Living psychology: animal minds

About this free course

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Contents

Introduction

In this free course, *Living psychology: animal minds*, you will explore various questions about non-human animal minds, including whether animals have similar mental states to humans, such as emotions and cognitions. You will also consider whether animals may even have an understanding of others' mental states, such as beliefs, desires, intentions and so on, known as **Theory of Mind** (ToM).

Not only is this an interesting topic in its own right, but studying animals' mental abilities also sheds light on how human minds have evolved, and how they are similar to, and different from, the minds of other species. Indeed, many important findings in psychology have been, and continue to be, made by studying the behaviours and abilities of animals.

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A note on 'human' and 'animal' differentiation in this course

While humans are, of course, animals, for the purposes of this course the term 'animal' will be used to refer to non-human species, in order to allow a clear distinction between human and non-human mental abilities in the discussions.

Learning Outcomes

After studying this course, you should be able to:

- describe studies that have explored various questions about the nature of animal minds, such as whether animals experience emotions and can engage in problem-solving
- explain how evolutionary theory is relevant to questions about animal minds
- describe some studies that have attempted to explore whether animals have a Theory of Mind (ToM) and discuss what these studies have allowed psychologists to conclude
- outline how studying animal minds contributes to psychological knowledge about human minds
- explain some of the strengths and shortcomings of comparative laboratory-based methods in psychology.

1 Everyday perspectives: animal minds

Humans have a tendency to interpret behaviour as goal-directed. They use this interpretation to arrive at explanations for that behaviour and about the people showing it, including their intentions, emotions, knowledge and so on. Psychologists have called these **inferences** about others' minds '**Theory of Mind**' (ToM).

When it comes to animals, and humans' relationships with them, there are a number of important questions that psychologists have considered.

1. Does ToM, which allows people to understand that other humans have minds, also cause people to assume that animals have human-like minds?
2. Do animals actually have minds and, if so, to what extent are they like human minds?
3. Is ToM a uniquely human ability?

Before reading further, complete Activity 1.

Activity 1 Thinking about animal minds

Allow 20 minutes for this activity

Try to answer the following questions about animal minds, drawing on your own experiences and understandings. Type your responses (up to 100 words for each question) in the box below the three questions, and then select 'Save'.

1. Do animals feel emotions? What evidence is there to suggest that they do?
2. Can animals engage in deception?
3. How similar or different are humans and animals?

Provide your answer...

1.1 How people attribute human-like traits to animals

Now watch the following video in which other people answer the same questions as you just did in Activity 1. Think about how the views expressed in the video are similar to or different from your own.

Video content is not available in this format.

Everyday perspectives: animal minds

Reflecting on your answers to Activity 1, and the answers given by the people in the video clip you just watched, you will have probably noticed that people are very willing to attribute human-like mental attributes (such as emotions, beliefs, goals and intentions) to animals.

But what is the evidence for this supposition, apart from human observations and interpretations of animal behaviours? To what extent do animals ‘think’ and have mental experiences similar to those of humans?

2 Human ideas about other animals' minds

The tendency to ascribe human cognitive and emotional states to animals is known as **anthropomorphising**. For example, pet owners may infer that their dog is 'excited' about going to the park, 'upset' at being left home alone all day or 'confused' by a new toy.

Anthropomorphising can go beyond other animals and be applied to inanimate objects, as you may have experienced when your car 'refuses' to start, or your computer 'deliberately' crashes just when you need it to work. But this course concentrates on animals – organisms with brains.

Next, you will explore how brains have evolved over time. But first take a moment to complete Activity 2, which asks you to think about how you view the mental abilities of humans and other species.

Activity 2 Thinking about another's thinking: Lily and the biscuits

Allow 10 minutes for this activity

Think about the following scenario (adapted from Rasmussen et al., 1993). The scene is a typical household kitchen. On the kitchen counter is a plate of biscuits. Lily is in the kitchen. Lily is hungry and can see the biscuits.

Which of these assumptions, if any, do you think are reasonable to make:

- Lily likes eating biscuits
- Lily would be happy if she ate the biscuits
- Lily would be unhappy if she could not eat the biscuits
- Lily would feel guilty if she ate the biscuits without permission
- Lily would be able to remember eating the biscuits the next day.

Discussion

Would your answers change if you were told that Lily is (a) a 6-year-old girl, (b) a pet dog, (c) a pet cat, (d) a pet bird, or (e) a pet fish?

In the study that this activity was adapted from, Jeffrey Rasmussen and colleagues found that people tended to rate all of these assumptions as being highly reasonable of the young child (using a 7-point rating scale, where 1 indicated 'unreasonable' and 7 indicated 'reasonable'), although the item about remembering eating the biscuits the next day was considered the least reasonable assumption. However, the assumptions were also rated as fairly reasonable for the dog, cat, bird and fish, with the average reasonableness ratings decreasing in that order.

There were also differences to do with the type of assumed thinking, with 'simple' thinking (e.g. liking biscuits, being happy about eating biscuits) being rated as more similar between the human child and the non-human animals; whereas more 'complex' thinking (e.g. feeling guilty, remembering the next day) was rated as less similar between the human child and the non-human animals.

Does this reflect your own thoughts, according to who or what 'Lily' is?

Studies such as this one by Rasmussen et al. (1993) highlight an interesting tension: on the one hand, it is common for people to see 'humans' and 'animals' as fundamentally different, sometimes even to the extent of thinking that the rules of nature that apply to other species do not necessarily apply to humans. In fact, before the work of Charles Darwin, the idea of humans and animals being entirely separate was the mainstream view (Wynne, 2007). Finlay and Workman (2013) argue that this idea of humans being somehow 'more than' animals can even be found in some modern scientific work, not just in laypersons' ideas about human uniqueness.

On the other hand, there is evidence that people tend to ascribe human qualities, such as understanding and experiencing emotions, to animals. This tendency to **anthropomorphise** may not be universal, but it is nonetheless widespread (Waytz et al., 2010).

The question of why (and when) people anthropomorphise animals is an interesting one in its own right. But the main purpose of this course is to explore the similarities and differences between human and non-human minds.

The first thing to consider is the organic structure within which the 'mind' resides: the brain. And the next section of this course looks at how the evolution of brains has formed the basis of the evolution of minds.

3 The evolution of brains and minds

Before you go any further with this course, you need to explore some basic points about how **evolutionary theory** is used in psychology (Box 1).

Box 1 The use of evolutionary theory in psychology

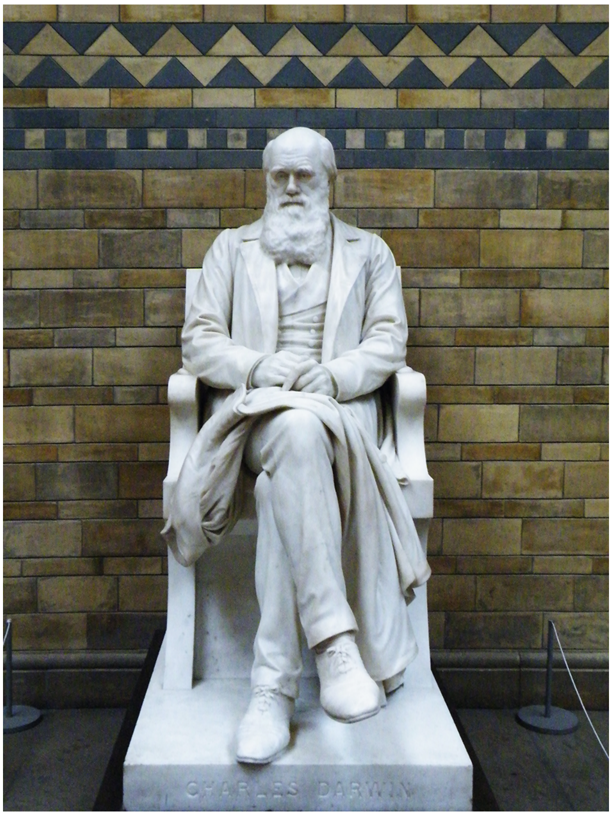


Figure 1 Charles Darwin's statue, Natural History Museum, London

Evolutionary theory, most closely associated with the work of Charles Darwin (1809–1882; Figure 1), states that species change over time. Changes that help an organism to survive and reproduce are called 'adaptations', and are passed on to subsequent generations. For example, if being tall and furry is helpful in a particular environment, then taller, furrier organisms will survive better than shorter, less furry ones, and will breed more successfully. Their offspring will tend to be tall and furry, and the taller and furrier of these offspring will be more likely to survive and reproduce than the shorter and less furry offspring. Over time, the entire species may become tall and furry, and may change enough from the original organisms to be considered a new species.

Evolutionary theory arose as part of biology and therefore focuses primarily on the physical characteristics of organisms, including the development of the brain. It is used in two ways in psychology:

- **Evolutionary psychology** considers human characteristics and asks how they may have evolved. For example, an evolutionary psychology approach to Theory of Mind (ToM) in humans would be to ask what advantage ToM would have given early human ancestors – why would ToM be **adaptive**? An explanation might be that early humans who had ToM were better able to predict others' behaviour than those who did not, which helped them when cooperating and competing with each other to survive and reproduce (Baron-Cohen, 1999).

- **Comparative psychology** considers both human and non-human characteristics and can be seen as 'animal psychology' in the broad sense, with humans being just one of the species under consideration. Indeed, some comparative psychologists exclude humans and focus only on animals (Dewsbury (2013) refers to this approach as 'zoological psychology'). As the term suggests, comparative psychology often (but not always) involves making *comparisons* between the abilities of different species. For example, comparing the problem-solving abilities of chimpanzees, humans, elephants and crows would be an example of comparative psychology in its most literal sense. Comparative psychology makes use of both artificial situations, such as observing animal behaviour in a laboratory, and real-world situations, observing animals in their natural habitats (known as **ethology**).

