

Brain Structure Associations with Age-Related Hearing Loss**Mark A. Eckert, Ph.D.**

- Belkhiria, C., Vergara, R. C., San Martín, S., Leiva, A., Marcenaro, B., Martinez, M., Delgado, C., & Delano, P. H. (2019). Cingulate cortex atrophy is associated with hearing loss in presbycusis with cochlear amplifier dysfunction. *Frontiers in Aging Neuroscience, 11*, 97.
- Boyen, K., Langers, D. R., de Kleine, E., & van Dijk, P. (2013). Gray matter in the brain: differences associated with tinnitus and hearing loss. *Hearing Research, 295*, 67-78.
- Burk, M. H., & Humes, L. E. (2008). Effects of long-term training on aided speech-recognition performance in noise in older adults. *Journal of Speech, Language, and Hearing Research, 51*(3), 759–771.
- Da Costa, S., van der Zwaag, W., Marques, J. P., Frackowiak, R. S., Clarke, S., & Saenz, M. (2011). Human primary auditory cortex follows the shape of Heschl's gyrus. *Journal of Neuroscience, 31*(40), 14067-14075.
- Eckert, M. A., Cute, S. L., Vaden, K. I., Kuchinsky, S. E., & Dubno, J. R. (2012). Auditory cortex signs of age-related hearing loss. *Journal of the Association for Research in Otolaryngology, 13*, 703-713.
- Eckert, M. A., Vaden Jr, K. I., & Dubno, J. R. (2019). Age-related hearing loss associations with changes in brain morphology. *Trends in Hearing, 23*, 2331216519857267.
- Grégoire, A., Deggouj, N., Dricot, L., Decat, M., & Kupers, R. (2022). Brain morphological modifications in congenital and acquired auditory deprivation: a systematic review and coordinate-based meta-analysis. *Frontiers in Neuroscience, 16*, 850245.
- Gröschel, M., Götze, R., Ernst, A., & Basta, D. (2010). Differential impact of temporary and permanent noise-induced hearing loss on neuronal cell density in the mouse central auditory pathway. *Journal of Neurotrauma, 27*(8), 1499-1507.
- Harris, K. C., Dubno, J. R., Keren, N. I., Ahlstrom, J. B., & Eckert, M. A. (2009). Speech recognition in younger and older adults: a dependency on low-level auditory cortex. *Journal of Neuroscience, 29*(19), 6078-6087.
- Issa, J. B., Haeffele, B. D., Agarwal, A., Bergles, D. E., Young, E. D., & Yue, D. T. (2014). Multiscale optical Ca²⁺ imaging of tonal organization in mouse auditory cortex. *Neuron, 83*(4), 944-959.
- Koops, E. A., de Kleine, E., & van Dijk, P. (2020). Gray matter declines with age and hearing loss, but is partially maintained in tinnitus. *Scientific Reports, 10*(1), 21801.
- Kuchinsky, S. E., Ahlstrom, J. B., Cute, S. L., Humes, L. E., Dubno, J. R., & Eckert, M. A. (2014). Speech-perception training for older adults with hearing loss impacts word recognition and effort. *Psychophysiology, 51*(10), 1046-1057.
- Lin, F., Ferrucci, L., An, Y., Goh, J., Doshi, J., Metter, E., Davatzikos, C., Kraut, M. A., & Resnick, S. M. (2014). Association of hearing impairment with brain volume changes in older adults. *Neuroimage, 90*, 84-92.
- Ma, W., Zhang, Y., Li, X., Liu, S., Gao, Y., Yang, J., Xu, L., Liang, H., Ren, F., & Gao, F. (2022). High-frequency hearing loss is associated with anxiety and brain structural plasticity in older adults. *Frontiers in Aging Neuroscience, 14*, 169.
- Manno, F. A., Rodríguez-Cruces, R., Kumar, R., Ratnanather, J. T., & Lau, C. (2021). Hearing loss impacts gray and white matter across the lifespan: systematic review, meta-analysis and meta-regression. *Neuroimage, 231*, 117826.
- Mudar, R. A., & Husain, F. T. (2016). Neural alterations in acquired age-related hearing loss. *Frontiers in Psychology, 7*, 828.
- Peelle, J. E., Troiani, V., Grossman, M., & Wingfield, A. (2011). Hearing loss in older adults affects neural systems supporting speech comprehension. *Journal of Neuroscience, 31*(35), 12638-12643.

