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Researchers find a lobster's sense of smell may hold the key to better electronic sensors

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European lobster (Hommarus gammarus). Credit: Bart Braun, public domain

(Medical Xpress)—Could lobsters help protect soldiers someday? A team of University of Florida researchers says they might.

Don't expect to see battlefields filled with spiny crustaceans on leashes, though. The secret lies in how the clawed creatures locate a specific

scent. UF Health researchers and engineers say they have identified the neurons involved in that ability—call it "lobster radar"—and that discovery may help them develop improved electronic "noses" to detect landmines and other explosives. For many years, scientists have worked to create sensors that can detect everything from contamination in food products to harmful bacteria, as well as land mines and explosives. And because of the dangerous nature of hazardous material detection, scientists are constantly looking for ways to improve those devices.

"An electronic nose has to recognize an odor and locate its source. Finding the source has often been the job of the person handling the electronic nose," said Barry W. Ache, distinguished professor of neuroscience and biology and director of the Center for Smell and Taste in UF's Evelyn F. and William L. McKnight Brain Institute. To date, the technology has had its drawbacks—especially when the nose is used to detect potentially deadly materials that could endanger its human handler.

Yuriy V. Bobkov, of the UF Whitney Laboratory for Marine Bioscience, originally discovered a type of olfactory neuron in lobsters that constantly discharges small bursts of electrical pulses, much like radar uses pulses of radio energy to detect airplanes or thunderstorms. UF researchers speculated that these so-called "bursting" neurons might cue the crustaceans in on an odor's location—especially important when they are searching for food or trying to avoid danger.

"Animals need to recognize a smell, but also determine where it is coming from," Ache said.

Odors exist as compounds that move through the air or water and settle on olfactory neurons in "whiffs." The time between whiffs depends on the distance between the smeller and the source of the smell. Sensing the time intervals allows animals to determine the location of an odor. That's

where bursting olfactory neurons from lobsters come in.

To try to solve the mystery of how lobsters process sensory information, Jose C. Principe and Il Memming Park, of the Computational NeuroEngineering Laboratory in UF's department of electrical and computer engineering, took information gleaned from these cells and created a computational model based on the range of such cells found in the olfactory organ.

Each bursting cell responds to a whiff at a different frequency, Ache said. Together, the neurons help pinpoint the location of a particular odor. Just as a person can hear a train moving from left to right, a lobster's set of olfactory neurons set the scene for the location of a smell.

By entering the lobster olfactory data into a computer model and giving artificial silicon neurons the same features found in the crustacean ones, then subjecting the neurons to simulated whiffs of odor, the researchers could determine how the bursting neurons function and how they set a scene that tells the animal the source of a smell.

"These cells as a population seem to provide a system for detecting odors in the spatial world," Ache said. "We hope not only to learn more about how these systems work, but how that information might be applied to challenges such as electronic noses."

In addition to improving electronic sensors, this finding will help scientists better understand the sense of smell in all animals—including humans.

"The involvement of bursting sensory neurons in olfactory processing is not unique to the lobster," Bobkov said. "It's likely to be a fundamental aspect of olfaction."

The team reported the findings in the January issue of the *Journal of Neuroscience*.

Provided by University of Florida