Using a Mixed Methods Approach to Investigate Patient-Reported Benefits of Cochlear Implant Listening Configurations

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INTRODUCTION

- Despite significant advances in the field of cochlear implants (CIs), there is no widely accepted criterion for when to counsel on bilateral CIs in adults.
- Previous literature suggests unique advantages of bimodal hearing[1-4] versus bilateral[5-7] cochlear implants (CIs) using performance-based speech recognition tasks; however, few studies have compared patient-reported differences.
  - Patient needs and preferences are often used to guide recommendations on whether bilateral CIs or bimodal hearing is best for that individual.
- The ***objective of the present study*** was to compare the patient-reported benefits of bimodal hearing and bilateral CIs using qualitative interviews and subjective ratings of listening effort during sentence recognition tasks.

METHODS

**The following poster presents preliminary findings from a small sample size therefore formal statistics were not performed.*

- **Participants:** 8 post-lingually deafened **adult CI users** (58– 74 years; 5 female; 4 bimodal; 4 bilateral).
  - All bilateral participants had no residual hearing bilaterally
  - Bimodal participants categorized using the following question: *"Do you think you need a second CI?"*
    - *n=1 said yes; abbreviated as bimodal (Y)*
    - *n=3 said no; abbreviated as bimodal (N)*
  - **Inclusion criteria:** Passing score on the Mini Mental Status Exam (MMSE)[8]; traditional CI candidate in both ears; >1 year of CI use; aided thresholds in the 20-35 dB range for 250-4,000Hz.

Unaided Thresholds in Hearing-Aid Ear

	250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
A Bimodal (N)	55	80	95	100	105	105	NR	NR
B Bimodal (N)	65	70	70	65	80	95	NR	NR
C Bimodal (N)	60	65	80	95	80	85	NR	NR
Bimodal (Y)	50	50	65	95	80	NR	NR	NR

Table 1. Individual unaided audiograms for hearing-aid ear of all bimodal participants. NR indicates no response at the limits of the audiometer for that particular frequency.

- **Qualitative Interviews:** conducted by an audiologist (JHL) using grounded theory.[9]
- **Speech Testing:** Tested in the bilaterally aided (i.e., HA+CI or CI+CI) condition using : 1) AzBio in quiet; 2) AzBio in noise (+10 dB SNR with multi-talker babble); and 3) the Perceptually Robust English Sentence Open-set (PRESTO)[10] test. After each task, participants rated demand using the NASA Task Load Index (NASA TLX)[11], a visual-analog rating scale.
  - Performance: *"How successful do you think you were in accomplishing the goals of the task set by the experimenter?"*
  - Effort: *"How hard did you have to work (mentally or physically) to accomplish your level of performance?"*
  - Frustration: *"How insecure, discouraged, irritated, stressed, and annoyed versus secure, gratified, content, relaxed, and complacent did you feel during the task?"*

RESULTS: INTERVIEWS

Question 1: *"What were some of drivers for you (and other patients) when it came to getting a second CI?"*

- Same equipment/more convenient
- Desire to improve localization
- High performance with 1st CI
- Clinicians making you aware it's an option
- Self-perceived lower performance of hearing aid ear
- *Desire to improve communication and overall hearing abilities

Question 2: *"What are some barriers to getting a second CI? In other words, why do you (and other patients) continue to use bimodal hearing?*

- Insurance
- Music
- Satisfaction with hearing aid
  - Less listening effort with HA
- Satisfaction with current communication outcomes Rehabilitation process
- *No sound/safety

Figure 2. Participant interviews were transcribed and thematically coded. Above shows identified themes in response to questions 1 and 2. The highest reported themes are marked with an asterisk.

