Mild Hearing Losses in Children: Impact and Management

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1

Introduction

- **Carol Flexer, PhD, FAAA, CCC-A, LSLS Cert. AVT**, received her doctorate in Audiology from Kent State University in 1982.
- She is a Distinguished Professor Emeritus of Audiology, The University of Akron.
- An international lecturer in pediatric and educational audiology and author of more than 155 publications including 17 books, Dr. Flexer is a past president of the Educational Audiology Association, the American Academy of Audiology, and the AG Bell Academy for Listening and Spoken Language.

2

What Did We Miss?

- Haven't we all, at some point, been dismayed to learn that a child was not wearing their hearing aid, or not using the remote microphone system!
- What did we miss?
- Are there additional strategies for talking with families and teachers about (mild) hearing loss?
- What about a brain talk?

3

To Begin with: Hearing is about the Brain

We tend to think we hear with our ears, but actually we hear with our brain.

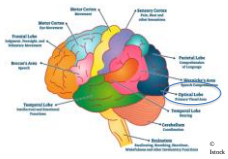
- Ears act like a doorway to help to get sound or auditory information to the brain.
- Think of a hearing loss as a "doorway" problem.
- The doorway can be blocked a little bit or a lot, depending on the hearing loss.
- This means that auditory information, such as conversations, lullabies, reading aloud, and more, isn't reaching the child's brain clearly.
- Modern hearing technologies such as digital hearing aids, cochlear implants, and other assistive listening devices are designed to break through the blocked doorway to deliver clearer auditory information to a child's brain so they can learn to understand the full meaning of sounds, words, and all the language they experience.

Sound carries information and information becomes knowledge!

4

The Ear is the "Doorway" to the Brain for Sound – Spoken Language/Information – Talking – Reading.

We hear with the brain – not with the ears!



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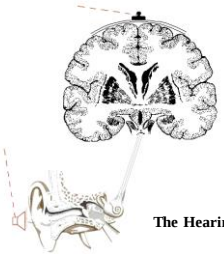
The Purpose of Technologies

- The purpose of technologies (e.g. hearing aids, cochlear implants, remote wireless systems) is to get sound -- auditory language information -- through the obstructed doorway to the brain.
- There is no other purpose!
- The choice of hearing technology depends on what is happening in the child's doorway.

6

Summary: The Hearing and Listening Mechanisms

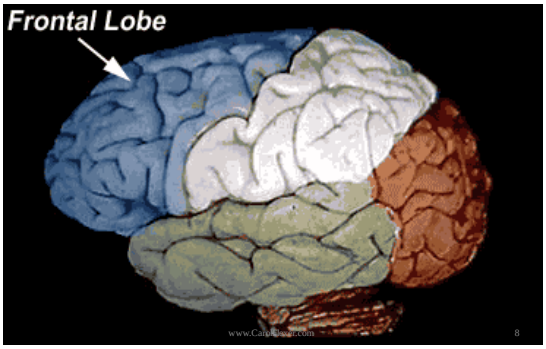


The Listening Mechanism: Learns the meaning of the neural events

The Hearing Mechanism: Takes in Vibrations

7

Start a conversation with The Real Ear: Hearing occurs in the Brain



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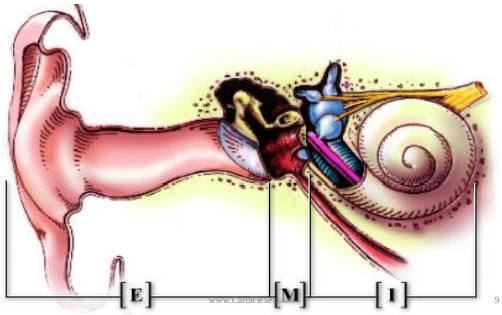
This is the doorway to the brain.

Outer (external), Middle and Inner Ear



9

Overview: Longitudinal Predictors of Aided Speech Audibility in Infants and Children (McCreery, et al, Ear & Hearing, 2015)

- Children with mild to severe hearing loss as a group have poorer language development than their hearing peers, and the impact of hearing loss on language increases as the amount of hearing loss increases.
- Providing children with well-fit hearing aids is associated with better rates of language development.
- However, the study showed that more than half of children's hearing aids were not fitted optimally (they were Underfit!), limiting the amount of brain access children had to speech information and auditory experience through the hearing aid.
- Many children with hearing loss who receive optimal, early services are able to "catch up" or significantly close the gaps with their hearing peers.

10

More…..

- Protection against language and literacy delays arises from managing the malleable factors:
  - properly fit hearing aids that maximize audibility
  - used consistently (10 to 12 hours per day, or 80% of awake time – "eyes open, technology on")
  - providing a rich linguistic environment around the child – parent talk can be increased and improved by coaching, beginning in infancy

Hearing aids work…..fit them early and appropriately -- and wear them!

11

Audiologists are Pivotal!

