Auditory and Demographic Factors Affecting Word Learning in Children (and Adults)

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

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PHONAK
life is on

IRC Hearing Industry Research Consortium

Arizona Community Foundation

oticon MEDICAL Because sound matters

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(and many more)  (and many more)  (and many more)  (and many more)

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Learning New Words

That’s a kitten.
Learning New Words

That’s the manubrium of the malleus.

The what?
Performance (% Correct): \( P_c = 1 - 0.80e^{-n/c} \)

Learning Speed:
- 3 = 1 trial (perfect learning)
- 2 = 10 trials
- 1 = 100 trials
- 0 = 1000 trials (no learning)
What Affects Word Learning?
Musical Training?

Years of Experience?

53 dB SPL
+3 dB signal-to-noise

<table>
<thead>
<tr>
<th>Hearing</th>
<th>n</th>
<th>Age (yrs)</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>20</td>
<td>8-12</td>
<td>Children</td>
</tr>
<tr>
<td>Normal</td>
<td>20</td>
<td>50-67</td>
<td>Adults</td>
</tr>
</tbody>
</table>

Bilingualism?

Hearing Loss?


<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Age (yrs)</th>
<th>Hearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>20</td>
<td>8-12</td>
<td>Normal</td>
</tr>
<tr>
<td>Children</td>
<td>21</td>
<td>8-12</td>
<td>Loss</td>
</tr>
<tr>
<td>Adults</td>
<td>15</td>
<td>50-67</td>
<td>Normal</td>
</tr>
<tr>
<td>Adults</td>
<td>17</td>
<td>52-78</td>
<td>Loss</td>
</tr>
</tbody>
</table>

- Learning Speed (log 1000/n)
Unilateral Hearing Loss?

Corrected Hearing Loss?

Corrected Hearing Loss?

Other Hearing Devices?


<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Age (yrs)</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>16</td>
<td>8-12</td>
<td>Transcutaneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Percutaneous</td>
</tr>
</tbody>
</table>

65 dB SPL

1 meter

Learning Speed (log 1000/n)

<table>
<thead>
<tr>
<th>Coupling Condition</th>
<th>Transcutaneous</th>
<th>Percutaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td></td>
<td></td>
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</table>
Noise?

Noise? Digital Noise Reduction

![Graph showing hearing level and learning speed](image)

**Table:**

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<th>Age (yrs)</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children</td>
<td>21</td>
<td>8-12</td>
<td>DNR off</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DNR on</td>
</tr>
</tbody>
</table>

- Hearing Level (dB re: ANSI 1989)
- Listening Condition
- Learning Speed (log 1000/n)

Noise? Directional Microphones

Frequency (Hz)
250 500 1000 2000 4000 8000

Hearing Level (dB)

Aided Binaural
-20 0 20 40 60 80 100 120

Unaided Right

Unaided Left

NH Binaural

Beamforming Technology

Word Recognition

70 dB SPL +10 dB signal-to-babble

NH

HL

Group n Age (yrs) Hearing
Children 26 8-17 Normal
Children 19 9-15 Loss

Pittman (in process) Learning new auditory information with three types of directional microphone technology, Phonak
Noise? Directional Microphones

Frequency (Hz)
250  500  1000  2000  4000  8000

Hearing Level (dB)

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<tr>
<td>Children</td>
<td>26</td>
<td>8-17</td>
<td>Normal</td>
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<tr>
<td>Children</td>
<td>19</td>
<td>9-15</td>
<td>Loss</td>
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</tbody>
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70 dB SPL
+10 dB signal-to-babble
Beamforming Technology

Learning Speed (log 1000/n)

NH  HL
Omni  Omni  Dir

Pittman (in process) Learning new auditory information with three types of directional microphone technology, Phonak
What have we learned?

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

Auditory proficiency, age, and language experience do not enhance the speed of word learning.

Hearing loss of any kind slows learning significantly.

Acoustic competitors slow learning significantly for everyone.

Corrected hearing loss significantly improves word learning speed.

While some noise management features can benefit speech perception, they appear to have little effect on word learning.
The End

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