The Auditory–Cognitive System: To Screen, or Not to Screen

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

The field is becoming increasingly aware of the importance of the ear–brain interplay undergirding most listening tasks. For example, cognitive skills, such as memory, have been shown to be important in investigations of hearing aid outcomes. Older adults with hearing loss and poor working memory are more susceptible to hearing aid distortions from signal-processing algorithms (*Ear Hear* 2013;34[3]:251-260), suggesting that cognitive skills should be taken into account in the hearing aid fitting.

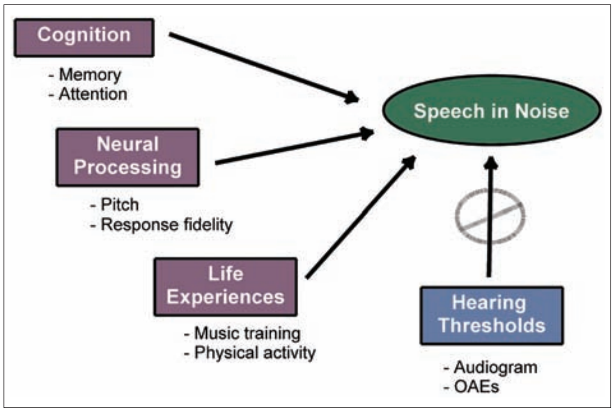
Cognitive function also appears to play a crucial role in speech-in-noise perception, especially in older adults. Imaging studies of word identification in unfavorable signal-to-noise ratios have revealed greater activation of memory and attention brain regions in older adults compared with younger adults (*Neuropsychologia* 2009;47[3]:693-703). To compensate for reduced audibility or deficits in temporal processing (*J Neurosci* 2012;32[41]:14156-14164; *J Acoust Soc Am* 2006;119[4]:2455-2466), older adults appear to draw more on cognitive resources than younger adults do (*Ear Hear* 2010;31[4]:471-479).

Despite this greater need to rely on cognitive resources, older adults often have a diminished cognitive reserve when trying to communicate in a complex listening environment (*Trends Amplif* 2006;10[1]:29-59). Therefore, older adults with preserved cognitive skills, such as working memory and attention, may have better speech-in-noise performance than those who have suffered cognitive losses.

We evaluated the role of the auditory–cognitive system in speech-in-noise perception in a group of older adults with hearing levels ranging from normal to moderate sensorineural hearing loss (*Hear Res* 2013;300:18-32). In these 120 older adults (age 55 to 79), we used structural equation modeling to evaluate the strength of contributions from cognitive function (memory and attention), peripheral hearing status (audiometric thresholds and distortion product otoacoustic emissions), and neural processing (subcortical measures of pitch and response fidelity) to speech-in-noise perception (QuickSIN, Hearing in Noise Test, and Words-in-Noise [WIN] test).

We also included a life experiences factor comprised of musical training because of its known long-term effects on speech-in-noise perception and memory (*PLoS ONE* 2011;6[5]:e18082) and physical activity because of its effects on hippocampal volume and memory (*Proc Natl Acad Sci U S A* 2011;108[7]:3017-3022).

We found that cognitive function and neural processing were the biggest contributors to variance in speech-in-noise perception, but life experiences also had an effect. Interestingly, the contribution of hearing thresholds was not significant. This



Cognition and neural processing factors had the biggest contributions to speech-in-noise performance. Interestingly, hearing thresholds did not significantly contribute to the model. (Adapted from ***Hear Res 2013;300:18-32****.)*

finding is consistent with previous work demonstrating that the audiogram is not a good predictor of speech-in-noise perception (*J Speech Lang Hear Res* 2013;56[1]:31-43).

So what is the take-home message—how can we apply these findings to our practice of audiology? This demonstration of the lack of correspondence between hearing thresholds and speech-in-noise performance supports the inclusion of measures such as the QuickSIN or WIN in our test batteries. We may also want to consider using an objective measure of auditory processing—the auditory brainstem to complex sounds (cABR)—to predict listening in real-world situations.

What about the evaluation of cognitive skills? As audiologists, we may believe that cognitive screening is beyond our scope of practice, and in fact, we cannot purchase most cognitive test batteries based on our credentials. One cognitive screening test that is now available for download by healthcare professionals is the Montreal Cognitive Assessment (**www.mocatest.org**), which is designed to assist in the detection of mild cognitive impairment (*J Am Ger Soc* 2005;53[4]:695-699).

The recent focus on the importance of cognitive function perhaps argues for the incorporation of a quick cognitive screening into the audiology battery in the near future.

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