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Researchers discover primary role of the olivocochlear efferent system

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New research from the Massachusetts Eye and Ear, Harvard Medical School and Harvard Program in Speech and Hearing Bioscience and Technology may have discovered a key piece in the puzzle of how hearing works by identifying the role of the olivocochlear efferent system in protecting ears from hearing loss. The findings could eventually lead to screening tests to determine who is most susceptible to hearing loss. Their paper is published today in the *Journal of Neuroscience*.

Until recently, it was common knowledge that exposure to a noisy environment (concert, iPod, mechanical tools, firearm, etc.), could lead to permanent or temporary hearing loss. Most audiologists would assess the damage caused by this type of exposure by measuring hearing thresholds, the lowest level at which one starts to detect/sense a sound at a particular frequency (pitch). Drs. Sharon Kujawa and Charles Liberman, both researchers at Mass. Eye and Ear, showed in 2009 that noise exposures leading to a temporary hearing loss in mice (when hearing thresholds return to what they were before exposure) in fact can be associated with cochlear neuropathy, a situation in which, despite having a normal threshold, a portion of auditory nerve fibers is missing).

The inner ear, the organ that converts sounds into messages that will be conveyed to and decoded by the brain, receives in turn fibers from the central nervous system. Those fibers are known as the olivocochlear efferent system. Up to now, the involvement of this efferent system in the protection from acoustic injury – although clearly demonstrated –

has been a matter of debate because all the previous experiments were probing its protective effects following noise exposures very unlikely to be found in nature.

Stephane Maison, Ph.D., investigator at the Eaton-Peabody Laboratory at Mass. Eye and Ear and lead author, explains. "Humans are currently exposed to the type of noise used in those experiments but it's hard to conceive that some vertebrates, thousands of years ago, were submitted to stimuli similar to those delivered by speakers. So many researchers believed that the protective effects of the efferent system were an epiphenomenon – not its true function."

Instead of using loud noise exposures evoking a change in hearing threshold, we used a moderate noise exposure at a level similar to those found in restaurants, conferences, malls, and also in nature (some frogs emit vocalizations at similar or higher levels) and instead of looking at thresholds, we looked for signs of cochlear neuropathy, Dr. Maison continued.

The researchers demonstrated that such moderate exposure lead to cochlear neuropathy (loss of auditory nerve fibers), which causes difficulty to hear in noisy environments.

"This is tremendously important because all of us are submitted to such acoustic environments and it takes a lot of auditory nerve fiber loss before it gets to be detected by simply measuring thresholds as it's done when preforming an audiogram," Dr. Maison said. "The second important discovery is that, in mice where the efferent system has been surgically removed, cochlear neuropathy is tremendously exacerbated. That second piece proves that the efferent system does play a very important role in protecting the ear from cochlear neuropathy and we may have found its main function."

The researchers say they are excited about this discovery because the strength of the efferent system can be recorded non-invasively in humans and a non-invasive assay to record the efferent system strength has already been developed and shows that one is able to predict vulnerability to acoustic injury (Maison and Liberman, Predicting vulnerability to acoustic injury with a noninvasive assay of olivocochlear reflex strength, *Journal of Neuroscience*, 20:4701-4707, 2000).

"One could envision applying this assay or a modified version of it to human populations to screen for individuals most at risk in noise environments," Dr. Maison concluded.

More information: "Efferent Feedback Minimizes Cochlear Neuropathy from Moderate Noise Exposure," *Journal of Neuroscience*, 2013.

Provided by Massachusetts Eye and Ear Infirmary