

Bimodal Devices on Children: A Survey of Clinician Fitting Practices in North America



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DISCLOSURES

- THIS PROJECT HAS RECEIVED SUPPORT FROM OTICON A/S
- DAVE GORDEY AND KAMILLA ANGELO ARE EMPLOYEES OF OTICON A/S

CONTRIBUTOR ACKNOWLEDGMENTS: THE KIPA GROUP



INTRODUCTION

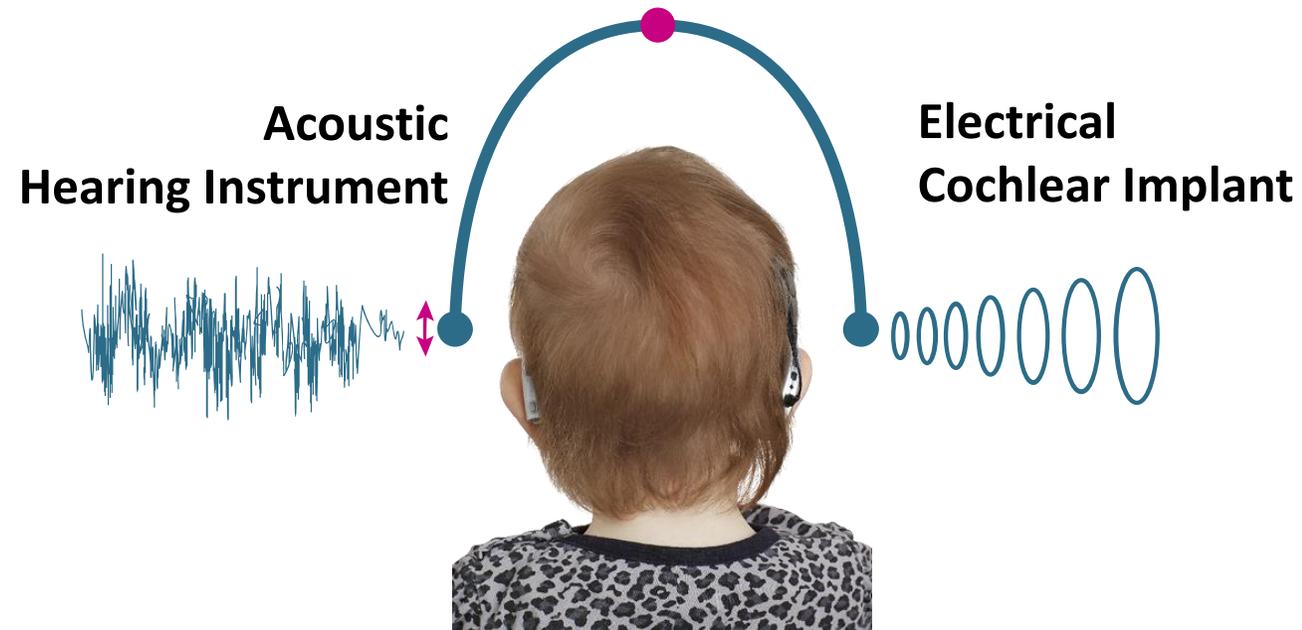
- Innovations in hearing aid and cochlear implant technologies mean children with hearing loss have more access to auditory information and more opportunities to develop age appropriate spoken language (Cole & Flexer, 2007).
- There are evidence-based fitting protocols for air conduction hearing aids to provide optimal amplification to infants and young children (e.g. AAA, 2013, Bagatto et. al, 2010).
- To our knowledge, there are no agreed upon evidence based fitting protocols for children using bimodal devices.

STUDY OBJECTIVE

- Anecdotal evidence and published research suggests that clinicians feel the fitting and management process of bimodal devices to children is “uncertain.”
- A survey was developed to **gather information regarding clinical management of bimodal devices for pediatric patients** seen at clinics within North America.
- We were interested in what procedures and protocols were used to fit/program and verify the HA and the CI for bimodal devices.

WHAT IS BIMODAL?

A Combination of 2 technologies



BENEFIT OF BIMODAL DEVICES

Ching et al., 2007; Davidson et al., 2015

- Adult & pediatric studies have demonstrated the benefits of using a hearing aid in the non-implanted ear
- Improved speech perception in quiet & noise, speech quality, music appreciation & ease of listening



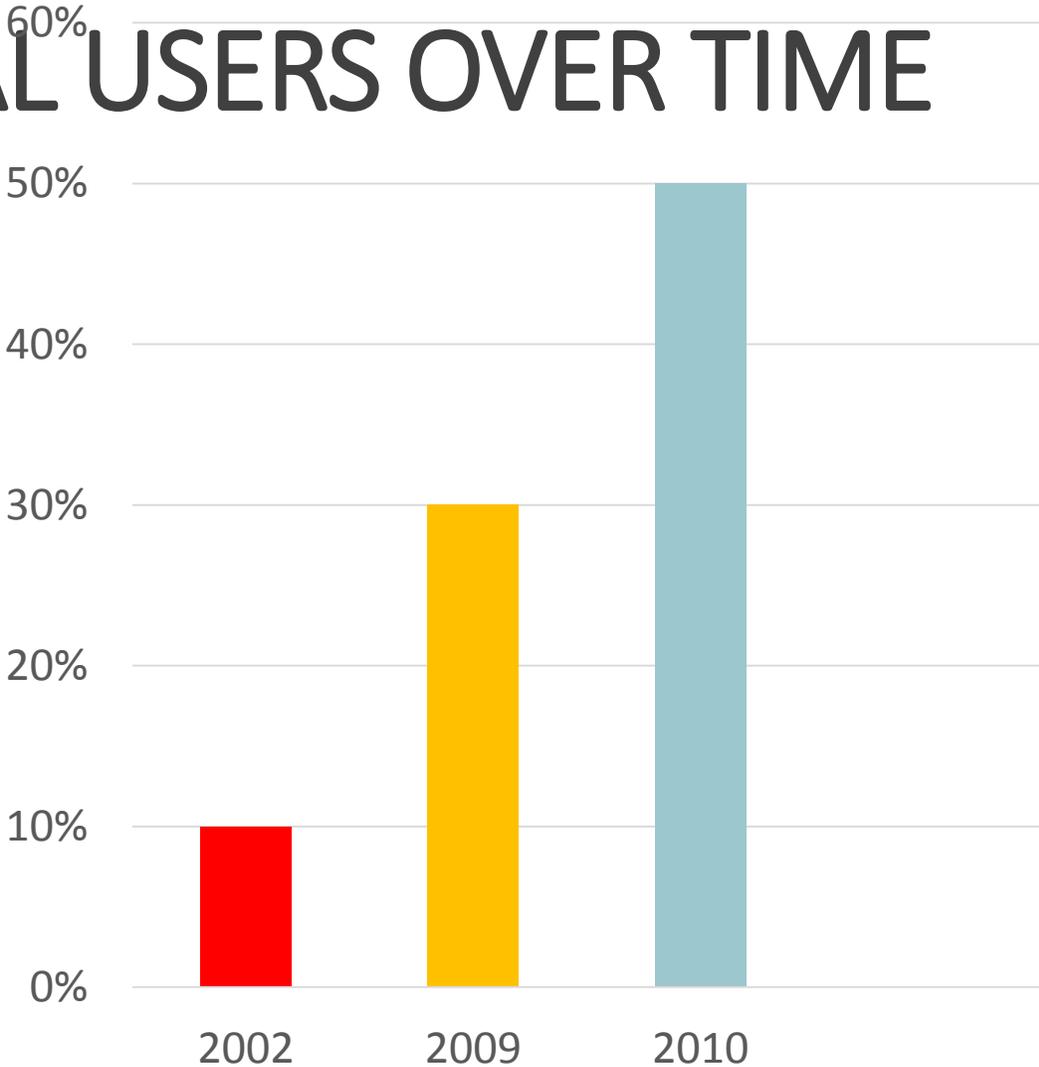
ADDITIONAL BENEFITS OF BIMODAL DEVICES

- Although benefits may vary across individuals and conditions
- Literature suggests that a period of HA use may facilitate spoken language and literacy skills in children eventually receiving a 2nd CI (Nittrouer & Chapman, 2009; Nittrouer et al., 2012; Nittrouer et al., 2014)
- (See reviews from Ching et al. 2007; Sammeth et al. 2011; & Schafer et al., 2011)

Bimodal Users

INCREASE IN BIMODAL USERS OVER TIME

- 2002: 10% (Tyler et al.)
- 2009: ~30% (Fitzpatrick et al.)
- 2010: > 50% with aidable hearing in non-CI ear (Dorman & Gifford)



FITTING ISSUES

- Studies have supported the coordinated fitting of a hearing aid (HA) and cochlear implant (CI) for bimodal use (CI + HA at non-implanted ear) that emphasizes audibility and balanced loudness across the two ears/devices (Blamey et al., 2000; Ching et al., 2001; Ching et al., 2007)
- No widely established fitting protocols for bimodal devices
- Obstacles to bimodal fitting related to current commercial CI and HA systems (For a review see Francart & McDermott, 2013)
- Best frequency response for HA fitting ? Best frequency allocation for CI?

