is a physical system a conscious system

Imitation A type of cultural learning involving high-fidelity copying of all elements of an observed behavior.

Individual learning Learning that does not require a social partner; includes learning by trial and error; insight; and exploration.

Inference to the best explanation The hypothesis that best explains the evidence should be inferred from the evidence over competing hypothesis. In this method, more than one hypothesis must be considered.

Information processing communication A signal sent by a sender to a receiver who decodes the signal to extract the information.

Insight A type of individual learning involving a sudden realization about how to solve a problem, without requiring trial and error.

Intentional communication Communication between minded agents; some theories require mindreading, like the Gricean account, and other theories do not.

Intentionality The "aboutness" of some mental states—the aspect of some mental states that allows them to be described as being directed towards an object. Intentionality is taken to be an essential feature of the mental domain, and is distinguished from consciousness.

Interpretationism The view according to which mental states are only had by an individual insofar as the individual is interpretable as having those mental states. Interpretationism has been defended by Donald Davidson and Daniel Dennett.

Intersubjective The property of being shared by at least two minds.

Kin selection An explanation for altruistic behavior in terms of an organism's having a gene that successfully reproduces because it causes the organism to help close relatives who also share copies.

Language Formal communicative system with a syntactic structure.

Language of thought hypothesis Proposes that thinking occurs in a mental language (*mentalese*) that resembles, in the right sorts of ways, spoken language.

Local (or stimulus) enhancement A type of social learning whereby observing another individual interacting with an object or location causes the observer to interact with the object or explore the location.

Logical problem critique The problem that it is difficult to distinguish between mindreading and behavior reading explanations of animals' performance on experimental tasks, like the false belief task or the goggles task.

Marr's levels of description Explanations at the computational level focus on the goal of the individual; explanations at the algorithmic level focus on the function that achieves the goal; and explanations at the implementation level focus on the physical organization of matter.

Mental representation A psychological object thought to have intentional properties such as content, success conditions, or reference, and which is essential for thought on mainstream views in philosophy and psychology. A mental representation relates to the world like the way a map of Toronto relates to the city of Toronto.

Mental time travel The ability to project oneself mentally either backward or forward in time, which allows one to remember past events or envision future events.

Metacognition The ability to represent mental states. Typically, metacognition is understood as the ability to have thoughts about mental states, while mindreading is understood as the specific ability to have thoughts about others' mental states.

Metaphysics of mind The philosophical project that investigates the nature and essential features of the mental.

Mind body problem Asks what kinds of relationships exist between mental event properties, functioning, etc. and physical events, properties, functioning, etc.

Mindreading (Theory of mind) The practice of attributing mental states to oneself and others.

Moral agent Individuals who have the ability to act morally, and hence who are responsible for their actions.

Moral Foundations Theory A theory that identifies dimension of morality including: harm/care, fairness/reciprocity, in-group/loyalty, authority/respect, purity/sanctity, liberty/oppression; developed by Jonathan Haidt and colleagues.

Moral particularism An approach to ethics that eschews moral principles and focuses on judgments about particular cases.

Moral patients Individuals who matter morally and have moral standing, but who may not be held morally responsible for their actions.

Moral subject A middle ground of moral participation between moral agent and moral patient suggested by Mark Rowlands (2012).

Morgan's Canon A prohibition on interpreting animal behavior in terms of higher cognitive processes if it can be interpreted in terms of lower cognitive processes.

Multiple realizability In the philosophy of mind, the idea that different physical states and events can play the right kinds of roles to count as the same mental state or event. For example, if the neuronal configuration in human Poppy's brain plays the right kind of causal role, then it is right to say that Poppy believes that water is wet. If a very different neuronal configuration in dolphin Frank's brain plays the right kind of causal role, then it is right to say that Frank believes that water is wet. In other words, the same belief, Poppy's belief that water is wet and Frank's belief that water is wet, are realized by different physical structures. It is often thought that functionalism's ability to accommodate multiple realizability is an advantage.

Ontogeny The development of an organism over the lifespan.

Operant conditioning A type of learning through which a behavior that is followed by a reinforcer becomes more frequent, while a behavior that is followed by a punishment becomes less frequent. It is also referred to as instrumental learning, and is a form of associative learning.

Operationalize A term used in scientific research to refer to the process through which a phenomenon receives a definition that renders it measurable.

Ostensive communication A type of intentional communication which requires both a message and an 'act of address' that signifies that the message is intended for the receiver.

Panpsychism The view according to which the fundamental building blocks of reality are minded.

Phenomenal consciousness The property of mental states that have a "what it is like" character, or a distinctively qualitative dimension that is accessible only to the subject.

Phylogeny The evolutionary history of an organism or taxa.

Physicalism The view that everything that exists, including the mind and the mental, is physical.

Problem of other minds I can directly know that I have a mind, but I can only infer that you have a mind. This problem has not been taken as a serious problem for other human minds but has been taken as a serious problem when it comes to other animal minds.

Proposition Content which can be expressed by a declarative sentence, and which is typically viewed as the object of belief. The same proposition may be expressed by different sentences. For example, "It is raining" and "Il pleut" express the same proposition.

Qualia The distinctive subjective character of conscious mental states. Examples might include the hurty-ness of pain (for you), the redness of the color red (for you), or the extreme irritation you might feel when someone runs her fingernails across a chalkboard.

Rationality Can be defined: structurally as when thought processes follow the rules of logic or another set of rules; behaviorally as when behavior makes sense given the organisms' past experience and current situation.

Reciprocal altruism A type of behavior in which one individual helps another individual with the expectation that the helped individual will provide a reward later on. If this expectation is warranted, then the helping behavior will not result in a loss of fitness for the helper.

Selective social learning/learning biases A type of cultural learning involving leaning strategies that shape how knowledge and skills spread through a community. Strategies include information about who to copy and when to copy.

Sentimentalism The meta-ethical view according to which morality is grounded in emotions.

Sherlock Holmes method Formulate explanations and then make predictions based on those explanations. A successful prediction confirms the explanation, and a failed one causes re-evaluation of the explanation.

Social intelligence hypothesis The hypothesis according to which the challenges of social interaction drives the development of sophisticated cognitive capacities. This view was developed by Alison Jolly and Nicholas Humphrey.

Social learning Includes learning by local (or stimulus) enhancement; conformity or copying; and emulation.

Social norm A pattern of behavior demonstrated by community members such that individuals are free to conform to the pattern of behavior or not and that individuals expect that community members will also conform, and will sanction those who do not conform.

Solipsism The doctrine that all that exists is one's own mind and its contents.

Systematicity The property of thought that entails that the ability to entertain one thought is essentially linked with the ability to entertain other thoughts.

Teaching A type of cultural learning involving effort on the part of a demonstrator that results in the learning of new information or skills on the part of the observer where: (1) an individual A modifies their behavior only in the presence of a naïve observer B; (2) A incurs some cost or derives no immediate benefit; and (3) as a result of A's behavior, B acquires knowledge or skills more quickly than they would otherwise (Caro and Hauser 1992).

Theoretical entity The entity designated by a theoretical term within a theory, and which is essentially unobservable.

Theory approach An approach to understanding consciousness that applies theories of consciousness to animals in order to determine which species would count as conscious according to that theory.

Trial and error A type of individual learning involving the manipulation of elements in the world in a relatively random way, not guided by the manipulation of mental representations in the head.

Utilitarianism The view according to which actions are morally right insofar as they maximize utility—pleasure, happiness, general well-being, or some other kind of goodness.

Veneer theory The view according to which morality is a cultural innovation that barely hides the intrinsically selfish nature of individuals.

Virtue ethics An ethical theory that insists on the essential role played by the cultivation of character traits and character in moral behavior.

Bibliography

Abbott, H. Porter. *The Cambridge Introduction to Narrative*. New York: Cambridge University Press, 2002.

Achenbach, Thomas M., and Craig S. Edelbrock. *Manual for the Child Behavior Checklist and Revised Child Behavior Profile*. Burlington, VT: T.M. Achenbach, 1983.

Adams, Christopher D., and Anthony Dickinson. "Instrumental Responding Following Reinforcer Devaluation." *The Quarterly Journal of Experimental Psychology Section B 33*, *2* (1981): 109–121.

Addessi, Elsa, and Sabrina Rossi. "Tokens Improve Capuchin Performance in the Reverse–Reward Contingency Task." *Proceedings of the Royal Society B: Biological Sciences 278*, *1707* (2011): 849–854.

Adelmann, Pamela K., and Robert B. Zajonc. "Facial Efference and the Experience of Emotion." *Annual Review of Psychology 40*, *1* (1989): 249–280.

Aglioti, Salvatore, Joseph F. X. DeSouza, and Melvyn A. Goodale. "Size-Contrast Illusions Deceive the Eye but Not the Hand." *Current Biology 5*, *6* (1995): 679–685.

Allen, Colin. "Animal Concepts Revisited: The Use of Self-Monitoring as an Empirical Approach." *Erkenntnis 51* (1999): 537–544.

Allen, Colin. "Transitive Inference in Animals: Reasoning or Conditioned Associations?" In *Rational Animals?* edited by Susan Hurley and Matthew Nudds, 175–185. Oxford: Oxford University Press, 2006.

Allen, Colin. "The Geometry of Partial Understanding." *American Philosophical Quarterly 50*, *3* (2013): 249–262.

Allen, Colin, and Marc Bekoff. *Species of Mind: The Philosophy and Biology of Cognitive Ethology*. Cambridge, MA: MIT Press, 1997.

Allen, Colin, and Marc D. Hauser. "Concept Attribution in Nonhuman Animals: Theoretical and Methodological Problems in Ascribing Complex Mental Processes." *Philosophy of Science 58* (1991): 221–240.

Allen, Jedediah W. P., and Mark H. Bickhard. "Emergent Constructivism." *Child Development Perspectives 5*, *3* (2011): 164–165.

Allen-Hermanson, Sean. "Insects and the Problem of Simple Minds: Are Bees Natural Zombies?" *Journal of Philosophy 105* (2008): 389–415.

Amy, Mathieu, Philipp Sprau, Piet de Goede, and Marc Naguib. "Effects of Personality on Territory Defence in Communication Networks: A Playback Experiment with Radio-Tagged Great Tits." *Proceedings of the Royal Society B: Biological Sciences 277*, *1700* (2010): 3685–3692.

Anderson, James R., and Gordon G. Gallup. "Which Primates Recognize Themselves in Mirrors?" *PLoS Biol 9*, *3* (2011): e1001024, doi:10.1371/journal.pbio.1001024.

Andics, A., M. Gácsi, T. Faragó, A. Kis, and Á. Miklósi. "Voice-Sensitive Regions in the Dog and Human Brain Are Revealed by Comparative fMRI." *Current Biology 24*, *5* (2014): 574–578.

Andrews, Kristin. "Interpreting Autism: A Critique of Davidson on Thought and Language." *Philosophical Psychology 15* (2002): 317–332.

Andrews, Kristin. "Chimpanzee Theory of Mind: Looking in All the Wrong Places?" *Mind & Language 20*, *5* (2005): 521–536.

Andrews, Kristin. "Politics or Metaphysics? On Attributing Psychological Properties to Animals." *Biology & Philosophy 24*, *1* (2009): 51–63.

Andrews, Kristin. "Beyond Anthropomorphism." In *The Oxford Handbook of Animal Ethics*, edited by Tom L. Beauchamp and R. G. Frey, 469–493. Oxford: Oxford University Press, 2011.

Andrews, Kristin. *Do Apes Read Minds? Toward a New Folk Psychology*. Cambridge, MA: MIT Press, 2012a.

Andrews, Kristin. "Robert W. Lurz, Mindreading Animals: The Debate over What Animals Know about Other Minds." *Notre Dame Philosophical Reviews* (2012b). http://ndpr.nd.edu/news/29824-mindreading-animals-the-debate-over-what-animals-know-about-other-minds/. Accessed July 25, 2014.

Andrews, Kristin. "Great Ape Mindreading: What's at Stake?" In *The Politics of Species: Reshaping Our Relationships with Other Animals*, edited by Raymond Corbey and Annette Lanjouw, 115–125. Cambridge: Cambridge University Press, 2013.

Andrews, Kristin. "The Folk Psychological Spiral: Explanation, Regulation, and Language." *The Southern Journal of Philosophy 53* (2015): 50–67.

Andrews, Kristin. "Naïve Normativity: The Social Foundation of Moral Cognition." *The Journal of the American Philosophical Association*, doi:10.1017/apa.2019.30, Online first, 20 January 2020.

Andrews, Kristin. *How to Study Animal Minds*. Cambridge University Press, forthcoming 2020.

Andrews, Kristin, Gary L. Comstock, Crozier G. K. D., Sue Donaldson, Andrew Fenton, Tyler M. John, L. Syd M. Johnson, Robert C. Jones, Will Kymlicka, Letitia Meynell, Nathan Nobis, David Pena-Guzman, James Rocha, Bernard Rollin, Jeff Sebo, Adam Shriver, Rebecca L. "Walker. Proposed Brief By Amici Curiae Philosophers in Support of the Petitioner-Appellant." https://www.nonhumanrights.org/content/uploads/In-re-Nonhuman-Rights-v.-Lavery-Proposed-Brief-by-PHILOSOPHERS-74435.pdf, 2018a.

Andrews, Kristin, Gary L. Comstock, Crozier G. K. D. Sue Donaldson, Andrew Fenton, Tyler M. John, L. Syd M. Johnson, Robert C. Jones, Will Kymlicka, Letitia Meynell, Nathan Nobis, David Pena-Guzman, Jeff Sebo. *Chimpanzee Rights: The Philosophers' Brief*, 1 edition. New York: Routledge, 2018b.

Andrews, Kristin, and Lori Gruen. "Empathy in Other Apes." In *Empathy and Morality*, edited by Heidi L. Maibom, 193–209. Oxford: Oxford University Press, 2014.

Andrews, Kristin, and Brian Huss. "Anthropomorphism, Anthropectomy, and the Null Hypothesis." *Biology & Philosophy 29* (2014): 1–19.

Andrews, Kristin, and Ljiljana Radenovic. "Speaking without Interpreting: A Reply to Bouma on Autism and Davidsonian Interpretation." *Philosophical Psychology 19* (2006): 663–678.

Apperly, Ian A., and Stephen A. Butterfill. "Do Humans Have Two Systems to Track Beliefs and Belief-like States?" *Psychological Review 116*, *4* (2009): 953–970.

Apperly, Ian A., and Elizabeth J. Robinson. "Children's Difficulties Handling Dual Identity." *Journal of Experimental Child Psychology 78*, *4* (2001): 374–397.

Apperly, Ian A., and Elizabeth J. Robinson. “Five-Year-Olds’ Handling of Reference and Description in the Domains of Language and Mental Representation.” *Journal of Experimental Child Psychology 83*, *1* (2002): 53–75.

Apperly, Ian A., and Elizabeth J. Robinson. “When Can Children Handle Referential Opacity? Evidence for Systematic Variation in 5- and 6-Year-Old Children’s Reasoning about Beliefs and Belief Reports.” *Journal of Experimental Child Psychology 85*, *4* (2003): 297–311.

Arbib, Michael A. “The Mirror System, Imitation, and the Evolution of Language.” In *Imitation in Animals and Artifacts*, edited by Chrystopher L. Nehaniv and Kerstin Dautenhahn, 229–280. Cambridge, MA: MIT Press, 2002.

Arbib, Michael A. “From Monkey-like Action Recognition to Human Language: An Evolutionary Framework for Neurolinguistics.” *Behavioral and Brain Sciences 28*, *2* (2005): 105–124.

Arbib, Michael A., Katja Liebal, and Simone Pika. “Primate Vocalization, Gesture, and the Evolution of Human Language.” *Current Anthropology 49*, *6* (2008): 1053–1076.

Argyle, Michael, and Mark Cook. *Gaze and Mutual Gaze*. New York: Cambridge University Press, 1976.

Aristotle. *The Complete Works of Aristotle. Volume One*. Edited by Jonathan Barnes. Princeton, NJ: Princeton University Press, 1984.

Arnold, Kate, and Klaus Zuberbühler. “Language Evolution: Semantic Combinations in Primate Calls.” *Nature 441*, *7091* (2006): 303.

Aron, Serge, R. Beckers, Jean-Louis Deneubourg, and J. M. Pasteels. “Memory and Chemical Communication in the Orientation of Two Mass-Recruiting Ant Species.” *Insectes Sociaux 40*, *4* (1993): 369–380.

Aronson, Lester Ralph. “Orientation and Jumping Behavior in the Gobiid Fish Bathygobius Soporator. American Museum Novitates; No. 1486” (1951). http://digitallibrary.amnh.org/dspace/handle/2246/3993. Accessed July 25, 2014.

Aronson, Lester Ralph. “Further Studies on Orientation and Jumping Behavior in the Gobiid Fish, Bathygobius Soporator.” *Annals of the New York Academy of Sciences 188*, *1* (1971): 378–392.

Arrington, Robert L., and Hans-Johann Glock. *Wittgenstein and Quine*. New York: Routledge, 1996.

Audi, Robert. “Dispositional Beliefs and Dispositions to Believe.” *Noûs 28*, *4* (1994): 419–434.

Baars, Bernard J. *A. Cognitive Theory of Consciousness*. Cambridge: Cambridge University Press, 1988.

Babikova, Zdenka, Lucy Gilbert, Toby J. A. Bruce, Michael Birkett, John C. Caulfield, Christine Woodcock, John A. Pickett, and David Johnson. “Underground Signals Carried through Common Mycelial Networks Warn Neighbouring Plants of Aphid Attack.” Edited by Nicole van Dam. *Ecology Letters 16*, *7* (2013): 835–843.

Baillargeon, Renee, Rose M. Scott, and Zijing He. “False-Belief Understanding in Infants.” *Trends in Cognitive Sciences 14*, *3* (2010): 110–118.

Balter, Michael. “Stone-Throwing Chimp Is Back – And This Time It’s Personal.” *Science Now*, May 9, 2012. http://news.sciencemag.org/2012/05/stone-throwing-chimp-back-and-time-its-personal. Accessed July 25, 2014.

Bar-On, Dorit. *Speaking My Mind: Expression and Self-Knowledge*. New York: Oxford University Press, 2004.

Bar-On, Dorit. “The Origin of Meaning: Must We ‘Go Gricean’?” *Mind and Language 28*, *3* (2013): 342–375.

Bard, Kim A., Brenda K. Todd, Chris Bernier, Jennifer Love, and David A. Leavens. “Self-Awareness in Human and Chimpanzee Infants: What Is Measured and What Is Meant by the Mark and Mirror Test?” *Infancy 9*, *2* (2006): 191–219.

Bargh, John A., Mark Chen, and Lara Burrows. “Automaticity of Social Behavior: Direct Effects of Trait Construct and Stereotype Activation on Action.” *Journal of Personality and Social Psychology 71*, *2* (1996): 230–244.

Barkow, Jerome H., Leda Cosmides, and John Tooby. *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*. New York: Oxford University Press, 1995.

Baron-Cohen, Simon. *Mindblindness: An Essay on Autism and Theory of Mind*. Cambridge, MA: MIT Press, 1995.

Barrett, Louise. *Beyond the Brain: How Body and Environment Shape Animal and Human Minds*. Princeton, NJ: Princeton University Press, 2011.

Barrett, Louise, Peter Henzi, and Drew Rendall. "Social Brains, Simple Minds: Does Social Complexity Really Require Cognitive Complexity?" *Philosophical Transactions of the Royal Society B: Biological Sciences 362*, *1480* (2007): 561–575.

Bartal, Indal Ben-Ami, Jean Decety, and Peggy Mason. "Empathy and Pro-Social Behavior in Rats." *Science 334*, *6061* (2011): 1427–1430.

Bartal, Indal Ben-Ami, Haozhe Shan, Nora Molasky, Teresa Murray-Torres, Jasper Williams, Jean Decety, Peggy Mason. "Anxiolytic Treatment Impairs Helping Behavior in Rats." *Frontiers in Psychology 7, 158* (2016): 850.

Barth, Hilary, Nancy Kanwisher, and Elizabeth Spelke. "The Construction of Large Number Representations in Adults." *Cognition 86*, *3* (2003): 201–221.

Bateson, Melissa, Suzanne Desire, Sarah E. Gartside, and Geraldine A. Wright. "Agitated Honeybees Exhibit Pessimistic Cognitive Biases." *Current Biology 21*, *12* (2011): 1070–1073.

Baumard, Nicolas, and Dan Sperber. "Weird People, Yes, but Also Weird Experiments." *Behavioral and Brain Sciences 33*, *2–3* (2010): 84–85.

Bebko, Adam, Phillips, Krista, and Andrews, Kristin. Dancing Around the Starting Line: Gene-Culture Co-Evolutoin in Nonhuman Animals, in preparation.

Bebko, Adam "Factors Influencing the Choice of Foraging Route in Wild East Bornean Orangutans (Pongo pygmaeus morio)." Master's Thesis. York University, Toronto, Canada, 2012.

Beck, Jacob. "The Generality Constraint and the Structure of Thought." *Mind 121*, *483* (2012): 563–600.

Beck, Jacob. "Why We Can't Say What Animals Think." *Philosophical Psychology 26*, *4* (2013): 520–546.

Beck, Jacob. "Do Nonhuman Animals have a Language of Thought?" In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 46–55. New York: Routledge, 2018.

Behne, Tanya, Malinda Carpenter, and Michael Tomasello. "One-Year-Olds Comprehend the Communicative Intentions behind Gestures in a Hiding Game." *Developmental Science 8*, *6* (2005): 492–499.

Bekoff, Marc. *Why Dogs Hump and Bees Get Depressed: The Fascinating Science of Animal Intelligence, Emotions, Friendship, and Conservation*. Novato, CA: New World Library, 2013.

