Hearing Aids: Not Just Four Components Anymore

John Nelson, Vice President, Global Audiology Relations
Global Audiology, GN ReSound

Now a Five Chapter Story

MODEL	CLEAN	BALANCE	STABILIZE
Signal is modeled to replicate characteristics of the natural ear	Unwanted noise is removed from the signal	Signal is adjusted to achieve the proper balance between low/high frequencies and soft/loud sounds	Signal is corrected before it enters the receiver to eliminate acoustic feedback

CONNECTIVITY

Allows for interaction between hearing instruments and allows receiving of audio signals from remote transmitters to increase signal-to-noise ratio for the listener

MODEL

WARP Processing™

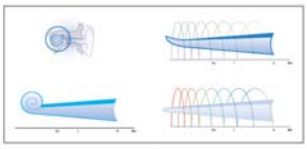
- Models the signal to replicate the way the natural ear breaks down sound into distinct pitches.
- It forms the core for other sound treatment and is the foundation for clear and distinct sound.

Environmental Classifier™

- Analyzes the sound environment then models the signal to replicate that environment in a digital format.
- It identifies how loud or soft sounds are, whether they are speech or other sounds, and where they are coming from.

MODEL

WARP Processing™



Environmental Classifier™

Sound inputs	Loudness	Environments
Quiet	Less than 54dB	1. Quiet
Speech	Less than 60dB	2. Soft speech
	More than 60dB	3. Loud speech
Speech in Noise	Less than 75dB	4. Soft speech in noise
	More than 75dB	5. Loud speech in noise
Noise	Less than 75dB	6. Soft noise
	More than 75dB	7. Loud noise

MODEL

WARP Processing™

Benefit: Near-zero distortion and remarkable purity.

Environmental Classifier™

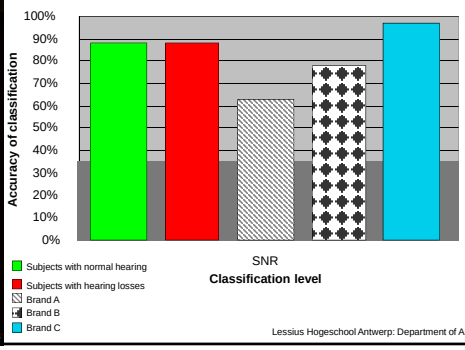
Benefit: Foundation that allows us to balance the signal into such fine nuances.

Research: Accuracy of Classification

- 40 sound files
- 15 Subjects with normal hearing
- 15 Subjects with hearing losses
- 3 Hearing Aids (with environmental classification & datalogging)

Lessius Hogeschool Antwerp: Department of Audiology

Classification Accuracy: Speech vs. Speech in Noise vs. Noise



Lessius Hogeschool Antwerp: Department of Audiology

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CONNECTIVITY

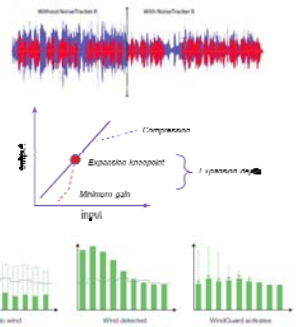
Insert Connectivity Comments

CLEAN

Noise Tracker™II	o Eliminates just enough background noise for comfortable listening with reduced effort. o The speech signal remains intact and natural sound quality is maintained.
Expansion	o Lowers the noise floor of the hearing instrument, ensuring best sound quality in quiet situations.
Windguard™	o Uses a new sound processing technique which utilizes inputs from both microphones together to recognize and reduce annoying wind noise. o Preserves amplification for other sounds.

CLEAN

- Noise Tracker™ II
- Expansion
- Windguard™



ReSound

CLEAN

- Noise Tracker™ II

Benefit: Increases end user comfort in noisy listening situations without compromising speech understanding.

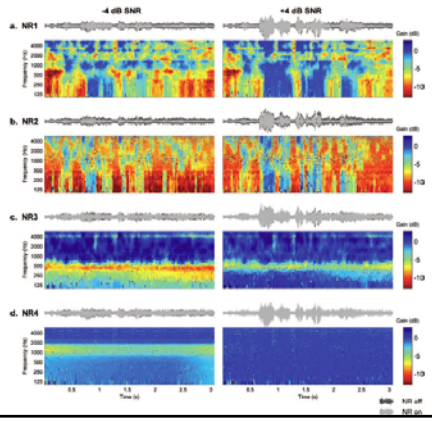
- Expansion

Benefit: Users, even those with a mild hearing loss, will not be bothered by low-level noise that is too soft for Noise Tracker to detect.

