Bumblebees make false memories too

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New evidence suggests bumblebees may experience 'confusion' between flower patterns. Credit: Nicole Milligan

It's well known that our human memory can fail us. People can be forgetful, and they can sometimes also "remember" things incorrectly, with devastating consequences in the classroom, courtroom, and other areas of life. Now, researchers show for the first time in the Cell Press journal *Current Biology* on February 26 that bumblebees can be

unreliable witnesses too.

The new study is the first to explore false memories in any non-human animals, the researchers say. They now suspect that the phenomenon may be widespread in the animal kingdom.

"We discovered that the memory traces for two stimuli can merge, such that features acquired in distinct bouts of training are combined in the animal's mind," says Lars Chittka of Queen Mary University of London. As a result, "stimuli that have actually never been viewed before, but are a combination of the features presented in training, are chosen during memory recall."

Bumblebees are rather clever animals, which explains why Chittka has been studying learning and memory in the insects for the last 20 years. The bees can remember the patterns, colors, and scents of various kinds of flowers. They can also navigate to those flowers and back home again over long distances.

Most times when people have studied memory in animals, errors in performance have been taken to mean that the animals failed to learn the task or perhaps learned it and then forgot. But Chittka and his colleague Kathryn Hunt wondered: What if animals can experience a more interesting type of memory failure?

To find out, Chittka and Hunt first trained bumblebees to expect a reward when visiting a solid yellow artificial flower followed by one with black-and-white rings or vice versa. During subsequent tests, bees were given a choice between three types of flowers. Two were the yellow and the black-and-white types they'd seen before. The third type of flower had yellow-and-white rings, representing a mixed-up version of the other two. Minutes after the training, the bees showed a clear preference for the flower that most recently rewarded them. Their short-

term memory for the flowers was good.

One or three days later, however, something very different happened when the bumblebees' memory was put to the test. At first, the bees showed the same preference displayed in the earlier tests, but as the day wore on, they appeared to grow confused. Half of the time, they began selecting the flower with yellow rings, even though they'd never actually seen that one in training before.

Chittka and Hunt say that the insects' observed merging of long-term memories is similar to the memory conjunction errors humans sometimes make. They don't think those false memories in either bumblebees or humans are simply "bugs in the system," but rather are side effects of an adaptive memory system that is working rather well. In fact, Chittka's team recently found that people who are particularly good at learning rules to classify objects are also especially prone to these false memory illusions.

"There is no question that the ability to extract patterns and commonalities between different events in our environment [is] adaptive," Chittka says. "Indeed, the ability to memorize the overarching principles of a number of different events might help us respond in new situations. But these abilities might come at the expense of remembering every detail correctly."

In bees, with their limited brain capacity, the pressure to "economize" by storing overarching features of a class of objects rather than each individual object might be even more intense. Chittka's lab is now using radar tracking to follow bees and their choices of flowers over a lifetime.

"We are fascinated to learn how lifetime experiences accumulate and are integrated in making day-to-day foraging decisions," he says.

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