Bekoff, Marc, and Dale Jamieson (eds). *Interpretation and Explanation in the Study of Animal Behavior: Vol. 1, Interpretation, Intentionality, and Communication*. Boulder, CO: Westview Press, 1990.

Bekoff, Marc, and Jessica Pierce. *Wild Justice: The Moral Lives of Animals*. Chicago, IL: University of Chicago Press, 2009.

Bekoff, Marc, Colin Allen, and Gordon M. Burghardt. *The Cognitive Animal: Empirical and Theoretical Perspectives on Animal Cognition*. Cambridge, MA: MIT Press, 2002.

Bennett, Edward L., David Krech, and Mark R. Rosenzweig. "Reliability and Regional Specificity of Cerebral Effects of Environmental Complexity and Training." *Journal of Comparative and Physiological Psychology 57*, *3* (1964): 440–441.

Bennett, Jonathan. "Some Remarks about Concepts." *Behavioral and Brain Sciences 1* (1978): 557–560.

Bentham, Jonathan. *An Introduction to the Principles of Morals and Legislation.* http://www.koeblergerhard.de/Fontes/BenthamJeremyMoralsandLegislation1789.pdf, 1879.

Beran, Michael J., Bonnie M. Perdue, Jessica L. Bramlett, Charles R. Menzel, and Theodore A. Evans. "Prospective Memory in a Language-Trained Chimpanzee (Pan Troglodytes)." *Learning and Motivation 43*, *4* (2012): 192–199.

Beran, Michael J., J. David Smith, Joshua S. Redford, and David A. Washburn. "Rhesus Macaques (Macaca Mulatta) Monitor Uncertainty during Numerosity Judgments." *Journal of Experimental Psychology: Animal Behavior Processes 32*, *2* (2006): 111–119.

Bermúdez, José Luis. *Thinking without Words*. Oxford: Oxford University Press, 2003.

Bermúdez, José Luis. "The Force-Field Puzzle and Mindreading in Non-Human Primates." *Review of Philosophy and Psychology 2*, *3* (2011): 397–410.

Berns, Gregory. *How Dogs Love Us: A Neuroscientist and His Adopted Dog Decode the Canine Brain*. New York: New Harvest, 2013.

Berns, Gregory S., Andrew M. Brooks, and Mark Spivak. "Functional MRI in Awake Unrestrained Dogs." Edited by Stephan C. F. Neuhauss. *PLoS ONE 7*, *5* (2012): e38027.

Bicchieri, C. *Norms in the Wild: How to Diagnose, Measure, and Change Social Norms*. Oxford: Oxford University Press, 2017.

Biro, Dora, and Tetsuro Matsuzawa. "Use of Numerical Symbols by the Chimpanzee (Pan Troglodytes): Cardinals, Ordinals, and the Introduction of Zero." *Animal Cognition 4*, *3–4* (2001): 193–199.

Block, Ned. "On a Confusion about a Function of Consciousness." In *The Nature of Consciousness: Philosophical Debates*, edited by Ned Block, Owen Flanagan and Güven Güzeldere, 375–416. Cambridge, MA: MIT Press, 1997.

Bloom, Paul. "Can a Dog Learn a Word?" *Science 304*, *5677* (2004): 1605–1606.

Bodamar, Mark D., and R. Allen Gardner. "How Cross-Fostered Chimpanzees (Pan Troglodytes) Initiate and Maintain Conversations." *Journal of Comparative Psychology 116*, *1* (2002): 12–26.

Boesch, Christophe. "Aspects of Transmission of Tool-Use in Wild Chimpanzees." In *Tools, Language and Cognition in Human Evolution*, edited by K. R. Gibson, 171–183. New York: Cambridge University Press, 1993.

Boesch, Christophe. "Cooperative Hunting in Wild Chimpanzees." *Animal Behaviour 48*, *3* (1994): 653–667.

Boesch, Christophe. "Cooperative Hunting Roles among Taï Chimpanzees." *Human Nature 13*, *1* (2002): 27–46.

Boesch, Christophe. "Joint Cooperative Hunting among Wild Chimpanzees: Taking Natural Observations Seriously." *Behavioral and Brain Sciences 28* (2005): 692.

Boesch, Christophe. "What Makes Us Human (Homo Sapiens)? The Challenge of Cognitive Cross-Species Comparison." *Journal of Comparative Psychology 121* (2007): 227–240.

Boesch, Christophe, and Hedwige Boesch. "Mental Map in Wild Chimpanzees: An Analysis of Hammer Transports for Nut Cracking." *Primates 25*, *2* (1984): 160–170.

Bolhuis, Johan J., Kazuo Okanoya, and Constance Scharff. "Twitter Evolution: Converging Mechanisms in Birdsong and Human Speech." *Nature Reviews Neuroscience 11*, *11* (2010): 747–759.

Bonnie, Kristin E., Victoria Horner, Andrew Whiten, and Frans B. M. de Waal. "Spread of Arbitrary Conventions among Chimpanzees: A Controlled Experiment." *Proceedings of the Royal Society B*, *274* (2007): 367–372.

Brent, Lauren J. N., Daniel W. Franks, Emma A. Foster, Kenneth C. Balcomb, Michael A. Cant, Darren P. Croft. "Ecological Knowledge, Leadership, and the Evolution of Menopause in Killer Whales." *Current Biology 25* (2015): 746–750.

Brosnan, Sarah F., Hillary C. Schiff, and Frans B. M. de Waal. "Tolerance for Inequity May Increase with Social Closeness in Chimpanzees." *Proceedings of the Royal Society B: Biological Sciences 272*, *1560* (2005): 253–258.

Brosnan, Sarah F., Catherine Talbot, Megan Ahlgren, Susan P. Lambeth, and Steven J. Schapiro. "Mechanisms Underlying Responses to Inequitable Outcomes in Chimpanzees, Pan Troglodytes." *Animal Behaviour 79*, *6* (2010): 1229–1237.

Brotcorne, Fany, Gwennan Giraud, Noëlle Gunst, Agustín Fuentes, I. Nengah Wandia, Roseline C. Beudels-Jamar, Pascal Poncin, Marie-Claude Huynen, and Jean-Baptiste Leca. "Intergroup Variation in Robbing and Bartering by Long-Tailed Macaques at Uluwatu Temple (Bali, Indonesia)." *Primates 58*, *4* (2017): 505–516.

Borgia, Gerald. "Bower Quality, Number of Decorations and Mating Success of Male Satin Bowerbirds (Ptilonorhynchus Violaceus): An Experimental Analysis." *Animal Behaviour 33*, *1* (1985): 266–271.

Botero, Maria. "Bringing Touch Back to the Study of Emotions in Human and Non-Human Primates: A Theoretical Exploration." *International Journal of Comparative Psychology 30*, *10* (2018).

Botero, Maria. "Primates Are Touched by Your Concern: Touch, Emotion, and Social Cognition in Chimpanzees." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 372–380. New York: Routledge, 2018.

Bower, Bruce. "The Hot and Cold of Priming: Psychologists Are Divided on Whether Unnoticed Cues Can Influence Behavior." *Science News 181*, *10* (2012): 26–29.

Boysen, Sarah T., Gary G. Berntson, Michelle B. Hannan, and John T. Cacioppo. "Quantity-Based Interference and Symbolic Representations in Chimpanzees (Pan Troglodytes)." *Journal of Experimental Psychology: Animal Behavior Processes 22*, *1* (1996): 76–86.

Boysen, Sarah T., Kimberly L. Mukobi, and Gary G. Berntson. "Overcoming Response Bias Using Symbolic Representations of Number by Chimpanzees (Pan Troglodytes)." *Animal Learning & Behavior 27*, *2* (1999): 229–235.

Braddon-Mitchell, David, and Frank Jackson. *The Philosophy of Mind and Cognition*. Oxford: Blackwell Publishers, 1996.

Bradshaw, Gay A., Theodora Capaldo, Lorin Lindner, and Gloria Grow. "Building an Inner Sanctuary: Complex PTSD in Chimpanzees." *Journal of Trauma & Dissociation: The Official Journal of the International Society for the Study of Dissociation (ISSD) 9*, *1* (2008): 9–34.

Braithwaite, Victoria. *Do Fish Feel Pain?* Oxford: Oxford University Press, 2010.

Bratman, Michael. "Shared Cooperative Activity." *The Philosophical Review 101*, *2* (1992): 329–341.

Bräuer, Juliane, Josep Call, and Michael Tomasello. "All Great Ape Species Follow Gaze to Distant Locations and around Barriers." *Journal of Comparative Psychology 119*, *2* (2005): 145–154.

Bräuer, Juliane, Juliane Kaminski, Julia Riedel, Josep Call, and Michael Tomasello. "Making Inferences about the Location of Hidden Food: Social Dog, Causal Ape." *Journal of Comparative Psychology 120*, *1* (2006): 38–47.

Bräuer, Juliane, Magdalena Keckeisen, Andrea Pitsch, Juliane Kaminski, Josep Call, and Michael Tomasello. "Domestic Dogs Conceal Auditory but Not Visual Information from Others." *Animal Cognition 16*, *3* (2013): 1–9.

Brook, Andrew, and Kathleen Akins. *Cognition and the Brain: The Philosophy and Neuroscience Movement*. New York: Cambridge University Press, 2005.

Brooks, Rodney A. "Intelligence without Representation." *Artificial Intelligence 47*, *1–3* (1991): 139–159.

Brosnan, Sarah F., and Frans B. M. de Waal. "A Proximate Perspective on Reciprocal Altruism." *Human Nature 13* (2002): 129–152.

Brown, Culum, Martin P. Garwood, and Jane E. Williamson. "It Pays to Cheat: Tactical Deception in a Cephalopod Social Signalling System." *Biology Letters 8*, *5* (2012): 729–732.

Bshary, Redouan, Andrea Hohner, Karim Ait-el-Djoudi, and Hans Fricke. "Interspecific Communicative and Coordinated Hunting between Groupers and Giant Moray Eels in the Red Sea." *PLoS Biology 4*, *12* (2006): e431, doi:10.1371/journal.pbio.0040431.

Buckner, Cameron. "Morgan's Canon, Meet Hume's Dictum: Avoiding Anthropofabulation in Cross-Species Comparisons." *Biology & Philosophy 28*, *5* (2013): 853–871.

Bugnyar, Thomas, Maartje Kijne, and Kurt Kotrschal. "Food Calling in Ravens: Are Yells Referential Signals?" *Animal Behaviour 61*, *5* (2001): 949–958.

Burghardt, Gordon M. *The Genesis of Animal Play: Testing the Limits*. Cambridge, MA: MIT Press, 2005.

Burkart, Judith M., Ernst Fehr, Charles Efferson, and Carel P. van Schaik. "Other-Regarding Preferences in a Non-Human Primate: Common Marmosets Provision Food Altruistically." *Proceedings of the National Academy of Sciences 104*, *50* (2007): 19762–19766.

Burkhardt, Richard W. *Patterns of Behavior: Konrad Lorenz, Niko Tinbergen, and the Founding of Ethology*. Chicago, IL: University of Chicago Press, 2005.

Buttelmann, David, Malinda Carpenter, and Michael Tomasello. "Eighteen-Month-Old Infants Show False Belief Understanding in an Active Helping Paradigm." *Cognition 112*, *2* (2009): 337–342.

Buttelmann, David, Norbert Zmyj, Moritz M. Daum, and Malinda Carpenter. "Selective Imitation of In-group over Out-group Members in 14-month-old Infants." *Child Development 84, 2* (2013): 422–428.

Butterfill, Stephen A., and Ian A. Apperly. "How to Construct a Minimal Theory of Mind." *Mind & Language 28*, *5* (2013): 606–637.

Byrne, Richard W. "What's the Use of Anecdotes? Distinguishing Psychological Mechanisms in Primate Tactical Deception." In *Anthropomorphism, Anecdotes, and Animals*, edited by Robert W. Mitchell, Nicholas S. Thompson and H. Lyn Miles, 134–150. Albany: State University of New York Press, 1997.

Byrne, Richard W., and Anne E. Russon. "Learning by Imitation: A Hierarchical Approach." *Behavioral and Brain Sciences 21*, *5* (1998): 667–684.

Byrne, Richard W., and Andrew Whiten, (eds). *Machiavellian Intelligence: Social Expertise and the Evolution of Intellect in Monkeys, Apes, and Humans*. Oxford: Oxford University Press, 1988.

Caine, Nancy G., Rebecca L. Addington, and Tammy L. Windfelder. "Factors Affecting the Rates of Food Calls given by Red-Bellied Tamarins." *Animal Behaviour 50*, *1* (1995): 53–60.

Call, Josep. "Inferences about the Location of Food in the Great Apes (Pan Paniscus, Pan Troglodytes, Gorilla Gorilla, and Pongo Pygmaeus)." *Journal of Comparative Psychology 118*, *2* (2004): 232–241.

Call, Josep. "Inferences by Exclusion in the Great Apes: The Effect of Age and Species." *Animal Cognition 9*, *4* (2006): 393–403.

Call, Josep, and Michael Tomasello. "The Social Learning of Tool Use by Orangutans (Pongo Pygmaeus)." *Human Evolution 9*, *4* (1994): 297–313.

Call, Josep, and Michael Tomasello. "A Nonverbal False Belief Task: The Performance of Children and Great Apes." *Child Development 70*, *2* (1999): 381–395.

Call, Josep, and Michael Tomasello (eds). *The Gestural Communication of Apes and Monkeys*. New York: Taylor & Francis Group/Lawrence Erlbaum Associates, 2007.

Call, Josep, Brian Hare, Malinda Carpenter, and Michael Tomasello. "'Unwilling' versus 'Unable': Chimpanzees' Understanding of Human Intentional Action." *Developmental Science 7* (2004): 488–498.

Camaioni, Luigia. "Continuity versus Discontinuity in the Development of Pre-Linguistic and Linguistic Communication." *Sistemi Intelligenti 5*, *2* (1993): 189–197.

Camp, Elisabeth. "Thinking with Maps." *Philosophical Perspectives 21*, *1* (2007): 145–182.

Camp, Elisabeth. "A Language of Baboon Thought?" In *Philosophy of Animal Minds*, edited by Robert Lurz, 108–127. New York: Cambridge University Press, 2009.

Camp, Elisabeth, and Eli Shupe. "Instrumental Reasoning in Nonhuman Animals." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 100–108. New York: Routledge, 2018.

Capitan, William H., and Daniel Davy Merrill. *Art, Mind, and Religion*. Pittsburgh, PA: University of Pittsburgh Press, 1967.

Carey, Susan. *The Origin of Concepts*. New York, Oxford: Oxford University Press, 2009.

Caro, Tim M., and Marc D. Hauser. "Is there Teaching in Nonhuman Animals." *Quarterly Review of Biology 67* (1992): 151–174.

Carpenter, Malinda, Nameera Akhtar, and Michael Tomasello. "Fourteen-through 18-Month-Old Infants Differentially Imitate Intentional and Accidental Actions." *Infant Behavior and Development 21*, *2* (1998): 315–330.

Carroll, Lewis. "What the Tortoise Said to Achilles." *Mind 4, 14* (1895): 278–280.

Carruthers, Peter. "Brute Experience." *The Journal of Philosophy 86*, *5* (1989): 258–269.

Carruthers, Peter. *Phenomenal Consciousness*. Cambridge: Cambridge University Press, 2000.

Carruthers, Peter. "Suffering without Subjectivity." *Philosophical Studies 121* (2004): 99–125.

Carruthers, Peter. *Consciousness: Essays from a Higher-Order Perspective*. Oxford: Oxford University Press, 2005.

Carruthers, Peter. "Meta-Cognition in Animals: A Skeptical Look." *Mind & Language 23*, *1* (2008): 58–89.

Carruthers, Peter. "How We Know Our Own Minds: The Relationship between Mindreading and Metacognition." *Behavioral and Brain Sciences 32* (2009): 121–182.

Carruthers, Peter. "Introspection: Divided and Partly Eliminated." *Philosophy and Phenomenological Research 80*, *1* (2010): 76–111.

Carruthers, Peter. *The Opacity of Mind: An Integrative Theory of Self-Knowledge*. Oxford: Oxford University Press, 2011.

Carruthers, Peter. "Animal Minds Are Real, (Distinctively) Human Minds Are Not." *American Philosophical Quarterly 50* (2013): 233–247.

Carruthers, Peter. "The Problem of Animal Consciousness." *92nd Pacific Division Meeting of the American Philosophical Association 92* (2018): 179–205.

Carruthers, Peter, and J. Brendan Ritchie. "The Emergence of Metacognition: Affect and Uncertainty in Animals." *Foundations of Metacognition 6* (2012): 76–93.

Cartmill, Erica A., and Richard W. Byrne. "Orangutans Modify Their Gestural Signaling According to Their Audience's Comprehension." *Current Biology17*, *15* (2007): 1345–1348.

Cavalieri, Paola, and Peter Singer. *The Great Ape Project: Equality beyond Humanity*. New York: St. Martin's Press, 1993.

Chalmers, David J. "Facing Up to the Problem of Consciousness." In *Toward a Science of Consciousness*, edited by Stuart R. Hameroff, Alfred W. Kaszniak, and Alwyn C. Scott, *1*: 5–28. Cambridge, MA: MIT Press, 1996.

Chapman, Colin A., and Louis Lefebvre. "Manipulating Foraging Group Size: Spider Monkey Food Calls at Fruiting Trees." *Animal Behaviour 39*, *5* (1990): 891–896.

Chater, Nick, and Cecilia Heyes. "Animal Concepts: Content and Discontent." *Mind and Language 9* (1994): 209–246.

Cheney, Dorothy L., and Robert M. Seyfarth. "Attending to Behaviour versus Attending to Knowledge: Examining Monkeys' Attribution of Mental States." *Animal Behaviour 40*, *4* (1990): 742–753.

Cheney, Dorothy L., and Robert M. Seyfarth. *How Monkeys See the World: Inside the Mind of Another Species*. Chicago, IL: University of Chicago Press, 1996.

Cheney, Dorothy L., and Robert M. Seyfarth. "Constraints and Preadaptations in the Earliest Stages of Language Evolution." *The Linguistic Review 22*, *2–4* (2005): 135–159.

Cheney, Dorothy L., and Robert M. Seyfarth. *Baboon Metaphysics: The Evolution of a Social Mind*. Chicago, IL: University of Chicago Press, 2007.

Cheney, Dorothy L., and Robert M. Seyfarth. "Flexible Usage and Social Function in Primate Vocalizations." *Proceedings of the National Academy of Sciences 115, 9* (2018): 1974–1979.

Chomsky, Noam. *Aspects of the Theory of Syntax*. Cambridge, MA: MIT Press, 1965.

Chomsky, Noam. "Human Language and Other Semiotic Systems." In *Speaking of Apes: A Critical Anthology of Two-Way Communication with Man*, edited by Thomas A. Sebeok and Jean Umiker-Sebeok, 429–440. New York: Plenum Press, 1980.

Chudek, Maciej, Sarah Heller, Susan Biro, and Joseph Henrich. "Prestige-Biased Cultural Learning: Bystander's Differential Attention to Potential Models Influencing Children's Learning." *Evolution and Human Behavior 33* (2012): 46–54.

Churchland, Paul M. "Eliminative Materialism and the Propositional Attitudes." *The Journal of Philosophy 78* (1981): 67–90.

Clark, Andy, and David Chalmers. "The Extended Mind." *Analysis 58*, *1* (1998): 7–19.

Clark, Andy, and Josefa Toribio. "Doing without Representing?" *Synthese 101*, *3* (1994): 401–431.

Clayton, Nicola S., and Anthony Dickinson. "Episodic-like Memory during Cache Recovery by Scrub Jays." *Nature 395*, *6699* (1998): 272–274.

Clayton, Nicola S., Joanna M. Dally, and Nathan J. Emery. "Social Cognition by Food-Caching Corvids. The Western Scrub-Jay as a Natural Psychologist." *Philosophical Transactions of the Royal Society B: Biological Sciences 362*, *1480* (2007): 507–522.

Clifford, William. "Body and Mind." In *Lectures and Essays*, Vol. 2. Cambridge, UK: Cambridge University Press, 31–70, 1879/2011.

Colbert-White, Erin N., Michael A. Covington, and Dorothy M. Fragaszy. "Social Context Influences the Vocalizations of a Home-Raised African Grey Parrot (Psittacus Erithacus Erithacus)." *Journal of Comparative Psychology 125*, *2* (2011): 175–184.

Connor, Richard C., Rachel Smolker, and Lars Bejder. "Synchrony, Social Behaviour and Alliance Affiliation in Indian Ocean Bottlenose Dolphins, Tursiops Aduncus." *Animal Behaviour 72*, *6* (2006): 1371–1378.

Corballis, Michael C. "On the Evolution of Language and Generativity." *Cognition 44*, *3* (1992): 197–226.

Corballis, Michael C. *From Hand to Mouth: The Origins of Language*. Princeton, NJ: Princeton University Press, 2002.

Corballis, Michael C. "Language as Gesture." *Human Movement Science 28*, *5* (2009): 556–565.

Corbey, Raymond, and Annette Lanjouw (eds). *The Politics of Species: Reshaping Our Relationships with Other Animals*. Cambridge: Cambridge University Press, 2013.

Cosmides, Leda, and John Tooby. "Cognitive Adaptations for Social Exchange." In *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*, edited by J. Barkow, L. Cosmides and J. Tooby, 163–228. New York: Oxford University Press, 1992.

Costello, Kimberly, and Gordon Hodson. "Exploring the Roots of Dehumanization: The Role of Animal-Human Similarity in Promoting Immigrant Humanization." *Group Processes & Intergroup Relations 13*, *1* (2010): 3–22.

Crick, Francis, and Christof Koch. "Are We Aware of Neural Activity in Primary Visual Cortex?" *Nature 375*, *6527* (1995): 121–123.

