Listening Effort in Age-Related Hearing Loss

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Age-related hearing loss is associated with changes in subcortical auditory processing, reduced gray matter in auditory cortex, and increased risk of cognitive difficulty. However, in many cases, listeners with hearing loss are able to understand conversational speech very well. One reason for this success is that listeners are able to engage additional linguistic processes to understand speech that is acoustically degraded, partially compensating for the adverse effect of hearing loss on the auditory speech signal.

LISTENING EFFORT

We now know, though, that a third factor must also be weighed in this balance between loss and compensation in everyday listening. The past decade has seen an explosion of interest in “listening effort,” a broad term referring to the processes beyond simple intelligibility that occur during speech perception. In many ways, the notion of effort during listening has been an extremely useful framework because it helps account for listener behaviors and experiences not captured by simple intelligibility measures (Ear Hear. 2016;37:5S).

For example, imagine two clients who are fitted with hearing aids, both of whom score perfectly on a speech intelligibility test. One client complains that it is difficult to understand what people are saying, whereas the other glows that her hearing aid has been a huge help and speech understanding levels are as good as they were when she was younger. Incorporating listening effort as an outcome measure—as many clinicians do, at least intuitively—helps differentiate these two cases, whereas intelligibility scores do not.

The concept of listening effort also brings definitional challenges, not least of which are the many ways that speech comprehension can be effortful. Does “listening effort” refer to fatigue, attention, arousal, or some combination of these and other factors? How can we measure effort? We think that a productive way to frame the problem is in terms of the specific cognitive and physiological processes listeners need to engage when listening to speech. In our view, some listening situations might be difficult because listeners need to rely more on their attention systems, whereas other situations require listeners to rely more on their knowledge of language. These situations depend on separate cognitive and neural mechanisms, and should be treated differently.

The effects of age-related hearing loss are not confined to the auditory system; they reverberate through systems of attention and memory, on which we rely for everyday behavior.

PHYSIOLOGICAL CHANGES

In a recent paper, we reviewed many of the physiological changes associated with age-related hearing loss, and how consequences of these changes are observed in neural processing at all levels of the auditory system (Trends Neurosci. 2016;39:486). Of particular interest is how hearing loss is reflected in complex, high-level cognitive behaviors: hearing
loss is associated with poorer memory for speech, longer response times when making decisions about sentences, and increased brain activity in distinct regions of frontal cortex associated with attention and working memory. Thus, there is clear evidence from multiple sources that demonstrate increased cognitive demand when listeners with hearing loss attend to speech. Similar cognitive challenges are seen in listeners with good hearing when listening to speech in noise, and more work is needed to understand which factors may be specific to hearing loss.

**COGNITIVE BURDEN**

The important take-home message is that the effects of age-related hearing loss are not confined to the auditory system; they reverberate through systems of attention and memory, on which we rely for everyday behavior. Although there are many ways speech processing can be effortful, increased cognitive demands are one family of consequences that clearly impact communication effectiveness and memory. A corollary of this finding is that by improving auditory processing it is possible to reduce the cognitive burden faced by listeners. In a very real way, the work of audiologists and other hearing professionals supports not only auditory processing but also cognitive function: by improving a patient’s hearing, you also free their brains to focus on other things.