RESULTS: SENTENCE RECOGNITION ACCURACY

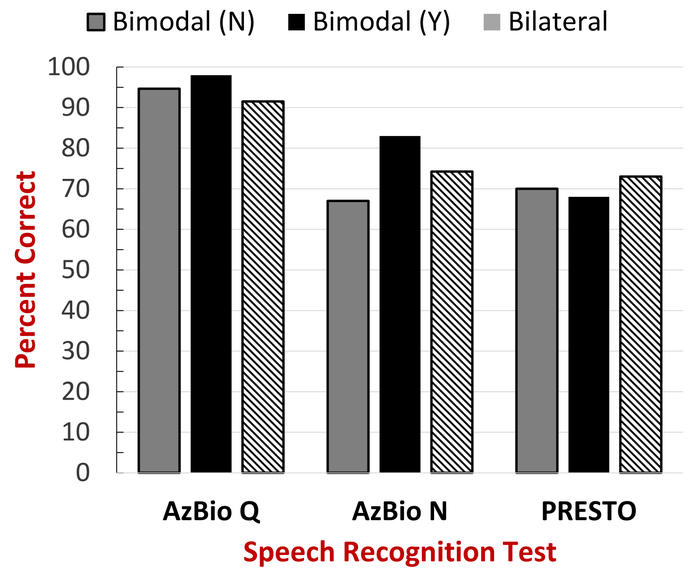
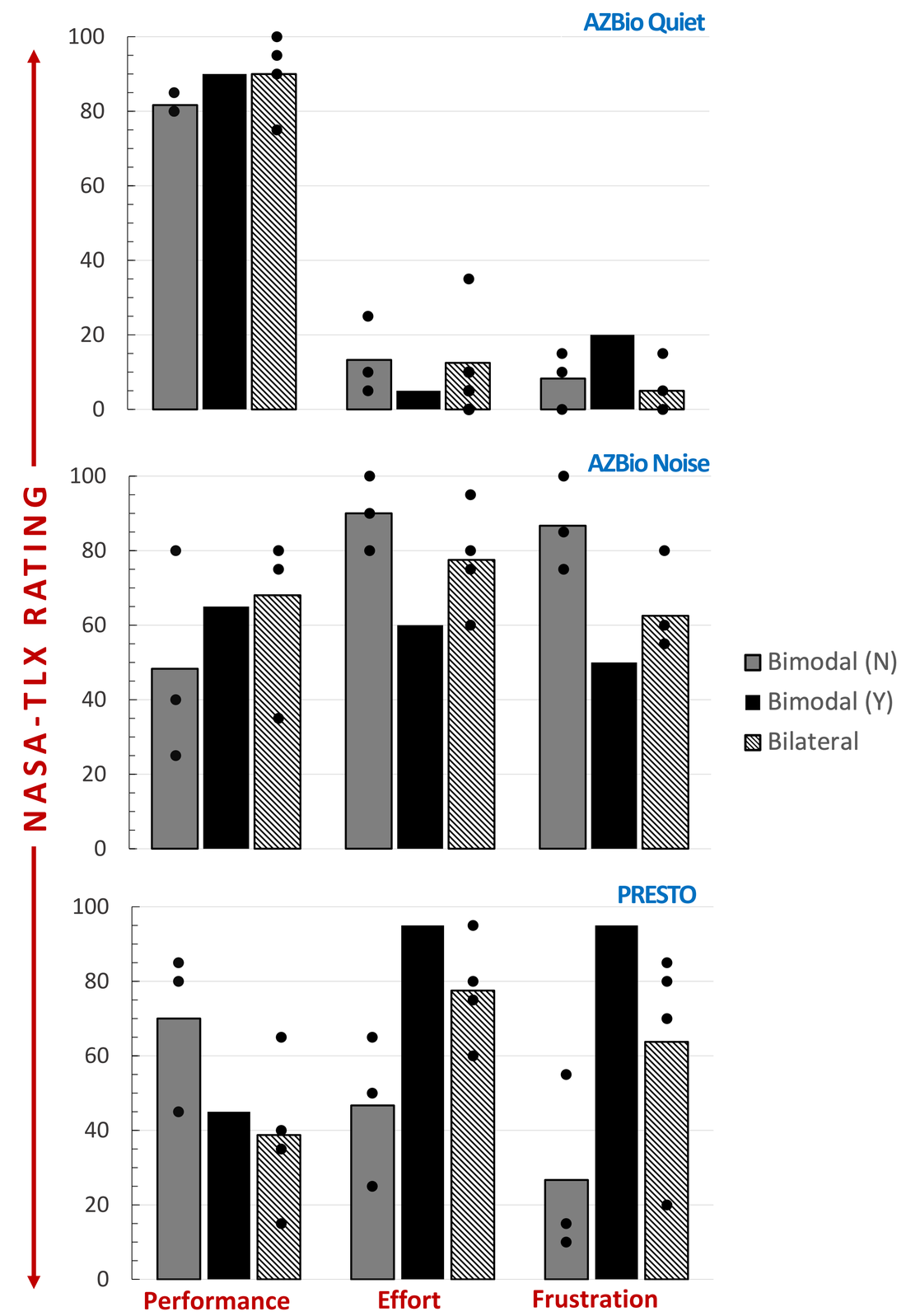


