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Beyond ANSI Standards: Acoustic Accessibility for Children with Hearing Loss

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Welcome

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BEYOND ANSI STANDARDS: ACOUSTIC ACCESSABILITY FOR CHILDREN WITH HEARING LOSS

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Purpose

- Infants and children with hearing loss must have good acoustic access to facilitate the auditory brain development that will enable them to use audition to learn language.
- This course will assist clinicians in determining if auditory environments and technologies are providing the necessary and optimal auditory access to attain and sustain listening, spoken language and literacy outcomes.

LEARNER OUTCOMES

1. Attendees will recognize the necessary acoustic requirements for auditory access in different situations, e.g. classroom , home, playground etc.
2. Attendees will describe strategies designed to identify if auditory access is being obtained in all environments through a knowledge of signal-to noise-ratio, background noise, and reverberation.
3. Attendees will explain techniques for repairing poor acoustic accessibility in the child's primary amplification (e.g. hearing aids and cochlear implants) and also in the environment.

Family's Desired Outcome

- The family's desired outcome guides us – ethically and legally.
- What is your long term goal for your child?
- Where do you want your child to be at age 3, 5, 14, 20?
- What does it take to get there?
- *95% of children with hearing loss are born to hearing and speaking families.*
- This talk is all about the **context** of acoustic accessibility through professional collaboration if the family chooses listening and talking for **today's child** who is deaf or hard of hearing.

Why Is Audiologic Information Critical?

- ***Because of advances in technology and new research about brain neuroplasticity***, the audiologist's role has expanded in pediatric sectors.
- ***Because of advances in technology and new research about brain neuroplasticity*** the landscape of deafness has changed.
- ***Because of advances in technology and new research about brain neuroplasticity,*** families, audiologists and listening and spoken language specialists need to be sure they are stimulating auditory brain development.

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Main Ideas

- Hearing is a first-order event for the development of spoken communication and literacy skills.
- Anytime the word "hearing" is used, think "**auditory brain development**"!!
- Acoustic accessibility of *intelligible* speech is essential for brain growth.
- Signal-to-Noise Ratio is the key to hearing intelligible speech.
- ***Our early intervention programs and classrooms must take into consideration the listening capabilities and acoustic access of our children.***

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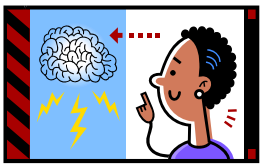

THE NEURAL BASIS OF LISTENING, LANGUAGE AND LITERACY

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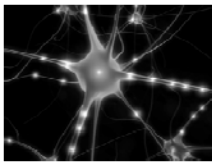

New Brain Research

Basic neural research now provides data that substantiates the necessity of accessing and stimulating auditory brain centers.

There is a science behind our practice!

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How Does The Auditory Brain Work?

- Important changes have been shown in the higher auditory centers due to hearing loss/deafness.
- The auditory cortex is directly involved in speech perception and language processing in humans (Kretzmer ie al, 2004).
- Normal maturation of central auditory pathways is a precondition for the normal development of speech and language skills in children (Sharma et. Al, 2009).

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How Much Practice Is Needed To Influence Neural Structure?

- Malcolm Gladwell: 10,000 hours of practice
- Hart and Risley: 46 million words heard by age 4
- Dehaene: 20,000 hours of listening as a basis for reading
- Pittman: Children with hearing loss require three times the exposure to learn new words and concepts due to the reduced acoustic bandwidth caused by the hearing loss

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Hart And Risley:
Implications Of Practice

- 7,430 words – 79 IQ
- 12,810 words – 107 IQ
- 21,105 words – 117+ IQ

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Appropriate Technology plus acoustic accessibility + Enriched Auditory Exposure

= AUDITORY BRAIN DEVELOPMENT

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~~Appropriate Technology plus acoustic accessibility~~ + Enhanced Auditory Exposure

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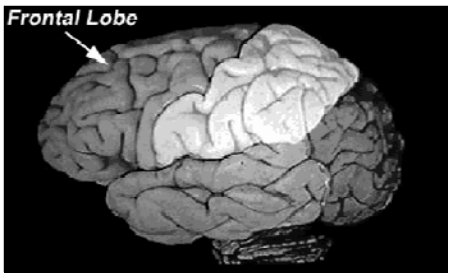
The Real Ear



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Acoustic Access To The Brain

- This is the biggest problem worldwide, for all degrees of hearing loss.
- Technology often is not programmed to today's possibilities.
- Auditory environments are not managed.
- ***Evidence must be obtained***, daily, about the technology is functioning.
- If the child is not progressing as expected – and everyone has very high expectations – suspect the technology/acoustic accessibility first.

It's All About The Brain

Hearing loss is not about the ears; it's about the brain!

Hearing aids, FM systems and cochlear implants are not about the ears; they are about the brain!

They are "brain access" tools.

And, the audiologist is the professional who makes brain access possible by managing hearing loss, technology, and acoustic environments.