ADJUSTING BIMODAL FIT FOR LOUDNESS: RECOMMENDATIONS

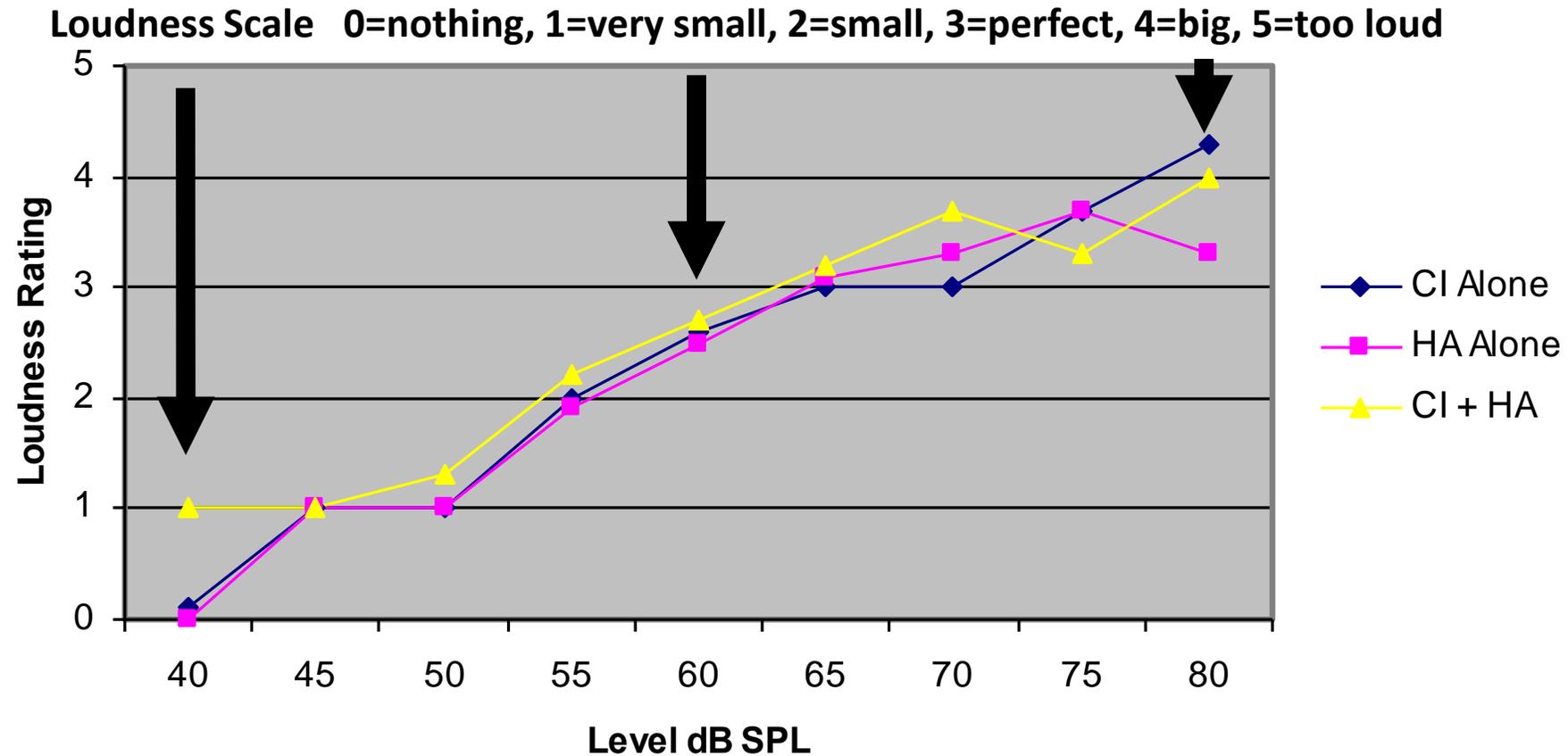
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ADJUSTING BIMODAL FIT FOR LOUDNESS: RECOMMENDATIONS

Balance comfort /loudness of input levels of speech from soft to loud across devices using:

- Live voice speech presentation
- Calibrated running speech @ ~60 dB SPL, ~70 dB SPL, ~80 dB SPL
- Environmental sounds at various levels
- Adjust Global Map C/M levels or volume, adjust output of hearing aid, evaluate compression characteristics of each device, evaluate frequency-specific C levels, output etc.

THE GOAL OF BIMODAL FITTING



BIMODAL FITTING CONSIDERATIONS

- *Do we deliver low frequency to the HA and high frequency to the CI? Or do we provide BOTH devices with the widest frequency range?*
(Vermiere et al., 2008; Simpson et al., 2009; Zhang et al., 2010)
- *Should we restrict HA gain to regions that have more residual hearing or low frequency regions?*
(Mok et al., 2006, 2010; Potts et al., 2009; Neuman & Svirsky, 2013; Davidson et al., 2015; Messersmith et al., 2015)
- *Should we consider frequency transposition/compression for HA? Or could this processing interfere with CI processing?*
(Gifford et al., 2007; McDermott & Henshall, 2010; Park et al., 2012; Perreau et al., 2013; Davidson et al., 2015)

ADULT BIMODAL SURVEY

Siburt & Holmes, 2015

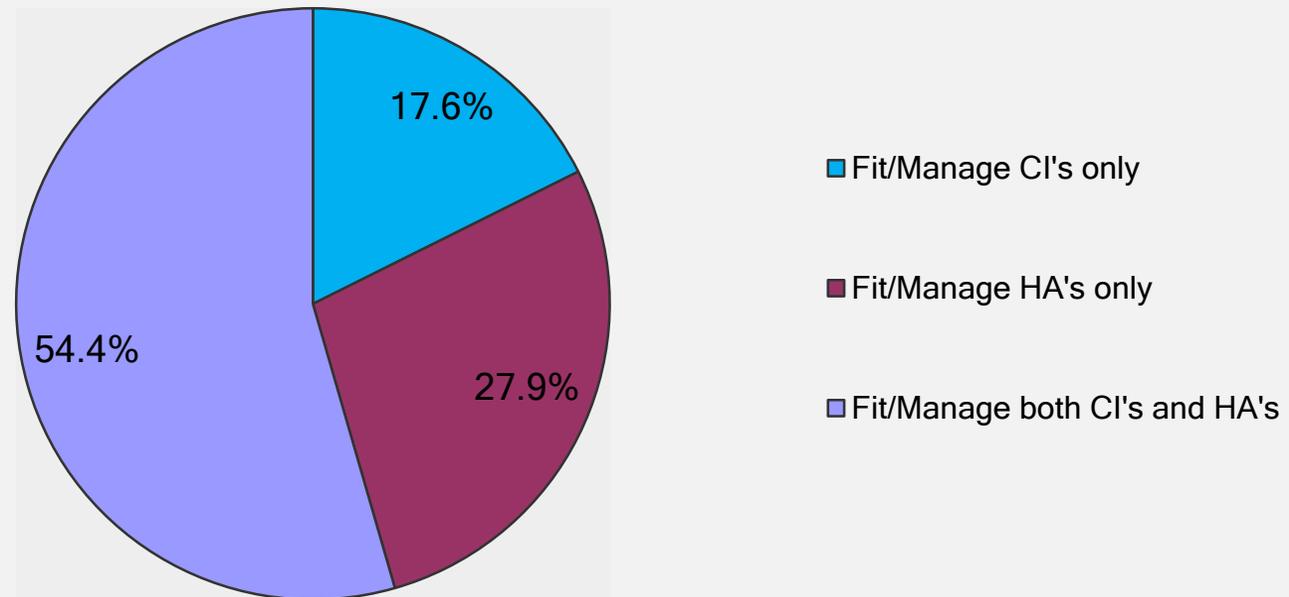
- **Large CI centers** (≥ 20 New CIs patients per year) **more likely to recommend bimodal fittings**
- **Half of all respondents waited at least two months after initial CI activation to program hearing aid**, none within two weeks of activation.
- **Professionals responsible for programming of the HA varied considerably:** HA and CIs were frequently programmed at separate facilities
- **Responses varied** as to HA prescriptive targets used, type of HA verification, and bimodal fitting protocols (if any) used

KIPA BIMODAL SURVEY (2016)

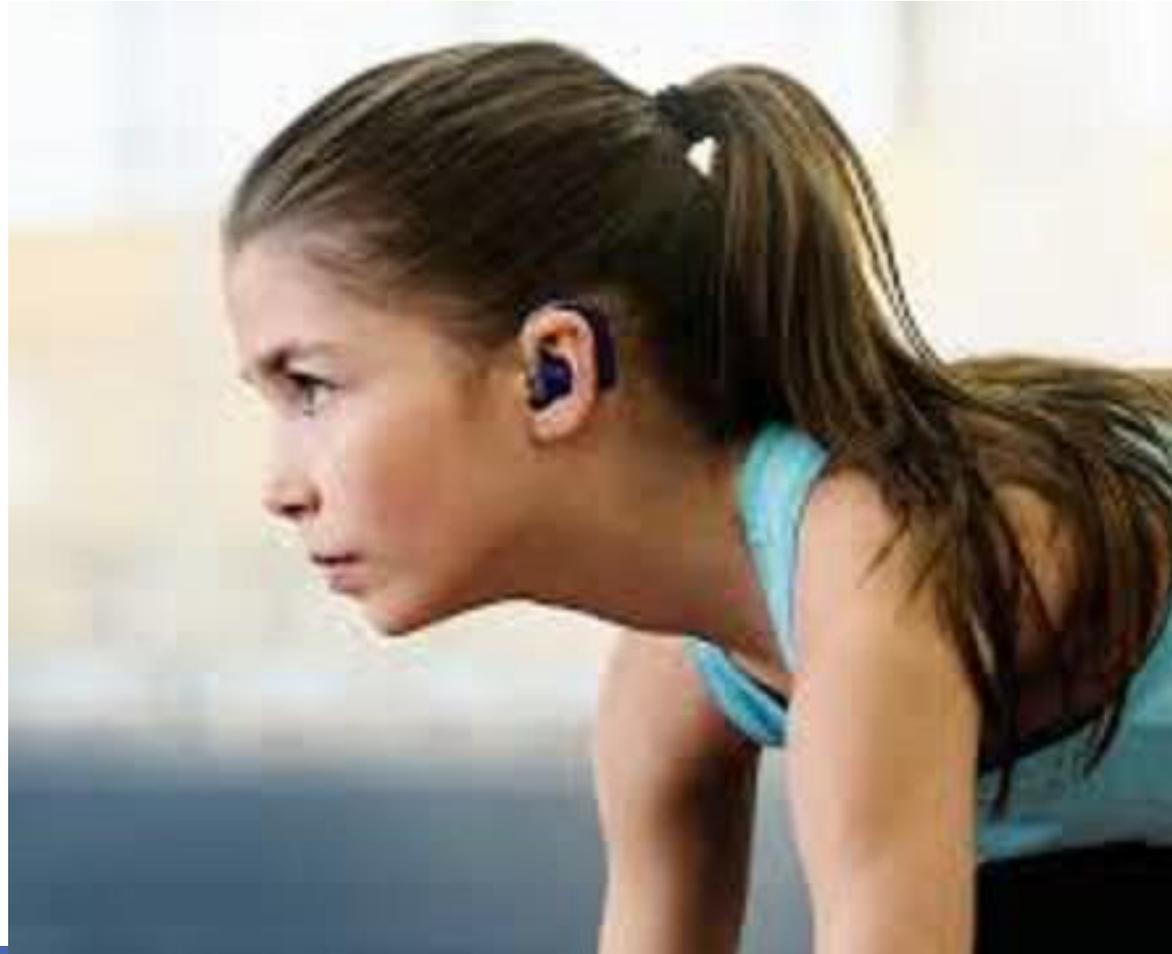
- A web-based survey was sent out to approximately 300 clinicians, and 85 responded.
- The survey was posted on the ACI blog; and distributed to pediatric clinics and hospitals identified from cochlear implant manufacturer websites and hearing aid manufacturers in the United States and Canada.
- Survey questions requested information about clinical practices when fitting cochlear implants, hearing aids and bimodal devices in children.

