



Northwestern University
Hearing Aid
Laboratory

Understanding and managing severe hearing loss

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Agenda

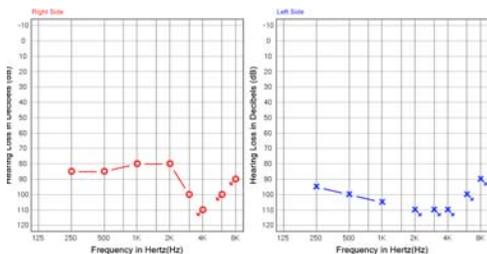
- ▶ Introduction (5 min)
- ▶ Etiologies and audiometric characteristics (15 min)
- ▶ Objective and subjective speech perception (10 min)
- ▶ Hearing aid fitting (10 min)
- ▶ Beyond the hearing aid (5 min)
- ▶ Counseling (10 min)
- ▶ Summary (5 min)

Introduction: What is severe loss?

- ▶ A classic definition: thresholds 71-90 dB HL
- ▶ A practical definition: when communication is significantly impaired
 - ▶ 39% of listeners describe their loss as severe
- ▶ A physiological definition: when cochlear damage patterns result in effects other than loss of audibility
 - ▶ Severely-impaired listeners probably have both outer and inner hair cell loss
- ▶ Severe loss characterized by:
 - ▶ Auditory thresholds worse than 60 dB HL
 - ▶ Reduced dynamic range
 - ▶ Poorer-than-normal speech recognition

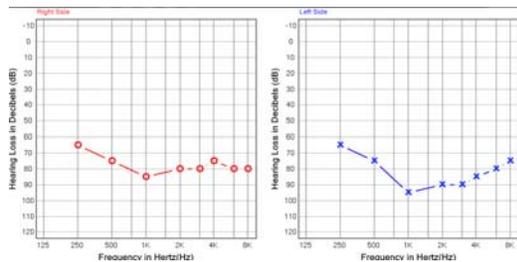
▶ Kochkin, 2007

Case study #1



WRS 68%/100 dB HL right, 0%/105 dB HL left.

Case study #2



WRS 36%/100 dB HL right, 8%/100 dB HL left.

Introduction: Why study severe loss?

- ▶ Patients with severe hearing loss are the most significantly impaired, the least predictable, and the least successful with hearing aids.
- ▶ Poor speech recognition has been attributed to "impaired processing", but there are few quantitative data.
- ▶ Our goals
 - ▶ describe audiometric profile
 - ▶ assess the typical hearing-aid fitting
 - ▶ explore the relationships between suprathreshold processing and speech recognition

Who we searched for and what we did

- ▶ PTA > 60 dB HL in at least one ear
- ▶ Hearing loss and hearing aid history
- ▶ Audiogram + LDLs to define dynamic range
- ▶ Dead regions
- ▶ Spectral resolution
- ▶ Speech in quiet and in noise
- ▶ Subjective communication ability
- ▶ Current aid features and electroacoustic analysis at user settings

Ages and etiologies

- ▶ 39 adults (26 women, 27 men) 54-93 years old (mean 78)
- ▶ 90% sensorineural loss, 10% mixed loss
- ▶ 80% gradual loss, 20% sudden loss
- ▶ 20% childhood or congenital hearing loss
- ▶ 60% family history of hearing loss
- ▶ Probable etiologies
 - ▶ aging (44%)
 - ▶ Illness, such as measles or scarlet fever (18%)
 - ▶ ototoxicity (10%)
 - ▶ congenital or early-onset genetic loss (8%)
 - ▶ sudden loss attributed to viral or autoimmune etiology (5%)
 - ▶ multiple etiologies (15%)

Hearing aid history

- ▶ 90% aided (85% binaural)
- ▶ 80% BTE
- ▶ 80% WDRC
- ▶ Average hearing aid use 18 years
- ▶ Average age of current aid 3.6 years