Crockford, Catherine, Ilka Herbinger, Linda Vigilant, and Christophe Boesch. "Wild Chimpanzees Produce Group-Specific Calls: A Case for Vocal Learning?" *Ethology 110*, *3* (2004): 221–243.

Cronin, Katherine A., Kori K. E. Schroeder, and Charles T. Snowdon. "Prosocial Behaviour Emerges Independent of Reciprocity in Cottontop Tamarins." *Proceedings. Biological Sciences / The Royal Society 277*, *1701* (2010): 3845–3851.

Crystal, Jonathon D., and Allison L. Foote. "Metacognition in Animals." *Comparative Cognition and Behavior Reviews 4* (2009): 1–16.

Csibra, Gergely. "Recognizing Communicative Intentions in Infancy." *Mind & Language 25*, *2* (2010): 141–168.

Csibra, Gergely, and György Gergely. "Natural Pedagogy." *Trends in Cognitive Sciences 13*, *4* (2009): 148–153.

Cushman, Fiery, Liane Young, and Marc Hauser. "The Role of Conscious Reasoning and Intuition in Moral Judgment Testing Three Principles of Harm." *Psychological Science 17*, *12* (2006): 1082–1089.

D'Aniello, Biagio, Gun R. Semin, Alessandra Alterisio, Massimo Aria, and Anna Scandurra. "Interspecies Transmission of Emotional Information via Chemosignals: From Humans to Dogs (Canis lupus familaris)." *Animal Cognition 21, 1* (2018): 67–78.

Dally, Joanna M., Nicola S. Clayton, and Nathan J. Emery. "The Behaviour and Evolution of Cache Protection and Pilferage." *Animal Behaviour 72*, *1* (2006): 13–23.

Dao, James. "More Military Dogs Show Signs of Combat Stress." *The New York Times*, December 1, 2011, sec. U. S. http://www.nytimes.com/2011/12/02/us/more-military-dogs-show-signs-of-combat-stress.html. Accessed July 25, 2014.

Darimont, C. T., T. E. Reimchen, and P. C. Paquet. "Foraging Behaviour by Gray Wolves on Salmon Streams in Coastal British Columbia." *Canadian Journal of Zoology 81* (2003): 349–353.

Darley, John M., and C. Daniel Batson. "From Jerusalem to Jericho: A Study of Situational and Dispositional Variables in Helping Behavior." *Journal of Personality and Social Psychology 27*, *1* (1973): 100–108.

Darwin, Charles. *Descent of Man, and Selection in Relation to Sex*. New York: D. Appleton and Company, 1880.

Darwin, Charles. *The Expression of the Emotions in Man and Animals*. Mineola, NY: Dover Publications, 2007.

Daston, Lorraine, and Gregg Mitman (eds). *Thinking with Animals: New Perspectives on Anthropomorphism*. New York: Columbia University Press, 2005.

Davidson, Donald. "On the Very Idea of a Conceptual Scheme." *Proceedings and Addresses of the American Philosophical Association 47* (1973): 5–20.

Davidson, Donald. "Thought and Talk." In *Mind and Language*, edited by S. Guttenplan, 7–24. Oxford: Oxford University Press, 1975.

Davidson, Donald. "Rational Animals." *Dialectica 36* (1982): 317–327.

Davidson, Donald. *Inquiries into Truth and Interpretation*. Oxford: Oxford University Press, 1984.

Davidson, Donald. "Three Varieties of Knowledge." *Royal Institute of Philosophy Supplements 30* (1991): 153–166.

Davidson, Donald. *Subjective, Intersubjective, Objective*. Oxford, New York: Clarendon Press, Oxford University Press, 2001.

Dawkins, Richard, and John R. Krebs. "Animal Signals: Information or Manipulation." *Behavioural Ecology: An Evolutionary Approach 2* (1978): 282–309.

De Lillo, Carlo, D. Floreano, and F. Antinucci. "Transitive Choices by a Simple, Fully Connected, Backpropagation Neural Network: Implications for the Comparative Study of Transitive Inference." *Animal Cognition 4*, *1* (2001): 61–68.

de Waal, Frans B. M. *Chimpanzee Politics: Power and Sex among Apes*. New York: Harper & Row, 1982.

de Waal, Frans B. M. "Complementary Methods and Convergent Evidence in the Study of Primate Social Cognition." *Behaviour 118*, *3/4* (1991): 297–320.

de Waal, Frans B. M. "Anthropomorphism and Anthropodenial." *Philosophical Topics 27*, *1* (1999): 255–280.

de Waal, Frans B. M. "Silent Invasion: Imanishi's Primatology and Cultural Bias in Science." *Animal Cognition, 6* (2003): 293–299.

de Waal, Frans B. M. *Primates and Philosophers: How Morality Evolved*. Edited by Josiah Ober and Robert Wright. Princeton, NJ: Princeton University Press, 2006.

de Waal, Frans B. M. "The 'Russian Doll' Model of Empathy and Imitation." In *On Being Moved: From Mirror Neurons to Empathy*, edited by Stein Bråten, Vol. 68: 49–69. Amsterdam/Philadelphia: John Benjamins Publishing, 2007.

de Waal, Frans B. M. *The Age of Empathy: Nature's Lessons for a Kinder Society*. New York: Harmony Books, 2009.

de Waal, Frans B. M. "Natural Normativity: The 'Is' and 'Ought' of Animal Behavior." *Behaviour 151, 2–3* (2014): 185–204.

de Waal, Frans B. M., and Lesleigh M. Luttrell. "Mechanisms of Social Reciprocity in Three Primate Species: Symmetrical Relationship Characteristics or Cognition?" *Ethology and Sociobiology 9*, *2–4* (1988): 101–118.

de Waal, Frans B. M., and Angeline van Roosmalen. "Reconciliation and Consolation among Chimpanzees." *Behavioral Ecology and Sociobiology 5*, *1* (1979): 55–66.

DeGrazia, David. *Taking Animals Seriously: Mental Life and Moral Status*. Cambridge; New York: Cambridge University Press, 1996.

Dennett, Daniel C. "Beliefs about Beliefs." *Behavioral and Brain Sciences 1*, *4* (1978): 568–570.

Dennett, Daniel C. "Intentional Systems in Cognitive Ethology: The 'Panglossian Paradigm' Defended." *Behavioral and Brain Sciences 6*, *3* (1983): 343–355.

Dennett, Daniel C. *The Intentional Stance*. Cambridge, MA: MIT Press, 1987.

Dennett, Daniel C. "Out of the Armchair and into the Field." *Poetics Today 9*, *1* (1988): 205–221.

Dennett, Daniel C. "Real Patterns." *The Journal of Philosophy 88* (1991): 27–51.

Dennett, Daniel C. *Kinds of Minds: Toward an Understanding of Consciousness*. New York, NY: Basic Books, 1996.

Dennett, Daniel C. *Brainchildren: Essays on Designing Minds. Representation and Mind*. Cambridge, MA: MIT Press, 1998.

Dennett, Daniel C. "Intentional Systems Theory." In *Oxford Handbook of the Philosophy of Mind*, edited by B. McLaughlin, A. Beckermann, and S. Walter, 339–350. Oxford: Oxford University Press, 2009.

Dennett, Daniel C. *From Bacteria to Bach and Back: The Evolution of Minds*. New York, NY: W. W. Norton & Company, Inc, 2017.

Descartes, René. *Descartes: Philosophical Letters*. Oxford: Clarendon Press, 1970.

Descartes, René. "A Discourse on the Method for Conducting One's Reason Well and for Seeking the Truth in the Sciences." In *Philosophical Essays and Correspondence*, edited by Roger Ariew, 46–82. Cambridge: Hackett Publishing, 2000.

Di Bitetti, Mario S. "Food-Associated Calls and Audience Effects in Tufted Capuchin Monkeys, Cebus Apella Nigritus." *Animal Behaviour 69*, *4* (2005): 911–919.

Dickinson, Anthony. "Why a Rat Is Not a Beast Machine." In *Frontiers of Consciousness*, edited by Lawrence Weiskrantz and Martin Davies, 275–288. New York: Oxford University Press, 2008.

Donald, Merlin. *Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition*. Cambridge, MA: Harvard University Press, 1991.

Donald, Merlin. "Precis of Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition." *Behavioral and Brain Sciences 16*, *4* (1993): 737–747.

Donaldson, Sue, and Will Kymlicka. *Zoopolis: A Political Theory of Animal Rights*. Oxford: Oxford University Press, 2011.

Dreben, Burton. "Quine and Wittgenstein: The Odd Couple." In *Wittgenstein and Quine*, edited by Robert Arrington and Hans-Johann Glock, 39–61. New York, London: Routledge, 1996.

Dretske, Fred I. *Knowledge and the Flow of Information*. Cambridge, MA: MIT Press, 1981.

Dretske, Fred I. "The Epistemology of Belief." *Synthese 55*, *1* (1983): 3–19.

Dretske, Fred I. *Explaining Behavior*. Cambridge, MA: MIT Press, 1988.

Dretske, Fred I. "Minimal Rationality." In *Rational Animals?*, edited by Susan Hurley and Matthew Nudds, 107–115. Oxford: Oxford University Press, 2006.

Dudzinski, Kathleen, and Christine A. Ribic. "Pectoral Fin Contact as a Mechanism for Social Bonding among Dolphins." *Animal Behavior & Cognition 4, 1* (2017): 31–49.

Dummett, Michael. *The Seas of Language*. Oxford: Oxford University Press, 1993.

Dummett, Michael. *Origins of Analytical Philosophy*. Cambridge, MA: Harvard University Press, 1996.

Dummett, Michael. *The Nature and Future of Philosophy*. New York: Columbia University Press, 2010.

Dunbar, Robin. *Gossip, Grooming and the Evolution of Language*. London: Faber and Faber Ltd., 1996.

Dunlop, Rebecca, Sarah Millsopp, and Peter Laming. "Avoidance Learning in Goldfish (Carassius Auratus) and Trout (Oncorhynchus Mykiss) and Implications for Pain Perception." *Applied Animal Behaviour Science 97*, *2–4* (2006): 255–271.

Eales, Lucy A. "Song Learning in Zebra Finches: Some Effects of Song Model Availability on What Is Learnt and When." *Animal Behaviour 33*, *4* (1985): 1293–1300.

Eccleston, Paul. "Elephants that Never Forget Know How to Survive Drought." *The Telegraph*, August 11, 2008. https://www.telegraph.co.uk/news/earth/earthnews/3349220/Elephants-that-never-forget-know-how-to-survive-drought.html.

Eibl-Eibesfeldt, Irenäus. *Ethology: The Biology of Behavior*. New York: Holt, Rinehart and Winston, 1975.

Ekman, Paul. "An Argument for Basic Emotions." *Cognition & Emotion 6*, *3–4* (1992): 169–200.

Elowson, A. Margaret, Pamela L. Tannenbaum, and Charles T. Snowdon. "Food-Associated Calls Correlate with Food Preferences in Cotton-Top Tamarins." *Animal Behaviour 42*, *6* (1991): 931–937.

Emery, Nathan J., and Nicola S. Clayton. "Effects of Experience and Social Context on Prospective Caching Strategies by Scrub Jays." *Nature 414*, *6862* (2001): 443–446.

Emery, Nathan, Nicola Clayton, and Chris Frith. *Social Intelligence: From Brain to Culture* (1 edn). Oxford, New York: Oxford University Press, 2008.

Endler, John A., Lorna C. Endler, and Natalie R. Doerr. "Great Bowerbirds Create Theaters with Forced Perspective When Seen by Their Audience." *Current Biology 20*, *18* (2010): 1679–1684.

Enfield, Nicholas J. "Lip-Pointing: A Discussion of Form and Function with Reference to Data from Laos." *Gesture 1*, *2* (2001): 185–211.

Engelmann, Jan M., and Esther Herrmann. "Chimpanzees Trust Their Friends." *Current Biology 26*, *2* (2016): 252–256.

Erdőhegyi, Ágnes, József Topál, Zsófia Virányi, and Ádám Miklósi. "Dog-Logic: Inferential Reasoning in a Two-Way Choice Task and Its Restricted Use." *Animal Behaviour 74*, *4* (2007): 725–737.

Evans, Christopher S., and Linda Evans. "Chicken Food Calls Are Functionally Referential." *Animal Behaviour58*, *2* (1999): 307–319.

Evans, Christopher S., and Linda Evans. "Representational Signalling in Birds." *Biology Letters 3*, *1* (2007): 8–11.

Evans, Christopher S., and Peter Marler. "Language and Animal Communication: Parallels and Contrasts." *Comparative Approaches to Cognitive Science* (1995): 341–382.

Evans, Christopher S., Linda Evans, and Peter Marler. "On the Meaning of Alarm Calls: Functional Reference in an Avian Vocal System." *Animal Behaviour 46*, *1* (1993): 23–38.

Evans, Karen, Margaret Morrice, Mark Hindell, and Deborah Thiele. "Three Mass Strandings of Sperm Whales (*Physeter macrocephalus*) in Southern Australia Waters." *Marine Mammal Science 18*, *3* (2002): 622–643.

Evans, Gareth. *The Varieties of Reference*. Oxford: Clarendon Press, 1982.

Everett, Daniel. "Cultural Constraints on Grammar and Cognition in Pirahã." *Current Anthropology 46*, *4* (2005): 621–646.

Fahay, J. "Concurring Decision." http://www.nycourts.gov/ctapps/Decisions/2018/May18/M2018-268opn18-Decision.pdf, 2018.

Falotico, Tiago, Tomos Proffitt, Eduardo Ottoni, Richard A. Staff, and Michael Haslam. "Three Thousand Years of Wild Capuchin Stone Tool Use." *Nature Ecology & Evolution 3*, *7* (2019): 1034–1038.

Faragó, Tamás, Péter Pongrácz, Friederike Range, Zsófia Virányi, and Ádám Miklósi. "'The Bone Is Mine': Affective and Referential Aspects of Dog Growls." *Animal Behaviour 79*, *4* (2010): 917–925.

Fehér, Olga, Haibin Wang, Sigal Saar, Partha P. Mitra, and Ofer Tchernichovski. "De Novo Establishment of Wild-Type Song Culture in the Zebra Finch." *Nature 459*, *7246* (2009): 564–568.

Fellner, Wendi, Gordon B. Bauer, and Heidi E. Harley. "Cognitive Implications of Synchrony in Dolphins: A Review." *Aquatic Mammals 32*, *4* (2006): 511–516.

Ferdowsian, Hope R., Debra L. Durham, Charles Kimwele, Godelieve Kranendonk, Emily Otali, Timothy Akugizibwe, J. B. Mulcahy, Lilly Ajarova, and Cassie Meré Johnson. "Signs of Mood and Anxiety Disorders in Chimpanzees." *PLoS ONE 6*, *6* (2011): e19855.

Feyerabend, Paul. "Materialism and the Mind-Body Problem." *The Review of Metaphysics 17* (1963): 49–66.

Fischer, Julia. "The Myth of Anthropomorphism." In *Interpretation and Explanation in the Study of Animal Behavior: Vol. 1, Interpretation, Intentionality, and Communication*, edited by Marc Bekoff and Dale Jamieson, 96–117. Boulder: Westview Press, 1990.

Fitch, W. Tecumseh. "The Evolution of Speech: A Comparative Review." *Trends in Cognitive Sciences 4*, *7* (2000): 258–267.

Fitch, W. Tecumseh. "The Evolution of Language: A Comparative Review." *Biology and Philosophy 20*, *2–3* (2005): 193–203.

Fitch, W. Tecumseh, and Marc D. Hauser. "Computational Constraints on Syntactic Processing in a Nonhuman Primate." *Science 303*, *5656* (2004): 377–380.

Fitzpatrick, S. "Animal Morality: What is the Debate About?" *Biology & Philosophy 32*, *6* (2017): 1151–1183.

Flanagan, Owen J. *Consciousness Reconsidered*. Cambridge, MA: MIT Press, 1992.

Flombaum, Jonathan I., and Laurie R. Santos. "Rhesus Monkeys Attribute Perceptions to Others." *Current Biology 15*, *5* (2005): 447–452.

Fodor, Jerry A. *The Language of Thought*. The Language & Thought Series. New York: Crowell, 1975.

Fodor, Jerry A. *Psychosemantics: The Problem of Meaning in the Philosophy of mind*. Cambridge, MA: The MIT Press, 1987.

Foer, Jonathan Safran. *Eating Animals*. New York: Little, Brown and Company, 2009.

Fogel, Alan. *Developing through Relationships*. Chicago, IL: University of Chicago Press, 1993.

Foote, Allison L., and Jonathon D. Crystal. "Metacognition in the Rat." *Current Biology 17*, *6* (2007): 551–555.

Foote, Andrew D., Nagarjun Vijay, María C. Ávila-Arcos, Robin W. Baird, John W. Durban, Matteo Fumagalli, Richard A. Gibbs, M. Bradley Hanson, Thorfinn S. Korneliussen, Michael D. Martin, Kelly M. Robertson, Vitor C. Sousa, Filipe G. Vieira, Tomáš Vinař, Paul Wade, Kim C. Worley, Laurent Excoffier, Phillip A. Morin, M. Thomas P. Gilbert, and Jochen B.W. Wolf. "Genome-Culture Coevolution Promotes Rapid Divergence of Killer Whale Ecotypes." *Nature Communications 7* (2016): 11693.

Fouts, Roger S., and Deborah H. Fouts. "Chimpanzees' Use of Sign Language." In *The Great Ape Project*, edited by Paola Cavalieri and Peter Singer, 28–41. New York: St. Martins Press, 1993.

Fouts, Roger S., Alan D. Hirsch, and Deborah H. Fouts. "Cultural Transmission of a Human Language in a Chimpanzee Mother-Infant Relationship." In *Child Nurturance*, 159–193. New York: Springer, 1982.

Franco, Fabia, and George Butterworth. "Pointing and Social Awareness: Declaring and Requesting in the Second Year." *Journal of Child Language 23* (1996): 307–336.

Freeman, Hani D., and Samuel D. Gosling. “Personality in Nonhuman Primates: A Review and Evaluation of Past Research.” *American Journal of Primatology 72*, *8* (2010): 653–671.

Frey, Raymond Gillespie. *Interests and Rights: The Case against Animals*. Oxford: Clarendon Library of Logic and Philosophy, Oxford University Press, 1980.

Fujita, Kazuo. “Metamemory in Tufted Capuchin Monkeys (Cebus Apella).”*Animal Cognition 12*, *4* (2009): 575–585.

Gácsi, Márta, Ádám Miklósi, Orsolya Varga, József Topál, and Vilmos Csányi. “Are Readers of Our Face Readers of Our Minds? Dogs (Canis Familiaris) Show Situation-Dependent Recognition of Human’s Attention.” *Animal Cognition 7*, *3* (2004): 144–153.

Gagliano, Monica, Michael Renton, Martial Depczynski, and Stefano Mancuso. “Experience Teaches Plants to Learn Faster and Forget Slower in Environments Where It Matters.” *Oecologia 175*, *1* (2014): 63–72.

Galef, Bennett G. “Social Learning and Traditions in Animals: Evidence, Definitions, and Relationship to Human Culture.” *Wiley Interdisciplinary Reviews. Cognitive Science 3*, *6* (2012): 581–592.

Gallese, Vittorio, Luciano Fadiga, Leonardo Fogassi, and Giacomo Rizzolatti. “Action Recognition in the Premotor Cortex.” *Brain 119* (1996): 593–609.

Gallistel, C. R. “Prelinguistic Thought.” *Language Learning and Development 7*, *4* (2011): 253–262.

Gallup, Gordon G. “Self-Recognition in Primates: A Comparative Approach to the Bidirectional Properties of Consciousness.” *American Psychologist 32* (1977): 329–338.

Gallup, Gordon G. “Toward a Comparative Psychology of Self-Awareness: Species Limitations and Cognitive Consequences.” In *The Self: Interdisciplinary Approaches*, edited by Jaine Strauss and George R. Goethals, 121–135. New York: Springer, 1991.

Gallup, Gordon G. “Self-Awareness and the Evolution of Social Intelligence.” *Behavioral Processes 42* (1998): 239–247.

Gardner, R. Allen, and Beatrice T. Gardner. “Comparative Psychology and Language Acquisition.” *Annals of the New York Academy of Sciences 309* (1978): 37–76.

Garm, Anders, Magnus Oskarsson, and Dan-Eric Nilsson. “Box Jellyfish Use Terrestrial Visual Cues for Navigation.” *Current Biology 21*, *9* (2011): 798–803.

Garner, Roberta. *The Joy of Stats: A Short Guide to Introductory Statistics in the Social Sciences*. Ontario: Broadview Press, 2005.

Garson, Justin. *Biological Mind: A Philosophical Introduction*. London: Routledge, 2014.

Gazzaniga, Michael. *The Consciousness Instinct: Unraveling the Mystery of How the Brain Makes the Mind*. Farrar, Straus and Giroux, 2018.

Geertz, Clifford. *The Interpretation of Cultures*. New York: Basic Books, 1973.

Gelder, Tim Van. “What Might Cognition Be, If Not Computation?” *The Journal of Philosophy 92*, *7* (1995): 345–381.

Gendler, Tamar Szabó. “Alief and Belief.” *Journal of Philosophy 105*, *10* (2008): 634–663.

Gennaro, Rocco J. “Higher-Order Thoughts, Animal Consciousness, and Misrepresentation. A Reply to Carruthers and Levine.” In *Higher-Order Theories of Consciousness*, edited by Rocco J. Gennaro, 45–66. Amsterdam: John Benjamins, 2004.

Gentner, Timothy Q., Kimberly M. Fenn, Daniel Margoliash, and Howard C. Nusbaum. “Recursive Syntactic Pattern Learning by Songbirds.” *Nature 440*, *7088* (2006): 1204–1207.