It is widely accepted in psychology that the brain is the part of the body where the functions that involve the 'mind' take place. Everything you experience, feel, think, dream, remember, imagine and decide happens in your brain (although certain philosophers have questioned this supposition). A detailed discussion of *where* in the brain the mind is located is beyond the scope of this course (and, in fact, is still something of an open question in psychology). However, it is important to understand how the structure of the brain can enable the processes of the mind, and what this means for the minds of animals.

You will explore this more in the next section, using the specific example of emotion.

3.1 How brain structures enable mind processes: emotion

Emotion is an aspect of the mind that is relatively well understood in terms of **neuroanatomy**, as there are specific areas of the brain that, in humans, are involved in experiencing emotions. Emotions are processed by the **limbic system**, an area of the brain that sits between the brainstem and the cortex (see Figure 2). Of particular importance are the amygdalae ('amygdalae' is the plural; the singular is '**amygdala**'), two small structures − one on each side − within the temporal lobes, which are involved in both emotional processing (especially fear) and emotional memory.

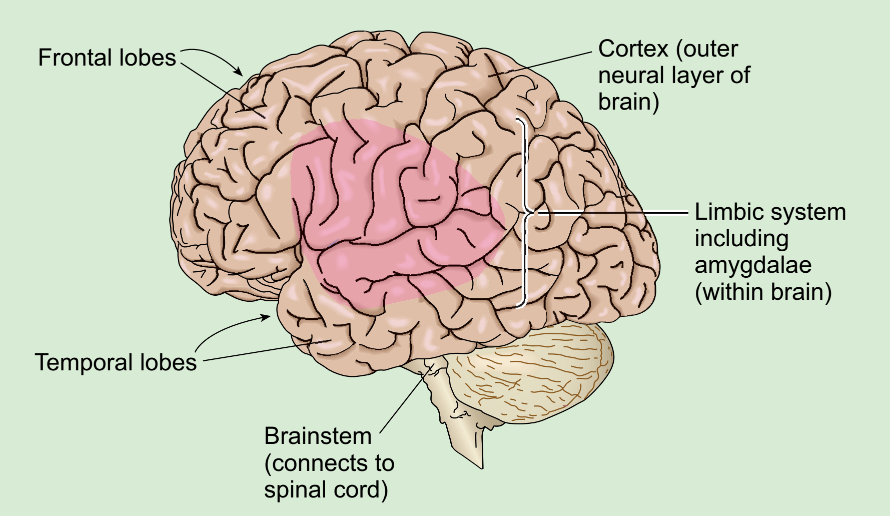


Figure 2 A diagram of a human brain showing the location of the limbic system

Based on both clinical observations of patients with damage to their limbic systems, and more modern **brain imaging** studies, it is well established that the limbic system is involved in human emotional processing (Phan et al., 2002; Papez, 1937).

It may therefore be reasonable to suggest that other animals who also have a limbic system might also experience emotions. And that species *without* a limbic system would *not* experience emotions.

Without looking up any information about different species' brains first, now have a go at Activity 3.

Activity 3 Which animals might experience emotions?

Allow 5 minutes for this activity

Which of these animals do you think might experience emotions? For example, do you think any or all of them would be capable of experiencing happiness, sadness, fear or anger?

- chimpanzees
- cats
- crows
- lizards

Discussion

You may be surprised to learn that all of the listed animals display evidence of being able to experience emotions to some degree (based on both behavioural and brain function studies). All of them have a limbic system of some sort – at least the amygdalae.

There is evidence that chimpanzees do experience, communicate and understand emotions (Bard, 2004). which you might have expected as they are very close relatives of humans. And you might not have been very surprised to learn that cats can experience emotions, based on your own experiences of them. There is evidence that cats experience fear in the presence of dogs, with specific responses being found in the amygdalae (Pavlova and Vanetsian, 2006).

Nonetheless, evidence of emotions is not limited to mammals: brain imaging has demonstrated fear responses in crows, again involving the amygdalae (Marzluff et al., 2012).

Figure 3 Can this Iberian wall lizard be happy, sad, frightened or angry?

The lizard (Figure 3) may have been the most surprising animal on the list. Indeed, it was once thought that the 'lizard brain', being older in evolutionary terms than the 'mammal brain', had not developed the more advanced structures and functions to be able to process emotions. But while the lizard brain lacks the neocortex (the 'newest' part of the brain, in evolutionary terms), lizards do have amygdalae (Lanuza et al., 1998), and there is evidence that this enables them to experience some degree of basic emotion. For example, Cabanac and Cabanac (2000) reported what they interpreted as a stress response in the heart rates of iguanas when they were handled by humans.

Taken together, these studies suggest that emotions, and the brain structures that give rise to them, arose quite early on in evolutionary terms, although amphibians in Cabanac and Cabanac's study did not show the same stress response as the lizards reptiles. These brain structures are found not only in humans, or primates, or even mammals, but also widely throughout **vertebrate species**. But that does not mean that all animals may experience emotions in the same way.

The next section of this course takes a comparative psychology approach, considering how emotions might be experienced and expressed by two different species: humans and domestic dogs.

3.2 Emotions in different species: humans and dogs

Psychologists have long distinguished between 'primary' and 'secondary' emotions:

- **Primary emotions** can be defined as the most basic emotions, generated by some external stimulus (e.g. fear in response to seeing a predator); and as being the initial response to something, felt before, and without, thinking.

- **Secondary emotions** are more complex, sometimes made up of a combination of primary emotions. They are not a direct and immediate response to a stimulus, and typically require a cognitive element. For example, while ‘sadness’ might be the primary emotion felt, ‘melancholy’ or ‘regret’ might be secondary emotions that are felt when a ‘sad’ event is thought about.

On this course, you will only consider primary emotions, as there is more compelling evidence that animals might experience these.

In humans, six primary emotions are associated with particular involuntary facial expressions, which were first identified by Darwin in his 1872 book *The Expression of the Emotions in Man and Animals*. Have a go at Activity 4, which looks at these six emotions.

Activity 4 Identifying human emotions from facial expressions

Allow 10 minutes for this activity.

Can you identify the emotions shown in each photo? Note them down in the box provided, then read the discussion to find out if you got them right.

Figure 4 A range of human facial expressions

Provide your answer...

Discussion

The emotions shown in the images are: (a) happiness, (b) sadness, (c) fear, (d) anger, (e) surprise and (f) disgust. These are considered to be primary human emotions, and these facial expressions are believed to be universal, i.e. this is how all people display these emotions facially, regardless of their cultural background or upbringing.

Interestingly, in a study of the emotional expressions of blind athletes after winning or losing at the 2004 Paralympic Games, Matsumoto and Willingham (2009) found that these expressions are also shown by congenitally blind people who have never themselves seen facial expressions. This suggests that these facial expressions may be instinctual or, at least, that they are not learned through observation.

So, are primary emotions (happiness, sadness, fear, anger, surprise and disgust) expressed in a similar way by animals? Clearly a species with no eyebrows, such as the Iberian wall lizard we saw earlier (Figure 3), can't express surprise in the same way as a human! But can you recognise what primary emotions are being expressed in the facial expressions of another species − the domestic dog? See how you get on with Activity 5.

Activity 5 A dog's facial expressions

Allow 10 minutes for this activity.

Can you identify the emotions being expressed by the Belgian Malinois dog in Figure 5?

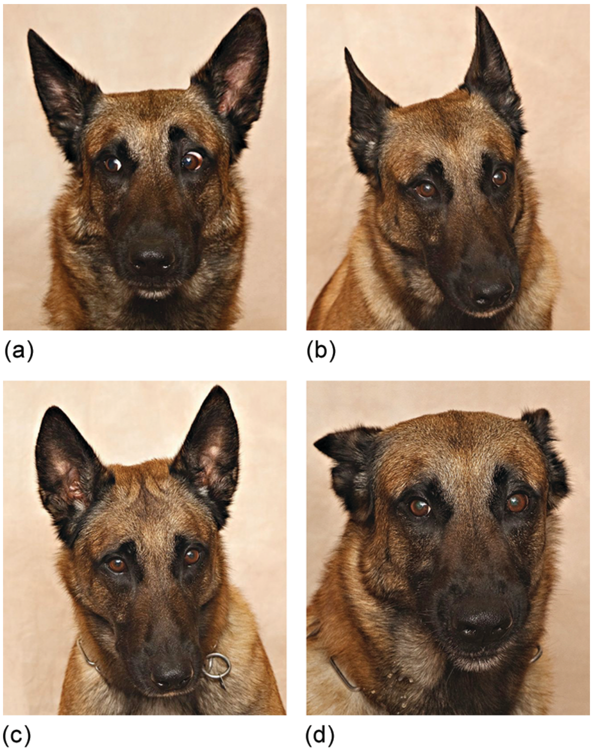


Figure 5 A Belgian Malinois dog showing a range of emotional facial expressions

Provide your answer...

Discussion

The emotions shown in the images of the Belgian Malinois are: (a) fear, (b) sadness, (c) surprise and (d) disgust.

