Current Perspectives on Minimal and Mild Hearing Loss in Children

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Normal Hearing

- Between -10 and 15 dB for children (Clarke 1981; Diefendorf & Gravel, 1996)
- Between 0 and 20-25 dB for adults
Minimal Hearing Loss

- PTA between 15 and 25 dB bilaterally
- High-frequency sensorineural loss = ≥ 2 frequencies above 2 kHz in one or both ears
- Loss of any degree in one ear

Mild Hearing Loss

- 26 – 40 dB HL bilaterally
Definition of minimal hearing loss is as much about configuration as it is about degree.
Prevalence of Minimal Hearing Loss

~ 1/1000 in the newborn period (Prive et al., 2000) and ~3/100 in the school-age population (Bess et al., 1998)
Joint Committee on Infant Hearing

Target Populations

• Permanent bilateral or unilateral, sensory or conductive hearing loss that averages 30-40 dB HL or more in the frequency region important for speech recognition (approx. 500 - 4000 Hz)

Non-Target Populations

• Hearing losses < 30 dB HL
What they asked...

Does a 2-stage (OAE/AABR) newborn hearing screen miss babies with mild hearing loss?

Johnson et al., Pediatrics 2005
N= 86,000 babies

Results:
- 4% failed OAE and passed A-ABR
- 77% of those missed with permanent hearing loss had mild HL (PTA ≤ 40 dB)
  - 57% had unilateral HL
  - 86% were sensorineural
II. Psychoeducational Outcomes:

The early years...
Grade Failure Rate

Bess et al. Oyler and Matkin

Bess & Tharpe, 1986
62% of those with academic difficulty had hearing loss of the right ear.
Psychoeducational Outcomes: Today
Impact of Unilateral Conductive Hearing Loss on Academic Performance
(Kesser, Krook, Gray, 2013)

- Case control survey  (n= 132)
- School children with aural atresia
- None repeated a grade but **65% required resource help**
- 45% received speech therapy
Early Effects of Unilateral Hearing Loss

• Cho Lieu (2004): Unilateral hearing loss (UHL)
  – Average age for first words = 12.7 months (WNL)
  – Average age for first 2-word utterances = 23.5 months (significant delay)
UHL and Speech-Language Scores

(Lieu, Tye-Murray, & Piccirillo, 2010)

- Sibling-controlled study of 6-12 y.o. with UHL
- n = 148
- Oral & Written Language Scales (OWLS)

Results:
- Children with UHL had poorer language comprehension, oral expression, and oral composite scores
III. Psychoeducational Outcomes: Minimal/Mild Bilateral Hearing Loss
Permanent Minimal Hearing Loss In School-Age Children (n=1218)

<table>
<thead>
<tr>
<th>HL Category</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>bilateral</td>
<td>12</td>
<td>1.0</td>
</tr>
<tr>
<td>High frequency</td>
<td>17</td>
<td>1.4</td>
</tr>
<tr>
<td>Unilateral</td>
<td>37</td>
<td>3.0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>66</td>
<td>5.4</td>
</tr>
</tbody>
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Bess et al., 1998
Failure Rates of Children with MHL & with Normal Hearing (Bess et al., 1998)
Fitzpatrick et al. (2015)

- Children under 4 years of age with mild bilateral and unilateral hearing loss
- Auditory and language skills equivalent between those with MMHL and those with normal hearing
What, if any, are the functional health effects of minimal hearing loss?

Self reported less energy and more stress than children with normal hearing

Bess et al., 1998
Listening Effort –
Attentional requirement necessary to understand speech
What they asked...

Assuming a limited effort capacity, will performance on a secondary task decrease when the primary listening task is made more difficult?

Bourland-Hicks & Tharpe, JSHLR, 2002
Dual-Task Paradigm

- Primary task: speech recognition in noise (PBK)
- Secondary task: button push to random presentations of probe light
Dual Task Paradigm

No difference in baseline RTs between groups
What they asked...

