Unilateral hearing loss in children

Impact and hearing solutions

A Sonova brand

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Hearing with only one ear is not enough for a child to function normally

Modern hearing solutions from Phonak can help children with Unilateral Hearing Loss (UHL) to be…

Ready for Success!

Learner Objectives

After this course, learners will be able to…
…describe the types of Unilateral Hearing Loss.
…identify the use cases of the Sky V, CROS II, and Roger Focus.
…describe the process of verifying CROS II and Roger Focus.

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Agenda

1. Impact of UHL for children
2. Various needs - multiple solutions
3. Phonak Sky™ V
4. CROS II and Sky V
5. Roger™ Focus

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Unilateral Hearing Loss?

One ear has **normal** hearing thresholds

Impaired ear has **any** degree of hearing loss

UHL is classified as '**minimal hearing loss**'

Single sided deafness (SSD) is a subset of UHL where there is no useable hearing on the impaired ear

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UHL in children

Prevalence

1 in 1,000 newborns are identified with UHL at birth

Progression

3 in 100 children may develop UHL by school age

Causes

- Bacterial meningitis
- Chiari malformation
- Congenital Cytomegalovirus (CMV)
- Enlarged Vestibular Aqueduct syndrome (EVA)
- Premature birth
- Unknown

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Hearing with both ears

- Binaural hearing capabilities
  - Binaural summation
  - Head shadow effect
  - Sound localization
  - Spatial release from masking
  - Precedence effect in reverberant enclosures

- Any impairment can result in difficulties in real-world listening environments such as:

Hearing in noise or at a distance

Localization

Segregating sounds

Selective attention

Speech understanding

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Impact of UHL for children

Academic and behavioral difficulties

General communication difficulties

Psycholinguistic dysfunction-ability to learn language

Quality of life effects

Social-emotional problems

Speech-language delay

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Language scores – Lieu et al. (2010)

<u>Unilateral hearing loss is associated with worse speech-language scores in children</u>

Case-control study of 74 matched pairs of siblings, ages- 6-12 yrs. Scores on the oral portion of the Oral and Written Language Scales (OWLS)

Children with UHL had worse scores than their siblings:
- **Language comprehension**
- **Oral expression**
- **Oral composite**

UHL was an independent predictor of the OWLS scores
Family income and maternal education were also independent predictors of oral expression and composite scores

Authors' conclusions
- School-aged children with UHL demonstrate worse oral language scores
- **Withholding hearing related accommodations should be reconsidered and studied**
- Parents and educators should be informed of UHL effects on oral language skills

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Language, cognitive, and achievement scores with differing audiologic characteristics – Lieu et al. (2013)

<u>Do audiologic characteristics predict outcomes in children with unilateral hearing loss</u>

Case-control study; 107 UHL 6-12 year old children as compared to sibling controls

Children with UHL had worse OWLS scores than their siblings (profound UHL being the worst):
- **Verbal cognitive**
- **Oral language**

No differences in achievement scores using Wechsler Individual Achievement Test.
Word recognition scores of the normal ear in quiet and noise correlate to higher scores

Authors' conclusions
- **School-aged children with UHL demonstrate worse language scores**
- **Profound UHL tended to have worse outcomes**
- No differences in right or left ear UHL

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Quality of life (QOL)- Borton (2007)

Quality of life in children with unilateral hearing loss: a pilot study

Qualitative study – child and parent focus groups
Quantitative study – Pediatric Quality of Life Inventory™ Version 4.0

Child reports – scored **more poorly** for several scales than those with normal hearing or bilateral hearing loss on all 3 main QOL scales (total, psychosocial & physical).
Parent reports – **similar to child reports** except better on psychosocial functioning as compared to bilateral hearing loss.

Author's conclusion
"[C]hildren with UHL demonstrated overall lower and a wider range of QOL scores compared to normal hearing peers and their peers with bilateral hearing loss."

