High versus Low Technology Hearing Aids: What Drives User Preferences?

Audiology Online #
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Learner Outcomes

- After this course, participants will be able to describe feature differences between currently available premium and entry-level hearing aids, previous studies of hearing aid technology outcomes, as well as details of best-practices fitting protocols used in these studies.
- After this course, participants will be able to describe the outcomes, such as speech recognition and sound quality ratings, associated with each hearing aid model.
- After this course, participants will be able to describe the factors that drove user preference for either the entry-level or the premium device.

High tech & low tech hearing aids

- Today's consumer has a lot of choices! In this project, we aimed to understand:
  - Are **hearing aid outcomes different** with entry versus premium-level hearing aids when both are fitted following **best practices**?
  - Do hearing aid users **prefer one device over another** if both have good outcomes?
  - What **reasons** drive user preferences?

Today's Agenda

0-3 Minutes	Introduction.
3-10 Minutes	Hearing aid technology levels: past studies.
10-15 Minutes	What hearing aids we used (tech levels) in this study.
15-25 Minutes	Fitting protocols and laboratory outcome measures.
25-30 Minutes	Measurement of user preferences.
30-45 Minutes	User preference maps.
45-50 Minutes	Clinical Implications.
50-55 Minutes	Discussion

Premium hearing aid features

- Form factor?
  - RIC or small or extended-wear cost more.
- Improved signal processing?
  - Smoother adaptive behaviour?
  - Improved noise reduction?
  - Better sound quality?
- Accessories & compatibility?
  - Remote microphones?
  - TV adapters?
  - Remote controls?
- Bluetooth connectivity?
  - For **bilateral linking**: Improving ease-of-use (matched volume and program control) as well as directional microphone efficacy through binaural beamforming technology?
  - **Smartphone and tablet** connectivity: access to audio (music and calls) streamed directly to the hearing aid?
  - Applications (**apps**): sophisticated user controls, remote communication with the hearing health care provider?

PAST STUDIES OF HIGH VS. LOW TECH HEARING AIDS

COX & JOHNSON COMPANION PAPERS (2016; 2017)
WU ET AL., (2019)

Cox et al. (2016) & Johnson et al. (2016;2017)

Companion papers

- 45 adults with hearing loss completed all 4 trials
  - One month with each type; a washout period in between
- Two brands, basic & premium for each brands (2011)
  - More vs fewer channels; all had directional mics & DNR
  - More vs less binaural streaming and automatic adaptation
  - mini BTE with slimtubes
- Fittings followed best practices
  - Fitted to NAL-NL2 with REM
  - 3 manual programs *(everyday, look & listen, speech-finder)*

Cox et al. (2016) & Johnson et al. (2016;2017)

Companion papers from a large study

- Lab outcomes:
  - Speech recognition: Aided benefit; no difference among aids. **~90% for all four aids.**
  - **Small improvement for localization** in quiet for premium, brand B.
- Real world outcomes:
  - All of the hearing aids provided **real world benefit** and reduced listening effort; no difference among aids.
  - High use rates (>9h/day) and **improved quality of life** (96% of participants).
- Preference:
  - 42 preferred one or more hearing aids; **preferences were mixed and small**.

Wu et al., (2019)

- One brand, two tech levels (2013 hearing aids)
- **Lab measures** found a few differences:
  - More benefit with premium features for speech in noise and for localization.
    - Paired comparisons found no difference between premium and basic on most measures of listening effort, sound quality
    - Higher ratings for premium features for wind noise
    - Higher ratings for basic and premium features in noise
- **Real world** assessment of outcome using **real-time** smartphone-based ecological momentary assessment:
  - Preference for noise management features (at either cost level) to be activated rather than de-activated

Summary: Does technology level really not matter? Or is it how we are measuring it?

- Lab measures show equivalent benefit on most but not all measures (Cox et al., 2014, Johnson et al., 2016;2017, Wu et al., 2019).
  - APHAB not designed for between-aid comparisons (Valente et al 1998; Cox, 2005)
- Real world questionnaires may help remove memory issues, but what questions should we be asking?

*What do we know about **how users view features**?*

Our study: Patient outcomes and preference with entry vs. premium level hearing aids.

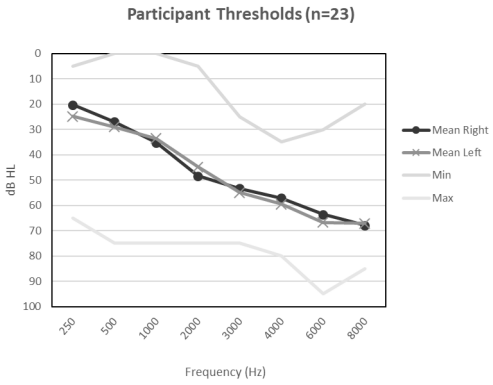
- User choice decisions in hearing aid selections are typically affected by a **wide range of factors** (Meister et al, 2001).
  - Appropriate **fitting practices and lab outcomes** are still important.
  - Non-audibility factors such as **form factor** may matter a lot!
  - Newer **wireless access & apps** are common features of today's premium aids.

