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Auditory Aging: A Look at Hearing Loss in Older Adults

By Kathleen M. Cienkowski

Hearing loss is one of the most common conditions affecting older adults. One in three people older than 60, and half of those older than 85, have hearing loss. As the baby boomers age, the U.S. will face the largest demographic shift in the nation's history. The topic of hearing loss and older adults simply can't be ignored.

Paul McCartney, the baby-faced Beatle, is 60 years old. Tina Turner, rock legend, still performs show-stopping numbers at 63 years of age. Certainly by the standard of popular entertainers, the definition of what it means to be an older adult has changed.

According to the United States Department of Health and Human Services, approximately 44 million Americans are aged 60 years or older, that is, one in every six adults.

As the baby boomers age, the United States will face the largest demographic shift in the nation's history. Most of these older adults are active members of their families and communities. The so-called "gray wave" is affecting the population worldwide. It is estimated in the next 25 years that the number of adults of retirement age (65 and older) will increase by 70 million worldwide in industrial nations.

Age-Related Hearing Loss

With this increase in the older population, we can expect to see an increase in the number of individuals suffering from presbycusis or age-related hearing loss. The natural aging process affects not only the ability to detect sounds at soft levels (hearing

thresholds) but also the ability to understand speech at typical conversational volume. This condition is progressive and does get worse with age.

No single factor is the cause of this loss in hearing ability. Changes are seen throughout the hearing system. The eardrum loses its elasticity and the joints of the bones in the middle ear (ossicular chain) stiffen. This leads to a less efficient transmission of sound. The number of sensory cells in the cochlea portion of the inner ear declines, resulting in the commonly seen pattern of high frequency hearing loss. This is called sensory presbycusis. Many people who suffer from sensory presbycusis report that they hear speech, but have difficulty understanding particularly in the presence of background noise.

A less common form of presbycusis that may affect both the high and low frequencies of hearing may occur in the metabolic structure. The location of this condition is situated in the stria vascularis, which supplies nutrients to the cochlea. Because presbycusis results in permanent sensorineural hearing loss, hearing aids are the treatment of choice.

The question facing many individuals with hearing loss and hearing health care professionals is: "Have we learned anything new about the aging process and hearing loss that will enable us to better meet the needs of older adults with hearing loss?" The answer to that question is a resounding yes! Research in the fields of audiology, gerontology, otolaryngology, and psychology is helping to reconfigure our views of how older adults perceive and recognize auditory information, especially speech information.

Common Complaint: I Can Hear Fine in Quiet. However, Background Noise is a Problem.

Many older adults do not report any hearing difficulties in quiet situations or for one-on-one communication. Even if a hearing loss is present, they will seem to be able to get by. However, in environments with lots of noise or echo (reverberation), older adults identify fewer words correctly than younger adults with equivalent hearing. Several possible causes have been suggested. The first is simply the loss of hearing sensitivity evident in the typical high-frequency hearing loss seen among many older adults. Older adults have more hearing loss than young adults and therefore do not perform as well.

However, not all the difficulties observed can be accounted for by the changes in hearing thresholds, because even older adults with normal hearing seem to have difficulty understanding in background noise. This has caused researchers to speculate that changes are also seen in supra-threshold abilities. Whereas threshold indicates the softest sound an individual can hear, supra-threshold measures refer to the ability to process information at louder, moderate, or intense levels of sound.

An example of supra-threshold ability is temporal processing. Temporal processing refers to an individual's ability to follow changes in an event over time: for example, catching a ball or anticipating an impending action. When listening to speech, sounds are available for only a few fleeting moments before they disappear, and within that timeframe, the listener is expected to understand what has been said. When the performance of older and younger adults with normal hearing and hearing loss are compared on temporal processing tasks, older adults display more difficulty than their

younger counterparts. In other words, age may affect one's ability to process rapidly changing auditory information.

Is It My Hearing Or My Brain?

Another possibility is that changes in the central auditory system may account for the speech understanding difficulties reported by older adults. The central auditory system coordinates information between the ear and brain. It plays an important role in processing complex information such as understanding speech in the presence of background noise or detecting differences in signal loudness or duration. Deterioration of neurons in the central auditory pathways (the pathways that transmit information from the cochlea to the auditory cortex in the brain) may limit an individual's ability to separate out important components of complex stimuli.