CLINICIAN ROLE(S) IN BIMODAL FITTINGS

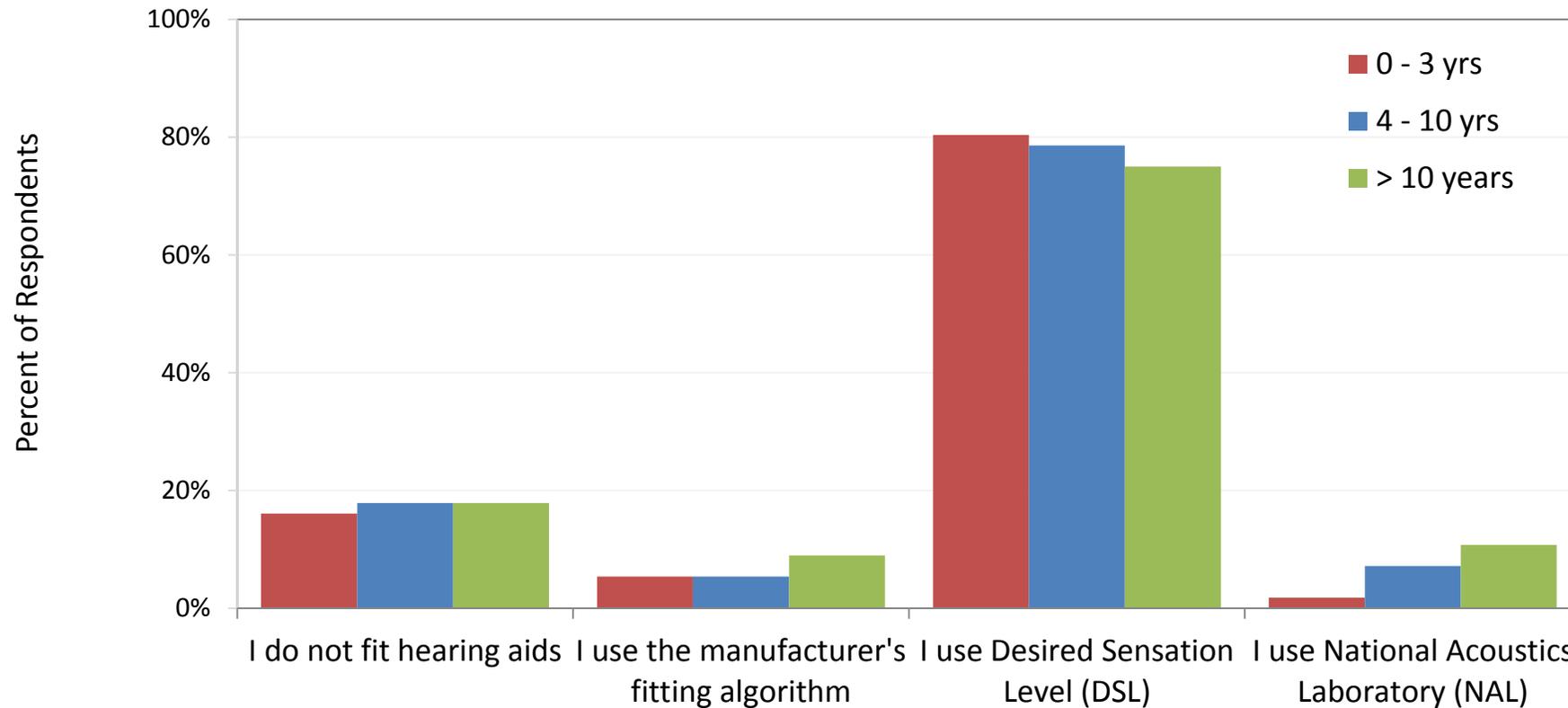
2. Which best describes your role in a bimodal fitting?



HEARING AID



HA SELECTION & FITTING METHOD



What procedures do you use for hearing aid selection and fitting? (check all that apply for the following age ranges).

HA SELECTION/FITTING: COMMENTS

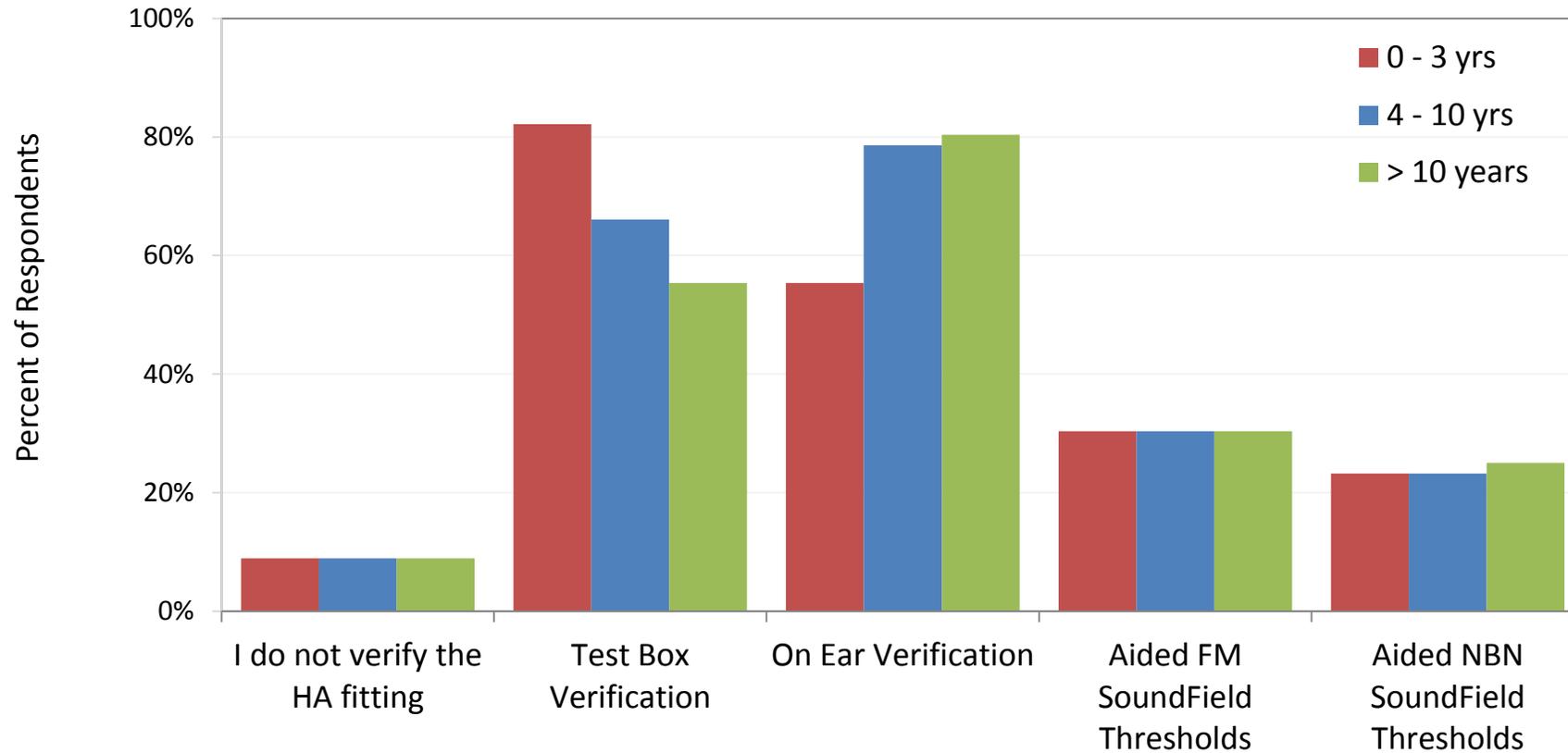


- “Depending on the age at initial HA fitting, I may use DSL child or DSL adult targets. If the child has not used a hearing aid prior to about 15+ years of age, I would do DSL adult. If they have used hearing aids prior to 15 years, I use DSL child”
- “NAL-NL2 for older teenagers and young adults”
- “I do not see children older than 5-6yr”

VERIFICATION AND VALIDATION

- *Verification* involves ensuring the electroacoustic characteristics of the hearing device to support the auditory habilitation needs of the child
- *Validation* is the process of assessing the impact of the hearing device fitting to determine whether it is delivering the intended outcome
- *Outcome measures* are used in the validation stage to determine progress and treatment efficacy

HEARING AID VERIFICATION



What procedures do you use for hearing aid verification?