These four images were used in a study by Bloom and Friedman (2013), which looked specifically at people's ability to recognise emotions expressed facially by a dog. Using photographs of the dog's face eliminated non-facial cues to emotion, such as tail-wagging, growling and so on. Despite being limited to only facial information, overall, people were quite accurate at identifying the correct emotions from the photographs. People − who were not dog experts − were shown 18 different photographs (three photos for each of the six primary emotions), including those above. Overall, they correctly identified the dog's emotional expression 45% of the time (compared with a chance level of 16.67%, which is what would be expected if the participants were simply guessing). There were substantial differences between the emotions, with the participants being most accurate at identifying happiness (88% correct) and anger (70% correct), and least accurate at identifying disgust (12.7% correct), which was often mistaken for sadness or anger.

You may wonder how the researchers could be sure that these were the emotions that the dog was expressing? That is a very good question! Bloom and Friedman needed stimuli (photographs) that showed a dog exhibiting natural emotional expressions. To obtain the stimuli, they exposed a police dog called Mal to a number of situations that would be expected to elicit the required emotion, and photographed Mal's responses. For example, for 'disgust', Mal's handler offered Mal a treat, which in fact contained an unpleasant-tasting medicine. For 'fear', Mal was approached with nail clippers − he was known to dislike having his nails clipped! And for 'happiness' Mal was shown his ball, which he liked to play with. These should, therefore, have been situations in which Mal was genuinely 'disgusted', 'happy' and so on. Though it is uncertain whether Mal's expressions are entirely natural or have been trained by, or learned from, his human handler. Nonetheless, as Darwin (1872) observed and reported in the nineteenth century, and as others have since (Bard, 2004), many species do display emotional behaviours in the wild.

In this section of the course you have learned about six 'universal' primary emotions which are, in humans and some other species, communicated to others by means of shared, easily recognisable outward expressions (particularly facial expressions, in the case of humans).

Next, you will learn about seven **primal** emotions, and their possible links to mental health in humans.

4 From animal to human emotions

Figure 6 Neuroscientist Jaak Panksepp (1943–2017) holding a degu

Another way of conceptualising basic emotions is in terms of the motivations that they give the animal experiencing them. The **neuroscientist** Jaak Panksepp identified seven distinct primal (rather than 'primary') emotions based on this conceptualisation.

The seven primal emotions, sometimes referred to as 'emotional feelings' or 'emotional systems', according to Panksepp (2010) are:

- SEEKING
- PLAY
- LUST
- CARE
- RAGE
- FEAR
- PANIC/GRIEF (note that Panksepp originally labelled this 'PANIC', but his later work re-conceptualised it as 'GRIEF').

According to Panksepp's theory, SEEKING, PLAY, LUST and CARE are all 'positive' emotions, in that they are rewarding and motivate the animal to continue a behaviour or seek out a stimulus. RAGE, FEAR and PANIC/GRIEF, on the other hand, are considered to be 'negative' emotions, which motivate the animal to discontinue a behaviour or avoid a stimulus.

4.1 The neurobiology of emotions

Panksepp argued that 'an understanding of the **neurobiology** of raw affective experiences, from pain to joy, remain problems of foremost importance for understanding the evolution of human consciousness' (Panksepp, 2005, p. 34), and that studying the emotional lives of animals is a necessary part of understanding human emotions.

Studying emotion in animals has a number of advantages, including the ability to examine emotions in a 'raw' state unaffected by human higher cognitive processes and **sociocultural** influences. It also allows researchers to conduct studies that would not be possible with human participants, including some basic neurological work exploring the brain structures involved in emotional processing. For example, the specific brain regions associated with different positive and negative emotions can be identified by direct electrical stimulation (e.g. Olds and Milner, 1954), which involves an invasive and potentially dangerous surgical procedure.

In such studies, the test subjects can be given control over the electrical stimulation of their own brains; for example, by pressing a lever to switch the electrical stimulation on or off. If the animal chooses to switch the stimulation on, that is considered to be evidence that the electrical stimulation produces a rewarding effect, indicating that the brain region where the electrode is located is involved in a positive emotion. The converse, of course, applies if the animal actively avoids stimulation, as that indicates that the brain area is involved in a negative, aversive emotion. This methodology, although originally developed in the 1950s, is still used to provide insight into the neural underpinnings of behaviour, particularly emotional motivational behaviour (e.g. Carlezon and Chartoff, 2007).

4.2 From neurobiology to mental health

In this video, recorded at the 2013 TEDx conference in Seattle, USA, Jaak Panksepp talks about his work on emotions in animals. He begins by giving an insight into the very human problems that initially attracted his interest in this area. He also discusses some ways in which the insights obtained from studying emotions in animals could be applied to the treatment of human mental health problems, such as depression.

View at: youtube:65e2qScV_K8

Activity 6 Considering applications of research into emotions in animals

Allow 45 minutes for this activity

Based on Panksepp's explanations in the video you have just watched, answer the following questions (typing your answers in the boxes provided).

1. What purpose do emotions serve?

Provide your answer...

Answer

Panksepp argues that emotions are experienced as either rewarding or aversive, and so serve the purpose of motivating the animal to behave in a certain way. Behaviours that are beneficial to survival give positive emotional experiences and are therefore repeated, while behaviours that are detrimental to survival are avoided.

2. How might primal emotions relate to mental health issues?

Provide your answer...

Answer

Panksepp identifies some direct relationships between primal emotions and mental health issues. Fear is related to anxiety, and panic (or grief) is related to panic attacks and depression. Panksepp also draws out a more general relationship: a lack of experiencing the 'care' emotion in childhood may lead to psychological problems in adulthood.

3. How might an understanding of emotions be applied to helping people with mental health issues?

Provide your answer...

Answer

Identifying the body's natural chemical responses to emotion (e.g. the role of **endogenous opioids**) can help to inform the development of drug treatments for mental health issues. Deep-brain stimulation of areas associated with positive emotions may also have the potential to help people with some mental health problems.

Human emotional responses, particularly the range of emotion-related behaviours that can be involved in mental health issues, are more complex than those emotional responses of other animals with less complex brains. However, the work of neuroscientists such as Panksepp shows how the emotional aspects of human lives are reflected in other species, and how using animal models can provide useful insights into how human problems arise and can be addressed.

In Sections 3 and 4 of this course, you have been introduced to ideas from evolutionary theory and comparative psychology. You've learned how these ideas relate to questions about animal minds, in particular the question of animals' experience of emotions.

You've also learned how studying the brain can allow psychologists to make inferences about the emotional experiences of animals.

In the next section of this course you will consider another key aspect of the mind: the ability to reason and solve problems.

Just like emotions, reasoning and problem-solving may initially seem uniquely human, but they are abilities that have evolved. They may therefore be present, to some extent, in other species.

5 Comparative cognition: reasoning and problem-solving

In humans, reasoning and problem-solving are aspects of what is known as '**executive function**'. Executive function is a term that encompasses a broad set of cognitive processes involved in deliberative, goal-oriented action. Although there is no single part of the brain responsible for executive function, there is strong evidence that the neocortex (the 'new' part of the brain, in evolutionary terms), and the frontal lobes in particular, play important roles (Alvarez and Emory, 2006).

As with the limbic system and emotion, which you learned about in Section 3.1 of this course, it is reasonable to infer that:

- species with a neocortex may have some degree of executive function, and
- species without a neocortex are unlikely to have developed executive function.

Now have a go at Activity 7. You'll see it asks the same question as Activity 3, but this time for executive function, rather than emotions.

Activity 7 Which animals might have executive function?

Allow 10 minutes for this activity

Look at the list of animals below. Which, if any, do you think might have the capability for executive function? For example, do you think any or all of them might be able to plan ahead and solve a problem?

- chimpanzees
- cats
- crows
- lizards

Discussion

Chimpanzees and cats are both mammals, and all mammals have a neocortex. It is therefore possible that both chimpanzees and cats have a degree of executive function, and some ability to plan ahead and solve problems. The chimpanzee neocortex is larger and more developed than that of the cat (see Figure 7), so it is likely to have a greater capability for executive function.

Non-mammalian species do not have a neocortex, although there is some evidence that a part of the bird brain called the dorsal ventricular ridge may perform the same function as the neocortex in mammals (Dugas-Ford et al., 2012). Crows may therefore have some degree of executive function.

Reptiles also have a dorsal ventricular ridge, although it is not as well developed as it is in birds, and (not being mammals) they lack a neocortex. It is therefore less likely that lizards would have executive function.

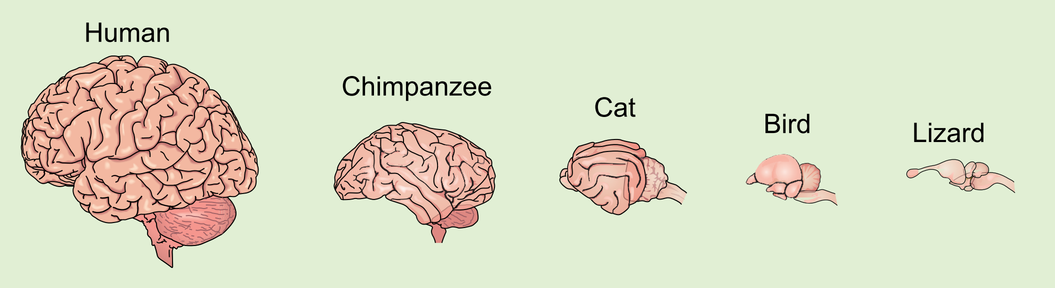


Figure 7 Differences in the brains of various species. The large, wrinkled neocortex is apparent in the human, chimpanzee and cat brains, and absent in the bird and lizard brains.

The anatomy of the brains of different species provides some information about their likely cognitive abilities, and can provide useful information about how, and when, different abilities evolved in the ancestors of modern species. But there still remains a need to test the actual abilities of animals to see how they perform on cognitive tasks.

