

# Efficacy of the Remote Microphone Hearing Aid for Novice Hearing Aid Users

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# *Disclosure*

*This study was sponsored by GN ReSound Government Services, and the hearing aids used in this study were provided by GN ReSound.*

# *Disclaimer*

*The views expressed in this presentation are those of the author and do not necessarily reflect the official policy of the Department of Army, Department of Defense, the U.S. Government, or GN ReSound.*

*We certify that all individuals who qualify as authors have been listed; each has participated in the conception and design of this work, the analysis of data, the writing of the document, and the approval of the submission of this version; that the document represents valid work; that if we used information derived from another source, we obtained all necessary approvals to use it and made appropriate acknowledgements in the document; and that each takes public responsibility for it. Nothing in the presentation implies any Federal/DOD/DOA endorsement.*

*Authors acknowledge that research protocol 354875 “A Clinical Comparison of Three Hearing Aid Fittings for Novice Hearing Aid Users” received applicable WRAMC Institutional Review Board review and approval.*

# Purpose

- Primary goal of amplification is to improve audibility.
- However, cosmetics, comfort and sound quality have strong influence on acceptance of hearing aids, particularly for first-time users of amplification.

# Purpose

- The purpose of this study was to compare 3 hearing aid styles in a group of novice hearing aid users.
  - Performance (perceived benefit)
  - Cosmetic appeal
  - Occlusion
  - Sound quality
  - Physical comfort, security of fit
  - Wind noise
  - Feedback

## *ReSound Live 9 series devices*

- Completely-in-the-Canal (CIC)



- Remote Microphone (RM)



- Behind-the-Ear (RIC)



# Completely-in-the-Canal (CIC)

- All components are in the ear canal
- Natural pinna effects are preserved
- Fit with appropriate venting, within canal-size restrictions



- Potential for increased occlusion due to vent size limitations

# Behind-the-Ear (RIC)

- Microphones above/behind pinna
- Directional microphones
- Receiver in the ear
- Fit with appropriate dome



- May be less secure
- Potential wind noise issues due to mic placement
- Loss of pinna cues

# Remote Microphone (RM)

- Mic in concha cymba
- No directional microphone (however, pinna effects are preserved)
- Allows for larger venting than CIC
- Less chance of wind noise problems than BTE
- More secure fit than BTE



# Participants

- 12 patients recruited from Army Audiology & Speech Center, WRAMC via clinician referrals and patient record review

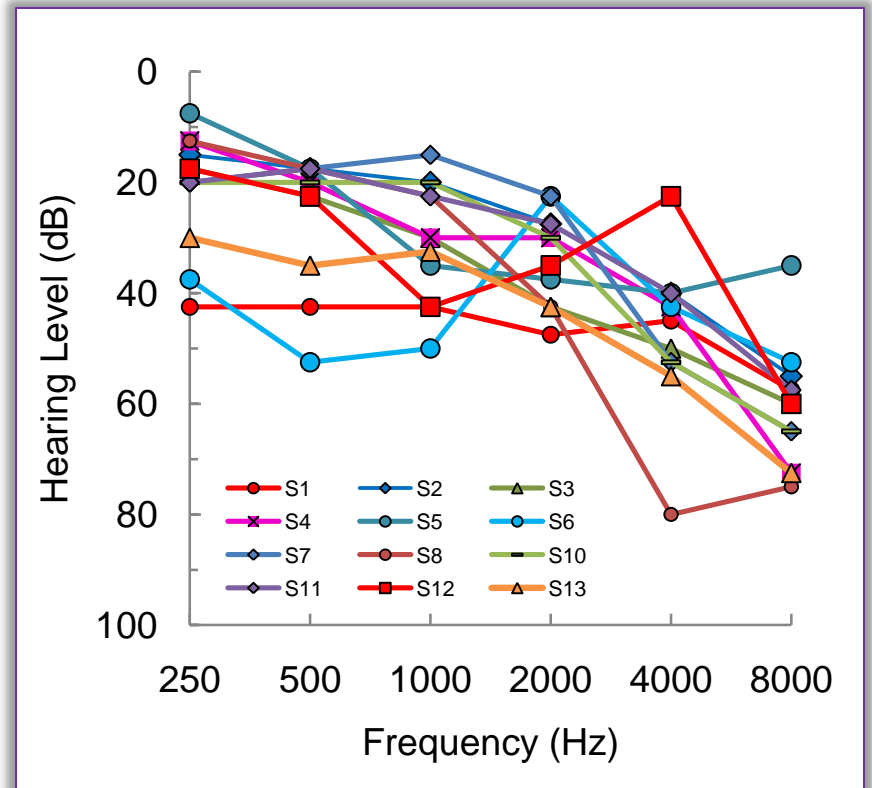
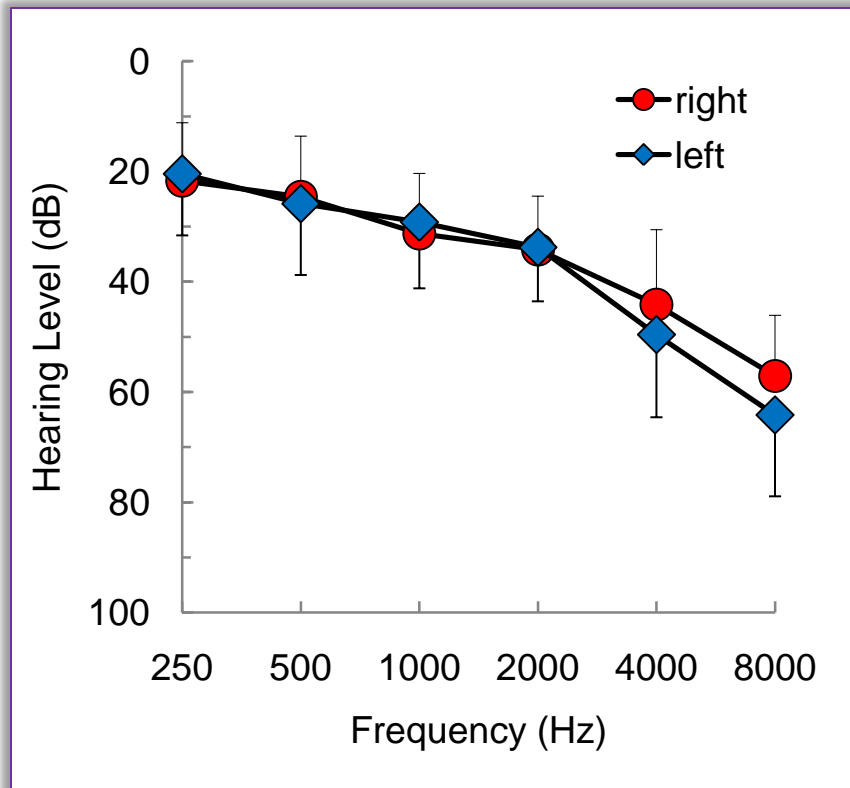
- No previous experience with hearing aids
- Active lifestyle
- Mild-to-moderate hearing loss  
(fitting range for all 3 devices)

# Participants

- 12 patients recruited from Army Audiology & Speech Center, WRAMC via clinician referrals and patient record review

- Average age: 57.9 years (range 47 – 69)
- 7 male, 5 female
- 3 AD, 5 RET, 3 FM

# Audiometric Thresholds



# Method

- One week acclimatization, then 3 consecutive 1-week trials (one week with each HA style).
- Order of fitting was counterbalanced across subjects
  - 6 different test orders (CIC-BTE-RM; BTE-RM-CIC, etc)
- Not shown HAs prior to fitting
- Standard clinical fitting procedures employed
  - “first fit”, then fine-tuning based on real-ear and pt feedback

# Method

- Following each trial week:
  - Laboratory measurements to evaluate speech understanding in noise and spatial release from masking
    - Hearing In Noise Test (HINT)
  - Questionnaire to evaluate satisfaction with fitting
    - Hearing Aid Acceptance Questionnaire
      - Developed specifically for this study

# Hearing Aid Acceptance Questionnaire

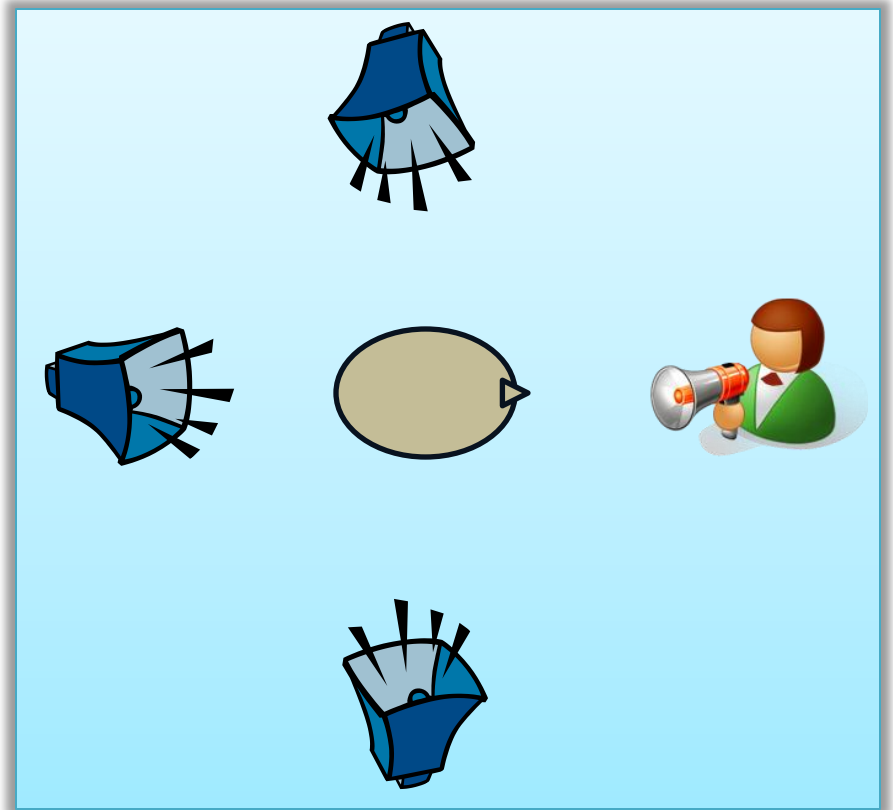
- Cosmetic appeal
- Occlusion
- Sound quality
- Physical comfort, security of fit
- Performance (in quiet, noise, localization)
- Wind noise
- Acoustic feedback
- Telephone use

