Does premium listening require premium hearing aids?

Effectiveness of basic and premium hearing aids on speech understanding and listening effort outcomes.

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For many adults seeking help for hearing difficulties ...

- The first step toward aural rehabilitation is selection of a hearing aid.
Levels of Hearing Aid Technology

- Basic
- Mid-level
- Premium
Several features that target speech understanding and listening effort differ for premium and basic hearing aids.
Premium tech = premium listening?

• Premium technologies are accompanied by explicit and implicit promises of improved performance with these devices.
• Many audiologists feel pressured to recommend higher-cost technologies to ensure that their clients have access to the best listening assistance available, and to provide the best basis for optimizing their clients’ listening skills.
Premium tech = premium listening?

- Premium tech = premium cost
- Older adults are at risk for reduced SES.
- For these patients increased costs for premium devices are major financial sacrifices
The problem:

- Independent research has not demonstrated that use of premium-level technology results in better everyday speech understanding or listening effort outcomes than use of basic-level technology.
- Such evidence is needed to help end-users make cost-effective decisions when purchasing hearing aids.
Purpose

- This research evaluated exemplars of basic and premium hearing aid technology from two major hearing aid manufacturers with the goal of evaluating speech understanding and listening effort performance in the laboratory and in the real-world.
Research Questions

In the laboratory and in daily life, are speech understanding and listening effort:

1. Better with hearing aids compared to without?
2. Further improved with examples of premium hearing aids compared to basic?
Participants

- 45 participants (30M, 15F)
- Age: 61 to 81 (M=70.3, SD=5.5)
- Symmetric mild to moderate sensorineural hearing loss
- English as first language
Design (e.g.)

Brand A
- Prefit
- Basic
- Premium

Brand B
- Premium
- Basic

Counterbalanced
Wash-out

Counterbalanced
Counterbalanced
Hearing aid fittings

- Bilateral, with appropriate coupling
- Fitted using best-practice protocols, starting with NAL targets
- Features set to manufacturers’ recommendations.
- 3 manually selectable programs:
  - “everyday” - default automatic
  - “look and listen” - fixed front-facing directional
  - “speech finder” - for 360° listening
Outcomes

- Assessed prior to the first hearing aid fitting*, and again after a 4 week acclimatization with each pair of hearing aids
  - **Self-report measures:**
    - Abbreviated Profile of Hearing Aid Benefit (APHAB) *Cox & Alexander, 1995*
    - Device-Oriented Subjective Outcome (DOSO) Scale *Cox, Alexander & Xu, 2014*
    - Speech, Spatial, and Qualities of Hearing Scale (-Benefit) (SSQ & SSQ-B) *Gatehouse & Noble, 2004; Jensen et al., 2009*
  - **In the laboratory –**
    - American Four Alternative Auditory Feature (AFAAF) test. *Xu & Cox, 2014*
    - Three simulated environments with soft, average, and loud noise.

* Responses to the SSQ were collected pre-hearing aid fitting only
  Responses to the DOSO and SSQ-B questionnaires were collected post-hearing aid fitting only
Laboratory Outcome Measure

- AFAAF
  - Example prompt: “Can you hear OLD clearly?”
  - Select from: HOLD, OLD, COLD, GOLD
- 80 items for each listening environment.
- HA set to default program
Laboratory Outcome Measure

- **Speech Understanding:**
  - Proportion correct scores were converted to rationalized arcsine units (RAUs) for analysis. *Studebaker, 1985*

- **Listening Effort**
  - Measured simultaneously with speech understanding. Rated after blocks of 20 words. Ratings were averaged for each environment.

<table>
<thead>
<tr>
<th>Listening Effort Scale</th>
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</thead>
<tbody>
<tr>
<td>1. No effort</td>
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<tr>
<td>2. Very little effort</td>
</tr>
<tr>
<td>3. Little effort</td>
</tr>
<tr>
<td>4. Moderate effort</td>
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<tr>
<td>5. Considerable effort</td>
</tr>
<tr>
<td>6. Much effort</td>
</tr>
<tr>
<td>7. Extreme effort</td>
</tr>
</tbody>
</table>
Results
Statistical comparisons

- A priori planned contrasts of:
  - Unaided and Aided (Question 1)
  - Basic and Premium (Question 2)
    - Basic and Premium (Brand A)
    - Basic and Premium (Brand B)
Speech Understanding
Question 1- Was speech understanding better with hearing aids compared to without?