  AIM: To study user **outcomes and preference** factors for entry-level versus premium using a **product profiles that generalize** to the real between-product selections that users make when choosing hearing aids.

- Research questions:
  1. Will appropriately-fitted entry-level and premium hearing aids provide different perceptual outcomes? Can we produce better fittings with premium hearing aids?
  2. With appropriately-fitted devices that differ widely in overall product profile, what factors are related to users' preferences for one aid over another?

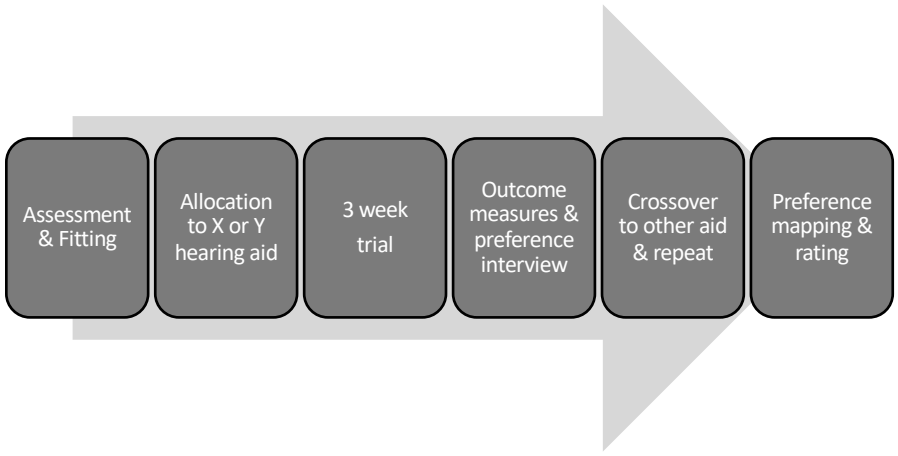
Participants

- 23 in total:
  - 15 male, 8 female
- Self-identified as smartphone owners
- Average age: 62 y (range: 24-78y)
- Average experience with hearing aids: 6.2 y (range: .3 – 27 y)



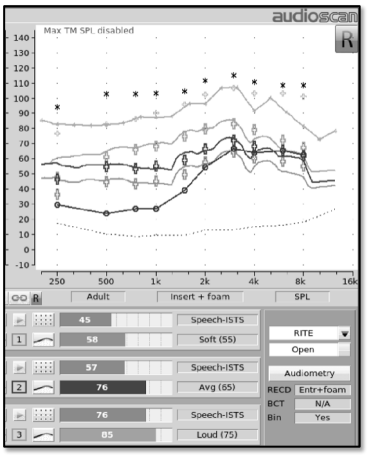
Feature	Premium (Pure Charge & Go Nx)	Basic (Intuis)
Form factor	Receiver-in-canal (RIC) *S, M, or P receivers*	Behind-the-ear (BTE) *Slimtube or earmold*
Amplification	*20 channels, 10 handles, slow & turbo feedback control*	*6 channels, 3 handles, feedback control on or off*
Bluetooth	Yes	No
Binaural link	Yes	No
Microphone directionality	4 settings including pinna-matched and narrow	Omni, pinna, or fixed
Noise reduction	7 settings, sound smoothing	Noise reduction on or off
Smartphone/tablet app compatible	Yes (including telepractice) *MyHearing or MyControl*	No
Accessories (optional)	TV Adapter, remote microphone, remote control	Remote control
Recharging	Yes	No

Study design

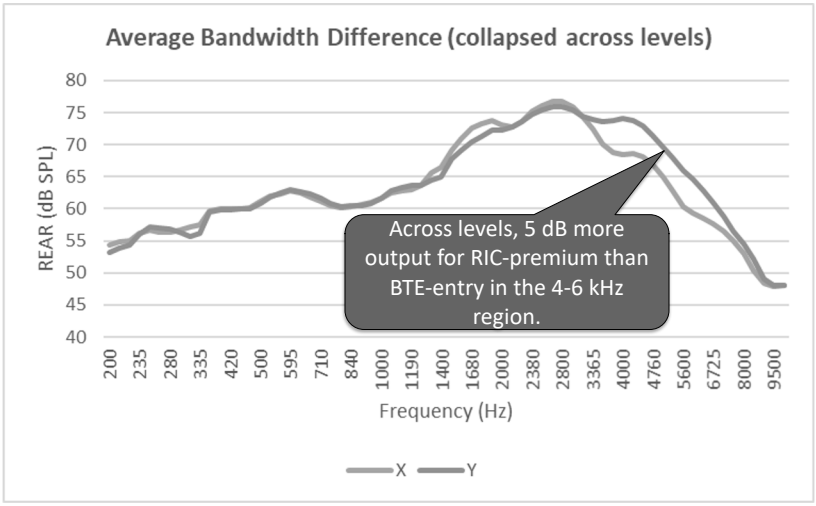


We followed a best practices protocol.