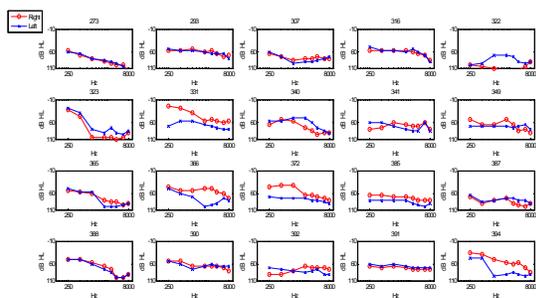
Hearing aid features

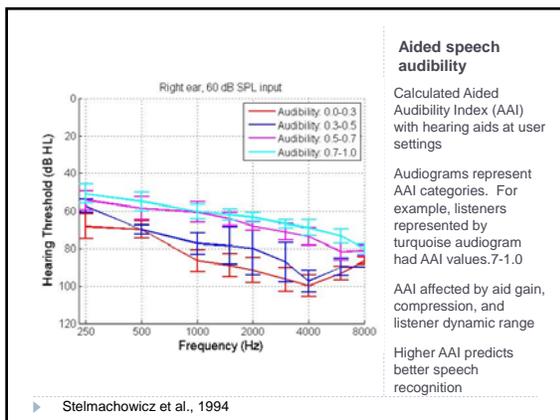
- ▶ 50% omnidirectional, 20% manual directivity, 30% automatic directivity
- ▶ 65% digital noise reduction
- ▶ 36% manual tcoil

ALD use

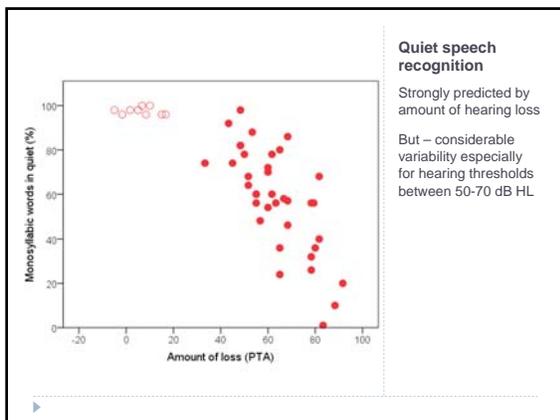
- ▶ 26% used assistive device
 - ▶ Streamer from TV or cell phone
 - ▶ 1 participant using personal FM
 - ▶ 1 participant using amplified phone
 - ▶ 0 participants using captioned phone
- ▶ 20% attended auditory rehabilitation class

