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UNIT 1. UNDERSTANDING ACCESSIBILITY.

Element 2. Learning Outcome 2

TRANSCRIPT: HEARING AND HEARING LOSS

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1 Slide 1

This is a presentation from LiveTextAccess: Training for real-time intralingual subtitlers.

2 Slide 2

This presentation is from the Unit 1: Understanding accessibility.

The target users and their needs is the topic for this presentation under Element 2.

3 Slide 3

The overall topic of this presentation is hearing and hearing loss.

This material has been created by EFHOH, SDI München and SUBTI-Access.

My name is Aïda Regel Poulsen. I represent European Federation of Hard of Hearing – EFHOH. I am the secretary of EFHOH, and I have a hearing loss. I use hearing aids. I am also an educated teacher, a teacher of the deaf, and a trained educational audiologist. I have worked as a hearing consultant for school children with hearing loss included in local school settings nationwide in Denmark for a great number of years. I retired since March 1st 2020.

4 Slide 4

The learning outcomes of this video lecture are:

- Explain how hearing works.
- Describe how hearing loss may occur.
- And to illustrate how hearing loss relates to the needs of users of real-time intralingual subtitles.

5 Slide 5

Firstly, we will look into how hearing works. Then we will discuss what hearing loss is. After that, we will discuss some terminology issues before concluding the video lecture.

6 Slide 6

Let´s take a look at the human ear and how it functions.

7 Slide 7

Sounds move around in the air like waves. Sound waves.

They hit the outer ear (the pinna), and if you look at each others' ears, you will notice, your ears are similar and still different. They shape differently.

This means, that outer ear and its curves lead the sound waves into the ear but the curves differ between you and somehow we hear differently. Also related acoustics in the room of course, but that is a different matter just now.

8 Slide 8

The sound waves are led into the ear canal. Children's ear canals are smaller, more narrow than adults' are. But also ear canals between adults vary.

The sound needs a certain space to let the sound waves move smoothly in through the ear canal. This matters to how the sound sounds.

If there is wax in the ear canal, this will block for the sound and the sound waves will not have the room and space they need.

Also, if there is an infection in the ear and the ear canal is swollen, this will change the route of the sound waves.

In through the ear canal, the sound waves travel and hit the ear drum.

The sound waves literally hit the ear drum as we tap or hit a drum. The ear drum as the skin on the drum will move and activate three little bones (malleus, incus and stapes) in the middle ear.

If there is a cold with infection and/or fluid in the middle ear where the three little bones are situated, this will limit the movements of these little bones and this will change and lower the hearing.

All this is in the conductive part of the ear. The conductive part of the hearing.

The stapes, one of the little bones, is attached to a small oval window which links middle ear to the cochlear, and we are now in the inner ear.

In cochlear there are two canals filled with fluid. And the sound waves are now transmitted to waves in fluid, like in the water, by the stapes moving rapidly. In each of these two canals there are hair cells. When the fluid is being put into motion, it makes the hair cells move just like sea grass in a stream.

The hair cells grow on the inner side of these two canals and when they are being moved, waved, they send electric impulses to the auditory nerve and the brain receives the sounds and the messages. Notice the movements in the cochlea, where high frequency hair cells are in the opening of the cochlea and low frequency up in the top of the cochlea. This is just like an organ: short pipes, high frequencies (the treble), long organ pipes, low frequencies (the bass).

This is basically how we hear.

The hair cells can be broken, damaged, or gradually degenerating and it is not yet possible to restore them.

But cochlear implants, where an electrode is implanted in cochlea, can to some extend replace the hair cells and send the electric impulses to the auditory nerve and the person can learn to hear.

9 Slide 9

And now to what hearing loss may occur as.

10 Slide 10

Hearing loss differ. Persons with hearing loss are affected in different ways by their hearing loss.

Hearing loss is often measured in an audiogram. In the audiogram, it will show how much of the hearing has been lost in the different frequency areas.

Also, hearing loss can be caused by different things. It can be genetic inherited. It may be caused by and damaged in an accident. It can be caused by some illness, or the medication needed in treatment, known in meningitis and cancer, for instance. It can be caused by repeatedly colds and middle ear infections. It can also be caused by noise, of course. Hearing difficulties can also be caused by difficulties in the auditory pathways in the brain.

This may show an audiogram with no measureable hearing loss but the person can still have problems with directional hearing and to discriminate sounds and speech.

Tinitus is also a well known diagnosis, which can be caused from different things and also sound different according to what has caused it.

11 Slide 11

Hearing loss are different and they are defined from the audiogram into 4 major categories. One is mild. The second is moderate. Then there is severe, and then profound hearing loss.

Hearing aids can be prescribed according to what the need is. And this is what we use the audiograms for. But it is also possible to have, for instance, a mild hearing loss in the low frequency area, and a severe hearing loss in the high frequencies. Furthermore, the audiogram is seldom enough. Tests need to be done as to find out how the auditory pathways in the brain work. It is also important to know if the person suffers from other illnesses. Some can be directly linked to developing hearing loss.

12 Slide 12

This is technically how an audiogram looks and we should also look here to the dynamic range in hearing. On the top, the horizontal line, we have the Hertz (Hz), the frequencies. And the lower frequencies go down to 250 Hz. Via the middle frequencies around 1000 Hz. And the higher frequencies at 8000 Hz. This is where speech sounds are. Human ear hear further up than 8000 Hz, but in the audiogram we do not measure that. However, that is surrounding sounds and they matter, of course. We use sounds for more than to talk and to communicate. We navigate using sounds. This is the directional hearing.