A large number and variety of behavioural tests have been conducted, on a wide range of species. The next section of this course gives a brief outline of just a few of these.

5.1 Animal problem-solving: using tools

From the earliest, most primitive stick or piece of rock, to the most sophisticated supercomputer or jet aircraft of modern times, humans have been using tools to solve problems since prehistoric times.

Given the advantages of using tools, it is perhaps surprising that it's not more common for animals to use them. There are examples of tool use by other species: some otters use stones to break open shellfish; some monkeys do the same to break open nuts; and some chimpanzees 'fish' for termites with sticks (Emery and Clayton, 2009). But it appears to be a general pattern that all humans use tools and most other species do not. Is this because animal minds do not have the capability to use tools? Tool use does, after all, involve a number of aspects of executive function, including: working out what a tool can be used for; planning how to use it; and remembering what the tool has managed to do (and failed to do) before.

While other species may not have the same degree of neocortical development and executive function as humans, are they able to use tools to solve problems to some extent?

There is evidence that the nearest evolutionary neighbours of humans, the other great apes (gorillas, chimpanzees, bonobos and orangutans), are able to solve problems using tools. A typical laboratory experiment involves putting food into an apparatus where the animal cannot reach it using their bodies alone, e.g. if testing chimpanzees, the apparatus will prevent the chimpanzees from reaching the food with their fingers. Tools, such as sticks of varying lengths or shapes, are left near the apparatus that will, if used correctly, allow the animal to access the food. Visalberghi and colleagues (1995) showed that a variety of primate species could solve such problems, but great apes were better than other primates (monkeys) at selecting the best tools, and adapting tools to the needs of the task.

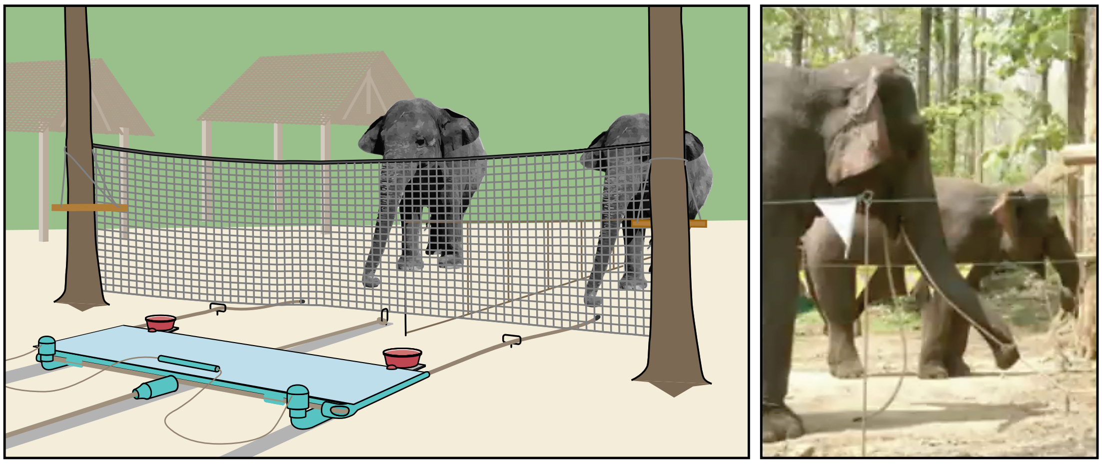
But possibly the best non-human tool users are, perhaps surprisingly, to be found in species without a neocortex: birds. Emery and Clayton (2009) and Seed and Byrne (2010) give examples of a number of bird species with impressive tool-using and problem-solving abilities, including crows, jays and finches. One of the star species, though, is the New Zealand kea (Figure 8).

Figure 8 A kea, possibly working out something surprisingly complicated

Keas have been shown to solve a fairly simple problem (where food is obtained by hauling up a string) on the first attempt − suggesting they had mentally worked out the solution before starting the task, rather than by trial and error (Werdenich and Huber, 2006). They have also been shown to solve ‘second-order’ tool-use tasks, where one tool must be used to acquire or adapt another, in order to then complete the task (Auersperg et al., 2010), and there is evidence that they can learn from observing other keas performing a problem-solving task (Huber et al., 2001). As well as being able to solve problems as individuals, keas have been shown to collaborate to solve problems too (Tebbich et al., 1996).

5.2 Cooperating elephants

Elephants have also been shown to cooperate with each other in order to solve a problem. Plotnik and colleagues (2011) tested pairs of elephants, who were led to a study area where there was a fence, with food on a tray on the other side of the fence, some distance out of reach. The food could be pulled to within their reach by means of a rope looped around the back of the tray, but only by both elephants working together. If one elephant pulled on the rope alone, it would simply slip round the back of the food tray. Figure 9 is an illustration of the problem set-up.



(a) (b)

Figure 9 Plotnik and colleagues' cooperative problem-solving task for elephants: (a) a ground view from beyond the tray of food; (b) a side view from the base of the barrier (fence)

Crucially, to solve the task, each elephant had to not only work out that solution but also understand that the *other* elephant had worked it out too and act accordingly. This is indeed what the elephants did! If one elephant was allowed into the study area before the other, the first elephant would wait until the second elephant had arrived and was able to assist before pulling on the rope. Furthermore, if one elephant's end of the rope was out of reach, the other elephant, whose end was within reach, seemed to understand this and did not bother pulling the rope. The elephants in Plotnik's study seemed to understand both the problem itself and each other's role in solving it.

Does this study indicate that the elephants understood each other's goals, desires and intentions? In other words, does this study provide evidence that the elephants possess a ToM? This is a tricky question to answer from such behavioural evidence, as you will explore further in Section 6 of this course. But first, you will look at the advanced problem-solving abilities of some more birds.

5.3 New Caledonian crows

Some of the problem-solving abilities that have been observed in non-mammal species, like the New Zealand kea, seem to provide evidence of executive function – which is involved in the planning and co-ordinating of actions. Now watch this video, which shows a different bird species, the New Caledonian crow, trying to solve a problem. The solution requires planning and co-ordinating eight separate steps.

Video content is not available in this format.
Chris Packham and the New Caledonian crow puzzle

Activity 8 Pause for thought

Allow 10 minutes for this activity

1. Having watched the video, do you think the crow displayed evidence of **executive function**?
2. Does the video illustrate any differences between human and animal problem solving?

Discussion

For a human research participant, this level of planning and co-ordination of actions would certainly be considered evidence of executive function, so it would also be reasonable to consider this as evidence of executive function in the crow.

However, the video also demonstrated a key difference between human and animal problem-solving. Chris Packham could work out the solution to the problem on his first attempt at solving it: he already had insight into the nature of the problem without having to explore it in a trial-and-error manner. But the crow had to attempt to use the short stick first, in order to understand that it was not long enough to reach the food. In addition, even though it was only alluded to in the video, the crow had to be trained on each piece of apparatus separately, learning about it by trial and error. The pieces of apparatus were then put together to create the puzzle.

For a long time, psychologists considered the insight into the nature of a problem (that Chris Packham showed in the video) to be uniquely human. This is a conclusion going back to the work of Edward Thorndike in the early twentieth century (e.g. Thorndike, 1911). However, in recent years research findings have emerged which suggest that some other species may also be able to show elements of insight in certain problem-solving situations (see Shettleworth, 2012, for a well-written and accessible summary of this literature).

In the next section of this course you will revisit collaborative problem-solving, looking at the role emotions and empathy play in animals working together.

5.4 Collaborative problem-solving: the role of emotions

Now watch this video, where the **ethologist** Professor Frans de Waal presents and discusses examples of collaboration and co-operation between animals (including in problem-solving). He frames the need for co-operation as part of the basis of morality. His discussion includes some early work with chimpanzees, which led to the 'cooperating elephants' study that you learned about in Section 5.2 of this course, as well as footage from the elephant study itself. Professor de Waal also discusses the role of emotions and empathy in animal collaboration, and the effect that they have on co-operation.

View at: youtube:GcJxRqTs5nk

Activity 9 Exploring cooperation and emotion in animals

Allow 45 minutes for this activity

Based on the video you've just watched, answer the following questions (go back and watch the video again if it helps).

1. Why have (some) animals evolved to cooperate with each other, rather than just to compete?

Provide your answer...

Answer

Many species, including higher primates such as humans, chimpanzees and bonobos, live in social groups. The members of such groups depend on each other for survival, so the relationships between individuals within the group are valuable and must be protected, or repaired if damaged.

Furthermore, some tasks cannot easily be completed by an individual working alone; for example, in the wild, many species hunt or drive away predators together. The same cooperative drive causes animals in the artificial situation of a laboratory experiment to collaborate to obtain food rewards.

2. What role might emotions have in motivating cooperation?

Provide your answer...

Answer

Frans de Waal argues that empathy, which he defines as 'the ability to understand and share the feelings of another', may play a role in motivating an animal to cooperate with another animal. The chimpanzees in his research tended to select responses (handing tokens to the human researcher) that would result in a partner chimpanzee also receiving a food reward, rather than responding either randomly or selfishly. He argues that this is because the chimpanzees 'care' about each other (remember that 'care' is also one of Panksepp's primal emotions). There is also evidence that some species (capuchin monkeys were featured in the video) have a sense of fairness, which may be involved in cooperation, and experience anger when treated unfairly.

Further reading

Brosnan and de Waal's (2003) findings that capuchin monkeys had a sense of fairness − or, rather, *un*fairness − attracted a lot of attention when it was published in the journal *Nature* in 2003. You may find it interesting to read the article Monkeys reject unequal pay for yourself.