Experiments that have looked at the ability of listeners to detect differences between complex sounds on the basis of duration (or length) have shown a strong effect of age. For example, using a gap detection task where listeners were asked to identify a gap or silent interval in a signal, investigators have shown that older adults required a longer silent interval between two bursts of noise to be able to detect the presence of two signals. While this may seem a strange task, the ability to detect small breaks or silent intervals in the speech signal may affect a listener's ability to perceive certain speech sounds, for example, stop consonants like "b" or "p" that are produced by the release of a quick burst of air.

It has also been suggested that changes in global cognitive ability may underlie some aspect of the speech perception difficulties. These are changes in cognitive skills

such as memory and attention, independent of hearing ability. Investigators have suggested that reductions in working memory and other facets of cognitive function may impact word recognition ability. One study compared younger and older listeners' ability to recognize key words from sentences embedded in background noise and to remember two to eight additional words in a recall task.

The results showed that older adults recalled fewer words in the presence of background noise. The researchers hypothesized that the background noise uses additional working memory space, thus limiting resources available to speech processing. Further, there is some evidence to suggest that memory performance declines for older adults with hearing loss because of increased demands on attention. It is possible that hearing loss places more demands on auditory attention when distracting signals are present.

You *Can* Learn At Any Age

We've all heard the expression, you can't teach an old dog new tricks. The implication is that changes such as the ones described above are part of the natural aging process and cannot be reversed. It further suggests that as we age we lose some of our ability to learn new skills and information. In this sense, aging is viewed as a process of slowly progressive mental loss. However, new evidence from functional neuroimaging studies (e.g. fMRI, functional magnetic resonance imaging) may offer a more optimistic view.

Recent investigations have focused on the assessment of memory, the cognitive domain most susceptible to aging. Neuroimaging studies compare the brain activity of

older and younger adults while performing a variety of mental tasks. The results may fall into three categories: 1) age-equivalent activity, that is younger and older adults display the same activation patterns; 2) age-related underactivation, that is older brains display less activity than younger brains; and 3) age-related increase in activation, where brain activity in a particular area is more active in older versus younger adults.

A predominate pattern of underactivation would be consistent with the popular belief of progressive decline in mental activity as a function of age. However, recent fMRI studies suggest that this is not the case. Both age-equivalent and increased activation patterns have been found for older adults.

For example, in a study of spatial working memory, the performance of older and younger adults was compared by asking participants to remember the location of three dots that appeared on a screen. A few seconds later, a circle appeared on screen and participants were asked to indicate whether or not the circle encompassed one of the previously displayed dots. Both groups were able to perform this task with a high degree of accuracy (> 90%). fMRI showed brain activity for both groups in the left and right parietal regions of the cortex associated with spatial processing. Young adults also showed activation of the right frontal cortex.

Older adults activated the right frontal region but also the left frontal region as well. In other words, older adults activated more brain regions than young adults for the same task. Similar results have been shown for studies of verbal working memory. This has led some researchers to speculate that older brains activate new areas in order to compensate for declines in other areas. This highlights the potential for brain plasticity across the life span. In other words, you *can* teach an old dog new tricks.

How Will Hearing Aids Change?

Back to our original question: in what way(s) will this new information impact how we treat hearing loss among older adults? Certainly, the hearing aid remains the first line of defense. Without question, changes in peripheral hearing sensitivity need to be addressed.

However, is there a way to build a better hearing aid, given the flexibility of advance technology incorporating what we are learning about the aging brain? Some manufacturers think so and are beginning to offer special fitting options for older adults. One company offers a “slow” speech-processing algorithm. This allows the hearing aid dispenser to select from slow versus fast acting compression. Fast-acting compression, (e.g., syllabic compression) is designed to keep the individual sounds of speech or phonemes audible to the listener. In contrast, slow acting compression (e.g., automatic gain/volume control) keeps the overall level of the signal comfortable for the listener.

The rationale for using slow-acting compression with older adults is that reduced cognitive abilities may limit the successful recognition of the fast components of speech particularly in the presence of background noise. Further, it has been suggested that an older listener’s ability to discriminate between different kinds of signal processing in hearing aids is dependent on cognitive function. Some investigators report that older adults with high cognitive function, as measured on a working memory span test, are able to identify differences in the performance of fast versus slow acting compression whereas those individuals with poor cognitive function (low memory span) cannot. However, further investigation of this area is needed.

