Researchers explain how tiny roundworms sense different kinds of touch

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(PhysOrg.com) -- Caenorhabditis elegans (C. elegans) is the very long name of a very small creature, and one of the most commonly used animals in biological research.

Researchers at the University of Michigan report new findings on how the tiny roundworm senses and differentiates between innocuous (gentle) and noxious (harsh) touch.

Shawn Xu, a Life Sciences Institute biologist and assistant professor of molecular and integrative physiology, and his lab have added new findings to their research on the 1-millimeter-long creature, showing that C. elegans is an important animal model for further exploring and learning about the genes that regulate pain sensation.

Xu and his team are interested in investigating how animals sense external and internal cues. They previously published findings in *Nature* (2006) showing that the worm has the sense of proprioception (the sense of "self") and depends on it to maintain body posture during movement. They also published in *Nature Neuroscience* (2008) that showed that the soil-dwelling C. elegans worm is able to detect and respond to flashes of light despite the fact that it is eyeless and also (Nature Neuroscience, 2010) how the C. elegans worm senses light, again, a process that C. elegans has in common with humans.

It is known that most animals, including the C. elegans, can distinguish between gentle and harsh touch. Xu and colleagues sought to shed light on the underlying mechanisms in C. elegans that allow them to distinguish between the two types of touch.

"This work is about how animals evolved the system to distinguish between these two different types of touch at the cellular and molecular levels," Xu said.

Previous work with C. elegans has yielded much useful information on gentle touch and the underlying mechanisms behind it, finding that many genes have been evolutionarily conserved, thus prompting the characterization of the function of their homologues in gentle touch sensation in mammals. Yet, little was known about the harsh touch sensation in C. elegans.

In the May 17 edition of the online-only journal *Nature Communications*, Xu and his lab published findings that show the underlying cellular mechanism at work that allows C. elegans to distinguish between harsh and gentle touch. In addition to analyzing the behavioral reaction to different types of touch, Xu and his team identified the neurons that detect harsh and gentle touch and also characterized the molecules, which are essentially channels that detect different types of touch.

"We were looking at the neural circuits," Xu said. "The nervous system is composed of neurons that are wired together by circuits, and that's how they process information. We wanted to know which neurons are responsible for detecting the harsh and gentle touch."

"Worms are much simpler than humans, but their behavioral responses to touch are similar to ours," said Laurie Tompkins, who oversees behavioral genetics grants at the National Institutes of Health. "Elucidating the molecules and neural circuitry involved in worms' responses to painful touch will advance efforts to understand and control pain—both in humans and other animal species."

More information: The neural circuits and sensory channels mediating harsh touch sensation in Caenorhabditis elegans, *Nature Communications* 2, Article number: 315 doi:10.1038/ncomms1308

Abstract
Most animals can distinguish two distinct types of touch stimuli: gentle (innocuous) and harsh (noxious/painful) touch, however, the underlying mechanisms are not well understood. Caenorhabditis elegans is a useful model for the study of gentle touch sensation. However, little is known about harsh touch sensation in this organism. Here we characterize harsh touch sensation in C. elegans. We show that C. elegans exhibits differential behavioural responses to harsh touch and gentle touch. Laser ablations identify distinct sets of sensory neurons and interneurons required for harsh touch sensation at different body segments. Optogenetic stimulation of the circuitry can drive behaviour. Patch-clamp recordings reveal that TRP family and amiloride-sensitive Na+ channels mediate touch-evoked currents in different sensory neurons. Our work identifies the neural circuits and characterizes the sensory channels mediating harsh touch sensation in C. elegans, establishing it as a genetic model for studying this sensory modality.

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