- Until Audiologists do their job, no one else can to theirs.
- Acoustic access to the brain, including access to incidental (free) information (the way 90% of knowledge is obtained by young children), is the biggest challenge for today's children with hearing loss (doorway problems) -- worldwide.
- We must have very high expectations for brain access of auditory information.
- If a child is not progressing as expected, suspect the equipment first.

12

Participation: Brain Knowledge

Do you think most children and families really know the only purpose of wearing hearing technology is to deliver auditory information to their brain for the growth of knowledge?

13

Mild Hearing Loss Is Not A Mild Problem

14

What is the Problem?

Hearing loss of any degree has cumulative effects on a child's development due to auditory neural deprivation and also due to deprivation of auditory experience (McCreery 2020).

15

Why Does Mild HL Get Missed?

- *Newborn screening misses it*
  - ABR does not identify mild HL
    - Johnson et al 2005
    - Tested all babies who failed OAE and passed ABR at 9 months
    - 21 of 973 had permanent HL
- *School screening misses it*
  - Screening may be performed at 25 dB and sometimes louder if the room is noisy
- Children "seem" to be developing speech and language, so learning and behavioral issues often are attributed to something else.
- Language development may appear to be progressing normally through age 2.....be sure to test language at age 3!

16

Key Issues for "Mild" Hearing Losses

- "Normal" hearing for children is 15 dB HL in both ears, at all frequencies and with normal middle ear function.
- Anything less places the child at risk for academic failure.
- Difficulty is with missing soft speech (auditory information) – showing *cumulative,* negative effects on language and cognitive development.
- Problems are distance hearing, overhearing, and listening in noise.
- Under-amplification is a much bigger problem than over-amplification.

17

Why Has Mild HL Been Ignored?

- Moderate to profound hearing loss is recognized as causing problems.
- Children with mild and unilateral hearing losses appear to be developing well in early childhood years.
- Terminology – what is the implication of "mild", "minimal"?
- First study to look at mild hearing loss – Quigley and Tomure, 1969
  - They evaluated children with hearing loss < 26 dB HL
  - Poorer than normal test results on word meaning, paragraph meaning and language

18

Research on 113 children with mild HL (Walker et al, 2017)

- 74% of children with mild HL were identified via Newborn hearing screening (NBHS)
- 26% were identified later due to passing NBHS, or not receiving NBHS
- 94% were fit with HA, but at a later time than those with more hearing loss
- Parents thought HA helped, but many were ambivalent
- Still work to be done on timely fitting and use of HA

19

Etiology

- CMV
  - By age 6 yrs 35% of infants with symptomatic CMV have HL
  - 11% of infants with asymptomatic CMV have HL
- Infections
  - Mumps, Bacterial meningitis (30% unilateral)
- EVA – can be unilateral or bilateral
- ANSD – can be unilateral or bilateral
- Congenital malformations
- Sudden idiopathic hearing loss
- Head trauma
- Noise induced
- Genetics

20

Progression of Minimal HL

- Fitzpatrick et al (2020) found that almost half of the children with mild bilateral hearing loss showed a decrease in hearing in at least one ear.
- Persistent long-term monitoring of children with mild hearing loss is essential.

21

Impact of Auditory Deprivation on Brain Function (Sharma, 2017)

- Neural changes – the brain adapts to the signal
  - More severe brain changes occur with severe and profound HL, but neural changes are present even with minimal HL
- When auditory information to the brain is degraded or diminished, there is activation of the frontal cortex, and that activation causes:
  - effortful listening,
  - an increase in the cognitive load
  - listening fatigue (all degrees of hearing loss experience listening fatigue)
- Early intervention, with any device, is essential
- For any technology fit to a child, listening practice must occur

22

Fitting Hearing Aids on Infants and Children With Mild, Moderate, Unilateral And Fluctuating Hearing Losses

23

McCreery and Walker (AAA 2018)

Title: *Using audibility to assess amplification candidacy for children with mild hearing loss*

- 74% ID through newborn hearing screening
- Median age of confirmation of hearing loss – 3 years
- 33% of children with mild hearing loss do not wear hearing aids.

24

McCreery 2018 continued

- Full time hearing aid users had better vocabulary skills than non-users
- Full and part-time hearing aid users had better morphosyntactic skills than non-users.
- Cumulative auditory experience affects structural aspects of language development.
- But, no significant differences in articulation skills were noted between users and non-users of hearing aids.

25

McCreery 2018 continued

- So, do not rely solely on audiological outcome measures to determine benefits from hearing aids.
- Testing speech discrimination at soft levels (35 dB HL), can help.
- In dB HL, a child's thresholds will appear to get worse over time as ear canal grows.
- We need a standard that incorporates how hearing loss affects audibility, and how do ear canal acoustics change over time.

