Binaural Hearing Ability with Bilateral Bone Conduction: Effect of Hearing Status

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Binaural Hearing

Binaural processing refers to the functions underlying human capabilities that are rendered possible or superior by the use of two ears rather than one.

- Provides spatial perception
  - Spatial awareness
  - Ability to localize sounds (directionality)
  - Noise supresion
  - Release from masking
Binaural hearing with bone conduction

With bone conduction transmission, sound from one stimulation position reaches both cochleae, suggesting decreased saliency of the binaural cues.

A common belief is that the difference between the two cochleae is 0 dB (transcranial attenuation) and there is no time delay.
Tests

Spatial Release from Masking

Binaural Intelligibility Difference (BILD)

JND: ITD and ILD

S₀N₀

S₀N₄₅

S₀N₁₈₀

Noise
Speech

Noise
Speech

S₀N₀

S₁₈₀N₀

S₀N₁₈₀

Time

ΔL

ΔT

Sine: 3.4 ms (1.7 ms rise/fall)
Low frequency: 588 Hz, High frequency 2940 Hz
Participants

Normal hearing
N=27

Symmetrical sensorineural hearing loss
N=15

Asymmetrical sensorineural hearing loss
N=10
Speech perception ($S_0 N_0$)
Binaural benefit, BC

Spatial Release from Masking

Binaural Intelligibility Level Difference
ITD and ILD, BC

**Interaural Temporal Difference**

- **Normal**
- **Symmetrical**
- **Asymmetrical**

**Interaural Level Difference**

- **Normal**
- **Symmetrical**
- **Asymmetrical**
Summary

• When speech and noise is co-located (S0N0), speech perception in noise is similar for AC and BC stimulation.

• A symmetrical sensorineural hearing loss reduces the SRM but not the BILD compared to normal hearing. Asymmetrical sensorineural hearing loss reduces both SRM and BILD compared with symmetrical hearing loss. However, participants with symmetrical as well as asymmetrical sensorineural hearing loss shown significant benefit of binaural stimulation.

• Participants with both symmetrical and asymmetrical sensorineural hearing loss have worse ability to use ITD and ILD cues compared with participant with normal hearing.
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