Hearing Loss, Hearing Aids, and the Business of Learning

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http://pedamp.asu.edu/presentations
Disclosures

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Learning New Words

That's a kitten.
Learning New Words

That’s the manubrium of the malleus.

Manubrium of the malleus

The what?

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A word isn’t really learned until it can be retrieved.
That’s why we make university students take tests.

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Vocabulary Learning and Hearing Loss


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Hearing Loss and Vocabulary Knowledge

College Students
97 Normal Hearing
93 Mild to Profound Hearing Loss


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Hearing Loss and Vocabulary Knowledge

College Students
89 Normal Hearing
25 w/Cochlear Implants <3.5 yrs
68 w/Cochlear Implants >3.5 yrs

Covertino et al (2014) Word and World Knowledge Among Deaf Learners With and Without Cochlear Implants, J Deaf Studies and Deaf Ed, 19;4

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How many words do children need to learn?

The average college student knows between 15,000 and 200,000 words (D’Anna et al 1991)

50,000 words
Learned over 18 years (3 to 22 years)
= 7 new words everyday

1,000 new words every year
= 3 new words every day
How is Word Learning Tested?
We’re looking for a blag.
Incidental Word-Learning Paradigms

Which one is the blag?


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Incidental Word-Learning Paradigms

Pittman et al. (2005) Rapid word-learning in normal-hearing and hearing-impaired children... Ear & Hearing, 26(6), 619-629.

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Rapid Word-Learning Paradigms


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Learning Speed:
3 = 1 trial (perfect learning)
2 = 10 trials
1 = 100 trials
0 = 1000 trials (no learning)

\[ P_c = 1 - 0.80e^{-n/c} \]
What Affects Word Learning?
Musical Training?

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Musicians</td>
<td>20</td>
<td>19 yrs</td>
</tr>
<tr>
<td>Non-Musicians</td>
<td>20</td>
<td>&lt;1 yr</td>
</tr>
</tbody>
</table>

Bilingual?

<table>
<thead>
<tr>
<th>Language</th>
<th>Hearing</th>
<th>Age</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monolingual</td>
<td>NH</td>
<td>8-12</td>
<td>20</td>
</tr>
<tr>
<td>Bilingual</td>
<td>NH</td>
<td>8-12</td>
<td>20</td>
</tr>
</tbody>
</table>

Hearing Loss? Aids


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Bilingual with Hearing Loss and Hearing Aids?

**Graphs:**
- **Frequency (kHz):**
  - Monolingual
  - Bilingual
- **Hearing Level (dB HL):**
  - 0.25
  - 0.5
  - 1
  - 2
  - 4
  - 8

**Table:**

<table>
<thead>
<tr>
<th>Language</th>
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<th>Age</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monolingual</td>
<td>HL</td>
<td>8-12</td>
<td>20</td>
</tr>
<tr>
<td>Bilingual</td>
<td>HL</td>
<td>8-12</td>
<td>13</td>
</tr>
</tbody>
</table>

**Figure:**
- Monolingual vs. Bilingual Learning Speed
- Language: English, Spanish, Arabic
- Hearing: Monolingual, Bilingual
- Age: 8-12

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Unilateral Loss?

<table>
<thead>
<tr>
<th>Group</th>
<th>Age</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unilateral</td>
<td>8-12</td>
<td>12</td>
</tr>
<tr>
<td>Bilateral</td>
<td>8-12</td>
<td>21</td>
</tr>
</tbody>
</table>

Listening Condition

|| Normal Hearing | Bilateral Loss | Unilateral Loss |
|----------------|---------------|----------------|
| Spanish        | Arabic        | Spanish        | Arabic         | Spanish        | Arabic         |

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Listening in Noise?

8-9 Year Olds

11-12 Year Olds

Performance (%)

Trials

Normal-Hearing Children


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Listening in Noise?

8-9 Year Olds

11-12 Year Olds

Performance (%)

Trial

Hearing-Impaired Children


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Digital Noise Reduction?

- **Group**: Children w/HL: 8-12 yrs, n = 13; Adults w/HL: 52-78 yrs, n = 13


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High-Frequency Amplification?


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Is rapid word-learning durable?

Learning

Retention Posttest

Word Bank

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Is rapid word-learning durable?

Children

8-15 years
33 Normal Hearing
22 Hearing Loss

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What Have We’ve Learned?

Learning is a fundamental skill acquired early and maintained throughout life.

Specific aspects of learning can be measured.

Uncorrected hearing loss impedes learning.

Corrected hearing loss (amplification) significantly improves learning for both children and adults.

But, there is more work to do because children with hearing loss have difficulty retaining rapidly learned words as well as their normally hearing peers.