Figure 3. Mean percent correct for the bimodal(N) (grey), bimodal(Y) (black), and bilateral (stripe) groups for each speech test is displayed. All three groups were tested in the bilaterally aided condition (CI+HA or CI+CI) using their everyday settings. Preliminary data suggests equivalent performance across the three groups for speech in quiet, speech in noise, and high-variability sentences.

RESULTS: SPEECH RECOGNITION RATINGS

Figure 4, 5, 6. Mean NASA-TLX ratings for the bimodal(N) (grey), bimodal(Y) (black), and bilateral (stripe) groups after completion of the three speech tests. Scores range from 0 to 100, with 0 indicating low effort/frustration and 100 indicating high effort/frustration. For the performance scale, 0 indicates perceived poor performance and 100 corresponds to perceived high performance. Individual data points are plotted. Preliminary data suggests that bimodal(N) participants perceive higher performance and lower effort/frustration than the bimodal(Y) and bilateral groups.



PRELIMINARY CONCLUSIONS

- Subjective ratings during sentence recognition tasks can be used to determine patient-perceived benefit of a CI listening configuration.
- Bimodal advantage (i.e., lower listening effort and frustration, higher perceived performance) when listening to high-variability sentences.
- The ultimate goal of this research is to develop a shared decision-making tool for selecting an appropriate CI listening configuration based on patient needs.

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Title: Using a Mixed Methods Approach to Investigate Patient-Reported Benefits of Cochlear Implant Listening Configurations

Introduction: Previous literature suggests unique advantages of bimodal hearing versus bilateral cochlear implants (CIs) using performance-based speech recognition tasks; however, few studies have compared patient-reported differences between these listening configurations. The objective of the present study was to compare the patient-reported benefits of bimodal hearing and bilateral CIs using clinical tools such as questionnaires and subjective ratings of listening during sentence recognition tasks.

Methods: A group of bimodal hearing and a group of bilateral CI patients completed qualitative interviews, the Cochlear Implant Quality of Life (CIQOL) questionnaire, and the Speech, Spatial, and Qualities of Hearing (SSQ) scale. Each group was also tested in the CI-only and bilaterally aided (i.e., HA+CI or CI+CI) conditions using the following sentence recognition tests: 1) AzBio in quiet; 2) AzBio in noise; and 3) Perceptually Robust English Sentence Open-set (PRESTO) test. After each speech recognition test, participants rated the quality, clarity, and mental demand of the sentence recognition tasks using the NASA Task Load Index (NASA TLX).

Results: Preliminary results demonstrated that two subgroups have emerged in the bimodal sample: bimodal patients who do and *do not* perceive a benefit from their current listening configuration. The bimodal subgroups could be differentiated using subjective ratings of mental demand on the NASA TLX for the AzBio in noise and PRESTO CI-only and CI+HA conditions. Moreover, these differences in subjective ratings emerged despite there being no significant difference in speech recognition accuracy between the CI+HA and CI-only conditions for both groups. Additional analyses will be reported using MANOVAs to determine if there was a significant difference between the bilateral and two bimodal groups on the questionnaires and subjective sentence recognition ratings. Themes obtained from the coding of qualitative interviews will also be compared across groups. Interview themes will expand on the questionnaire and sentence recognition ratings findings.

Conclusion: Pilot data suggested that subjective ratings of mental demand during sentence recognition tasks can be used to determine patient-perceived benefit of a CI listening configuration. Bimodal and bilateral CI comparisons will provide evidence on the patient-reported limitations and benefits of CI listening configurations. The ultimate goal of this research is to develop a shared decision-making tool for selecting an appropriate CI listening configuration based on patient needs.