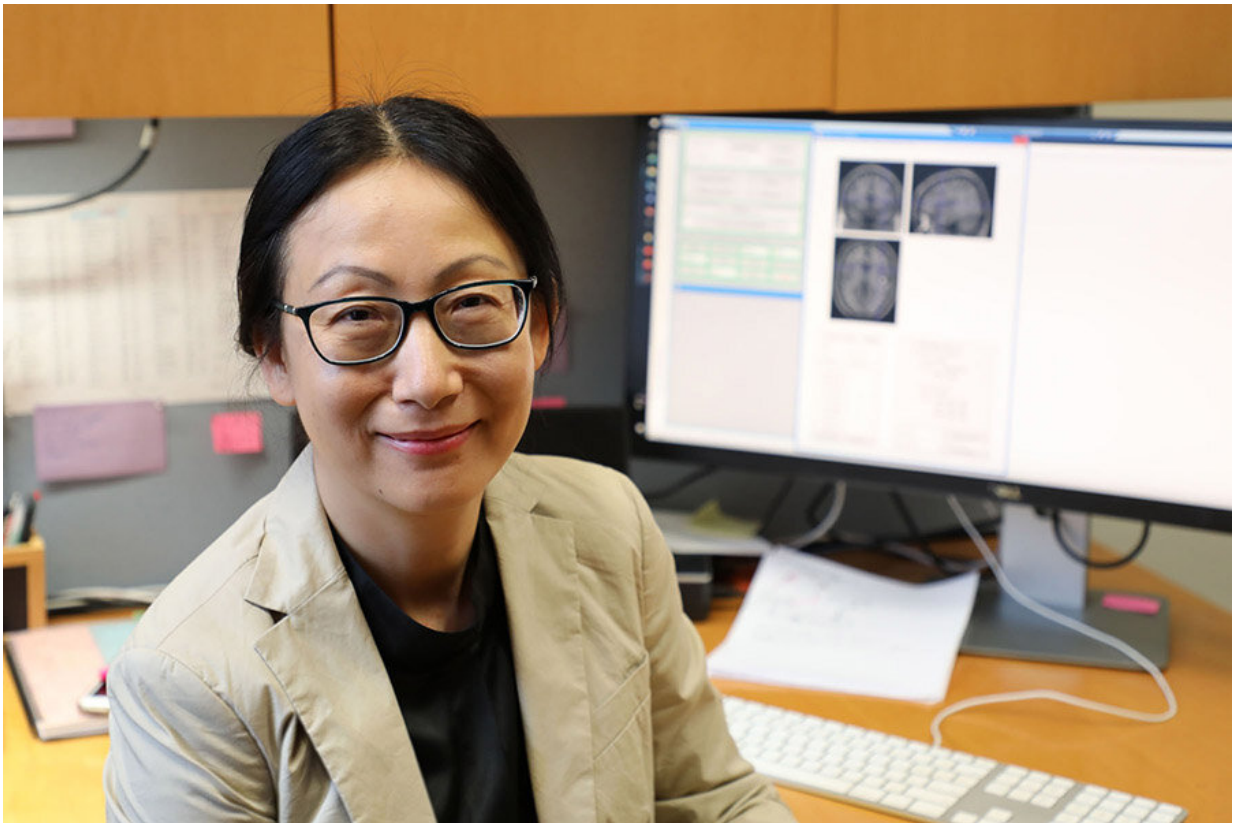


Researchers explore brain's sensory network to understand how brain perceives threat

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Wen Li is a professor of psychology at Florida State University and is also an affiliate of the neuroscience program. Credit: Florida State University

A Florida State University researcher's work to understand exactly what part of the brain is involved in disorders such as anxiety, PTSD and

other phobias is giving scientists and clinicians valuable insights into how to treat such disorders.

FSU Professor of Psychology Wen Li has published a pair of papers that lay out how the [brain](#)'s sensory cortex is much more involved in the way potential threats are processed than scientists previously understood.

"We are translating [basic science](#) done in the lab into treatment at the clinic," Li said. "By isolating specific neural mechanisms and inventing non-invasive techniques to target these mechanisms, we are developing new treatments for these debilitating and hard-to-treat conditions."

