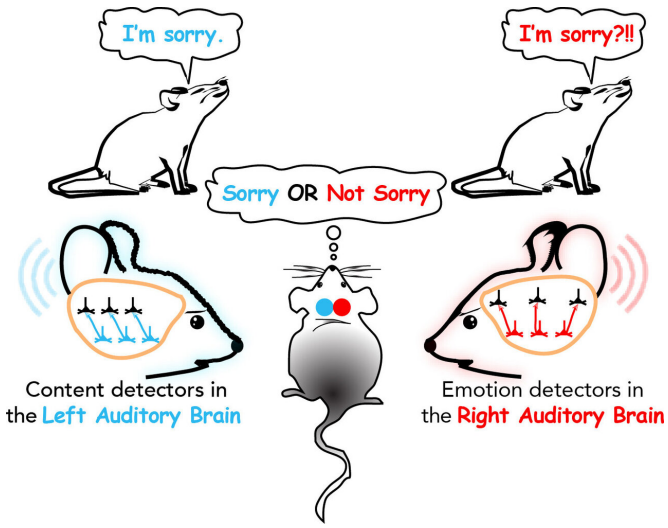
Scientists closer to unraveling mechanisms of speech processing in the brain

25 June 2019



Understanding differences between the left and right auditory processing centers' wiring diagram and sensitivity to tone sequences in the mouse brain are providing clues to specializations for processing speech. Such mapping could be useful in sorting out the potential miswiring at the root of neurodevelopment communication disorders like autism and schizophrenia. Credit: H. Lebreault

In the 1860s, French physician Paul Broca published his findings that the brain's speech production center was located in the left hemisphere. Though scientists have largely accepted since then that the left half of the brain dominates language processing, the reasons behind this lateralization have remained unclear.

"The lateralization of language processing in the auditory cortical areas of the brain has been known for over 150 years, but the function, neural mechanisms, and development of this hemispheric specialization are still unknown," said Hysell V. Oviedo, a biology professor with The Graduate Center, CUNY and the City College of New York.

A new study from Oviedo's lab, published in *Nature Communications*, makes headway into this mystery. Using the mouse as a model system, the researchers observed different specializations between the left and right auditory processing centers of the brain, and found differences in their wiring diagrams that may explain their distinct speech processing functions.

In addition to answering long-standing questions in neuroscience and language processing, the results of Oviedo's study could someday lead to a better understanding of certain mental health problems. Autism spectrum disorder has been linked to a failure of lateralized language processing to develop between the two halves of the brain. And abnormal lateralization is a risk factor for auditory hallucinations in schizophrenia.

One common feature of mouse vocalizations is syllables with downward jumps in pitch. The left auditory cortex in the mouse showed greater activation in response to these tone sequences, whereas the right auditory cortex appeared to be more of a generalist, responding to any tone sequence. Specializations to detect specific tone sequences prevalent in vocalizations could underlie the left auditory center's dominance in processing the content or meaning of speech. While the right auditory center's generalist scheme could underlie its dominance in processing the intonation or prosody of speech.

Notably, the specialized differences between the left and right sides are not innate. Rather, Oviedo says, the differences between their circuitry depend on the acoustic environment in which the mouse was raised.

"Our discovery of the differences in the wiring diagram provides the opportunity to study the molecular phenotypes that shape the development of vocalization processing and how it goes awry in neurodevelopmental communication disorders,"

Oviedo said.

Through a battery of experiments such as 3-D whole-brain imaging, electrophysiology, and optogenetics, the researchers analyzed properties including synaptic connectivity, axonal projections and development of both hemispheres. "Our study is the first to show that there are significant differences in the wiring diagram of the language centers in the brain that could underlie their distinct speech processing capabilities," Oviedo said.

More information: *Nature Communications* (2019). DOI: 10.1038/s41467-019-10690-3 , www.nature.com/articles/s41467-019-10690-3

Provided by CUNY Advanced Science Research Center