- Insert phones for audiometry
- Measured real ear to coupler difference (RECD)
- Validated targets (DSL v5 adult)
- Verified and fine tuned with calibrated speech signal (VF2)



RIC fittings offered greater high frequency output than BTEs & smoother in the 2-4 kHz region.

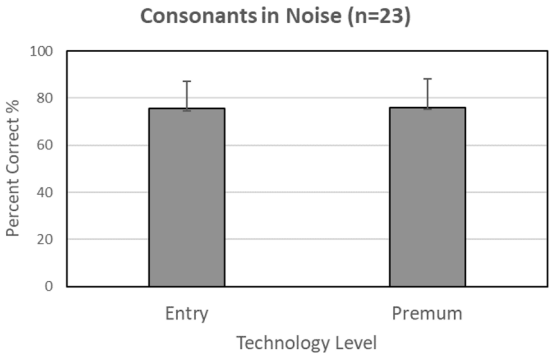


We measured a wide range of hearing aid outcomes:

- Consonant recognition in noise
- Sentence recognition in noise
  - In a surround of noise
- Sound quality ratings
- Loudness ratings
- Preference ratings & interview

Our listeners recognized more than 75% of consonants in noise with both hearing aids.

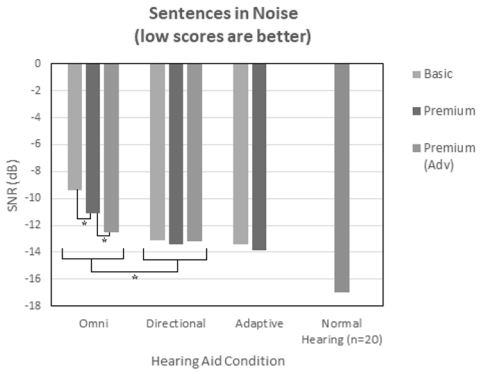
- No significant differences found between the basic and premium aided results.
- Recall that both were set to have the same (good) audibility, so perhaps not surprising.



UWO-DFD test (Cheesman & Jamieson, 1996).

Sentence scores in noise were better with both aids when directionality was enabled.

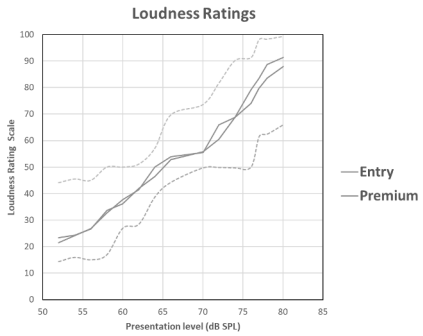
- The **premium pinna-matched mic** was better than either omni.
- **Directional benefit** for both aids.



U.S. Matrix Test (Hagerman 1982; Kollmeier 2015).

Both hearing aids provided loudness in the normal range.

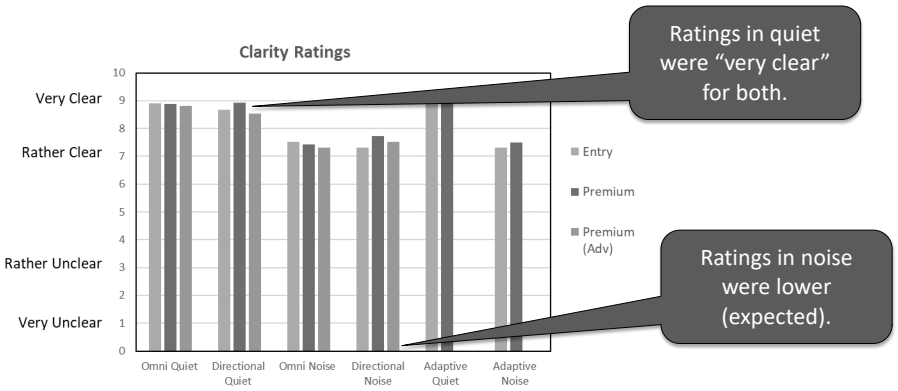
- No significant difference in loudness growth results between the technology levels.
- Average difference in inputs for matched loudness = .7 dB.
- Recall that the aids were both fitted to the same target.



Pseudorandom loudness task described in Van Eeckhoutte, Wouters, & Francart (2016)

Sound quality ratings (clarity) were very high for speech in quiet for both aids.

