MedicalXpress

Scientists offer insight into how the nervous system processes sensory information

April 24 2008

The Stowers Institute's Yu Lab has published the results of large-scale imaging experiments examining how social signals are represented in the sensory system.

Working with a newly-developed line of transgenic mice that expresses the genetic calcium indicator G-CaMP2, the team monitored neural activity in the vomeronasal organ (VNO), a sensory organ found in many vertebrate animals that detects pheromones.

The findings, which shed light on how animals identify one another, were published in the April 25 issue of *Science*.

The team's discovery shows that neurons encode information about the identity of animals in very specific ways. Information about gender is encoded by a small population of cells dedicated to detecting sex-specific cues in the urine. Additionally, many of these pheromone cues are regulated by the hormonal status of the animals — conveying their reproductive status.

In contrast, information about the genetic background and pedigree of an animal is encoded by the combinatorial activation of cells. Such combinatorial activation is unique for each individual, so each animal can be recognized by the signature pheromones they carry.

"We are interested in understanding how the nervous system processes sensory information to generate meaningful perception and behavioral

output," said Jie He, Ph.D., Postdoctoral Research Associate and first author on the paper. "In order to understand the process, we examined the mouse vomeronasal system because we knew it processed pheromone information in a robust and stereotyped way. In doing so, we established that vomeronasal neurons are capable of recognizing gender, identifying individuals, and detecting the physiological status of the animal."

This is believed to be the first study of VNO activation by natural pheromones at the systems level. It reveals an extraordinary richness of pheromone cues and some striking features of pheromone representation in the VNO.

"Our study shows that a dedicated neural circuit is likely involved in processing important social information such as gender," said Ron Yu, Ph.D., Assistant Investigator and senior author on the paper. "Although the importance of pheromones in social communication has been recognized for decades, we knew little about the nature of these signals at the sensory level. This work addresses this issue and provides insight into how social information is processed in the nervous system."

Although, as a species, human beings no longer rely on pheromones in social communications, the functioning of the nervous system follows principles similar to those revealed by the Yu Lab's mouse studies. The neural circuitry in the human brain underlies complex human behaviors. Proper formation of the neural circuitry and seamless processing of sensory information are essential for mental health. Alterations in either can lead to devastating psychiatric and neurological diseases such as schizophrenia, autism, Parkinson's disease, and Alzheimer's disease. Using animal models to dissect the neural circuitry and to reveal the molecular and cellular mechanism behind these important functions of the brain may lead to a better understanding of how the brain works and to possible treatments for neurological diseases.

Source: Stowers Institute for Medical Research