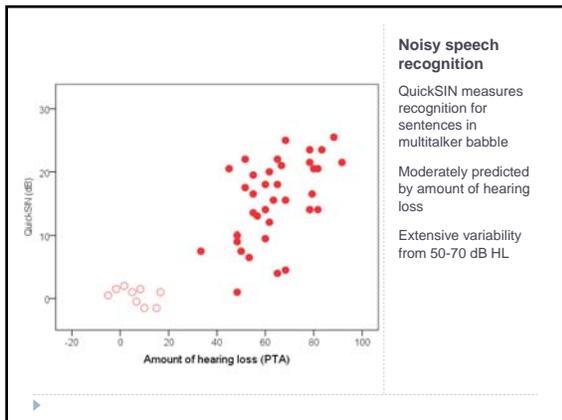
Some examples from our test group

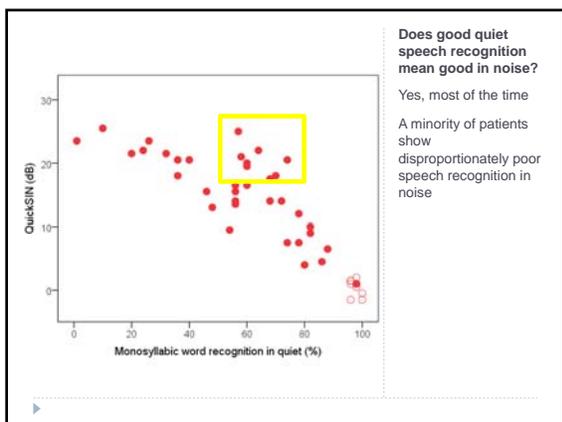


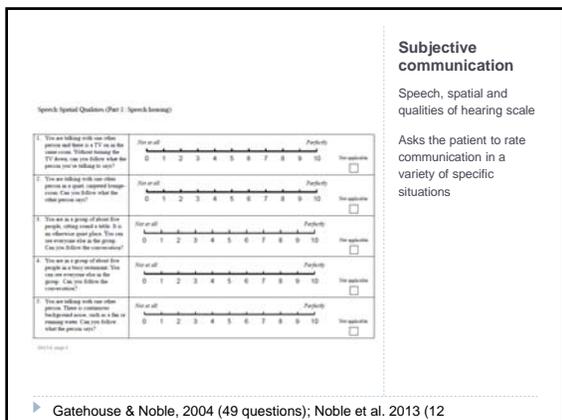


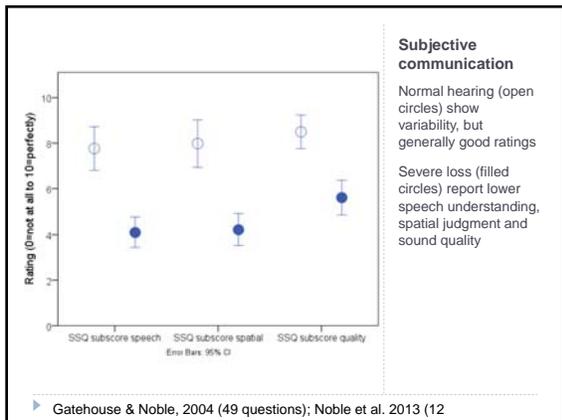
- ### Dead regions
- ▶ Areas of sparse or missing inner hair cells, such that tones presented at the CF of that region are heard via off-frequency listening
 - ▶ Threshold Equalizing Noise (TEN) test on CD
 - ▶ Shaped noise shifts thresholds across frequency to noise level (i.e., a 60 dB TEN noise should result in 60 dB HL thresholds). Thresholds exceeding TEN level by >10 dB suggest unmasked response was off-frequency
 - ▶ 13% identified as having dead region at 2 or 3 kHz; 6% with dead region at 1 kHz.
 - ▶ CNT some patients (loudness/audiometer limits)
- ▶ Moore, 2004; Hornsby & Dundas, 2009; Vinay & Moore, 2004

