The Distortional Aspect of Sensorineural Hearing Loss: What Can Be Done?

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Expert e-Seminar

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The A & D Components of SNHL

Plomp (1986)
The A & D Components of SNHL

Attenuation plus Distortion

Plomp, 1986
“D” in a Broader Context

The Distortional Component of SNHL

Beyond Threshold & Loudness Changes
Inside the Dynamic Range

Loudness Growth

[Graph showing loudness growth over dB HL]

Loudness

dB HL
Usability of the Remaining Dynamic Range

Frequency Resolution
Nelson & Turner, 1980

Simon & Yund, 1993
Inhibition
Temporal Resolution

Arthur et al., 1971
Temporal Resolution

Amplitude

How big of a gap?

Time

Drullman, Festen & Plomp, 1994
Upward Spread of Masking
Normal Hearing & USOM
example from Gagné, 1988

Noise @ 500 Hz.

<table>
<thead>
<tr>
<th>Frequency (Hz.)</th>
<th>Noise Level (dB SPL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>100</td>
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<tr>
<td>1000</td>
<td>90</td>
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<tr>
<td>2000</td>
<td>80</td>
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<td>4000</td>
<td>70</td>
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<tr>
<td>8000</td>
<td>60</td>
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Noise @ 1000 Hz.

<table>
<thead>
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<th>Frequency (Hz.)</th>
<th>Noise Level (dB SPL)</th>
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<tbody>
<tr>
<td>1000</td>
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<td>2000</td>
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<td>4000</td>
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<td>8000</td>
<td>70</td>
</tr>
<tr>
<td>16000</td>
<td>60</td>
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Measuring Excessive Masking

<table>
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<th>Frequency (Hz.)</th>
<th>dB HL</th>
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<tbody>
<tr>
<td>250</td>
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<tr>
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<td>16000</td>
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Region of excessive masking
Patient with Excessive USOM
from Klein et al., 1990

Intra Speech Masking
Temporal Masking

Dynamics Processing
CV F2 Transition

Variability: The Norm, Not the Exception
The Distortional Component of SNHL

The Effect: Speech Understanding in Noise

Task

- Spondees, 72 dB SPL
- Spondees, 84 dB SPL
- Monosyllabic, 72 dB SPL
- Monosyllabic, 84 dB SPL

Dirks et al., 1982
The Speech Signal up Close

Broad Band? Narrow Band?

“two weeks later”

two weeks later
Achieving Speech Recognition

Individual acoustic events must stand out of the clutter well enough to become linked.

Achieving Speech Recognition

The “ah-ha” Moment
The Distortional Component of SNHL

How Do We Address It Currently?

Above all else:
Improve Audibility & the S/N
Above all else: Improve Audibility & the S/N

Increase the *chances* of “ah-ha”

Control the Lows
Control the Lows

NAL-NL2

Voice Aligned Compression
Control the Lows

Increase the Bandwidth
Importance of HFs on Speech Localization

Best et al., 2005

A Closer Look at MC-WDRC
A Closer Look at MC-WDRC

- Enhanced Audibility with Comfort
- Decoupling response to vowels from consonants (USOM)
  - Packaging with Care

De-sensitivity
De-sensitivity

![Graph showing De-sensitivity measurements across different frequency bands.]
The Distortional Component of SNHL

The Future?

Further S/N Improvements?
Reverse Engineering of SNHL

Drullman, Festen & Plomp, 1994
Phoneme Enhancement

Please jot down how much change I need.
Please jot down how much change I need.

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