Impact of UHL summary

UHL in children

- Affects ~3% of school children
- May cause issues with language and academics
- Results in difficulty in complex or noisy environments

> "[A]ll children with permanent minimal hearing loss must be considered at risk for psychoeducational difficulties and managed accordingly."
>
> Porter et al (2016)

Academic difficulties – adapted from Gravel (2004)

Investigation	Failed (1 or more grades)	Resource help (1 or more grades)	Combined (failed and resource help)
Bess (1986)	35.0%	13.3%	48.3%
Oyler (1988)	24.3%	40.7%	65.0%
Jensen (1988)	18.0%	36.0%	54.0%
Martini (1988)	25.0%	-	-
Watier-Launey et al. (1998)	40.4%	-	-
Lieu (2004)	22.0 - 35.0%	12.0 – 41.0%	-

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Educational impact of UHL

⇧10 X

Likelihood of needing to repeat a year of school

Likelihood of needing additional educational resources

⇧ 5 X

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Other academic/psychosocial skill difficulties

- Higher incidence of failure rate/negative comments on report cards
  (Keller and Bundy, 1980)
- Teachers rate these children more negatively than normal hearing peers
  (Culbertson and Gilbert, 1986)
  - Attention to academic task
  - Peer relations and social confidence
  - Dependence-independence
  - Emotional lability
- Behavioral concerns
  (English and Church, 1999)

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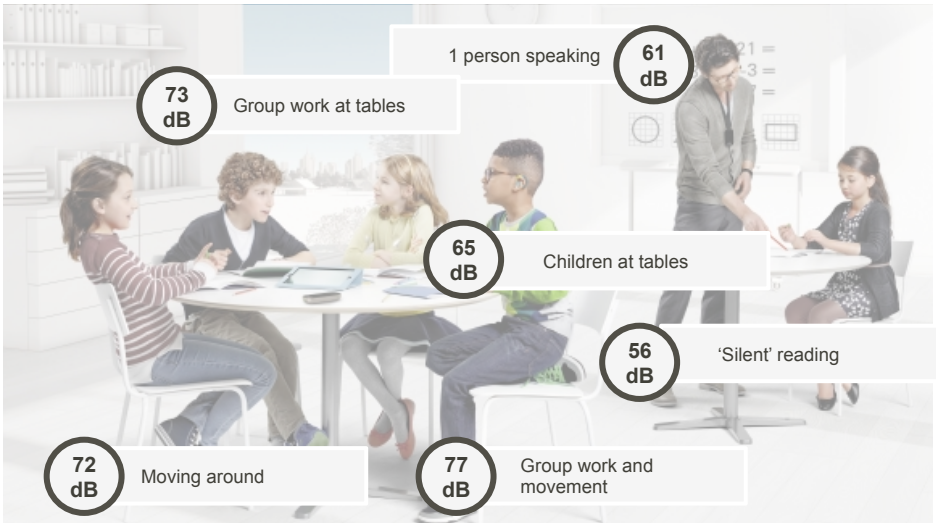
Typical classroom noise levels



» Results of internal noise surveys in 140 classrooms

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Complex listening tasks – difficulty arises

Speech and language scores may be within normal limits on some tests, BUT…

Breakdown may occur in complex listening environments

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Complex listening tasks – Lewis et al. (2015)

<u>Comprehension and sentence recognition in a simulated classroom environment</u>

18 normal hearing children (8-12 years old) matched with 18 with MBHL/UHL.
Classroom learning task and speech recognition task

Sentence recognition task – all children performed at or near ceiling
- **Children with UHL performed more poorly than children with NH on the complex tasks.**

Individual looking behavior differed between the 2 groups
- Attempting to visualize the talker may inefficiently utilize cognitive resources

Authors' conclusions
- **Children with UHL perform more poorly than peers with normal hearing during a complex task with multiple talkers**
- Patterns of looking behaviors differ – suggesting differences in use of visual information.

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What solutions can I offer for UHL?

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American Academy of Audiology statement

AMERICAN ACADEMY OF AUDIOLOGY
How's your hearing? Ask an Audiologist!

Children with minimal and mild hearing loss should be considered candidates for amplification and/or personal FM system or sound-field systems for use in school. Use of hearing aid amplification is indicated for some children with unilateral hearing losses. **The decision to fit a child with unilateral hearing loss should be made on an individual basis**, taking into consideration the child's or family's preference as well as audiologic, developmental, communication, and educational factors

The American Academy of Audiology (AAA)

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Various losses – multiple solutions

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UHL children are a heterogeneous group

Mild to moderately-severe UHL

- **Aidable UHL**
  - Impaired ear can be mild to more severely impaired
  - Consider for timing of treatment
    - Delaying amplification may lead to auditory deprivation
  - Benefits of amplification proven

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UHL children are a heterogeneous group

- **Severe/ to Profound UHL**
  - Impaired ear is unaidable
  - Significantly poor speech understanding

Severe to profound UHL **Severe to profound UHL**

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Hearing aid fitting on impaired ear

