Learning new words: Benefit of signal quality and quantity

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Disclosures

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![Oticon Medical](image)

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(and many more)

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- Ravi Sockalingam – Oticon Medical, US
- Liz Presson – Oticon Medical, US
Bone Conduction Amplification in Children: Stimulation via a Percutaneous Abutment versus a Transcutaneous Softband
Andrea L. Pittman

Word Recognition and Learning: Effects of Hearing Loss and Amplification Feature
Andrea L. Pittman¹, Elizabeth C. Stewart¹, Amanda P. Willman¹, and Ian S. Odgear¹

Detecting and Learning New Words: The Impact of Advancing Age and Hearing Loss
Andrea L. Pittman, Elizabeth C. Stewart, Ian S. Odgear, and Amanda P. Willman
Learning New Words

That’s a kitten.
Learning New Words

That's the manubrium of the malleus.

Manubrium of the malleus

The what?
A word isn’t really learned until it can be retrieved.
Learning New Words

Kitty!!
Learning something new

That’s why we make university students take tests.

Manulleus of the malibrium

Nasopharyngeal uvula?

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Vocabulary Learning and Hearing Loss

185 Normal Hearing
159 Hearing Loss
5-17 years of age

Bone-Anchored Hearing Device Applications

Conventional Skin-Drive

Percutaneous Direct-Drive


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# Bone-Anchored Hearing Device Applications

<table>
<thead>
<tr>
<th>Authors</th>
<th>Configuration</th>
<th>Subjects</th>
<th>Speech Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kara et al (2016)</td>
<td>Abutment vs. Softband</td>
<td>Adults and Children</td>
<td>Significant*</td>
</tr>
<tr>
<td>Verstraeten et al (2009)</td>
<td>Abutment vs. Softband</td>
<td>Adults</td>
<td>Abutment +10% better</td>
</tr>
<tr>
<td>Hol et al (2013)</td>
<td>Abutment vs. Magnet</td>
<td>Children</td>
<td>Abutment +7% better</td>
</tr>
</tbody>
</table>
To determine if the benefit of direct stimulation is limited to small improvements in speech perception or if direct stimulation also improves performance for auditory processes important for learning new information.
Method

Test Parameters
- 50 dB SPL in quiet
- 0° azimuth

Data Collection
- Computer interface
- Digital audio recordings

Tasks
1. Word recognition
2. Lexical decision
3. Non-word detection
4. Rapid word learning
Method

Participants
17 children with abutments
10 boys, 7 girls
7 – 15 years
14 bilateral conductive
1 unilateral conductive
2 unilateral profound

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Method
Fitting & Testing

Direct Drive

Skin Drive

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Method

Verification

Interacoustics Affinity Hearing Aid Analyzer with SHS10 Skull Simulator
Method

Verification

![Graph showing device output and difference (Skin-Direct) for different frequencies. The graph compares Skin Drive and Direct Drive.]
Method

Verification

Aided Sound-Field Thresholds

- Skin Drive
- Direct Drive

Difference (Skin-Direct)

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Air-Conduction Hearing Device Applications

21 children with SN hearing loss (8-12 years)

Oticon miniAlta RITE

FF Thresholds
- 10 kHz
- 4 kHz

Level (dB SPL)

Frequency (Hz)

4 kHz
10 kHz

sothnud
doztul
fosnush
stomun
homtul


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Word Recognition  NU-6 Word Lists (25 words)

21 children with SN hearing loss (8-12 years)

Oticon miniAlta RITE


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**Word Recognition** NU-6 Word Lists (25 words)

Direct stimulation improved perception of familiar words.

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>79%</td>
<td>72%</td>
</tr>
<tr>
<td>SD</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>N</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

F(1,15)=10.014, \( p=.006 \), N=.40

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Auditory Lexical Decision

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swin</td>
<td>Swim</td>
</tr>
<tr>
<td>Not Real</td>
<td>Not Real</td>
</tr>
</tbody>
</table>

“Swin”


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Auditory Lexical Decision

FF Thresholds
- 10 kHz
- 4 kHz

Oticon miniAlta RITE

21 children with SN hearing loss (8-12 years)

Wideband Amplification (% correct)

Narrowband Amplification (% correct)


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Auditory Lexical Decision

Direct stimulation improved children’s lexical decisions.

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>72%</td>
<td>59%</td>
</tr>
<tr>
<td>SD</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>N</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

F(1,15)=11.948, p=.004, N=.44

Δ17%
# Non-Word Detection 1.0

<table>
<thead>
<tr>
<th># of nonsense words</th>
<th>Example phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Clocks tick on time.</td>
</tr>
<tr>
<td>1</td>
<td>Birds <em>rike</em> long worms.</td>
</tr>
<tr>
<td>2</td>
<td><em>Dats</em> catch slow <em>bice</em>.</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
</tr>
</tbody>
</table>

**Dats catch slow bice.**


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Non-Word Detection 1.0

Oticon miniAlta RITE

21 children with SN hearing loss (8-12 years)


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Non-Word Detection 2.0

<table>
<thead>
<tr>
<th># of nonsense words</th>
<th>Example phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Clocks tick on time.</td>
</tr>
<tr>
<td>1</td>
<td>Birds <em>rike</em> long worms.</td>
</tr>
<tr>
<td>2</td>
<td><em>Dats</em> catch slow <em>bice</em>.</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
</tr>
</tbody>
</table>

*Dat* catch slow *bice*.
Non-Word Detection 2.0

Direct stimulation did NOT improve detection of unfamiliar words in context.

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1.41</td>
<td>1.18</td>
</tr>
<tr>
<td>SD</td>
<td>0.95</td>
<td>1.08</td>
</tr>
<tr>
<td>N</td>
<td>17</td>
<td>17</td>
</tr>
</tbody>
</table>

$F(1,16)=1.975, \ p=0.179, \ N=0.11$
Non-Word Detection 2.0

Pittman (in prep) Effects of audibility on the lexical decisions of children and adults with hearing loss.
Rapid Word Learning

homtul
stomun
doztuls
doztul
Rapid Word Learning

\[ P_c = 1 - 0.80e^{-n/c} \]

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

Rapid Word Learning


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Rapid Word Learning

Direct stimulation significantly improved the speed of word learning.

<table>
<thead>
<tr>
<th></th>
<th>Direct</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trials</td>
<td>60</td>
<td>166</td>
</tr>
<tr>
<td>SD</td>
<td>.21</td>
<td>.16</td>
</tr>
<tr>
<td>N</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

F(1,15)=7.694, p=.014, N=.34
Across-Task Benefit

Number of Tasks Showing Benefit with the Direct Drive

Age (years)

Unilateral (Conductive, SSD)
Bilateral (Conductive)

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What have we learned?

Detecting new words is directly related to the audibility of the auditory signal.

Learning new words is related to the clarity of the auditory signal.

Detecting and learning new words is not related to:

1) type of hearing loss
2) type of amplification device.
thank you
Little Variations Have Big Effects

Flores & Lasrado (in progress) Performance Variability between the Cochlear Americas™ SoundArc & Softband: Implications for device selection. AuD Research Project
Little Variations Have Big Effects

Flores & Lasrado (in progress) Performance Variability between the Cochlear Americas ™ SoundArc & Softband: Implications for device selection. AuD Research Project

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