Honey bees study finds that insects have personality too

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New research indicates that individual honey bees differ in personality traits such as novelty-seeking. Credit: L. Brian Stauffer

A new study in *Science* suggests that thrill-seeking is not limited to humans and other vertebrates. Some honey bees, too, are more likely than others to seek adventure. The brains of these novelty-seeking bees exhibit distinct patterns of gene activity in molecular pathways known to be associated with thrill-seeking in humans, researchers report.

The findings offer a new window on the inner life of the honey bee hive, which once was viewed as a highly regimented colony of seemingly interchangeable workers taking on a few specific roles (nurse or forager, for example) to serve their queen. Now it appears that individual honey bees actually differ in their desire or willingness to perform particular tasks, said University of Illinois entomology professor and Institute for

Genomic Biology director Gene Robinson, who led the study. These differences may be due, in part, to variability in the bees' personalities, he said. The study team also included researchers from Wellesley College and Cornell University.

"In humans, differences in novelty-seeking are a component of personality," he said. "Could insects also have personalities?"

Robinson and his colleagues studied two behaviors that looked like novelty-seeking in honey bees: scouting for nest sites and scouting for food.

When a colony of bees outgrows its living quarters, the hive divides and the swarm must find a suitable new home. At this moment of crisis, a few intrepid bees – less than 5 percent of the swarm – take off to hunt for a hive. These bees, called nest scouts, are on average 3.4 times more likely than their peers to also become food scouts, the researchers found.

"There is a gold standard for personality research and that is if you show the same tendency in different contexts, then that can be called a personality trait," Robinson said. Not only do certain bees exhibit signs of novelty-seeking, he said, but their willingness or eagerness to "go the extra mile" can be vital to the life of the hive.

The researchers wanted to determine the molecular basis for these differences in honey bee behavior. They used whole-genome microarray analysis to look for differences in the activity of thousands of genes in the brains of scouts and non-scouts.

"People are trying to understand what is the basis of novelty-seeking behavior in humans and in animals," Robinson said. "And a lot of the thinking has to do with the relationship between how the (brain's) reward system is engaged in response to some experience."

The researchers found thousands of distinct differences in gene activity in the brains of scouting and non-scouting bees.

"We expected to find some, but the magnitude of the differences was surprising given that both scouts and non-scouts are foragers," Robinson said.

Among the many differentially expressed genes were several related to catecholamine, glutamate and gamma-aminobutyric acid (GABA) signaling, and the researchers zeroed in on these because they are involved in regulating novelty-seeking and responding to reward in vertebrates.

To test whether the changes in brain signaling caused the novelty-seeking, the researchers subjected groups of bees to treatments that would increase or inhibit these chemicals in the brain. Two treatments (with glutamate and octopamine) increased scouting in bees that had not scouted before. Blocking dopamine signaling decreased scouting behavior, the researchers found.

"Our results say that novelty-seeking in humans and other vertebrates has parallels in an insect," Robinson said. "One can see the same sort of consistent behavioral differences and molecular underpinnings."

The findings also suggest that insects, humans and other animals made use of the same genetic "toolkit" in the evolution of behavior, Robinson said. The tools in the toolkit – genes encoding certain molecular pathways – may play a role in the same types of behaviors, but each species has adapted them in its own, distinctive way.

"It looks like the same molecular pathways have been engaged repeatedly in evolution to give rise to individual differences in novelty-seeking," he said.

More information: "Molecular Determinants of Scouting Behavior in Honeybees," *Science* (2012).

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