- Windguard™

Benefit: Increases comfort and reduces hearing fatigue in windy environments.

ReSound



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ReSound

BALANCE

WDRC

- Makes soft sounds audible and loud sounds comfortable for a perfect balance between audibility and comfort
- Personalized for the individual's hearing profile

Directional Mix Processing™

- Separates and balances low/high pitches, enabling differential treatment of speech and background noise
- Improves speech understanding in noise in all directional modes while maintaining optimal sound quality

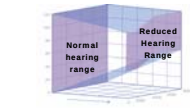
Environmental Optimizer

- Balances the volume level of the sound environment relative to the individual's needs
- Personalized for the individual's hearing profile

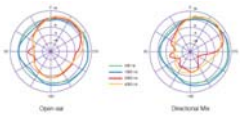
ReSound

BALANCE

WDRC



Directional Mix Processing™



Environmental Optimizer

ReSound

BALANCE

WDRC	**Benefit:** Ensures audibility of soft sounds and that loud sounds are not too loud. Prevents listening fatigue and increases comfort.
Directional Mix Processing™	**Benefit: :** Rich sound quality and enhanced ability to understand speech while retaining awareness of surroundings.
Environmental Optimizer	**Benefit:** Seamlessly adjusts to optimal audibility as the listener experiences different hearing situations.

ReSound

BALANCE

Binaural Fusion: Binaural Directionality	o Optimizes the directional characteristic so the listener benefits from both ears being omnidirectional, directional, or asymmetric directional depending on the speech and noise characteristics
Binaural Fusion: Environmental Optimizer II	o Optimizes the volume and noise reduction settings per environment based on input from both devices and providing coordinated adjustments
Other Directional Options	o Natural Directionality II o Binaural SoftSwitching o SoftSwitching o Autoscope Adaptive Directionality o Adaptive Directionality ™ o Multi-scope Adaptive Directionality™ o Omni-Directional, Fixed Directional

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BALANCE

Binaural Fusion: Binaural Directionality

Binaural Fusion: Environmental Optimizer II

Other Directional Options

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BALANCE

Binaural Fusion: Binaural Directionality	**Benefit:** Provides the user an improved signal to noise ratio for sounds from the looking direction without removing them from the natural listening environment.
Binaural Fusion: Environmental Optimizer II	**Benefit:** Provides the user a comfortable balanced listening experience based on their listening preferences
Other Directional Options	**Benefit:** Provides professional with the most tools to meet the needs of the individual

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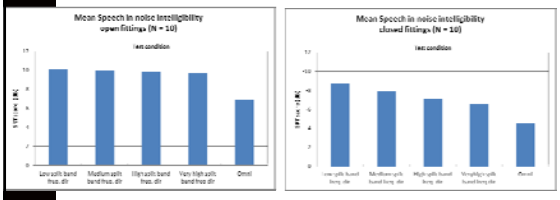
Results: Speech intelligibility in noise



(Moeller & Jespersen, 2012)

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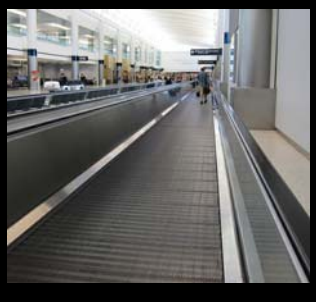
Some Auto Directionality systems are like stepping onto a moving sidewalk…

- You have no choice but to go along for the ride:



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Why not let the individual choose what to listen and focus on?

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How the Brain Processes Sounds in the Environment

DETECT	CHOOSE
A new sound in the environment draws your attention.	Filtering out sounds until you hear only what you want to hear.
Example: The sound of a candy wrapper during a lecture.	**Example:** Your child's laugh amongst other children at play in a park.

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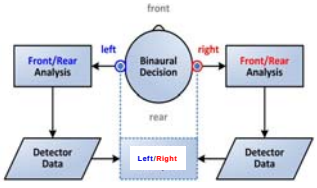
How Binaural Directionality Works



Decision to switch the microphone mode for one or both of the hearing aids is made based on the inputs received by the four speech detectors in the binaural set of devices.