Gergely, György, and Gergely Csibra. “Teleological Reasoning in Infancy: The Naïve Theory of Rational Action.” *Trends in Cognitive Sciences 7*, *7* (2003): 287–292.

Gergely, Gyorgy, Zoltan Nadasdy, Gergely Csibra, and Szilvia Bíró. “Taking the Intentional Stance at 12 Months of Age.” *Cognition 56* (1995): 165–193.

Gergely, György, Harold Bekkering, and Ildikó Király. “Rational Imitation in Preverbal Infants.” *Nature 415*, *6873* (2002): 755.
Gibson, James J. “The Theory of Affordances.” In *Perceiving, Acting, and Knowing. Towards an Ecological Psychology*, edited by Robert Shaw and John Bransford, 127–143. New York: Lawrence Erlbaum Associates, 1977.
Gilbert, Margaret. “Shared Intentional and Personal Intention.” *Philosophical Studies 144*, *1* (2009): 167–187.
Gill, Victoria. “Elephant Society ‘Still Disrupted Decades After Cull’.” *BBC News*, November 1, 2013. https://www.bbc.com/news/science-environment-24754682.
Glock, Hans-Johann. “Animals, Thoughts and Concepts.” *Synthese 123* (2000): 35–64.
Glock, Hans-Johann. “Animal Rationality and Belief.” In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 89–99. New York: Routledge, 2018.
Glüer, Kathrin, and Peter Pagin. “Meaning Theory and Autistic Speakers.” *Mind & Language 18*, *1* (2003): 23–51.
Godfrey-Smith, Peter. “On Being an Octopus: Diving Deep in Search of the Human Mind.” *Philosophy & Religion*, June 3, 2014. http://bostonreview.net/books-ideas/peter-godfrey-smith-being-octopus.
Goldman, Alvin I. *Simulating Minds: The Philosophy, Psychology, and Neuroscience of Mindreading*. Oxford: Oxford University Press, 2006.
Goldman, Alvin I., and Chandra. “Simulationist Models of Face-Based Emotion Recognition.” *Cognition 94*, *3* (2005): 193–213.
Gómez, Juan-Carlos. “Pointing Behaviours in Apes and Human Infants: A Balanced Interpretation.” *Child Development 78*, *3* (2007): 729–734.
Gómez, Juan-Carlos. “Embodying Meaning: Insights from Primates, Autism, and Brentano.” *Neural Networks 22*, *2* (2009): 190–196.
Gómez, Juan-Carlos. “The Ontogeny of Triadic Cooperative Interactions with Humans in an Infant Gorilla.” *Interaction Studies 11*, *3* (2010): 353–379.
Goodall, Jane. “Social Rejection, Exclusion, and Shunning among the Gombe Chimpanzees.” *Ethology and Sociobiology 7*, *3* (1986): 227–236.
Goodenough, Judith, Betty McGuire, and Robert A. Wallace. *Perspectives on Animal Behavior*. New York: J. Wiley, 1993.
Goodman, Charles. “Śāntideva.“ *The Stanford Encyclopedia of Philosophy* (Fall 2016 Edition), Edward N. Zalta (ed). https://plato.stanford.edu/archives/fall2016/entries/shantideva/.
Gordon, Deborah. *Ants At Work: How An Insect Society Is Organized*. New York: The Free Press, 2011.
Gosling, S. D., and O. P. John. “Personality Dimensions in Dogs, Cats, and Hyenas.” In *Annual Meeting of the American Psychological Society*, Washington, DC, 1998.
Gregg, Justin D., Kathleen M. Dudzinski, and Howard V. Smith. “Do Dolphins Eavesdrop on the Echolocation Signals of Conspecifics?” *International Journal of Comparative Psychology 20*, *1* (2007): 65–88.
Grice, H. Paul. “Meaning.” *The Philosophical Review 66* (1957): 377–388.
Griffin, Donald R. *Animal Minds*. Chicago, IL: University of Chicago Press, 1992.
Griffin, Donald R. “Afterward: What Is It Like?” In *The Cognitive Animal: Empirical and Theoretical Perspectives on Animal Cognition*, edited by Marc Bekoff, Colin Allen and Gordon M. Burghardt, 471–473. Cambridge, MA: MIT Press, 2002.
Griffith, Coleman R. *Principles of Systematic Psychology*. Urbana, IL: University of Illinois Press, 1943.
Grosenick, Logan, Tricia S. Clement, and Russell D. Fernald. “Fish Can Infer Social Rank by Observation Alone.” *Nature 445*, *7126* (2007): 429–432.
Gruen, Lori. *Ethics and Animals: An Introduction*. New York: Cambridge University Press, 2011.

Gruen, Lori. "Entangled Empathy." In *The Politics of Species: Reshaping Our Relationships with Other Animals*, edited by Raymond Corbey and Annette Lanjouw, 223–231. Cambridge: Cambridge University Press, 2013.

Gruen, Lori. *Entangled Empahty: An Alternative Ethic for Our Relationships with Animals*. Brooklyn, NY: Lantern Press. 2015.

Gruen, Lori. "The Moral Status of Animals." In *The Stanford Encyclopedia of Philosophy* (Fall 2017 Edition), edited by Edward N. Zalta, https://plato.stanford.edu/archives/fall2017/entries/moral-animal/.

Gruen, Lori. "Empathy in Mind." In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 485–490. New York: Routledge, 2018a.

Gruen, Lori. "Empathy." In *Critical Terms for Animal Studies*, edited by L. Gruen. Chicago, IL: Chicago University Press, 2018b.

Grüter, Christoph, M. Sol Balbuena, and Walter M. Farina. "Informational Conflicts Created by the Waggle Dance." *Proceedings of the Royal Society B: Biological Sciences 275*, *1640* (2008): 1321–1327.

Guéguen, Nicolas, and Jordy Stefan. "Hitchhiking and the 'Sunshine Driver': Further Effects of Weather Conditions on Helping Behavior'." *Psychological Reports 113*, *3* (2013): 994–1000.

Guldberg, Helene. "Can Orang-Utans Really Mime?" 2010. http://www.psychologytoday.com/blog/reclaiming-childhood/201008/can-orang-utans-really-mime. Accessed January 27, 2014.

Gunther, York H. *Essays on Nonconceptual Content*. Cambridge, MA: MIT Press, 2003.

Güth, Werner, Rolf Schmittberger, and Bernd Schwarze. "An Experimental Analysis of Ultimatum Bargaining." *Journal of Economic Behavior & Organization 3*, *4* (1982): 367–388.

Haesler, Sebastian, Christelle Rochefort, Benjamin Georgi, Pawel Licznerski, Pavel Osten, and Constance Scharff. "Incomplete and Inaccurate Vocal Imitation after Knockdown of FoxP2 in Songbird Basal Ganglia Nucleus Area X." *PLoS Biology 5*, *12* (2007): e321.

Haffenden, Angela M., and Melvyn A. Goodale. "The Effect of Pictorial Illusion on Prehension and Perception." *Journal of Cognitive Neuroscience 10*, *1* (1998): 122–136.

Haffenden, Angela M., and Melvyn A. Goodale. "Independent Effects of Pictorial Displays on Perception and Action." *Vision Research 40*, *10* (2000): 1597–1607.

Haidt, Jonathan. "The Emotional Dog and Its Rational Tail: A Social Intuitionist Approach to Moral Judgment." *Psychological Review 108*, *4* (2001): 814–834.

Haidt, Jonathan, Jesse Graham, and Craig Joseph. "Above and Below Left-Right: Ideological Narratives and Moral Foundations." *Psychological Inquiry 20* (2009): 110–119.

Haidt, Jonathan, and Craig Joseph. "The Moral Mind: How Five Sets of Innate Intuitions Guide the Development of Many Culture-Specific Virtues, and Perhaps Even Modules." In *The Innate Mind Volume 3: Foundations and the Future*, edited by P. Carruthers, S. Laurence, and S. Stich, 367–391. Evolution and Cognition. Oxford: Oxford University Press, 2008.

Haksar, Vinit. "Moral Agents." In *Routledge Encyclopedia of Philosophy*, edited by E. Craig, doi:10.4324/9780415249126-L049-1. London: Routledge, 1998.

Hamlin, J. Kiley, Karen Wynn, and Paul Bloom. "Social Evaluation by Preverbal Infants." *Nature 450* (2007): 557–560.

Hamm, Alfons O., Almut I. Weike, Harald T. Schupp, Thomas Treig, Alexander Dressel, and Christof Kessler. "Affective Blindsight: Intact Fear Conditioning to a Visual Cue in a Cortically Blind Patient." *Brain 126*, *2* (2003): 267–275.

Hammerschmidt, Kurt, and Julia Fischer. "Constraints in Primate Vocal Production." In *The Evolution of Communicative Flexibility: Complexity, Creativity, and Adaptability in Human and Animal Communication* (2008): 93–119. Cambridge MA: MIT Press.

Hampton, Robert R. "Rhesus Monkeys Know When They Remember." *Proceedings of the National Academy of Sciences of the United States of America 98* (2001): 5359–5362.

Hampton, Robert R. "Status of Nonhuman Memory Monitoring and Possible Roles in Planning and Decision Making." In *Animal Thinking: Contemporary Issues in Comparative Cognition*, edited by Randolf Menzel and Julia Fischer, 105–120. Cambridge, MA: The MIT Press, 2011.

Hardcastle, Valerie G. "The Why of Consciousness: A Non-Issue for Materialists." *Journal of Consciousness Studies 3*, *1* (1996): 7–13.

Hare, Brian, and Michael Tomasello. "Domestic Dogs (Canis Familiaris) Use Human and Conspecific Social Cues to Locate Hidden Food." *Journal of Comparative Psychology 113*, *2* (1999): 173–177.

Hare, Brian, and Vanessa Woods. *The Genius of Dogs: How Dogs Are Smarter Than You Think*. New York: Dutton, 2013.

Hare, Brian, Michelle Brown, Christina Williamson, and Michael Tomasello. "The Domestication of Social Cognition in Dogs." *Science 298*, *5598* (2002): 1634–1636.

Hare, Brian, Josep Call, and Michael Tomasello. "Communication of Food Location between Human and Dog *(Canis familiaris)*." *Evolution of Communication 2*, *1* (1998): 137–159.

Hare, Brian, Josep Call, and Michael Tomasello. "Do Chimpanzees Know What Conspecifics Know?" *Animal Behaviour 61* (2001): 139–151.

Harman, Gilbert. "Studying the Chimpanzees' Theory of Mind." *Behavioral and Brain Sciences 1* (1978): 576–577.

Harriman, Philip Lawrence. *The New Dictionary of Psychology*. New York: Philosophical Library, 1947.

Hassin, Ran R., James S. Uleman and John A. Bargh (eds). *The New Unconscious*. Oxford Series in Social Cognition and Social Neuroscience. Oxford: Oxford University Press, 2005.

Haug, Marc, and Richard E. Whalen. *Animal Models of Human Emotion and Cognition*. Washington, DC: American Psychological Association, 1999.

Hauser, Marc D., and Peter Marler. "Food-Associated Calls in Rhesus Macaques (Macaca Mulatta): I. Socioecological Factors." *Behavioral Ecology 4*, *3* (1993): 194–205.

Hauser, Marc D. "Costs of Deception: Cheaters are Punished in Rhesus Monkeys (*Macaca mulatta*)." *Proceedings of the National Academy of Sciences 89*, *12* (1992): 137–139.

Hauser, Marc D., Noam Chomsky, and W. Tecumseh Fitch. "The Faculty of Language: What Is It, Who Has It, and How Did It Evolve?" *Science 298*, *5598* (2002): 1569–1579.

Hauser, Marc D., Patricia Teixidor, L. Fields, and R. Flaherty. "Food-Elicited Calls in Chimpanzees: Effects of Food Quantity and Divisibility." *Animal Behaviour 45*, *4* (1993): 817–819.

Hauser, Marc D., Fritz Tsao, Patricia Garcia, and Elizabeth S. Spelke. "Evolutionary Foundations of Number: Spontaneous Representation of Numerical Magnitudes by Cotton–top Tamarins." *Proceedings of the Royal Society of London. Series B: Biological Sciences 270*, *1523* (2003): 1441–1446.

Hauser, Marc D., and Richard W. Wrangham. "Manipulation of Food Calls in Captive Chimpanzees: A Preliminary Report." *Folia Primatologica 48*, *3–4* (1987): 207–210.

Hayes, Catherine. *The Ape in Our House*. Oxford, England: Harper, 1951.

Heath, Joseph. *Following the Rules: Practical Reasoning and Deontic Constraint*. Oxford: Oxford University Press, 2008.

Hebb, Donald Olding. *The Organization of Behavior; a Neuropsychological Theory*. New York: Wiley, 1949.

Heider, Fritz, and Simmel, Marianne. "An Experimental Study of Apparent Behavior." *American Journal of Psychology 57* (1944): 243–259.

Heil, John. *Philosophy of Mind: A Guide and Anthology*. New York: Oxford University Press, 2004.

Henrich, J. *The Secret of Our Success*. Princeton, NJ: Princeton University Press, 2016.

Henrich, Joseph, Robert Boyd, Samuel Bowles, Colin Camerer, Ernst Fehr, Herbert Gintis, Richard McElreath, Michael Alvard, Abigail Barr, Natalie Smith Henrich, Kim Hill, Francisco Gil-White, Michael Gurven, Frank W.

Marlowe, John Q. Patton, and David Tracer. "Economic Man in Cross-Cultural Perspective: Behavioral Experiments in 15 Small-Scale Societies." *Behavioral and Brain Sciences 28*, *6* (2005): 795–815.
Henrich, Joseph, Steven J. Heine, and Ara Norenzayan. "The Weirdest People in the World?" *Behavioral and Brain Sciences 33*, *2–3* (2010): 61–83.
Herman, Louis M. "Cognitive Performance of Dolphins in Visually Guided Tasks." In *Sensory Abilities of Cetaceans: Laboratory and Field Evidence*, edited by J. A. Thomas and R. A. Kastelein, 455–462, Boston, MA: Springer, 1990.
Herman, Louis M. "What Laboratory Research Has Told Us about Dolphin Cognition." *International Journal of Comparative Psychology 23*, *3* (2010): 310–330.
Herman, Louis M., Sheila L. Abichandani, Ali N. Elhajj, Elia YK Herman, Juliana L. Sanchez, and Adam A. Pack. "Dolphins (Tursiops Truncatus) Comprehend the Referential Character of the Human Pointing Gesture." *Journal of Comparative Psychology 113*, *4* (1999): 347–364.
Herman, Louis M., Douglas G. Richards, and James P. Wolz. "Comprehension of Sentences by Bottlenosed Dolphins." *Cognition 16*, *2* (1984): 129–219.
Hernandez-Lallement, J., M. van Wingerden, C. Marx, M. Srejic, and T. Kalenscher. "Rats Prefer Mutual Rewards in a Prosocial Choice Task." *Frontiers in Neuroscience 8* (2015): 443.
Hernandez-Lallement, Julen, Marijn van Wingerden, Sandra Schable, and Tobias Kalenscher. "Basolateral Amygdala Lesions Abolish Mutual Reward Preferences in Rats." *Neurobiology of Learning and Memory 127* (2016): 1–9.
Herrmann, Esther, Stefanie Keupp, Brian Hare, Amrisha Vaish, and Michael Tomasello. "Direct and Indirect Reputation Formation in Nonhuman Great Apes (Pan Paniscus, Pan Troglodytes, Gorilla Gorilla, Pongo Pygmaeus) and Human Children (Homo Sapiens)." *Journal of Comparative Psychology 127*, *1* (2013): 63–75.
Herrnstein, Richard J., and Donald H. Loveland. "Complex Visual Concept in the Pigeon." *Science 146*, *3643* (1964): 549–551.
Hess, Elizabeth. *Nim Chimpsky: The Chimp Who Would Be Human*. New York: Bantam Books, 2008.
Heyes, Cecilia M. "Reflections on Self-Recognition in Primates." *Animal Behaviour 47* (1994): 909–919.
Heyes, Cecilia M. "Theory of Mind in Nonhuman Primates." *Behavioral and Brain Sciences 21*, *1* (1998): 101–114.
Heyes, Cecilia M. "Beast Machines? Questions of Animal Consciousness." In *Frontiers of Consciousness*, edited by Lawrence Weiskrantz and Martin Davies, 259–274. New York: Oxford University Press, 2008.
Heyes, Cecilia M. *Cognitive Gadgets: The Cultural Evolution of Thinking*. Cambridge, MA: Harvard University Press, 2018.
Hinde, Robert A. *Animal Behaviour; a Synthesis of Ethology and Comparative Psychology*. New York: McGraw-Hill, 1970.
Hobaiter, Catherine, David A. Leavens, and Richard W. Byrne. "Deictic Gesturing in Wild Chimpanzees, (Pan Troglodytes)? Some Possible Cases." *Journal of Comparative Psychology 128* (2013): 82.
Hobson, R. Peter. *Autism and the Development of Mind*. Hillsdale: L. Erlbaum Associates, 1993.
Hockings, Kimberley J., James R. Anderson, and Tetsuro Matsuzawa. "Road Crossing in Chimpanzees: A Risky Business." *Current Biology 16*, *17* (2006): 668–670.
Holland, Peter C. "Occasion Setting in Pavlovian Conditioning." In *Psychology of Learning and Motivation: Advances in Research and Theory*, edited by D. L. Medin, 69–125. San Diego, CA: Academic Press, 1992.
Hollis, Karen L., and Elise Nowbahari. "Toward a Behavioral Ecology of Rescue Behavior." *Evolutionary Psychology 11*, *3* (2013): 147470491301100320.

Hood, Lois, Lois Bloom, and Charles J. Brainerd. "What, When, and How about Why: A Longitudinal Study of Early Expressions of Causality." *Monographs of the Society for Research in Child Development 44*, *6* (1979): 1–47.

Hopkins, William D., Jared P. Taglialatela, and David A. Leavens. "Chimpanzees Differentially Produce Novel Vocalizations to Capture the Attention of a Human." *Animal Behaviour 73*, *2* (2007): 281–286.

Hopper, Lydia M., Antoine Spiteri, Susan P. Lambeth, Steven J. Schapiro, Victoria Horner, and Andrew Whiten. "Experimental Studies of Traditions and Underlying Transmission Processes in Chimpanzees." *Animal Behaviour 73* (2007): 1021–1032.

Hopper, Lydia M., Susan P. Lambeth, Steven J. Schapiro, and Andrew Whiten. "Observational Learning in Chimpanzees and Children Studied through 'Ghost' Conditions." *Proceedings of the Royal Society of London B: Biological Sciences 275*, *1636* (2008): 835–840.

Horner, Victoria, J. Devyn Carter, Malini Suchak, and Frans B. M. de Waal. "Spontaneous Prosocial Choice by Chimpanzees." *Proceedings of the National Academy of Sciences of the United States of America 108*, *33* (2011): 13847–13851.

Horner, Victoria, Andrew Whiten, Emma Flynn, and Frans de Waal. "Faithful Copying of Foraging Techniques Along Cultural Transmission Chains by Chimpanzees and Children." *PNAS 103* (2006): 13878–13883.

Hostetter, Autumn B., Monica Cantero, and William D. Hopkins. "Differential Use of Vocal and Gestural Communication by Chimpanzees (Pan Troglodytes) in Response to the Attentional Status of a Human (Homo Sapiens)." *Journal of Comparative Psychology 115*, *4* (2001): 337–343.

Hostetter, Autumn B., Jamie L. Russell, Hani Freeman, and William D. Hopkins. "Now You See Me, Now You Don't: Evidence That Chimpanzees Understand the Role of the Eyes in Attention." *Animal Cognition 10*, *1* (2007): 55–62.

Huber, Ludwig, Natálie Popovová, Sabine Riener, Kaja Salobir, and Giulia Cimarelli. "Would Dogs Copy Irrelevant Actions from Their Human Caregiver?" *Learning & Behavior 46*, *4* (2018): 387–397.

Hubley, Penelope. "The Development of Cooperative Action in Infants." PhD Dissertation, University of Edinburgh, 1983.

Hume, David. *A Treatise of Human Nature*. Edited by David Fate Norton and Mary J. Norton. Oxford: Oxford University Press, 2000.

Humphrey, Nicholas K. "Nature's Psychologists." In *Consciousness and the Physical World*, edited by B. D. Josephson and V. S. Ramachandran, 57–80. Oxford: Pergamon Press, 1980.

Humphrey, Nicholas K., and L. Weiskrantz. "Vision in Monkeys after Removal of the Striate Cortex." *Nature 215*, *5101* (1967): 595–597.

Hunt, Gavin R. "Manufacture and Use of Hook-Tools by New Caledonian Crows." *Nature 379*, *6562* (1996): 249–251.

Hurley, Susan. "Animal Action in the Space of Reasons." *Mind & Language 18*, *3* (2003): 231–257.

Hurley, Susan, and Matthew Nudds. "The Questions of Animal Rationality: Theory and Evidence." In *Rational Animals?*, edited by Susan Hurley and Matthew Nudds, 1–84. Oxford: Oxford University Press, 2006a.

Hurley, Susan, and Matthew Nudds (eds). *Rational Animals?* Oxford: Oxford University Press, 2006b.

Hursthouse, Rosalind. *Ethics, Humans, and Other Animals: An Introduction with Readings*. New York: Routledge, 2000.

Huxley, Thomas H. "On the Hypothesis That Animals Are Automata, and Its History." *Fortnightly Review 16* (1874): 555–580.

Imanishi, Kinji. "Social Behavior in Japanese Monkeys, Macaca Fuscata." *Psychologia 1*, *1* (1957): 47–54.

Inoue, Sana, and Tetsuro Matsuzawa. "Working Memory of Numerals in Chimpanzees." *Current Biology 17*, *23* (2007): R1004–R1005.

