Honey-bee aggression study suggests nurture alters nature

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The study looked at bee aggression in European (pictured) and Africanized honey bees. Credit: Photo by Diana Yates.

A new study reveals that changes in gene expression in the brain of the honey bee in response to an immediate threat have much in common with more long-term and even evolutionary differences in honey-bee aggression. The findings lend support to the idea that nurture (an organism's environment) may ultimately influence nature (its genetic inheritance).

The study, appearing this week in the Proceedings of the National Academy of Sciences, used microarray analysis to measure changes in gene expression in the brains of European honey bees and the much more aggressive Africanized honey bees. Microarrays offer a snapshot of the thousands of genes that are activated at a given point in time. By

comparing microarrays of bees in different environmental and social conditions, the researchers were able to look for patterns of gene expression that coincided with aggression.

Honey bees respond aggressively only if their hive is disturbed. But when disturbed they mount a vigorous defense - the all too familiar bee sting. The researchers observed that changes that occur in the brain of a European honey bee after it is exposed to alarm pheromone (a chemical signal that the hive is in danger) look a lot like the more gradual changes that occur over the bee's lifetime. (Old bees are more aggressive than young bees.)

Even more striking was the finding of a very similar pattern of brain gene expression in Africanized honey bees. In terms of brain gene expression, Africanized bees "look" like they were just exposed to a whiff of alarm pheromone, even though they weren't.

"Microarray analysis is revealing large-scale gene expression patterns that are giving us new insights into the relationships between genes and social behavior," said Gene Robinson, a professor of neuroscience and of entomology at the University of Illinois, who led the study. "Some of the same genes associated with aggression that vary due to heredity also vary due to environment. This shows how nature and nurture both act on the genome, which provides an alternative to the old 'nature versus nurture' dichotomy."

The new findings may begin to explain how the evolutionary diversity of behavioral traits is achieved, he said.

"We suggest that the molecular processes underlying environmental effects on aggression - that is, responsiveness to alarm pheromone - could have evolved into molecular processes underlying inherited differences in aggression exhibited by Africanized honey bees and

European honey bees - nurture begets nature," the authors wrote.

The study was made possible by a National Science Foundation Frontiers in Biological Research grant, led by University of Illinois medical information science professor and department head Bruce Schatz, who is also an affiliate of the Institute for Genomic Biology.

"The study is one of the most exciting to emerge yet from 'BeeSpace,' an NSF-sponsored project which is the first of its kind to use genomics and new bioinformatics on a massive scale to understand how nature and nurture influence behavior," Schatz said.

Source: University of Illinois at Urbana-Champaign (news : web)