



Dopamine Drives Bee Desires: Study

Like in humans, the neurotransmitter appears to play a role in generating wanting-like behavior and, perhaps, happy memories in honeybees.



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Cravings for sugary treats and other “wants” in humans are driven by the activity of dopamine-producing cells in our mesolimbic system. Experimental research now suggests that a similar system might also exist in honeybees (*Apis mellifera*), spurring them to “want” to search for sources of nectar.

ABOVE:
Honeybee (*Apis mellifera*)

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In a study published today (April 28) in *Science*, researchers found that bees’ dopamine levels were elevated during the search for food and dropped once the food was consumed. Dopamine may also help trigger a hedonic, or pleasant, “memory” of the sugary treat, the researchers say, as dopamine levels rose again when foragers danced to tell other foragers about the foods’ locations.

“The whole story is new. To show that there is a wanting system in insects is generally new,” says study coauthor Martin Giurfa, a neuroscientist at Paul Sabatier University in Toulouse, France. “Bees are truly amazing.”

In both humans and invertebrates, dopamine is known to be involved in learning and reward. Giurfa and his team have been studying the neurotransmitter in bees, and several years ago, they characterized many of the neural pathways that involved dopamine. “We found so many so diverse pathways that we said, ‘There might be more than just representing reinforcement, representing punishment, representing reward.’” He began to look for other roles dopamine might play in honeybee behavior.



A photo of a honeybee (*Apis mellifera*) taken in the field.

SONGKUN SU

Observing managed beehives of Fujian University’s College of Bee Science in Fuzhou, China, Giurfa’s collaborators used whole-brain liquid chromatography to measure the amount of dopamine in bees shortly after they left the hive, when they arrived at a food source—a series of artificial feeders—or right after they fed. Shortly after they left the nest and all throughout their flight to a food source, the bees’ dopamine levels tended to be high. But once the bees had a sugary meal, their dopamine levels dropped, indicating that the motivation to feed was gone, Giurfa says.

When foragers returned to the hive, they performed the famous waggle dance,

letting other foragers know through bouts of vigorous shaking about the location of food sources. The researchers found that when bees danced, dopamine levels were high—as high as they were in bees heading out in search of food. This indicated to Giurfa that the bees may have been “evoking” the sensation of searching for the nectar as they danced, much in the way a person might fondly recall receiving a tasty treat. “Having the dancers showing this peak of dopamine when they start dancing, you have to think this is not a robot. It's someone having a memory,” says Giurfa.

Artificially increasing and decreasing the bees’ dopamine levels didn’t affect the amount of time they took to forage. However, when the researchers decreased the bees’ dopamine levels, the bees spent more time inside the hive, leading the researchers to again conclude that dopamine has something to do with their “want” to forage. Moreover, artificially increasing dopamine levels helped the bees learn odor-association tasks better, even half an hour after they got the dopamine boost, suggesting the neurotransmitter might help hungry bees learn about the location of a new food source.

The researchers also tested all of the bees by themselves to remove any potential social influences on dopamine. Even solo, bees experienced high dopamine levels when seeking out something to eat, especially after food deprivation.

“I think it’s a very interesting and thought-provoking paper,” University of Minnesota neuroscientist Karen Mesce, who has collaborated with some of the authors of the papers previously, tells *The Scientist*, but she cautions that a bee’s wanting-like drive may not be quite like a human’s. “We have to be very careful when we’re talking about insects. The term ‘hedonic’ is equated with pleasurable. Most of us don’t associate emotion with insects. Many neuroscientists are not convinced that bees are self-reflecting and have pleasurable states.”