Old ears

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If you are under, say, 35, you might as well stop reading: you should have no reason to worry about your ears. But for many of us who are somewhat older, a noticeable hearing loss may become a bit cumbersome every now and then. And as it turns out the loss is worst where it hurts most: in the high frequency regime.

Let us first look at the data. In the figure, hearing loss data are given as a function of frequency for a large sample of people at various ages (Courtesy: Dr. Jan de Laat, Leiden University Medical Center). And indeed, already at age 60, the loss of high-frequency tones is frightening: over 35 dB at 8 kHz, increasing about 10 dB for every 5 years of age. Once we're 80, we'll be practically deaf for 8 kHz and up.

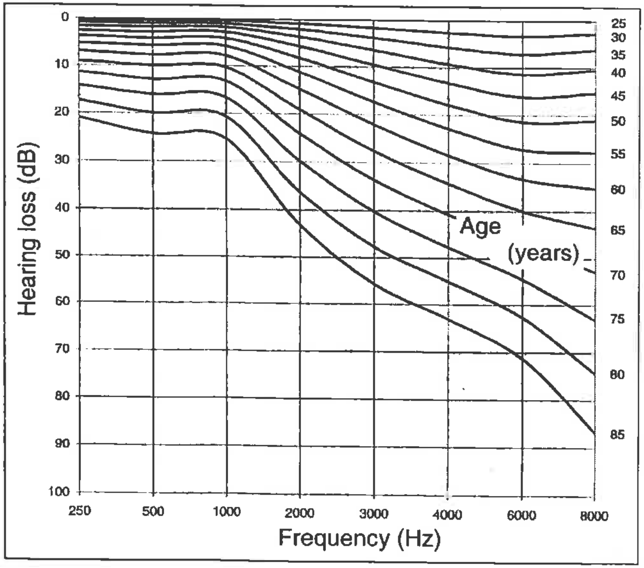
Why is hearing loss at the higher frequencies so bad? When listening to our stereo at home, we can turn up the treble a bit for compensation, no problem. And in a person to person conversation, we don't really have problems either. That is until we are having a conversation at some cocktail party. Then we notice: the background noise makes things worse.

One aspect playing a role here concerns consonants like p, t, k, f and s. They contain mainly high-frequency information, and will therefore easily be masked, or will become mixed up. Another aspect relates to the role of sound localization in selecting one conversation out of a background noise (sometimes referred to as the 'cocktail party effect'). We are pretty good at localizing sound: up to 1-2o in the forward direction (see William M. Hartmann in Physics Today, November 1999, p. 24 ff).

We use two mechanisms to do that. First, by using the phase- or arrival time difference between the two ears: the Interaural Time Difference (ITD). Of course, the information is unambiguous only if the wave length is large compared to the distance between our ears. It is therefore effective only at the lower frequencies, say, below 1,5 kHz. However, in ordinary rooms and halls, reflected sound often dominates, especially for low frequencies. This is because the acoustical absorption decreases with decreasing frequency for almost all reflecting surfaces. As a result, the ITD becomes unreliable in such situations, and the low frequencies are not much of a help to spatially isolate one conversation from the noise.

Fortunately, we have a second mechanism, which uses the intensity difference between the two ears for sound coming from aside: the Interaural Level Difference (ILD). We remember that sound waves become effectively diffracted when their wavelength is much shorter than our head: the head casts a shadow, so to speak. Therefore, ILD works well above, say, 3 kHz.

Alas, look at the graph: the high-frequency region is where old ears have problems. So the ILD doesn't work too well either. In the end, we may have to resort to what deaf people do all along: use our eyes, and see the talking....



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