The Complexities of Listening and Understanding in Children with Minimal / Mild Hearing Loss

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Definitions of MMHL

- Heterogeneous group of hearing loss configurations
- All losses may be conductive or sensorineural

<table>
<thead>
<tr>
<th>Bilateral</th>
<th>Unilateral</th>
<th>High Frequency</th>
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<tbody>
<tr>
<td>Minimal: 16-25 dB HL</td>
<td>Affected ear ≥ 20 dB HL</td>
<td>≥25 dB HL for 2 or more frequencies above 2 kHz</td>
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<tr>
<td>Mild: 25-45 dB HL</td>
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- Represent over 5% of school-age children (Bess et al, 1998; Niskar et al, 1998)
What are the effects of minimal/mild hearing loss on children?

• The answers are not always as clear as we’d like them to be
• What does research tell us?
Potential Difficulties

**Communication**
- Soft/distant speech
- Noise/reverberation
- Localization
- Listening effort
- Speech/language

**Academic/Cognitive**
- Grade retention
- Additional educational assistance
- Verbal academic tests
- Full-scale IQ

**Psychosocial**
- Teacher ratings
- Perceived functional health
- Physical, social, emotional functioning
- Attention

(Bess et al., 1986; Bess et al., 1998; Bess & Tharpe, 1986; Borton et al., 2010; Crandell, 1993; Culbertson & Gilbert, 1986; English & Church, 1999; Johnson et al., 1997; Klee & Davis-Dansky, 1986; Lieu et al., 2010, 2012; Porter et al., 2013; Ruscetta et al., 2005; Newton, 1983; Oyler et al., 1987, 1988)
Similarities

Communication
- Standardized Language measures
- Speech perception in quiet
- Speech perception in noise

Academic/Cognitive
- IQ
  - Verbal
  - Non-verbal
  - Full scale
- Reading
- Academic Skills

Psychosocial
- Behavior
- Teacher ratings of performance
- Self-concept
- Quality of life

Bess et al., 1998; Borton et al., 2010; Crandell, 1993; Culbertson & Gilbert, 1986; Klee & Davis-Dansky, 1986; Lewis et al., submitted; Lieu et al., 2010, 2012; Porter et al., 2013)
Why can’t we all agree?

- Heterogeneity of hearing losses within the same population
- Perceptions
- Tests
Heterogeneity of Hearing Losses
Perceptions

• Person with MMHL may not realize what is being missed
• Perceptions of difficulties may influence expectations, behaviors, and progress

If a tree falls.......?
Effects of Minimal/Mild Hearing Loss: Children’s, Parents’, Teachers’ Perceptions

Subjects
• 20 children (8-12 years) with unilateral or bilateral MMHL
• One parent/guardian of each child
• One classroom teacher for 10 of the children

Procedures
• Structured interviews were conducted
• Broad topic areas

Analysis
• Qualitative and quantitative methods
Challenge versus No-Challenge

% of All Coded Utterances

- Awareness / Understanding
- Groups / Noise
- Limited Visual Access

Child: No Challenge
Child: Challenge
Parent: No Challenge
Parent: Challenge
Teacher: No Challenge
Teacher: Challenge
Challenges Reported as Not Related to Hearing Loss (Triads only)

- Personality
- Control
- Negative Behavior
- Academic Challenges
- Attention
- Same as Normal Hearing

Number of Occurrences

Parent
Teacher

BOYS TOWN National Research Hospital
What do these preliminary results suggest?

• Perspectives are important
  – Clinician/family/educator understanding
  – Counseling
  – Habilitation
  – Critical review of the literature
Tests

• Who/what/where/when are you testing?
• Sensitivity to potential problems
Comprehension and sentence recognition by Children with MMHL in a simulated classroom environment

(Lewis et al., submitted)

• Previous work in our lab
  – children adults with NH (Valente et al., 2012)

• Participants
  – 18 children (8-12 yrs) with NH and 18 with MMHL
    • 8 with bilateral HL
    • 10 with unilateral HL
  – Age-matched
  – WASI 2FSIQ within 1.25 SD of mean
  – All testing completed without amplification
Testing took place in a simulated classroom with control of acoustics, noise and listening tasks.

Realistic classroom learning task:
- Video recordings of talkers positioned around the subject,
- Teacher + 4 Students

Speech recognition task:
- Sentence repetition
- Single talker, auditory-only
- Quasi-randomly from the 5 loudspeakers

Acoustical environment:
- Neutral spectrum background noise, HVAC systems at 50 dBA
- Talkers presented at 60 dBA
  - +10 dB SNR at listening location
- 600 ms RT60 at 1 kHz
Looking Behavior

• Proportion of Events Visualized
  – How often listeners looked directly at the talker as he/she was speaking during the classroom learning task

• Overall looking behavior
Results

• Sentence Recognition
  • All except 2 children with MMHL scored ≥ 89%

• Comprehension
  • Significant effect of age and HL (p<.05)
  • No age x HL interaction
Looking Behavior

• How often did listeners look directly at the talker as he/she was speaking?

• No significant differences across age or HL and no interactions
• Looking behavior

![Box plots showing overall looking behavior by age group and hearing status.](image)

- No significant differences across age or HL and no interactions.
- MMHL children show a different pattern of looking behavior than the NH children.
What do these results tell us?

• Despite performing at or near ceiling on a sentence recognition task, younger children with NH and children with MMHL perform more poorly than older children with NH on more complex listening tasks.

• Individual looking behaviors vary
  – Under some conditions, it is possible that attempting to visualize the talker may inefficiently utilize cognitive resources that would otherwise be allocated for comprehension.
Summary

• Multiple factors can influence how we understand the potential difficulties that may be experienced by children with MMHL.

• Tasks representing the types of listening and learning activities experienced in classrooms under plausible acoustic conditions may be better indicators of real-world speech understanding in these environments than simple speech recognition tasks.
Thanks for listening!