Nonlinear Frequency Compression

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Overview

- How does SoundRecover work?
- What are the benefits of using SoundRecover?
- Who is a candidate for SoundRecover?
- How do I verify SoundRecover?
- Conclusion
More Hearing
More Hearing: SoundRecover

- Exclusive Phonak non-linear frequency compression system
- Expands audibility for the full spectrum of sounds
Audibility alone does not = intelligibility
Benefits of SoundRecover Visual analogy
Frequency Transposition vs. SoundRecover

What does Frequency Transposition do?

What does SoundRecover do?

How to fit additional high frequencies into the hearing range?
SoundRecover: Amplitude Compression vs Frequency Compression
More Hearing with SoundRecover

- Expands hearing to include the full spectrum of sounds
- Enhances audibility of crucial, high-pitched speech sounds and subtle environmental sounds
- All sounds are audible without being shrill or tinny
- No spectral overlap and other, non-compressed sounds remain unaffected
- Speech understanding and environmental awareness are improved even in difficult listening situations
- Fast acclimatization
- Now proven effective for hearing losses of all degrees and configurations
Audibility alone does not = intelligibility

Even when audibility can be achieved, it is often difficult to identify and discriminate high-frequency sounds
(Hogan and Turner, 1998)

Sensorineural hearing loss results in
- Reduced frequency resolution
- Problems recognizing & discriminating complex sounds

Excess amplification of high frequencies can actually have negative effects on sound quality and speech intelligibility
High frequency audibility

Conventional amplification can rarely provide meaningful, usable gain above about 5 kHz.
SoundRecover
The Fitting Range

SoundRecover for all degrees of hearing loss, audiometric configurations

![Graph showing the fitting range for SoundRecover](chart.png)
Sound Recover

Benefit for mild to moderate hearing loss

Audéo YES Field Study

Design:

- 12 patients
- At home
- SoundRecover on/off

Method:

- Spontaneous acceptance
- Freiburger
- Speech in Noise
- Questionnaire
Sound Recover
Benefit for mild to moderate hearing loss

Freiburger monosyllabic words - with and without SR

<table>
<thead>
<tr>
<th></th>
<th>T1</th>
<th>T4</th>
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<tbody>
<tr>
<td>Without</td>
<td>48.57</td>
<td>55.83</td>
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<tr>
<td>SR</td>
<td>47.14</td>
<td>48.75</td>
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% Correct

With Sound Recover
Without Sound Recover
Sound Recover
Benefit for mild to moderate hearing loss

Speech in noise test with cafeteria noise (65 dB)

Improvement over time
Sound Recover

Benefit for mild to moderate hearing loss

Collaborative study of the University of Melbourne and Zürich - SoundRecover benefits

Goal:
1. Evaluate SoundRecover default setting
2. Benefit of SoundRecover

Design:
- 16 subjects - 11 with moderate HL, 5 with severe
- Evaluated different settings of SoundRecover - double blinded
- Consonant test, diary
SoundRecover:
User Preferences

Sound Recover On
Sound Recover Off
No difference

# of times preferred
Sound Recover
Benefit for mild to moderate hearing loss

Results

![Bar chart showing the number of times preferred setting mentioned for different FrC settings.]

- Def: default setting
- FrC values: def, Def +1, Def +2
- No of times preferred setting mentioned:
  - No difference between programs
  - No FrC
  - Def –2
  - Def –1
  - Def

The chart indicates the benefit of different FrC values for Sound Recover in managing hearing loss.
Sound Recover
Benefit for mild to moderate hearing loss

Results:

- Most of the subjects preferred SoundRecover on to SoundRecover off
- On average, the subject’s preferences were for the default rather than no SoundRecover setting or +/- 1 setting
- This means that fine tuning is not needed most of the time
Sound Recover
Benefit for mild to moderate hearing loss

Phoneme thresholds with and without Frequency Compression (mild to moderate hearing losses)

Recognition thresholds for s(9k), s(6k), d

Thresholds relative to Unaided Thresholds dB

Aided FrC off
Aided FrC on
Sound Recover
Benefit for mild to moderate hearing loss
Sound Recover
Benefit for mild to moderate hearing loss

“In speech, the fricative consonants such as /s/ and /sh/ are often perceived more readily with frequency compression. Just as importantly, they are usually also made easier to discriminate. In addition to high-frequency components of speech, certain other sounds, such as birdsong and various environmental noises, can typically be heard better as well.”

Hugh McDermott
A Phonak hears more
SoundRecover

- 58 year old man saying "Zick"
  - Before SoundRecover
  - SoundRecover after 2 months
  - SoundRecover after 3 months

Recordings courtesy of Andrea Bohnert at the University Hospital for ENT and Communication Disorders, Mainz, Germany.
SoundRecover
Fitting and Verification
Sample fitting:
Sample fitting:

Audibility is limited here.

Audibility is better here (judging by peak SL of at least 10 dB).
Sample fitting (with NFC):

SSSSS

SHHHH
Sample fitting (with NFC):

Closer, but not overlapping.

When I listen to them, do they sound different?
Sample fitting (with NFC):

When I listen to speech, how is the overall sound quality?
Male vs female speech?
Fine-tuning tips:

**SoundRecover too strong? (it lowers too much)**
- S and SH are indistinguishable. User may perceive lisping when hearing speech
- Sound quality too piercing, too harsh, or too loud. We can provide more cues within a wearable fitting & let them acclimatize
- Problems will likely occur first for female speech

**SoundRecover too weak? (it doesn't lower enough)**
- No improvement, either electro-acoustically or behaviorally
- This can also occur if the fitting doesn't have enough gain to make the frequency-compressed energy audible. VERIFY, VERIFY, VERIFY, for the individual ear
SoundRecover
Fitting and Verification

*All adaptive functions are now switched off. The hearing instruments are ready for measurement.*
A Phonak hears more

SoundRecover
Conclusion

Soundrecovery: 5 Reasons why!

1. Dead Regions / No Response
2. Receiver limitations - unable to provide sufficient gain
3. Sound Quality - too much high frequency gain causes poor sound quality/distortion due to reduced frequency resolution
4. Broader tuning curves due to high frequency hearing loss create distortion with amplification
5. Equal loudness issues with reduced dynamic range
Questions?

Download slides at
www.ihsinfo.org/convention
Thank you!

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