6 Do animals understand other minds?

A substantial body of research has considered the question of whether animals show signs of having a Theory of Mind (ToM). As described earlier in this course, possessing a ToM involves having an understanding that others have mental states, including knowledge, beliefs, desires, goals, and so on. Might animals possess this type of understanding?

Many studies that have considered this question have used chimpanzees − the closest evolutionary relatives of humans, and so perhaps the most likely candidates for possessing ToM abilities (abilities which humans, undisputedly, do possess). In this section of the course you will be introduced to some of these studies, and asked to reflect on what they have allowed psychologists to conclude about ToM in non-human primates.

6.1 How can researchers test Theory of Mind in animals?

Psychologists attempting to study ToM in animals need to find methods that do not rely on language skills, as have many of the studies looking at ToM in humans (for example, the vast body of work in developmental psychology that has considered when various ToM skills develop in children).

Activity 10 Do you think animals understand others' minds?

Allow 10 minutes for this activity

Stop and reflect for a moment on how you might decide whether an animal has an understanding of others' mental states. You may want to think of your pet (if you have one), or a pet you have come into contact with, and describe anything you have observed that would lead you to think that they do or do not understand others' mental states − such as emotions, perceptions, knowledge, intentions and so on.

Provide your answer...

Discussion

Perhaps you came up with some anecdotal examples, such as your pet dog or cat seeming to understand when you are angry or upset. You may have thought of instances, e.g. from watching wildlife television programmes, where animals seem to deliberately try to deceive another animal, to give it a 'false belief', for example, by pretending to hide food in one place, but secretly moving it to another place. In one account, the **primatologist** Jane Goodall describes how a monkey who had spied fruit in a tree refrained from retrieving it, or even looking at it, until the other monkeys present had left the area (Goodall, 1971). Might this suggest that the monkey understood that its own behaviour would affect the knowledge (i.e. mental states) of the other monkeys?

As humans, we assume that our own **conspecifics** have understanding of other minds. So it may be difficult for us not to think animal behaviours and abilities are evidence for their understanding of others' minds, which, as you learned in Section 2 of this course, has been referred to as anthropomorphising.

But how do we know that an animal behaving in a particular way has not just learned to respond to aspects of their environment based on physical cues (physical stimuli in the animal's environment), without any actual understanding of others' minds? For example, an animal who 'hides' food out of sight of another animal may have simply learned that if it hides the food when the other animal is present, the chance of that food being taken is high, whereas if it hides the food in the absence of other observers, the food is available for them to enjoy later. This explanation does not assume that the animal hiding the food has any concept of another's mental states (desires, knowledge, etc.). Many behaviours that animals display could be explained as learned behavioural responses or, perhaps **innate** (or *instinctive*) behavioural responses in reaction to certain stimuli.

Activity 11 Which animals might have Theory of Mind (ToM)?

Allow 10 minutes for this activity

The animals from Activities 3 and 7 of this course are listed here again. Which, if any, do you think might have a ToM?

Different aspects of ToM include, for example, the understanding of false beliefs (that people can hold a belief that is not consistent with reality), and that what people can see, leads them to have certain beliefs about, and knowledge of, the world.

- Chimpanzees
- Cats
- Crows
- Lizards

Discussion

You might have thought that chimpanzees are most likely to have an understanding of other minds (or a ToM), given that they are close relatives of humans in evolutionary terms. If you own a pet cat, you might perhaps think they have at least some ability to detect certain emotional states that you (or other animals) might be experiencing.

What about lizards or crows? You may well have been less willing to attribute ToM to these animals. Only very recently have researchers turned to study ToM in crows and lizards, and to date the research is limited and inconclusive. You'll discover as you work through the next few sections of this course, that it has been quite a challenge to devise tests that can answer questions about whether animals have ToM. The majority of studies have been carried out on chimpanzees: Section 6.2 will introduce some of this research.

6.2 Animal understanding of human goals and intentions

Read and consider the very influential study described in Box 2. It is especially significant because it was the study that first coined the term ‘Theory of Mind’.

Box 2 Premack and Woodruff: Does the chimpanzee have a Theory of Mind?

David Premack and Guy Woodruff (1978) were interested in whether chimpanzees showed evidence of understanding the *goals* and *intentions* of human beings. They argued that an understanding of human goals and intentions would constitute evidence of an animal having what they called a Theory of Mind. Premack and Woodruff explained this term as referring to an understanding of others and oneself as having mental states: ‘an individual has a Theory of Mind if he imputes mental states to himself and others’ (Premack and Woodruff, 1978, p. 515).

Premack and Woodruff saw ToM essentially as a ‘system of inferences’, and described it as a ‘theory’ because of two key observations: mental states are not *directly* observable (and hence need to be inferred); and the system (of inferences) is used to make *predictions* about an individual’s behaviour (a feature of theories is that they are often used to make predictions). The reasoning behind this study, which closely follows previous studies carried out with children, is that it is reasonable to take evidence of an understanding of another’s goals and intentions as an indication of possessing a ToM − that is an understanding that others have mental states.

The basic procedure used in this study was to show adult chimpanzees a series of videotaped scenes of a human struggling with a variety of problems − most involving inaccessible food. Some problems were relatively simple to solve, whereas others were more complex. For example, a simple problem involved a banana hanging out of reach of the human, and a box being available to step on to reach up to the banana. A more complex problem involved the human having to move a box, on which were piled several concrete blocks, in order to reach a banana − the heavy blocks had to be removed first, then the box could be moved to gain access to the banana. The video clips lasted 30 seconds and were played in front of the chimpanzees, but paused 5 seconds before the end so that the solution (to the problem of accessing the food) was not revealed. At this point the chimpanzees were presented with a pair of photographs, only one of which depicted the correct solution to the problem (e.g. placing and stepping on to a box to reach the banana). Figure 10 shows two of the photographs.

Figure 10 Photographs from the study by Premack and Woodruff (1978): (a) trying to

get to an out-of-reach banana (above left); (b) the correct solution to the problem of reaching the banana (above right).

Essentially, what Premack and Woodruff found was that the chimpanzees were able to correctly choose the photograph that solved the problem of reaching the food, for nearly all the problems they were presented with in the videos. Premack and Woodruff believed that the chimpanzees' consistent choice of the correct photographs indicated that the animals recognised the video as representing a problem, understood the human actor's purpose (intentions and goals − their mental states) and chose the solutions that were compatible with the purpose. The chimpanzees' ability to reliably pick the picture that solved the problem was seen by Premack and Woodruff as indicating that they attributed desires and intentions to others, and used these to make inferences and predictions about another's behaviour: in this case, humans trying to solve a problem. This was taken as an indication that chimpanzees have a ToM.

Now have a go at answering the questions in Activity 12.

Activity 12 Do you agree with Premack and Woodruff's interpretation?

Allow 10 minutes for this activity

Do you agree with Premack and Woodruff" interpretation of the findings of their study, which you have just read about?

Can you think of any alternative explanation for the chimpanzees' behaviour that does not involve making such inferences?

Provide your answer...

Discussion

Several philosophers independently made essentially the same key point about Premack and Woodruff's study: that the chimpanzee may be solving the problem themselves, and thus choosing the correct photograph on this basis, without having to have any understanding of the human actor's goals and intentions (Dennett, 1978). The important point made by these responses is that in order to assume that an individual observer (in this case the chimpanzee) is making inferences about another's mental states, it is necessary that the observer's own mental states − including goals, desires, intentions, and so on − do not match those of the other. If the observers themselves have the same mental states, then they could simply be interpreted as acting on their *own* intentions. Given the strong likelihood that the chimpanzees in Premack and Woodruff's study would want to reach the banana, the solutions they chose could just be an indication that they can solve this type of problem for themselves. This explanation does not require any inferences to be made about the human actor's intentions, goals or desires.

The Premack and Woodruff study has inspired a large body of research that has followed up on the essential question of whether animals have an understanding of other minds, or just act according to learned behaviours in response to environmental stimuli. This has led to various alternative procedures being designed in an attempt to assist in answering this question.

In a review article published 20 years after Premack and Woodruff's landmark study, Heyes (1998) assessed the evidence on ToM in non-human primates and concluded that the studies carried out to that point did not provide any evidence of an understanding of others' minds. In particular, Heyes pointed out that all existing studies were consistent with an interpretation in terms of either 'behavioural rules' (learned behavioural responses to stimuli) or an understanding of others' mental states. Because of that ambiguity, it was not possible to draw clear inferences about which of these may underlie animals' observed behaviours. Heyes, in 1998, urged that there was a need for studies that could distinguish between these two possible interpretations. There would be little point, she argued, in producing further observations of animal behaviour that would be consistent with both accounts if researchers wished to learn more about whether animals do indeed possess a ToM.

More recently, 10 years after Heyes' (1998) review, Call and Tomasello (2008) presented an updated review of studies of ToM in chimpanzees. Considering a range of different types of studies, they came to the conclusion that the evidence so far did strongly suggest that chimpanzees have at least *some* understanding of others' minds.

In the next sections of this course, you will learn more about some of the studies that have been conducted on this topic, starting with some designed to look at whether chimpanzees understand perception and knowledge, i.e. that others have visual perspectives that influence what they come to know and believe. As you will discover, the evidence suggests that chimpanzees *do* display some such understanding, but that it is limited compared with what very young human children have been shown to understand.

6.3 Chimpanzees' understanding of perception and knowledge

Understanding another's perspective − appreciating that what someone else sees can be different from what we see ourselves, and that what they see will influence both their knowledge and behaviours − has been considered to be a basic element of Theory of Mind (ToM).