- Hearing impairment can very by degree
  - Mild to severe
- Amplification should be default fitting option
- Benefit determined through trial period
- Remote microphone usage for noisy situations or listening at a distance

Phonak Sky V with Roger

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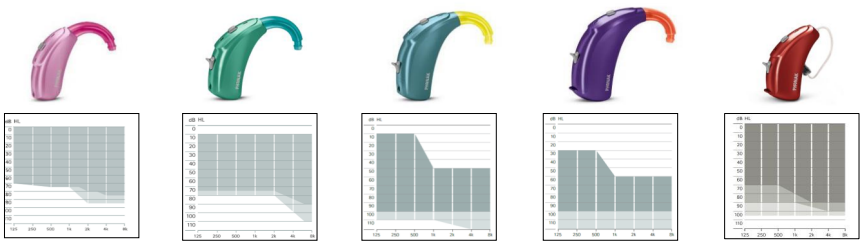
Phonak Sky V

- 5 models to fit any loss
- 16 Mix & Match color options
- Tamperproof options for even the smallest listener
- Optimized hearing performance especially for a child's environment
- IP68
- Indicator Light

Sky V-M | Sky V-P | Sky V-SP | Sky V-UP | Sky V-RIC



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High performing technology for children

SoundRecover2

Giving children access to a broader range of sounds essential for speech and language development

AutoSense Sky OS

The first automatic program designed specifically for kids

Roger and directional setting

Bringing the benefits of directional microphones to the Roger program

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Using Roger with Sky V

- Sky V plus Roger Receiver on poorer ear
- Roger Focus on better ear for binaural benefit

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Quality of life improves with hearing aids – McKay (2002)

To Aid or Not to Aid: Children with Unilateral Hearing Loss

Surveys rating aspects of the child's daily life.
20 surveys from parents of children with mild to moderately severe UHL, aged 2-17

Parent comments:
"It would be a blessing if we put hearing aids on these kids sooner"
"He was missing one half of everything before he got his hearing aid"

Results:
Auditory areas - improvement
All areas - same, improved, or significantly improved
Children liked their hearing aids, parents were happy and had wished their children had been fit earlier

Author's conclusion
"[W]e believe that children with UHL (who fit candidacy requirements) should minimally receive a trial with amplification. Fitting these children has appeared to improve their quality of life. We believe that without this opportunity, the children are being denied access to their full potential."

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Severe to profound UHL

- Hearing impairment is unaidable
  - Also called Single Sided Deafness (SSD)
- Fitting goal → Sound received in the normal ear

Phonak solutions

Phonak CROS II

Roger Focus

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Contralateral Routing of Signal - CROS

- Candidates and considerations for using CROS technology:
  - Goal is to access sound from the 'bad side'
  - Child is able to recognize dynamics of the acoustic environment
  - Trial period is helpful
  - Remote wireless microphone usage for noisy situations or listening at a distance will provide best hearing

Phonak CROS II
With Sky V and Roger

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CROS II benefits

Performance

- StereoZoom for speech in noise
- Venture chip benefits
  - Directional microphones
  - Better battery consumption

Ease of use

Look & feel

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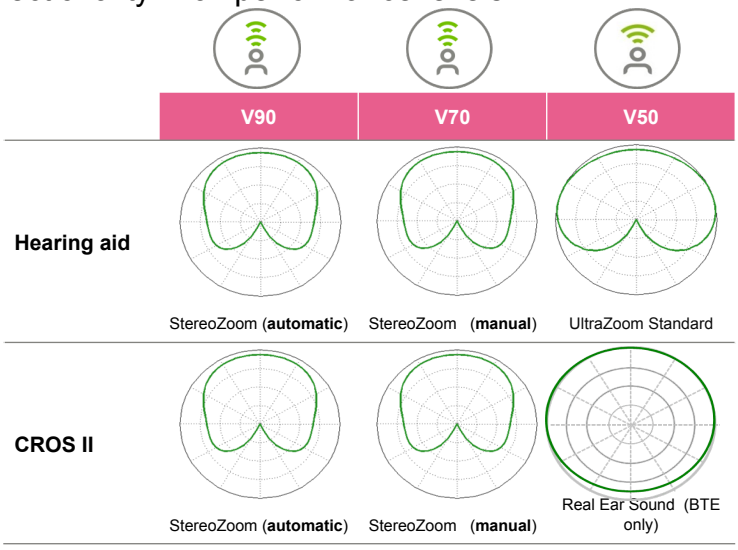
Directionality in all performance levels



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30% longer battery life than previous CROS