HA VERIFICATION: COMMENTS



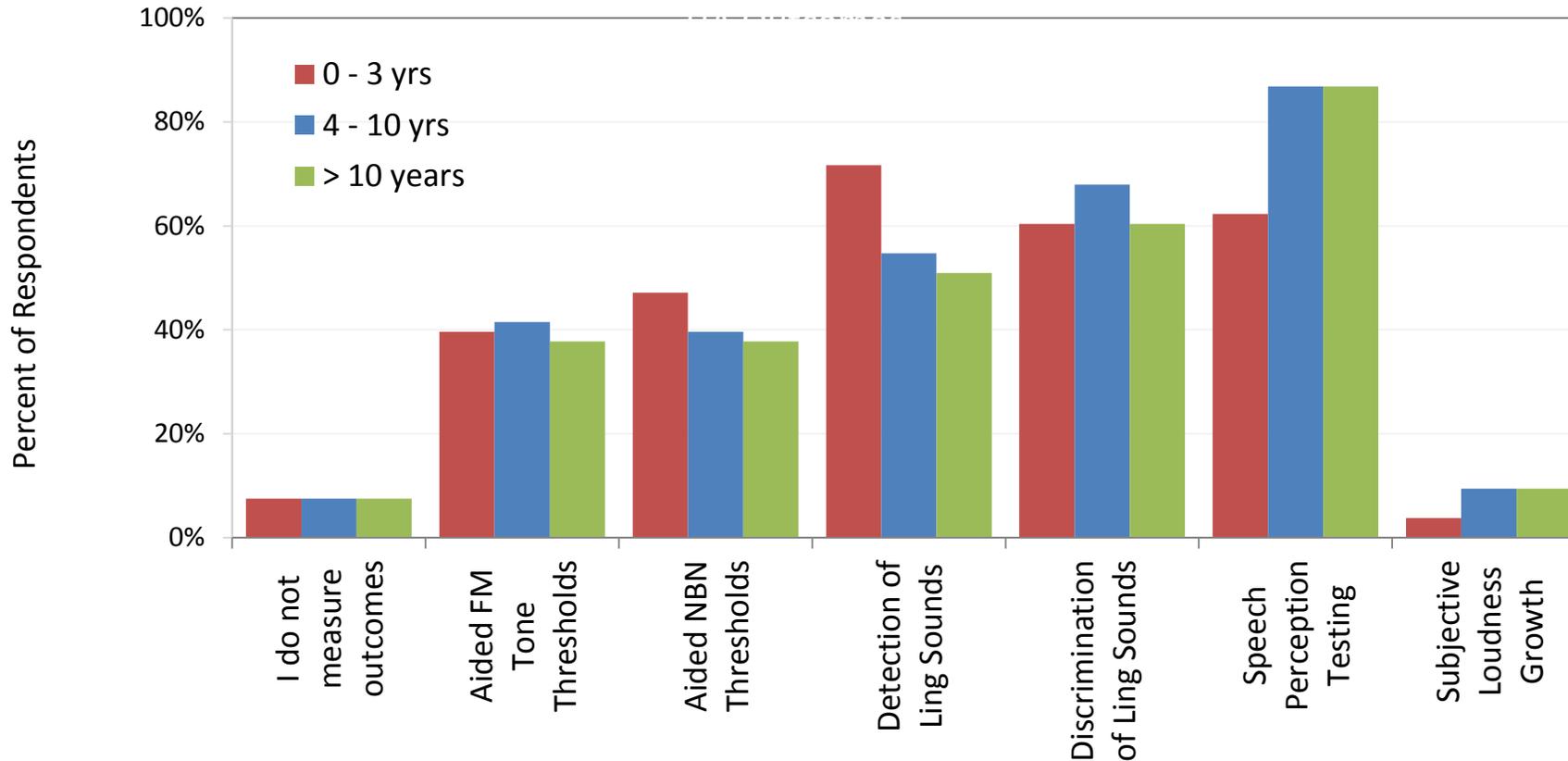
- “RECD or probe-mic measures whenever possible. About 50% of the time we have to use simulated due to patient compliance or time limitations”
- “If there is a vented earmold, I try to do on-ear measures. I take RECD measures for every patient if possible, but may verify it in the test box”
- “Narrowband used as a comparison to FM tones, unless child is unresponsive to FM tones”

HA VERIFICATION: COMMENTS



- “Based on age and cooperation, may not be able to do real ear but try for RECD values may not always do NBN but always do Ling sounds, alphabet letter, word, phoneme, etc. identification at quiet speech soft and average and average speech in noise”
- “Recorded Ling-6 (dB HL) thresholds for all age groups (though not routinely)”
- “Ling 6 sounds in sound field”

HA Measured Outcomes



What procedures do you use for hearing aid outcome measures?

- Loudness Growth measures are seldom used for HA



HA MEASURED OUTCOMES: COMMENTS

- “VRISD for phonemic discrimination in infants up to ~24 months”
- “Do not always do NBN but always do phoneme, alphabet letter, word or sentence identification in quiet (soft and average speech) and noise”
- “Questionnaires, for example parent and child questionnaires PEACH/LittleEARS”
- “We work alongside auditory-verbal therapists and we rely on their informal and formal assessments to help us determine outcomes”
- “Also, coordinate with AVT and/or SLP to monitor speech and language skill development”

