Impact of Minimal Hearing Loss in Children

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GENERAL DEFINITIONS

• Minimal HL: AC thresholds from 16 dB HL to 25 dB HL
  – a.k.a. as slight, borderline normal
• Mild HL: AC threshold between 25 and 40-45 dB HL
• Unilateral HL: AC thresholds >20 dB HL in the affected ear with thresholds in the good ear <15 dB HL
• High-frequency HL: AC thresholds >25 dB HL for 2 or more frequencies above 2 kHz
• All losses may be conductive or sensorineural

A Global Definition

• Minimal Hearing loss can include:
  – Unilateral sensorineural hearing loss
  – Slight bilateral sensorineural hearing loss
  – High-frequency sensorineural hearing loss
  – Conductive hearing loss that is fluctuating, temporary, or long-term

What do we know about the effects of minimal hearing loss?

• What does research tell us?
Potential Difficulties Experienced by Children with Minimal Hearing Loss: Summarizing the Research

• Speech/language issues
  — Culbertson & Gilbert, 1986; Oyler et al, 1987, 1988; Lieu et al, 2010

• Poorer perception of soft or distant speech as well as speech in noise and/or reverberation
  — Bess et al, 1986; Crandell, 1993; Culberston & Gilbert, 1986; Johnson et al, 1997; Ruscetta et al, 2005

• Localization difficulties
  — Bess et al, 1986; Newton, 1983

• Increased listening effort
  — Hicks & Tharpe, 2002**

• Higher rate of grade retention

• Require additional educational assistance (not performing at grade level)
  — Bess & Tharpe, 1986; Oyler et al, 1987, 1988; English & Church, 1999

• Lower scores on verbal academic tests
  — Culbertson & Gilbert, 1986; Oyler et al, 1987, 1988

• Lower full-scale IQ
  — Klee & Davis-Dansky, 1986
Potential Difficulties Experienced by Children with Minimal Hearing Loss: Summarizing the Research

- Poorer teacher ratings in numerous areas (e.g., communication, attention, behavior, adaptation, responsibility)
- Poorer perceived functional health (e.g., self esteem, energy and stress, social support)
  - Bess et al, 1998

Potential Difficulties Experienced by Children with Minimal Hearing Loss: Summarizing the Research

- Issues related to physical, social, and emotional functioning
  - Borton et al, 2010
- Right-sided UHL may have more deleterious effects than left-sided UHL
- Greater degrees of HL in poorer ear may have more deleterious effects
  - Bess et al, 1986; English & Church, 1999; Klee & Davis-Dansky, 1986

Let’s look at a few examples
Bess and Tharpe, 1986

- 60 children with USHL selected from patient files
- Only 23% of children had HL identified before 5 years of age (mean = 5.68 yr)
- 35% had failed at least one grade (1 had failed 2 grades)
- 13.3% were receiving resource help
- All received “preferential seating”
- 20% described by teachers as having some behavior problems

UHL

- Subgroup of 25 children (6-13 yrs) selected for further testing compared to 25 children with NH
- Localization and speech recognition in children with USHL (Bess et al, 1986)
  - Children with USHL exhibited greater localization errors and errors increased with increasing degree of HL

- Children with USHL exhibited poorer speech recognition under all conditions
  - With speech to the impaired ear, children with greater degree of UHL performed more poorly
  - With speech to the better ear, those children with RE impairment performed more poorly at poorer SNRs
  - With speech to the better ear, children who had failed a grade performed more poorly than those who had not
English & Church, 1999

- UHL update
- Questionnaires sent to educational audiologists
- Records review of 423 children from across the United States
- Used a high-frequency average (1, 2, 4 kHz) to rule out children with transient conductive losses

Grade retention is no longer a widely recommended educational practice

- Additional educational difficulties (22%)
  - Learning disabilities 13%
  - Mental retardation 4%
  - Vision (not correctable with lenses) 3%
  - ADHD 2%
  - Autism 0.2%

15% had behavioral concerns but, by report, almost ½ of those had additional contributing factors

- 54% received additional SPED Services (other 46%—monitoring only)
  - 27% fit and monitor amplification
  - 16% resource room support only
  - 6% speech/language/listening therapy only
  - 5% combination of services
• Overall Academic Performance
  – 13% above average
  – 63% average
  – 24% below average
  • Consistent with a randomly drawn sample
• More males received SPED services
• SPED services increased as degree of HL in poor ear increased

Crandell, 1993

• Compared speech recognition in noise for 20 children with NH and 40 children with MSHL (ages 5-15 yrs)
  – PTA between 15-30 dB HL in at least one ear with no AC threshold worse than 45 dB HL from 250-4000 Hz.
• Americanized version of BKB Sentence test
  – Speech at 65 dB SPL
  – Noise at +6, +3, 0, -3, and -6 dB SNR

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>NH (%)</th>
<th>MSHL (%)</th>
<th>Difference</th>
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<tbody>
<tr>
<td>Quiet</td>
<td>99.7</td>
<td>96.3</td>
<td>3.4</td>
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<tr>
<td>+6</td>
<td>96.2</td>
<td>83.5</td>
<td>12.7</td>
</tr>
<tr>
<td>+3</td>
<td>94.7</td>
<td>74.9</td>
<td>19.8</td>
</tr>
<tr>
<td>0</td>
<td>93.2</td>
<td>67.3</td>
<td>25.9</td>
</tr>
<tr>
<td>-3</td>
<td>84.4</td>
<td>53.8</td>
<td>30.6</td>
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<tr>
<td>-6</td>
<td>70.7</td>
<td>38.1</td>
<td>33.6</td>
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</tbody>
</table>
Bess et al, 1998