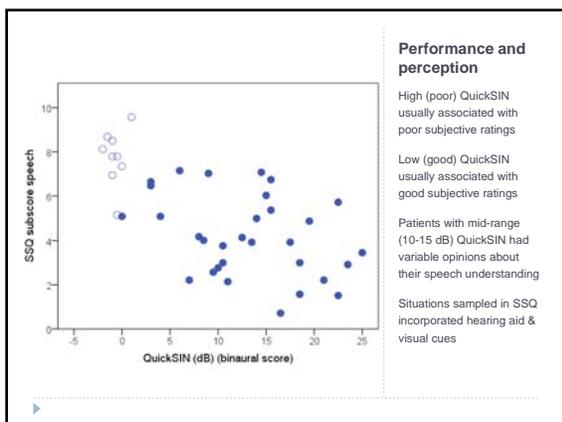


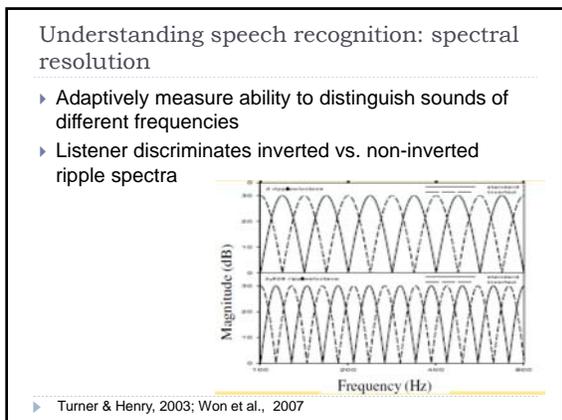


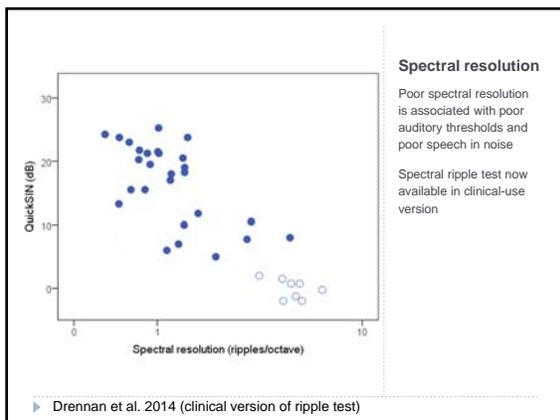




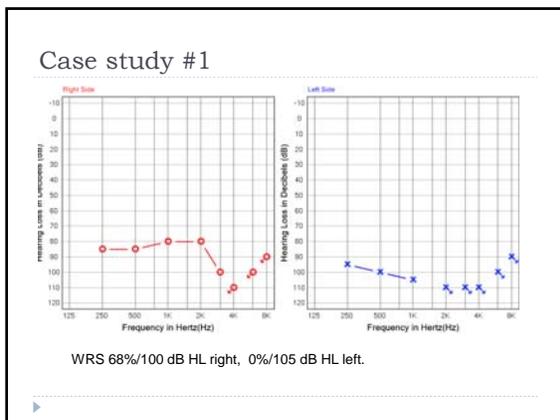




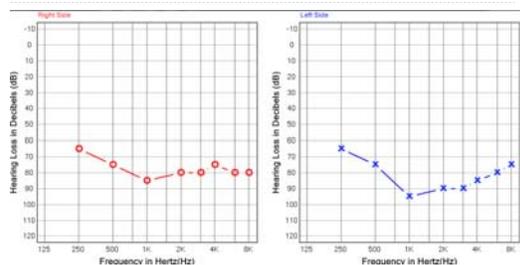




- Data summary**
- Patients with relatively good or relatively poor thresholds within the group have the most predictable speech recognition
 - Speech recognition is least predictable in the middle of the group (50-70 dB HL thresholds)
 - Patients with better speech-in-noise recognition
 - Have better quiet speech recognition
 - Have better spectral resolution
 - Rate their communication ability more favorably
 - Devote effort to listening and use good strategies
 - Communication ability is likely to be affected by both cochlear pathology and cognitive abilities
-



Case study #2



WRS 36%/100 dB HL right, 8%/100 dB HL left.

Recommendations - testing

- ▶ **Speech in noise tests**
 - ▶ Identify disproportionately poor speech-in-noise patients
 - ▶ Patients perceive their complaint is being addressed
 - ▶ Guide specific recommendations and counseling
- ▶ **TEN test**
 - ▶ Needs clearer clinical guidelines
 - ▶ Not clear that it should dictate hearing aid response
 - ▶ May be difficult to administer due to severity of loss
- ▶ **Spectral resolution**
 - ▶ Provides suprathreshold information to explain patient abilities
 - ▶ Patients with poor spectral resolution may not benefit from improved audibility

Recommendations – hearing aids

- ▶ **Recommend behind-the-ear hearing aids**
 - ▶ Manual telecoils
 - ▶ Directional microphones
 - ▶ Reduced chance of acoustic feedback
 - ▶ Assistive device compatibility
- ▶ **Custom earmold**
 - ▶ Maximize chance of good audibility
- ▶ **If ITEs must be used (preference/dexterity), include tc coil and consider remote control or memory button**
- ▶ **Digital noise reduction**
 - ▶ Limited data for listeners with severe loss, but in general should reduce listening effort (freeing much-needed cognitive resources)

Recommendations - telecoils

- ▶ Provide a manual telecoil
 - ▶ Autocoil may not engage on all telecoil-compatible phones
 - ▶ Room loops require a manual telecoil
- ▶ Make sure the patient knows how to engage and use the telecoil
 - ▶ provide written materials and practice
 - ▶ reinforce at each follow-up appointment
- ▶ Demonstration loop in office
- ▶ Handout with list of local room loops
- ▶ Information about public accommodations and ADA



Recommendations – assistive devices

- ▶ Evaluate needs
- ▶ Discuss options
- ▶ Maintain in-office library of assistive devices
 - ▶ Consider options beyond current aid manufacturer (for compatibility with future hearing aids)
 - ▶ Try them yourself
 - ▶ A demonstration is worth a thousand words
- ▶ Captioned phones are free with audiologist documentation



Recommendations – training

- ▶ Recommend aural rehabilitation classes.
- ▶ If there is no suitable class available in the community, consider developing your own.



Communication and Hearing Enhancement
 Westminster Place, Evanston IL
 Summer 2013



July 11, 2013 Introduction to hearing loss
 July 18, 2013 Communication difficulties
 July 25, 2013 Communication strategies
 Aug 1, 2013 Auditory training and memory
 Aug 8, 2013 Hearing aids
 Aug 15, 2013 Assistive listening devices & ADA

Recommendations – support and advocacy

- ▶ Learn about local HLAAs groups
- ▶ Provide HLAAs materials (brochures, newsletters)

Find your local HLAAs chapter



▶ <http://www.hearingloss.org/content/hlaa-chapters-and-state-organizations>

Recommendations - counseling

- ▶ Emphasize the individual
- ▶ De-emphasize the hearing aid
- ▶ Encourage multi-faceted approach
- ▶ Encourage self-advocacy
- ▶ Include and educate family members
- ▶ Be available

Thank you and contact information

- ▶ Supported by NIH R01 DC60014.
- ▶ Thanks to
 - ▶ Richard Wright and Erick Gallun for helpful planning discussions
 - ▶ Jong Ho Won for sharing and modifying the ripple test
 - ▶ Michael Blackburn and Eric Hoover for collecting hearing-impaired data
 - ▶ Arleen Li for collecting normal-hearing data
 - ▶ Laura Mathews for data management and keeping us organized
 - ▶ Sanreka Watley for help with recruitment
 - ▶ Siemens Hearing Instruments and Audiology Online

Thank you

- ▶ Contact: p-souza@northwestern.edu.
- ▶ More information: www.halab.northwestern.edu

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