

Hearing Loss and Aging

Over 25 million Americans have some degree of hearing loss and, as the average age of the population increases, this number will rise. - [V. M. Bloedel Hearing Research Center Home](#)

As we get older, our hearing begins to lose some of its sharpness and clarity. This process of age-related hearing loss is known as presbycusis. Hearing loss happens for many reasons. Some people lose their hearing slowly as they age. This condition is known as presbycusis (prez-buh-KYOO-sis). Doctors do not know why presbycusis happens, but it seems to run in families. Another reason for hearing loss may be exposure to too much loud noise. This condition is known as noise-induced hearing loss. Many construction workers, musicians, airport workers, tree cutters, and people in the armed forces have hearing problems because of too much exposure to loud noise. Sometimes loud noise can cause a ringing, hissing, or roaring sound in the ears, called tinnitus (tin-NY-tus).

About 40% of people over 65 have hearing loss, but estimates vary from 30% to 85% according to the criteria used. Only a fourth of people who need hearing aids wear them. About a fourth of those without aids are deprived because their doctors don't screen or are not enthusiastic about hearing aids. But in three-fourths, this lack is due to poor public education and attitude. Eighteen million people have some hearing trouble in one or both ears, six million in both ears, and about 500,000 can't even hear shouted speech. In a six year period, the population increased 6% and hearing loss skyrocketed 29%. Six out of ten with marked problems in hearing are over 65.

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It used to be that people aged 65 and older were the most likely to need hearing aids, but now hearing loss is a baby boomer phenomenon -- as President Bill Clinton recently demonstrated when he was fitted with hearing aids.

Presbycusis (prez-bee-KU-sis) is the most common hearing problem in older people. In fact, people over age 50 are likely to lose some hearing each year. Presbycusis is an ongoing loss of hearing linked to changes in the inner ear. People with this kind of hearing loss may have a hard time hearing what others are saying or may be unable to stand loud sounds. The decline is slow. Just as hair turns gray at different rates, presbycusis develops at different rates.

Presbycusis: the loss of hearing that occurs in most individuals with age. Presbycusis is estimated to effect 30-35% of adults 65-75 years old and 40-45% of adults over 75 years old. Hearing loss associated with presbycusis is greater for high-frequency sounds. The hearing loss is gradual, so many adults do not even realize that their hearing is diminishing.

Presbycusis

Age-related hearing loss is called presbycusis (presby = elder, cusic = hearing).

Everyone who lives long enough will develop some degree of age-related hearing loss. Those who damage their ears through noise develop it sooner and people who live in noisy societies have more presbycusis than those who live in quiet environments.

Presbycusis is the most common form of hearing loss and is thought to be due to the combined effects of intrinsic aging of the peripheral or central auditory systems, the accumulated effects of wear-and-tear. Most cases of presbycusis include high-frequency sensitivity loss, which disrupts speech comprehension in proportion to the sensitivity loss. The condition worsens with age.

Two major forms of presbycusis are sensory and strial. The sensory form is due to loss of outer hair cells in the inner ear and is associated with high-frequency loss. Most people with sensory presbycusis can hear speech but have difficulty in understanding it. That is, their auditory sensitivity is satisfactory but speech discrimination (which depends upon high frequency hearing ability) is reduced. Fortunately, modern hearing aids can correct the high-frequency loss and provide great benefit to the wearer.

The strial or metabolic form of presbycusis is less common and affects both the low and high frequencies. This form of hearing loss is due to pathology of the stria vascularis, which, through its metabolism, is the source of electrical energy driving the cochlea. Recently, it has been shown that strial presbycusis, which is more common in women than in men, is associated with cardiovascular disease. Although unproven as yet, it may be the case that measures to prevent cardiovascular disease, such as fitness and exercise, weight reduction, lowering of high cholesterol levels, smoking cessation, and diet modification, may delay its onset. This appears to be a logical but untested hypothesis.

HEARING LOSS IS THE MOST common chronic human disability: one in 10 Americans has enough hearing loss to cause serious communication problems. In people over the age of 60, this number increases to 30 percent and then to more than 50 percent for those over 80 years of age. During the past two decades, progress toward understanding the biological foundations of both normal and impaired hearing has been rapid. UW scientists have played major roles in these advances, including pioneering the field of inner-ear hair cell regeneration and significantly advancing knowledge in the areas of cochlear implants, hearing development, genetics of hearing loss, vestibular testing, and early diagnosis of hearing loss in children.

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What about Music?

Music plays an amazingly important role in the lives of people of all ages, whether it is through music-making or just simply listening. It is evident that aging has an effect on hearing, but what about the perception of music? During some personal conversation at a local nursing home, one woman professed, "I can't sing anymore! Age has effected my ears and my voice. Age effects everything!" Conversations like these, as well as what I know about hearing and aging already, lead me to believe that there must be some change in the perception of music with age.