The Decibels (dB) are shown on the vertical line. That is the volume of the sound. Any newborn with no hearing loss will hear at 0 dB at all frequencies. Not just hear at 0 Db, but in the range between 0 to 120 dB. This is the dynamic range. Within the range of the 120 dB is the total dynamic range for a typical hearing and we hear from near and far away. We also sense the mood of others when they talk. This is how we sense our intonation. Any hearing loss will limit the dynamic range. For adults we consider an audiogram between 0 and 20 dB to be a typical threshold. This is because hearing aids make a noise when they work and you cannot treat a hearing loss of less than 20 dB. But it may affect the individual, though.

The UCL means uncomfortable level. Even with hearing loss, the uncomfortable level may be less than the 120 dB. Some people suffer hyperacousis.

13 Slide 13

This speech banana is what we rather use in educational audiology. It is easier to understand for everybody else. Note also, that speech bananas vary. They vary from one country and language to another. I am only showing you one of the most used pictures of a speech banana. When you google “speech banana”, you find many different versions. Notice in particular, also the surrounding sounds from everyday life. Not just the speech sounds that are in the banana. Everyday sounds give us directional hearing, for instance in traffic. It reminds us on sounds that are close to us and far from us, and come from left or the right side. This audiogram with the speech banana goes down to 125 Hz. The audiograms showing people’s hearing loss in this presentation only go down to 250 Hz.

14 Slide 14

And I will explain to you how to read the audiogram. The red line is the right ear, and the blue line is the left ear. But often to save colour print when we work, we get the audiograms in black and white. So round dots mean right ear, and the crosses mean the left ear.

It is very important to differ between the two ears.They don’t necessarily come out with the same hearing, or audiogram. And also the two ears have different jobs in hearing to do, related the hemispheres in the brain.

15 Slide 15

None of the above audiograms are age-related hearing loss. Most typical is high frequency loss. In the cochlea, high frequency hair cells are right at the entrance of the cochlea, and all sounds pass through there. This is like the door mat in your corridor. It gets worn out. Age-related hearing loss is also typically high frequency loss.

The typical audiogram used goes from 250 Hz to 8000 Hz, which is the area where we also find the speech sounds. But there are sounds below 250 Hz as well as beyond 8000 Hz too. But audiological treatment for people with hearing loss is a matter of enabling the person to pick up speech sounds and understand speech. Note also that, the hearing test is a screening. We do not test all the sounds, individual Hz, or frequencies in the audiogram, because it would take far too long for both the Hard of Hearing person, as well as the audiologist. So we test typically from 250 Hz, you can see the figures, up to 8000 Hz. Notice, please, on figure 1 and 2, where there is a steep fall in the curve, for instance, from 2000 to 3000 Hz, that frequencies between 2 and 3 KHz are being tested to find where exactly the difference occurs and the curve gets a steeper fall.

Figure 1 could indicate that the person has been working with shooting. Military, or hunting. This damage to the ear is typical to this population. Figure 2 could indicate lack of oxygen during birth, where figure 3 and 4 could indicate a genetic hearing loss. Figure 4, with the very flat curve, seems somehow easier to treat audiologically, because it seems to be just a matter of turning up the volume. But it is at the same time a moderate to severe hearing loss. The steep curves in figure 1, 2 and 3 can cause some distortion.

But there are other measures to be taken as well, for instance, discrimination score, DS, in short, and how well the person with hearing loss discriminates words. The hearing can also be damaged in the auditory pathways in the brain or the auditory nerve that processes the sounds to the brain.

To roughly decide whether a person could be a candidate for cochlear implant (CI), the audiogram must show a severe hearing loss, as well as the discrimination score must show a score no better than 60%. But again there are more tests to be done than just these two.

16 Slide 16

The audiogram indicates how the hearing aids should be tuned in, but the audiogram is, as described, not at all enough.

Different hearing aid brands give the person with hearing loss different experience with sounds. In this way, it is just like buying shoes. You know which size you need, but the brands will fit you in different ways. It can be necessary to try out different types of hearing aids, as well as have them re-tuned to make them fit better.

Also the moulds, or the domes in the ear canal play a very important role in passing the sounds from the environment through the auditory system up to the brain.

Hearing aids use different sizes of batteries depending on the size of the hearing aid. This means that we cannot all just have the smallest ones.

We need to have the hearing aids that support us best with the type and degree of hearing loss each person has.

17 Slide 17

And now to the terminology in this presentation.

18 Slide 18

There is “Hearing Loss”, “to have a hearing loss”. And there are those who like to identify themselves as “Hard of Hearing”.

We are different: some like to be a person with a hearing loss and others call themselves Hard of Hearing.

We have been through the audiogram. We have been through Conductive Heaing Loss, shortly, and Sensorineural Heaing Loss, which is in the inner ear.

The decibel, and in short this is dB. And the Hertz, the frequencies, and in short Hz.

19 Slide 19

And we came around Discrimination Score, which is shortened DS.

Dynamic Range was mentioned, which helps understanding intonation for instance.

Auditory pathways was mentioned. Auditory pathways are in the brain processing the sounds.

Then the speech banana and the frequency of speech sounds.

Then audiological treatment like Hearing Aids, in short HA.

Together with hearing aids, we use moulds, that are in our ears, or domes, for other types of hearing aids.

And Cochlear Implant, in short CI, was mentioned. CIs are for hearing loss that cannot be sufficiently treated with hearing aids.

20 Slide 20

And the summary of this presentation.

21 Slide 21

This presentation has been about:

- How hearing works and what can harm a person's hearing, this be in the ear or in the auditory pathways in the brain.
- How to understand audiograms and diagnoses in hearing loss.
- And briefly how a hearing loss can be treated.

22 Slide 22

And in order to learn more.

23 Slide 23

There are no exercises with this presentation, but I like to draw your attention to some more literature on this topic.

Thank you for your attention.

24 Disclaimer, acknowledgement and copyright information

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