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Sound deprivation in one ear leads to speech recognition difficulties

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Chronic conductive hearing loss, which can result from middle-ear infections, has been linked to speech recognition deficits, according to the results of a new study, led by scientists at Massachusetts Eye and Ear and published September 6 in the journal *Ear and Hearing*.

This study suggests that not properly treating infections or other conditions that chronically affect the middle ear may lead to neural deficits and increased difficulties hearing in noisy environments.

"Our results suggest that chronic sound deprivation can lead to speech recognition difficulties consistent with cochlear synaptopathy, a condition also known as "hidden hearing loss." Accordingly, clinicians should consider providing amplification in the management of unilateral conductive hearing loss," said Stéphane F. Maison, Ph.D., a Principal Investigator and hearing scientist in the Eaton-Peabody Laboratories at Mass. Eye and Ear and an Assistant Professor of Otolaryngology Head-Neck Surgery at Harvard Medical School.

Sound waves travel through the ear canal before reaching the eardrum and the tiny bones of the middle ear, where they are converted into electrical signals in the inner ear and transmitted to the brain via the auditory nerve. Conductive hearing loss occurs when sound transmission from the ear canal to the inner ear is impaired, leading to a reduction in sound levels and an inability to hear soft sounds. Sensorineural hearing loss, on the other hand, occurs in the inner ear when the conversion of sound-induced vibrations into electrical signals in the auditory nerve is impaired.

Middle-ear infections are the most common cause for doctor visits and medication prescriptions among U.S. children, with about 75 percent of kids experiencing one or more bout of ear infections before age 3. These infections can re-occur and persist for many months, resulting in communication difficulties that can persist after the disease has

resolved.

In the new study, researchers retrospectively reviewed the hearing profiles of 240 patients who visited the Audiology department at Mass. Eye and Ear with either an acute or chronic conductive hearing loss but with normal sensorineural function on hearing tests. The researchers found that patients with a longstanding conductive hearing impairment of moderate, to moderately severe degree had lower speech-recognition scores on the affected side than the healthy side, even when the speech was loud enough to be clearly audible.

The new study validates previous research led by Dr. Maison in adult mice in 2015, showing that longstanding conductive impairment leads to loss of the synaptic connections between the inner ear's sensory cells and the auditory nerve that relays the electrical signals to the brain. Prior research at the Mass. Eye and Ear first identified this novel type of sensorineural damage after noise exposure, and dubbed it "cochlear synaptopathy", or "hidden hearing loss."

"People with hearing loss in one ear are often reluctant to engage in rehabilitation or treatment as they still can rely on the better ear. Our study suggests that, in absence of treatment, speech perception may worsen in time," said Dr. Maison. "If what we have observed in mice is applicable to humans, there is a possibility that unilateral sound deprivation may affect the good ear as well."

The findings are especially important considering that children with asymmetric hearing loss have higher rates of academic, social, and behavioral difficulties according to the authors.

Provided by Massachusetts Eye and Ear Infirmary