Itakura, Shoji, Bryan Agnetta, Brian Hare, and Michael Tomasello. “Chimpanzee Use of Human and Conspecific Social Cues to Locate Hidden Food.” *Developmental Science 2*, *4* (1999): 448–456.

Iyer, Ravi, Spassena Koleva, Jesse Graham, Peter Ditto, and Jonathan Haidt. “Understanding Libertarian Morality: The Psychological Dispositions of Self-Identified Libertarians.” *PLOS ONE 7*, *8* (2012): e42366.

Jackson, Frank. “What Mary Didn’t Know.” *The Journal of Philosophy 83*, *5* (1986): 291–295.

Jacobs, Lucia F., and Emily R. Liman. “Grey Squirrels Remember the Locations of Buried Nuts.” *Animal Behaviour 41*, *1* (1991): 103–110.

James, William. *The Principles of Psychology, Volumes I and II*. Cambridge, MA: Harvard University Press, 1981.

Jamieson, Dale. “Science, Knowledge, and Animal Minds.” *Proceedings of the Aristotelian Society 98* (1998): 79–102.

Jamieson, Dale. “What Do Animals Think?” In *The Philosophy of Animal Minds*, edited by Robert W. Lurz, 15–34. New York: Cambridge University Press, 2009.

Jamieson, Dale, and Marc Bekoff. “Carruthers on Nonconscious Experience.” *Analysis 52* (1992): 23–28.

Janik, Vincent M., Laela S. Sayigh, and R. S. Wells. “Signature Whistle Shape Conveys Identity Information to Bottlenose Dolphins.” *Proceedings of the National Academy of Sciences 103*, *21* (2006): 8293–8297.

Jensen, Keith, Josep Call, and Michael Tomasello. “Chimpanzees Are Rational Maximizers in an Ultimatum Game.” *Science 318*, *5847* (2007): 107–109.

Jensen, Keith, Joan B. Silk, Kristin Andrews, Redouan Bshary, Dorthy L. Cheney, Nathan Emery, Charlotte K. Hemelrijk, Kay Holekamp, Derek C. Penn, Josef Perner, and Christoph Teufel. “Social Knowledge.” In *Animal Thinking: Contemporary Issues in Comparative Cognition (Strüngmann Forum Reports)*. Randolf Menzel and Julia Fischer, eds. MIT Press (2011): 267–292.

Jolly, Alison. “Lemur Social Behavior and Primate Intelligence.” *Science 153*, *3735* (1966): 501–506.

Kahneman, Daniel, Barbara L. Fredrickson, Charles A. Schreiber, and Donald A. Redelmeier. “When More Pain Is Preferred to Less: Adding a Better End.” *Psychological Science 4*, *6* (1993): 401–405.

Kaminski, Juliane, Juliane Brauer, Josep Call, and Michael Tomasello. “Domestic Dogs Are Sensitive to a Human’s Perspective.” *Behaviour 146*, *7* (2009): 979–998.

Kaminski, Juliane, Josep Call, and Julia Fischer. “Word Learning in a Domestic Dog: Evidence for ‘Fast Mapping.’” *Science 304*, *5677* (2004): 1682–1683.

Kano, Fumihiro, Masayuki Tanaka, and Masaki Tomonaga. “Enhanced Recognition of Emotional Stimuli in the Chimpanzee (Pan Troglodytes).” *Animal Cognition 11*, *3* (2008): 517–524.

Kant, Immanuel. [1798] 2010, “Anthropology from a Pragmatic Point of View (1798)”, in *Anthropology, History, and Education*, (Cambridge Edition of the Works of Immanuel Kant), Robert Louden and Gunter Zoller (eds. and trans.), Cambridge: Cambridge University Press, 227–429. Original is *Anthropologie in pragmatischer Hinsicht*, published in the standard *Akademie der Wissenschaften* edition, volume 7. doi:10.1017/CBO9780511791925.

Kant, Immanuel. [1784–5] 1997, “Moral Philosophy: Collin’s Lecture Notes”, in *Lectures on Ethics*, (Cambridge Edition of the Works of Immanuel Kant), P. Heath and J.B. Schneewind (ed. and trans.), Cambridge: Cambridge University Press, pp. 37–222. Original is *Anthropologie in pragmatischer Hinsicht*, published in the standard *Akademie der Wissenschaften* edition, volume 27, doi:10.1017/CBO9781107049512.

Kant, Immanuel. *Critique of Pure Reason*. Translated by Paul Guyer and Allen W. Wood. Cambridge: Cambridge University Press, 1998.

Kaufman, Allison B., Erin N. Colbert-White, and Curt Burgess. “Higher-Order Semantic Structures in an African Grey Parrot’s Vocalizations: Evidence from the Hyperspace Analog to Language (HAL) Model.” *Animal Cognition* 16, 5 (2013): 1–13.

Keagy, Jason, Jean-François Savard, and Gerald Borgia. "Male Satin Bowerbird Problem-Solving Ability Predicts Mating Success." *Animal Behaviour 78*, *4* (2009): 809–817.

Keeley, Brian L. "Anthropomorphism, Primatomorphism, Mammalomorphism: Understanding Cross-Species Comparisons." *Biology and Philosophy 19*, *4* (2004): 521–540.

Kellogg, Winthrop Niles, and Luella Agger Kellogg. *The Ape and the Child: A Study of Environmental Influence upon Early Behavior*. New York, London: Whittlesey House McGraw-Hill Book Co., 1933.

Kendal, Rachel, Lydia M. Hopper, Andrew Whiten, Sarah F. Brosnan, Susan P. Lambeth, Steven J. Schapiro, and Will Hoppitt. "Chimpanzees copy dominant and knowledgeable individuals: Implications for cultural diversity." *Evolution and Human Behavior 36*, *1* (2015): 65–72.

Kennedy, John S. *The New Anthropomorphism*. Cambridge: Cambridge University Press, 1992.

Key, Brian. "Why Fish Do Not Feel Pain." *Animal Sentience 1*, *3*. https://animalstudiesrepository.org/animsent/vol1/iss3/1, 2016.

Kilian, Annette, Sevgi Yaman, Lorenzo von Fersen, and Onur Güntürkün. "A Bottlenose Dolphin Discriminates Visual Stimuli Differing in Numerosity." *Animal Learning & Behavior 31*, *2* (2003): 133–142.

Kim, Jaegwon. *Philosophy of Mind*. Cambridge, MA: Westview Press, 2006.

King, Barbara J. *The Dynamic Dance Nonvocal Communication in African Great Apes*. Cambridge, MA: Harvard University Press, 2004.

King, Barbara J. *How Animals Grieve*. Chicago, IL: The University of Chicago Press, 2013.

King, Barbara J., and Stuart G. Shanker. "How Can We Know the Dancer from the Dance? The Dynamic Nature of African Great Ape Social Communication." *Anthropological Theory 3*, *1* (2003): 5–26.

King, Stephanie L., and Vincent M. Janik. "Bottlenose Dolphins Can Use Learned Vocal Labels to Address Each Other." *Proceedings of the National Academy of Sciences 110*, *32* (2013): 13216–13221.

King, Stephanie L., Laela S. Sayigh, Randall S. Wells, Wendi Fellner, and Vincent M. Janik. "Vocal Copying of Individually Distinctive Signature Whistles in Bottlenose Dolphins." *Proceedings of the Royal Society B: Biological Sciences 280*, *1757* (2013): 20130053.

Kirchhofer, Katharina C., Felizitas Zimmermann, Juliane Kaminski, and Michael Tomasello. "Dogs (Canis Familiaris), but Not Chimpanzees (Pan Troglodytes), Understand Imperative Pointing." *PloS One 7*, *2* (2012): e30913.

Kiriazis, Judith, and C. N. Slobodchikoff. "Perceptual Specificity in the Alarm Calls of Gunnison's Prairie Dogs." *Behavioural Processes 73*, *1* (2006): 29–35.

Kitcher, P. "Ethics and Evolution: How to Get Here from There." In *Primates and Philosophers: How Morality Evolved*, edited by S. Macedo and J. Ober, 120–139. Princeton, NJ: Princeton University Press, 2006.

Kitcher, P. *The Ethical Project*. Cambridge: Harvard University Press, 2011.

Kitzmann, Carolyn D., and Nancy G. Caine. "Marmoset (Callithrix Geoffroyi) Food-Associated Calls Are Functionally Referential." *Ethology 115*, *5* (2009): 439–448.

Knörnschild, Mirjam, Marion Feifel, and Elisabeth K. V. Kalko. "Mother–offspring Recognition in the Bat Carollia Perspicillata." *Animal Behaviour 86*, *5* (2013): 941–948.

Koch, Christof. *Consciousness: Confessions of a Romantic Reductionist*. Cambridge, MA: MIT Press, 2012.

Koch, Christof, Marcello Massimini, Melanie Boly, and Giulio Tononi. "Neural Correlates of Consciousness: Progress and Problems." *Nature Reviews. Neuroscience 17*, *5* (2016): 307–321.

Kohda, Masanori, Takashi Hotta, Tomohiro Takeyama, Satoshi Awata, Hirokazu Tanaka, Jun-ya Asai, and Alex L. Jordan. "If a Fish Can Pass the Mark Test, What are the Implications for Consciousness and Self-Awareness Testing in Animals?" *PLOS Biology 17*, *2* (2019): e3000021.

Kohlberg, Lawrence. *The Philosophy of Moral Development: Moral Stages and the Idea of Justice*. San Francisco: Harper & Row, 1981.

Kohlberg, Lawrence, and Clark Power. “Moral Development, Religious Thinking, and the Question of a Seventh Stage.” *Zygon®16*, *3* (1981): 203–259.

Köhler, Wolfgang. *The Mentality of Apes*. New York: Harcourt, Brace & Co., Inc., 1925.

Korsgaard, Christine. “Morality and the Distinctiveness of Human Action.” In *Primates and Philosophers: How Morality Evolved*, edited by S. Macedo and J. Ober, 98–119. Princeton, NJ: Princeton University Press, 2006.

Korsgaard, C. *Fellow Creatures: Our Obligations to the Other Animals*. Oxford: Oxford University Press, 2018.

Krachun, Carla, Malinda Carpenter, Josep Call, and Michael Tomasello. “A Competitive Nonverbal False Belief Task for Children and Apes.” *Developmental Science 12*, *4* (2009): 521–535.

Krause, Mark A., and Roger S. Fouts. “Chimpanzee (Pan Troglodytes) Pointing: Hand Shapes, Accuracy, and the Role of Eye Gaze.” *Journal of Comparative Psychology 111*, *4* (1997): 330–336.

Krebs, John R., and Nicholas B. Davies. *Behavioural Ecology: An Evolutionary Approach*. New York: Wiley, 2009.

Krech, David, Mark R. Rosenzweig, and Edward L. Bennett. “Effects of Environmental Complexity and Training on Brain Chemistry.” *Journal of Comparative and Physiological Psychology 53*, *6* (1960): 509–519.

Kruska, D. “Comparative Quantitative Study on Brains of Wild and Laboratory Rats. I. Comparison of Volume of Total Brain and Classical Brain Parts.” *Journal Für Hirnforschung 16*, *6* (1975): 469–483.

Kühl, Hjalmar S., Ammie K. Kalan, Mimi Arandjelovic, Floris Aubert, Lucy D’Auvergne, Annemarie Goedmakers, Sorrel Jones, Laura Kehoe, Sebastien Regnaut, Alexander Tickle, Els Ton, Joost van Schijndel, Ekwoge E. Abwe, Samuel Angedakin, Anthony Agbor, Emmanuel Ayuk Ayimisin, Emma Bailey, Mattia Bessone, Matthieu Bonnet, Gregory Brazolla, Valentine Ebua Buh, Rebecca Chancellor, Chloe Cipoletta, Heather Cohen, Katherine Corogenes, Charlotte Coupland, Bryan Curran, Tobias Deschner, Karsten Dierks, Paula Dieguez, Emmanuel Dilambaka, Orume Diotoh, Dervla Dowd, Andrew Dunn, Henk Eshuis, Rumen Fernandez, Yisa Ginath, John Hart, Daniela Hedwig, Martijn Ter Heegde, Thurston Cleveland Hicks, Inaoyom Imong, Kathryn J. Jeffery, Jessica Junker, Parag Kadam, Mohamed Kambi, Ivonne Kienast, Deo Kujirakwinja, Kevin Langergraber, Vincent Lapeyre, Juan Lapuente, Kevin Lee, Vera Leinert, Amelia Meier, Giovanna Maretti, Sergio Marrocoli, Tanyi Julius Mbi, Vianet Mihindou, Yasmin Moebius, David Morgan, Bethan Morgan, Felix Mulindahabi, Mizuki Murai, Protais Niyigabae, Emma Normand, Nicolas Ntare, Lucy Jayne Ormsby, Alex Piel, Jill Pruetz, Aaron Rundus, Crickette Sanz, Volker Sommer, Fiona Stewart, Nikki Tagg, Hilde Vanleeuwe, Virginie Vergnes, Jacob Willie, Roman M. Wittig, Klaus Zuberbuehler, and Christophe Boesch. “Chimpanzee Accumulative Stone Throwing.” *Scientific Reports 6* (2016): 22219.

Kundey, Shannon, Andres De Los Reyes, Chelsea Taglang, Rebecca Allen, Sabrina Molina, Erica Royer, and Rebecca German. “Domesticated Dogs Canis Familiaris React to What Others Can and Cannot Hear.” *Applied Animal Behaviour Science 126*, *1* (2010): 45–50.

Kutsukake, Nobuyuki, and Duncan L. Castles. “Reconciliation and Post-Conflict Third-Party Affiliation among Wild Chimpanzees in the Mahale Mountains.” *Tanzania. Primates 45*, *3* (2004): 157–165, doi:10.1007/s10329-004-0082-z.

LaGraize, Stacey C., Christopher J. Labuda, Margaret A. Rutledge, Raymond L. Jackson, and Perry N. Fuchs. “Differential Effect of Anterior Cingulate Cortex Lesion on Mechanical Hypersensitivity and Escape/avoidance Behavior in an Animal Model of Neuropathic Pain.” *Experimental Neurology 188*, *1* (2004): 139–148.

Lakshminarayanan, Venkat R., and Laurie R. Santos. “Capuchin Monkeys are Sensitive to Others’ Welfare.” *Current Biology 18*, *21* (2008): R999–R1000.

Laland, Kevin N. “Social learning strategies.” *Animal Learning & Behavior 32*, *1* (2004): 4–14.

Laland, Kevin, and Vincent M. Janik. “The Animal Cultures Debate.” *Trends in Ecology & Evolution 21*, *10* (2006): 542–547.

Lamme, Victor A. F. “Towards a True Neural Stance on Consciousness.” *Trends in Cognitive Sciences 10*, *11* (2006): 494–501. doi:10.1016/j.tics.2006.09.001.

Lamme, Victor A. F. “How Neuroscience Will Change Our View on Consciousness.” *Cognitive Neuroscience 1*, *3* (2010): 204–220, doi:10.1080/17588921003731586.

Leavens, David A. “The Plight of the Sense-making Ape.” In *Enactive Cognition at the Edge of Sense-making*, edited by T. Froese and M. Cappuccio, 81–104. Basingstoke: Palgrave MacMillan, 2014.

Leavens, David A., and William D. Hopkins. “Intentional Communication by Chimpanzees: A Cross-Sectional Study of the Use of Referential Gestures.” *Developmental Psychology 34*, *5* (1998): 813–822.

Leavens, David A., and William D. Hopkins. “The Whole-Hand Point: The Structure and Function of Pointing from a Comparative Perspective.” *Journal of Comparative Psychology 113*, *4* (1999): 417–425.

Leavens, David A., William D. Hopkins, and Kim A. Bard. “Indexical and Referential Pointing in Chimpanzees (Pan Troglodytes).” *Journal of Comparative Psychology 110*, *4* (1996): 346–353.

Leavens, David A., William D. Hopkins, and Roger K. Thomas. “Referential Communication by Chimpanzees (Pan Troglodytes).” *Journal of Comparative Psychology 118*, *1* (2004): 48–57.

Leavens, David A., William D. Hopkins, and Kim A. Bard. “Understanding the Point of Chimpanzee Pointing Epigenesis and Ecological Validity.” *Current Directions in Psychological Science 14*, *4* (2005a): 185–189.

Leavens, David A., Jamie L. Russell, and William D. Hopkins. “Intentionality as Measured in the Persistence and Elaboration of Communication by Chimpanzees (Pan Troglodytes).” *Child Development 76*, *1* (2005b): 291–306.

Leavens, David A., Jamie L. Russell, and William D. Hopkins. “Multimodal Communication by Captive Chimpanzees (Pan Troglodytes).” *Animal Cognition 13*, *1* (2010): 33–40.

Lee, Kisung, Paul E. Kinahan, Jeffrey A. Fessler, Robert S. Miyaoka, Marie Janes, and Tom K. Lewellen. “Pragmatic Fully 3D Image Reconstruction for the MiCES Mouse Imaging PET Scanner.” *Physics in Medicine and Biology 49*, *19* (2004): 4563.

Legerstee, Maria, and Yarixa Barillas. “Sharing Attention and Pointing to Objects at 12 Months: Is the Intentional Stance Implied?” *Cognitive Development 18*, *1* (2003): 91–110.

Le Roux, Aliza, Noah Snyder-Mackler, Eila K. Roberts, Jacinta C. Beehner, and Thore J. Bergman. “Evidence for Tactical Concealment in a Wild Primate.” *Nature Communications 4* (2013), doi: 10.1038/ncomms2468.

Leslie, Alan M. “Infant Perception of a Manual Pick-up Event.” *British Journal of Developmental Psychology 2*, *1* (1984): 19–32.

Lesson, Sarah Beth, Brandon Tinklenberg, and Kristin Andrews. “Belief and Representation in Nonhuman Animals.” In *The Routledge Handbook of Philosophy and Psychology 2nd Edition*, edited by Sarah Robins, John Symons, and Paco Calvo. New York: Routledge, (2020): 370–383.

Levine, J. “Materialism and Qualia: The Explanatory Gap.” *Pacific Philosophical Quarterly 64*, *4* (1983): 354–361.

Lewes, George Henry. *Sea-Side Studies at Ilfracombe, Tenby, the Scilly Isles, and Jersey*. Edinburgh: William Blackwood & Sons, 1860.

Lewis, David. “Psychophysical and Theoretical Identifications.” *Australasian Journal of Philosophy 50*, *3* (1972): 249–258.

Lewis, David. “Lewis, David: Reduction of Mind.” In *A Companion to the Philosophy of Mind*, edited by S. Guttenplan, 412–431. Oxford: Blackwell, 1994.

Liebal, Katja, Josep Call, Michael Tomasello, and Simone Pika. “To Move or Not to Move: How Apes Adjust to the Attentional State of Others.” *Interaction Studies 5*, *2* (2004): 199–219.

Linton, Ralph. *The Study of Man*. New York: Appelton-Century Crofts, 1936.

Lorenz, Konrad. *King Solomon's Ring: New Light on Animal Ways*. New York: Crowell, 1952.

Lovejoy, A.O. ([1936] 2001). *The Great Chain of Being: A Study in the History of an Idea*, Reprint, Cambridge, MA: Harvard University Press.

Lowe, E. Jonathan. *An Introduction to the Philosophy of Mind*. Cambridge: Cambridge University Press, 2000.

Luncz, Lydia V., and Christophe Boesch. "Tradition Over Trend: Neighboring Chimpanzee Communities Maintain Differences in Cultural Behavior Despite Frequent Immigration of Adult Females." *American Journal of Primatology 76*, *7* (2014): 649–657.

Luncz, Lydia V., Roger Mundry, and Christophe Boesch. "Evidence for Cultural Differences between Neighboring Chimpanzee Communities." *Current Biology 22*, *10* (2012): 922–926.

Lurz, Robert W. "In Defense of Wordless Thoughts about Thoughts." *Mind & Language 22*, *3* (2007): 270–296.

Lurz, Robert W. *The Philosophy of Animal Minds*. New York: Cambridge University Press, 2009.

Lurz, Robert W. *Mindreading Animals: The Debate over What Animals Know about Other Minds*. Cambridge, MA: MIT Press, 2011.

Lurz, Robert W., and Carla Krachun. "How Could We Know Whether Nonhuman Primates Understand Others' Internal Goals and Intentions? Solving Povinelli's Problem." *Review of Philosophy and Psychology 2*, *3* (2011): 449–481.

Lyons, Derek E., Andrew G. Young, and Frank C. Keil. "The Hidden Structure of Overimitation." *Proceedings of the National Academy of Sciences 104*, *50* (2007): 19751–19756.

MacDermot, Kay D., Elena Bonora, Nuala Sykes, Anne-Marie Coupe, Cecilia S. L. Lai, Sonja C. Vernes, Faraneh Vargha-Khadem, Fiona McKenzie, Robert L. Smith, and Anthony P. Monaco. "Identification of FOXP2 Truncation as a Novel Cause of Developmental Speech and Language Deficits." *The American Journal of Human Genetics 76*, *6* (2005): 1074–1080.

Machery, E., and Mallon, R. "Evolution of Morality." In *The Moral Psychology Handbook,* edited by J. M. Doris, 3. Oxford: Oxford University Press, 2010.

MacLean, Evan L., Luke J. Matthews, Brian A. Hare, Charles L. Nunn, Rindy C. Anderson, Filippo Aureli, Elizabeth M. Brannon, Call J, Drea CM, Emery NJ, Haun DB, Herrmann E, Jacobs LF, Platt ML, Rosati AG, Sandel AA, Schroepfer KK, Seed AM, Tan J, van Schaik CP, and Wobber V. "How Does Cognition Evolve? Phylogenetic Comparative Psychology." *Animal Cognition 15*, *2* (2012): 223–238.