A second consideration is the changing demographics of the older population. As the baby boomers age, we see more and more individuals with hearing loss who remain active in their communities. Many are working, involved in volunteer and church groups, or travel on a regular basis.

As a consequence, their listening demands are greater and more varied than generations past. A single response hearing aid may not be sufficient to meet their auditory needs. Many analog and digital hearing aids offer a multiple memory feature. Multiple memories allow several different hearing aid responses for different listening situations to be stored in a single instrument. The advantages include: providing the listener easy access to special features (e.g. a directional microphone for background noise or a telephone switch), and providing flexibility in the frequency response of the hearing aid for different listening demands (e.g. a different setting for listening to music versus understanding conversations in a noisy place). In order to be able to take advantage of the multiple memory feature, an individual needs to demonstrate varied listening needs preferable measured on a communication needs scale or questionnaire.

Changes in hearing aid response should be verified by real ear or other test measures. Individuals with severe-to-profound hearing loss may not be appropriate candidates for multiple memories because their degree of hearing loss precludes the successful adjustment of the hearing aid due to feedback or gain limitations. Also the listener should have the cognitive and physical abilities to successfully adjust and manipulate the multiple memory features.

A final consideration is older adults whose cognitive function is impaired by disease processes such as Alzheimer disease (AD). The incidence of hearing loss among

this population is reported to be significantly higher than among older adults with normal cognitive function. AD is characterized by a slow progressive loss of mental function including a disruption of thought, memory, and language.

Initial disease stages may include mild forgetfulness that progresses in later stages to the inability to complete simple tasks, like brushing teeth or getting dressed.

Individuals with AD may have difficulty speaking, reading, or writing. Individuals may also become anxious or aggressive, or wander away from home. As the disease progresses, the amount of care the individual requires increases substantially. Caregivers and family members report frustration dealing with individuals with AD that often center on communication. Yet hearing difficulties may go undetected because the symptoms of hearing loss are mistaken for cognitive decline.

Studies have found positive benefits of amplification for individuals with AD including a reduction in care-giver reported problem behaviors (e.g. television is too loud, or forgetfulness) and a reduction in hearing handicap after hearing aid use.

However, family members or nursing staff may be reluctant to provide hearing aids. Expensive hearing aids that are lost or broken may not be easy to replace and may place an undue financial burden on the family. In cases such as this, there are alternative amplification devices that may be better suited to the needs of the individual. A personal amplifier (e.g., pocket talker) may be purchased for less than \$200. Starter hearing aids, and telephone and television amplifiers provide a lower cost option. It is important that family members and caregivers meet with the audiologist to develop a plan of action for managing the hearing problem.

The face of hearing healthcare will change along with the changing population demographics in the new millennium. As we learn more about the aging brain and sensory systems through research and new techniques like neuroimaging, we may reformulate what we think about how older adults hear and perceive auditory information, especially speech. Further, armed with greater understanding of the aging process, we may better fit hearing aids and other amplification devices to the needs of the older population.

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For More Information on Hearing Loss and Older Adults, or Hearing Loss in General, Visit These Resources

National Institute on Deafness and Other Communication Disorders

Sections on their website include “Hearing Loss and Older Adults” and “Presbycusis.”

www.nidcd.nih.gov

NIDCD Information Clearinghouse

1 Communication Avenue

Bethesda, MD 20892-3456

800/241-1044 Voice

800/241-1055 TTY

American Academy of Audiology

Includes how to find an audiologist and general hearing health information.

www.audiology.org

8300 Greensboro Drive, Suite 750

McLean, VA 22102

703/790-8466 Voice

800/AAA-2336

American Academy of Otolaryngology-Head and Neck Surgery

Includes a five-minute hearing test.

www.entnet.org

One Prince Street

Alexandria, VA 22314

703/836-4444 Voice

703/519-1585

American Speech-Language-Hearing Association

Referral service and information on hearing loss.

www.asha.org

10801 Rockville Pike

Rockville, MD 20852

301/897-3279

301/897-0157 TTY

National Institute on Aging Information Center

Information on various aspects of aging.

www.nia.nih.gov

P.O. Box 8057

Gaithersburg, MD 20898-8057

800/222-2225 Voice

800/222-4225 TTY

SIDEBAR ACCOMPANYING ARTICLE

Quality of Life for Older Adults Who Use Hearing Aids with FM Assistive Listening Systems

By Mark Ross

Studies have shown that persons using hearing aids report fewer depressive feelings, richer social relationships, and a higher quality of life than those who do not.