*** A day is defined by 12 hours of use**

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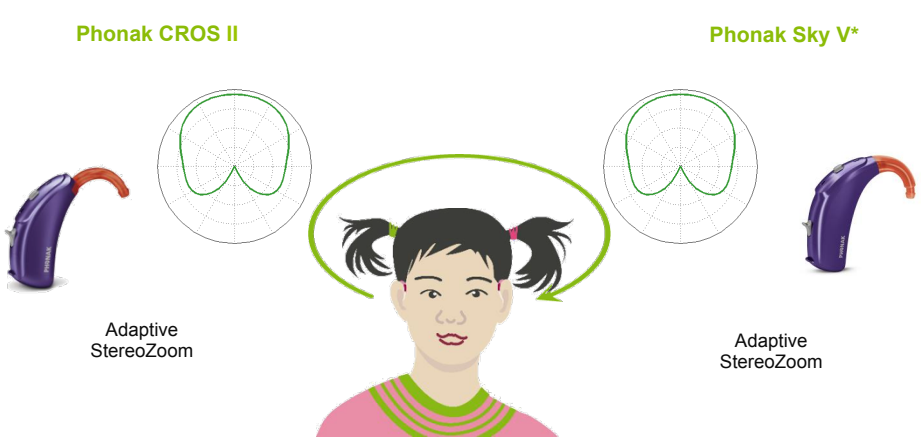
StereoZoom and Phonak CROS II



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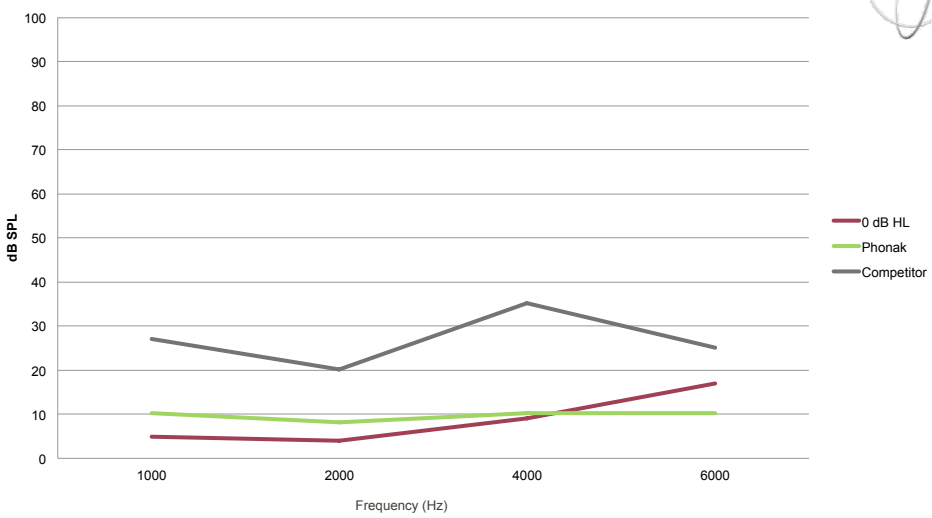
Low noise floor with CROS II



Field Study News – Phonak CROS II – Electroacoustic measurements look at key performance aspects of two wireless CROS systems (July 2015)

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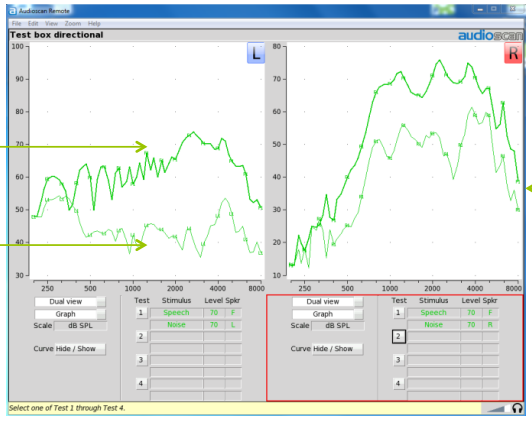
Directional microphone benefit with CROS II



Field Study News – Phonak CROS II – Electroacoustic measurements look at key performance aspects of two wireless CROS systems (July 2015)

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Thank you for your suggestions

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CROS II benefits

Performance

Ease of use

- Automatic switching to Roger with Sky V RogerReady
- Simplified fitting approach

Look & feel

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Roger, CROS II and Sky V – easier than ever for children

