## **Hearing Loss**

### This is something that effects all of us!

Al Klase Revised Oct - 2020

### Beware!

- <u>Classical musicians at extreme risk for hearing loss.</u>
  - Classical musicians are at extreme risk for hearing loss. A Finnish study among classical musicians found that 15 percent of the musicians in the study suffered from permanent tinnitus, in comparison to 2 percent among the general population. Temporary tinnitus affected another 41 percent of the musicians in group rehearsals and 18 percent of those in individual rehearsals. It is estimated that 15 percent of the general population experience tinnitus temporarily.
- <u>Google:</u> "hearing loss in musicians"
- Etc., Etc., Etc,,,,,,,,
- In short: Aging Sucks!

## **Presbycusis** (Old Man's Hearing)



Even if we avoid exposure to very loud noise, the ear's outer hair cells may also simply wear out as we age, leading to age related hearing loss. In this condition, high frequency outer hair cells tend to die off before low-frequency ones, possibly because the high frequency outer hair cells have to work harder if their job is to amplify acoustic vibrations on a cycle by cycle basis. Consequently, patients with age-related hearing loss often have normal sensitivity at low frequencies, but progressively poorer sensitivity for higher frequencies, as shown here:



Figure 1 shows that average hearing sensitivity for males at age 65 is about 40 dB worse that at age 20; the loss is not as bad for females, but is still about 25 dB. Compared with our adolescent insistence that our music amplifiers be flat within at worst +3dB, and preferably within +1dB, these losses are huge. (Please note that these are averages, and people who have avoided exposure to loud sounds and have not been affected by diseases or ototoxic medicines that damage hearing may well have less HF loss in their old age.)

### **Online tests**

Here are some on-line hearing test that give you objective data that you can interpret yourself. Many othe site are available, but they mostly want to sell professional services and, of course, hearing aids.

- Masking a Tone by Noise
- The Audiogram
- <u>Audiogram with Calibration</u> (pulsed)

### Subjective Test

- <u>https://www.resound.com/en-us/online-hearing-test</u>
- For me: "Based on your answers during the test, you likely have a mild to moderate hearing loss."
- They want an email addresss.

### A lot of info if you care to dig deeper.

<u>https://auditoryneuroscience.com/index.php/acoustics/clinical-audiograms</u>

#### My Tests 16 Sep 2020 https://hearingtest.online/



20 Sep 2020 - Pure Tone Audiogram - FROM

# Some other sound related info on the following slides.

## **The Decibel Defined**

- Relative measurements on a logarithmic scale.
- The Bel, named for Alexander Graham Bell, is equal to the log of the power ratio of two signals.
- Tenths of Bels, decibels, are commonly used.
  - $dB = 10 \log P_2 / P_1$
  - $dB = 20 \log V_2 / V_1$

## What Decibels Really Mean

- 1 dB smallest audible change
- 3 dB modest change twice the power
- 6 dB twice the voltage 4 times the power
- 10 dB 10 times power
- 20 dB 100 times power, 10 times voltage
- 30 dB 1000 times power
- 60 dB 1 million x power, 1000 x voltage
- 120 dB 10<sup>12</sup> x power, 10<sup>6</sup> x voltage

120dB is the approximate dynamic range of the human ear, and represents a power ratio of 1 Quadrillion to 1.



Fig. 1-36. Curves showing the threshold of hearing, discomfort, and pain. (Courtesy, General Radio Co.)

FROM: "The Audio Cyclopedia" by Howard M. Tremaine

## For the human voice, a frequency response of 300-3000 Hertz is sufficient for intelligibility.



FROM: "The Audio Cyclopedia" by Howard M. Tremaine

# Realistic sound reproduction requires a wider frequency response.



#### FROM: "The Audio Cyclopedia" by Howard M. Tremaine

### **The Fletcher-Munson Statistics** The frequency response of your ear changes with over-all sound level.



- So, set your tone controls flat, and turn the volume up until it sounds good!
- "Loudness Controls" may improve enjoyment at reduced listening levels.

### **The Bad News**