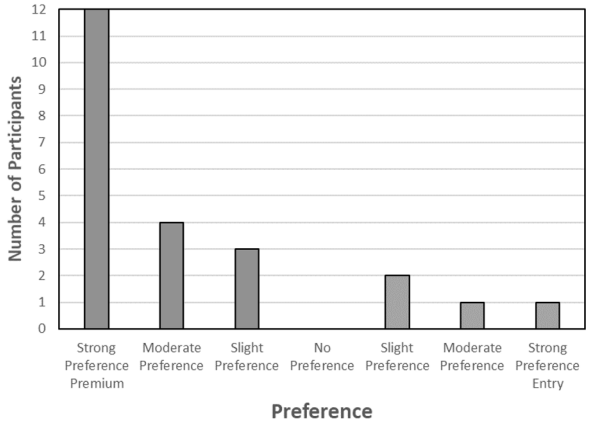
No significant differences between aids.



Gabrielsson scales (1979; 1988).

Despite near-equivalent lab outcomes, the majority of participants **strongly preferred** the premium aid.

- Only 4 preferred the entry hearing aids
- Entry choosers were all aged 68 years or older



SO WE ASKED THEM WHY…

https://www.signhealth.org.uk/why-are-deaf-people-more-likely-to-have-mental-health-problems/why-graphic/

What is group concept mapping?

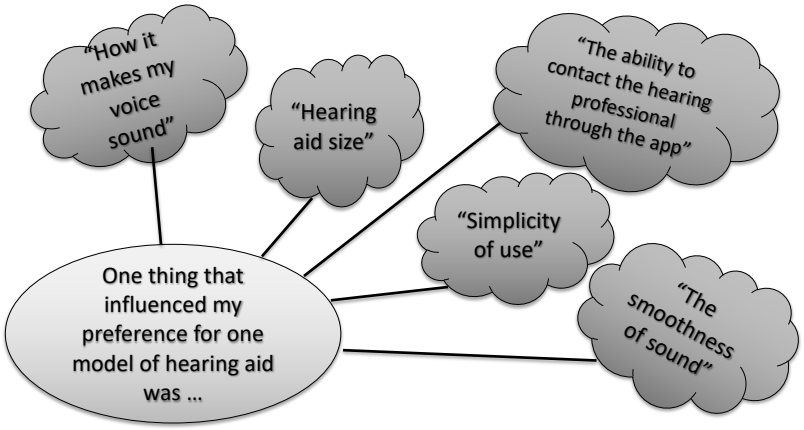
- A methodology for organizing the ideas of a group into statistically derived visual representations
- Uses quantitative methods to assess qualitative data on complex, intangible concepts

(Kane and Trochim, 2007)

Brainstorming & statement generation

- Participants allowed to listen to the recordings of previous appointments to refresh memory.
- Asked to complete the statement **"one thing that influenced my preference for one model of hearing aid was … "** with as many ideas as possible.
- Research team worked together to remove duplicate statements, resulting in 83 unique statements

Some example statements



Sorting

- Done by each participant individually
- Sorting involves a drag-and-drop activity where statements are grouped based on common ideas.
- Sorting **Dos**:
  - Sorting statements with similar underlying meaning together
  - Naming categories based on meaning of statements
- Sorting **don’ts:**
  - Grouping statements based on value (“not important”)
  - Grouping statements unrelated to one another (“miscellaneous”, “Not applicable”).

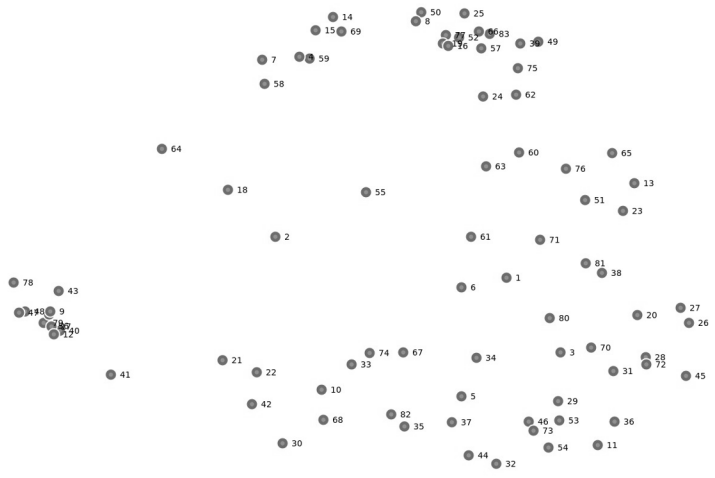
Rating

- Rating activity to assess the importance of each of the statements generated.
- Participants asked to rate, on a Likert scale, “how important is this factor when choosing a hearing aid?”. This was done for all statements.

Creating the point map

- The concept mapping software creates the two-dimensional point map using sorting data
- Proximity of points (corresponding to statements) based on their likelihood of being grouped together during sorting.