Findings from her latest study were published this month in *The Neuroscientist* along with a review paper in *Trends in Cognitive Sciences*.

The sensory cortex refers to all cortical brain areas associated with sensory function. Its primary job is to detect information such as body temperature, touch, texture or pain. Li, who is also affiliated with FSU's Neuroscience Program, debunks the myth that the sensory cortex is absent from active threat evaluation and subservient to top-down instruction from other parts of the brain in the processing of threat information.

"Identification of this new frontier—the sensory cortex—in the threat network will open many new opportunities and promises major breakthroughs in the research of threat processing and its various disorders that have affected humankind in general, for which there is still extremely limited remedy," Li said.

In the review piece published in *Trends in Cognitive Sciences*, Li and co-author Andreas Keil of the University of Florida synthesized a wide range of existing peer-reviewed research and findings from both human and animal models.

Li and Keil reviewed studies involving human brain activity, the magnetic fields generated by neuron activity, and blood flow associated with brain activity. They also examined how specific areas of damage in the brain affect behavior and cognition.

They complemented this work with a thorough review of animal studies utilizing optogenetics, which uses light and genetic engineering to control and track neural activity, providing more accurate information into which areas of the brain are involved in threat processing.

Mounting evidence from human and animal studies supports Li's concept of a new roadmap of how threats are processed in the sensory cortex.

"This theory fills a long-standing gap and resolves an important controversy and myth in the research of threat processing," Li said.

The amygdala, an almond-shaped structure in the center of the brain, has been long considered by scientists to be the "center of fear" and thought to be largely responsible for how an individual responds to frightening circumstances or perceives threats. [Research published by Li](#) in 2022 revealed a new pathway to fear through the sensory cortex.

The brain's sensory cortex stores long-term mnemonic representations of threat, meaning humans can re-live the past or simulate future scenarios by integrating features of a memory into their assessment of a new situation. This feature causes the brain to input information into the memory system about perceived environmental threats.

The resulting threat-filled sensory neurons then trigger downstream threat-processing in the amygdala portion of the brain and other areas of the brain.

"These ideas motivate a sensory account of threat processing, involving

an initial threat evaluation in the sensory cortex and extending throughout the brain's networks," Li said. "This understanding has the potential to revolutionize the conceptualization of threat-related disorders and their treatment."

For the past several decades, researchers had focused on a narrow view of exactly how the brain is able to quickly identify and respond to threats—a critical survival skill.

"Dr. Li has consistently been at the forefront of new, much broader models of threat processing involving many sensory systems," said Distinguished Research Professor and Director of FSU's Anxiety and Behavioral Health Clinic Brad Schmidt. "This work is reshaping how scientists understand fear and anxiety and may ultimately underpin new treatment methods. This review paper appears in one of the leading journals in the field and is very likely to be a seminal paper that will influence work in the area for the next decade."

Li's work in *The Neuroscientist* is a complement to the research in *Trends in Cognitive Sciences* and provides an in-depth analysis on how mnemonic representation of threat is stored in the brain's sensory cortex.

"Particularly, this research highlights the powerful content-addressable memory, arising from the architecture of the sensory cortex, that is capable of supporting smart—fast and precise—threat processing," Li said.

Li and co-author Donald Wilson of the New York University School of Medicine and the Nathan S. Kline Institute for Psychiatric Research used similar review techniques to conduct this research, exploring more deeply into the brain's basic cellular and microcircuit processes.

"The [sensory cortex](#) stores engrams that hold our threat memories, and

the simple, well-understood architecture of the olfactory, or piriform, [cortex](#) provides a primal entry point for research to unlock this mystery," Li said.

Both studies provide a springboard for further scientific research into the brain's highly complex network of neural processes and represent a disruptive break from the long-held idea that [threat](#) conceptualization is centered on the amygdala or the limbic system.

More information: Wen Li et al, Threat Memory in the Sensory Cortex: Insights from Olfaction, *The Neuroscientist* (2023). [DOI: 10.1177/10738584221148994](#)

Wen Li et al, Sensing fear: fast and precise threat evaluation in human sensory cortex, *Trends in Cognitive Sciences* (2023). [DOI: 10.1016/j.tics.2023.01.001](#)

Provided by Florida State University

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