- Profant, O., Škoch, A., Balogová, Z., Tintěra, J., Hlinka, J., & Syka, J. (2014). Diffusion tensor imaging and MR morphometry of the central auditory pathway and auditory cortex in aging. *Neuroscience*, *260*, 87-97.
- Profant, O., Škoch, A., Tintěra, J., Svobodová, V., Kuchárová, D., Svobodová Burianová, J., & Syka, J. (2020). The influence of aging, hearing, and tinnitus on the morphology of cortical gray matter, amygdala, and hippocampus. *Frontiers in Aging Neuroscience*, *12*, 553461.
- Qi, R., Su, L., Zou, L., Yang, J., & Zheng, S. (2019). Altered gray matter volume and white matter integrity in sensorineural hearing loss patients: a VBM and TBSS study. *Otology & Neurotology*, *40*(6), e569-e574.
- Qian, Z. J., Chang, P. D., Moonis, G., & Lalwani, A. K. (2017). A novel method of quantifying brain atrophy associated with age-related hearing loss. *NeuroImage: Clinical*, *16*, 205-209.
- Rigters, S. C., Bos, D., Metselaar, M., Roshchupkin, G. V., Baatenburg de Jong, R. J., Ikram, M. A., Vernooij, M. W., & Goedegebure, A. (2017). Hearing impairment is associated with smaller brain volume in aging. *Frontiers in Aging Neuroscience*, *9*, 2.
- Rosemann, S., & Thiel, C. M. (2020). Neuroanatomical changes associated with age-related hearing loss and listening effort. *Brain Structure and Function*, *225*(9), 2689-2700.
- Schneider, P., Andermann, M., Wengenroth, M., Goebel, R., Flor, H., Rupp, A., & Diesch, E. (2009). Reduced volume of Heschl's gyrus in tinnitus. *Neuroimage*, *45*(3), 927-939.
- Simpson, A. N., Matthews, L. J., Cassarly, C., & Dubno, J. R. (2019). Time from hearing-aid candidacy to hearing-aid adoption: A longitudinal cohort study. *Ear and Hearing*, *40*(3), 468.
- Vaden Jr, K. I., Kuchinsky, S. E., Ahlstrom, J. B., Teubner-Rhodes, S. E., Dubno, J. R., & Eckert, M. A. (2016). Cingulo-opercular function during word recognition in noise for older adults with hearing loss. *Experimental Aging Research*, *42*(1), 67-82.
- Vaden, K. I., Kuchinsky, S. E., Ahlstrom, J. B., Dubno, J. R., & Eckert, M. A. (2015). Cortical activity predicts which older adults recognize speech in noise and when. *Journal of Neuroscience*, *35*(9), 3929-3937.
- Vaden, K. I., Kuchinsky, S. E., Cude, S. L., Ahlstrom, J. B., Dubno, J. R., & Eckert, M. A. (2013). The cingulo-opercular network provides word-recognition benefit. *Journal of Neuroscience*, *33*(48), 18979-18986.
- Wong, P. C., Warrier, C. M., Penhune, V. B., Roy, A. K., Sadehh, A., Parrish, T. B., & Zatorre, R. J. (2008). Volume of left Heschl's gyrus and linguistic pitch learning. *Cerebral Cortex*, *18*(4), 828-836.
- Woolsey, T. A., & Van der Loos, H. (1970). The structural organization of layer IV in the somatosensory region (SI) of mouse cerebral cortex: the description of a cortical field composed of discrete cytoarchitectonic units. *Brain Research*, *17*(2), 205-242.