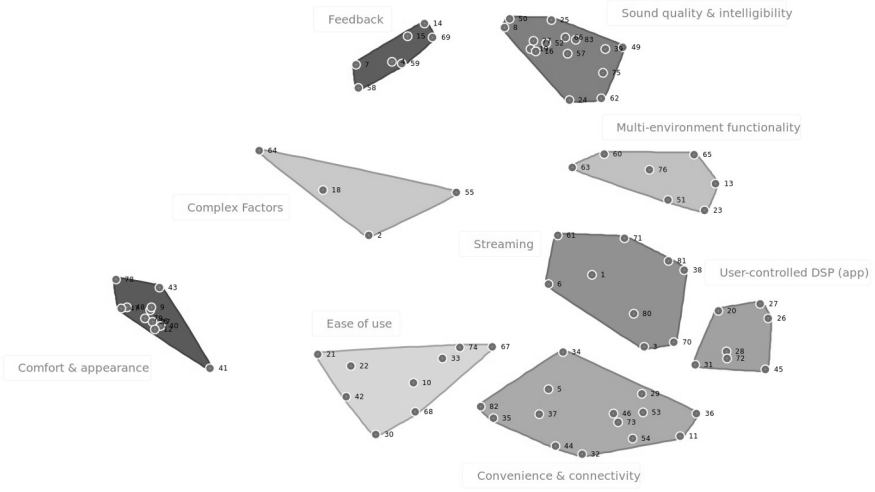
Our point map



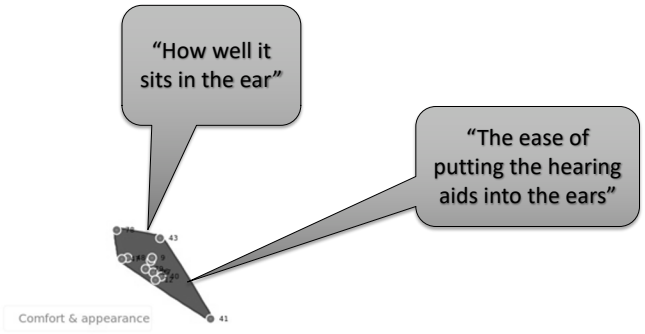
Creating the cluster map

- Statistical software groups the points into shapes. This partitions the statements into “clusters” linked by topic.
- Several cluster solutions are provided. The researchers choose one for interpretation.

Our cluster map



Comfort & appearance



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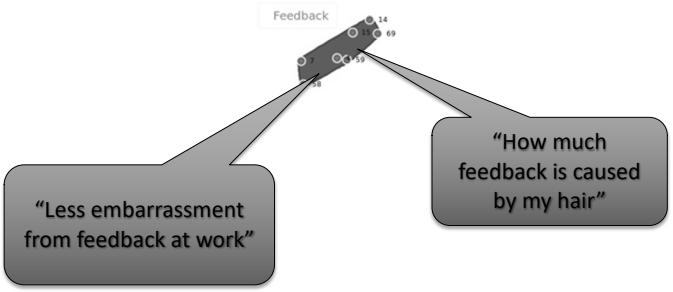
Feedback



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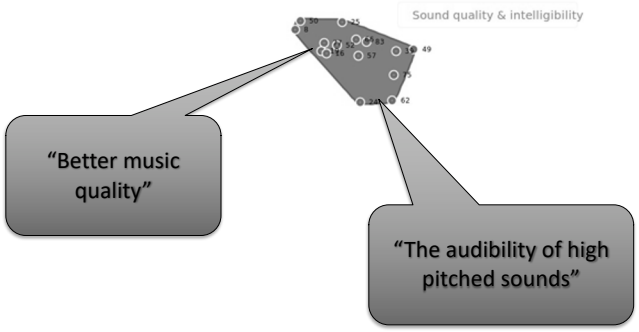
Sound quality & Intelligibility



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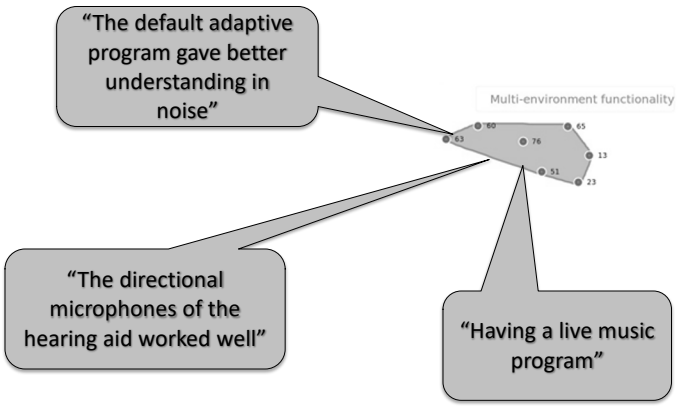
Multi-environment functionality