Stronger evidence that chimpanzees may understand seeing in a way that implies an understanding of mental states originates from what has come to be known as the **food competition paradigm** (Call and Tomasello, 2008; this procedure was first introduced by Hare et al., 2000).

In their natural social environments, chimpanzees are often in situations involving competition for food with other **conspecifics** in their group. It has been suggested that considering these more naturalistic types of behaviours, rather than those involving (for example) cooperative interactions with humans, might be a better and more sensible way to test for any understanding of other minds in chimpanzees, and other animals (Hare et al., 2000).

The food competition paradigm involves a procedure in which a dominant chimpanzee and a subordinate chimpanzee are competing for food. Box 3 describes the basic procedure used in this type of study.

Box 3 The food competition paradigm procedure

Figure 11 displays the basic procedure used in the food competition paradigm. A subordinate chimpanzee and a dominant chimpanzee are each placed in a room, located on opposite sides of a middle room. Each of the side rooms has a door that leads into the middle room. As depicted in Figure 11, these doors can be partly raised, which allows each individual to see into the middle room, and to see the other chimpanzee looking under their own door. The experimental procedure involves a human placing pieces of food at various locations within the room, in view of one or both of the chimpanzees (where the food is placed, and which of the chimpanzees is able to watch it being placed, varies according to the experimental condition). Once the food has been placed, the doors for both individuals are opened wide so they can enter the middle room.

The basic problem for the subordinate chimpanzee is that the dominant chimpanzee will take all of the food it can see (or has seen being placed, and so knows where it is). The small barriers (labelled 'occluders' in Figure 11), allow the food to be placed so that only one or other chimpanzee can see it.

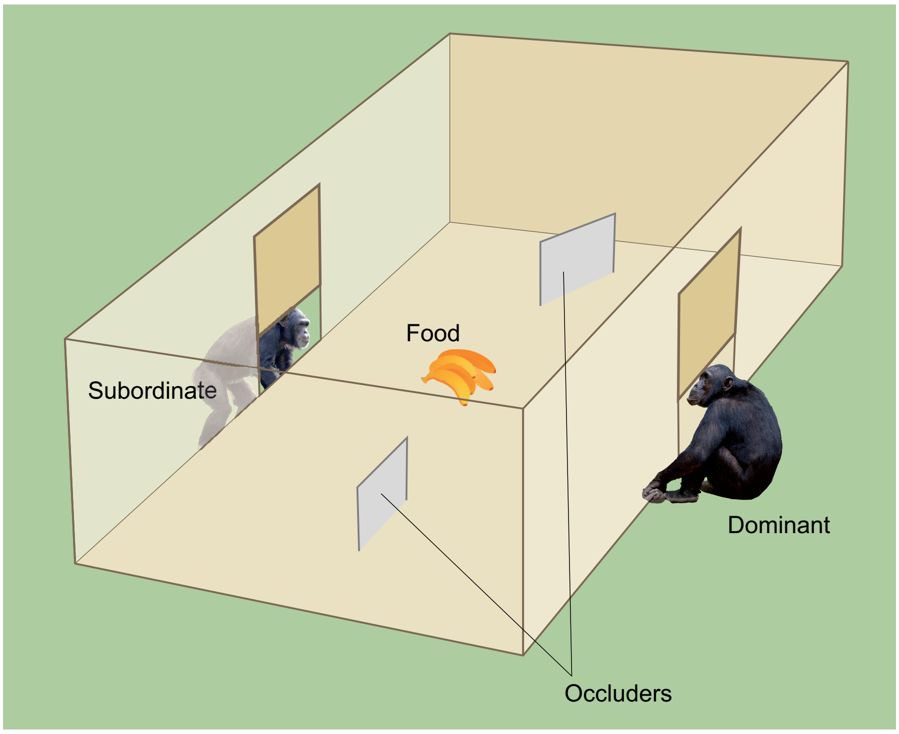


Figure 11 The food competition paradigm (Source: based on Hare et al., 2000)

Hare et al. (2000) used variations on the food competition procedure in order to create two main conditions. In one condition, food was placed so that both animals could see it; and in the other condition (Figure 12), the food was placed behind a small barrier (occluder) so the subordinate chimpanzee could see it, but the dominant chimpanzee could not . The question of interest was whether the subordinate chimpanzee would take into account whether the dominant competitor was able to see the food or not, and act accordingly.

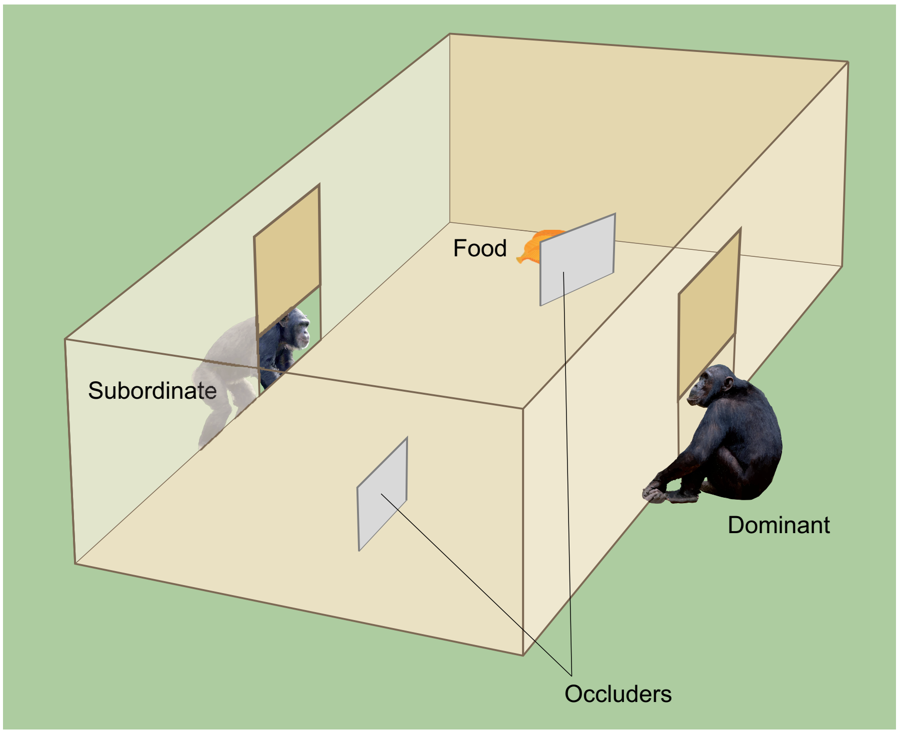


Figure 12 The food competition paradigm − variation

It was found that the subordinate chimpanzee did seem to detect whether the dominant chimpanzee could or could not see the food, as they approached the food more frequently when it could not be seen by the dominant chimpanzee. This finding does suggest that the subordinate chimpanzee had the ability to understand perception, at least to the extent of being able to track what others see.

A number of variations on this study design, based on the same food competition paradigm, have been implemented, which have generally led to further evidence of an understanding of perception in chimpanzees. Hare and colleagues (2001) adapted this procedure in order to test whether chimpanzees seem to understand what another *has seen*, as well as what they can currently see, and thus in a sense what the other 'knows' (Apperly, 2011). In their study, they manipulated the procedure described in Box 3, so that the dominant chimpanzee could not see the food that was hidden behind the barrier in any of the conditions, but either *had* or *had not* seen it being placed behind the barrier. The question then becomes: is the subordinate chimpanzee less likely to approach the food that the dominant chimpanzee *has* seen placed, and thus *knows* is there? Indeed, this is the result that was found, suggesting that chimpanzees may also understand that seeing something leads to possessing *knowledge* in the future.

While behavioural rules might explain the chimpanzees' behaviours in any one of these various food competition studies, Call and Tomasello (2008) have argued that, taking all these studies together, they present strong evidence for an understanding that others have perceptions that lead them to see and know things. Thus, chimpanzees arguably do behave − even in controlled laboratory studies − in ways that can reasonably be interpreted as indicating that they do have an understanding of the mental states of perception and knowledge.

In the next section of this course you will consider the evidence regarding chimpanzees' understanding of false belief, that is beliefs that are not consistent with reality.

6.4 Chimpanzees' understanding of false belief

The food competition paradigm has also been adapted to try to test whether chimpanzees appear to understand *false* beliefs. As described in Section 6.3, Hare and colleagues (2001) created a version of the task where dominant chimpanzees either witnessed (informed condition) or did not witness (uninformed condition) the location where the food was placed. A second version of this task used in this study included a procedure whereby the dominant chimpanzee always witnessed the initial location of the reward, but then the reward was moved to a second location (unwitnessed, hence creating a 'false belief', rather than simply ignorance). The subordinate chimpanzee witnessed the food placement and movement in all conditions, and so knew exactly where the food was placed at all times. The subordinate chimpanzee was also able to see that the dominant chimpanzee had witnessed where the food was, and whether or not it had witnessed the food being moved to the new location, which varied depending on the experimental condition.

Pause for a moment and think about what would be evidence that the subordinate chimpanzee has an understanding of false belief in this study.

How would you expect the subordinate chimpanzee to behave in the conditions where the dominant chimpanzee had witnessed the food being moved from its original location, compared with where it did not witness this relocation of the food? It would seem reasonable to predict that if the subordinate chimpanzee realised that the dominant competitor actually had a *false belief* about the location of the food (in the condition where it did not see the food being moved), the subordinate chimpanzee would be more likely to approach the food on its own, compared with the condition where the food movement had been witnessed by the dominant animal.