Phonak CROS II,
Phonak Sky™ V and Roger™

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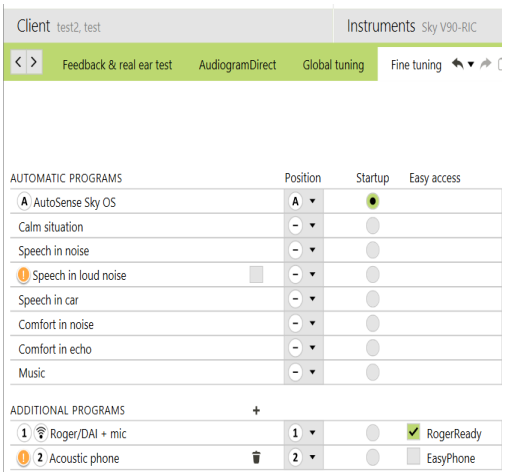
CROS II fitting in junior mode

Start up program

- If you select Junior Mode you will have a startup program of Roger/ DAI + Mic
- Select AutoSense Sky OS as a start up program
- Roger/DAI+mic- first manual program



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CROS II and Sky V – easier than ever for the fitter

Easier fitting with iCube II

- Fewer steps
- Microphones are active during fitting

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CROS II fitting guide

Desktop Fitting Guide

This guide provides you with a detailed introduction to fitting a Phonak CROS II or a Phonak CROS B system in Phonak Target **5.0** and later. For fitting of the hearing instruments, please see the Hearing Instruments Desktop Fitting Guide.

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CROS II benefits

Performance

Ease of use

Look & feel

- New housings
- New housing colors
- New CROS Hook

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CROS II BTE choices

CROS II-13

CROS II-13 with CROS Hook

CROS II with SlimTube

CROS II-312

CROS II-312 with SlimTube

CROS II-312 with CROS Tip

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Phonak CROS II-13 – New colors starting December 2016!

CROS II-13 Housing

New Q2	New Q3	New T3	New T7	New M6	New M7
Electric Green	Caribbean Pirate	Precious Pink	Alpine White	Lava Red	Blue Ocean
New M8	P1	P2	P3	P4	P5
Majesty Purple	Sand Beige	Amber Beige	Sandalwood	Chestnut	Champagne
P6	P8	P9	01	Q1	P7
Silver Gray	Velvet Black	Ruby	Beige	Petrol	Graphite Gray

CROS Hook

New Q7	New Q6	New R3	New R2	New R1	New R4
Purple	Blue	Pink	Yellow	Green	Orange
13					
Transparent					

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Phonak CROS II-13 with CROS hook- child friendly design

- BTE 13 housing
- IP67
- 18 housing colors and 7 CROS Hook colors
- Mix & Match with Sky V
- Push button and volume control
- High-tech composite material
- Tamperproof door available

Using the CROS Hook and Sky V-P tamperproof battery door will meet the IEC standards for small children

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Phonak CROS II Hook

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CROS II benefits - summary

Performance

- StereoZoom for speech in noise
- Venture chip benefits
  - Directional microphones
  - Better battery consumption

Ease of use

- Automatic switching to Roger with Sky V RogerReady
- Simplified fitting approach

Look & feel

- New housings
- New housing colors
- New CROS Hook

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- **Setup**
- Position the client in front of the speaker
- Program the hearing instrument and CROS II transmitter in Target.
- *If you are using the iCube II, hang the iCube II around the client's neck to allow for instant adjustment based upon verification feedback.*

- **Client preparation/explanation**
- The follow test is going to allow us to see how your CROS system is working. We will be able to see how well the hearing instrument and the CROS transmitter are programmed, as well as verify that the CROS transmitter is picking up and transmitting the sound from your poorer hearing ear to your better hearing ear. If anything is not working appropriately, we will be able to see it and address it.

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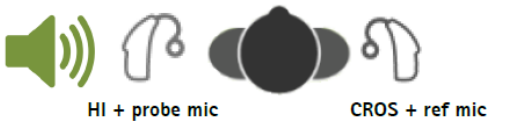
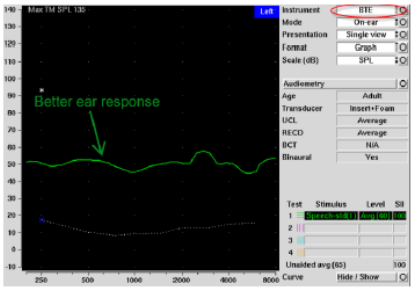
Procedure

Measure the aided response on the **"better hearing ear"**

- Place the reference microphones on both ears.
- Insert the probe microphone in the better ear **canal only.**
- Place both the hearing instrument and CROS II transmitter in the ears. Ensure that the instrument is programmed and active.
- Select **<on ear measure>** and the relevant hearing instrument (**<BTE>**).
- With the speaker directly facing the better ear, record the response at either 55 or 60 dB SPL.



