Study suggests Pavlovian response might be more complicated than thought

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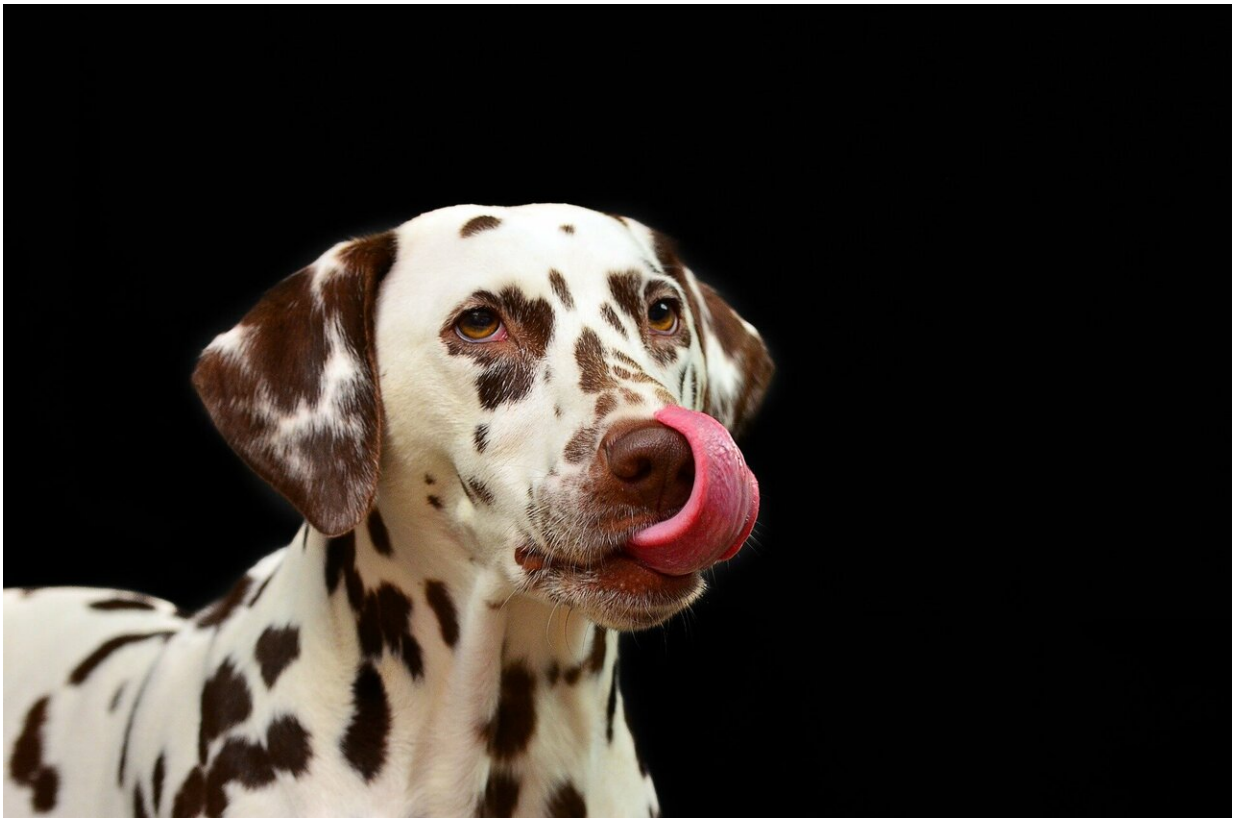

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A small team of researchers at the California Institute of Technology has found evidence that suggests the famous Pavlovian response might be more complicated than previously thought. In their paper published in

the journal *Nature Human Behavior*, the group describes four experiments they carried out with volunteers and what they learned from them. Hillary Raab and Catherine Hartley with New York University have published a News and Views piece in the same journal issue in which they discuss the experiments and findings by the researchers.

Back in the late 1800s, Nobel Prize-winning physiologist Ivan Pavlov published "The Work of the Digestive Glands," an overview of work he had done surrounding temperament conditioning and involuntary reflex actions in animals. He had found that dogs, for example, could be conditioned to respond involuntarily to a reward. Make a noise just before giving a treat several times in a row, and the dog will come to salivate upon hearing the noise whether it results in a treat or not. This type of response has come to be known as the Pavlovian response. The key principle is that the dog, or a human behaving in similar ways, is not controlling the reflex—it happens automatically. Since Pavlov's time, a lot of scientists have tested the response in humans and other animals, and many have tried to explain it. And now, the team at CIT has found that it might be much more complicated than previously thought.

Raab and Hartley note that researchers looking into reinforcement learning and behavioral neuroscience, in general, have developed learning theories that are distinguished by being "model-free" or "model-based." The former refers to learning as a result of rewards or punishments, but which is not associated with predicted outcomes. The latter refers to environmental situations in which characteristics of outcomes are used to evaluate the value of a current action. They note that the research by the team at MIT resulted in evidence showing that the Pavlov response did not conform to either theory, suggesting it might be more involved than prior testing has shown.

In the experiment, volunteers were shown visual cues on computer screens that hinted at a reward on the next screen. As the volunteers

gazed at the screen, the researchers monitored their eyes to see where they stared and for how long—they also looked for changes in the size of the pupil, an automatic response to a perceived stimulus. The researchers report that the responses given by the volunteers suggested that Pavlovian conditioning involves two types of learning that are distinct from one another—one that involves valuation of an outcome and another which is sensitive to devaluation, represented by less change in pupil size as volunteers ate the food pictured on the computer screen.

More information: Eva R. Pool et al. Behavioural evidence for parallel outcome-sensitive and outcome-insensitive Pavlovian learning systems in humans, *Nature Human Behaviour* (2019). DOI: 10.1038/s41562-018-0527-9