# Method

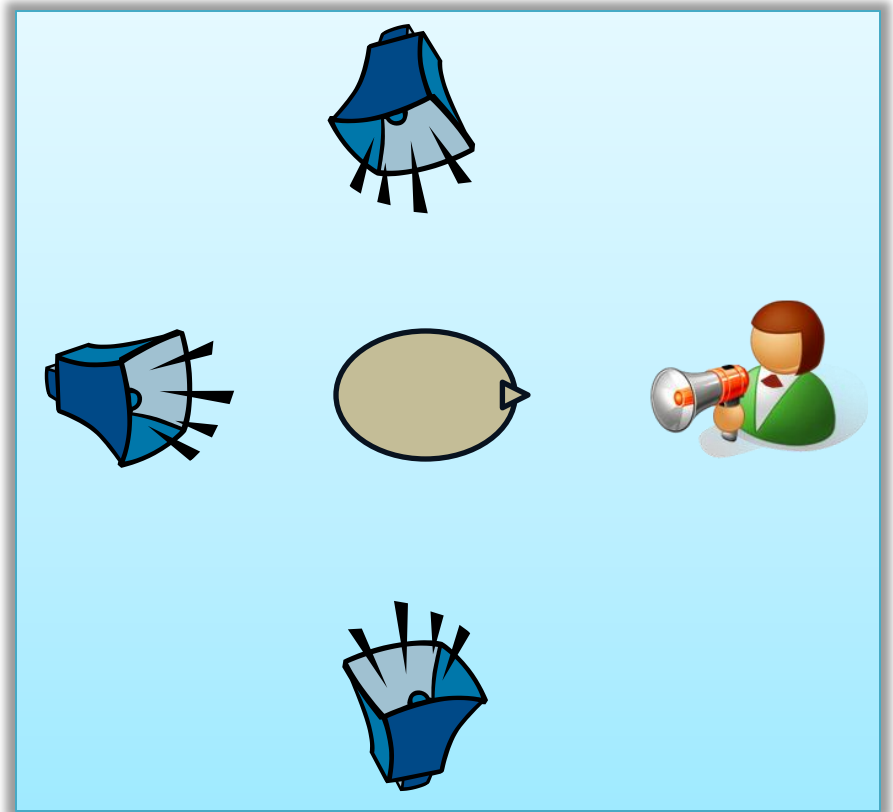
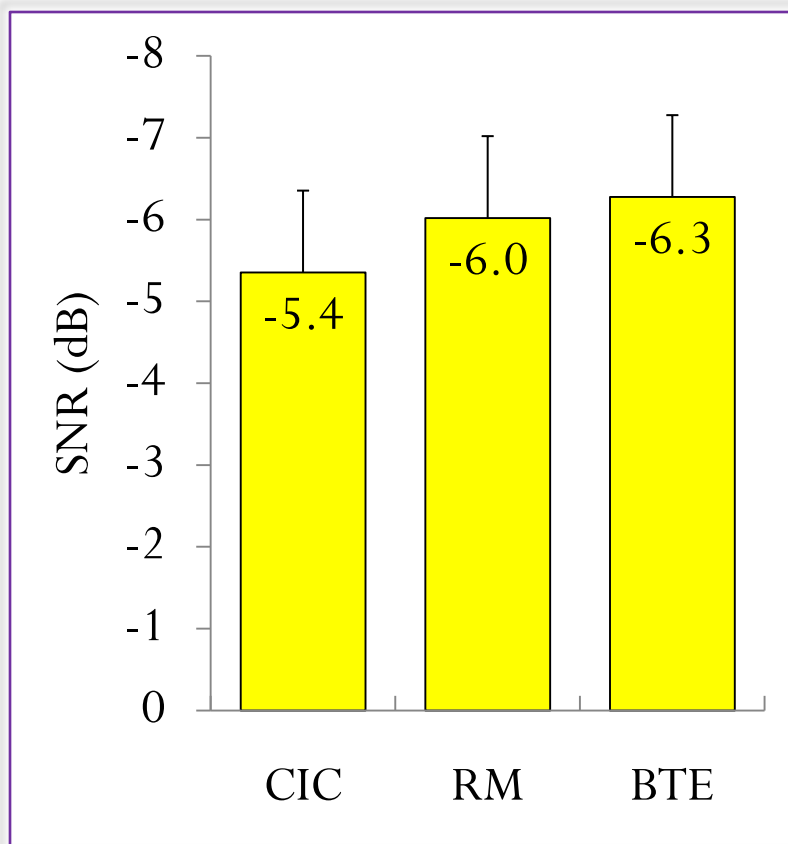
- At conclusion of study, participants rank-ordered preference for devices
- Were fit with preferred devices at no cost as compensation for their participation
- Of 12 subjects...
  - 5 preferred the BTE fitting
  - 4 preferred the RM fitting
  - 3 preferred the CIC fitting

# Hearing In Noise

- Adaptive method to determine the SNR at which stimulus sentences are identified correctly 50% of the time.
- Noise is presented at a fixed 65 dBA level and the sentence levels are varied depending on the accuracy of the listener's response.



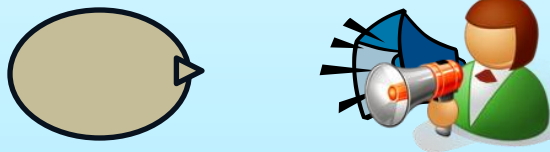
# No significant difference in performance between the 3 devices for speech recognition in noise



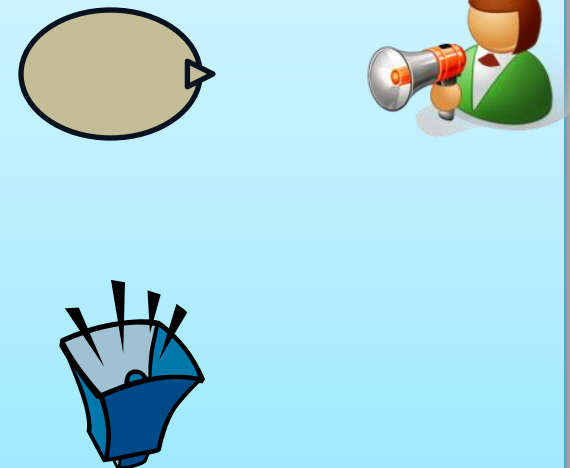
# Spatial Hearing

(spatial release from masking)

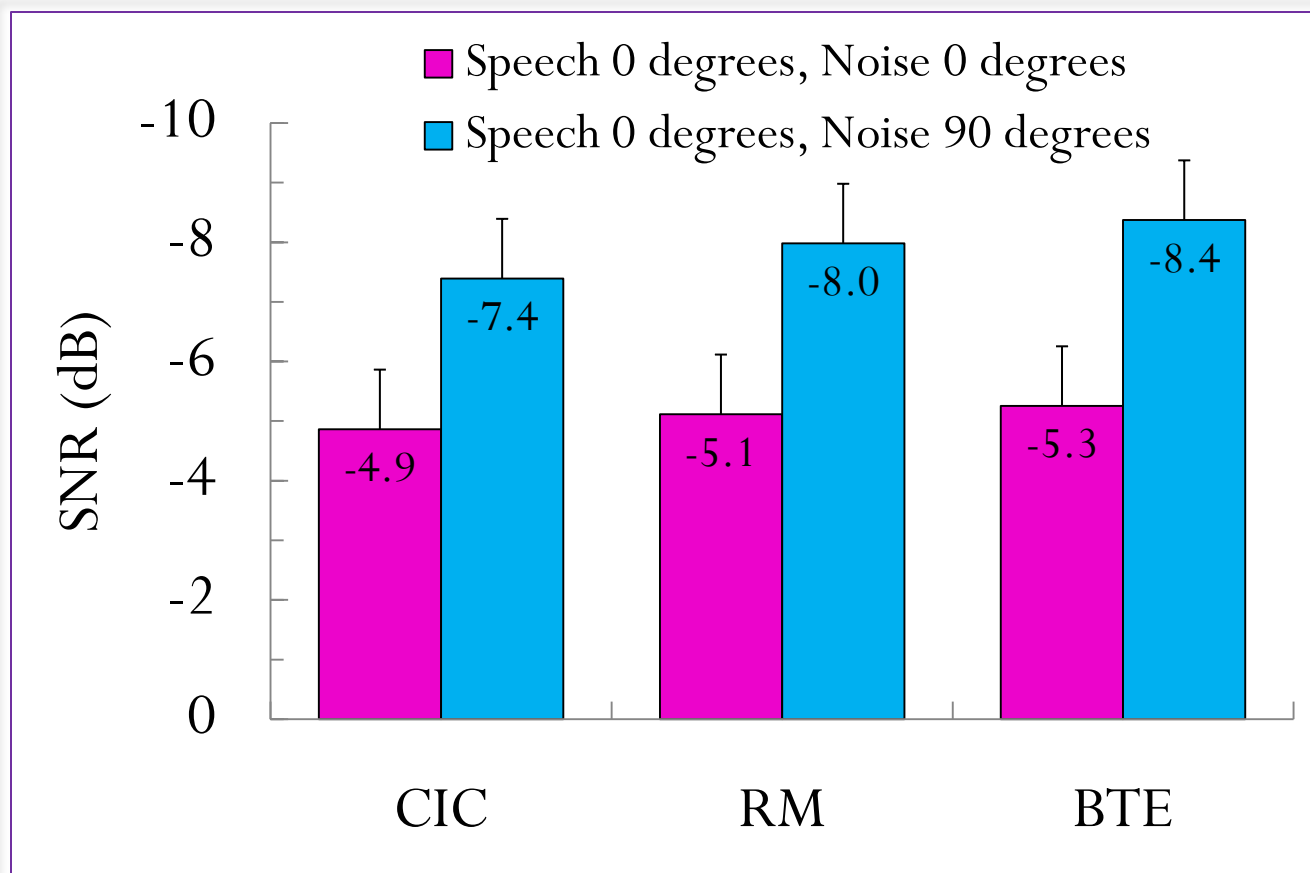
Co-located  
speech and noise



Spatially-separated  
speech and noise



# No significant difference in performance between the 3 devices for spatial release from masking



# Hearing Aid Acceptance Questionnaire

SUBJECT # _____ / FITTING = _____	<u>Without</u> hearing aids	<u>With these</u> hearing aids
I have difficulty hearing on the telephone.	A B C D E F G	A B C D E F G
I have to ask people to repeat themselves when in noisy environments.	A B C D E F G	A B C D E F G
I am bothered by wind noise.	A B C D E F G	A B C D E F G
I lack self-confidence regarding my communication ability.	A B C D E F G	A B C D E F G
Other people's voices sound unnatural to me.	A B C D E F G	A B C D E F G
I am unable to understand the people with whom I speak most often.	A B C D E F G	A B C D E F G
I am bothered by my own chewing sounds.	A B C D E F G	A B C D E F G
I have difficulty locating the source of a sound.	A B C D E F G	A B C D E F G
My own voice sounds abnormal to me.	A B C D E F G	A B C D E F G
Other people's voices sounds unclear to me.	A B C D E F G	A B C D E F G
My voice sounds too loud to me when I talk.	A B C D E F G	A B C D E F G
I have to ask people to repeat themselves in one-on-one quiet situations.	A B C D E F G	A B C D E F G
I am dissatisfied with my hearing ability.	A B C D E F G	A B C D E F G

## INSTRUCTIONS:

Circle the answer that comes closest to your everyday experience.