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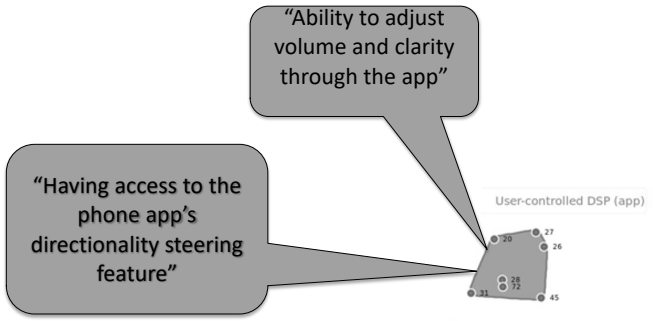
User-controlled DSP (app)



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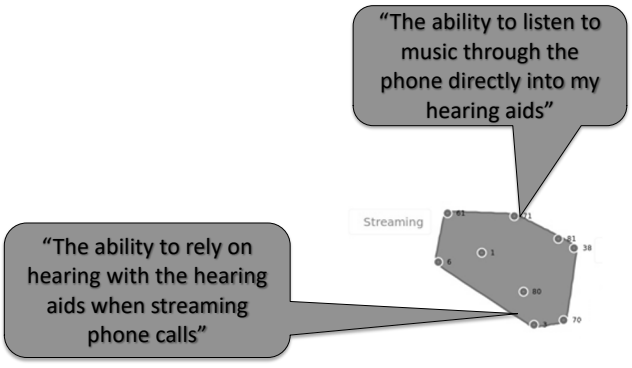
Streaming



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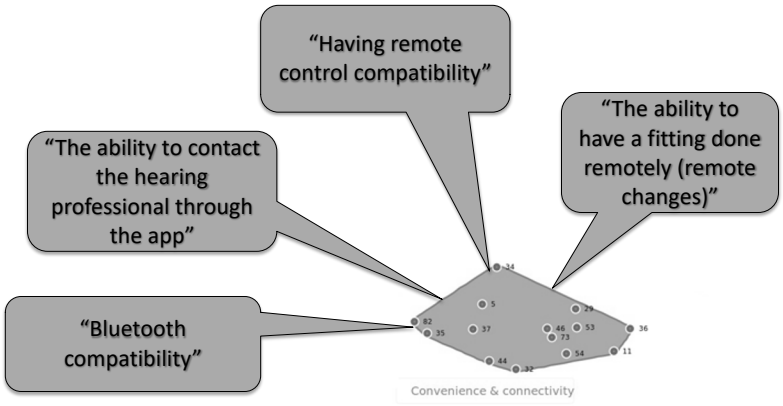
Convenience & connectivity



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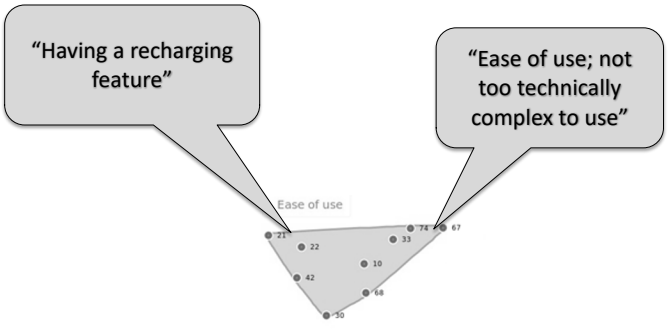
Ease of use



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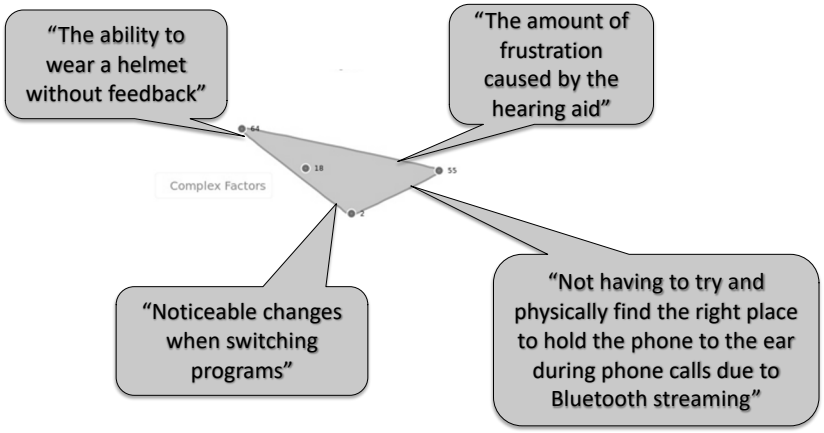
Complex Factors-



