Learning Objectives

1. Participants will be able to describe the impact of hearing-related changes in aging adults.

2. Participants will be able to identify barriers to communication to change with low-tech solutions.

Hearing

- The process, function, or power of perceiving sound; specifically: the special sense by which noises and tones are received as stimuli (Webster).

- Hearing is the sense that obtains information about the world around us using the pressure fluctuations in the air (sounds) that are produced by vibrating objects. (Plack, 2005)

Hearing Includes Processing

(Central) Auditory Processing includes the auditory mechanisms that underlie the following abilities or skills:

- sound localization and lateralization;
- auditory discrimination;
- auditory pattern recognition;
- temporal aspects of audition;
- temporal ordering;
- temporal masking;
- auditory performance in competing acoustic signals (including dichotic listening); and auditory performance with degraded acoustic signals.

Information Processing is Bi-Directional

**Bottom-Up Factors**

- Basic Acoustic Processing
  - Intensity
  - Frequency
  - Duration
  - Phase, etc.

- Speech and Background Noise?
- Hearing Loss?

**Top-Down Factors**

- Higher-Order Functions
  - State of Arousal
  - Attention
  - Working Memory
  - Linguistic Competence, etc.

- Falling Asleep During Presentation?
- Perceptual and Cognitive Declines?
Top-Down Processing: Example 1
- McGurk Effect

From www.YouTube.com
http://www.youtube.com/watch?v=aFPtc8BVdJk

Top-Down Processing: Example 2
- We use our linguistic knowledge to "guess" what a word is within its context
- Listen to this: 🎧

What was actually said:
"Last week, my grandfather went failing on the lake."

What is Hearing Really?

- Communication
  Effective use and transmission of information
- Comprehension
  Correct interpretation of acoustic/linguistic information
- Listening
  Hearing with attention and intention
- Hearing
  Access to Acoustic Information
- Ear
- Positive Feedback Loops
- Negative Feedback Loops

Hearing Loss and Aging

Helen Keller, 1880-1968

"Blindness separates people from things. Deafness separates people from people."

Example Case

Pure Tone Average = 30 dB HL
(mean of 500, 1000, & 2000 Hz)
This patient has mild presbycusis
Normal = < 25 dB HL
Mild = 26 to 40 dB HL
Moderate = 41 to 55 dB HL
Moder-Severe = 56 to 70 dB HL
Severe = 71 to 90 dB HL
Profound = > 90 dB HL
MULTI-FACTORIAL
Aging and Speech Understanding Difficulties

Vascular and Metabolic Changes
Neural Changes
Cognitive Changes

Poorer Temporal Processing
Noise Interference on Speech Cues

Rajan & Cainer (2008); Schneider et al (2007)

Simulations

Hearing Loss
No Hearing Loss
Mild Noise-Induced Hearing Loss
Moderate Noise-Induced Hearing Loss
Mild Presbycusis
Moderate Presbycusis

Audiogram
Sound File
Quiet
Noise
Quiet
Noise
Quiet
Noise
Quiet
Noise

From http://facstaff.uww.edu/bradleys/radio/hlsimulation/

High-Frequency Hearing Loss
In looking at a masking of common sounds by re using your it and de ibel or loudne, it can be seen a even a mild i re un ylo means e individual loses e sounds.

From Davis & Atcherson (2007)

Hearing Loss Impacts Communication
• Loss of Audibility – most debilitating
• Loss of Frequency Resolution
• Loss of Temporal Information
• Loss of Binaural Hearing Skills

Common Causes of Hearing Loss
• Presbycusis/ Genetics
• Otitis Media/ Excess Cerumen
• Vocation and/ or Recreation
  • High noise levels (e.g., farming, hunting, etc.)
  • Personal music devices; stereo systems
• Pharmacologics/ Ototoxicity

Common Barriers to Communication
• Noise and Reverberation
  • Signal-to-Noise Ratio Issue
• Distance
  • Sound and Vision Issue
Noise and Reverberation

Signal-to-Noise Ratio (SNR)

Determination of Signal-to-Noise Ratio

- If speech is 70 dB and noise is 60 dB, then SNR is +10 dB
- If speech is 60 dB and noise is 70 dB, then SNR is -10 dB
- Common SNRs
  - Urban: +9 to +14 dB
  - Outdoors: +5 to +8 dB
  - Parties: -2 to +1
  - Classrooms: -7 to +5

Distance

- Crandell & Bess (1986)
  - Effect of distance, noise, and reverberation
  - 20 children with normal hearing (5-7 y/o)
  - SNR of +6 dB
  - Reverberation time of 0.45 s
  - Distances were 6, 12, and 24 ft
  - Sentences presented:
    - 89% at 6 ft
    - 55% at 12 ft
    - 24% at 24 ft

What about people with hearing loss?