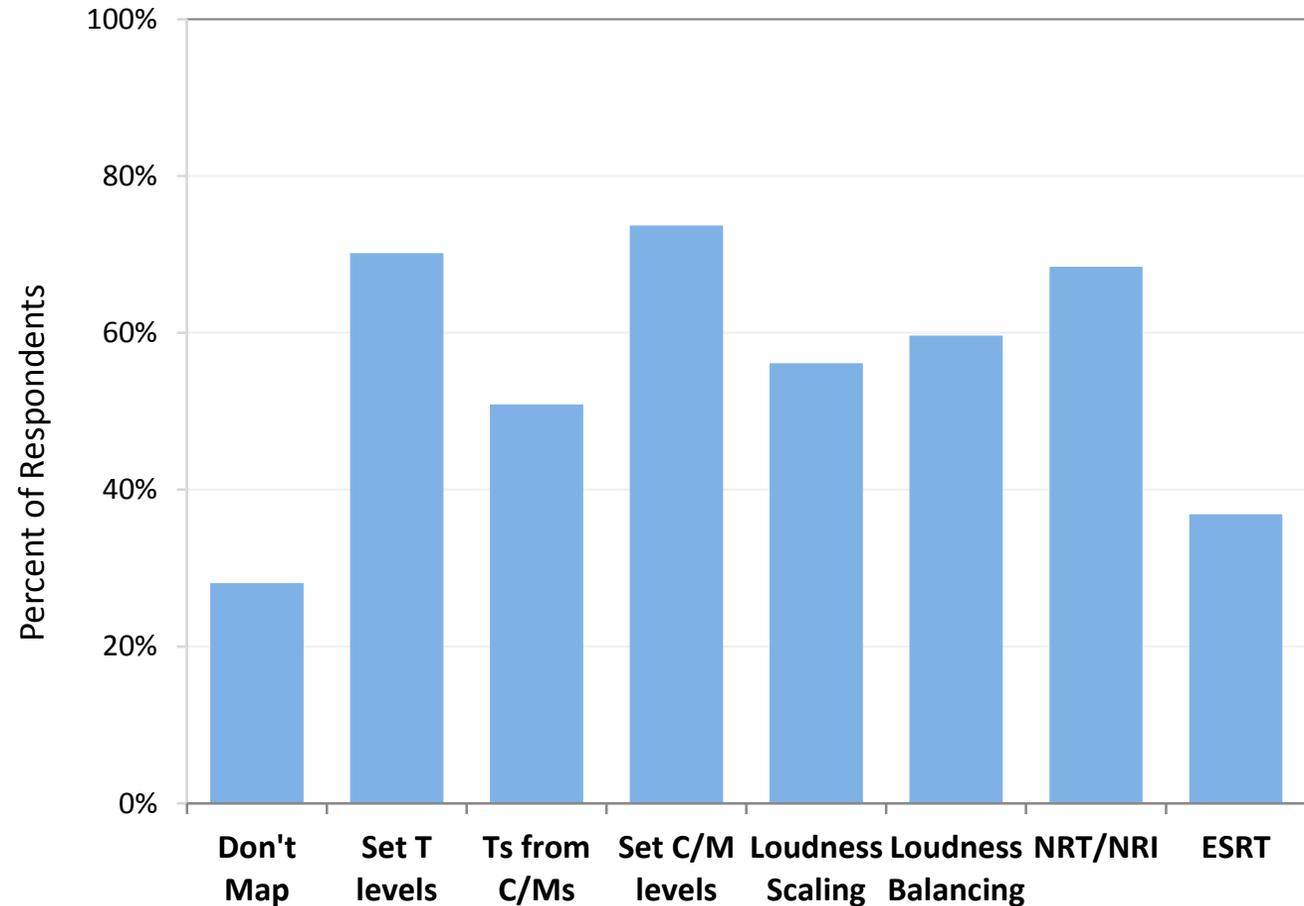
COCHLEAR IMPLANT



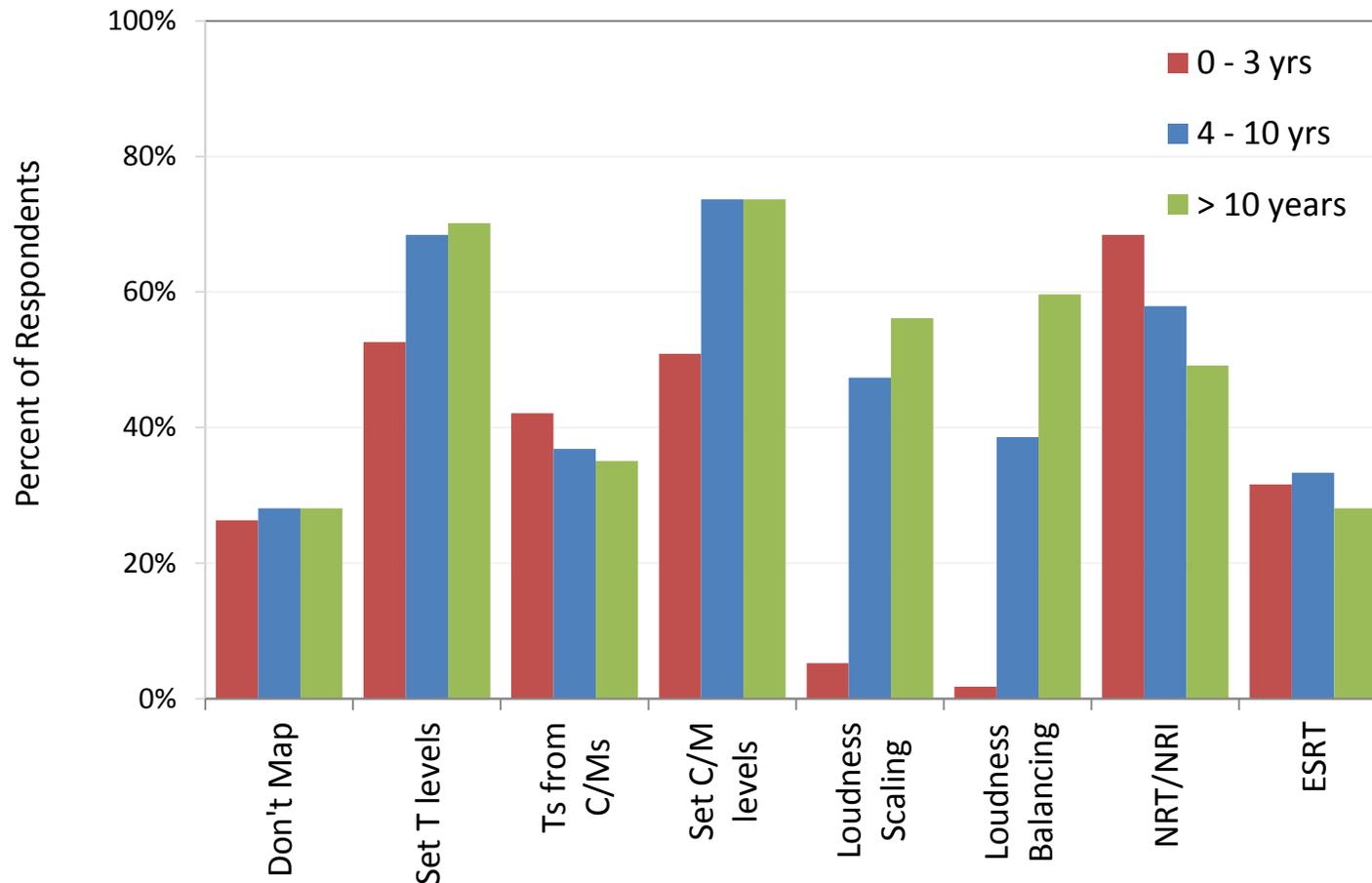
CI MAPPING PROCEDURES

What procedure do you use for CI mapping? (check all that apply)

- Clinicians use a wide variety of procedures to complete the mapping process
- One procedure does not fit all



CI MAPPING PROCEDURES: DIFFERENT AGES



- Even within specific age groups, one procedure does not fit all
- NRT/NRI is used across age groups
- Loudness scaling/balancing not used below age 4

MAPPING PROCEDURE: COMMENTS



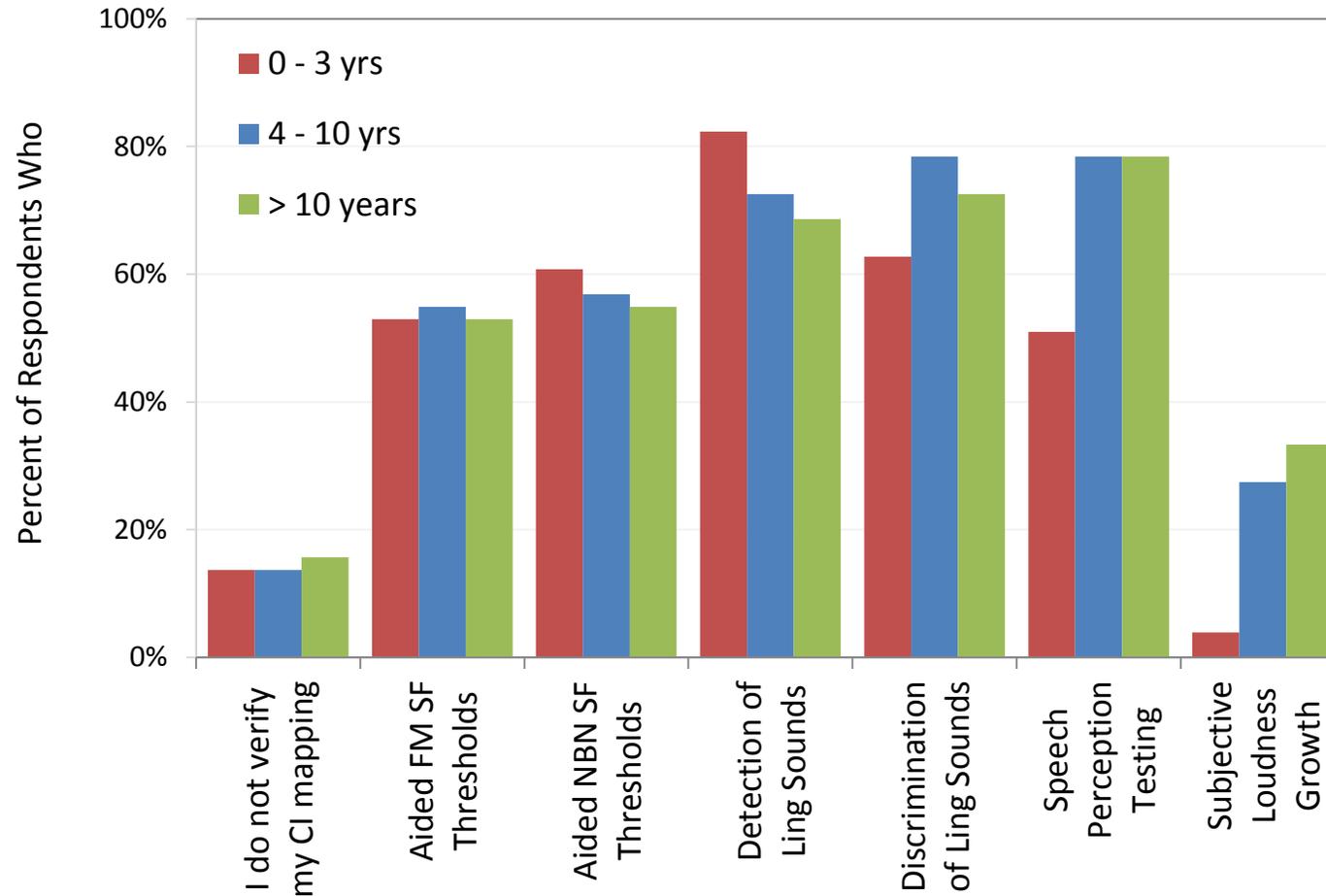
- “ESRT only for difficult cases where NRT/NRI/ART not present.”
- “I set T levels in Cochlear but often let T's be predicted by C's in MedEl and AB devices”
- “We use ESRT in unilateral patients when possible (many of our young patients are bilateral short sequential); we use NRT and NRI as a basis for setting the C/M levels, but do not use offset map suggestions”

MAPPING PROCEDURE: COMMENTS



- “The age range here is a little broad- I use NRT for the under 2 year set and then try to use play audiometry to set Ts when applicable.”
- “NRT, etc. may be used for mapping on patients with multiple medical conditions and poor communication abilities, regardless of age”
- “ESRT and ECAPs utilized on rare basis for actually settings psychophysical levels, but definitely not routinely; Loudness scaling for under 4 years of age may only be good v. bad”

MAPPING VERIFICATION



What procedure do you use to verify your CI mapping? (check all that apply for the following age ranges).

- Loudness growth procedures are age-dependent
- All other procedures are not age-dependent

MAPPING VERIFICATION: COMMENTS



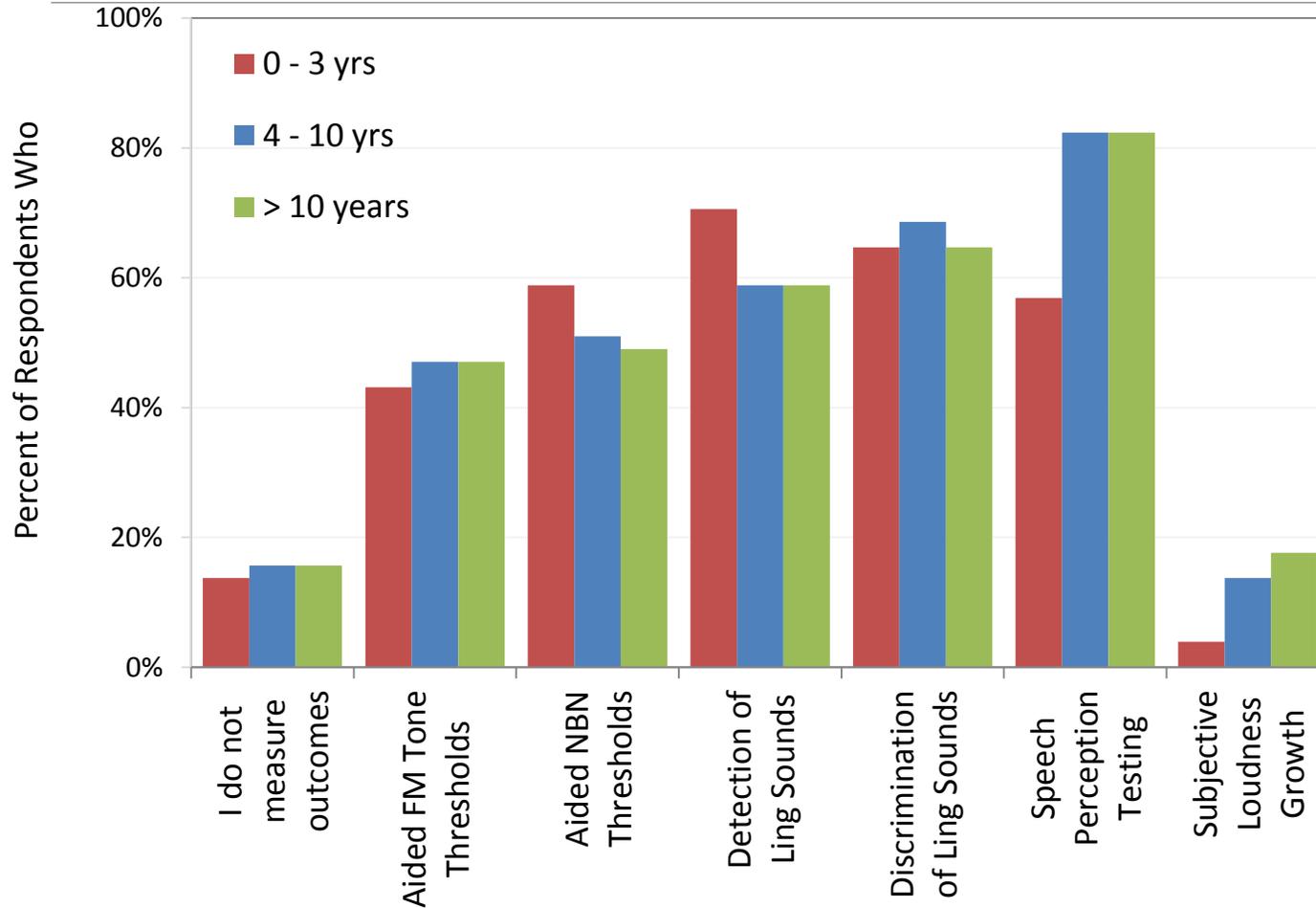
- “It would have been helpful to have an investigator definition of verification vs. measuring outcomes. To my knowledge, there is no way to "verify" CI programming the way you can "verify" hearing aid fitting using real-ear or simulated real-ear measures”
- “Identification of phoneme, word, alphabet letters, sentences (if needed) in quiet (35dB, 50dB and in noise)”
- “We use all measures with all age groups”