- In the laboratory
- In daily life
Question 1 - Was Aided better than Unaided?

Speech: 62 dB SPL
+5 dB SNR

$p < .001$

Speech understanding (RAU)

Unaided
Basic A
Basic B
Premium A
Premium B

Average listening levels
Question 1 - Was Aided better than Unaided?

For each speech level:

**Soft**
- Unaided: 50
- Basic A: 60
- Basic B: 70
- Premium A: 80
- Premium B: 90

**Average**
- Unaided: 80
- Basic A: 90
- Basic B: 95
- Premium A: 100
- Premium B: 100

**Loud**
- Unaided: 100
- Basic A: 100
- Basic B: 100
- Premium A: 100
- Premium B: 100

**Daily Life**
- Unaided: 40
- Basic A: 50
- Basic B: 60
- Premium A: 70
- Premium B: 80

Significance levels:
- Soft: $p < .001$
- Average: $p < .001$
- Loud: $p < .005$
- Daily Life: $p < .001$
Question 1- Was speech understanding better with hearing aids compared to without?

- In the laboratory: **Yes.**
- In daily life: **Yes.**
Question 2- Was speech understanding further improved with examples of Premium hearing aids compared to Basic hearing aids?

- In the laboratory
Question 2- Was Premium better than Basic?

Speech understanding (RAU)

Speech: 55 dB SPL  
+10 dB SNR

Soft listening levels

Unaided  Basic A  Basic B  Premium A  Premium B
Question 2 - Was Premium better than Basic?

Speech understanding (RAU)

Speech: 55 dB SPL +10 dB SNR

Unaided
Basic A
Basic B
Premium A
Premium B

Soft listening levels

NS
Question 2- Was Premium better than Basic?

Speech: 55 dB SPL +10 dB SNR

Speech understanding (RAU)

Soft listening levels

Unaided Basic A Basic B Premium A Premium B

NS
Question 2- Was Premium better than Basic?

Speech: 62 dB SPL +5 dB SNR

Average listening levels

Speech understanding (RAU)

Unaided | Basic A | Basic B | Premium A | Premium B

NS
Question 2 - Was Premium better than Basic?

Speech understanding (RAU)

<table>
<thead>
<tr>
<th>Average listening levels</th>
<th>Unaided</th>
<th>Basic A</th>
<th>Basic B</th>
<th>Premium A</th>
<th>Premium B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speech: 62 dB SPL</td>
<td>NS</td>
<td></td>
<td></td>
<td>+5 dB SNR</td>
<td></td>
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Speech: 62 dB SPL
+5 dB SNR
Question 2- Was Premium better than Basic?

Speech understanding (RAU)

Average listening levels

Speech: 62 dB SPL +5 dB SNR

Unaided Basic A Basic B Premium A Premium B

NS

Basic B

Premium B
Question 2- Was Premium better than Basic?

Speech: 70 dB SPL
0 dB SNR

Speech understanding (RAU)

Unaided  Basic A  Basic B  Premium A  Premium B

Loud listening levels
Question 2- Was Premium better than Basic?

Speech understanding (RAU)

<table>
<thead>
<tr>
<th>Loud listening levels</th>
<th>Unaided</th>
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<th>Basic B</th>
<th>Premium A</th>
<th>Premium B</th>
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<td>90</td>
<td></td>
<td></td>
<td>100</td>
<td></td>
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<tr>
<td>0 dB SNR</td>
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*NS*
Question 2- Was Premium better than Basic?

