Learning new words: Benefit of signal quality and quantity

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Disclosures

This work was supported by grants from:

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(And many more)

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Ravi Sockalingam – Oticon Medical, US
Liz Presson – Oticon Medical, US

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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. Odgeare¹

Detecting and Learning New Words: The Impact of Advancing Age and Hearing Loss
Andrea L. Pittman, Elizabeth C. Stewart, Ian S. Odgeare, 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?

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

Kitty!!
Manulleus of the malibrium

Nasopharyngeal uvula?

That’s why we make university students take tests.
Vocabulary Learning and Hearing Loss

Bone-Anchored Hearing Device Applications

Conventional Skin-Drive

Percutaneous Direct-Drive


## 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>
Learning something new

**Purpose**

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.

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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

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
Method

Verification

Interacoustics Affinity Hearing Aid Analyzer with SHS10 Skull Simulator
Method

Verification

The diagram shows a comparison of device output in dB μN across different frequencies (kHz) for Skin Drive and Direct Drive. The difference in device output (Skin-Direct) is also displayed in a bar chart.

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Method

Verification

Aided Sound-Field Thresholds

- Skin Drive
- Direct Drive

In-Situ Hearing Threshold (dB HL)

Difference (Skin-Direct)

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Air-Conduction Hearing Device Applications

Oticon miniAlta RITE

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

FF Thresholds
- 10 kHz
- 4 kHz


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Direct stimulation improved perception of familiar words.

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

F(1,15)=10.014, \( p=0.006 \), N=.40
Auditory Lexical Decision


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Auditory Lexical Decision

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

Oticon miniAlta RITE

FF Thresholds
- 10 kHz
- 4 kHz

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>

\[ F(1,15)=11.948, \ p=.004, \ N=.44 \]
## 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 rike long worms.</td>
</tr>
<tr>
<td>2</td>
<td>Dats catch slow bice.</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
</tr>
</tbody>
</table>

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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>ripe</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*. © 2019 Pittman All Rights Reserved
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>

$F(1,16)=1.975, \ p=.179, \ N=.11$
Non-Word Detection 2.0

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

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Rapid Word Learning

- homtul
- doztul
- stomun
- doztuls
Rapid Word Learning

Learning something new

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

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

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Rapid Word Learning

FF Thresholds
- 10 kHz
- 4 kHz

Oticon miniAlta RITE

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

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>

\[ F(1,15)=7.694, \ p=.014, \ N=.34 \]
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 ...
  ... independent of the type of hearing loss
  ... independent of the type of amplification device.
thank you