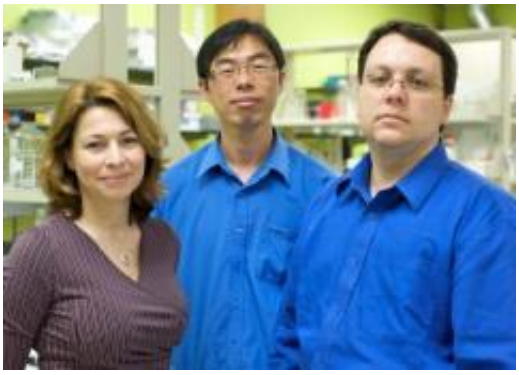
Estrogen controls how the brain processes sound

May 5 2009



This is Liisa Tremere, Jin Jeong, and Raphael Pinaud. Credit: University of Rochester

Scientists at the University of Rochester have discovered that the hormone estrogen plays a pivotal role in how the brain processes sounds.

The findings, published in today's issue of *The Journal of Neuroscience*, show for the first time that a sex hormone can directly affect auditory function, and point toward the possibility that estrogen controls other types of sensory processing as well. Understanding how estrogen changes the brain's response to sound, say the authors, might open the door to new ways of treating hearing deficiencies.

"We've discovered estrogen doing something totally unexpected," says Raphael Pinaud, assistant professor of brain and cognitive sciences at the

University of Rochester and lead author of the study. "We show that estrogen plays a central role in how the brain extracts and interprets auditory information. It does this on a scale of milliseconds in neurons, as opposed to days, months or even years in which estrogen is more commonly known to affect an organism."

Previous studies have hinted at a connection between estrogen and hearing in women who have low estrogen, such as often occurs after menopause, says Pinaud. No one understood, however, that estrogen was playing such a direct role in determining auditory functions in the brain, he says. "Now it is clear that estrogen is a key molecule carrying brain signals, and that the right balance of hormone levels in men and women is important for reasons beyond its role as a sex hormone," says Pinaud.

Pinaud, along with Liisa Tremere, a research assistant professor of brain and cognitive sciences, and Jin Jeong, a postdoctoral fellow in Pinaud's laboratory, demonstrated that increasing estrogen levels in brain regions that process auditory information caused heightened sensitivity of sound-processing neurons, which encoded more complex and subtle features of the sound stimulus. Perhaps more surprising, says Pinaud, is that by blocking either the actions of estrogen directly, or preventing brain cells from producing estrogen within auditory centers, the signaling that is necessary for the brain to process sounds essentially shuts down. Pinaud's team also shows that estrogen is required to activate genes that instruct the brain to lay down memories of those sounds.

"It turns out that estrogen plays a dual role," says Pinaud. "It modulates the gain of auditory neurons instantaneously, and it initiates cellular processes that activate genes that are involved in learning and memory formation."

Pinaud and his group stumbled upon these findings while investigating how estrogen may help change neuronal circuits to form memories of

familiar songs in a type of bird typically used to understand the biology of vocal communication. "Based on our findings we must now see estrogen as a central regulator of hearing," he says. "It both determines how carefully a sound must be processed, and activates intracellular processes that occur deep within the cell to form memories of sound experiences."

Pinaud and his team will continue their work investigating how neurons adapt their functionality when encountering new sensory information and how these changes may ultimately enable the formation of memories. They also will continue exploring the specific mechanisms by which estrogen might impact these processes.

"While we are currently conducting further experiments to confirm it, we believe that our findings extrapolate to other sensory systems and vertebrate species," says Pinaud. "If this is the case, we are on the way to showing that estrogen is a key molecule for processing information from all the senses."

Source: University of Rochester (news : web)