MAPPING VERIFICATION: COMMENTS



- “Loudness growth measures - primarily during the mapping process, not to validate program”
- “Narrowband noise only used if absolutely necessary related to child's attention; subjective loudness growth measures for under 4 may be as simple as good v. bad, little v. big, okay loud v. too loud”

MAPPING OUTCOMES



What procedure do you use to measure outcomes of your CI mapping? (check all that apply for the following age ranges).

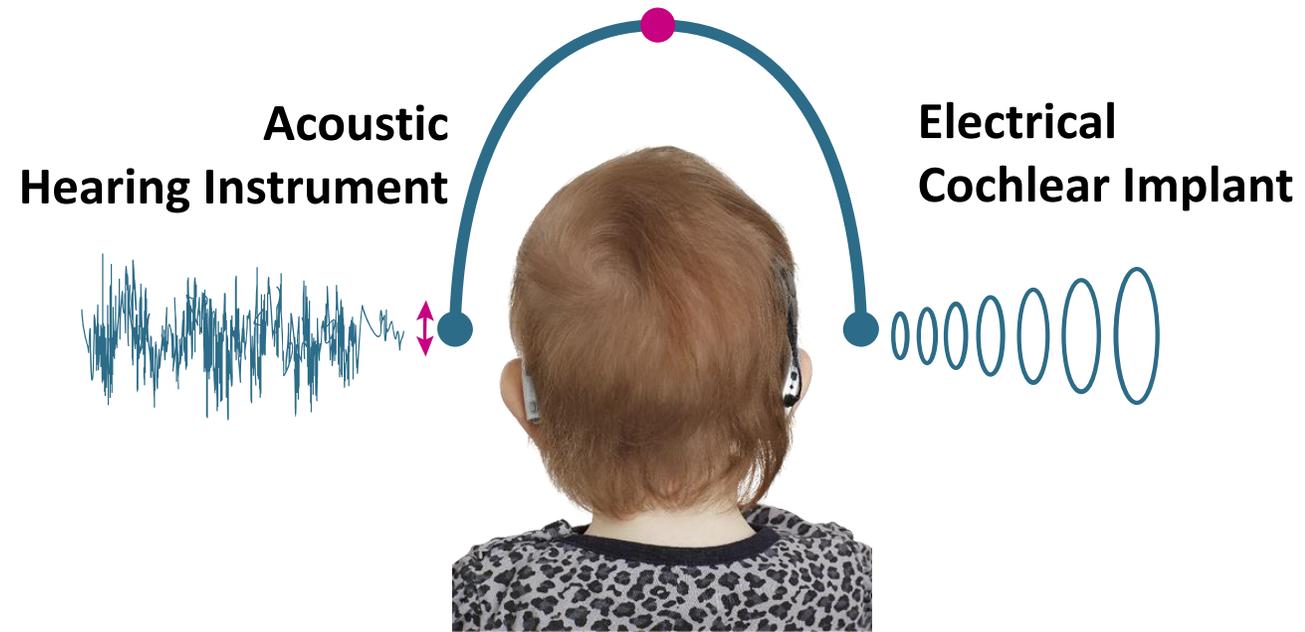
- Procedures are similar to those used for verification

MAPPING OUTCOMES: COMMENTS



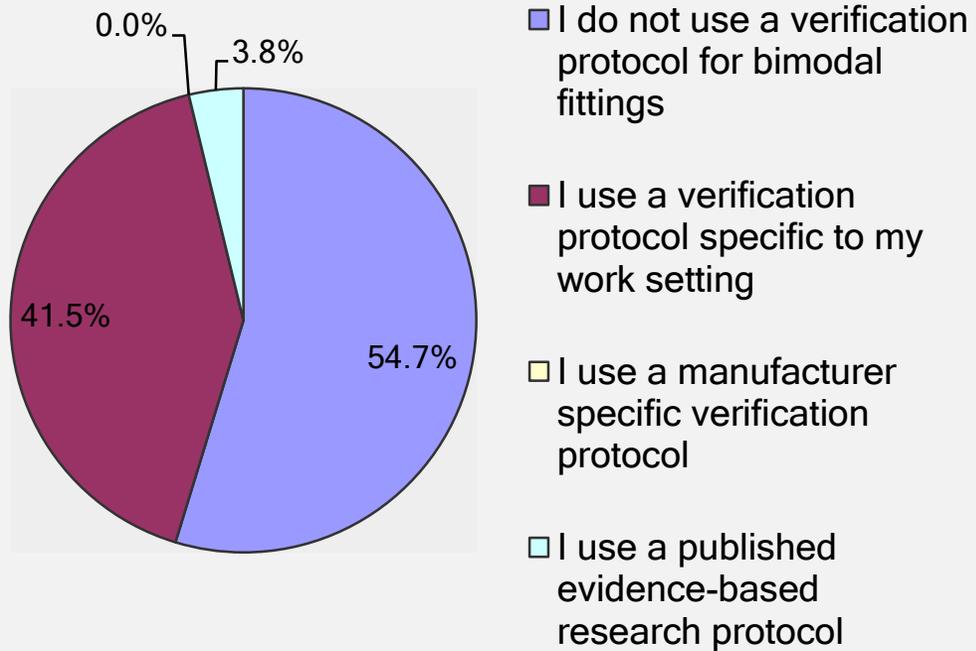
- “Receptive/expressive language development; parent/teacher reports”
- “Also coordinate with AVT and/or SLP to monitor development of speech and language skill development, particularly with the youngest groups”
- “We work alongside auditory-verbal therapists and rely on their formal and informal speech, language, literacy and listening assessments to help determine outcomes”
- “Based on age and ability, letter, word, sentence identification - quiet soft and average speech, noise”
- “I have not separated outcome measures CI vs HA”

BIMODAL



BIMODAL FITTING: VERIFICATION

Are you using a verification protocol for bimodal fittings?



BIMODAL FITTING: VERIFICATION



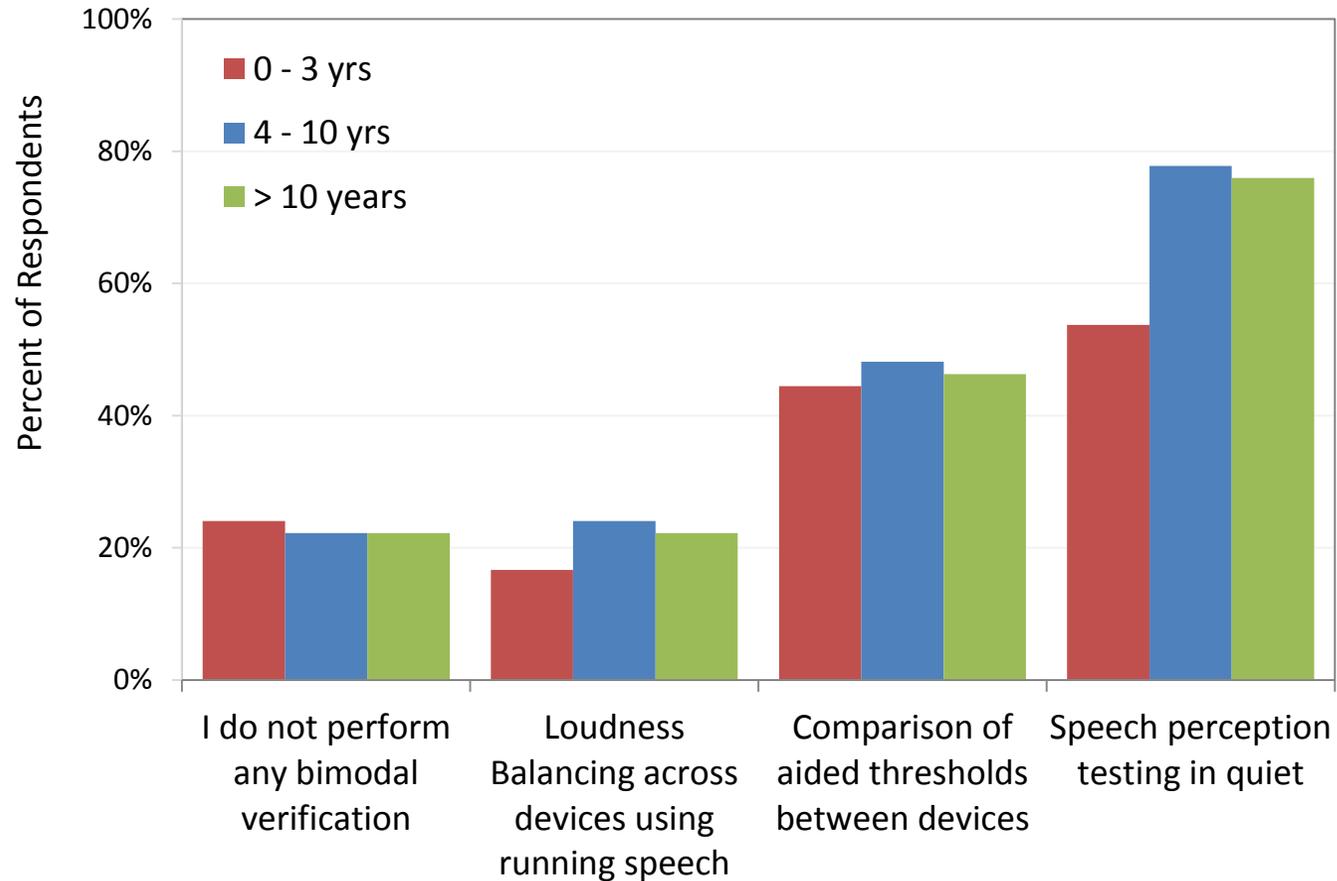
- “Nothing more than verifying the fitting for each ear individually and then assessing bimodal speech understanding as well as bimodal loudness balancing for older children who are able to provide this feedback”
- “I don't use a set protocol but when possible, attempt speech perception with CI alone and then CI + HA to ensure that there is no detriment performance”
- “Verify HA by itself and CI by itself. Do word rec in all 3 conditions”

