Amplitude Compression: Timing is Everything

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Wide Dynamic Range Compression
Wide Dynamic Range Compression
The Problem with Slow-Acting Compression

SLOW: 

FAST: 

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The Problems with Fast-Acting Compression
The Problems with Fast-Acting Compression
The Problems with Fast-Acting Compression

![Graph showing output (dB SPL) vs. input (dB SPL) for noise and speech with SNR: 20 dB.]

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The Problems with Fast-Acting Compression

![Diagram showing input vs. output in dB SPL with SNR: 10 dB and noise and speech regions.]

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Adaptive Compression
(SpeechGuard)

- Slowly follows gradual input changes
- Quickly reacts to large increases in input
- Quickly reacts to large decreases in input
Adaptive Compression
(SpeechGuard)

• Rapidly reduce gain for high-level sounds
• Rapidly re-establish gain for lower-level sounds
• Better preserve the shape of the acoustic waveform
• Optimize the signal-to-noise ratio
Purpose

Determine the benefits of adaptive compression to children’s and adult’s ability to manage complex listening environments.

Complex Environments:

- Speech perception
- Perception of environmental sounds
- Visual task
Participants

Children
20 with normal hearing
   7-12 years
15 with hearing loss
   7-12 years

Adults
21 with normal hearing
   21-30 years
26 with hearing loss
   50-65 years
   66-78 years

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Amplitude Compression Parameters

- Single compression model
- 4 channels
- Compression ratio = 3:1
- Knee point of 40 dB SPL
- Time constants
  - Slow: attack ~20ms, release ~800ms
  - Fast: attack ~10ms, release ~40ms
  - Adaptive: Speech Guard

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Auditory Stimuli

+10 dB

+4 dB

Trigger

Target

Playground Noise

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Auditory Stimuli

Non-overlapping

Overlapping

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Auditory Stimuli

- Door
- "Dog"
- "Apple"
- Cough

Words

Environmental Sounds

Trigger
Target
Playground Noise

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Complex Task

Animal  Person  Thing  ??

Person  Food  Animal  ??

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BIRDCALL

SLOW
A: 20 ms
R: 800 ms

FAST
A: 10 ms
R: 40 ms

ADAP
A: Var
R: Var

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## Listening Conditions

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RESULTS
Words

![Graph showing performance in words for normal hearing and hearing loss groups with and without overlap.](image)

- Normal Hearing:
  - Slow: 80%
  - Fast: 80%
  - Adapt: 80%

- Hearing Loss:
  - Slow: 60%
  - Fast: 60%
  - Adapt: 60%

**Groups:**
- Adults
- Children

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Words

![Graph showing performance of normal hearing and hearing loss groups with and without overlap.]

- **Normal Hearing:**
  - Performance for normal hearing across fast, slow, and adaptive conditions.
  - Performance is generally high without overlap and still good with overlap.

- **Hearing Loss:**
  - Performance for hearing loss across fast, slow, and adaptive conditions.
  - Performance is lower overall, with noticeable differences in performance between normal and hearing loss conditions.

- **Groups:**
  - Adults and children are tested separately.
Sounds

- Sounds with no overlap:
  - Normal hearing:
    - Slow: 100%
    - Fast: 100%
    - Adap: 100%
  - Hearing loss:
    - Slow: 50%
    - Fast: 50%
    - Adap: 50%

- Sounds with overlap:
  - Normal hearing:
    - Slow: 80%
    - Fast: 80%
    - Adap: 80%
  - Hearing loss:
    - Slow: 40%
    - Fast: 40%
    - Adap: 40%

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Sounds

**Figure:** Bar graph showing performance (as a percentage) with or without overlap for different groups and sound rates.

- **NORMAL HEARING**
  - No overlap:
    - Slow: 80%
    - Fast: 80%
    - Adapted: 80%
  - Overlap:
    - Slow: 80%
    - Fast: 80%
    - Adapted: 80%

- **HEARING LOSS**
  - No overlap:
    - Slow: 60%
    - Fast: 60%
    - Adapted: 60%
  - Overlap:
    - Slow: 60%
    - Fast: 60%
    - Adapted: 60%

*Note: The graph compares performance across different groups (adults, children) and sound rates (slow, fast, adapted) with and without overlap. The performance metrics are measured as a percentage of correct responses.*
Conclusions

Listeners with hearing loss had difficulty with:

- Partial acoustic information
- Fast-acting compression
- Environmental sounds

Adaptive compression

- Improved recognition of speech and environmental sounds
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