

What can fruit flies teach us about how creatures find food?

March 31 2020



Drosophila sp fly. Credit: Muhammad Mahdi Karim / Wikipedia. GNU Free Documentation License, Version 1.2

Can you imagine looking for a destination without a GPS, visual landmarks, or even street signs?

This is the reality for fruit flies, as they search for [food](#) or a mate. Researchers have uncovered different cues that influence these searches,

but until now, haven't yet understood how individual directional cues and search movements are used together. Thanks to a recently published study of fruit flies in *PLOS Computational Biology* from researchers at Drexel University's School of Biomedical Engineering, Science and Health Systems, researchers now have a way to parse out how different mechanisms are used individually and in conjunction with each other.

The findings not only give clarity into how flies find food, but because of the very close similarities in the sensory organs of flies and how they smell compared to other animals, the results may help answer broader questions about how animals search for food influences broader food ecology and the environment. The team is working on these answers currently in the Bhandawat Lab, where they study how an animal's nervous system, muscle-body interaction and environment influence behavior.

In the current study, the team converted the flies' nerve cells (olfactory nerve cells) that usually respond to odors into light sensing cells to detail the paths of flies as they find food, leave, and attempt to return back to the food. To do this, the team projected light in a small region of a larger area to stimulate receptor nerve cells that control fruit flies' sense of smell. The study area was separated into three zones: the 'central core' where the researchers activated flies' nerve cells, an 'annular region' without any stimulation or directional cues, and the 'border' between the two zones. When flies were in the border zone, light intensity lessened, which prodded the flies to go back towards food.

The authors reported that flies use a simple, [effective strategy](#)—as soon as they leave what they are looking for (the central core) – they slow down significantly and turn sharply. These [sharp turns](#) at the border bring them back to the stimulated region. They also make several non-orienting changes, such as slow down and turn frequently inside the central core to stay in the stimulated region longer. The model created

for this study also allowed for individual mechanisms to be removed, thereby allowing researchers to study each one more deeply.

In the annular region or the central core, the flies could use either or both of two mechanisms: non-orienting changes where changes in speed or turn-rate can alter a fly's trajectory, or path integration, a technique study authors liken to an 'internal compass' that measures location in relation to the path taken to help the flies find their way back. Tracking fly movement in these zones, the team measured the interplay between orienting, non-orienting, and the 'internal compass' used by flies to get to their destination.

"This study shows how non-orienting movement can be an effective mechanism for finding resources when directional cues are absent," said senior author Vikas Bhandawat, Ph.D., an associate professor in the School of Biomedical Engineering, Science and Health Systems. "Non-orienting movements are also found in expert navigators, such as desert ants. Once they are near their home, they depend on these movements to get there. Using [fruit flies](#), we are finally gaining ground on tracking these movements alongside other techniques used and how environments and information can alter them."

In previous lab studies, scientists have observed different strategies animals use to find food or mates and found that when animals lack directional cues, they can use their 'internal compass' to keep track of their movements.

But, unlike the current Drexel study, such work allowed for little control over the structure of the research to know the relative importance of these individual strategies, and how they are combined in any given scenario. Alternatively, in laboratory settings, scientists sometimes give participants clear cues to reach a destination, making it difficult to derive useful insights about the subject's real strategy.

"One of the main takeaways here is that smell—as a sensation in the near past—is an effective sensory cue for flies, and likely many other animals," said lead author Liangyu Tao, graduate student in the School of Biomedical Engineering, Science and Health Systems. "Responding to that, slowing down and turning hard is what gets you close. Perhaps people can learn from this in our searches too."

More information: Liangyu Tao et al. Mechanisms underlying attraction to odors in walking *Drosophila*, *PLOS Computational Biology* (2020). [DOI: 10.1371/journal.pcbi.1007718](https://doi.org/10.1371/journal.pcbi.1007718)

Provided by Drexel University

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