Bilateral speech and noise data steers the directional technology to allow the end-user to make the most appropriate binaural decision

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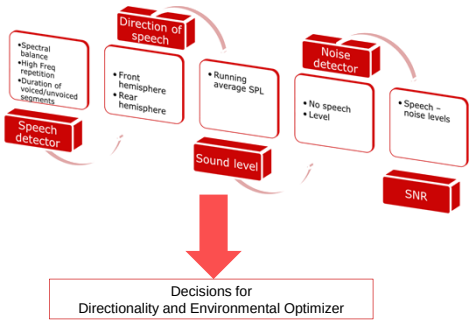
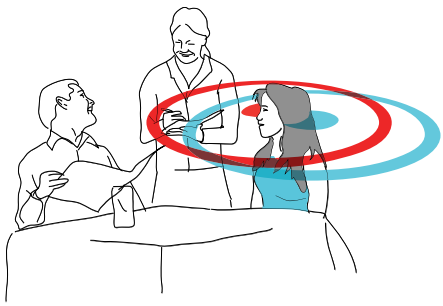
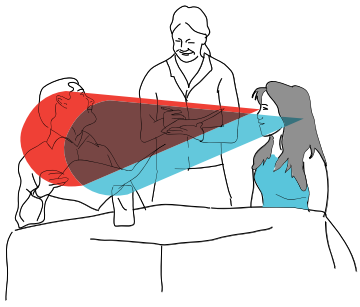
Input to Steering: Synchronized Parameters



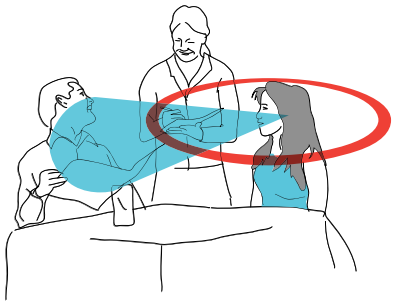
Omni/Omni mode



Directional/Directional mode



Asymmetric Directional mode



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Binaural Directionality

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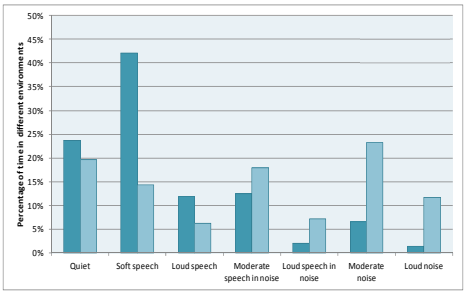
Two Cases:
Mr. Dark Blue & Mr. Light Blue



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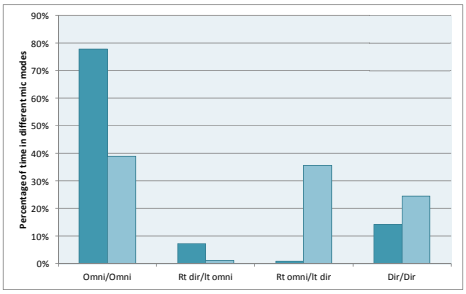
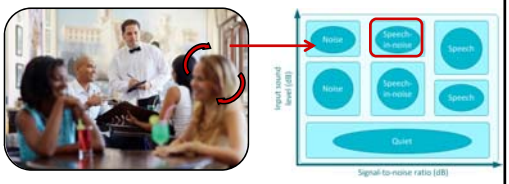
Binaural Directionality Results: Mr. Dark Blue & Mr. Light Blue



Binaural Environmental Optimizer II



Binaural Environmental Optimizer II

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CONNECTIVITY

Allows for interaction between hearing instruments and allows receiving of audio signals from remote transmitters to increase signal-to-noise ratio for the listener

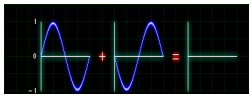
STABILIZE

DFS Ultra™

- Stabilizes the signal by suppressing feedback through phase cancellation and built in WhistleControl.
- Provides sufficient gain without introducing artifacts or compromising sound quality.

STABILIZE

DFS Ultra™

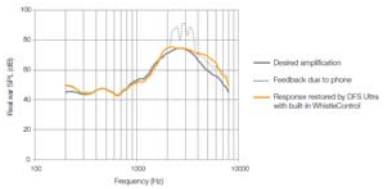


Feedback | Feedback cancellation filters add signal in opposite phase | Feedback is eliminated

STABILIZE

DFS Ultra™

Benefit: Confidence using the telephone, embracing, wearing hats and so on.



