How 'nature's ultimate sensory machines' integrate sight and smell

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“Flies are nature’s ultimate sensory machines, outperforming any human-engineered devices,” said Mark Frye of the University of California, Los Angeles. Adult fruit flies can distinguish small differences in odor concentration across antennae separated by less than one millimeter. Flies can also see in all directions at once, though the picture may be grainy.

Flies’ keen senses allow for some incredible maneuvers. During flight, a male housefly chasing a female can make turns within 40 milliseconds—less than the blink of an eye. When they’re hungry, flies track weak scents of food to far-flung places. Both feats depend on the tight integration of sight and smell.

Now, Frye and Brian Duistermars, also of UCLA, have begun to explore just what flies need to pull it off. Their findings, published online on February 14th in *Current Biology*, a publication of Cell Press, provide insight into the brains of other animals, including our own, they said.

“We know a lot about how individual sensory systems work,” Frye said. “Our view gets cloudy when it comes to the integration of senses.”

They already knew that certain neurons in the fly brain are sensitive to the motion of the whole panorama, whereas others zero in on small objects. They now find that the panoramic view of the world is what’s required for accurate odor tracking. Small object landmarks aren’t enough to keep the insects on the right path.

“Fruit flies have 700 times lower visual spatial resolution than humans, and they have five times fewer olfactory receptor types,” the researchers wrote. “Yet their ability to find smelly things in visual landscapes as diverse as forests, deserts, and backyard patios would suggest behavioral performance greater than might be predicted by the sum of sensory inputs. The results presented here show that odor signals activate powerful visual stabilization reflexes to accurately track an appetitive odor plume. The requisite visual feedback cues emerge from the wide-field visual processing centers of the brain, not the small-field object-tracking centers, thus hinting at possible neuroanatomical substrates.”

Frye expects the principles at work in the fly may be extrapolated to other animals. It might also be applied in other arenas, he said, such as building better robots.

Source: Cell Press