Statement is true:

- A Always (99%)
- B Almost Always (87%)
- C Generally (75%)
- D Half-the-time (50%)
- E Occasionally (25%)
- F Seldom (12%)
- G Never (1%)

*Profile of Hearing Aid Benefit (PHAB) response format (Cox et al, JAAA, 1991)*

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I have to ask people to repeat themselves when in noisy environments.	A B C <b>D</b> E F G	A B C D E F G
I am bothered by wind noise.	A B C D <b>E</b> F G	A B C D E F G
I lack self-confidence regarding my communication ability.	A B C <b>D</b> E F G	A B C D E F G
Other people's voices sound unnatural to me.	A B C D E <b>F</b> G	A B C D E F G
I am unable to understand the people with whom I speak most often.	A B <b>C</b> D E F G	A B C D E F G
I am bothered by my own chewing sounds.	A B C D E F <b>G</b>	A B C D E F G
I have difficulty locating the source of a sound.	A B C D <b>E</b> F G	A B C D E F G
My own voice sounds abnormal to me.	A B C D E F <b>G</b>	A B C D E F G
Other people's voices sounds unclear to me.	A B <b>C</b> D E F G	A B C D E F G
My voice sounds too loud to me when I talk.	A B C D E F <b>G</b>	A B C D E F G
I have to ask people to repeat themselves in one-on-one quiet situations.	<b>A</b> B C D E F G	A B C D E F G
I am dissatisfied with my hearing ability.	A B <b>C</b> D E F G	A B C D E F G

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# Hearing Aid Acceptance Questionnaire

Questions regarding your hearing aid experience ONLY:		<u>With these hearing aids</u>
I experience feedback (squealing) when wearing these hearing aids.		A B C D E F G
I feel people are aware of my hearing loss because I am wearing these hearing aids.		A B C D E F G
These hearing aids are so comfortable that I forget I am wearing them.		A B C D E F G
I am pleased with the appearance of these hearing aids.		A B C D E F G
These hearing aids feel secure in my ears (i.e., will not fall off).		A B C D E F G
These hearing aids are comfortable.		A B C D E F G
I feel that wearing these hearing aids has improved my quality of life.		A B C D E F G

## INSTRUCTIONS:

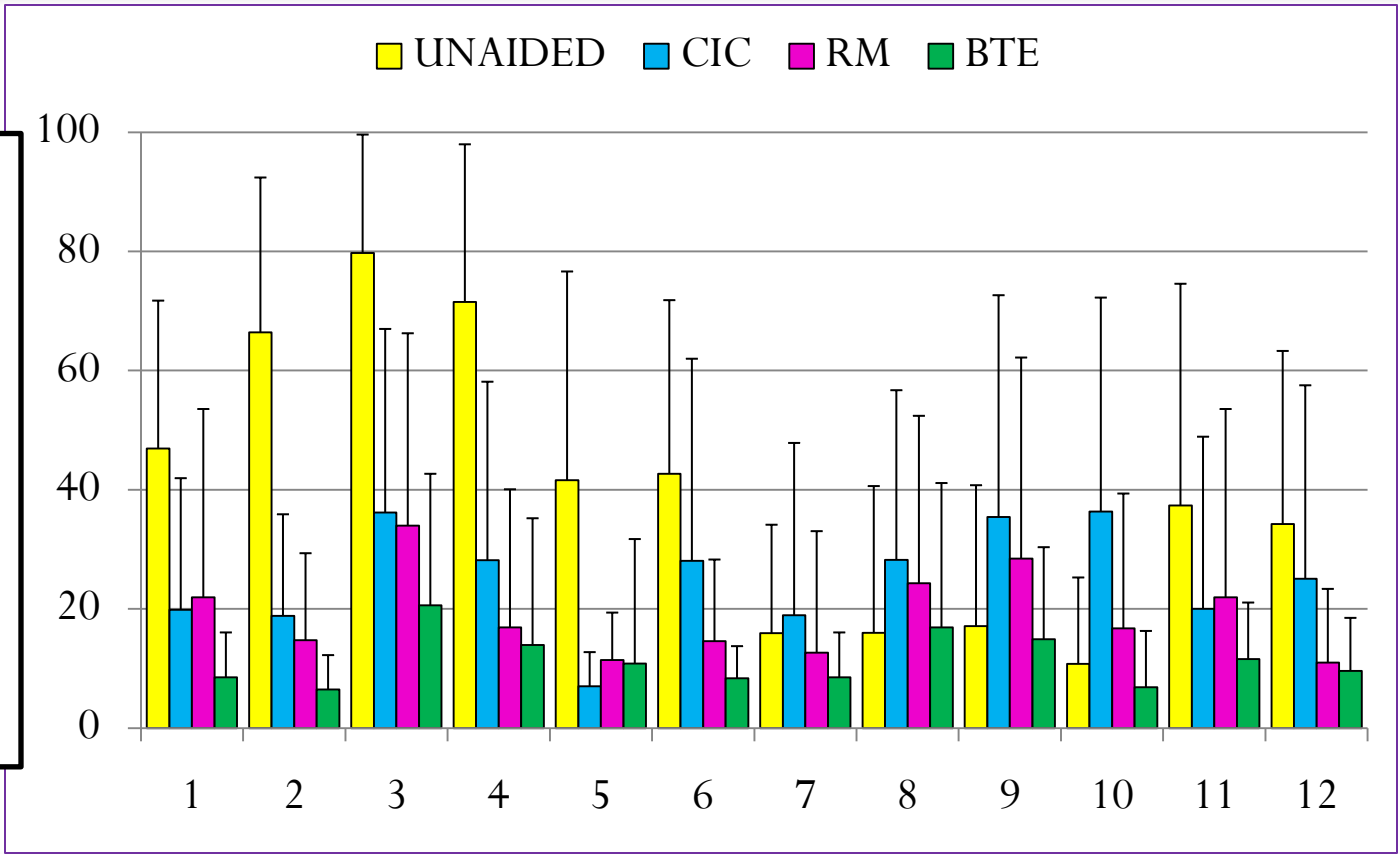
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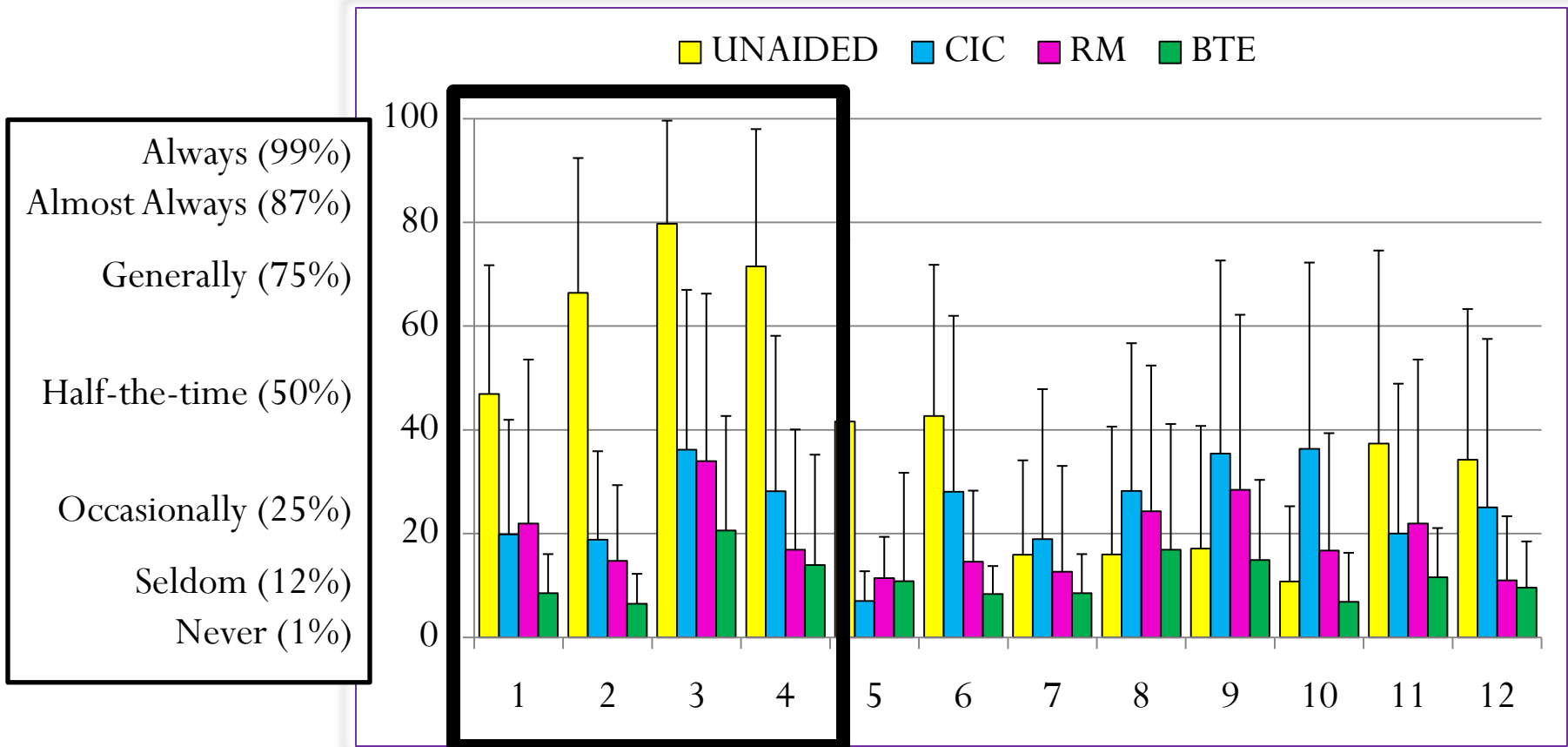
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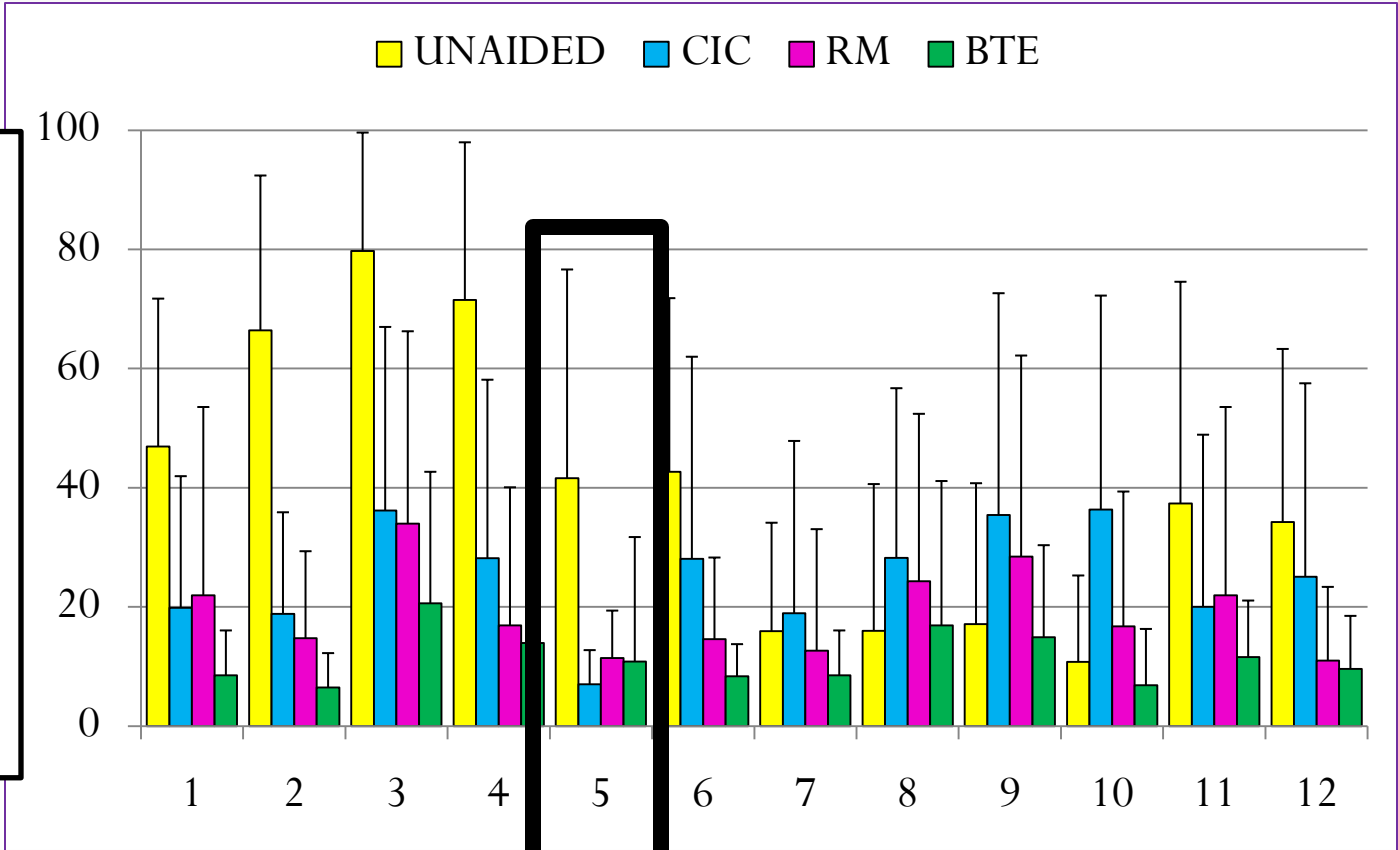