Do children with HL experience more fatigue than children with NH?

Hornsby, Werfel, Camarata, Bess, American Journal of Audiology (2013)
http://aja.asha.org
What they did...

- 10 children with hearing loss (CHL) and 10 age-matched peers with normal hearing (CNH)
- Subjective ratings of fatigue using the PedsQL Multidimensional Fatigue Scale
- All had normal non-verbal intelligence
What they did...

Method:

PedsQL Multidimensional Fatigue Scale:

– General Fatigue (e.g., “I feel tired”)
– Sleep/Rest Fatigue (e.g., “I rest a lot”)
– Cognitive Fatigue (e.g., “It is hard for me to think quickly”)
– Composite Score
What they found...

More Fatigue
Why is this important?

The fatigue scores reported herein indicated more fatigue experienced by children with hearing loss than children with cancer, rheumatoid arthritis, diabetes, and obesity (Varni et. Al, 2002; 2004; 2009; 2010)
IV. Current Status of Hearing Technology Use
Hearing Technology Options for UHL

- Traditional hearing aids
- Contralateral Routing of Signal (CROS) hearing aids
- Frequency modulated (FM) systems
- Cochlear implants
Traditional Hearing Aids for UHL

• Unaidable hearing
  – Profound SNHL
  – Very poor word recognition
  – Marked intolerance for amplified sounds

(Valente et al., 2002)
Traditional Hearing Aids for UHL

- Binaural interference - decrease in bilateral performance when an individual is receiving asymmetric auditory input (Jerger et al, 1993)
- Evidence of BI for adults, but not children, when listening to asymmetrically-degraded speech (Rothpletz et al, 2004)
- No binaural advantage when listening to asymmetrically-degraded speech (Rothpletz et al, 2004)
Sound Localization in Children with UHL
(Johnstone, Nabelek, Robertson, 2010)

• Some children showed improved sound localization with hearing aid on impaired side IF:
  – Fit with 1st hearing aid by 5 years
  – Young (6-9 years)

• Hearing aid impaired localization in older children (10-14 years)
Decision Support Guide for Hearing Aid Use in Infants & Children with Minimal/Mild Bilateral Hearing Loss

Marlene Bagatto & Anne Marie Tharpe

A Sound Foundation Through Early Amplification Conference Proceedings
July 2014
What is Happening in the Real World?
Fitzpatrick et al. (2010). Clinical Practice for Children with Mild Bilateral and Unilateral Hearing Loss, *Ear & Hearing*

**Fig. 2.** Amplification recommendation by hearing loss at identification ($N = 255$).
What they did...

Queried parents of 272 children with permanent, bilateral, mild-to-severe hearing loss

What they found...

• On average, parents reported children wore hearing aids ~ 10 hours/day (data logging indicated ~ 8 hours/day)

• Longer hearing aid use time associated with older age, poorer hearing, and higher maternal education level

• For every 10-dB increase in better ear PTA, the average HA use time increased by .50 hour
Six year old with MMHL:

- Speech/language delays – therapy since age 2 years
- Mother was ‘dismissed’ by audiologists
- Used sound field FM at school
After one week of hearing aid use:

• ‘Mom! I can hear my footsteps now!’
• She asks for her hearing aids every morning and wears until bedtime
• Mother reports she is more socially connected and engaged
• Understands better on the phone and FaceTime
• Happier demeanor
V. Final Words
Summary

• A significant portion of children with permanent MMHL have been found to demonstrate difficulties observed
  – In academic settings
  – Under laboratory conditions
  – By parents and teachers
  – By the children themselves
Why do some children with MMHL have significant academic difficulties while others do not???
What are the contributing stressors?

• Listening conditions?
• Listening effort?
• Lack of early or aggressive intervention?
• Lack of effective amplification?
• Concomitant otitis media?
• Etiology?
We still have much to discover!