HI + probe mic **CROS + ref mic**



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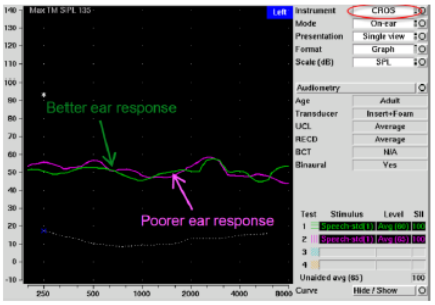
Measure the aided response on the **"poorer hearing ear"**

- Do not change the position of the probe mic, reference mic, or CROS system.
- Ensure that the hearing instrument and the CROS transmitter are still turned ON.
- Change the hearing instrument selection to **<CROS>**. By changing the selection to CROS, this switches the reference microphone to the side of the transmitter.
- Rotate the client so that the speaker is facing the poorer hearing ear.
- Record the response at the same dB SPL previously used.

HI + probe mic **CROS + ref mic**



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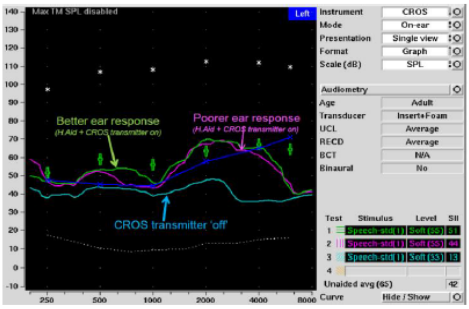
Ideally, the 'better ear' and the 'poorer ear' responses should be very similar with responses within 2-3 dB of each other. If they differ greatly (i.e. 4-5 dB or higher), fine-tuning may be required to allow them to match as closely as possible. If your responses differ greatly, check the following:

- Position of the speaker When you switching sides, ensure that the placement of the speaker to the ear is as identical.
- Position of the instrument on the ear. Check the position of the hearing instrument and CROS transmitter on the ear.
- Programming of the CROS system. Verify that the programming of the CROS system is balanced and comfortable.

If you are unable to match the 2 responses, please check the CROS system to ensure that it is functioning properly. If the CROS system is not working or the transmitter is faulty, you may see the responses captured below.



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Roger Focus

- Children with severe to profound UHL
- Increase the signal-to-noise ratio of the important information to the normal hearing ear
- Benefit for hearing in noise and over distance
  - Classroom
  - Car
  - Social outings

Roger Focus

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Roger Focus

55 Phonak pediatric UHL solutions

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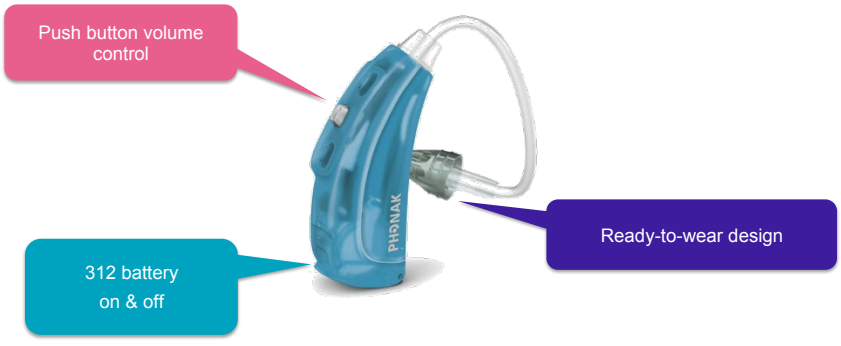
Easy and comfortable receiver



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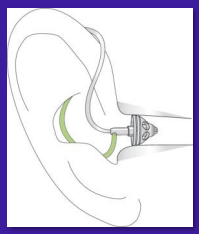
Roger Focus – easy to fit, easy to wear

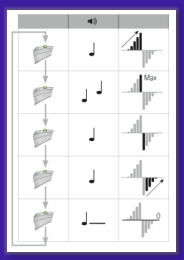
4 SlimTubes
0,1,2,3

Open domes

Volume changed with button presses

Volume can be deactivated





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Roger Focus

Fitting an ear-level wireless receiver

Don't forget:

- ☐ Open ear canal – the child should be able to hear environmental sounds and speech normally on the good side
- ☐ Coupling – SlimTube is standard, but Roger Focus can also be used with an ear hook and an open ear mold

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Focus on fun

17 fun colors to choose from

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Roger microphone and transmitter choices

- All Roger microphones and media transmitters can be used

Roger Touchscreen Mic

Roger Pass-around

Roger Multimedia Hub

Roger Pen

Roger Clip-On Mic

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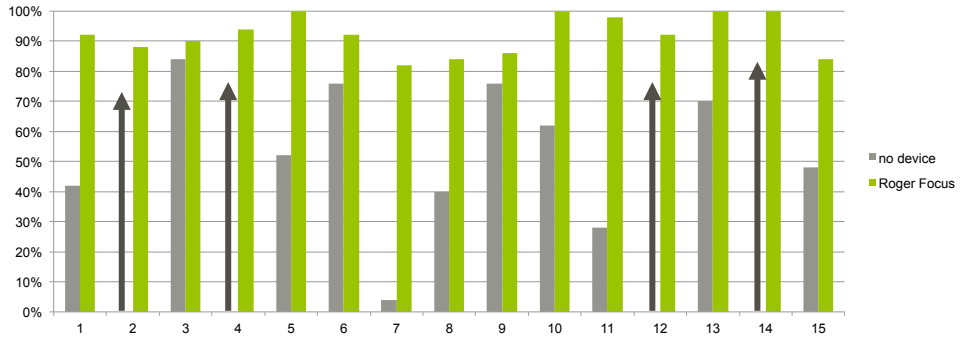
Maximum performance: Roger Focus Evidence

Speech-in-noise testing revealed an average improvement of 53% with Roger Focus compared to no device



N=15 BKB-SIN, -5dB SNR noise at 65dBSPL

Note: with the exception of subjects 3 and 9 all individual scores showed significant improvement

Subjects 2, 4, 12, and 14 scored 0% without any device and almost 100% with Roger Focus.

roger

Jones, et al. Phonak FSN June 2014

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Verification of the Roger Focus

- AAA (2008) suggest procedures for fitting RMHA, including in the ear probe microphone measures of output for speech and loud inputs.
- •Schafer et al. (2014) wanted to validate these AAA guidelines and recruited 26 normal hearing children to their study
- • Their goals of obtaining real ear measures for RMHA were: To verify the measured output for prescribed-gain targets from 1 to 4 kHz for speech stimuli
- To confirm that the RMHA volume did not exceed predicted loudness discomfort levels
- To assess changes to the real ear unaided response (REUR) when placing the open sound delivery system in the ear

- •Results: On average prescription targets were met from 1 to 4 kHz within ± 3 dB, although at times HF targets at 3 and 4 kHz could not be met
- MPO of the RMHA never exceeded MPO limits and overall, was significantly less than estimated UCLs
- Some change in REUR due to the open sound delivery system were noted, but differences were small (e.g., overall REUR was an average 1 dB higher c.f. REOR, and around 3-4 dB at 3 & 4 kHz)

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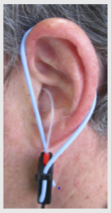
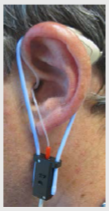
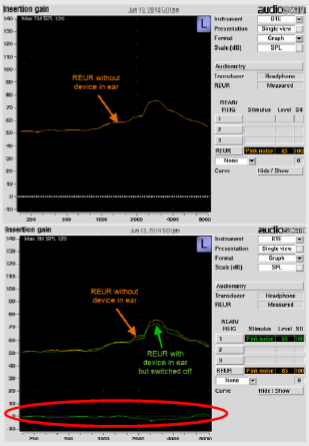
Verifying RMHAs

Step	Equipment set-up	Electro-acoustic results
Assessment of changes in REUR 1. Insert probe tube 2. Select 'on ear measures', **real ear insertion gain**, BTE. 3. Record the clients REUR for a moderate stimulus level (e.g., 65 dB SPL) 4. Insert the RMHA into the ear but leave the device turned off at this stage. Select 'REAR' and present the stimulus at the same level used in step 3. ***Interpretation:*** *If the REUR is similar to REAR1, it means that the REIG is approx. 0dB. This implies minimal disruption of residual hearing function by the presence of the open fit sound delivery system.*	 	