- 1) I am unable to understand the people with whom I speak most often.
- 2) I have to ask people to repeat themselves in quiet situations.
- 3) I have to ask people to repeat themselves in noisy environments.
- 4) I am dissatisfied with my hearing ability.
- 5) I have difficulty locating the source of a sound.
- 6) Other people's voices sound unclear to me.
- 7) Other people's voices sound unnatural to me.
- 8) My own voice sounds abnormal to me.
- 9) My voice sounds too loud to me when I talk.
- 10) I am bothered by my own chewing sounds.
- 11) I am bothered by wind noise.
- 12) I have difficulty hearing on the telephone.



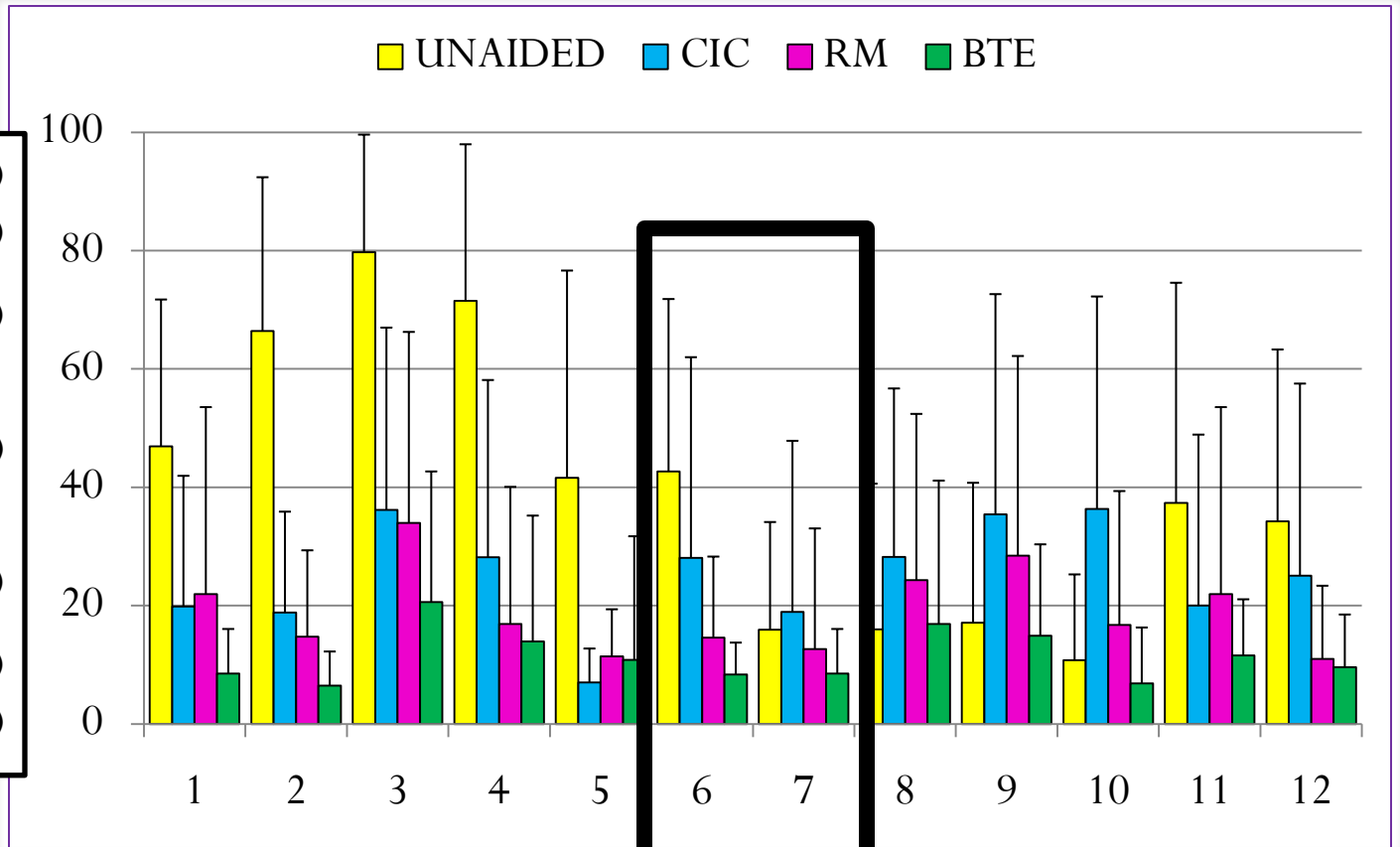
- 1) I am unable to understand the people with whom I speak most often.
- 2) I have to ask people to repeat themselves in one-on-one quiet situations.
- 3) I have to ask people to repeat themselves when in noisy environments.
- 4) I am dissatisfied with my hearing ability.