Other Barriers to Communication

- Poor lighting, and backs to windows
- Poor visual contact (e.g., not looking at patient, surgical mask, facial hair)
- Exaggerated Speech
- Poor or no conversational repair strategies
- Telephone issues

Poor Visual Contact
Use of Visual Contact

Hearing Loss Impacts Health
- Reduced psychosocial functioning leading to:
  - Increased feelings of isolation, depression, loneliness, fear, frustration, and disappointment (Crandall et al., 1998; Bess et al., 1989)
  - Poorer physical health (Crandall et al., 1998; Mulrow et al., 1990)
- HOWEVER, improvements seen with hearing aids and cochlear implants (Cohen et al., 2004; Mo et al., 2005)

Hearing Loss Projections

Some Information from the MarkeTrak VII data by the Better Hearing Institute (Kochkin, 2005)

http://www.betterhearing.org/index.cfm

Hearing Loss Population by Age

Hearing and Aging
Impact of Aging on Speech Perception

- Even in the absence of hearing loss, older subjects require 3-5 dB greater SNR than young listeners (Schneider, Daneman, & Murphy, 2005)

- Perhaps the problem isn’t that older people have true cognitive differences than young. Rather, the need for greater SNR places a greater strain on the cognitive resources. This creates more effortful listening. (Pichora-Fuller, 2006)

On Auditory Tests Robust Against Hearing Loss

- Performance on the battery of auditory processing measures by elderly hearing-impaired listeners was systematically related to individual differences in cognitive function rather than auditory function, especially for stimuli not affected by peripheral hearing loss. (Humes, 2005)

Pearl of Wisdom

“Hearing loss may be an individual’s problem, but…

Communication is everyone’s problem.”

Samuel R. Atcherson

Louder is Better (Stewart & Wingfield, 2008)

What Can We Do?

Things We Need More Efforts In

- Health Promotion and Hearing Loss Prevention

- Awareness and Acceptance of Hearing-Related Problems (Cognitive issues included)

- Frequent Hearing Screenings (at least annually)

- Research
Things We Can All Do

- **Screening** for hearing difficulties
- Slow down and speak clearly, and **use conversational repair strategies**
- Face our patients when talking to them
- Consider ways of minimizing noise sources or increasing the “signal”
- Avoid “Elderspeak”

Quick In-House Screening

**5-Minute Hearing Loss Questionnaire**

- Quick assessment and compare results to 2,394 other adults with hearing loss

**A Single Question**

- Simply asking “Do you have a hearing loss?” has a sensitivity of 0.71.

Practice of Hearing Screening by Physicians and Nurses

Conversational Repair Strategies

- Ask what patient did and did not understand
- Ask patient to repeat instructions, or write them down following instruction
- Instead of repeating word-for-word, revise or paraphrase

Miscommunication and Social Relationships

PortaPro In-Office Amplifiers
Amplifiers Help to Increase Signal-to-Noise Ratio

From Davis & Atcherson (2007)

No Amplifier

With Amplifier

No Noise

DO YOU SEE ME?

DO YOU SEE ME?

DO YOU SEE ME?

DO YOU SEE ME?

DO YOU SEE ME?

No Noise

High Noise

DO YOU SEE ME?

DO YOU SEE ME?

DO YOU SEE ME?

DO YOU SEE ME?

DO YOU SEE ME?

Personal Amplifiers for TVs

From Davis & Atcherson (2007)

Telecoils and Loops

The Hearing Loop Process

1. Start with the source, for our example (shown below), take an earphone and plug it into the source.
2. The source (TV) signal is fed to the "transmitter" amplifier.
3. From the amplifier a wire is run around the perimeter of the room and brought back to the amplifier to create a complete loop.
4. Lastly, the hearing aid user turns their hearing aid to the coil mode and a coil sound is picked up by the coil thanks to the magnetic field created by the loop.

Source
Amplifier
Loop

Telecommunication

How well does one understand on standard phone? (Impacts scheduling, phone consults, requests for help, etc.)

What alternate telecommunication options are available?

TTY to TTY
TTY to voice, or voice to TTY (Relay)
Voice-Carryover, or similar (e.g., Captel)

Bluetooth Technology

3-Line Captel

The noise conversation and the options are both controlled on one phone line. 3-Line Captel provides a combined conversation and telephone line. The 3-line Captel provides a combined conversation and telephone line.
What to Look For

- Frequent need to have things repeated
- Turning head to one side (the better ear)
- Misunderstandings and bluffing
- Excuses for not hearing
- Patient’s speech seems to be “different”

Related Considerations

- Hearing loss can be mistaken for dementia
- Inactivity can lead to excess cerumen production
- Caregivers may not always know how to keep hearing aids functioning
- Lost opportunities to refer for critical cases

Resources for Hearing Loss

- UALR Technology Access Center - [http://www.uams.edu/chrp/audiospeech/](http://www.uams.edu/chrp/audiospeech/)
- Association of Late Deafened Adults - [http://www.alda.org](http://www.alda.org)
- Healthy Hearing (Consumer Info) - [http://www.healthyhearing.com/](http://www.healthyhearing.com/)
- DeafMD (Consumer Info in ASL) - [http://www.deafmd.org](http://www.deafmd.org)

Parting Quote

“It is more important to know what sort of patient has a hearing loss, than what sort of hearing loss a patient has.”

Sir William Osler, M.D., 1849-1919