If the child is not progressing as expected

- Suspect technology first
  - Is the child hearing well enough?
  - Is the child hearing high frequencies
- Is the child wearing technology consistently?
  - If a child is using technology for only 4 hrs/day, it will take 6 years for the child to hear what a typically hearing child hears in one year.

If the child is not progressing as expected

- Does the family have appropriate expectations?
  - Are they requiring use of technology
  - Are they providing auditory stimulation
  - Do they expect the child to listen and talk
- Do the clinicians working with the child have appropriate auditory expectations?
- Do all of the child's environments allow sound transmission from the talkers to the child…e.g. acoustic accessibility? Is noise and reverberation managed?

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What does the technology need to be doing to meet the needs of acoustic accessibility?

- The child needs to hear throughout the frequency range
  - 6000 and 8000 Hz really do matter
  - Missing high frequencies results in missing grammatical markers for pluralization, possessives, and missing non-salient morphemes (e.g. morphemes that are not stressed during conversation such as prepositions)
- The child needs to hear at a soft enough level
  - Soft speech is about 35 dBHL.
  - If a child cannot hear soft speech, she will not hear
    - Peers in the classroom or on playground
    - Will not "overhear" conversation and will have limited incidental learning
    - Will have reduced language and literacy skills
    - Moeller (2011) reported that in her research 40% of children fit with hearing aids were underfit.
- Aided hearing at 0 dB is not the goal
  - It can cause distortion

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The technology needs to be distortion free

- Children with HL have more difficulty managing distortion
- Sources of distortion in the technology
  - Does activation from the special features of technology cause distortion?
  - Timing and activation of special features could cause issues
  - Activation of some of these features may reduce audibility of some of the frequency range
- If the child is not making progress, consider these factors
- Distortion between
  - HA and FM
  - HA and CI
  - FM input
    - Personal FM and SF

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External distortion

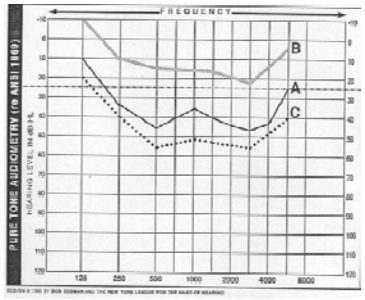
- Noise and reverberation
  - –What effect does this have on the hearing aid?
  - –What does noise do to the technology?

Speech Intelligibility

What Does Intelligible Speech Look Like?

- Every speech sound needs to be audible
- At typical and soft conversational levels
- At distances and up close
  - –"Overhearing/incidental" is critical
  - –90% of what infants and young children know about the world they learn incidentally

The Audiology Fruit



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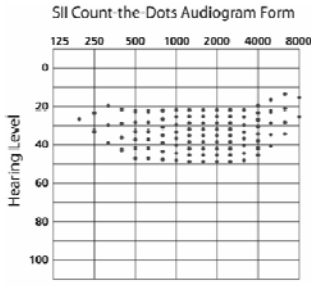
Mueller And Killion - 2010



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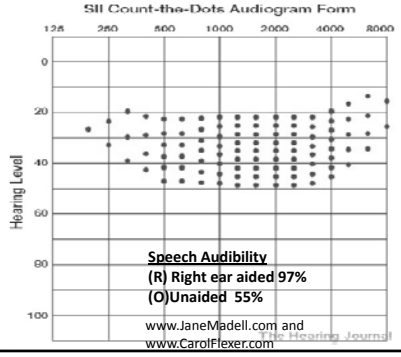
The SII-Based Method for Estimating the Articulation Index



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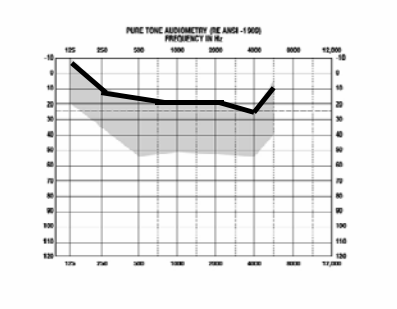
Can We Call It The Speech Bean?



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How does the child's auditory environment effect technology decisions?

- Noise – smart phone SML apps
  - How noisy is the home?
  - Is the child in daycare?
  - What after school activities does the child participate in?
  - Should the infant/child have an FM?
- Noise is a factor even for infants
- Helping families learn to turn off noise
  - Turn off dishwasher during dinner
  - Turn off background radio/TV
  - Music is only useful when it is adult directed
    - Otherwise it is noise

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Information The Audiologist Need to Supply to the Family and Interventionists

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Unaided test results

- Copy of test results
  - Parents should take audiogram home from test
- Degree and type of hearing loss
  - The cross-check principle
    - Behavioral tests
    - Objective tests
      - » Immittance and OAE (ABR?)
- Speech audiometry
  - Threshold
  - Discrimination (supra-threshold)

Speech Perception Testing

- Diagnostic testing
  - What can the child hear if speech is loud enough to overcome the HL (40 dB SL)?
- Functional testing
  - How the child functions in daily living situations
    - Typical conversational level (50 dBHL)
    - Soft conversational level (35 dBHL)
    - Competing noise (50 dBHL + 5 SNR)

Test Results With Technology

- Technology thresholds (R,L,B)
- Speech audiometry
  - Threshold
  - Discrimination
    - Typical and soft conversational levels
      - (Not loud levels)
    - Quiet and in noise

Why Is Speech Perception Important?