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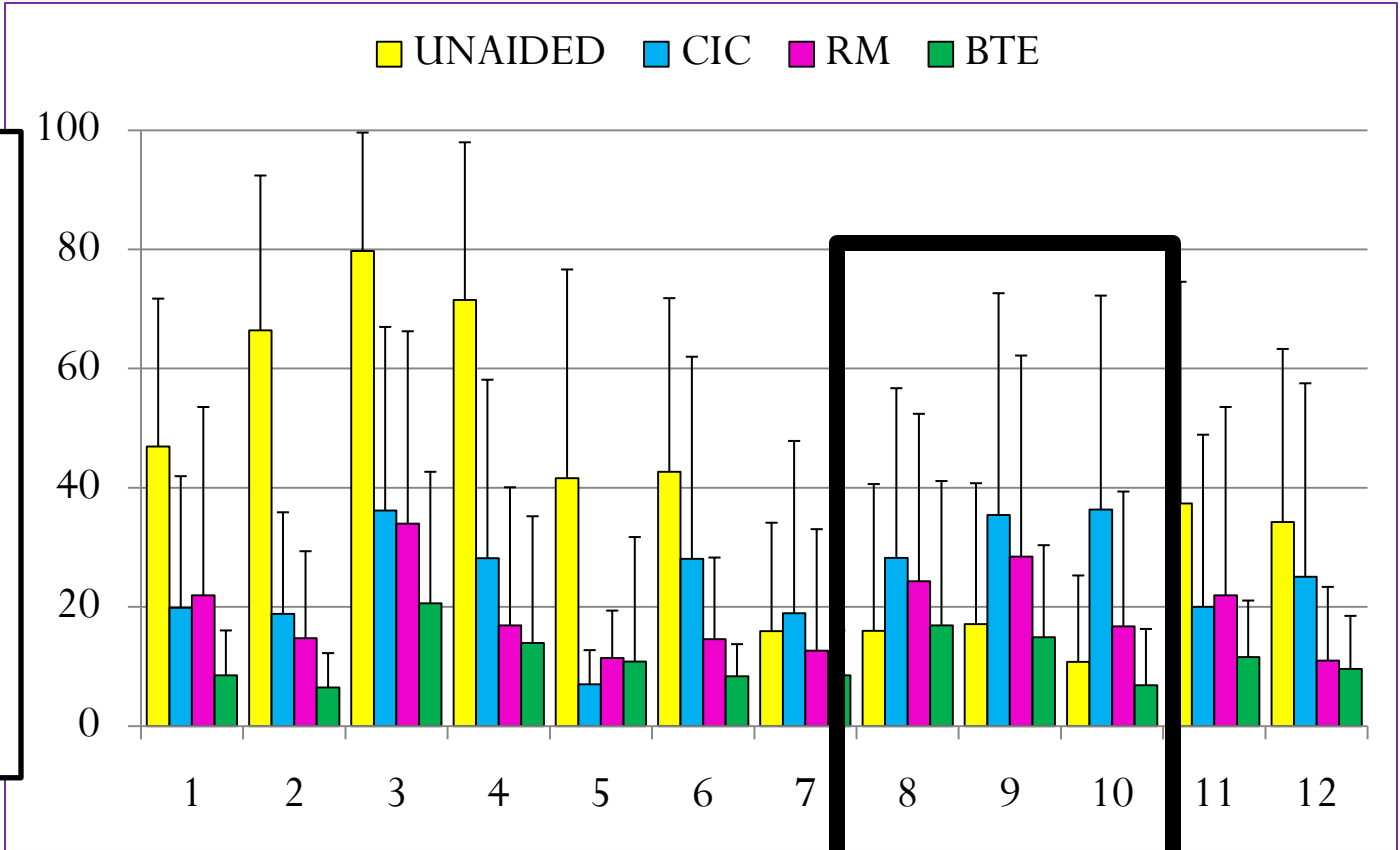
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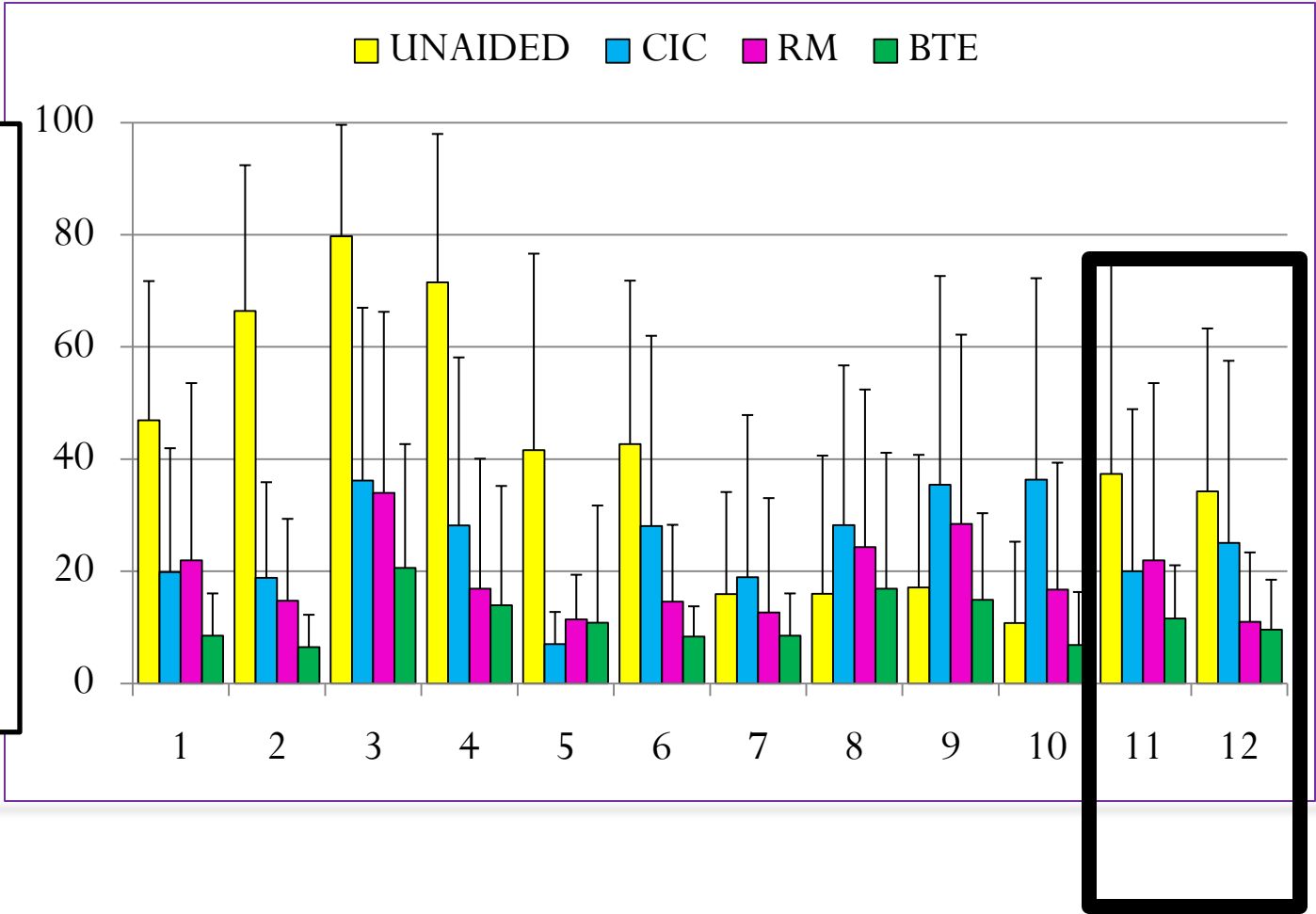
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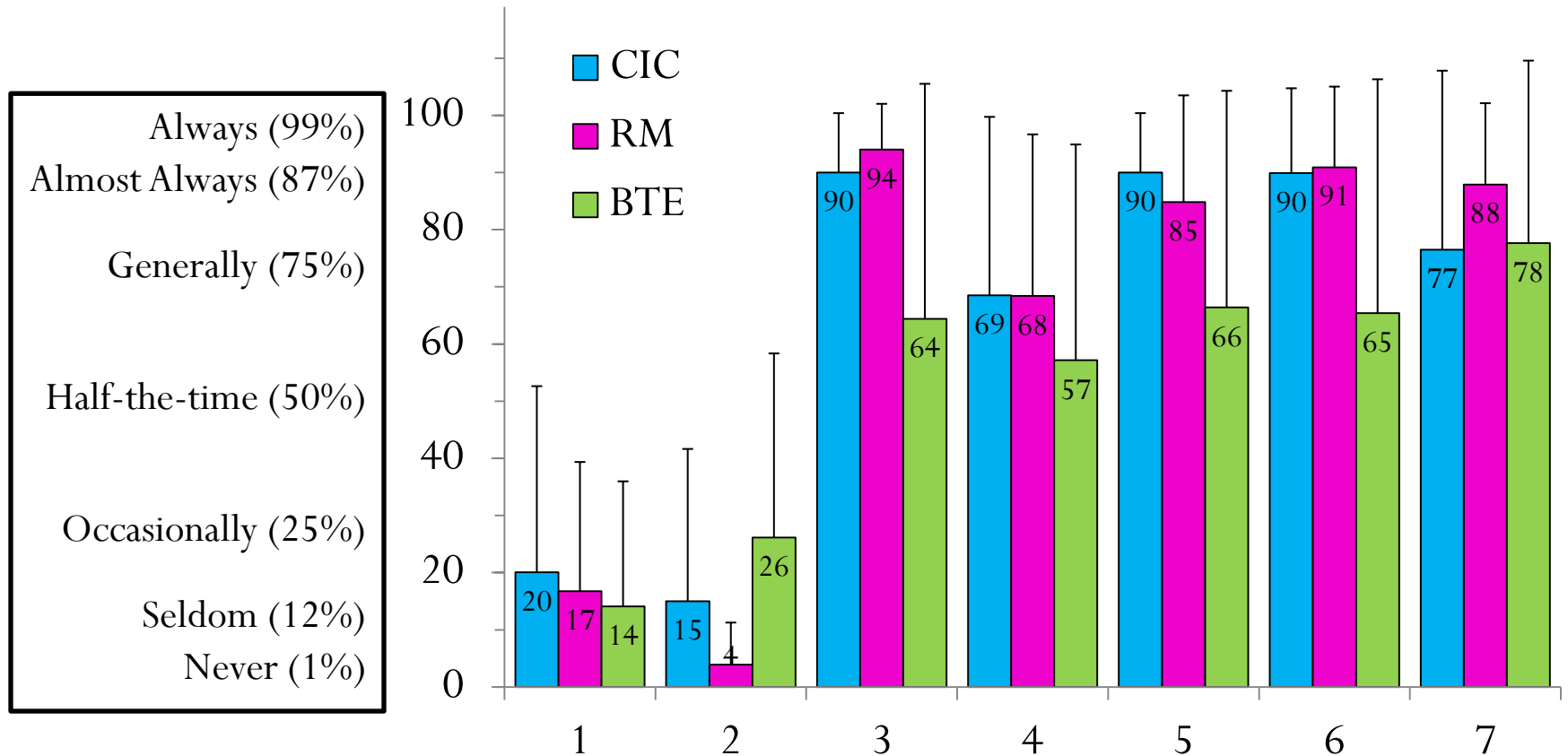


