In Older Adults, the Brain Can Still Be Trained to Hear in Noise

By Nina Kraus, PhD, & Samira Anderson, AuD, PhD

Despite significant advancements in hearing aid technology, listeners with hearing loss continue to express frustration when trying to understand conversation in noisy environments. Even with a favorable signal-to-noise ratio, older adults struggle more in these listening situations than younger adults do for a number of reasons, including deficits in central auditory processing and cognitive function. It has become clear that we need to think beyond the ear when managing hearing loss, especially in older adults.

In the last decade, we have seen a renewal of interest in auditory training, perhaps spurred by advances in computer technology that allow for adaptive manipulation of stimuli as the listener's performance improves. In recognition of the need for auditory training, some hearing aid companies now offer auditory training software that can be used on a personal computer or iPad.

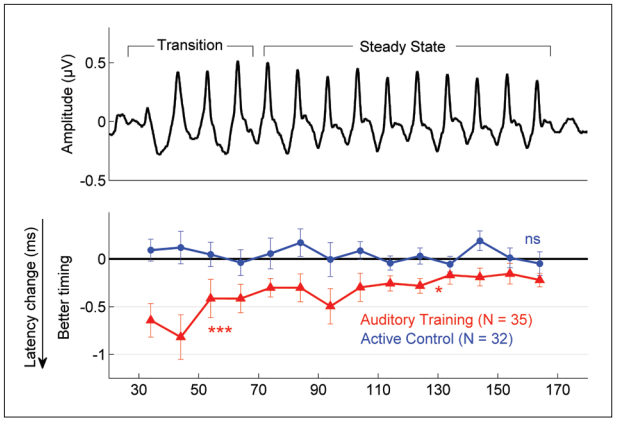
There is evidence for the benefits of auditory training in improving speech-in-noise perception of older adults (***Int J Audiol* 2007;46[7]:374-383**) and young adults (***Cereb Cortex* 2012;22[5]:1180-1190**), yet most hearing aid users do not make use of this training. Perhaps a greater awareness of brain's continued plasticity into older adulthood would inspire some to pursue exercises that improve both cognitive health and perceptual abilities.

We recently published a study examining the effects of a commercially available software program, Posit Science's Brain Fitness Program, on neural processing of speech in noise (***Proc Natl Acad Sci* 2013;110[11]:4357-4362**). In this study, participants who had normal hearing or mild to moderate hearing loss were randomly assigned to one of two training groups.

Thirty-five participants ranging in age from 55 to 70 used Brain Fitness, an auditory-based cognitive training program, on their personal computers for one hour per day, five days a week, for eight weeks—a big time commitment. The training involved rotating through six modules that combined adaptive perceptual and memory demands in a variety of contexts (for details of training, refer to ***J Am Geriatr Soc* 2009;57[4]:594-603**). The training focuses the listener's attention on the consonant-vowel transition—the perceptually vulnerable region of speech—by initially expanding the transition and then gradually shortening it as performance improves.

Another 32 participants matched in age, sex, IQ, and hearing were assigned to the active control group. They watched a series of educational DVDs and answered detailed questions, following the same training schedule as the Brain Fitness group.

Before and after training, participants underwent perceptual and cognitive testing, and their brainstem responses to the speech syllable /da/ presented in quiet and in a background of two-talker babble were recorded.



Top: Grand-average waveform. Bottom: Earlier latencies were found in the auditory training group but not the active control group. (Adapted from Proc Natl Acad Sci *2013;110[11]: 4357-4362.)*

The results were quite promising. Neural timing was improved in the Brain Fitness group, with earlier brainstem latencies, especially in noise and in the region corresponding to the consonant-vowel transition. In addition, there was less temporal jitter in peak timing, such that the timing of the peaks was more consistent. There also were concomitant gains in performance on hearing in noise (Quick Speech-in-Noise Test) and cognitive tests of short-term memory and speed of processing. Participants were quite enthusiastic about the training, reporting that they noticed improvements in their hearing ability and were better able to focus on conversations. The active control group did not experience these benefits.

One notable aspect of this study is that training appears to partially reverse the effects of aging on neural timing (***J Neurosci* 2012;32[41]:14156-14164**), thus improving central auditory processing. We hope that these results will encourage audiologists and other clinicians to consider auditory training to be an essential component of management of individuals with hearing loss.

Dr. Kraus (left) is a professor of auditory neuroscience at Northwestern University, investigating the neurobiology underlying speech and music perception and learning-associated brain plasticity. **Dr. Anderson** is an alumna of Dr. Kraus's Auditory Neuroscience Laboratory and assistant professor in the hearing and speech sciences department of the University of Maryland, where she is studying the effects of hearing loss and aging on neural processing in older adults.