Speech understanding (RAU)

<table>
<thead>
<tr>
<th></th>
<th>Unaided</th>
<th>Basic A</th>
<th>Basic B</th>
<th>Premium A</th>
<th>Premium B</th>
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<tbody>
<tr>
<td>NS</td>
<td></td>
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Speech: 70 dB SPL
0 dB SNR
Question 2- Was speech understanding further improved with examples of Premium hearing aids compared to Basic hearing aids?

- In daily life...
Question 2- Was Premium better than Basic?

Three questionnaires combined

Speech Understanding Benefit

<table>
<thead>
<tr>
<th></th>
<th>Basic A</th>
<th>Basic B</th>
<th>Premium A</th>
<th>Premium B</th>
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<tbody>
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<td></td>
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</table>

NS
Question 2- Was Premium better than Basic?

Three questionnaires combined

Speech Understanding Benefit

Basic A

Premium A

NS
Question 2- Was Premium better than Basic?
Question 2- Was speech understanding further improved with examples of Premium hearing aids compared to Basic hearing aids?

- In the laboratory: **No.**

- In daily life: **No.**

  - These findings held when exemplars from each brand were compared separately.
Listening Effort
Question 1- Was listening effort reduced with hearing aids compared to without?

• In the lab
Question 1 - Was Aided less than Unaided?

Speech: 62 dB SPL
+5 dB SNR

More effort

$p < .001$

Listening Effort Rating

More effort

Average listening levels

Unaided
Basic A
Basic B
Premium A
Premium B

Less effort
Question 1 - Was Aided less than Unaided?

The bar charts illustrate the Listening Effort Ratings for different conditions: Unaided, Basic A, Basic B, Premium A, and Premium B. The conditions are categorized into three levels: Soft, Average, and Loud.

- **Soft**: The chart shows a significant difference (p < .001) with Aided being less than Unaided.
- **Average**: The chart indicates a significant difference (p < .001) with Aided being less than Unaided.
- **Loud**: The chart does not show a significant difference (NS), indicating no significant difference between Aided and Unaided.

The bars are color-coded and labeled accordingly to represent each condition.
Question 1- Was listening effort reduced with hearing aids compared to without?

- In daily life
Question 1- Was listening effort reduced with hearing aids compared to without?

**Brand A**

- **Basic A**
- **UN vs Basic A**
- **Premium A**
- **UN vs Premium A**

**Brand B**

- **Basic B**
- **UN vs Basic B**
- **Premium B**
- **UN vs Premium B**

For both brands, there is a significant reduction in listening effort benefit with the use of hearing aids compared to without, indicated by the star and $p < .001$. The plots show a decrease in effort benefit with the use of hearing aids across different levels of unaided listening effort.
Question 1- Was listening effort reduced with hearing aids compared to without?

• In the laboratory: **Yes. For soft and average level speech.**

• In daily life: **Yes.**
Question 2- Was listening effort further reduced with examples of Premium hearing aids compared to Basic hearing aids?

• In the laboratory

• In daily life
Question 1- Is Premium better than Basic?

- Soft
- Average
- Loud
- Daily Life
Question 1- Is Premium better than Basic?
Question 1 - Is Premium better than Basic?
Question 2- Was listening effort further improved with examples of Premium hearing aids compared to Basic hearing aids?

• In the laboratory: **No.**

• In daily life:  **No.**
  - Overall, these findings held when exemplars from each brand were compared separately.
  - For loud-level speech listening effort was less with Brand B’s premium aids. This difference was small.
Summary

Using exemplars of basic and premium hearing aid technology from two major hearing aid manufacturers, speech understanding and listening effort in the laboratory and in daily life overall were:

1. Better with hearing aids compared to without.
2. Not further improved with examples of premium hearing aids compared to basic.
Take home message

• Older adults with uncomplicated, adult-onset, mild to moderate SNHL can receive substantial speech understanding and listening effort benefit with modern hearing devices when they are fitted using best-practice protocols.

• Premium-feature hearing aids are not a requirement for optimal listening for older adults with mild to moderate hearing impairment.
Take home message

• We should shift focus from technologic details to person-centered rehabilitation.

• More independent effectiveness research is needed for different hearing aid technologies across manufacturers.
Acknowledgement

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References