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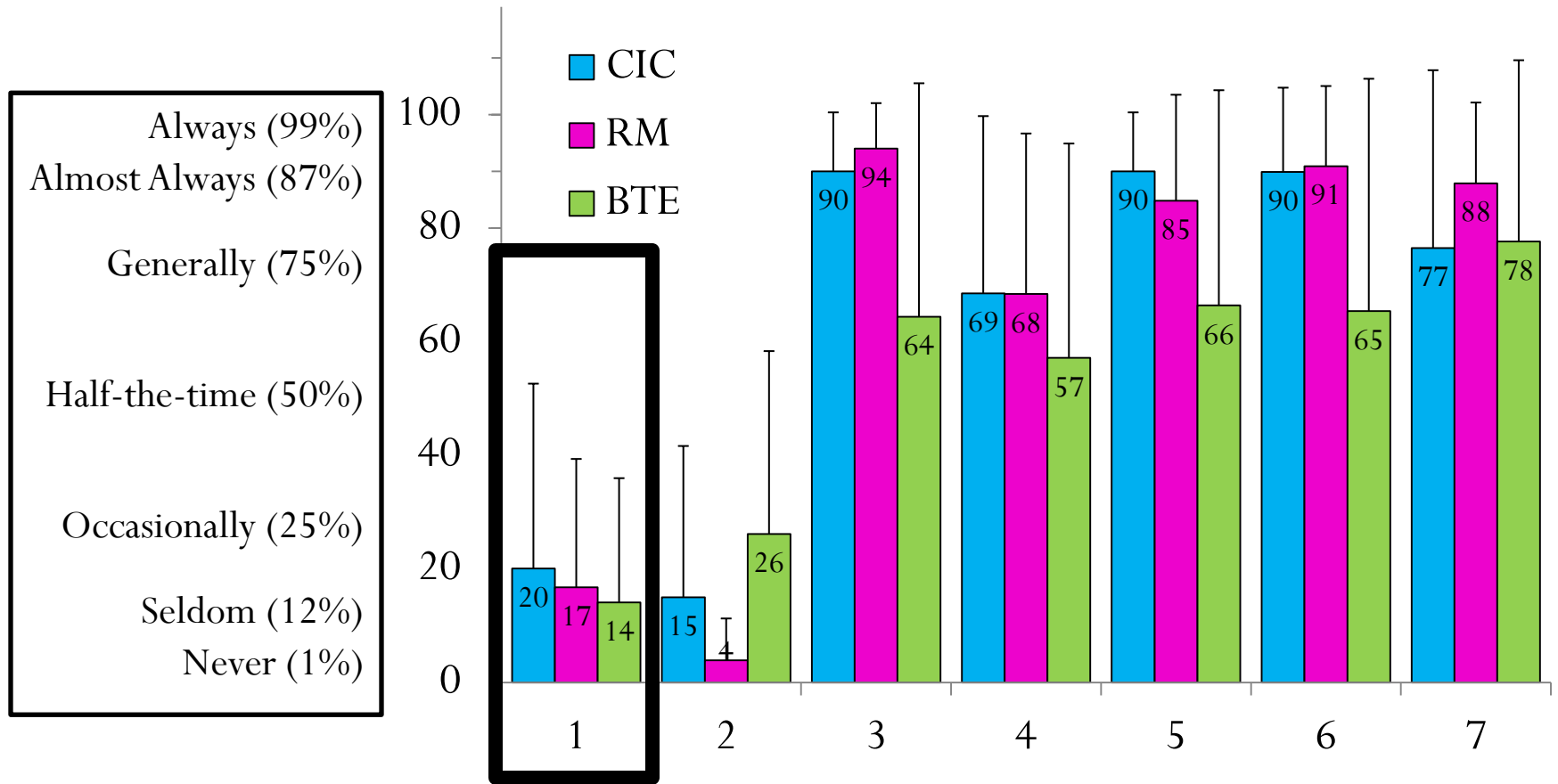
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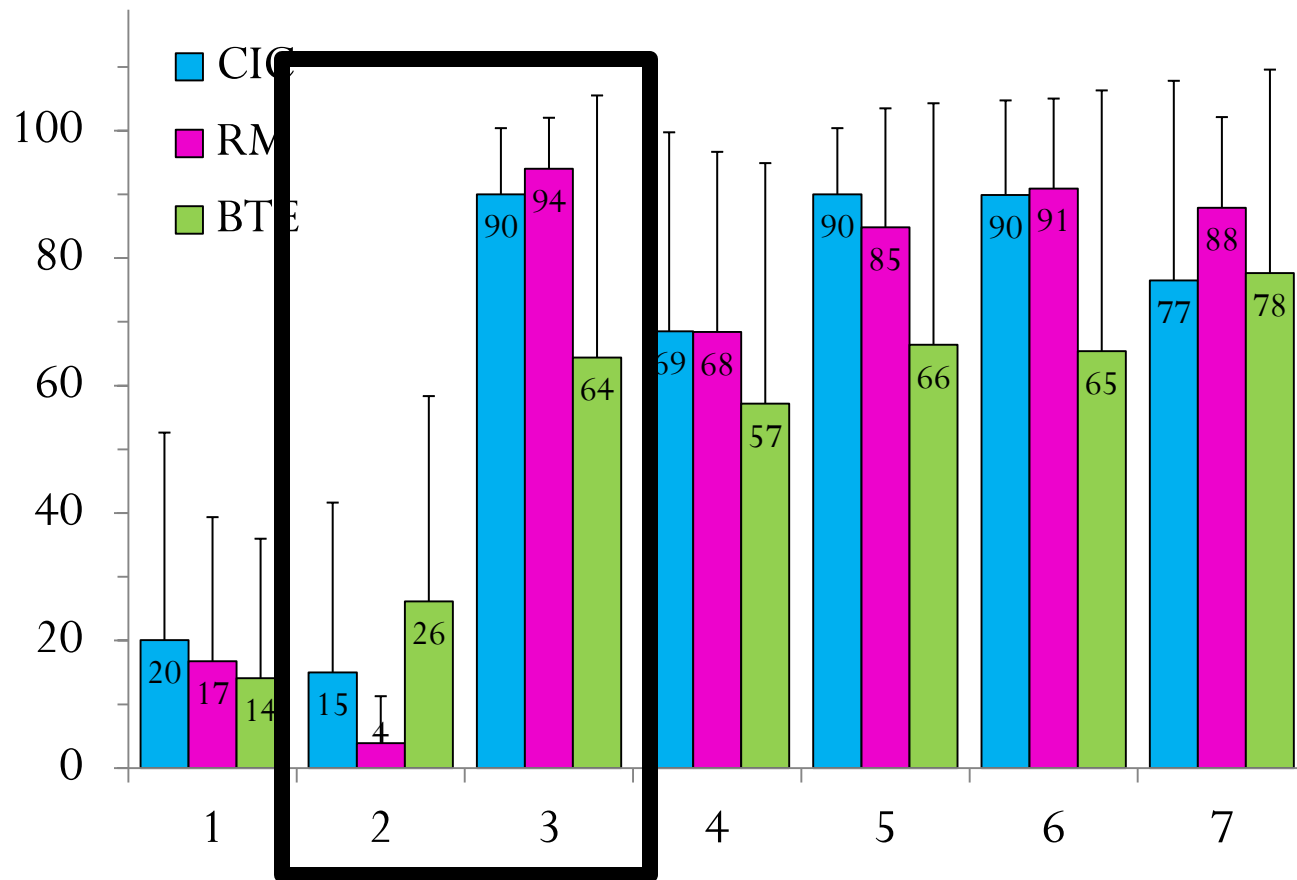


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- 7) I feel that wearing these hearing aids has improved my quality of life.