However, the researchers found that this was not the case. The subordinate chimpanzee was no more likely to approach the food when the dominant chimpanzee had not seen it being moved, than when they had seen it being moved. This suggests that chimpanzees may not understand false beliefs. This task can be interpreted as testing the subordinate animal's ability to keep track of what knowledge the dominant one had, and then decide to retrieve the food or not according to this information.

Taking the results of the procedures reported by Hare and colleagues (2001) all together, the findings suggest that chimpanzees were able to distinguish between the informed and uninformed conditions, indicating that they have an understanding of their competitor's knowledge versus ignorance (what they don't know). However, they were unable to distinguish between the uninformed and the misinformed (false belief) conditions − providing no evidence for understanding that their competitor had a false belief.

Other studies using similar experimental designs (also based on food competition tasks) have supported Hare and colleagues' conclusion that chimpanzees seem to understand knowledge and ignorance, but not false belief (Kaminski et al., 2008). Juliane Kaminski and colleagues (2008) compared chimpanzees' performance with that of 6-year-old children undertaking a very similar competitive task (but competing for toys rather than food). The children showed understanding of knowledge and ignorance, *and* false belief.

Overall, the evidence from laboratory studies that sought to test for understanding of false beliefs in chimpanzees suggests that they do not understand these belief states (Call and Tomasello, 2008).

In this section of the course, you have considered a number of different research studies (using chimpanzees) that set out to look for evidence of ToM in animals, and thought about what these have allowed researchers to conclude. You have considered studies looking at the understanding of human goals and intention, visual perspective-taking (perception and knowledge) and false belief. Next, in Section 7, you'll explore some issues around the methods used in ToM studies

7 Thinking about methods: laboratory and natural settings

In Section 6 of this course, you were introduced to some studies which set out to investigate whether animals have a Theory of Mind (ToM). Such investigations are of interest from an evolutionary psychology perspective, since they might help psychologists to understand more about how and when ToM abilities developed (in evolutionary terms) in humans, and whether such abilities are unique to humans (go back to Box 1 in Section 3 of this course, to remind yourself about evolutionary psychology). Studies of ToM abilities in animals may also inform our understanding of the extent to which ToM may be possible in the absence of language (a controversial issue within the **developmental psychology** literature on ToM).

As you learned in Section 6.2, Premack and Woodruff (1978) presented findings from what has since become an extremely influential and widely-discussed study. They argued that the chimpanzees in their study displayed an understanding of human goals and intentions, and that, to some extent at least, this indicated a ToM.

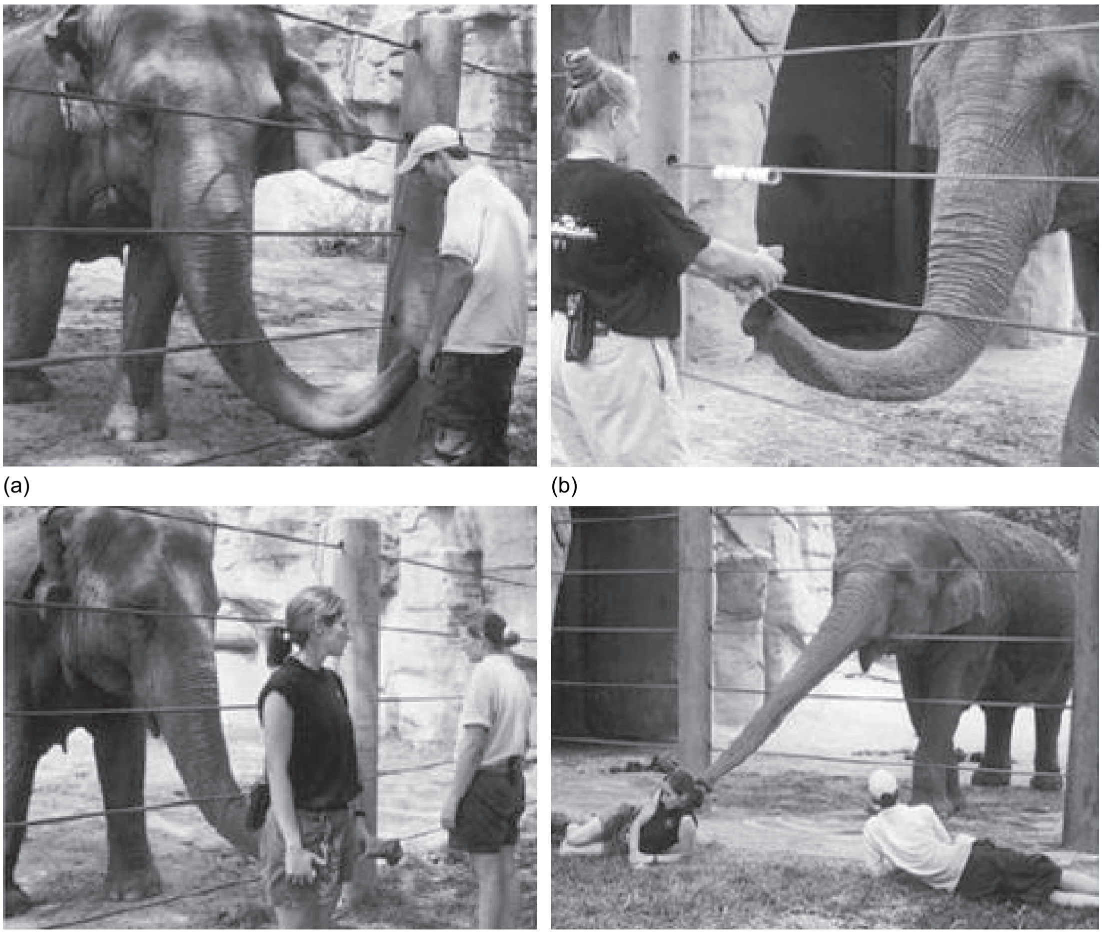
Figure 13 Jane Goodall interacting with a chimpanzee

Premack and Woodruff's conclusions have been challenged though, and their study, as well as other studies taking a similar approach, have led to much discussion, debate and controversy regarding the interpretation of the findings.

In this section, you will further consider some of the approaches taken by researchers, and the methodological issues that emerge, in relation to investigations of ToM in animals.

7.1 Studies on animals' understanding of 'seeing'

While chimpanzees have been the animal most frequently focused on by researchers interested in Theory of Mind (ToM) in animals, the abilities of non-primates have also been studied. Donna Nissani (2004) discusses some studies she has carried out with elephants. In one set of studies, Nissani used adapted versions of studies on chimpanzees' understanding of seeing (carried out by Povinelli and Eddy, 1996). Figure 14 shows some scenes from Nissani's studies.



(a) (b) (c) (d)

Figure 14: Nissani's study: (a) The elephant's natural begging pose; (b) The elephant making the 'incorrect' choice between food and a rock; (c) The elephant making an equivocal choice between a facing and an away-facing human (that is, it wasn't clear whether the elephant was choosing correctly or incorrectly); (d) The elephant making the 'incorrect' choice between the facing and away-facing human

As you can see from Figure 14, the elephant is required to make a choice, which will either be 'correct' (will gain them food) or 'incorrect' (will not gain them food). In order to get them used to the general procedure, they are first presented with a number of trials where they need to learn to choose between a piece of food and a rock, using their natural begging gesture (image (a)). They are then presented with the experimental trials in which they are required to choose between a human who can see them, and a human who cannot see them (images (c) and (d)).

Now watch this video: it shows the procedure used by Nissani in this series of studies, which looked for evidence of an understanding of 'seeing' in elephants.

Video content is not available in this format.

The procedure used by Nissani in her series of ‘seeing’ studies with elephants

Nissani (2004) reported that elephants initially performed poorly, failing even to distinguish the presence of food − as determined by the food versus rock task (Figure 14 (b): the elephant gestures towards a human holding a rock, rather than one holding food). However, the elephants soon learned to beg correctly (e.g. approaching the human who was facing them, and thus could see them, rather than the human who was facing away) in all the conditions, on most of the trials (around 70%) in which they were tested. They performed in the facing and away-facing condition as well as the chimpanzees in a previous study by Povinelli and Eddy (1996), and outperformed the chimpanzees in other tests (such as, when a bucket was placed over the head of one experimenter, obscuring their vision, while the other had no bucket over their head). But despite the elephants performing better than the chimpanzees in Povinelli and Eddy’s study, they nevertheless begged *incorrectly* around one-third of the time. So, as Nissani points out in the video, findings from her studies remain equivocal − or inconclusive − on the issue of whether elephants do understand seeing.

Considering the issue of how methods and study designs used might influence the results obtained, Nissani identified a number of methodological issues with the original Povinelli and Eddy chimpanzee studies. She pointed out that these factors may have had an impact on the chimpanzees’ ability to demonstrate an understanding of perception in these studies. In particular, Nissani notes various aspects that made the procedure artificial and unnatural (such unnatural procedures are said to lack **ecological validity**). Among the key points that Nissani (2004) raises, and some of the adaptations she made to address these in her studies with elephants, are

- The required ‘begging’ (for food) gesture used was ‘natural’ for the elephants, but (most likely) not for the chimpanzees in the original Povinelli and Eddy studies.

- The elephants in Nissani's studies had been raised in more natural conditions, whereas the chimpanzees in the original studies had mostly been born in captivity and subjected to experimentation for most of their lives.
- Povinelli and Eddy's studies used young chimpanzees, between the ages of 5 and 6 years.
- The way in which the experimental and control trials were set up in the original procedure, and the nature of the rewards offered, made it quite plausible that the chimpanzees may have misunderstood what was required of them, and/or they may have lacked motivation to carry out the intended task (e.g. owing to a lack of sufficient rewards being offered in the test trials).

