

Surprising findings reveal desert ants orient to the geomagnetic field

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Desert ants (*Cataglyphis*) at the nest entrance. Credit: Foto: Pauline Fleischmann

Desert ants (*Cataglyphis*) spend the first weeks of their lives exclusively in the nest. For around four weeks, they nurse the queen and the brood, dig tunnels, build chambers or tidy up. At some point, they leave the nest to start their outdoor career, working as foragers until death.

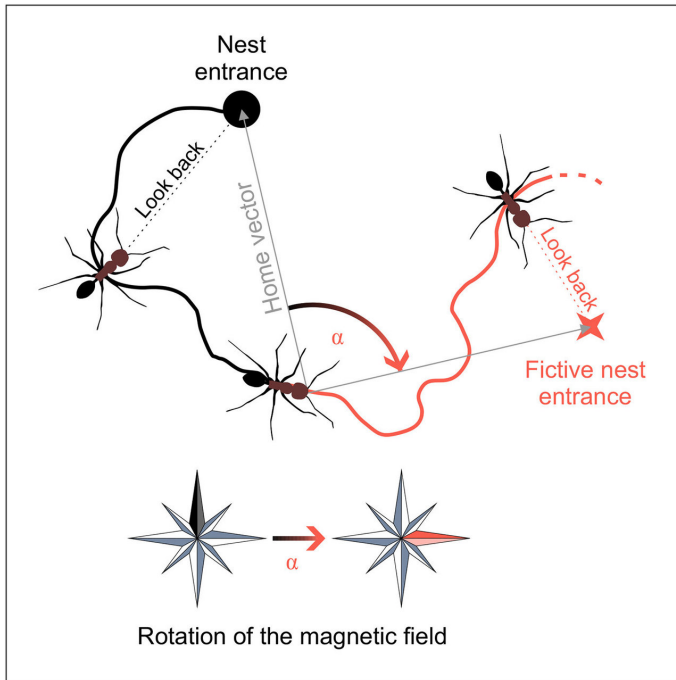
Pirouettes lead the way

Before an ant sets out to forage, it has to calibrate its navigational system. For this purpose, the insects exhibit a peculiar behaviour lasting two to three days: They perform so-called "learning walks" to explore the vicinity of the [nest](#) entrance and frequently turn about their vertical body axes while doing so. High-speed video recordings show that the ants stop repeatedly during these pirouetting motions. What is special about the longest of these stopping phases is that at this moment, the ants always look back toward the nest entrance, even though they are unable to see the tiny hole in the ground.

Researchers from the Biocenter of the University of Würzburg have now made the surprising discovery that the desert ant uses the Earth's magnetic [field](#) as an orientation cue during these calibration trips. This ability had been previously unknown for [desert ants](#).

Pauline Fleischmann and Robin Grob, research assistants of Professor Wolfgang Rössler, who holds the Chair of Zoology II at the Biocentre of the University of Würzburg, conducted the tests in the summer of 2017. The scientists designed the experiment together with Professor Rüdiger Wehner from the Brain Research Institute of the University of Zurich and physicist Valentin Müller from the University of Würzburg. They present their research results in the current issue of the journal *Current Biology*.

"While they are foraging for food, desert ants venture several hundred metres away from their nest, pursuing a sinusoidal path that includes larger loops. Once they have found food, they return to the nest entrance in a straight line," says Wolfgang Rössler, describing the ants' astonishing navigational abilities. The researchers had previously known that the ants rely on the position of the sun and landmarks as orientational cues and integrate this information with the steps traveled.



desert ants no longer looked towards the real nest entrance but toward a predictable new location—the fictive nest entrance. "Their path integration provides them with a new vector to the nest based on the information of the magnetic field," Wolfgang Rössler explains. The scientists admit that they were surprised by this finding. They say that although individual ant species are known to respond to changes in the magnetic field under certain conditions, the necessity and distinct influence on navigation in *Cataglyphis* ants was unexpected.

With this result, the researchers raise further questions. For instance, when do desert ants use their magnetic sense? It might well be that they rely on it during the first weeks of their life underground. After all, a navigational aid can be quite useful in total darkness. But this is only a hypothesis at this point.

Looking for the nest entrance, Desert Ants use the geomagnetic field for orientation (black). This can be concluded from experiments, in which the geomagnetic field was artificially rotated (red). Credit: *Current Biology*

Experiments in Greece

Recent research results have shown, however, that the desert ant also looks back to the nest entrance during its learning walks in the absence of solar information or landscape cues. "This sparked the idea that the insects might navigate using the Earth's magnetic field as a cue, as some birds do," Pauline Fleischmann says.

To confirm their hypothesis, the researchers traveled to the south of Greece, where *Cataglyphis* ants are native. They took a 1.5-m-high pair of Helmholtz coils with them. A defined current passed through the coils creates an almost homogeneous, precisely known magnetic field between the coils. This enabled the researchers to study the behaviour of the desert ants during their learning walks in their natural habitat under controlled conditions.

A surprising outcome

The result was unambiguous: When the scientists changed the orientation of the magnetic field, the

The second question the scientists want to tackle is how and whether the [ants](#) switch between the different navigational cues of the position of the sun, landmarks and the magnetic field. Experienced foragers are already known to perform re-learning walks when they are forced to do so, for example, by changing the environment at the [nest entrance](#). It is unclear, however, whether they also rely on magnetic field cues in this case or whether they use their solar compass as during the foraging trips.

And ultimately, there is the overarching question of where the [magnetic field sensor](#) is located and how it works. According to Wolfgang Rössler, this question takes you deep into the field of orientational and navigational research in insects. How does the comparably small ant brain manage to store navigational information on the position of the sun, the [magnetic field](#) and landmarks, and integrate this information with distance data from their step counter? Rössler believes that this question goes far beyond the field of behavioural research and neurosciences and is of great interest for computer science and robotics, too.

More information: Pauline Nikola Fleischmann et al, The Geomagnetic Field Is a Compass Cue in *Cataglyphis* Ant Navigation, *Current Biology* (2018).

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