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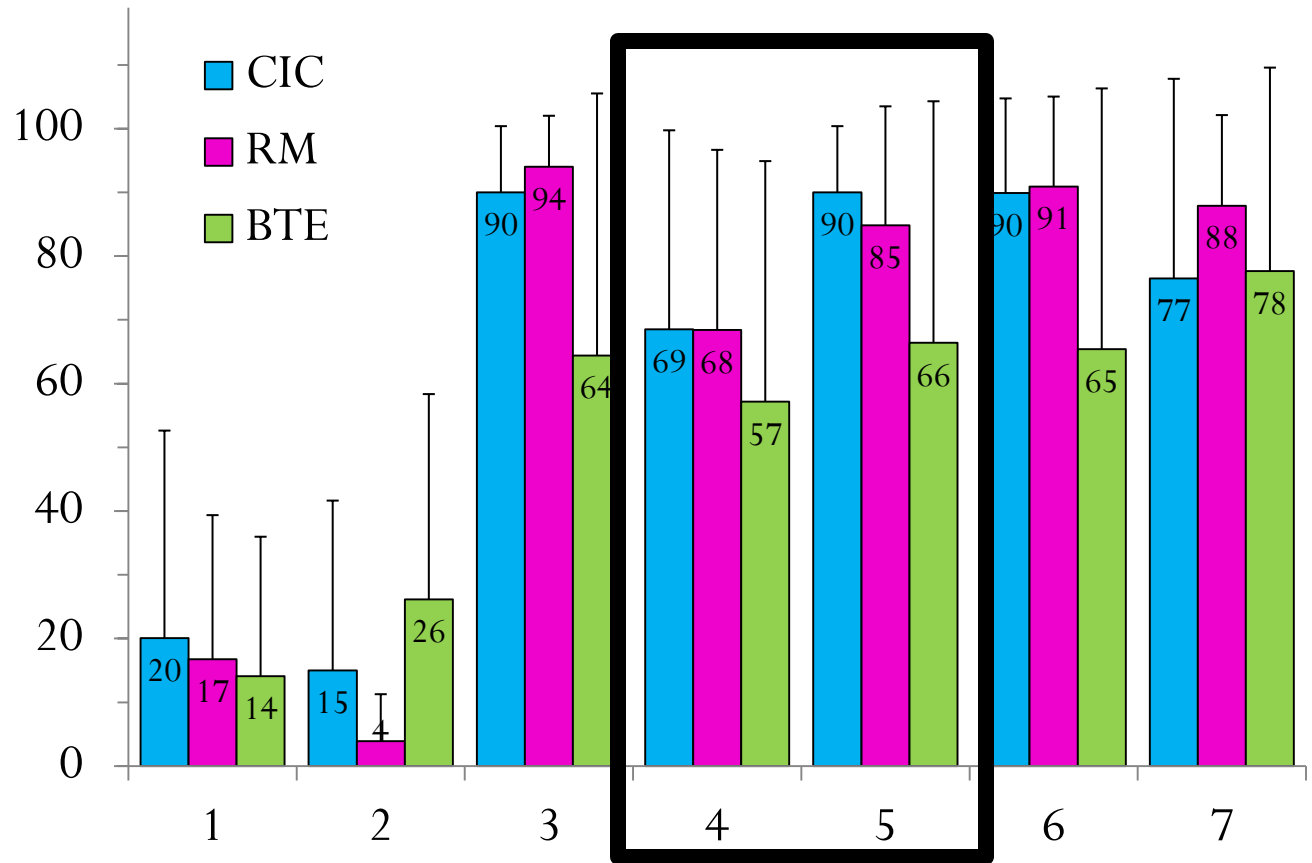
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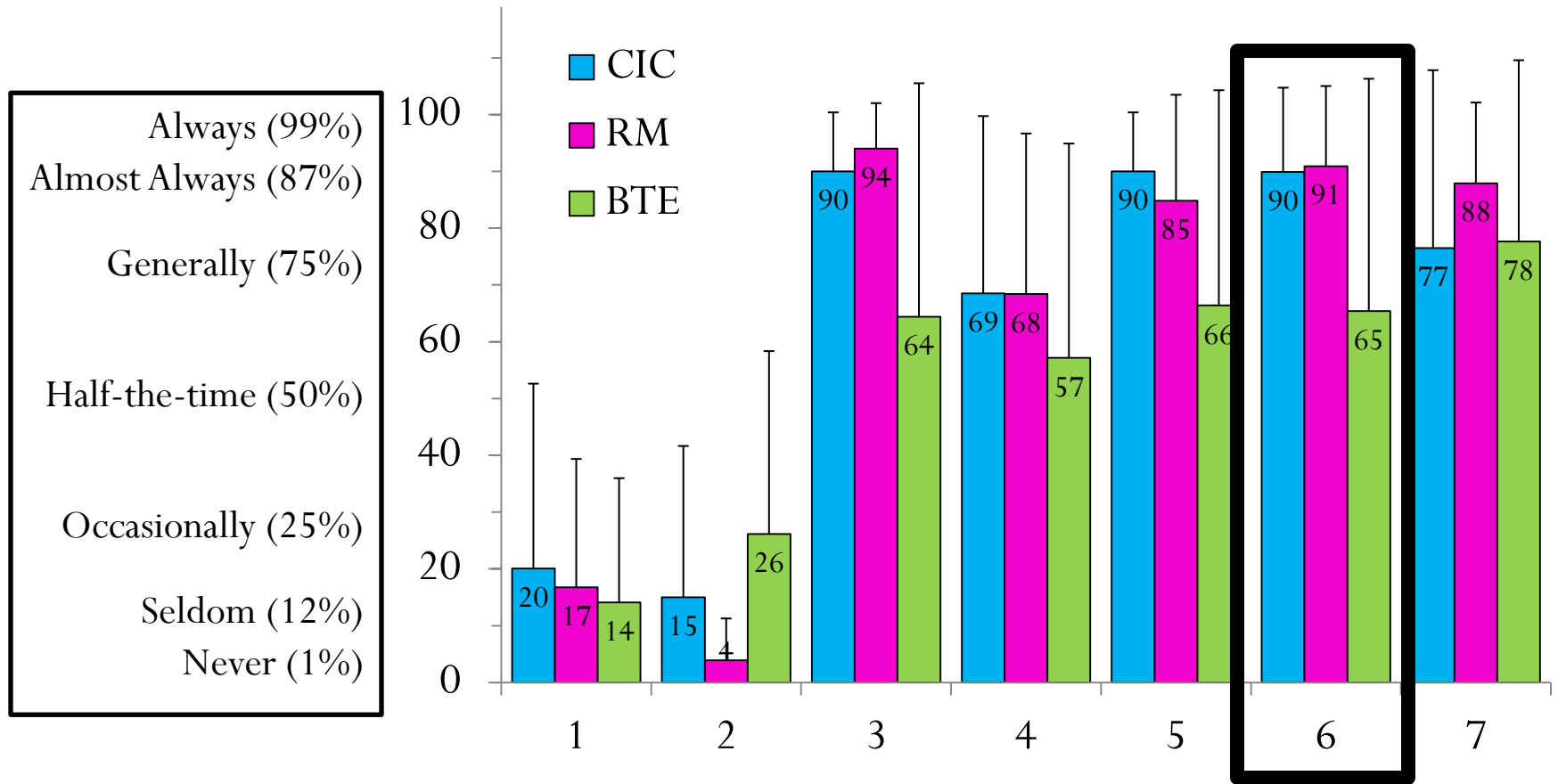
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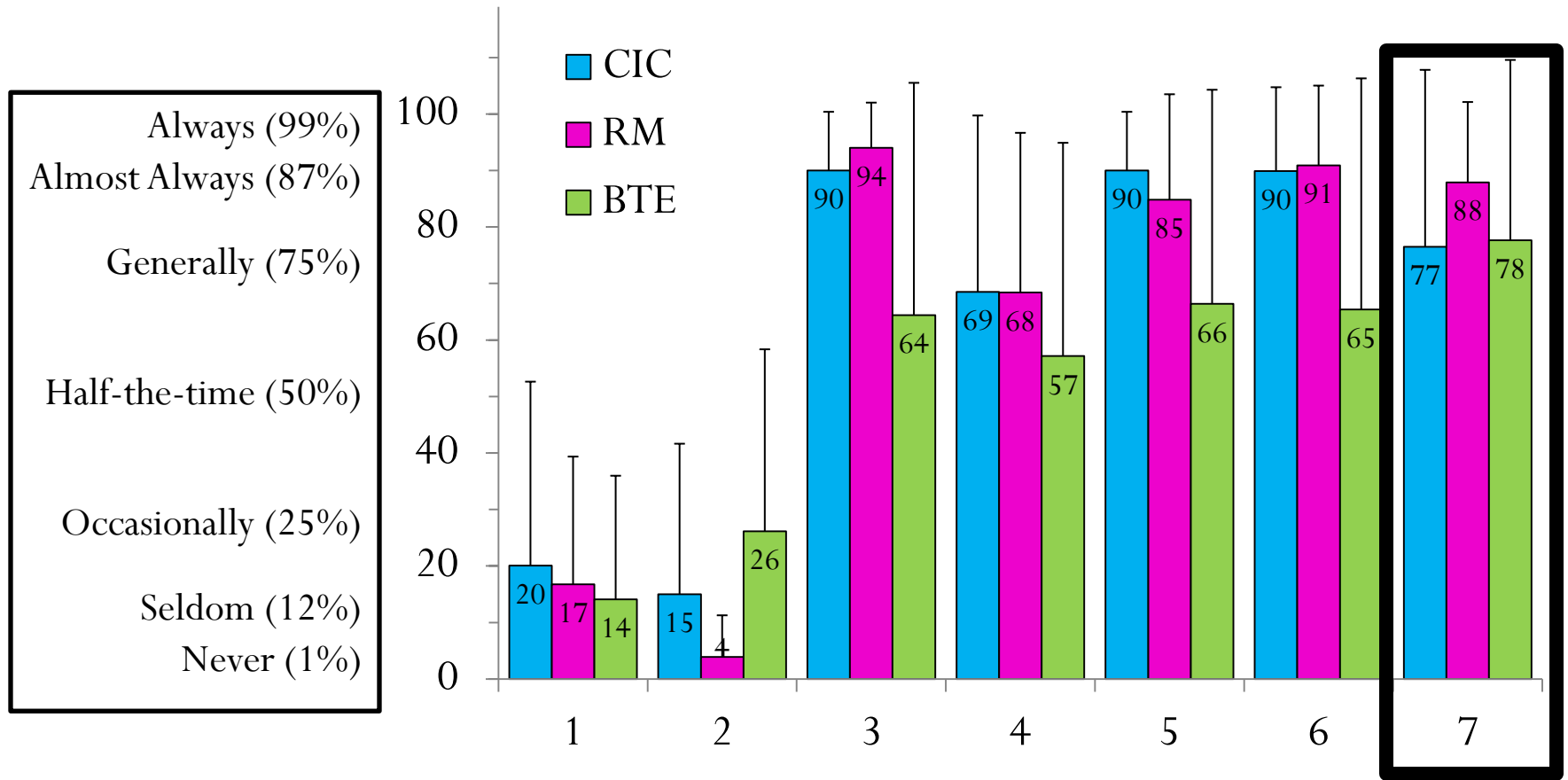
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- 4) These hearing aids are so comfortable that I forget I am wearing them.
- 5) These hearing aids are comfortable.



6) These hearing aids feel secure in my ears. (i.e., will not fall off)



7) I feel that wearing these hearing aids has improved my quality of life.