In her adapted studies, Nissani addressed many of the methodological issues identified. For example, she used adult elephants, and tried to create a more natural context by using tasks and behavioural responses that occur more spontaneously in a naturalistic setting. As mentioned earlier, the performance of Nissani's elephants was better than that of the chimpanzees in the Povinelli and Eddy studies (although the elephants still made errors around one-third of the time).

Nissani also reported replicating the original Povinelli and Eddy study with chimpanzees. She made procedural variations in order to address many of the issues she identified, including using adult chimpanzees (in a zoo setting) who had not previously taken part in psychological experiments. She also made some more subtle adjustments: for example, altering the way the practice and test trials were organised, and the way in which the rewards were offered. Nissani found that the performance of the chimpanzees was improved (they performed above chance levels, which means they were not just choosing randomly), with findings comparable to those obtained with the elephants (Nissani, 2004).

These various procedural adaptions demonstrate the importance of paying careful attention to the methodological details of these types of laboratory studies, since relatively minor variations may influence the outcomes.

The issue of laboratory studies being artificial, and the extent to which they can be said to have ecological validity (in other words, to represent behaviours and abilities that occur in a naturalistic setting) is important to keep in mind when evaluating the results of comparative research. As you have seen, researchers such as Nissani have attempted to maximise the ecological validity of laboratory studies by using contexts and tasks that are more akin to what occurs in an animal's natural environment. Some of these studies have found that animals do appear to show evidence of abilities, which previous studies using more artificial contexts suggested they did not possess, such as the understanding of seeing. Another approach, however, is to observe animals' naturally occurring behaviours in fully naturalistic settings. You will consider this approach in the next section.

7.2 Studies on animals' understanding of false belief: deception

As you learned in Section 6.4 of this course, comparative laboratory studies using the food competition paradigm have failed to provide evidence that chimpanzees understand that others can have false beliefs; although they do suggest that chimpanzees have some understanding of others' perception and knowledge.

Another strategy for looking for signs of false belief understanding in animals, is to consider whether they seem to engage in acts of deliberate deception. In humans, the ability to deceive is closely linked to the understanding that other people can have false beliefs. For example, a footballer who strives to instil in a goalkeeper a false belief about which way the ball will be heading. This deliberate attempt to instil a false belief in another is known as *deception*. This raises the question as to whether animals also display evidence of deliberate deception, and if so, whether this might indicate that they, too, understand that others can have false beliefs.

This next video discusses evidence that animals can deceive, drawing upon naturalistic examples rather than laboratory studies. It considers what this evidence might tell us about animal understanding of others' mental states.

Watch the video and then answer the questions in Activity 13.

Video content is not available in this format.

Do animals lie?

Activity 13 Deception in animals

Allow 20 minutes for this activity

1. In the video you have just watched, how does Professor Celia Heyes explain 'functional deception'? Give an example of this type of deception in relation to animals.

Provide your answer...

Answer

Heyes notes that functional deception (also known as 'tactical deception'; Whiten and Byrne, 1988), involves behaving in a way that leads another animal to make a mistake. However, the important point about functional deception is that it does not require an understanding of others' mental states or an attempt to manipulate these. An example of functional deception in animals is when an animal changes its appearance in order to mimic another type of animal, thereby deceiving a predator. You may have thought of other examples.

2. Does deceptive behaviour in animals indicate that they may have an understanding of others' mental states in any contexts?

Provide your answer...

Answer

As you saw in the video, theorists have different perspectives on this question. Some view instances of deception by animals as not involving any deliberate effort, or 'thinking', whereas, for others, some examples of deception by animals provide compelling evidence that they do 'think' about goals, and ways of acting to achieve these. Heyes points out that the ability to deceive can come about by associative learning, which does *not* involve an understanding of false belief in others; rather, it involves an animal learning that, if it behaves in a certain way, this can lead another animal to behave in a way that benefits the first animal.

3. What might be the most compelling evidence that animals *intentionally* deceive others by trying to manipulate their mental states?

Provide your answer...

Answer

Deceptive behaviour that appears to be flexible and adaptive might provide the strongest evidence. Consider Jane Goodall's example of the young chimpanzee who suppressed his urge to make excited calls when presented with food, so as not to alert dominant members of the group. Might this be explained in terms of the chimpanzee understanding that, if he made a noise, the others in the group would come to know that there was food available, but that if he kept quiet the others would not gain this knowledge? The issue of competing explanations emerges here, since this behaviour could just be an example of associative learning, rather than reflecting a genuine understanding of how to influence the beliefs and knowledge of others.

The issue of whether animals intentionally deceive, by setting out to manipulate another's mental state, remains debated. Some theorists have argued that intentional deception is a uniquely human cognitive ability (e.g. Cheney and Seyfarth, 1990; Tomasello and Call, 1997).

In naturalistic contexts, such as when an animal refrains from giving a food call so as not to alert other animals to the presence of the food (as you saw illustrated by the chimpanzee example in the video you have just watched), deceit might be a behaviour that they have learned maximises their own chances of getting the food (Heyes, 1998).

Controlled experimental studies investigating deception in animals, such as those which have tested whether chimpanzees can learn to refrain from indicating the location of hidden food, have found that it typically takes very many trials for the animals to learn to do this. This has led some psychologists to suggest that an associative-learning explanation might be more plausible than one that involves the animals having an actual understanding of how they can manipulate others' mental states (as noted by Hare et al., 2006). However, Hare and colleagues (2006) used an adapted study design, from which they report finding evidence that chimpanzees can purposefully attempt to manipulate the mental states of others.

So it seems that both laboratory-based and naturalistic studies of ToM in animals are open to different competing interpretations. This has led to debates between theorists about which interpretation is the most plausible. Considering data from a range of different methodological approaches seems likely to be a good strategy in trying to answer questions about the nature of animal minds.

7.3 Behind the scenes of the Dog Cognition Centre

You are nearly at the end of this course about animal minds. In this final section you will explore some research that at has looked at whether domestic dogs show evidence of having a Theory of Mind (ToM), and you'll then consider the strengths and weaknesses of the methods used in this specific research, as well as laboratory-based and naturalistic studies more generally.

In this video, Juliane Kaminski talks about the research she has been carrying out on dog cognition at Portsmouth University. This research has offered insights into whether dogs understand 'seeing' as a mental state.

Research with domestic dogs is of interest to psychologists because, unlike primates such as chimpanzees (and some non-primates, such as elephants), dogs have a long history of living alongside humans. For them, interacting with humans can reasonably be considered to be a part of their natural environment.

Watch the video and then have a go at answering the questions in Activity 14.

Video content is not available in this format.
The Dog Cognition Centre

Activity 14 Social cognition in dogs

Allow 20 minutes for this activity

1. Why is the study of cognition in animals relevant to understanding the evolution of human cognition?

Provide your answer...

Answer

In the video, Kaminski points out that, in order to better understand the evolution of cognition in humans, it is useful to compare human cognition with cognition in non-human species in order to see where the differences are.

2. According to this video, what is special about dogs in particular, compared with other species?

Provide your answer...

Answer

Dogs were the first species that humans domesticated, around 20 or 30 thousand years ago; they may therefore have evolved specialised cognitive skills as they adapted to life with humans.

3. What is a disadvantage of naturalistic studies that observe behaviour in the wild?

Provide your answer...

Answer

It is often not possible to control the different factors in the wild in order to determine which variables may be having a particular effect.

4. What are the strategies used by researchers at the Dog Cognition Centre to try to make their data as valid as possible?

Provide your answer...

Answer

Three strategies are used:

- As many dogs as possible are used in the studies.
- Different experimental conditions are presented to dogs in different orders, which is called **counterbalancing**. This allows the researcher to rule out the influence of **order effects**, whereby the order of presentation of conditions has an influence on the results (e.g. dogs may always perform differently in the condition presented first, whichever it is; so if, for each dog, a different condition is presented first, this effectively cancels out any such effects across the range of dogs used in the study).
- Measures (such as counterbalancing and controlling all other variables) are taken to ensure that only the variable(s) of interest can affect the dependent variable (DV).

5. What does Kaminski say about ecological validity in relation to studies with dogs?

Provide your answer...

Answer

Ecological validity might be less of an issue in controlled laboratory studies with domestic dogs, compared with other animals, since domestic dogs' natural environment is very similar to the laboratory setting (being in a confined space with a human/their owner).

6. Does the evidence in this video suggest that dogs have a ToM?

Provide your answer...

Answer

Kaminski says that, although dogs seem to have some level of understanding of the other's (human's) perspective, there is currently no evidence to suggest that they have the level of understanding necessary to constitute having a ToM.

Conclusion

This free course, *Living psychology: animal minds*, has introduced you to research that addresses issues related to psychologists' understanding of animal minds. You have learned about approaches in comparative psychology and considered how these relate to the area known as evolutionary psychology, and encountered a number of studies addressing the question of the nature of animal minds and cognitive abilities, drawing on examples of brain studies, laboratory-based research and naturalistic observations.

You have also learned that people tend to anthropomorphise when thinking about animals, attributing to them human-like desires, intentions, emotions and other mental states and experiences. But also that there is strong evidence that animals can experience a range of emotions and engage in reasoning and problem solving.

You have also seen that Theory of Mind (ToM) studies can be controversial and open to competing interpretations and conclusions, and that there are both strengths and shortcomings of comparative laboratory-based research studies.

This OpenLearn course is an adapted extract from the Open University course DD210 *Living psychology: from the everyday to the extraordinary*.

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