BIMODAL FITTING: VERIFICATION



- “I verify hearing aids only based on a combination of evidence based, manufacturer specific & work setting best practices”
- “Loudness balancing is also not possible in many cases due to severity of the hearing loss in the unimplanted ear”

BIMODAL FITTING: VERIFICATION



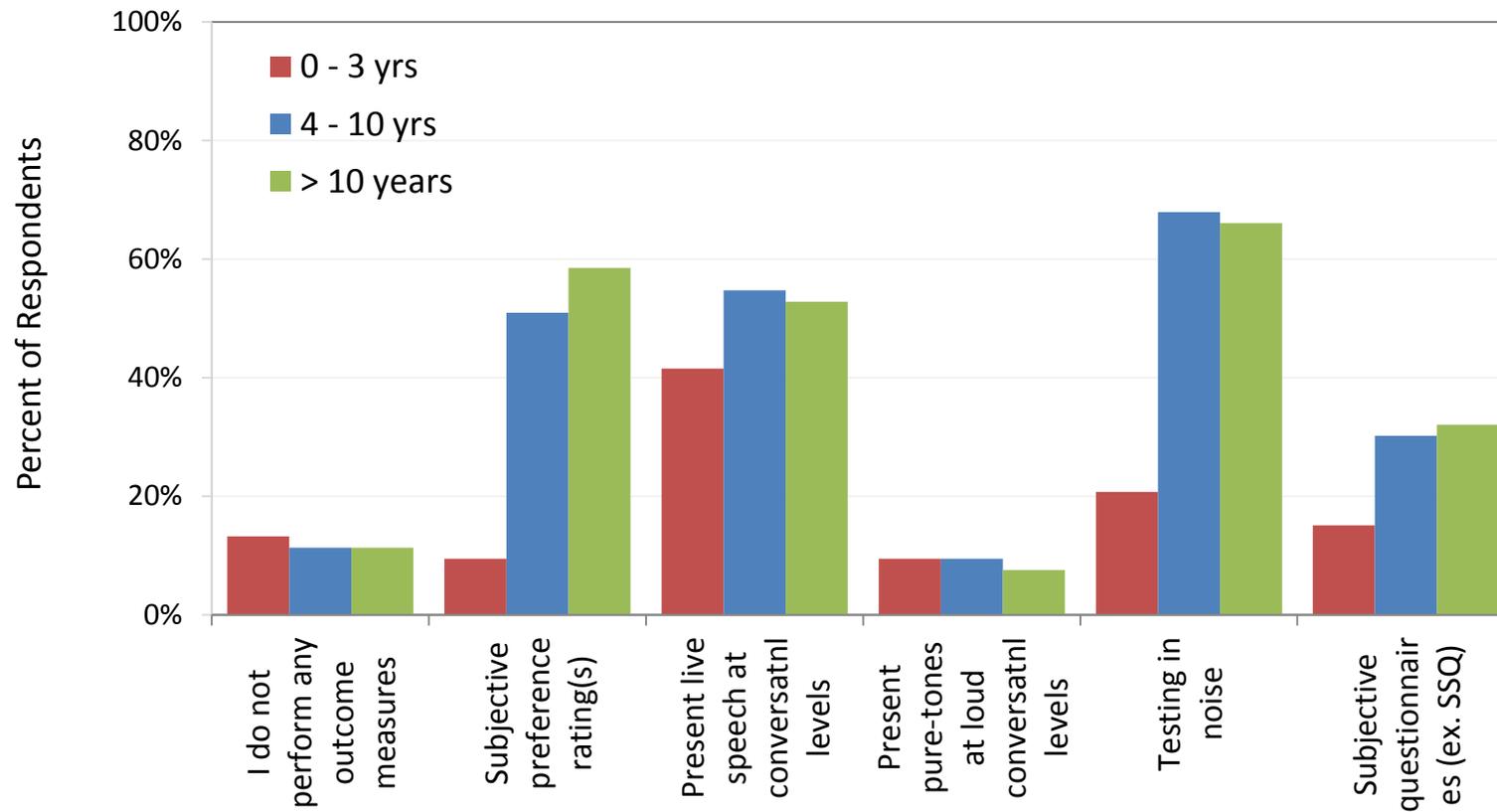
What verification procedures do you use for bimodal fittings?

BIMODAL FITTING: VERIFICATION



- “We complete speech perception for everyone in the HA alone, CI alone, and bimodal conditions; however, I am reluctant to indicate this as bimodal verification”
- “Again, I do not use loudness balancing for all children 0-3, but do use it as soon as they appear developmentally ready and demonstrate reliable responses”
- “Testing at soft speech levels and in noise (e.g. PSI Sentences or BKB-SIN) seem to be the most sensitive. I prefer to test both as one does not predict the other”

BIMODAL: OUTCOME MEASURES



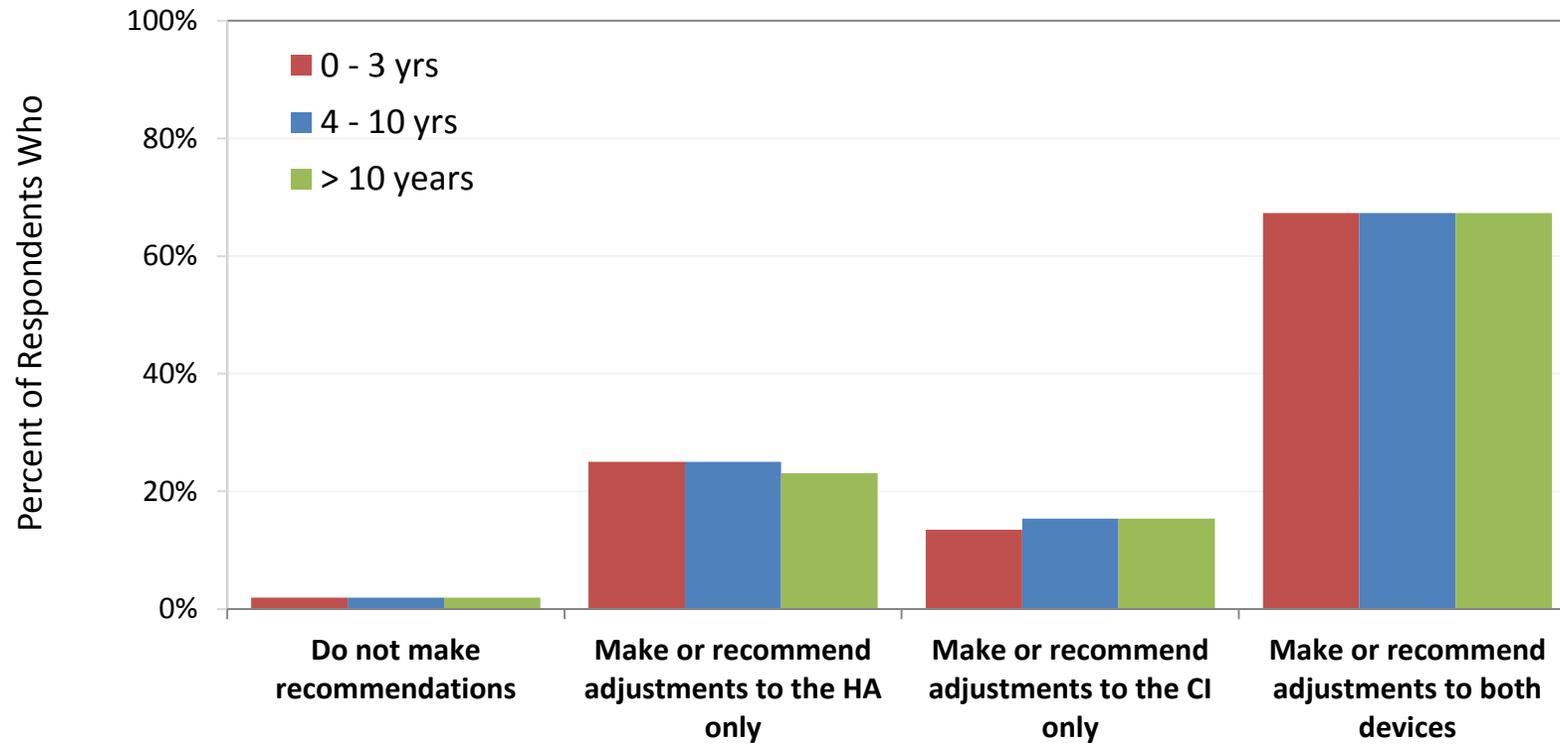
What outcome measurement procedures do you use for bimodal fittings?