# Audio (aver L&R) by style choice

- **BTE:**

- 2 male, 3 female

- 2 RET, 3 FM

- Mean age: 60 years

- **RM:**

- 4 male, 0 female

- 2 AD, 2 RET

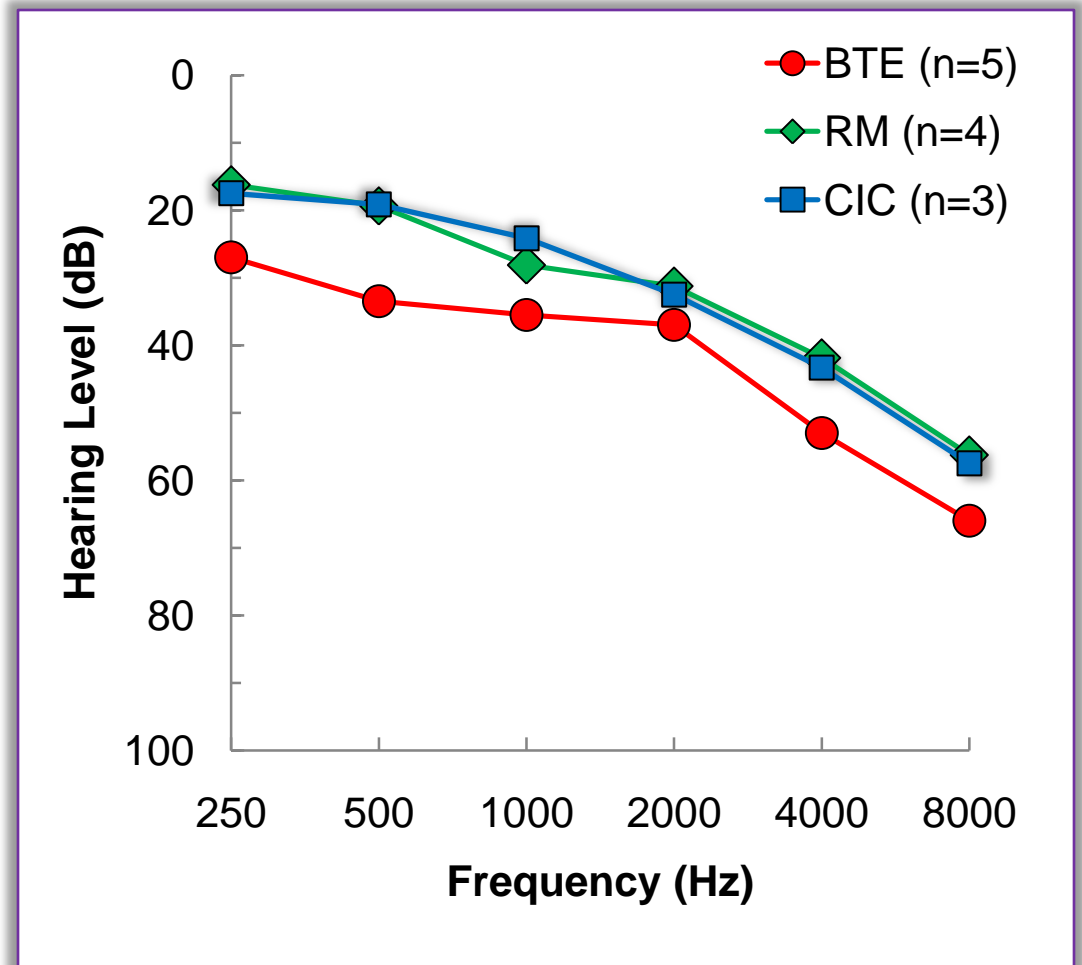
- Mean age: 54 years

- **CIC:**

- 1 male, 2 female

- 1 AD, 1 RET, 1 FM

- Mean age: 59 years



# Audio (aver L&R) by style choice

- **BTE:**

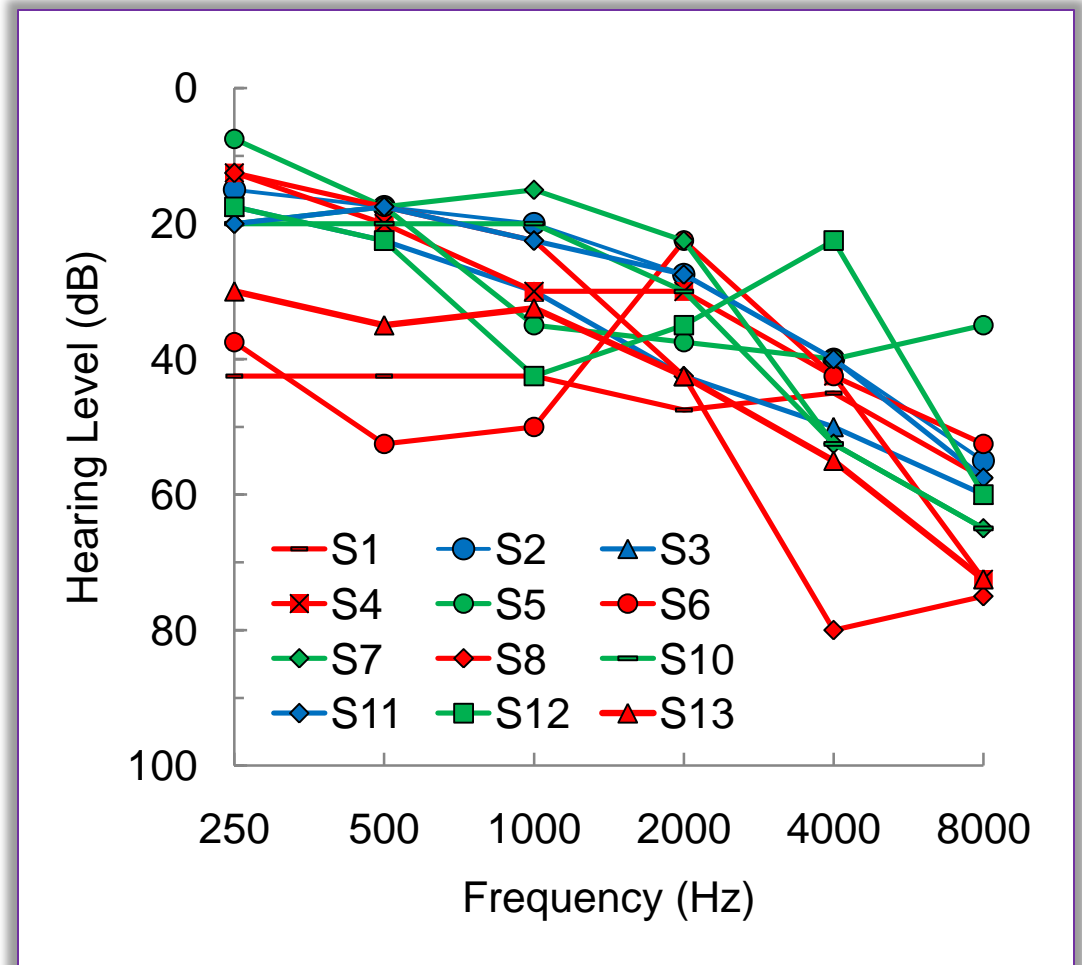
- 2 male, 3 female
- 2 RET, 3 FM
- Mean age: 60 years

- **RM:**

- 4 male, 0 female
- 2 AD, 2 RET
- Mean age: 54 years

- **CIC:**

- 1 male, 2 female
- 1 AD, 1 RET, 1 FM
- Mean age: 59 years



# Conclusions

- Little difference in performance was seen for laboratory testing (speech in noise and spatial release from masking)
- On average, participants reported good benefit from all hearing aid styles for listening in quiet, listening in noise, ability to localize, and improved quality of life.

# Conclusions

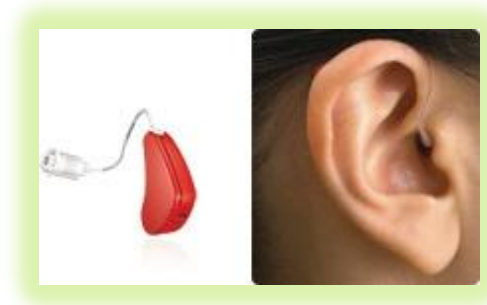
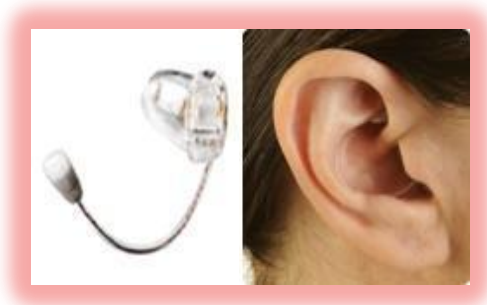
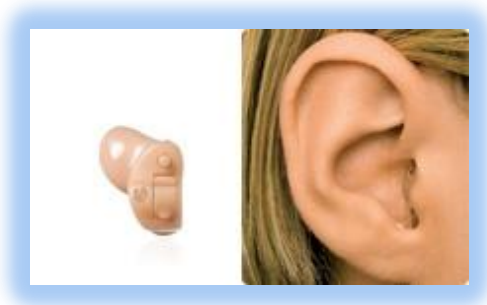
- Subjectively, participants rated CIC and RM devices more highly for cosmetics, comfort, and security of fit, relative to the BTE.
- BTE and RM devices were rated more favorably with regard to occlusion, clarity of other people's voices, telephone use, and overall satisfaction with hearing ability, as compared to the CIC.
- On average, the BTE was rated slightly higher for speech understanding in quiet and noisy environments.

# Conclusions

- Subjects were fairly evenly divided in their final preferences (5 BTE, 4 RM, 3 CIC).
  - This result was not significantly different from chance
- Only one participant ranked the RM as the least appealing of the three styles, it was otherwise ranked second.

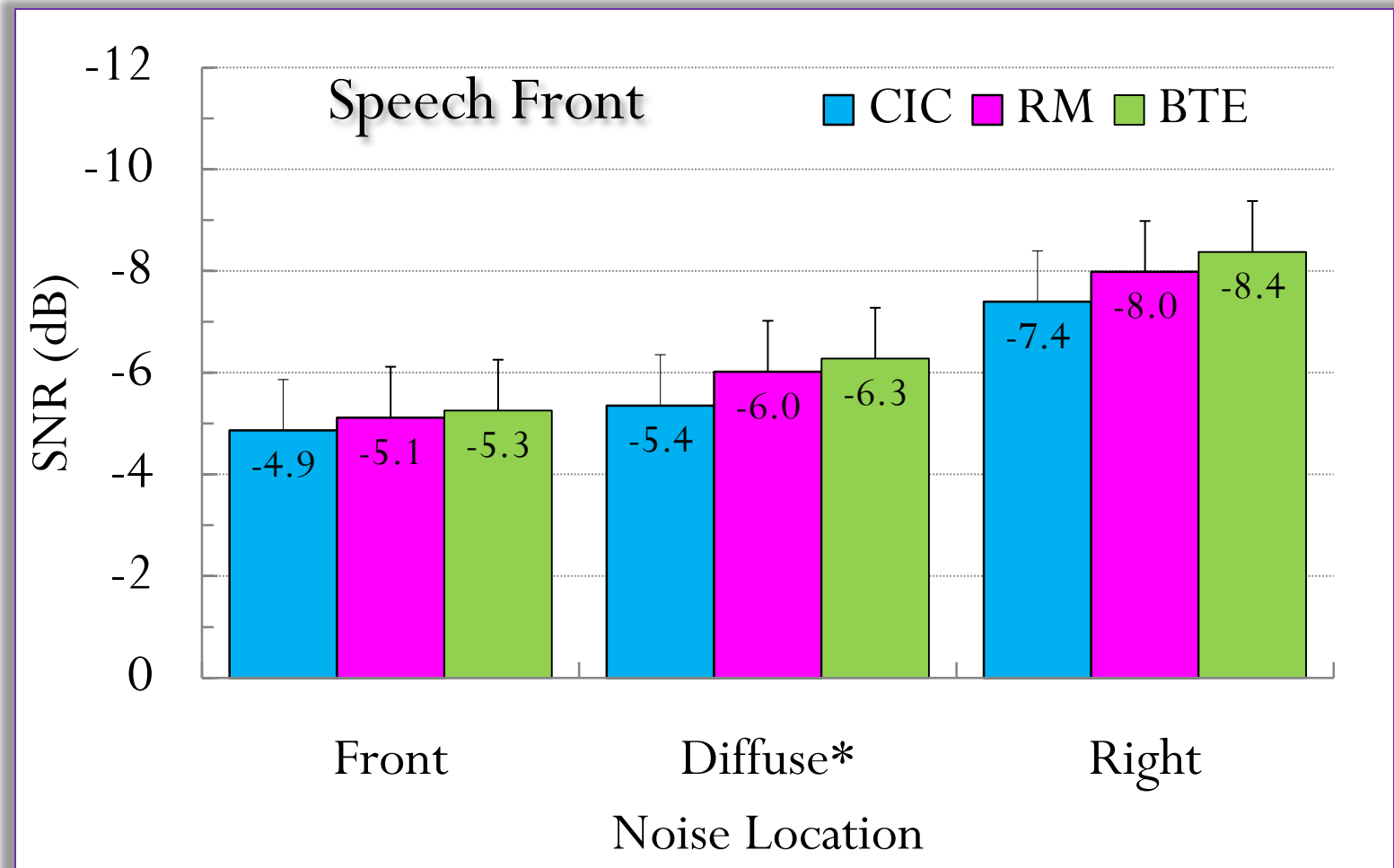
# Conclusions

- A patient's satisfaction with a first hearing aid fitting will often influence acceptance of and success with hearing aids over a lifetime. The RM offers another alternative to meet each individual's amplification needs.





# Laboratory Tests



\*Diffuse = noise from right, left and back loudspeakers