MacLean, Evan L., Brian Hare, Charles L. Nunn, Elsa Addessi, Federica Amici, Rindy C. Anderson, Filippo Aureli, Joseph M. Baker, Amanda E. Bania, Allison M. Barnard, Neeltje J. Boogert, Elizabeth M. Brannon, Emily E. Bray, Joel Bray, Lauren J. N. Brent, Judith M. Burkart, Josep Call, Jessica F. Cantlon, Lucy G. Cheke, Nicola S. Clayton, Mikel M. Delgado, Louis J. DiVincenti, Kazuo Fujita, Esther Herrmann, Chihiro Hiramatsu, Lucia F. Jacobs, Kerry E. Jordan, Jennifer R. Laude, Kristin L. Leimgruber, Emily J. E. Messer, Antonio C. de A. Moura, Ljerka Ostojić, Alejandra Picard, Michael L. Platt, Joshua M. Plotnik, Friederike Range, Simon M. Reader, Rachna B. Reddy, Aaron A. Sandel, Laurie R. Santos, Katrin Schumann, Amanda M. Seed, Kendra B. Sewall, Rachael C. Shaw, Katie E. Slocombe, Yanjie Su, Ayaka Takimoto, Jingzhi Tan, Ruoting Tao, Carel P. van Schaik, Zsófia Virányi, Elisabetta Visalberghi, Jordan C. Wade, Arii Watanabe, Jane Widness, Julie K. Young, Thomas R. Zentall, and Yini Zhao. "The Evolution of Self-Control." *Proceedings of the National Academy of Sciences 111*, *20* (2014): E2140–E2148.

Maibom, Heidi Lene (ed). *Empathy and Morality*. New York: Oxford University Press, 2014.

Mann, J., and C. Karniski. "Diving Beneath the Surface: Long-Term Studies of Dolphins and Whales." *Journal of Mammalogy 98* (2017): 621–630.

Manser, Marta B. “The Acoustic Structure of Suricates’ Alarm Calls Varies with Predator Type and the Level of Response Urgency.” *Proceedings of the Royal Society of London. Series B: Biological Sciences 268*, *1483* (2001): 2315–2324.

Manser, Marta B., Matthew B. Bell, and Lindsay B. Fletcher. “The Information That Receivers Extract from Alarm Calls in Suricates.” *Proceedings of the Royal Society of London. Series B: Biological Sciences 268*, *1484* (2001): 2485–2491.

Manser, Marta B., Robert M. Seyfarth, and Dorothy L. Cheney. “Suricate Alarm Calls Signal Predator Class and Urgency.” *Trends in Cognitive Sciences 6*, *2* (2002): 55–57.

Marcus, Ruth Barcan. “Some Revisionary Proposals about Belief and Believing.” *Philosophy and Phenomenological Research 50* (1990): 133–153.

Marler, Peter, Alfred Dufty, and Roberta Pickert. “Vocal Communication in the Domestic Chicken: I. Does a Sender Communicate Information about the Quality of a Food Referent to a Receiver?” *Animal Behaviour 34* (1986): 188–193.

Marler, Peter, Christopher S. Evans, and Marc D. Hauser. “Animal Signals: Motivational, Referential, or Both.” In *Nonverbal Vocal Communication: Comparative and Developmental Approaches*, edited by H. Papoušek, U. Jürgens, and M. Papoušek, 66–86. Cambridge, UK: Cambridge University Press,1992.

Márquez, Cristina, Scott M. Rennie, Diana F. Costa, and Marta A. Moita. “Prosocial Choice in Rats Depends on Food-Seeking Behavior Displayed by Recipients.” *Current Biology 25*, *13* (2015): 1736–1745.

Marr, David. *Vision: A Computational Investigation into the Human Representation and Processing of Visual Information*. San Francisco: W. H. Freeman, 1982.

Marsh, Heidi L., and Suzanne E. MacDonald. “Information Seeking by Orangutans: A Generalized Search Strategy?” *Animal Cognition 15*, *3* (2012): 293–304.

Marzluff, John M., and Tony Angell. *Gifts of the Crow: How Perception, Emotion, and Thought Allow Smart Birds to Behave like Humans*. New York: Free Press, 2012.

Marzluff, John M., Robert Miyaoka, Satoshi Minoshima, and Donna J. Cross. “Brain Imaging Reveals Neuronal Circuitry Underlying the Crow’s Perception of Human Faces.” *Proceedings of the National Academy of Sciences 109*, *39* (2012): 15912–15917.

Mather, Jennifer A., and Roland C. Anderson. “Personalities of Octopuses (Octopus Rubescens).” *Journal of Comparative Psychology 107*, *3* (1993): 336–340.

Matsuzawa, Tetsuro. “Chimpanzee Ai and Her Son Ayumu: An Episode of Education by Master-Apprenticeship.” In *The Cognitive Animal: Empirical and Theoretical Perspectives on Animal Cognition*, edited by Marc Bekoff, Colin Allen, and Gordon M. Burghardt, 189–195, Cambridge, MA: MIT Press, 2002.

Matsuzawa, Tetsuro. “Evolutionary Origins of the Human Mother-Infant Relationship.” In *Cognitive Development in Chimpanzees*, edited by Tetsuro Matsuzawa, Masaki Tomonaga and Masayuki Tanaka, 127–141. New York: Springer, 2006.

Matsuzawa, Tetsuro, Masaki Tomonaga and Masayuki Tanaka (eds). *Cognitive Development in Chimpanzees*. New York: Springer, 2006.

Matthews, Danielle (ed). *Pragmatic Development in First Language Acquisition*. Trends in Language Acquisition Research, Vol. 10. Amsterdam: John Benjamins Publishing Company, 2014.

Maynard-Smith, John, and David Harper. *Animal Signals*. Oxford: Oxford University Press, 2003.

McAninch, Andrew, Grant Goodrich, and Colin Allen. “Animal Communication and Neo-Expressivism.” In *The Philosophy of Animal Minds*, edited by Robert W. Lurz, 128–144, Cambridge, UK: Cambridge University Press, 2009.

McGeer, Victoria. “The Regulative Dimension of Folk Psychology.” In *Folk Psychology Re-Assessed*, edited by Daniel D. Hutto and Matthew Ratcliffe. Dordrecht, Netherlands: Springer, (2007): 137–156.

McGeer, Victoria. “Mind-Making Practices: The Social Infrastructure of Self-Knowing Agency and Responsibility.” *Philosophical Explorations 18*, *2* (2015): 259–281.

McGinn, Colin. “Can We Solve the Mind-Body Problem?” *Mind 98*, *391* (1989): 349–366.

McNeill, David (ed). *Language and Gesture*. Cambridge: Cambridge University Press, 2000.

Mechner, Francis. “Probability Relations within Response Sequences under Ratio Reinforcement.” *Journal of the Experimental Analysis of Behavior 1*, *2* (1958): 109–121.

Meketa, Irina. “A Critique of the Principle of Cognitive Simplicity in Comparative Cognition.” *Biology & Philosophy* February *16* (2014): 1–15.

Melis, Alicia P., and Michael Tomasello. “Chimpanzees’ (Pan Troglodytes) Strategic Helping in a Collaborative Task.” *Biology Letters 9* (2013): 1–4.

Meltzoff, Andrew N. “Infant imitation after a 1-week delay: Long-term memory for novel acts and multiple stimuli.” *Developmental Psychology 24* (1988): 470–476.

Meltzoff, Andrew N., and M. Keith Moore. “Imitation of Facial and Manual Gestures by Human Neonates.” *Science 198*, *4312* (1977): 75–58.

Melzack, Ronald, and Patrick D. Wall. *The Challenge of Pain*. New York: Penguin, 2008.

Menzel, Randolf, and Julia Fischer (eds). *Animal Thinking: Contemporary Issues in Comparative Cognition*. Strüngmann Forum Reports. Cambridge, MA: MIT Press, 2012.

Mikhalevich [Meketa], Irina. (2014) “A Critique of the Principle of Cognitive Simplicity in Comparative Cognition,” *Biology & Philosophy* 29: 731–745.

Miklósi, Ádam, and Krisztina Soproni. “A Comparative Analysis of Animals’ Understanding of the Human Pointing Gesture.” *Animal Cognition 9*, *2* (2006): 81–93.

Miklósi, Adam, Józcef Topál, and Vilmos Csányi. “Comparative Social Cognition: What Can Dogs Teach Us?” *Animal Behaviour 67*, *6* (2004): 995–1004.

Miles, H. Lyn, Robert W. Mitchell, and Stephen E. Harper. “Simon Says: The Development of Imitation in an Enculturated Orangutan.” In *Reaching into Thought: The Minds of the Great Apes*, edited by Anne Russon, Kim Bard, and Sue Taylor Parker, 278–299. Cambridge: Cambridge University Press, 1996.

Miller, Noam, Simon Garnier, Andrew T. Hartnett, and Iain D. Couzin. “Both Information and Social Cohesion Determine Collective Decisions in Animal Groups.” *Proceedings of the National Academy of Sciences 110*, *13* (2013): 5263–5268.

Millikan, Ruth. “Styles of Rationality.” In *Rational Animals*, edited by Susan Hurley and Matthew Nudds, 117–126. Oxford: Oxford University Press, 2006.

Mischel, Walter, and Ebbe B. Ebbesen. “Attention in Delay of Gratification.” *Journal of Personality and Social Psychology 16*, *2* (1970): 329–337.

Mischel, Walter, Ebbe B. Ebbesen, and Antonette Raskoff Zeiss. “Cognitive and Attentional Mechanisms in Delay of Gratification.” *Journal of Personality and Social Psychology 21*, *2* (1972): 204–218.

Mitani, John, and David Watts. “Boundary Patrols and Intergroup Encounters in Wild Chimpanzees.” *Behaviour 138*, *3* (2001): 299–327.

Mitchell, Robert W., Nicholas S. Thompson and H. Lyn Miles (eds). *Anthropomorphism, Anecdotes, and Animals*. SUNY Series in Philosophy and Biology. Albany: State University of New York Press, 1997.

Mody, Shilpa, and Susan Carey. “The Emergence of Reasoning by the Disjunctive Syllogism in Early Childhood.” *Cognition 154* (2016): 40–48.

Mohamed, Othman A., Maud Jonnaert, Cassandre Labelle-Dumais, Kazuki Kuroda, Hugh J. Clarke, and Daniel Dufort. “Uterine Wnt/ß-Catenin Signaling Is Required for Implantation.” *Proceedings of the National Academy of Sciences of the United States of America 102*, *24* (2005): 8579–8584.

Moll, Henrike, and Michael Tomasello. “Cooperation and Human Cognition: The Vygotskian Intelligence Hypothesis.” *Philosophical Transactions of the Royal Society B: Biological Sciences 362*, *1480* (2007): 639–648.

Monsó, Susana. "Empathy and Morality in Behaviour Readers." *Biology & Philosophy 30*, *5* (2015): 671–690.

Monsó, Susana, and Kristin Andrews. "Animal Moral Psychologies." In *The Oxford Handbook of Moral Psychology*, edited by John Doris and Manuel Vargas. New York: Routledge, forthcoming.

Moore, Richard. "Ontogenetic Constraints on Paul Grice's Theory of Communication." In *Pragmatic Development in First Language Acquisition*, edited by Danielle Matthews, 87–104. Amsterdam: John Benjamins, 2014.

Moore, Richard. "Meaning and Ostension in Great Ape Gestural Communication." *Animal Cognition 19* (2016): 223–231.

Moore, Richard. "Convergent Minds: Ostension, Inference and Grice's Third Clause." *Interface Focus 7* (2017), doi:10.1098/rsfs.2016.0107.

Morgan, C. Lloyd. *Animal Life and Intelligence*. London: E. Arnold, 1891. http://archive.org/details/animallifeintell00morguoft. Accessed July 25, 2014.

Morgan, C. Lloyd. *An Introduction to Comparative Psychology*. London: Walter Scott Publishing Company, 1903.

Morgan, C. Lloyd. "Autobiography." In *A History of Psychology in Autobiography*, edited by Carl Murchison and Edwin Garrigues Boring, 237–264. Worcester, MA: Clark University Press, 1930.

Morris, Anne K. "Development of Logical Reasoning: Children's Ability to Verbally Explain the Nature of the Distinction between Logical and Nonlogical Forms of Argument." *Developmental Psychology 36*, *6* (2000): 741–758.

Morton, Adam. *The Importance of Being Understood: Folk Psychology as Ethics*. New York: Routledge, 2003.

Moshman, David. "From Inference to Reasoning: The Construction of Rationality." *Thinking & Reasoning 10*, *2* (2004): 221–239.

Mulcahy, Nicholas J., and Josep Call. "Apes Save Tools for Future Use." *Science 312*, *5776* (2006): 1038–1040.

Murchison, Carl, and Edwin Garrigues Boring. *A History of Psychology in Autobiography*. Worcester, MA: Clark University Press, 1930.

Musgrave, Stephanie, David Morgan, Elizabeth Lonsdorf, Roger Mundry, and Crickette Marie Sanz. "Tool Transfers are a Form of Teaching among Chimpanzees." *Scientific Reports 6* (2016): 34783.

Mutic, Samiljana, Valentina Parma, Yvonne Felicitas Brunner, and Jessica Freiherr. "You Smell Dangerous: Communicating Fight Responses Through Human Chemosignals of Aggression." *Chemical Senses 41, 1* (2016): 35–43.

Myowa-Yamakoshi, Masako, Masaki Tomonaga, Masayuki Tanaka, and Tetsuro Matsuzawa. "Imitation in Neonatal Chimpanzees (Pan Troglodytes)." *Developmental Science 7*, *4* (2004): 437–442.

Myowa-Yamakoshi, Masako, and Tetsuro Matsuzawa. "Imitation of intentional manipulatory actions in chimpanzees (*Pan troglodytes*)." *Journal of Comparative Psychology 114* (2000): 381–391.

Nagel, Thomas. "What Is It Like to Be a Bat?" *The Philosophical Review 83*, *4* (1974): 435–450.

Nakamichi, Masayuki, Eiko Kato, Yasuo Kojima, and Naosuke Itoigawa. "Carrying and Washing of Grass Roots by Free-Ranging Japanese Macaques at Katsuyama." *Folia Primatologica 69*, *1* (1998): 35–40.

Neyman, Jerzy, and Egon S. Pearson. *Joint Statistical Papers*. Berkeley: University of California Press, 1967.

Nisbett, Richard E., and Timothy D. Wilson. "Telling More than We Can Know: Verbal Reports on Mental Processes." *Psychological Review 84*, *3* (1977): 231–259.

Nishie, Hitonaru, and Michio Nakamura. "A Newborn Infant Chimpanzee Snatched and Cannibalized Immediately After Birth: Implications for 'Maternity Leave' in Wild Chimpanzee." *American Journal of Physical Anthropology 165*, *1* (2018): 194–199.

Nonhuman Rights Project. "First-Ever Lawsuits Filed on Behalf of Captive Chimpanzees to Demand Court Grant Them Right to Bodily Liberty (Press Release)." December 2, 2013. http://www.nonhumanrightsproject.org/wp-content/uploads/2013/11/NhRP-Press-Release-Dec-2-2013.pdf.

Nucci, Larry P., and Elliot Turiel. "Social Interactions and the Development of Social Concepts in Preschool Children." *Child Development 49*, *2* (1978): 400–407.

Nussbaum, Martha C. "Beyond the Social Contract: Toward Global Justice." *Tanner Lectures on Human Values 24* (2004): 413–508.

Nussbaum, Martha C. "The Moral Status of Animals." *The Chronicle of Higher Education 3* (2006). http://www.arcusfoundation.org/images/uploads/downloads/The_Moral_Staus_of_Animals_by_Martha_Nussbaum_2006.pdf. Accessed July 25, 2014.

Ohashi, Gaku, and Tetsuro Matsuzawa. "Deactivation of Snares by Wild Chimpanzees." *Primates: Journal of Primatology 52*, *1* (2011), 1–5.

Okamoto, Sanae, Masaki Tomonaga, Kiyoshi Ishii, Nobuyuki Kawai, Masayuki Tanaka, and Tetsuro Matsuzawa. "An Infant Chimpanzee (Pan Troglodytes) Follows Human Gaze." *Animal Cognition 5*, *2* (2002): 107–114.

Onishi, Kristine H., and Renée Baillargeon. "Do 15-Month-Old Infants Understand False Beliefs?" *Science 308*, *5719* (2005): 255–258.

Osvath, Mathias. "Spontaneous Planning for Future Stone Throwing by a Male Chimpanzee." *Current Biology 19*, *5* (2009): R190–R191.

Osvath, Mathias, and Elin Karvonen. "Spontaneous Innovation for Future Deception in a Male Chimpanzee." *PLoS ONE 7*, *5* (2012): e36782.

Overduin-de Vries, A. M., Olesen, C. U., de Vries, H., Spruijt, B. M., and Sterck, E. H. M. "Sneak Copulations in Long-Tailed Macaques (Macaca fascicularis): No Evidence for Tactical Deception." *Behavioral Ecology and Sociobiology 67*, *1* (2013): 101–111.

Ozonoff, Sally, Bruce F. Pennington, and Sally Rogers. "Executive Function Deficits in High-Functioning Autistic Individuals: Relationship to Theory of Mind." *Journal of Child Psychology and Psychiatry 32, 7* (1991): 1081–1105.

Pack, Adam A., and Louis M. Herman. "Sensory Integration in the Bottlenosed Dolphin: Immediate Recognition of Complex Shapes across the Senses of Echolocation and Vision." *The Journal of the Acoustical Society of America 98*, *2* (1995): 722–733.

Pack, Adam A., and Louis M. Herman. "Dolphin Social Cognition and Joint Attention: Our Current Understanding." *Aquatic Mammals 32*, *4* (2006): 443–460.

Panksepp, Jaak. "Affective Consciousness: Core Emotional Feelings in Animals and Humans." *Consciousness and Cognition 14*, *1* (2005): 30–80.

Panksepp, Jaak, and Jeff Burgdorf. "'Laughing' Rats and the Evolutionary Antecedents of Human Joy?" *Physiology and Behavior 79* (2003): 533–547.

Parr, Lisa A. "The Discrimination of Faces and Their Emotional Content by Chimpanzees (Pan Troglodytes)." *Annals of the New York Academy of Sciences 1000*, *1* (2003): 56–78.

Parr, Lisa A., Bridget M. Waller, and Jennifer Fugate. "Emotional Communication in Primates: Implications for Neurobiology." *Current Opinion in Neurobiology 15*, *6* (2005): 716–720.

Parr, Lisa A., Bridget M. Waller, Sarah J. Vick, and Kim A. Bard. "Classifying Chimpanzee Facial Expressions Using Muscle Action." *Emotion 7*, *1* (2007): 172–181.

Patterson, Francine G. "The Gestures of a Gorilla: Language Acquisition in Another Pongid." *Brain and Language 5*, *1* (1978): 72–97.

Pavani, F., Irina Boscagli, Francesco Benvenuti, Marco Rabuffetti, and Alessandro Farnè. "Are Perception and Action Affected Differently by the Titchener Circles Illusion?" *Experimental Brain Research 127*, *1* (1999): 95–101.

Pelé, Marie, Valérie Dufour, Bernard Thierry, and Josep Call. "Token Transfers among Great Apes (Gorilla Gorilla, Pongo Pygmaeus, Pan Paniscus, and Pan Troglodytes): Species Differences, Gestural Requests, and Reciprocal Exchange." *Journal of Comparative Psychology 123*, *4* (2009): 375–384.

Penn, Derek C. "How Folk Psychology Ruined Comparative Psychology: And How Scrub Jays Can Save It." In *Animal Thinking: Contemporary Issues in Comparative Cognition*, edited by Randolf Menzel and Julia Fischer, 253–266. Cambridge, MA: MIT Press, 2012.

Penn, Derek C., and Daniel J. Povinelli. "On the Lack of Evidence That Non-Human Animals Possess Anything Remotely Resembling a 'Theory of Mind.'" *Philosophical Transactions of the Royal Society B*, *362*, *1480* (2007): 731–744.

Pepperberg, Irene M. *The Alex Studies: Communication and Cognitive Capacities of an African Grey Parrot*. Cambridge, MA: Harvard University Press, 1999.

Pepperberg, Irene M., Suzanne Gray, Shilpa Mody, Francesca Cornero, and Susan Carey. "Logical Reasoning by a Grey Parrot (*Psittacus erithacus*)? A Case Study of the Disjunctive Syllogism." *Behavior 156*, *5* (2018): 1–37.

Perner, Josef. *Understanding the Representational Mind*. Cambridge, MA: MIT Press, 1991.

Perner, Josef, and Ted Ruffman. "Infants' Insight into the Mind: How Deep." *Science 308*, *5719* (2005): 214–216.

Perry, Susan, Mary Baker, Linda Fedigan, Julie Gros-Louis, Katherine Jack, Katherine C. MacKinnon, J. Manson, M. Panger, K. Pyle, and L. Rose. "Social Conventions in Wild White-Faced Capuchin Monkeys: Evidence for Traditions in a Neotropical Primate." *Current Anthropology. Special Issue: Divergences and Commonalities within Taxonomic and Political Orders 44* (2003), 241–268.

Pika, Simone, and John Mitani. "Referential Gestural Communication in Wild Chimpanzees (Pan Troglodytes)." *Current Biology 16*, *6* (2006): R191–R192.

Pika, Simone, and Thomas Bugnyar. "The Use of Referential Gestures in Ravens (Corvus Corax) in the Wild." *Nature Communications 2* (2011): 560.

Pilley, John W., and Alliston K. Reid. "Border Collie Comprehends Object Names as Verbal Referents." *Behavioural Processes 86*, *2* (2011): 184–195.

Pillow, Bradford H. "Epistemological Development in Adolescence and Adulthood: A Multidimensional Framework." *Genetic, Social, and General Psychology Monographs 125*, *4* (1999): 413–432.

