Animals found to track scents using alternating strategies of sniffing ground and air

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A new study helps explain a poorly characterized, yet common behavior among animals and shows that foraging mammals take advantage of the

physics of how scents move in the air and along the ground.

Most people are familiar with seeing a rabbit pausing and standing on its hind legs to sniff the air or a dog alternating between sniffing the ground and the air. But deciphering why animals engage in these behaviors is challenging for scientists.

"We used what we know about how scent is carried by the wind and on the ground to understand better why animals engage in this behavior," explains co-lead author Nicola Rigolli, postdoctoral research fellow at the Machine Learning Genoa Centre, Dept Civil Chemical Environmental Engineering, University of Genova, Italy. "We then used machine learning techniques to identify the optimal strategy for locating the source of a scent."

In their experiments, the team created computer simulations of how scents move in a turbulent environment. They then modeled the pros and cons of different approaches an animal might take to track a smell. The models show that a computer-simulated animal designed to minimize the time it takes to track a scent would alternate between sniffing the air and casting along the surface of the ground to find the smell.

When an animal is far downwind of the scent, they will pause and rear up to smell more frequently because they are more likely to catch a distant scent in the air. As they close in on the source of the odor, animals will sniff along the ground more often and pause to sniff the air less frequently.

"Airborne scents are sparse and more difficult to track than scents along the ground, but they move faster and over longer distances. The benefits of sniffing near the ground or in the air therefore vary depending on the animal's distance from the scent's source," explains co-lead author Gautam Reddy. Reddy conducted the study as a postdoctoral research

fellow at the NSF-Simons Center for Mathematical and Statistical Analysis of Biology at Harvard University in Cambridge, Massachusetts.

The team's discoveries may also apply to sea creatures such as crabs or mollusks, which also appear to move their bodies at different heights while tracking a potential food source. But the authors cautioned that the model is a simplified version of real life. It does not consider every possible variable that may affect animal behavior. For example, animals may have a more limited capacity for remembering information than a computer, and their memory limitations may influence their behavior.

"We hope our results inspire other scientists to conduct experiments with dogs, rodents and aquatic animals that can help us learn more about these behaviors in real-world settings," concludes the senior author Massimo Vergassola. Vergassola led the study while working first at the University of California, San Diego as a professor of physics, and then at the Laboratoire de physique de l'École Normale Supérieure, Sorbonne Université, Paris, in conjunction with fellow senior author, Agnese Seminara, a professor of fluid dynamics at the University of Genoa.

The research was published in *eLife*.

More information: Nicola Rigolli et al, Alternation emerges as a multi-modal strategy for turbulent odor navigation, *eLife* (2022). DOI: 10.7554/eLife.76989

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