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Wireless Communication Options for Hearing Instruments

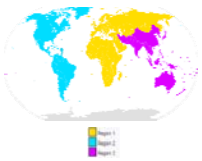
- Telecoil
- FM Systems
- Near Field Magnetic Induction (NFMI)
- Propriatory FM Radio Transmission

- Communication Languages: Bluetooth & Proprietary

Types of Wireless Communication

Industry-Scientific-Medical (ISM) bandwidth is defined by the ITU-R (International Telecommunications Union) for radio communication

Frequency range [Hz]	Centre frequency [Hz]	Availability
6.765–6.795 MHz	6.780 MHz	Subject to local acceptance
13.553–13.567 MHz	13.560 MHz	
26.957–27.283 MHz	27.120 MHz	
40.66–40.70 MHz	40.68 MHz	
433.05–434.79 MHz	433.92 MHz	
902–928 MHz	915 MHz	Region 2 only
2.400–2.500 GHz	2.450 GHz	
5.725–5.875 GHz	5.800 GHz	
24–24.25 GHz	24.125 GHz	
61–61.5 GHz	61.25 GHz	Subject to local acceptance
122–123 GHz	122.5 GHz	Subject to local acceptance
244–246 GHz	245 GHz	Subject to local acceptance



Device-to-Device Connectivity: Synchronized Volume and Push Button

The listener makes a change to the volume control or push button on one instrument and the other instrument is automatically updated to match.

The result is a convenient and seamless hearing instrument wearing experience.

Latency for volume and push button changes will nearly always take <1 second to synchronize

Synchronized Push Button/VC: Patient Benefits

- Simplifies the process for changing listening programs
- Guess-work removed from finding a balance between ears when adjusting volume
- Delay in device-2-device for distinct tones from each ear
- For patients with dexterity issues, it makes adjusting the hearing instruments easier
- How about a Remote Control with more visual information?

Device-to-Device Connectivity: Comfort Phone

Comfort Phone uses wireless communication to adjust settings in both ears simultaneously.

Comfort Phone identifies the "phone ear" and "non-phone ear" and instantly attenuates the non-phone ear by 6 dB for the duration of the call.

ReSound

Comfort Phone Not Activated

Comfort Phone Activated

ReSound

ReSound LiNX™ connects to the best accessories

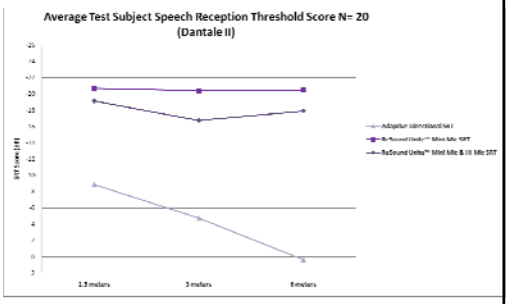
ReSound Unite 2.4 GHz wireless accessories

ReSound

ReSound Unite™ Mini Microphone

- Direct audio streaming to the hearing aids
- Fixed clip or lanyard
- Small dimensions
- Battery life > 8 hours
- Line In functionality
- Bandwidth
  - 20 Hz to 9.4 kHz (Line in)
  - 200 Hz to 5 khz (Microphone)
- At least 7 meters of range
- Only 18ms wireless latency (delay)

Proof of Benefit: ReSound Unite™ MiniMic



Made for iPhone hearing aids:
Say hello to endless possibilities…

Made for iPod iPhone

The ReSound Smart app

Full control and personalization at your fingertips

ReSound

How to Demo: Debunking Myths

I don't have time to demo
Good demos do not need to take more than 15 minutes

I don't have the right earmolds or product in inventory
Good demos do not have to perfectly mimic the final fitting

I don't have surround sound speakers or a flat screen TV
Good demos do not require fancy TVs and speaker set ups

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How to Demo: The First 5 Minutes

1. Program the instruments with First Fit settings
   Ask the patient if the volume is comfortable
2. Calibrate DFS (or use InitFree DFS)
3. Pair Unite accessories
4. Save, exit, open and close battery doors
   Put on put on ears
5. Explain the audiometric results

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How to Demo: The Next 10 minutes

6. Don't fuss over fine tuning – it is about demonstrating audibility and demoing accessories
7. Involve the companion
8. Take them outside (weather and mobility permitting)
9. "Put them in the Driver's Seat" – Give them remote control or Give them the Wheel
10. Put the Mini Mic on the companion and instruct the patient to switch to streaming
11. Have a DVD cued up and the Unite TV connected

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