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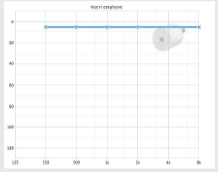
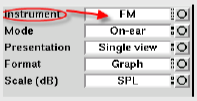
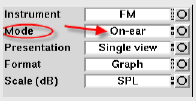
Verifying RMHAs

Step	Equipment set-up	Electro-acoustic results
Verifying output of RMHA. 1. Enter the pure tone audiogram into the verification system		N/A
2. Select 'FM' from the hearing instrument menu		N/A
3. Select the 'on-ear' mode		N/A

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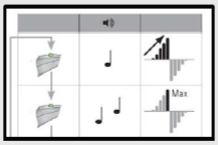
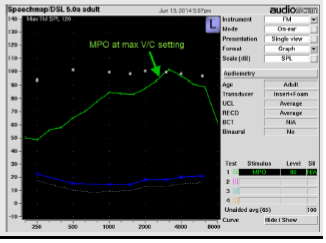
Verifying RMHAs

Step	Equipment set-up	Electro-acoustic results
4. Switch the transmitter into its verification mode* and place it in the test box with its Mic aligned with the reference Mic. For the inspiro, you only need to ensure the lapel microphone is in the box.		N/A
5. If the device has a manual V/C, set this to maximum and select the 'MPO' stimulus. If required, adjust the receiver settings to ensure the MPO isn't exceeding Targets at this maximum volume setting. If there is no manual V/C, skip this step.		

* For dynamic FM simply switch into omni mode. For Roger Transmitters, see Appendix 1.

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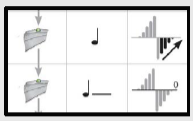
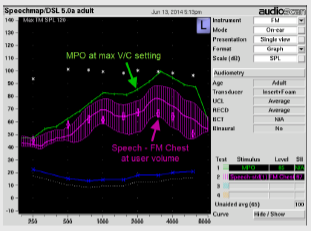
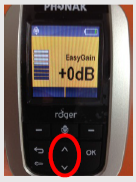
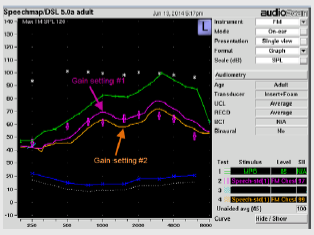
Verifying RMHAs

Step	Equipment set-up	Electro-acoustic results
6. At user volume, select Std-Speech (1) or (2) and choose FM chest or FM Boom for level. *Record the speech curve and check against targets in the 1 to 4 kHz region.*	 	
7. If desired/required, adjust the RMHA gain setting to try to meet targets from 1 to 4 kHz*. ***Note:** You can only adjust Roger Focus gain with the Roger inspiro transmitter. For iSense micro, you can use the FM successware*		

* see Appendix 2 for detailed instructions on adjusting easyGain

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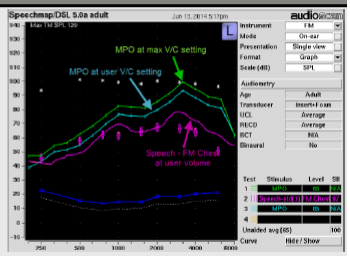
Verifying RMHAs

Step	Equipment set-up	Electro-acoustic results
8. Re-run MPO at the user volume setting after any gain adjustments have been made.		

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Roger DigiMaster 5000 & 7000

- Good for those children that cannot support ear level technology
  - Draining ears
  - Sensory issues
  - Ear malformations
- Only need a Roger Touchscreen Mic or Roger Inspiro
  - One tap connection
- Unique adaptive behavior ensures the volume is right at any noise level

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With known struggles of children with UHL,

"the most professionally responsible approach is recommended. That is, all children with hearing loss should be provided with the tools necessary to help them reach their full potential."

Porter et al. (2016)

Children with UHL and Phonak solutions

Sky V

CROS II with Sky V

Roger Focus

70 Phonak pediatric UHL solutions

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Roger solutions in noise

Sky V with Roger receiver

CROS II with Roger receiver worn on the Sky V side

Roger Focus

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Roger solutions in noise – for all children with UHL

Design-integrated for CI

Roger X for bone anchored hearing aids, streamers and DAI

roger

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Children with UHL

"With infants being identified with UHL at a very early age, it is time for clinicians to consider all intervention avenues available and take the opportunity to positively impact the development of children with UHL to help them reach their maximum potential."

Krishman & Van Hyfte (2016)

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Ready for success

- Phonak Sky V
- Phonak CROS II
- Roger Focus

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Questions?

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