Pitt, David, "Mental Representation." *The Stanford Encyclopedia of Philosophy* (Fall 2013 Edition), Edward N. Zalta, (ed). http://plato.stanford.edu/archives/fall2013/entries/mental-representation/. Accessed July 25, 2014.

Ploog, Detlev. "Is the Neural Basis of Vocalization Different in Non-Human Primates and Homo Sapiens?" *The Speciation of Modern Homo Sapiens 106* (2004): 121–135.

Plooij, Franciscus Xaverius. "Some Basic Traits of Language in Wild Chimpanzees." In *Action, Gesture, and Symbol: The Emergence of Language*, edited by A. Lock, 111–131. New York: Academic Press, 1978.

Plotnik, Joshua M., Frans B. M. de Waal, and Diana Reiss. "Self-Recognition in an Asian Elephant." *Proceedings of the National Academy of Sciences 103*, *45* (2006): 17053–17057.

Plotnik, Joshua M., Daniel L. Brubaker, Rachel Dale, Lydia N. Tiller, Hannah S. Mumby, and Nicola S. Clayton. "Elephants have a Nose for Quantity." *Proceedings of the National Academy of Sciences 116*, *25* (2019): 12566–12571.

Pollick, Amy S., and Frans B. M. De Waal. "Ape Gestures and Language Evolution." *Proceedings of the National Academy of Sciences 104*, *19* (2007): 8184–8189.

Poniewozik, James. "Looks like Meerkat Love." *Time Magazine*, November 2, 2007. http://content.time.com/time/magazine/article/0,9171,1680162,00.html. Accessed July 25, 2014.

Poole, Joyce H., and Petter Granli. "Signals, Gestures, and Behavior of African Elephants." In *The Amboseli Elephants: A Long-Term Perspective on a Long-Lived Mammal*, edited by Cynthia J. Moss, Harvey Croze, and Phyllis C. Lee, 109–127. Chicago, IL: University of Chicago Press, 2011.

Portavella, Manuel, Blas Torres, and Cosme Salas. "Avoidance Response in Goldfish: Emotional and Temporal Involvement of Medial and Lateral Telencephalic Pallium." *Journal of Neuroscience 24* (2004): 2335–2342.

Poulin-Dubois, Diane, Ivy Brooker, and Alexandra Polonia. "Infants Prefer to Imitate a Reliable Person." *Infant Behavior and Development 34* (2011): 303–309.

Povinelli, Daniel J., and Jennifer Vonk. "Chimpanzee Minds: Suspiciously Human?" *Trends in Cognitive Sciences 7*, *4* (2003): 157–160.

Povinelli, Daniel J., and Jennifer Vonk. "We Don't Need a Microscope to Explore the Chimpanzee's Mind." *Mind & Language 19*, *1* (2004): 1–28.

Povinelli, Daniel J., Timothy J. Eddy, R. Peter Hobson, and Michael Tomasello. "What Young Chimpanzees Know about Seeing." *Monographs of the Society for Research in Child Development 61*, *3* (1996): 1–189.

Povinelli, Daniel J., Jesse Bering, and Steve Giambrone. "Chimpanzee 'Pointing': Another Error of the Argument by Analogy." *Pointing: Where Language, Culture, and Cognition Meet* (2003): 35–68.

Pratt, Stephen C. "Recruitment and Other Communication Behavior in the Ponerine Ant Ectatomma Ruidum." *Ethology 81*, *4* (1989): 313–331.

Premack, David. "On the Assessment of Language Competence in the Chimpanzee." *Behavior of Nonhuman Primates 4* (1971): 185–228.

Premack, David, and Guy Woodruff. "Does the Chimpanzee Have a Theory of Mind?" *Behavioral and Brain Sciences 1*, *4* (1978): 515–526.

Prinz, Jesse. *The Conscious Brain: How Attention Engenders Experience*. New York: Oxford University Press, 2012.

Prinz, Jesse J. "A Neurofunctional Theory of Consciousness." In *Cognition and the Brain: The Philosophy and Neuroscience Movement*, edited by Andrew Brook, Kathleen Akins and Steven Davis, 381–396. Cambridge: Cambridge University Press, 2005.

Prior, Helmut, Ariane Schwarz, and Onur Güntürkün. "Mirror-Induced Behavior in the Magpie (Pica Pica): Evidence of Self-Recognition." *PLoS Biology 6* (2008): e202.

Proctor, Darby, Rebecca A. Williamson, Frans B. M. de Waal, and Sarah F. Brosnan. "Chimpanzees Play the Ultimatum Game." *Proceedings of the National Academy of Sciences 110*, *6* (2013): 2070–2075.

Pruetz, Jill D., and Paco Bertolani. "Savanna Chimpanzees, Pan Troglodytes verus, Hunt with Tools." *Current Biology 17*, *5* (2007): 412–417.

Putnam, Hilary. "Minds and Machines." In *Dimensions of Mind*, edited by Sidney Hook, 148–180. New York: New York University Press, 1960.

Putnam, Hilary. "Psychological Predicates." In *Art, Mind, and Religion*, edited by W. H. Capitan and D. D. Merrill, 37–48. Pittsburgh: University of Pittsburgh Press, 1967.

Quine, Willard Van Orman. *Word and Object*. Cambridge, MA: MIT Press, 1960.

Raby, Caroline R., Dean M. Alexis, Anthony Dickinson, and Nicola S. Clayton. "Planning for the Future by Western Scrub-Jays." *Nature 445*, *7130* (2007): 919–921.

Raihani, Nichola, and Amanda R. Ridley. "Experimental Evidence for Teaching in Wild Pied Babblers." *Animal Behaviour 75* (2008): 3–11.

Raio, Candace M., David Carmel, Marisa Carrasco, and Elizabeth A. Phelps. "Nonconscious Fear Is Quickly Acquired but Swiftly Forgotten." *Current Biology 22*, *12* (2012): R477–R479.

Rakoczy, Hannes, Felix Warneken, and Michael Tomasello (2008) "The Sources of Normativity: Young Children's Awareness of the Normative Structure of Games." *Developmental Psychology 44* (2008): 875–881.

Ramsey, Grant. "Culture in Humans and Other Animals." *Biology & Philosophy 28* (2013): 457–479.

Regan, Tom. *The Case for Animal Rights*. Berkeley: University of California Press, 2004.

Reiss, Diane L. "Pragmatics of Human–Dolphin Communication." PhD Thesis, Temple University, 1983.

Reiss, Diane L. *The Dolphin in the Mirror: Exploring Dolphin Minds and Saving Dolphin Lives*. Boston: Houghton Mifflin Harcourt, 2011.

Reiss, Diana, and Lori Marino. "Mirror Self-Recognition in the Bottlenose Dolphin: A Case of Cognitive Convergence." *Proceedings of the National Academy of Sciences 98* (2001): 5937–5942.

Rekers, Yvonne, Daniel B. M. Haun, and Michael Tomasello. "Children, but Not Chimpanzees, Prefer to Collaborate." *Current Biology: CB 21, 20* (2011): 1756–1758.

Rendall, Drew, and Michael J. Owren. "Animal Vocal Communication: Say What." In *The Cognitive Animal*, edited by Marc Bekoff, Colin Allen, and Gordon M. Burghardt, 307–314. Cambridge, MA: MIT Press, 2002.

Rescorla, Michael. "Chrysippus' Dog as a Case Study in Non-Linguistic Cognition." In *The Philosophy of Animal Minds*, edited by Robert W. Lurz, 52–71. Cambridge: Cambridge University Press, 2009a.

Rescorla, Michael. "Cognitive Maps and the Language of Thought." *The British Journal for the Philosophy of Science 60*, *2* (2009b): 377–407.

Rescorla, Michael. "Maps in the Head?" In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 34–45. New York: Routledge, 2018.

Rescorla, Robert A. "Response-Outcome versus Outcome–Response Associations in Instrumental Learning." *Animal Learning & Behavior 20*, *3* (1992): 223–232.

Richerson Peter J., and Robert Boyd. *Not By Genes Alone: How Culture Transformed Human Cognition*. Chicago, IL: University of Chicago, 2005.

Rilling, Mark, and Colin McDiarmid. "Signal Detection in Fixed-Ratio Schedules." *Science 148*, *3669* (1965): 526–527.

Rizzolatti, Giacomo. "The Mirror Neuron System and Its Function in Humans." *Anatomy and Embryology 210*, *5* (2005): 419–421.

Rizzolatti, Giacomo, and Michael A. Arbib. "Language within Our Grasp." *Trends in Neurosciences 21*, *5* (1998): 188–194.

Rizzolatti, Giacomo, and Laila Craighero. "The Mirror-Neuron System." *Annual Review of Neuroscience 27*, *1* (2004): 169–192.

Rizzolatti, Giacomo, Leonardo Fogassi, and Vittorio Gallese. "Neurophysiological Mechanisms Underlying the Understanding and Imitation of Action." *Nature Reviews Neuroscience 2*, *9* (2001): 661–670.

Romanes, George John. *Animal Intelligence*. New York: Appleton, 1912.

Rorty, Richard. "Mind-Body Identity, Privacy, and Categories." *The Review of Metaphysics 19*, *1* (1965): 24–54.

Rosch, Eleanor. "Natural Categories." *Cognitive Psychology 4* (1973): 328–350.

Rosch, Eleanor. "Cognitive Representations of Semantic Categories." *Journal of Experimental Psychology: General 104*, *3* (1975): 192–233.

Rose, James D. "The Neurobehavioral Nature of Fishes and the Question of Awareness and Pain." *Reviews in Fisheries Science 10*, *1* (2002): 1–38.

Rose, James D. "Anthropomorphism and 'Mental Welfare' of Fishes." *Diseases of Aquatic Organisms 75* (2007): 139–154.

Rowlands, Mark. *The Philosopher and the Wolf: Lessons from the Wild on Love, Death, and Happiness*. New York: Pegasus Books, 2009.

Rowlands, Mark. *Can Animals Be Moral?* Oxford: Oxford University Press, 2012.

Rudolf von Rohr, Claudia Rudolf, Carel P. van Schaik, Alexandra Kissling, and Judith M. Burkart. "Chimpanzees' Bystander Reactions to Infanticide." *Human Nature 26* (2015): 143–160.

Russon, Anne E. "Orangutan Rehabilitation and Reintroduction: Successes, Failures, and Role in Conservation." In *Orangutans: Geographic Variation in Behavioral Ecology and Conservation*, edited by S. A. Wich et al., 327–350. Oxford: Oxford University Press, 2009.

Russon, Anne E., and Kristin Andrews. "Orangutan Pantomime: Elaborating the Message." *Biology Letters 7*, *4* (2011a): 627–630.

Russon, Anne E., and Kristin Andrews. “Pantomime in Great Apes: Evidence and Implications.” *Communicative & Integrative Biology 4*, *3* (2011b): 315–317.

Russon, A., and Galdikas, B. “Imitation in Free-Ranging Rehabilitant Orangutans.” *Journal of Comparative Psychology 107* (1993): 147–161.

Rutz, Christian, Shoko Sugasawa, Jessica E. M. van der Wal, Barbara C. Klump, and James J. H. St Clair. “Tool Bending in New Caledonian Crows.” *Royal Society Open Science 3*, *8* (2016): 160439.

Salas, Cosme, Cristina Broglio, Emilio Dúran, Antonia Gómez, Francisco M. Ocana, Fernando Jimenez-Moya, and Fernando Rodriguez. “Neuropsychology of Learning and Memory in Teleost Fish.” *Zebrafish 3* (2006): 157–171.

Śāntideva. *The Bodhicaryāvatāra*, Kate Crosby and Andrew Skilton (trans.), New York: Oxford World’s Classics, 1995.

Santos, Laurie R., Aaron G. Nissen, and Jonathan A. Ferrugia. “Rhesus Monkeys, Macaca Mulatta, Know What Others Can and Cannot Hear.” *Animal Behaviour 71*, *5* (2006): 1175–1181.

Sato, Nobuya, Ling Tan, Kazushi Tate, and Maya Okada. “Rats Demonstrate Helping Behavior Toward a Soaked Conspecific.” *Animal Cognition 18*, *5* (2015): 1039–1047.

Savage-Rumbaugh, E. Sue. *Ape Language: From Conditioned Response to Symbol*. New York: Columbia University Press, 1986.

Savage-Rumbaugh, E. Sue, and Roger Lewin. *Kanzi: The Ape at the Brink of the Human Mind*. New York: Wiley, 1994.

Savage-Rumbaugh, E. Sue, Kelly McDonald, Rose A. Sevcik, William D. Hopkins, and Elizabeth Rubert. “Spontaneous Symbol Acquisition and Communicative Use by Pygmy Chimpanzees (Pan Paniscus).” *Journal of Experimental Psychology: General 115*, *3* (1986): 211–235.

Savage-Rumbaugh, E. Sue, Jeannine Murphy, Rose A. Sevcik, Karen E. Brakke, Shelly L. Williams, Duane M. Rumbaugh, and Elizabeth Bates. “Language Comprehension in Ape and Child.” *Monographs of the Society for Research in Child Development 58*, *3–4* (1993): 1–252.

Schechtman, Marya. *The Constitution of Selves*. Cornell University Press, 2007.

Schwartz, Bennett L., Christian A. Meissner, Megan Hoffman, Siân Evans, and Leslie D. Frazier. “Event Memory and Misinformation Effects in a Gorilla (Gorilla Gorilla Gorilla).” *Animal Cognition 7*, *2* (2004): 93–100.

Schwartz, Bennett L., Megan L. Hoffman, and Siân Evans. “Episodic-like Memory in a Gorilla: A Review and New Findings.” *Learning and Motivation 36*, *2* (2005): 226–244.

Schwitzgebel, Eric. “A Phenomenal, Dispositional Account of Belief.” *Nous 36*, *2* (2002): 249–275.

Schwitzgebel, Eric. “Belief.” *The Stanford Encyclopedia of Philosophy* (Summer 2019 Edition), Edward N. Zalta (ed). Forthcoming. https://plato.stanford.edu/archives/sum2019/entries/belief/.

See, Adam. “Reevaluating Chimpanzee Vocal Signals: Toward a Multimodal Account of the Origins of Human Communication.” In *The Evolution of Social Communication in Primates*, edited by Marco Pina and Nathalie Gontier, 195–215. New York: Springer International Publishing, 2014.

Seed, Amanda, and Richard Byrne. “Animal Tool-Use.” *Current Biology 20*, *23* (2010): R1032–R1039.

Seeley, Thomas D. *Honeybee Democracy*. Princeton, NJ: Princeton University Press, 2010.

Seeley, Thomas D., and Susannah C. Buhrman. “Nest-Site Selection in Honey Bees: How Well Do Swarms Implement the ‘Best-of-N’ Decision Rule?” *Behavioral Ecology and Sociobiology 49*, *5* (2001): 416–427.

Seeley, Thomas D., and P. Kirk Visscher. “Choosing a Home: How the Scouts in a Honey Bee Swarm Perceive the Completion of Their Group Decision Making.” *Behavioral Ecology and Sociobiology 54*, *5* (2003): 511–520.

Sellars, Wilfred. “Empiricism and the Philosophy of Mind.” In *Foundations of Science and the Concepts of Psychology and Psychoanalysis*, edited by Herbert Feigl and Michael Scriven, 253–329. Minnesota Studies in the Philosophy of Science. Minneapolis: Univerisity of Minnesota Press, 1956.

Senghas, Ann, and Marie Coppola. “Children Creating Language: How Nicaraguan Sign Language Acquired a Spatial Grammar.” *Psychological Science 12*, *4* (2001): 323–328.

Seyfarth, Robert M., and Dorothy L. Cheney. “Production, Usage, and Comprehension in Animal Vocalizations.” *Brain and Language 115*, *1* (2010): 92–100.

Shanker, Stuart G., and Barbara J. King. “The Emergence of a New Paradigm in Ape Language Research: Beyond Interactionism.” *Behavioral and Brain Sciences 25*, *5* (2002): 646–651.

Shannon, Claude Elwood, and Warren Weaver. *The Mathematical Theory of Communication*. Urbana: University of Illinois Press, 1949.

Sharpe, Lynda L., Amy Hill, and Michael I. Cherry. “Individual Recognition in a Wild Cooperative Mammal Using Contact Calls.” *Animal Behaviour 86*, *5* (2013): 893–900.

Shaw, Robert, and John Bransford. *Perceiving, Acting, and Knowing: Toward an Ecological Psychology*. Hillsdale: New York: Lawrence Erlbaum Associates, 1977.

Shettleworth, Sara J. “Clever Animals and Killjoy Explanations in Comparative Psychology.” *Trends in Cognitive Sciences 14*, *11* (2010a): 477–481.

Shettleworth, Sara J. *Cognition, Evolution and Behavior*. Oxford: Oxford University Press, 2010b.

Shettleworth, Sara J. *Fundamentals of Comparative Cognition*. New York: Oxford University Press, 2013.

Shriver, Adam. “Minding Mammals.” *Philosophical Psychology 19*, *4* (2006): 433–442.

Shriver, Adam. “The Unpleasantness of Pain for Nonhuman Animals.” In *The Routledge Handbook of Philosophy of Animal Minds*, edited by Kristin Andrews and Jacob Beck, 176–184. Routledge, 2017.

Shumaker, Robert W., Ann M. Palkovich, Benjamin B. Beck, Gregory A. Guagnano, and Harold Morowitz. “Spontaneous Use of Magnitude Discrimination and Ordination by the Orangutan (Pongo Pygmaeus).” *Journal of Comparative Psychology 115*, *4* (2001): 385–391.

Silk, Joan B. “Using the ‘F’-Word in Primatology.” *Behaviour 139*, *2–3* (2002): 421–446.

Simon, M., M. Brad Hanson, L. Murrey, Jakob Tougaard, and Fernando Ugarte “From Captivity to the Wild and Back: An Attempt to Release Keiko the Killer Whale.” *Marine Mammal Science 25* (2009): 693–705.

Singer, Peter. *Animal Liberation*. New York: New York Review of Books; distributed by Random House, 1990.

Slobodchikoff, Con N. “Cognition and Communication in Prairie Dogs.” In *The Cognitive Animal, Empirical and Theoretical Perspectives*, edited by Marc Mekoff, Colin Allen, and Gordon M. Burghardt, 257–264. Cambridge, MA: MIT Press, 2002.

Slobodchikoff, Con N., Andrea Paseka, and Jennifer L. Verdolin. “Prairie Dog Alarm Calls Encode Labels about Predator Colors.” *Animal Cognition 12*, *3* (2009): 435–439.

Slocombe, Katie E., and Klaus Zuberbühler. “Functionally Referential Communication in a Chimpanzee.” *Current Biology 15*, *19* (2005): 1779–1784.

Slocombe, Katie E., and Klaus Zuberbühler. “Food-Associated Calls in Chimpanzees: Responses to Food Types or Food Preferences?” *Animal Behaviour 72*, *5* (2006): 989–999.

Smet, Anna F., and Richard W. Byrne. “African Elephants Can Use Human Pointing Cues to Find Hidden Food.” *Current Biology 23*, *20* (2013): 2033–2037.

Smith, J. David. “The Study of Animal Metacognition.” *Trends in Cognitive Sciences 13*, *9* (2009): 389–396.

Smith, J. David, Jonathan Schull, Jared Strote, Kelli McGee, Roian Egnor, and Linda Erb. “The Uncertain Response in the Bottlenosed Dolphin (Tursiops Truncatus).” *Journal of Experimental Psychology: General 124*, *4* (1995): 391–408.

Smith, J. David, Wendy E. Shields, Jonathan Schull, and David A. Washburn. “The Uncertain Response in Humans and Animals.” *Cognition 62*, *1* (1997): 75–97.

Smith, J. David, Wendy E. Shields, and David A. Washburn. “The Comparative Psychology of Uncertainty Monitoring and Metacognition.” *Behavioral and Brain Sciences 26*, *3* (2003): 317–339.

Smith, J. David, Michael J. Beran, Justin J. Couchman, and Mariana V. C. Coutinho. "The Comparative Study of Metacognition: Sharper Paradigms, Safer Inferences." *Psychonomic Bulletin & Review 15*, *4* (2008): 679–691.

Smith, J. David, Justin J. Couchman, and Michael J. Beran. "The Highs and Lows of Theoretical Interpretation in Animal-Metacognition Research." *Philosophical Transactions of the Royal Society B: Biological Sciences 367*, *1594* (2012): 1297–1309.

Sober, Elliott. "Comparative Psychology Meets Evolutionary Biology." In *Thinking with Animals*, edited by Lorraine Daston and Gregg Mitman, 85–99. New York: Columbia University Press, 2005.

Sober, Elliott. "Anthropomorphism, Parsimony, and Common Ancestry." *Mind & Language 27*, *3* (2012): 229–238.

Solms, Mark. "Dreaming and REM Sleep Are Controlled by Different Brain Mechanisms." *Behavioral and Brain Sciences 23* (2000): 793–1121.

Spaulding, Shannon. *How We Understand Others: The Science and Philosophy of Social Cognition*. New York: Routledge, 2018.

Spelke, Elizabeth S. "Principles of Object Perception." *Cognitive Science 14*, *1* (1990): 29–56.

Spelke, Elizabeth S., and Gretchen Van de Walle. "Perceiving and Reasoning about Objects: Insights from Infants." *Spatial Representation: Problems in Philosophy and Psychology* (1993): 132–161.

Spelke, Elizabeth S., Claes von Hofsten, and Roberta Kestenbaum. "Object Perception in Infancy: Interaction of Spatial and Kinetic Information for Object Boundaries." *Developmental Psychology 25*, *2* (1989): 185–196.

Sperber, Dan, and Deirdre Wilson. *Relevance: Communication and Cognition*. Cambridge, MA: Harvard University Press, 1986.