BIMODAL: OUTCOME MEASURES



- “Parental questionnaires for the youngest children (e.g., LittleEARS and Auditory Skills Checklist) though these do not necessarily indicate appropriateness of the "bimodal" nature of the hearing. Neither does the SSQ or other questionnaires for the older children, necessarily. This is unfortunate and I hope that this working group is attempting to develop something and provide guidance!”
- “BKB-SIN”
- “Implementation of subjective questionnaires is pending”

BIMODAL FITTING: ADJUSTMENTS



If adjustments are needed to the bimodal fitting based on the outcome measurement results, I:

BIMODAL FITTING: ADJUSTMENTS



- “I might make minor adjustments to the hearing aid, but if it's way off I send them to their hearing aid provider”
- “Recommendations depend on where the concern is seen and the severity of the loss in the unimplanted ear”
- “It would be considered "over-stepping" if I were to make a programming or adjustment setting to the audiologist who manages the CI”
- “I have not come across a situation when I needed to make any adjustments. Generally, the limited number of bimodal patients I follow are happy with the settings we establish through DSL and mapping”
- “Well this depends. I will adjust what is needed to maximize speech understanding, loudness balancing, and language development. It is not limited to just HA adjustments or CI adjustments”

ADJUSTMENT COMMENTS



- “There are fewer CI audiologists than Clinic Audiologists at our facility but we have a close relationship and share office space. We communicate via email or in the patients electronic medical record but the family is ultimately responsible for scheduling and attending follow-up in CI or Audiology Clinic as recommended”
- “I adjust both the hearing aid and cochlear implant for most patients. For those who received their hearing aid elsewhere before coming to us for a CI, I will communicate back with the referring audiologist”

ADJUSTMENT COMMENTS



- “Depends on the situation, but for the most part I would feel comfortable enough to contact the other professional about my recommendations. I may suggest the parent do the same”
- “Again, the CI team in our facility is not receptive to our feedback regarding anything CI-related, with the exception of initial referrals”

OTHER COMMENTS



- “I am very cautious about the use of frequency lowering algorithms (i.e. Sound Recover) and tend to decrease the impact of that on the HA side. I feel like the implant can provide much better high frequency information for most kids and so I don't try to make the HA meet DSL targets for thresholds that are above 90 dB HL from 2 kHz and higher. I look forward to hearing the results of this survey and getting some solid clinical guidance.”

OTHER COMMENTS



- “A retrospective review completed several years ago by the clinic I was then employed by indicated that many patients who could benefit from bimodal fitting chose not to pursue the option due to feedback from the hearing instrument and the perception that the benefit received did not outweigh the costs in time and effort.”

HA FITTING / VERIFICATION SUMMARY

- A clear majority (80%) are using an evidence-based prescriptive method to fit hearing aids to children (e.g. DSL).
- Verification (RECD, REAL EAR, Test Box) measures are age dependent, and relate to the cooperation of the child.
- Outcome measures for children with hearing aids were variable, but used more with older children.

CI FITTING SUMMARY

- Variability in mapping procedures for children with cochlear implants exist, likely due to CI manufacturer recommendations, and age of child. (i.e. one company may recommend measuring “T” levels, others may not).
- A high percentage of participants reported using objective measures (NRT/NRI/ART and ESRT) across all age groups. This may reflect the desire to verify/support their behavioural measurements.
- The use of loudness balancing and scaling were utilized for less than half of the children aged 4 to 10 years old, and almost never with children from birth to 3 years old. This may reflect clinician’s uncertainty with obtaining reliable measures with these test tools on younger children.

CI VERIFICATION SUMMARY

- Compared to hearing aids, there are a lack of standardized verification procedures for cochlear implants
- Other than speech discrimination testing, the use of verification/outcome testing was highly variable and measures were not age dependent.

BIMODAL FITTING & VERIFICATION SUMMARY

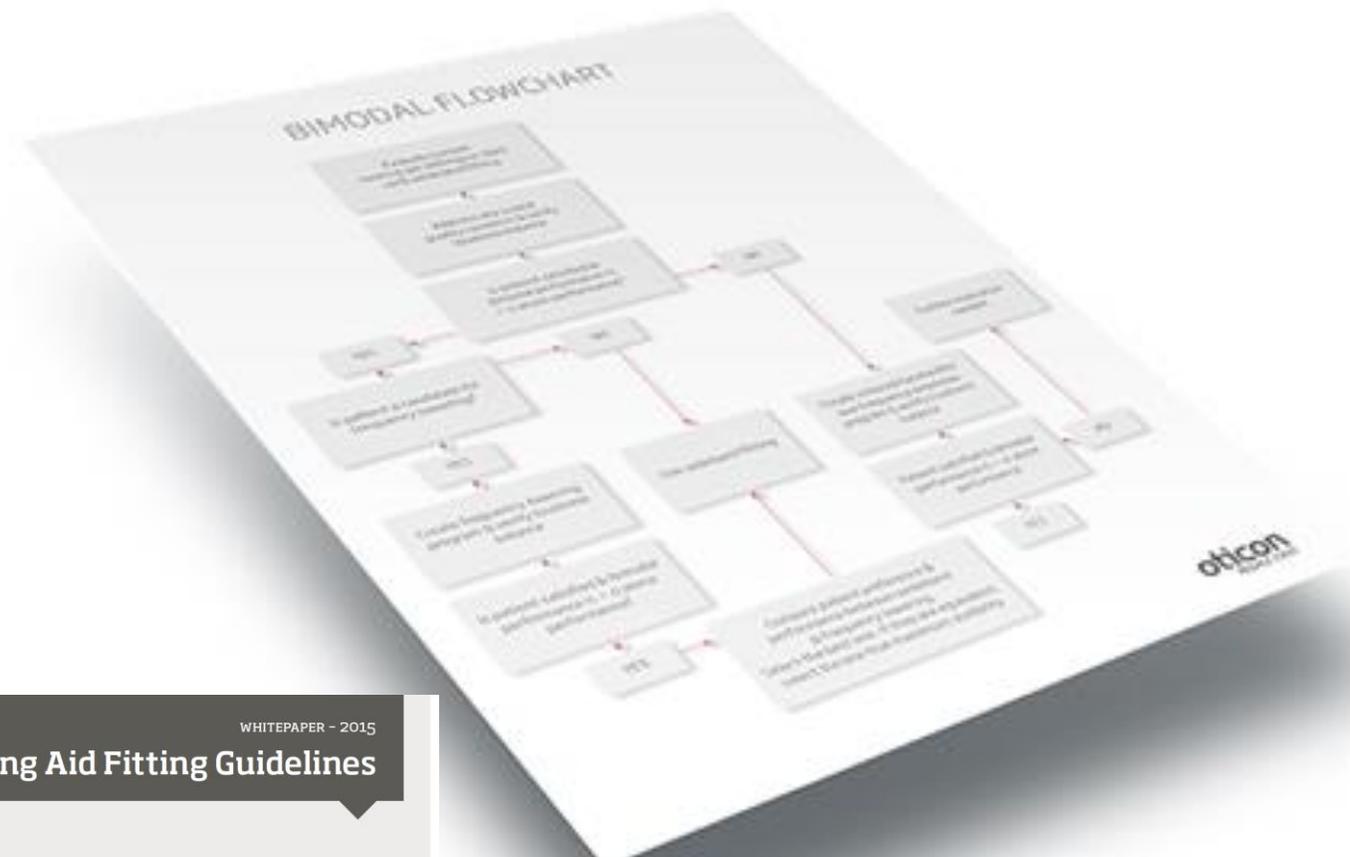
- There is considerable uncertainty regarding verification of bimodal fittings. This reflects the lack of standardized verification procedures for bimodal fittings.
- Participants reported using speech perception testing for older children as their primary method of verification and as an outcome measure.
- For those who manage CI only or HA only, some participants commented that they were reluctant to make or recommend adjustments to the device they did not fit.

OVERALL CONCLUSIONS

- Compared to hearing aids, the verification and outcome measures used for cochlear implants are highly variable. Only half of the participants report that they fit both hearing aids and cochlear implants, which makes coordinated hearing care for children using bimodal devices challenging.
- We have confirmed that due to the lack of evidence-based fitting protocols for bimodal devices, the majority of clinicians are using their own, internally developed fitting protocol/guideline, or are not using a systematic protocol/guideline at all.

Bimodal Whitepaper from Carissa Reyes

Outlines a new fitting flow for loudness balancing with a cochlear implant



WHITEPAPER - 2015

Bimodal Hearing Aid Fitting Guidelines

ABSTRACT
In a bimodal fitting, one ear is stimulated acoustically with a hearing aid and the other is stimulated electrically with a cochlear implant.

To bring bimodal benefits to all children and adults with unilateral implants and aidable hearing in the contralateral ear, Oticon has implemented a bimodal fitting guide in the Genie fitting software. As developed by Carissa Reyes, Staff Audiologist at Boys Town National Research Hospital, the bimodal fitting flowchart serves as a guide to clinical audiologists as they navigate the bimodal fitting process. The goal is to provide a logic- and evidence-based method for decision-making, yet keeping in mind the constraints in everyday clinical practice.

Based on the latest knowledge on bimodal research, this paper explains the rationale, the recommended

FUTURE DIRECTIONS

- Development of a guidance document for CI fitting (note-Messersmith et al, Cochlear Implant Best Practice Guidelines-An Update-Saturday April 8th).
- Development of evidence-based clinical guidelines that can be translated into practical fitting strategies for clinicians working with bimodal devices and children.
- Hearing industry software and fitting tools that are optimized for bimodal device fittings.
- Explore age-related outcomes for children and bimodal fittings that help us understand what are acceptable fittings and exceptional fittings.

Cochlear Implant Fitting, Verification and Evaluation: A Proposed Guidance Document

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