- 1218 children from the same school district
- 3 categories of MSHL:
  - BSHL (20-40 dB HL)
  - HFSHL (>25 dB HL at 2 or more freq above 2 kHz)
  - USHL (>20 dB HL in impaired ear and ≤15 dB HL in other ear)
- Students in 3rd, 6th, and 9th grades

Compared children with MSHL to matched group on children with NH
- Audiological evaluations
- Comprehensive Test of Basic Skills (CBTS) from school records
- SIFTER completed by teachers
- Revised Behavior Problem Checklist (RBPC) administered to teachers
- Data on grade retention from school records
- COOP Adolescent Chart Method

Prevalence of HL
- USHL—3.0% (37)
- BSHL—1.0% (12)
- HFSHL—1.4% (17)
• SIFTER (collapsed across all grades)
  — A greater percentage of children with MHL displayed marginal or failure scores for all subtests (academics, attention, communication, participation, school behavior)
  • Only statistically significant for the communication subtest
  • Possible influence of subject numbers per group
    — MHL=29; Control=105

• Grade retention

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<th>3rd</th>
<th>6th</th>
<th>9th</th>
</tr>
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<tbody>
<tr>
<td>District Average**</td>
<td>2%</td>
<td>3%</td>
<td>8%</td>
</tr>
<tr>
<td>MHL</td>
<td>29%</td>
<td>36%</td>
<td>47%</td>
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• Functional health
  — Grade 6
    • MHL subjects showed significantly greater dysfunction in the areas of self-esteem and energy
  — Grade 9
    • MHL subjects showed significantly greater dysfunction in the areas of social support, stress, and self-esteem
But…..

- Some studies have shown performance similar to peers with NH on some measures
- Some studies have suggested that children with MHL may “catch up” in specific areas as they get older

Kiese-Himmel, 2001

- 31 children with UHL, ages 1-10 years
- All children fitted with hearing aids following identification of HL
- 4-year study
- Non-verbal intelligence within normal range
- Slight delay in use of 2-word phrases
- Only 2 children scored below age level for receptive vocabulary and 4 below age level for expressive vocabulary
- All WNL on 6 subtests of German version of ITPA

Colletti et al, 1988

- 40 adults who were identified with UHL before school age and had no other significant general or neurologic disorders
- Compared to control group with NH matched for age and gender
- Questionnaire to identify objective and subjective indices of psychosocial disability and handicap
No differences

- Scholastic achievement
- Type of employment
- Use of sedatives and alcohol
- Scores on Social Problems Questionnaire

Differences

- Speech recognition in noise
- Sound localization
- Hobbies involving listening to or playing music
- Attending theatre performances, etc.
- UHL group perceived fewer problems with phone conversations in noise

Bess et al., 1998

- California Test of Basic Skills scores were significantly lower for children with MHL when compared to children with NH in 3rd grade but not in 6th and 9th grades
- No significant differences between groups at any grade on the Revised Behavior Problem Checklist
So, why don’t we have a consensus?

- Viewing the problem from multiple perspectives
- Difficulties may vary depending on hearing loss configuration
- Tests may not be sensitive to subtle difficulties experienced by this population

Multiple Perspectives

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

Newton, 1983

- Study of sound localization in children with severe unilateral hearing loss
- Subjects with UHL had much greater spread of errors across 3 types of sounds
  - 500 Hz PT, 500 Hz NBN, HP noise at 3 kHz
- 57% of the subjects were not aware of any difficulties prior to the study
Dancer et al., 1995

- Students with UHL demonstrated lower performance on most measures...
- ...but were rated as working up to their potential
- Results suggest lower expectations for children with UHL
  - Could affect willingness of both teacher and student to provide academic challenges

Oyler et al, 1988

- Teachers rated children with UHL as performing adequately when compared to classmates
- "5 times as many children [with HL] were receiving special services and 10 times as many had repeated one or more grades"

Culbertson & Gilbert, 1986

- Teachers rated children with UHL more negatively than age-matched peers with NH on 4 of 5 categories
  - Attention to academic task
  - Peer relations and social confidence
  - Dependence-independence
  - Emotional lability
- No difference between two groups of children in terms of their self-concept
Stein, 1981

- School-age children with UHL
- Low correlations between parent and teacher ratings of children's behavior
- Parents perceived more problems than teachers
- Perspectives?

Hearing-Loss Characteristics

- Unilateral HL
  - Sound localization
  - Speech perception in noise
  - Speech to poor ear
- Bilateral and HF HL
  - Speech perception in noise
  - Especially for HF speech sounds
- Difficulties as a result of HL may be misinterpreted as behavior, attention, etc.

Sensitivity of Tests

- Educational performance
  - Multiple factors interacting
- Speech/language
  - Advanced language skills
    - Social reasoning
    - Discourse participation
    - Complex narratives, syntax, vocabulary
- Can the test address a wide variety of areas sufficiently?
What now?

• Look beyond the basics
• Systematic examination of a range of skills that support language and learning
  – Speech perception in real environments (or realistic simulations)
  – Listening effort
  – Advanced language skills
• Social/emotional development
• Variety of measures across age ranges

A Great Resource re: MHL
http://www.cdc.gov/ncbddd/ehdi/unilateralhi.htm

“Minimal is not inconsequential”

(Fred Bess, 2004...as quoted in the Proceedings from the National Workshop on Mild and Unilateral Hearing Loss, 2005)
Thanks for listening!

References


References


References

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