Sripada, Chandra Sekhar, and Stephen Stich. 'A Framework for the Psychology of Norms." In *The Innate Mind: Volume 2: Culture and Cognition*, edited by P. Carruthers, S. Laurence, and S. Stich, 280–301. New York: Oxford University Press, 2007.

Stegmann, Ulrich. *Animal Communication Theory: Information and Influence*. Cambridge: Cambridge University Press, 2013.

Stéphan, Paul Morissette, and Marcelle Ricard. "Two Perspectives on Pointing in Infancy." In *Joint Attention: Its Origins and Role in Development*, edited by C. Moore and P. J. Dunham, 85–101. New York: Lawrence Erlbaum Associates Inc., 1995.

Sterelny, Kim. *The Evolved Apprentice: How Evolution Made Humans Unique*. Cambridge: MIT Press, 2012.

Stich, Stephen P. "Do Animals Have Beliefs?" *Australasian Journal of Philosophy 57* (1979): 15–28.

Stich, Stephen P. *From Folk Psychology to Cognitive Science: The Case against Belief*. Cambridge, MA: MIT Press, 1983.

Stoerig, Petra. "Blindsight, Conscious Vision, and the Role of Primary Visual Cortex." *Progress in Brain Research 155* (2006): 217–234.

Stokoe, William C. *Language in Hand: Why Sign Came Before Speech*. Washington, DC: Gallaudet University Press, 2001.

Strack, Fritz, Leonard L. Martin, and Sabine Stepper. "Inhibiting and Facilitating Conditions of the Human Smile: A Nonobtrusive Test of the Facial Feedback Hypothesis." *Journal of Personality and Social Psychology 54*, *5* (1988): 768–777.

Strawson, Galen. *Real Materialism: And Other Essays*. Oxford: Oxford University Press, 2008.

Subiaul, Francys, Jennifer Vonk, Sanae Okamoto-Barth, and Jochen Barth. "Do Chimpanzees Learn Reputation by Observation? Evidence from Direct and Indirect Experience with Generous and Selfish Strangers." *Animal Cognition 11*, *4* (2008): 611–623.

Suddendorf, Thomas, and David L. Butler. "The Nature of Visual Self-Recognition." *Trends in Cognitive Sciences 17*, *3* (2013): 121–127.

Suddendorf, Thomas, and Michael C. Corballis. "Mental Time Travel and the Evolution of the Human Mind." *Genetic, Social, and General Psychology Monographs 123*, *2* (1997): 133–167.

Suddendorf, Thomas, and Michael C. Corballis. "The Evolution of Foresight: What Is Mental Time Travel, and Is It Unique to Humans?" *Behavioral and Brain Sciences 30*, *3* (2007): 299–312.

Suddendorf, Thomas, and Michael C. Corballis. "Behavioural Evidence for Mental Time Travel in Nonhuman Animals." *Behavioural Brain Research 215*, *2* (2010): 292–298.

Suddendorf, Thomas, and Andrew Whiten. "Mental Evolution and Development: Evidence for Secondary Representation in Children, Great Apes, and Other Animals." *Psychological Bulletin 127*, *5* (2001): 629–650.

Taglialatela, Jared P., Jamie L. Russell, Jennifer A. Schaeffer, and William D. Hopkins. "Chimpanzee Vocal Signaling Points to a Multimodal Origin of Human Language." *PLoS ONE 6*, *4* (2011): e18852.

Taglialatela, Jared P., Lisa Reamer, Steven J. Schapiro, and William D. Hopkins. "Social Learning of a Communicative Signal in Captive Chimpanzees." *Biology Letters 8*, *4* (2012): 498–501.

Tan, Shaun. *The Arrival*. New York: Arthur A. Levine Books, 2007.

Tanner, Joanne E. "Gestural Phrases and Gestural Exchanges by a Pair of Zoo-Living Lowland Gorillas." *Gesture 4*, *1* (2004): 1–24.

Tanner, Joanne E., Francine G. Patterson, and Richard W. Byrne. "The Development of Spontaneous Gestures in Zoo-Living Gorillas and Sign-Taught Gorillas: From Action and Location to Object Representation." *Journal of Developmental Processes 1* (2006): 69–103.

Tennie, C., Josep Call and Michael Tomasello. "Ratcheting Up the Ratchet: On the Evolution of Cumulative Culture." *Philosophical Transactions of the Royal Society B 364* (2009): 2405–2415.

Terrace, Herbert S., and Janet Metcalfe. *The Missing Link in Cognition: Origins of Self-Reflective Consciousness*. Oxford: Oxford University Press, 2005.

Terrace, Herbert S., Laura-Ann Petitto, Richard J. Sanders, and Thomas G. Bever. "Can an Ape Create a Sentence?" *Science 206*, *4421* (1979): 891–902.

Than, Ker. "Gorilla Youngsters Seen Dismantling Poachers' Traps—A First." July 18, 2012. https://news.nationalgeographic.com/news/2012/07/120719-young-gorillas-juvenile-traps-snares-rwanda-science-fossey/. Accessed May 29, 2019.

Thelen, Esther, and Linda Smith. *A Dynamic Systems Approach to the Development of Cognition and Action*. Cambridge, MA: MIT Press, 1996.

Thelen, Esther, Gregor Schoner, Christian Scheier, and Linda B. Smith. "The Dynamics of Embodiment: A Field Theory of Infant Perseverative Reaching." *Behavioral and Brain Sciences 24*, *1* (2001): 1–34.

Thompson, Evan. *Mind in Life: Biology, Phenomenology, and the Sciences of Mind*. Cambridge, MA: Harvard University Press, 2007.

Thorndike, Edward L. *Individuality*. Boston: Houghton, Mifflin, 1911.

Thornton, Alex, and Nichola J. Raihani. "Identifying Teaching in Wild Animals." *Learning & Behavior 38*, *3* (2010): 297–309.

Thornton, Alex, and Katherine McAuliffe. "Teaching in Wild Meerkats." *Science 313* (2006): 227–229.

Tibbetts, Elizabeth A., and James Dale. "Individual Recognition: It Is Good to Be Different." *Trends in Ecology & Evolution 22*, *10* (2007): 529–537.

Tinbergen, Niko. *The Study of Instinct*. Oxford: Clarendon Press, 1951.

Tinbergen, Niko. *Curious Naturalists*. New York: Basic Books, 1958.

Tinbergen, Niko. "On Aims and Methods of Ethology." *Zeitschrift Für Tierpsychologie 20*, *4* (1963): 410–433.

Tinbergen, Nikolaas, and Albert C. Perdeck. "On the Stimulus Situation Releasing the Begging Response in the Newly Hatched Herring Gull Chick (Larus Argentatus Argentatus Pont.)." *Behaviour 3*, *1* (1950): 1–39.

Tolman, Edward C., Benbow F. Ritchie, and D. Kalish. "Studies in Spatial Learning. II. Place Learning versus Response Learning." *Journal of Experimental Psychology 36*, *3* (1946): 221–229.

Tolman, Edward C., B. F. Ritchie, and D. Kalish. “Studies in Spatial Learning. V. Response Learning vs. Place Learning by the Non-Correction Method.” *Journal of Experimental Psychology 37, 4* (1947): 285–292.

Tomasello, Michael. *Origins of Human Communication*. Cambridge, MA: MIT Press, 2008.

Tomasello, Michael. *A Natural History of Human Morality*. Cambridge: Harvard University Press, 2016.

Tomasello, Michael, and Klaus Zuberbühler. “Primate Vocal and Gestural Communication.” In *The Cognitive Animal: Empirical and Theoretical Perspectives on Animal Cognition*, edited by M. Bekoff, C. Allen and G. M. Burghardt, 293–299. Cambridge, MA: MIT Press, 2002.

Tomasello, Michael, M. Davis-Dasilva, L. Camak, and K. Bard. “Observational Learning of Tool-Use by Young Chimpanzees.” *Human Evolution 2, 2* (1987): 175–183.

Tomasello, Michael, Malinda Carpenter, and Ulf Liszkowski. “A New Look at Infant Pointing.” *Child Development 78, 3* (2007): 705–722.

Tomasello, Michael, and Joseph Call. “Thirty Years of Great Ape Gestures.” *Animal Cognition 22, 11* (2018): 1–9.

Tomasello, Michael, A. C. Kruger, H. H. Ratner. “Cultural Learning.” *Behavioral and Brain Sciences 16* (1993): 495–511.

Tononi, Giulio. “An Information Integration Theory of Consciousness.” *BMC Neuroscience 5* (November) (2004): 42, doi:10.1186/1471-2202-5-42.

Tononi, Giulio. “Consciousness as Integrated Information: A Provisional Manifesto.” *The Biological Bulletin 215, 3* (2008): 216–242, doi:10.2307/25470707.

Trevarthen, Colwyn. “Descriptive Analyses of Infant Communicative Behavior.” In *Studies in Mother–Infant Interaction*, edited by H. R. Schaffer, 227–270. London: Academic Press, 1977.

Trevarthen, Colwyn. “Communication and Co-Operation in Early Infancy: A Description of Primary Intersubjectivity.” In *Before Speech*, edited by M. Bullowa, 321–347. Cambridge: Cambridge University Press, 1979.

Trevarthen, Colwyn, and Penelope Hubley. “Secondary Intersubjectivity: Confidence, Confiding and Acts of Meaning in the First Year.” In *Action, Gesture and Symbol: The Emergence of Language*, edited by Andy Lock, 183–229. London: Academic Press, 1978.

Tschudin, Alain, Josep Call, R. I. M. Dunbar, Gabrielle Harris, and Charmaine van der Elst. “Comprehension of Signs by Dolphins (Tursiops Truncatus).” *Journal of Comparative Psychology 115, 1* (2001): 100–105.

Tulving, Endel. *Elements of Episodic Memory*. Oxford: Clarendon Press, 1983.

Tulving, Endel. “Episodic Memory and Autonoesis: Uniquely Human?” In *The Missing Link in Cognition: Origins of Self-Reflective Consciousness*, edited by Herbert S. Terrace and Janet Metcalfe, 3–56. New York: Oxford University Press, 2005.

Twain, Mark. *Tom Sawyer and Huckleberry Finn*. Ware: Wordsworth Classics, 1992.

Tye, Michael. “The Problem of Simple Minds: Is There Anything It Is like to Be a Honey Bee?” *Philosophical Studies 88* (1997): 289–317.

Tylor, Edward Burnett. *Primitive Culture*. New York: Brentano’s, 1871.

Udell, Monique A. R., Nicole R. Dorey, and Clive D. L. Wynne. “Wolves Outperform Dogs in Following Human Social Cues.” *Animal Behaviour 76, 6* (2008): 1767–1773.

Udell, Monique A. R., Nicole R. Dorey, and Clive D. L. Wynne. “Can Your Dog Read Your Mind? Understanding the Causes of Canine Perspective Taking.” *Learning & Behavior 39, 4* (2011): 289–302.

Udell, Monique A. R., Jessica M. Spencer, Nicole R. Dorey, and Clive D. L. Wynne. “Human-Socialized Wolves Follow Diverse Human Gestures and They May Not Be Alone.” *International Journal of Comparative Psychology 25* (2012): 97–117.

Uller, Claudia. “Disposition to Recognize Goals in Infant Chimpanzees.” *Animal Cognition 7* (2004): 154–161.

University of Oxford. “Rat and Ant Rescues ‘Don’t Show Empathy’.” *Science Daily*, 12 August 2012.
Van Bergen, Yfke, Isabelle Coolen, and Kevin Laland. “Nine-Spined Sticklebacks Exploit the Most Reliable Source When Public and Private Information Conflict.” *Proceedings. Biological Sciences 271*, *1542* (2004): 957–962.
Van de Waal, Erica, Christèle Borgeaud, and Andrew Whiten. “Potent Social Learning and Conformity Shape a Wild Primate’s Foraging Decisions.” *Science 340*, *6131* (2013): 483–485.
Van de Waal, Erica, Nathalie Renevey, Camille Monique Favre, and Redouan Bshary. “Selective Attention to Philopatric Models Causes Directed Social Learning in Wild Vervet Monkeys.” *Proceedings of the Royal Society of London B: Biological Sciences 277*, *1691* (2010): 2105–2111.
Van Gelder, Tim. “What Might Cognition Be, If Not Computation?” *The Journal of Philosophy 92*, *7* (1995): 345–381.
Van Leeuwen, Edwin J. C., Katherine A. Cronin, Daniel Haun, Roger Mundry, and Mark D. Bodamer. “Neighbouring Chimpanzee Communities Show Different Preferences in Social Grooming Behaviour.” *Proceedings of the Royal Society B: Biological Sciences 279*, *1746* (2012): 4362–4367.
van Leeuwen, E. J. C., Cronin, K. A., and Haun, D. B. M. “A Group-Specific Arbitrary Tradition in Chimpanzees (*Pan troglodytes*).” *Animal Cognition 17*, *6* (2014): 1421–1425.
Varner, Gary E. *Personhood, Ethics, and Animal Cognition: Situating Animals in Hare’s Two Level Utilitarianism*. Oxford: Oxford University Press, 2012.
Vasconcelos, Marco. “Transitive Inference in Non-Human Animals: An Empirical and Theoretical Analysis.” *Behavioural Processes 78*, *3* (2008): 313–334.
Veà, Joaquim, and Jordi Sabater-Pi. “Spontaneous Pointing Behaviour in the Wild Pygmy Chimpanzee (Pan Paniscus).” *Folia Primatologica 69*, *5* (1998): 289–290.
Vincent, Sarah, Rebecca Ring, and Kristin Andrews. “Normative Practices of Other Animals.” In *Routledge Handbook of Moral Epistemology*, edited by A. Zimmerman, K. Jones, and M. Timmons, 57–83. New York: Routledge, 2019.
Vigo, Ronaldo, and Colin Allen. “How to Reason without Words: Inference as Categorization.” *Cognitive Processing 10*, *1* (2009): 77–88.
Vinden, Penelope G. “Children’s Understanding of Mind and Emotion: A Multi-Culture Study.” *Cognition & Emotion 13*, *1* (1999): 19–48.
Voltaire. *Philosophical Dictionary*. Translated by H. I. Woolf. New York: A. A. Knopf, 1929.
Von Frisch, Karl. *The Dance Language and Orientation of Bees*. Cambridge: Harvard University Press, 1967.
von Rohr, Claudia Rudolf, Judith M. Burkart, and Carel P. van Schaik. “Evolutionary Precursors of Social Norms in Chimpanzees: A New Approach.” *Biology & Philosophy 26*, *1* (2011): 1–30.
von Rohr, Claudia Rudolf, Sonja E. Koski, Judith M. Burkart, Clare Caws, Orlaith N. Fraser, Angela Ziltener, and Carel P. van Schaik. “Impartial Third-Party Interventions in Captive Chimpanzees: A Reflection of Community Concern.” Edited by Mark Briffa. *PLoS ONE 7*, *3* (2012): e32494.
Warneken, Felix, and Michael Tomasello. “Altruistic Helping in Human Infants and Young Chimpanzees.” *Science 311*, *5765* (2006): 1301–1303.
Watson, John B. “Psychology as the Behaviorist Views It.” *Psychological Review 20*, *2* (1913): 158–177.
Watts, David P., and John C. Mitani. “Boundary Patrols and Intergroup Encounters in Wild Chimpanzees.” *Behaviour 138*, *3* (2001): 299–327.
Watts, David P., Martin Muller, Sylvia J. Amsler, Godfrey Mbabazi, and John C. Mitani. “Lethal Intergroup Aggression by Chimpanzees in Kibale National Park, Uganda.” *American Journal of Primatology 68*, *2* (2006): 161–180.

Watumull, Jeffrey, Marc D. Hauser, Ian G. Roberts, and Norbert Hornstein. “On Recursion.” *Frontiers in Psychology 4* (2014), doi:10.3389/fpsyg.2013.01017.

Watwood, Stephanie L., Peter L. Tyack, and Randall S. Wells. “Whistle Sharing in Paired Male Bottlenose Dolphins, Tursiops Truncatus.” *Behavioral Ecology and Sociobiology 55*, *6* (2004): 531–543.

Wegner, Daniel M. *The Illusion of Conscious Will*. Cambridge, MA: MIT Press, 2002.

Weir, Alex A. S., Jackie Chappell, and Alex Kacelnik. “Shaping of Hooks in New Caledonian Crows.” *Science 297*, *5583* (2002): 981–981.

Weisbuch, Max, Kristin Pauker, and Nalini Ambady. “The Subtle Transmission of Race Bias via Televised Nonverbal Behavior.” *Science 326*, *5960* (2009): 1711–1714.

Weiss, Alexander, James E. King, and Lori Perkins. “Personality and Subjective Well-Being in Orangutans (Pongo Pygmaeus and Pongo Abelii).” *Journal of Personality and Social Psychology 90*, *3* (2006): 501–511.

Wellman, Henry M., David Cross, and Julanne Watson. “Meta-Analysis of Theory-of-Mind Development: The Truth about False Belief.” *Child Development 72*, *3* (2001): 655–684.

Wheeler, Brandon C. “Production and Perception of Situationally Variable Alarm Calls in Wild Tufted Capuchin Monkeys (Cebus Apella Nigritus).” *Behavioral Ecology and Sociobiology 64*, *6* (2010): 989–1000.

Wheeler, Brandon C., W. A. Searcy, M. H. Christiansen, M. C. Corballis, J. Fischer, C. Grüter, D. Margoliash, et al. “Communication.” In *Animal Thinking: Contemporary Issues in Comparative Cognition*, edited by R. Menzel and J. Fischer, 187–205. Cambridge, MA: MIT Press, 2011.

White, Thomas. *In Defense of Dolphins: The New Moral Frontier*. New York: John Wiley & Sons, 2007.

Whitehead, Hal, and Luke Rendell. *The Cultural Lives of Whales and Dolphins*. Chicago, IL: University of Chicago Press, 2014.

Whiten, Andrew. “Primate Culture and Social Learning.” *Cognitive Science 24*, *3* (2000): 477–508.

Whiten, Andrew, and Richard W. Byrne. *Machiavellian Intelligence II: Extensions and Evaluations*. Cambridge; New York: Cambridge University Press, 1997.

Whiten, Andrew, and Byrne, Richard. “The Machiavellian Intellect Hypotheses.” In *Machiavellian Intelligence*, edited by R. W. Byrne and A. Whiten, 1–9. Oxford: Oxford University Press, 1988.

Whiten, Andrew, Jane Goodall, William C. McGrew, Toshisada Nishida, Vernon Reynolds, Yukimaru Sugiyama, Caroline E. G. Tutin, Richard W. Wrangham, and Christophe Boesch. “Cultures in Chimpanzees.” *Nature*, *399* (1999): 682–685.

Whiten, Andrew, Deborah M. Custance, Juan-Carlos Gomez, Patricia Teixidor, Kim A. Bard. “Imitative Learning of Artificial Fruit Processing in Children (*Homo Sapiens*) and Chimpanzees (*Pan Troglodytes*).” *Journal of Comparative Psychology 110* (1996): 3–14.

Whiten, Andrew, Antoine Spiteri, Victoria Horner, Kristin E. Bonnie, Susan P. Lambeth, Steven J. Schapiro, and Frans B. M. de Waal. “Transmission of Multiple Traditions within and between Chimpanzee Groups.” *Current Biology 17*, *12* (2007): 1038–1043.

Wilson, Timothy D. *Strangers to Ourselves: Discovering the Adaptive Unconscious*. Cambridge, MA: Belknap Press of Harvard University Press, 2002.

Wimmer, Heinz, and Josef Perner. “Beliefs about Beliefs: Representation and Constraining Function of Wrong Beliefs in Young Children’s Understanding of Deception.” *Cognition 13*, *1* (1983): 103–128.

Wit, Sanne de, and Anthony Dickinson. “Associative Theories of Goal-Directed Behaviour: A Case for Animal–human Translational Models.” *Psychological Research PRPF 73*, *4* (2009): 463–476.

Wozniak, Robert. “Conwy Lloyd Morgan, Mental Evolution, and The Introduction to Comparative Psychology.” 1997. http://www.brynmawr.edu/psychology/rwozniak/morgan.html#5. Accessed July 25, 2014.

Wu, Wayne. “The Neuroscience of Consciousness.” *The Stanford Encyclopedia of Philosophy* (Fall 2018 Edition), Edwards N. Zalta, (ed). https://plato.stanford.edu/entries/consciousness-neuroscience/.

Wynne, Clive D. L. *Do Animals Think?* Princeton, NJ: Princeton University Press, 2004.

Wynne, Clive D. L., and Monique A. R. Udell. *Animal Cognition: Evolution, Behavior and Cognition*. New York: Palgrave Macmillan, 2013.

Xu, Fei, and Elizabeth S. Spelke. "Large Number Discrimination in 6-Month-Old Infants." *Cognition 74*, *1* (2000): B1–B11.

Yamamoto, Shinya, Tatyana Humle, and Masayuki Tanaka, "Chimpanzees Help Each Other Upon Request." *PLOS ONE 4*, *10* (2009): e7416.

Yazdi, Amir Amin, Tim P. German, Margaret Anne Defeyter, and Michael Siegal. "Competence and Performance in Belief–Desire Reasoning across Two Cultures: The Truth, the Whole Truth and Nothing but the Truth about False Belief?" *Cognition 100*, *2* (2006): 343–368.

Zawidzki, Tadeusz Wieslaw. *Mindshaping: A New Framework for Understanding Human Social Cognition*. Cambridge, MA: A Bradford Book, 2013.

Zentall, Thomas R., Tricia S. Clement, Ramesh S. Bhatt, and Jessica Allen. "Episodic-like Memory in Pigeons." *Psychonomic Bulletin & Review 8*, *4* (2001): 685–690.

Index

Note: Entries refer to non-human animals unless otherwise specified; Page numbers in *italic* refer to figures and tables; Page numbers in **bold** refer to glossary entries