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INSIDE JEB

Ants swing and probe with antennae to stay on scent track

A carpenter ant exploring on wood. Photo credit: Souvik Mandal.

Creatures that negotiate the world in the dark tend to have a great sense of smell. Some sniff out friends, food and home with sensitive noses, while insects and crustaceans follow odour trails with pairs of waving antennae. Ryan Draft from Harvard University, USA, explains that ants are capable of interpreting the subtle differences in perceived odour strength picked up by their antennae while scurrying along scent trails. However, he adds, 'little attention has been given to the actual behavioural strategies and the patterns of antennae movements'. Intrigued by the mechanisms that allow animals to navigate by their noses, Draft and colleagues Matthew McGill, Vikrant Kapoor and Venkatesh Murthy, also from Harvard, decided to get to the bottom of exactly how black carpenter ants (*Camponotus pennsylvanicus*) manoeuvre their antennae as they track an odour trail.

Kapoor designed an enclosed infra-red illuminated arena where McGill and Draft could lay scent trails and film the ants' responses in the dark. 'We didn't know what the animals would respond to and what they could and couldn't do,' says Draft, recalling how he and McGill screened a wide range of continuous tracks. 'We tried … straight, curved, zig-zagged and branching trails. We also explored dashed and gapped line trails and even random dots and random scratches', says Draft. Even then, some ants were keen to explore, while others refused to cooperate. McGill and Draft also filmed how ants that had lost an antenna coped, before patiently tracking the positions of the tips of each ant's antennae, and their head and body to accurately reconstruct their manoeuvres.

Comparing the intact ants' movements before and after they locked onto the odour trail, the team could see that the insects that were searching for a trail held their antennae apart and moved the tips over a small range. However, when the ants encountered an odour trail, they swung the antennae tips over wider arcs and performed in one of three possible ways. On some occasions the ants locked their antennae onto the trail, while weaving their bodies back and forth across the path (the authors call this swinging motion sinusoidal behaviour). In the second strategy, the ants stationed themselves in a static position close to the trail while whisking the antennae back and forth across it to learn more about the odour distribution (probing behaviour). But once the ant was certain that it had locked onto a trail, it hugged the path tightly, whisking the antennae back and forth to the edges of the odour band, always holding the trail between the two antennae (trail following).

Draft comments, 'we saw … different uses for the left and right antenna while tracking', and adds that this bias was boosted when the ants negotiated a curved trail, holding the antenna that was on the inside of the curve in the odour trail as they followed it around. In addition, the team noticed that the ants moved their antennae in the opposite direction to their bodies, to ensure that they were always located in different regions of the trail to enhance any odour differences between the two locations. And, when the ants were deprived of one antenna they coped remarkably well – compensating by sweeping the remaining antenna through a wider angle – although their precision decreased.

'The big take away for us is just how sophisticated ants are in using their antennae to gather signals from the environment', says Draft, who adds, 'This is the first step to understand how sensory signals guide behaviour'.

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