Study reveals rats have greater episodic memory than previously thought

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A rat in the center of eight spices. IU scientists used over 00 spices in two circular 'arenas' with different black-and-white patterns on the floor to gauge rat's ability to remember information in specific contexts. Credit: Indiana University

Anyone who has ever spotted a familiar face at a party but been unable to place where or when they last met that person knows the difference between episodic memory and familiarity.

Familiarity is mere recognition. Episodic memory is the ability to recall a memory's context—to remember where and when you saw that familiar face. It's also the difference between sputtering your way through a reintroduction or smoothly referring back to details about the last time you talked to your acquaintance.

Although it's easy to grasp the difference in these types of memory in ourselves, it's not easy to know how animals see the world. Do their memories also take context into account?

A new study by Indiana University researchers that appears online today in the journal *Current Biology* suggests that rats exhibit much stronger episodic memory than previously thought. It is the first study to show that these animals can remember more than 30 events in context.

The lead author on the study is Danielle Panoz-Brown, a graduate student in the lab of Jonathon Crystal, a professor in the IU Department of Psychological and Brain Sciences, who is also an author on the paper.

"Most work shows that rats, and other animals, remember one, two or perhaps three events," Crystal said. "This new work shows that rats remember many events—over 30—and are likely able to remember many more using episodic memory."

The study from Indiana University found that rats could remember dozens of events in context. Credit: Indiana University

He added that the existence of episodic memory in lower animals has implications for research on human diseases that affect memory, including Alzheimer's, Parkinson's and Huntington's diseases, since the majority of research on the brain—and the drugs used to treat memory diseases and dementia—start out based on insights into how the brain works in rats.

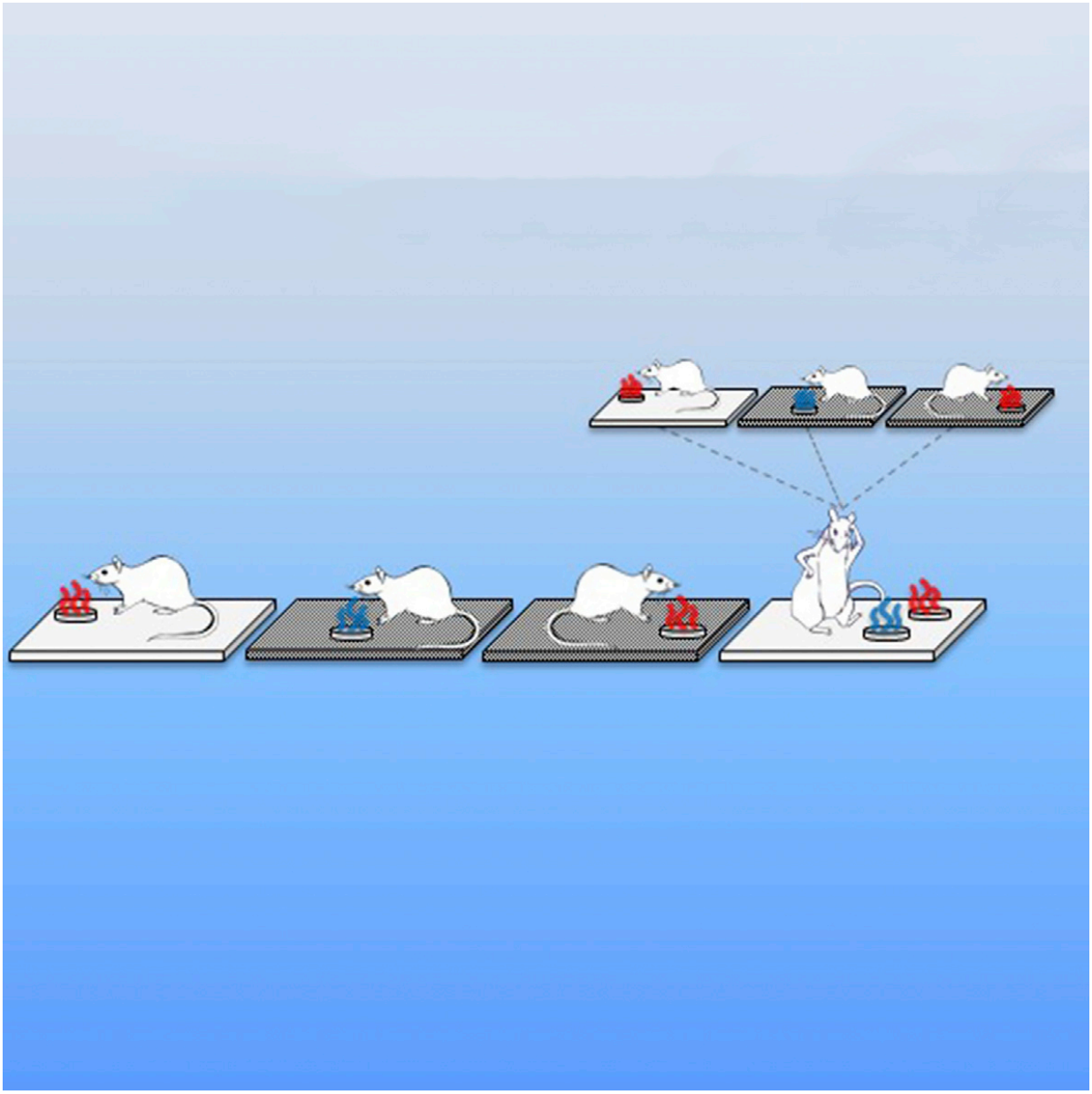
So, if a pharmaceutical company creates an Alzheimer's drug to target memory based on research into one type of memory—the part of the brain responsible for finding missing objects, for example—but doesn't also have data on the type of memory that helps individuals remember

