Friend, foe or queen? Study highlights the complexities of ant perception

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Researchers found that the trap-jaw ant worker, left, cannot perceive a queen of the same species unless the queen also shares the chemical signature of the worker's nest. Here, the worker has retracted its antennae, a sign that it recognizes its queen. Credit: Adrian A. Smith

Researchers report that trap-jaw ants recognize the unique odor of a fertile queen only if the queen also shares the workers' own chemical cologne - a distinctive blend of dozens of smelly, waxy compounds that coat the ants' bodies from head to tarsus. The discovery offers new

insights into how social animals evolved and communicate with others in their group, the researchers say.

The findings, reported in *Biology Letters* , reveal that chemical context makes all the difference to the trap-jaw ant (*Odontomachus brunneus*), said University of Illinois postdoctoral researcher Adrian Smith , who led the study with U. of I. entomology professor and animal biology department head Andrew Suarez.

"In that overall chemical profile - 40 to 50 compounds that they're producing and that coat their entire body - the ants can tell who belongs in the nest and who doesn't," Smith said. Once they recognize the distinctive blend of odors that defines their nest, the ants can sniff out the queen, who also smells of nonacosene, a universal signal of fertility in this species of trap-jaw ant. Only queens are allowed to add this particular scent to their repertoire. Any worker that dares to ramp up her own reproductive status (and the accompanying nonacosene odor) in a nest that already has a queen will be disciplined by the other workers, who can smell that something's wrong, Smith said.

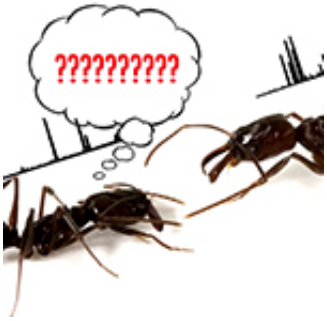
Previously, researchers assumed that the smell of nonacosene, alone, would signal to worker ants that they were in the presence of a queen, Smith said. He tested this hypothesis by presenting queens from other colonies to workers of the same species. Normally, when a worker recognizes a queen, it immediately adopts a submissive pose, retracting its antennae, crouching and backing away, Smith said. But workers failed to retract their antennae when confronting a queen from a distant colony.

When workers encountered queens from a different nest in their own colony - one with a nearly identical background odor profile - they did retract their antennae, an overt sign that they recognized the queen.

"This demonstrates that when an ant walks up to another ant, it's

basically doing a hierarchical assessment," Smith said. "First, is this individual a nest-mate? If the answer is yes, then: Is this individual fertile or not?"

Answering these two questions is fundamental to the workings of the nest, Smith said. In the same way that someone in the military first notices whether another soldier is wearing the same uniform before looking at the insignia that mark that soldier's rank, the ants operate in a highly hierarchical system and must pay attention to the context as well as the details of an individual's status.



Credit: Adrian A. Smith

Unlike humans, however, ants can collect this information only at close range, by antennating other ants.

"That's the point of perception; that's the point of seeing something for them," Smith said. "These chemical compounds aren't volatile; they don't waft off the ant, and they're only perceptible within a really short range, like a few millimeters, basically."

In a second set of experiments, the researchers exposed some queenless ant colonies to nonacosene by placing the fertility compound on a glass

slide inside the nest. In other nests, which functioned as controls, the researchers placed glass slides with no fertility signal. There was no difference in behavior between the ants that were exposed to nonacosene and those that weren't, indicating, once again, that the fertility compound in isolation signals nothing meaningful to the ants. Only in the proper context can the ants make sense of the fertility signal.

"This research highlights the importance of the social context in which signals are nested," Suarez said. "It is relevant to the evolution of communication for any animal that lives in a group."

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