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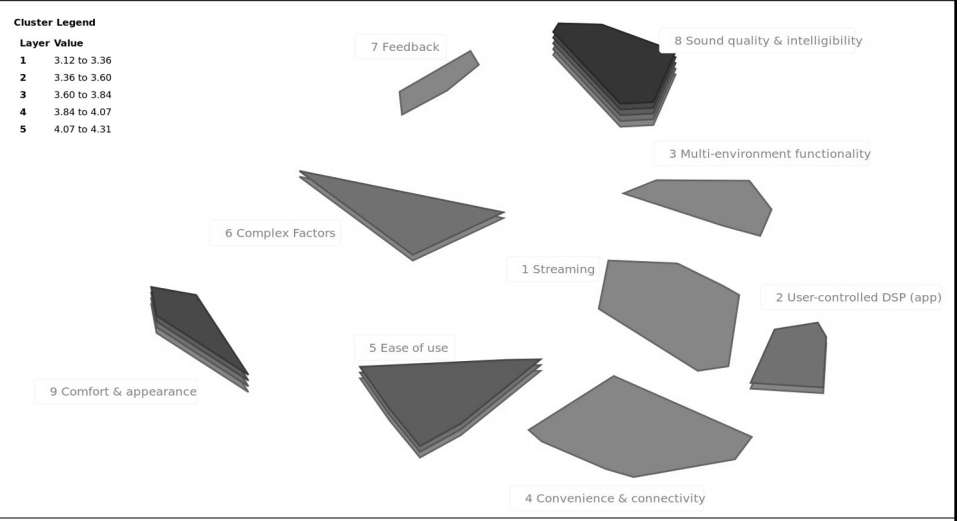
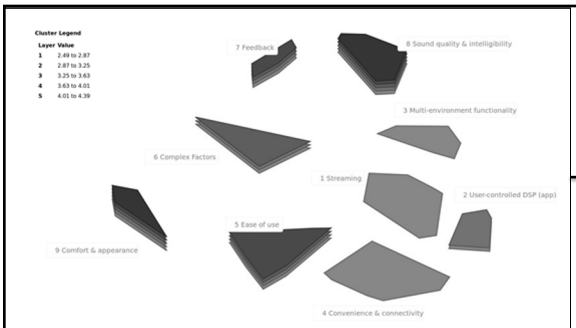
Cluster rating map

- The importance information is taken from the rating activity and incorporated into the cluster map
  - Taller cluster have higher average importance ratings
- Can be conducted on the entire group of participants or select sub-groups to see differences

Overall rating map

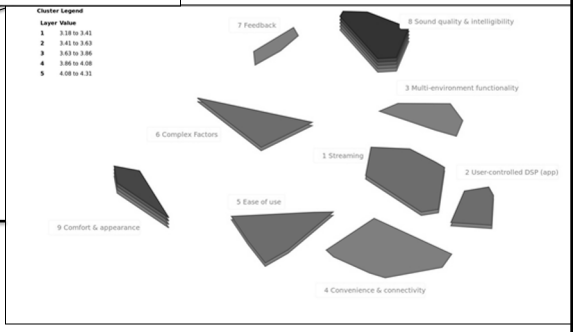




Basic choosers

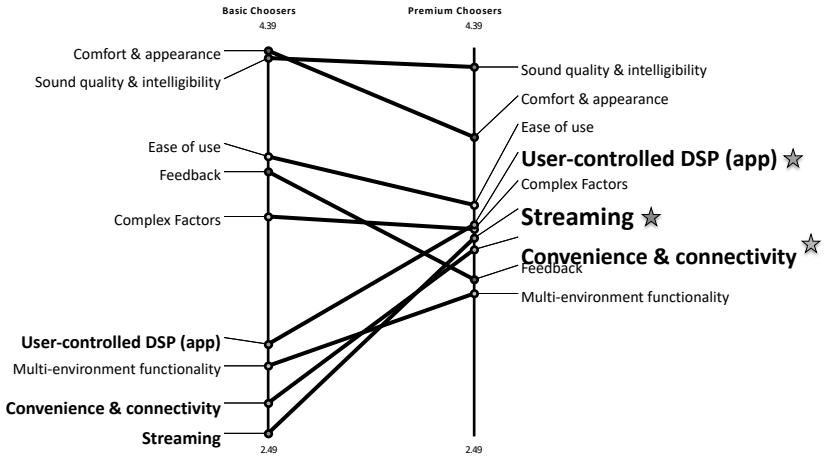
Visual comparison is difficult – is there a better way?