the important people, places and things in their life, it runs the risk of producing a product that helps a person remember where they put the car keys, but not how they met their spouse.

That risk is the impetus behind several other studies published by Crystal over the past several years. In January, Crystal's lab reported evidence that animals also possess independent working memory systems by showing that rats could remember a longer list of items when asked to recall a combination of physical locations and smells versus when they used only a single category of information. And prior to that, they found that rats also possess "source memory," which is the ability to recall where a new piece of information was acquired.

To conduct the new study, Panoz-Brown and Crystal developed a series of challenges in which rats were asked to recall up to 30 different scents—basil, strawberry and banana, among many others—to earn a treat. However, they only earned the reward when they chose the correct scent in a certain context—one of two circular "arenas" with different black-and-white patterns on the floor.

The rats were exposed to a series of many odors and then taught to associate "new" odors—ones to which they had not been previously exposed—with food. After learning this "rule," they were put into one arena and exposed to an odor (for example, a strawberry). They were then put into a second arena and exposed to two odors (such as blueberry and strawberry). Finally, they were placed back into the first arena and presented with two odors. They correctly chose blueberry as the "new" odor, despite their previous exposure in the other context.



Rats were challenged to remember which scent they had not yet smelled in their current context. Credit: Indiana University

The results suggest the rats realized the second odor counted as "new" since they had not yet encountered it in the second context. Moreover, the rats performed similarly on several other challenges, including a test

designed to challenge their ability to recall these "rules" over time and an attempt to confuse them through rapidly switching the contexts.

"Our findings suggest that the ability to represent numerous episodic memories is quite old in the evolutionary timescale," Crystal said. "More broadly, our work supports the view that rats may be used to model fundamental aspects of human memory."

Unfortunately, not many researchers study these more-complex areas of memory. One major reason is that it's just easier to target the parts of the brain that remember location. Automated technology used by many labs makes it easier to simply track a rat as it runs through a maze—a test of location-based memory—as opposed to studying more-sophisticated forms of memory.

For that, Crystal's lab relies on a large team of undergraduate students who can prepare more-complex tests and closely monitor the results. IU undergraduate researchers who worked on this study were Hannah E. Corbin, Stefan J. Dalecki, Meredith Gentry, Sydney Brotheridge and Christina M. Sluka, who are all also authors on the paper. Also an author is Jie-En Wu, a member of Crystal's lab who was a high school student at the time of the research reported in the paper.

More information: Danielle Panoz-Brown et al, Rats Remember Items in Context Using Episodic Memory, *Current Biology* (2016). DOI: 10.1016/j.cub.2016.08.023

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episodic-memory.html