

# Slightly lost bumble bees use scent to find their way home

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Put yourself in the exoskeleton of a bumble bee for a moment: Your world would be a riot of colors and scents, both essential to guide your search for pollen and nectar. Bumble bees have excellent vision: They

have a pair of compound eyes that can distinguish UV and most colors except red, plus three additional simple eyes specialized in detecting polarized light. Their sense of smell dwarfs ours: Approximately 100 times more sensitive, and capable of sniffing out illegal drugs or explosives at airports, confirming pregnancy in women, or detecting cancers and diabetes in early-stage patients.

Now, researchers have shown that [bumble bees](#) can also use their [sense of smell](#) to locate their nest. This is especially important when the landscape suddenly changes; for example, when familiar visual landmarks are blown away by wind. The results are published in *Frontiers in Behavioral Neuroscience*.

"Here we show that bumble bees rely on their own scent marks, which they deposit at their [nest entrance](#) while leaving for a foraging trip, to find back home when the [visual cues](#) are not sufficiently reliable," said first author Sonja Eckel, a Ph.D. student at the Department of Neurobiology of Bielefeld University in Germany.

## Visual landmarks

Eckel and colleagues studied the homing behavior of the buff-tailed bumble bee *Bombus terrestris* in the laboratory. In nature, these bumble bees nest in abandoned mouseholes, hidden under grass or leaves. Here, the foragers had learned to locate their nest entrance by visually orienting themselves against two sets of landmarks within a round enclosed flight arena, 150 cm across and 85 cm high. The first set consisted of three black vertical stripes—each 12 cm wide and 85 cm long—against the white background of the arena walls. The second, of three cylinders, each 2.5 cm wide and 15 cm high, was arranged in a triangle around the entrance hole.

The arena floor provided no [visual information](#), being covered with a

random red-and-white pattern—presenting as black and white for bumble bees. After some practice, workers flew straight back to the entrance when returning from a visit to the outer foraging chamber, where they were provided with pollen and nectar.

Bumble bees possess multiple scent glands, which distribute chemicals all over their body. Previous research has shown that whenever they touch any surface, for example that of their nest entrance, they passively leave scent marks. The researchers captured these scent marks by placing a glass ring around the entrance, which foragers tended to walk across when exiting or returning to the nest.

## **Tricking the bumble bees**

Eckel and the team then tricked the bumble bees by abruptly changing the location of both sets of visual landmarks, independently of each other. Now, these gave conflicting information about the entrance's location, neither marking the correct spot. The true entrance was closed off and concealed—with success, as none of the returning foragers subsequently found it.

The researchers measured how long, and at which distance, returning foragers hovered around either false location for the entrance, based on the conflicting landmarks. They assumed that the longer a forager hovered around any spot, and the smaller her average flight distance to it, the more focused she was in that spot as the best candidate for the entrance's location.

Typically, foragers seemed equally focused on either false location, implying that they used both sets of visual landmarks to unsuccessfully try and relocate their nest. But a [dramatic change](#) occurred whenever the researchers placed the glass ring—carrying bumble bee scent marks—around either location. Now, foragers overwhelmingly focused

on the false location suggested by the scent marks.

The researchers concluded that [foragers](#) use their sense of smell as well as vision to find their way home, in particular when visual information is conflicting.

## Bouquet of scents

"While visual information is perceived over larger distances and leads a bumble bee towards the approximate location of the nest, scent marks are used to pinpoint the exact location of the nest entrance in the near range. Most likely, [physical contact](#) is necessary to identify the scent," said Eckel.

"Our [chemical analysis](#) showed that this [scent](#) is a bouquet of hydrocarbons, fatty acids, and other substances, such as esters and alcohols. Many of these substances are known to be used by bumble bees in other behavioral contexts, [and] also by other insect species. In our follow-up research, we want to investigate how different sensory cues are learnt and combined by bumble bees to allow them to discriminate different behaviorally relevant goals, such as the nest hole and food sources."

**More information:** Nest-associated scent marks help bumblebees localizing their nest in visually ambiguous situations, *Frontiers in Behavioral Neuroscience* (2023). [DOI: 10.3389/fnbeh.2023.1155223](https://doi.org/10.3389/fnbeh.2023.1155223). [www.frontiersin.org/articles/1155223/full](https://www.frontiersin.org/articles/1155223/full)

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