Premium choosers



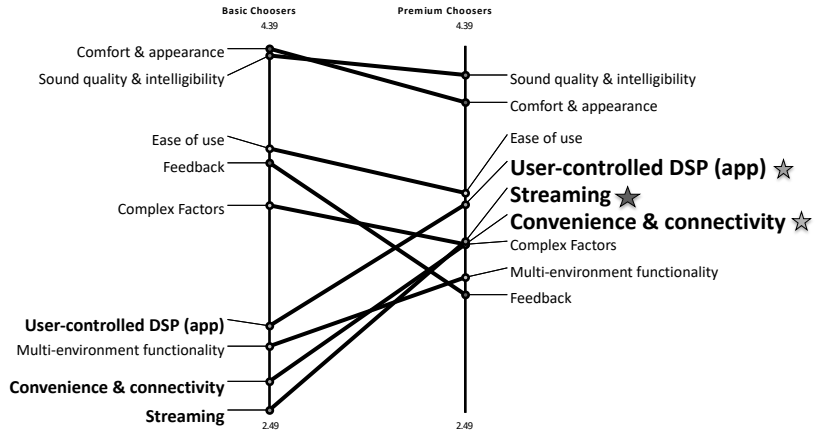
Entry-Level vs. Premium

(all participants)



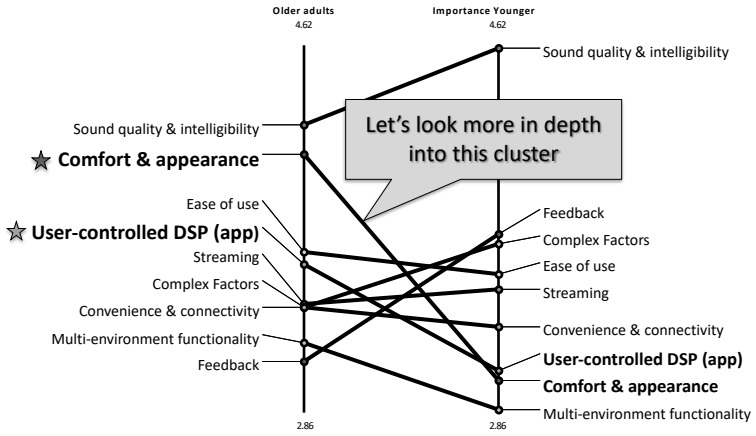
Entry-Level vs. Premium

(participants over 60y)



Older vs. Younger

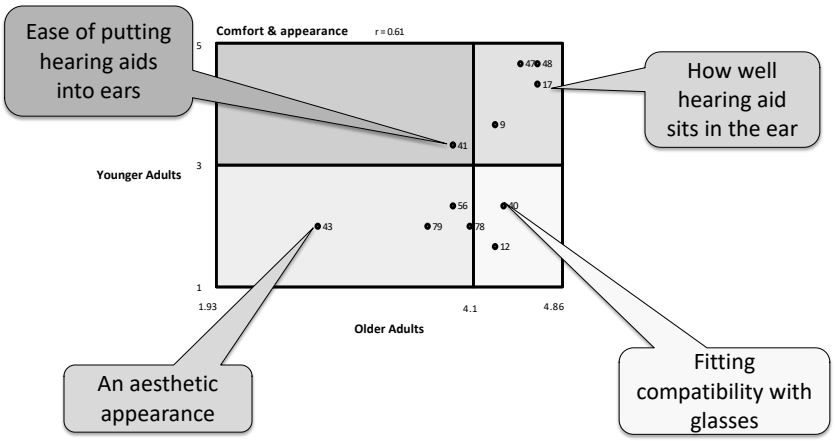
(premium choosers)



Go-zone analysis

- Allows a within-cluster importance rating comparison between two groups for each statement in that cluster
- The different areas on the map indicate how the individual statements are rated compared to the cluster average

Comfort & appearance factors for older and younger adults who chose premium:



TAKE HOME MESSAGES

Take home messages

- Features that matter to everyone:
  - Physical comfort and appearance of the hearing aids
  - Sound quality and speech intelligibility

Take home messages

- Features that matter more to premium choosers:
  - The ability to stream calls and music on their hearing aids.
  - Having access to an app where directionality settings can be modified
  - Overall convenience and accessory compatibility

Clinical implications

- **Premium choosers** valued having streaming and remote support access through their apps. It is definitely worth the clinical time to learn these new features and to provide **successful coaching** to help your patients derive value and success.

Clinical Implications

- Ensure **adequate time** given to app installation and **orientation**
  - Min 30 minute coaching session to install and teach the apps; scheduled specific time for this.
- Wide of phones were successfully used:
  - iPhone, Samsung, Google Pixel, LG, Motorolla.
- Occasional longer/rescheduled appointments if technical difficulties arose… not frequent.

Clinical implications

- **Physical comfort and hearing well** were valued highly regardless of technology level. Ensure good outcomes for all patients, ensure a good fit to the ear, and provide good audibility using real ear measurement and fitting to targets.

Clinical implications

- **Older and younger user groups** contained individuals who valued premium features. **Don't assume** a lack of motivation to use new or advanced technology based on age. Assess the individual.

Clinical implications

- **Hearing aid users** valued having access to remote support. They liked the convenience of being able to contact their hearing healthcare provider and receive remote support. **Take advantage of these new features when they are available.**

Thank you!

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