26

McCreery 2018 -- Recommendations

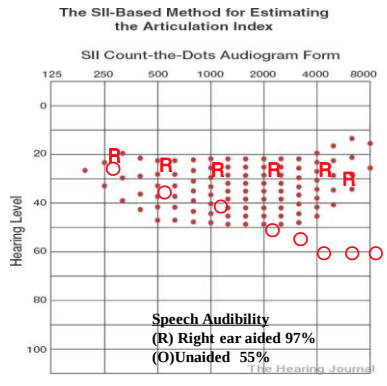
- Children with unaided Speech Intelligibility Index (SII) < 80 should be considered candidates for amplification.
- Enter audiogram into Verifit.
- Observe unaided SII value for average speech.
- Consider other language values beyond vocabulary.
- Extend this procedure to unilateral hearing losses.

27

McCreery 2018 Recommendations

- Families should be coached to anticipate how the child may miss conversational nuances and subtle social details in noisy situations.
- Families should determine ways to inform the child of information that might have been missed.

28



29

Speech Perception Testing:

What Auditory Information is Getting to the Brain?

30

Speech Perception Testing

- Diagnostic testing
  - What can the child hear if speech is loud enough to overcome the HL (e.g., 40 dB SL)?
- Functional testing –Critical for Validation of technology fittings
  - How the child functions in daily living situations with technology – each ear:
    - Typical conversational level (50 dB HL)
    - Soft conversational level (35 dB HL)
    - Competing noise (50 dB HL + 5 SNR)

31

What is "Good" Speech Perception?

- Speech Perception Qualifiers – Madell et al, 2011
  - Describing performance:
    - Excellent 90-100%
    - Good 80-89%
    - Fair 70-79%
    - Poor < 70%
- Children with hearing loss need to hear as well as children with typical hearing, to learn.
- We need to describe performance accurately.

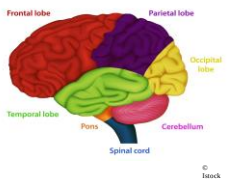
32

Summary

- **Suspect equipment first - and the child last!**
- Look for evidence to demonstrate equipment function
- Equipment has to be functioning appropriately
- Child has to use it (10-12 hours per day; 80% of awake time) and parents need audiologists to check in with them to facilitate wear-time….maybe via tele-audiology and data logging (Munoz, 2023).
- Enriched auditory language stimulation must occur all day, every day with parent involvement in order to grow the child's brain with knowledge
- Beware of the subtle *cumulative effects* of missing information due to distance and noise
- All of the child's environments must be acoustically accessible in order to **attain and sustain listening**, spoken language, and psycho-social outcomes

33

Thank you for Listening!



34

Participation: One Action

Based on what you have learned in this presentation, what do you plan to DO new, better, or different?

35

Resources

36

Hearing First

- https://hearingfirst.org/
- This website offers many ideas for the advancement of listening, talking and pre-literacy skills. Their suggestions are helpful and appropriate for all children, not only for children with hearing loss.

37

38

BabyBeats

Search for 'Advanced Bionics' in the iTunes® or the Google Play™ store.

Look for the BabyBeats app and download. This App is free!

BabyBeats™

39

Supporting Success for Children with Hearing Loss – Karen Anderson

- http://successforkidswithhearingloss.com/
- Teacher Tools is designed to support all aspects of instruction by addressing underlying skills and word knowledge that support all curriculum content. There are articles related to current topics and trends, sections on developing instructional skills, student self-advocacy, self-concept and a forum for discussion of current issues and concerns. A Teacher Tools membership includes materials such as worksheets and activities appropriate for all school age levels and an extensive information resource library.

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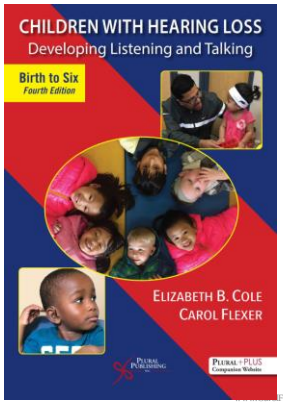

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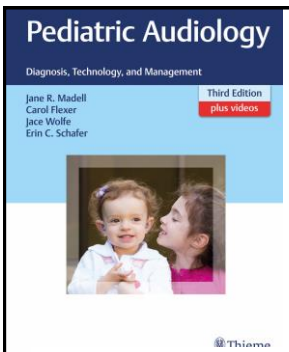
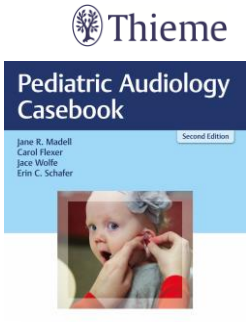
46





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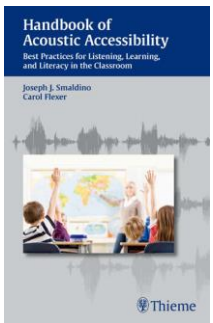

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48