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## **Metacognition**

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Research on animal metacognition—**cognition** about cognition—is primarily concerned with the question: Do animals know when they know and when they do not know?

### ***Human Metacognition***

The study of animal metacognition is rooted in research on human cognitive psychology. The keys to human metacognition are beliefs and judgments about **memory**. For example, the question “What is the name of the frog in The Muppet Movie” might elicit a *feeling of knowing*—a judgment that one could select the name on a multiple choice test, even if one cannot recall it now. Such judgments, remarkably, can be made accurately even when the answer cannot be recalled. Metacognitive judgments are subject to some consistent biases, such as overconfidence, but they can also be quite accurate, especially when people can test themselves.

### ***Animal Cognition***

Animal cognition refers to animals’ ability of to process external information, store and retrieve that information from memory, and produce resulting thoughts and behaviours. Animal cognition is often distinguished from other kinds of animal learning, such as **classical conditioning** and **operant conditioning**. Different animals have different cognitive specialties; for example, many **primates** are social in ways that parallel human social cognition; some caching **birds** have spatial memories for the location of hidden food that put human spatial memory to shame.

The study of animal metacognition revolves around the concept of uncertainty—that is, discriminating between situations in which one is certain, versus uncertain, of what to do. Animals frequently appear to be uncertain, as when a **horse** hesitates before jumping a hurdle that it may not be able to clear. But, by itself, appearing uncertain is not evidence of metacognition. The question, which has been addressed over the past dozen years, is can animals report that they are uncertain? And can they report uncertainty about their memories?

### *Animal Metacognition*

Most of the evidence concerning animal metacognition is based on studies of **rhesus macaque monkeys**. Some of that evidence, as well as evidence from other species, is reviewed briefly below.

In seminal studies on animal metacognition, which were performed in the mid 1990s, animals were asked to do a task, such as identify whether a tone was high or low pitch. Crucially, they were also given a third response option: An “escape” response, which allowed them to skip the trial and move on. Monkeys and **dolphins** both tended to escape difficult trials more than easy trials, providing the first evidence that they could make uncertain responses (see Smith & Washburn, 2005, for a review).

In another innovative study, rhesus monkeys were allowed to opt out of taking a test before it had occurred (see Hampton, 2001). The subjects were shown an image on a touch-sensitive computer monitor; their task was to remember the image so that, later, they would be able to select it when it was presented along with other images in a multiple-choice test. The animals could also opt out of the test and settle for a food reward that, while less attractive than the reward for a correct response, was better than responding incorrectly and receiving no reward. The monkeys appeared to opt out of the most difficult trials, and thus they did better when they chose to take the test than when it was forced on them. This suggests they could monitor uncertainty in their memories. When **pigeons** were faced with the same task, however, they did not demonstrate an ability to monitor uncertainty.

A third kind of evidence for animal metacognition comes from a task in which, essentially, rhesus monkeys were asked to gamble on their memories (Kornell et al., 2007). The monkeys were shown six pictures, one at a time. Then they were shown nine pictures and had to touch the one that had been presented previously. After they responded, the monkeys were asked how many “tokens” they wanted to wager on their response. The tokens were icons, displayed on the screen, which were automatically exchanged for food rewards. If a subject touched the “high risk” icon, they would either gain or lose three tokens, depending on whether their previous response had been right or wrong. If they touched the “low risk” icon, they gained one token, regardless of their previous accuracy. The monkeys’ bets demonstrated that they were confident following

correct responses and uncertain following errors. More importantly, because the monkeys had previous experience with the betting paradigm, they were able to respond metacognitively beginning on their first day of the task. This finding implies that they had learned a general metacognitive ability that was not task-specific.

### ***Self Reflection***

Do animals experience metacognition the way humans do? In the study of animal behaviour, it is always critical to recognise that similar behaviours do not necessarily result from similar underlying processes and/or experiences. Many human metacognitive experiences, such as a tip-of-the-tongue—when one feels tantalizingly close to recalling an answer (e.g., Kermit) that just will not come—are intensely conscious and involve an element of self reflection. Thus far, the evidence suggests that some animals, including primates and dolphins, can distinguish between what they know and what they do not know. The degree to which they are aware of, or consciously processing, their metacognitive judgments remains uncertain.

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