- It determines how children perform in all daily activities
- It provides information about auditory brain access for language and cognitive development
- It provides a clue about auditory brain development

If You Do Not Test Speech Perception, You Will Not Know:

- What the person hears
- More important – what the person does not hear
- If there has been a change in perception
- If there is something you can do to improve auditory functioning

Information The Audiologist Needs From Family And Interventionists

Information The Audiologist Needs From Family And Interventionists

- How many hours/day is the child wearing the technology?
- What environments is the child in?
  - Day care? Noise?
- Does the child like the technology?
  - If not, when is the technology a problem?
    - Loud sounds bother him?
    - Location e.g. – car
- Any evidence that the device is not working well?

Information The Audiologist Needs From Family And Interventionists

- What the child is hearing
  - Auditory development
    - Hierarchy
  - Phoneme perception
  - Distance range -
    - Does the child hear soft speech?
      - Incidental access or does child need direction to attend?
    - Does the child hear from a distance?
  - Consistency of response to sound
- Voice quality
- Language development (receptive and expressive)
- Speech production

Information The Audiologist Needs From Family And Interventionists

- Describe concerns/observations about:
  - How the child is hearing in specific environments
  - How is the child hearing at a distance
  - How the child accepts technology
  - How the child is learning auditorily
  - How the child is progressing

Interpretation And Management

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Speech Perception: How Good Is Good Enough?

- Speech perception qualifiers (Madell et al, 2011)
  - Excellent 90-100%
  - Good 80-89%
  - Fair 70-79%
  - Poor < 70%
- If the child's speech perception is not good enough, what do we need to do to repair it?

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A Collaborative Agreement About Auditory Progress

- Share all information
  - Audiologist, family, interventionist, teacher, others
  - Parent is not responsible for information dissemination
- Take everyone's concerns seriously
- Listen to evidence about substantiate concerns and observations
  - e.g. he cannot hear Ling sounds at more than 4 feet
  - Can't produce sibilants
  - My toddler is in a noisy daycare

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How Do We Know Auditory Access Is Sufficient?

- Technology thresholds
  - If not sufficient,
    - Reprogram or change technology
    - Acoustically-tuned earmolds
    - Remote microphone is not a substitute for well programmed primary technology
  - YES, YOU CAN PERFORM AIDED THRESHOLD TESTING
    - Present from below expected threshold
    - Short presentation will not turn on compression

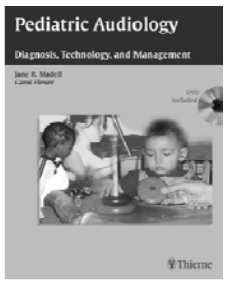
Repairing Speech Perception Deficits

- Auditory brain access with equipment
- Auditory exposure –
  - Listening age
  - Hrs/day equipment is worn
- Auditory environments
  - Do we need FM at home? Playground?
- Daily auditory enrichment and embellishment
  - Parent focused, guided by the Listening and Spoken Language Specialist (LSLS)

Summary

Summary

- Suspect equipment first
- Look for evidence to demonstrate equipment function
- Equipment has to be functioning
- Child has to use it
- Enriched auditory language stimulation must occur all day, every day with parent involvement
- All of the child's environments must be acoustically accessible



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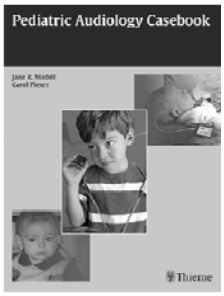

General References

- Cole, E., & Flexer, C. (2011). *Children with Hearing Loss: Developing Listening and Talking, Birth to Six, 2nd ed.* San Diego: Plural Publishing.
- Madell, J., & Flexer, C. (2008). *Pediatric Audiology: Diagnosis, Technology, and Management.* New York: Thieme Medical Publishers.
- Madell, J., & Flexer, C. (2011). *Pediatric Audiology Casebook* New York: Thieme Medical Publishers.
- Madell, J; Batheja, R, Klemp, E and Hoffman, R (2011) Evaluating Speech Perception Performance, Audiology Today, September-October, 52-56.
- Merzenich, M.M. (2010, April). *Brain plasticity-based therapeutics in an audiology practice*. Learning Lab presented at the American Academy of Audiology National Conference, San Diego.
- Robertson, L. (2009). *Literacy and Deafness: Listening and Spoken Language.* San Diego: Plural Publishing.