Because musical tone is a complex combination of frequencies, it produces vibrations along the full length of the basilar membrane. To see a wonderful demonstration of these vibrations, [click here](#). We know that presbycusis causes hearing loss in high-frequency sounds. As a result, we must lose at least some ability to hear and tune notes correctly. Imagine what music would sound like if you could not hear high-pitched notes as well as low-pitched notes. The same piece of music you once knew and loved could be new music to your ears after age 65.

Although this school of thought is common, recent research has found that age has little effect on the discrimination of mode, rhythm, and contour in melodies. A study conducted at Bucknell University by Andrea R. Halpern demonstrated that under their testing conditions, age had no significant effect on the discrimination of mode, rhythm and contour. In fact, the difference arose most between musicians and non-musicians of all ages. Musicians performed marginally better on these tasks than did non-musicians. Other sources indicate similar conclusions.

Despite these findings, the observational evidence remains. Perhaps the designs of these studies did not fully consider the effect of the sound of an orchestra on perception versus the sound of a solo melody. Subjects in these experiments were being tested on the mode, rhythm, and contour of a solo melody, where the brain could fill in a "missing fundamental" or the harmonics of a pitch. However, when an orchestra is playing together, it might be more difficult to distinguish high-frequency sounds. This theory is analogous to the cocktail-party-effect, a phenomenon where speech discrimination is decreased in the presence of background noise.

Additionally, future studies must be sure to document the auditory thresholds of their subjects and use them as a basis for comparison. If the older subjects in the previous experiments did not suffer from severe presbycusis, then music perceptibility would most likely be conserved. After all, no study examining effects on audition should omit basic tests of hearing ability.

Despite the conflicting theories, music is still an essential activity for the cultivation of the mind and the body. Scientific findings show that music-making helps make active older Americans even healthier. In particular, significant increases in Human Growth Hormone, decreases in anxiety, depression and loneliness resulted following keyboard

lessons. Additionally, music therapy continues to be a popular method of remediation for physical, psychological, cognitive, and social functioning. Research on this topic is needed in order to understand the specific functioning of each level of music perception. In the meantime, we should all continue to create and enjoy music for as long as we can.

Backus, John. *The Acoustic Foundations of Music*. New York: W.W. Norton & Company, Inc, 1969.

Halpern, Andrea R; Bartlett, James C; Dowling, W. Jay. *Perception of Mode, Rhythm, and Contour in Unfamiliar Melodies: Effects of Age and Experience*. **Music Perception**. Summer 1998: Vol. 15, No. 4, 335-355.

Krumhansl, Carol L. *Cognitive Foundations of Musical Pitch*. New York: Oxford University Press, 1990.

Facts About Sound and Hearing

- **Frequency range : With normal hearing, one can hear frequencies from 20 Hz to 20,000 Hz. (20 cycles/sec to 20,000 cycles/sec).**
- **Intensity range : With normal hearing, one can hear intensities from 0 dB to 140 dB. This corresponds to power ratio (defined as ratio of the highest audible intensity to the lowest audible intensity) equal to 100,000,000,000,000.**
- Recommended maximum allowable exposure times (by Nova Scotia Department of Labor) are :
 - 16 hours for 80 dBA sound
 - 8 hours for 85 dBA sound
 - 4 hours for 90 dBA sound
 - 2 hours for 95 dBA sound
 - 1 hour for 100 dBA sound
 - 30 min for 105 dBA sound
 - 15 min for 110 dBA sound
 - 7.5 min for 115 dBA sound
 - 0 min for above 115 dBA sound (there should be no exposure at this level)

- Number of channels: We often characterize sound systems by number of channels. Mono means 1 - channel system, stereo means 2 - channel system, quadro means 4 - channel system. We have two ears, so one can think that auditory system is stereo (2 channel), but as a matter of fact sound in each ear is divided into 24 discrete channels called critical bands. Therefore auditory system (hearing system) acts as 48 - channel system.

Critical bands allow discrimination of different sounds simultaneously. Also they allow to hear sounds in noisy situations (for example conversation during party or in the cafeteria). Hearing loss is often accompanied by damage to the critical bands, which in some situations can profoundly change ear's selectivity. Hearing aids (HA's) act like 1-channel devices since they can't feed signals directly to separate critical bands. Therefore they do not compensate for this deficiency.

- **Illustration of hearing loss (intensity) : Let's assume that a single bird sitting far away in the tree produces a sound level 0 dB (barely audible).A person with hearing loss (after going to "bad clubs'') requires a minimum sound level of 40 dB in order to hear the sound. How many birds have to sit in the tree in order for this person to hear them ? Answer: 10,000. For the person with 50 dB loss it will take 100,000 birds and with 60 dB loss it will take 1,000,000 birds.**
- Potential dangers: Hunting and target shooting, power tools, noisy vehicles, loud music (concert, club, walkman, stereo system at home or in the car). Please wear hearing protection in the situations like that.