The study, published in the February 2003 issue of *The Hearing Journal*, begins by briefly reviewing the potential impact of a hearing loss upon a person's quality of life (broadly defined). While this may appear to be obvious, even people who personally suffer from a hearing loss often underestimate its full impact.

Studies have shown that in addition to the communicative problems wrought by a hearing loss, people with hearing loss report greater social and emotional problems than

do those with normal hearing. The hearing loss may also affect a person's self-esteem and influence social satisfaction. Additionally, there is a greater incidence of health-related problems (such as high blood pressure and cardiac-related problems) among people with hearing loss than among normally hearing people of a comparable age.

There is nothing surprising here; this has been well known for years. Also pretty well known is the fact that amplification (hearing aids) can help reduce these effects. Studies have shown that persons using hearing aids report fewer depressive feelings, richer social relationships, and a higher quality of life than those who do not. The fact that hearing aids can help communication and social functioning *and* improve one's emotional state is not surprising (it would be odd if hearing aids did *not* help in this way).

What this study investigated, however, was whether the addition of a personal FM (radio hearing aid) system to the hearing aid condition can further decrease the impact of a hearing loss, beyond which occurs with a hearing aid alone. What a personal FM system does is provide people with hearing loss with a "third" (or "remote") ear -- one that they can locate closer to the source of sounds than the two ears fixed on our heads.

Research Findings

Two groups of ten older subjects participated in the study, one group at the University of Florida and the other at Washington University School of Medicine. They were all fitted with personal behind-the-ear (BTE) hearing aids (the Phonak Claro), under which a small FM receiver was plugged. Each person also received the HandyMic FM microphone/transmitter (about the size-and-half the width of an eyeglass case). A quality of life questionnaire (testing psychosocial and functional health status) was administered prior to the FM/HA fitting and after one month of use.

The results, in accordance with previous studies, do show that amplification improves quality of life. But we already know this; what the investigators were trying to do was determine the value of *adding* the FM system to the hearing aid condition. In this respect, the results are somewhat ambiguous. Perhaps the FM made an additional contribution to the benefits accruing from hearing aid amplification alone and perhaps not. This was not clear from the study. However, as the author's report, the study is still continuing.

I contacted the senior investigator (Dr. Samantha Lewis) and asked her for an update, which she graciously provided. The two sites have since tested a number of additional subjects and have also employed a number of additional hearing handicap scales. They analyzed the differences between the benefits accruing to just hearing aid usage alone compared to those obtained when an FM is also used. To date, they did not find any further improvement in quality of life measures when an FM system is added. Their reasoning for this negative result, which I concur with, is basically the reason I'm reviewing this study (sometimes, it is as necessary to report what is *not* found as what is).

We know an FM system will increase the speech-to-noise ratio, and we know that this will increase speech perception performance. This is indisputable. But an FM system cannot help if a person does not use it, and use it whenever it is needed. According to the authors, the subjects in this study did not feel comfortable utilizing the FM system. They were aware that it would help in noisy restaurants and other noisy places, but they were hesitant in deploying it as a visible assistive listening device.

The problem here is not technology. The technology is available and it can help. But it cannot help if the person with a hearing loss is reluctant to be upfront about his or her communication needs.

According to Dr. Lewis, the next step in this study is to conduct a group program that will focus on FM use and assertiveness training. Its purpose would be encourage people with hearing loss to be more willing to “assert” their own listening requirements. It is possible for people to overcome their reluctance to employ a visible assistive listening device (like the personal FM microphone/transmitter) and to reap the benefits of improved listening performance. We see this all the time in SHHH meetings (where one must beware of multiple FM microphones being stuck in one’s face!).

There is also no doubt in my mind that a person’s quality of life will be enhanced if his or her listening performance improves, particularly in acoustically challenging conditions. I will be looking forward to the results of Dr. Lewis’s next study, after she and her colleagues have encouraged their subjects to be more assertive regarding their use of personal FM systems.

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