

Metacognition: Faced with a test, rats can check their knowledge first

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Researchers have found evidence that rats are capable of metacognition—that is, they can possess knowledge of their own cognitive states. This ability, which can also be thought of as the capacity to assess or reflect on one's own mental processes, was previously only recognized in humans and other primates. The findings are reported by Allison Foote and Jonathon Crystal of the University of Georgia and appear online in the journal *Current Biology*, published by Cell Press, on March 8th.

Assessing metacognition skills in non-human animals is made difficult by our limited ability to communicate with animals about abstract information or concepts. But in past work, metacognition in primates had been successfully probed by employing an ingenious technique: Animals were familiarized with a test that assessed a certain kind of knowledge that they may or may not have obtained during a "study period," and were then given a choice of taking the test or declining it.

Animals were taught that by electing to take the test and passing it, they would receive a large reward, but that failing the test would yield no reward. Declining the test would yield a small reward. Therefore, animals faced with the decision of taking or declining the test would, in principle, have the chance to weigh the likelihood that they would pass the test (and receive a large reward) against the option of declining the test and receiving a certain, but smaller, reward.

In the new work, researchers utilized this approach to study the

knowledge rats had of the information they possessed. During the "study phase" of the experiments, rats were presented with a brief noise of either short duration (between 2 and 3.6 seconds in length) or long duration (between 4.4 and 8 seconds). In the subsequent test, rats had to classify the recent noise as either "short" or "long"—a relatively easy choice if the noise fell to one extreme or another (for example, 8 seconds), but a difficult choice if the noise happened to be of more intermediate length (for example, 4.4 seconds).

But prior to the time-discrimination test, rats were given a choice of whether to take the test at all by poking their nose into one of two apertures. If the rat opted out of the test, it received a small food reward; if it opted in, it was subsequently presented with two levers, one of which it knew from past training represented "short duration" and one "long duration." Selection of the correct lever resulted in a large reward, whereas an incorrect choice yielded nothing.

Two lines of evidence from the experiments indicated that rats can judge whether they have enough information to pass the test. First, the researchers observed that the more difficult the time-discrimination task was, the more frequently rats opted to decline the test. And second, accuracy in the test declined as the difficulty of the time-discrimination task increased, and this decline in accuracy was greater when rats were not given the choice of declining the test—that is, when they were "forced" to take it. The findings indicate that rats were able to assess, on a trial-by-trial basis, whether they were likely to pass the test if they took it.

The findings broaden our understanding of the prevalence of certain cognitive skills in the animal kingdom, and, as the authors point out in their paper, may provide opportunities to study the neuroanatomical and molecular mechanisms that underlie metacognition.

Source: Cell Press

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