

Impact of Subtle Hearing Loss on the Cognition of Young Adults

By Yune S. Lee, PhD

Mounting evidence suggests connections between hearing loss and cognitive impairment may exist—even though making sense of a connection between these faculties is not intuitive. It's been documented, for example, that cochlear implant (CI) users exhibited relatively poor executive functioning in areas including working memory (*J Deaf Stud Deaf Educ.* 2014 Oct;19(4):456), and older adults with mild-to-moderate hearing loss had worse verbal comprehension than older adults with normal hearing (*J Am Acad Audiol.* 2006 Jul-Aug;17(7):487). Perhaps one of the most striking reports is the increased prevalence of dementia following hearing loss in older adults (*Arch Neurol.* 2011 Feb;68(2):214). In this prospective, large-scale study, Lin and colleagues found that the incidence ratio of dementia was 1.89, 3.0, and 4.94 for mild, moderate, and severe hearing loss, respectively, after a 12-year follow-up of older adults. Although evidence of direct influence of hearing loss on cognitive impairment remains elusive (i.e., hearing loss can increase the likelihood of dementia by reducing social interaction as well as increasing stress and depression), it has been theorized that too much listening effort can drain neural resources that could be otherwise allocated to cognitive processes (*Ear Hear.* 2016 Jul-Aug;37 Suppl 1:5S). Such a notion draws support from behavioral studies involving normal-hearing individuals who demonstrated reduced memory capacity when listeners were faced with degraded speech signals (*Mem Cognit.* 2014 May; 42(4): 622).


Although hearing loss is more prevalent in older adults, there is a growing concern of hearing loss in young adults due to increased everyday exposure to noise at dangerous levels. According to surveys, over 90 percent of college students use personal music devices, and nearly half of these students listen to music at volumes exceeding safety standards for occupational noise exposure (*Ear Hear.* 2008 Oct;29(5):791; *Am J Public Health.* 2010 Jun;100(6):1095). The pervasive use of personal music devices and lack of guidance in volume control place approximately 1.1 billion adolescents and young adults at risk of hearing loss (WHO, 2015). Nevertheless, little research attention has been devoted to investigating the impact of hearing loss on cognitive functioning



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in this younger population. Our recent study, however, demonstrated that even subtle, albeit clinically normal, hearing loss can alter brain activity during speech perception (*eNeuro.* 2018 Jun 8;5(3). pii: ENEURO.0263).

In this study, we examined 35 young healthy adults between 18 to 41 years old and monitored their brain activity in response to sentences with varying syntactic complexity. Whereas the classic language network in the left fronto-temporal cortices exhibited greater activity as a function of sentence difficulty, activity in the right anterior prefrontal cortex also emerged, showing negative correlation with hearing acuity. The finding was somewhat surprising in that the right frontal activity is commonly seen in older adults during language tasks—an effect attributed to aging-related brain plasticity (*Front Aging Neurosci.* 2016 May 23;8:110). The right frontal area, however, was not correlated with age difference among young adults; even after controlling for age, the right frontal activity still showed a robust association with hearing acuity. Obviously, the current correlational findings cannot solely establish causal relation between hearing loss and cognitive impairment. Longitudinal follow-up research is warranted to further characterize whether the early brain plasticity would imply depletion of neural resources down the line, ultimately leading to dementia (*Arch Neurol.* 2011).

In light of emerging evidence highlighting connections between hearing and cognition, one cannot stress enough the importance of early prevention of hearing loss before it takes a toll on an individual's well-being, placing medical burdens on society. Medical practitioners and educators should alert parents and adolescents by disseminating critical messages and conveying our research findings and those of others: *Youngsters, it's time to protect your ears!* 



Dr. Lee is an assistant professor of speech and hearing science at Ohio State University. He studies the connection between speech, language, and music using various approaches, including neuroimaging (fMRI, fNIRS), behavioral, and genetics. For more details of his research programs, visit the SLAM lab website (<https://osu-slam.github.io>).