

Beyond Hearing: Music Perception in Bone-Anchored Hearing Implant Users

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Audiology Online

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Disclosures

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Conflicts of Interests:

- CJL: Advanced Bionics Medical Advisory Board; MED-EL Music Advisory Board; Advanced Bionics, Oticon Medical, & MED-EL Research Funding; Spiral Therapeutics CMO & Consultant
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Background

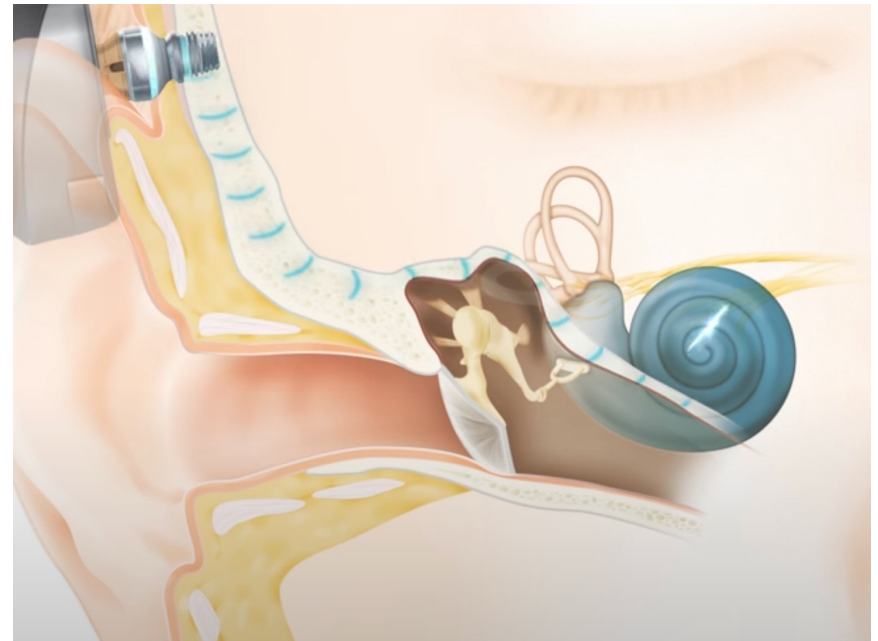
- Music is a highly complex acoustic stimulus
- Accurate delivery of high-fidelity information is essential for music perception, vocal emotion, and speech-in-noise
- Music serves as an excellent tool to measure complex sound performance
- Music is an important feature of everyday life and affects patient QOL

Background

- Patients with SSD/HL report music as sounding less natural, less pleasant, and less distinct (Meehan et al., 2017)
- SSD/HL patients are eligible for HA, BAHIs, and CIs depending on the type & severity of hearing loss
- HA & CIs are limited in the high-quality transmission of musical information (Vaisberg et al., 2021; Looi et al., 2019)

Bone Anchored Hearing Implants (BAHI)

- Sound vibrations are transferred to the implant located on the skull
- Bone oscillations bypass the external and middle ear to the directly stimulate the cochlea
- Inner ear converts vibrations into hair cell depolarizations to stimulate the auditory nerve



Hypothesis

Basic music perception performance is poorer in BAHI ears compared to the better-hearing ear and normal hearing (NH) controls.

Methods

- *Subjects:* 18 BAHI users & 11 NH control subjects
- *Study Setting:* Prospective study with testing performed onsite in the laboratory or remotely via direct connect
- *Primary Outcomes:*
 - Pitch Discrimination
 - Melodic Contour Identification
 - Basic Tempo Perception
 - Rhythmic Clocking
 - Instrument Identification
 - Polyphonic Pitch Detection
 - Harmonic Chord Discrimination

Pitch Perception

Which sound is higher in pitch?

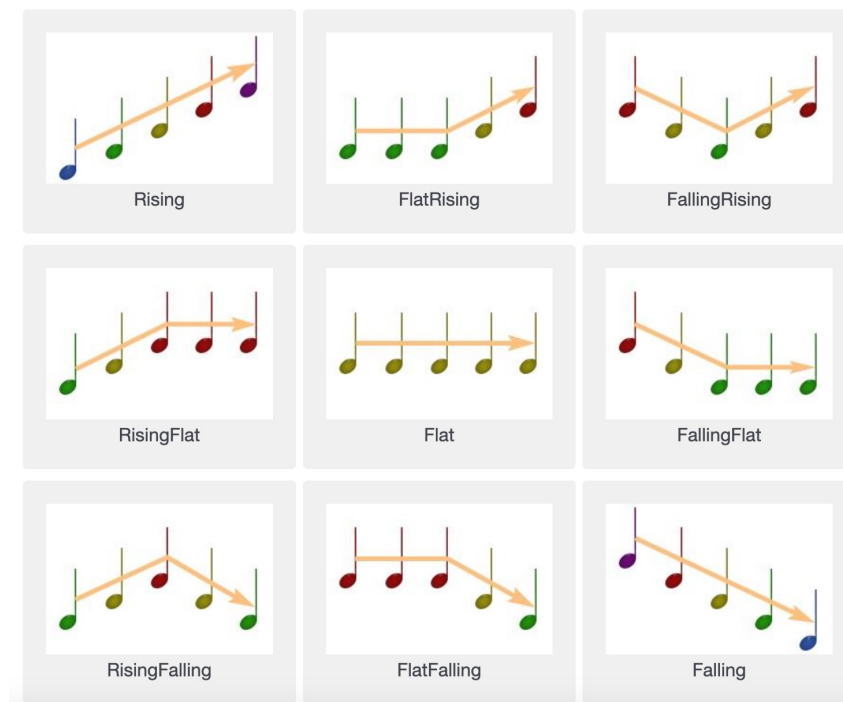
First

Second



Melodic Contour Identification

Please select the melodic contour image that reflects the audio clip



Rhythmic Clocking

You will hear 2 patterns played sequentially. Please select whether the 3rd note in the 2nd pattern is early or late.

EARLY

LATE



Basic Tempo Perception

You will hear 2 patterns played sequentially. Please select whether the 2nd pattern is slower or faster than the 1st pattern.

SLOWER

FASTER



Instrument Identification

Which instrument?



Piano



Violin



Clarinet



Polyphonic Pitch Identification

Which tone has 3 notes?

First

Second



Harmonic Chord Discrimination

You will hear 3 sounds. Please select the sound that is different from the others.

First

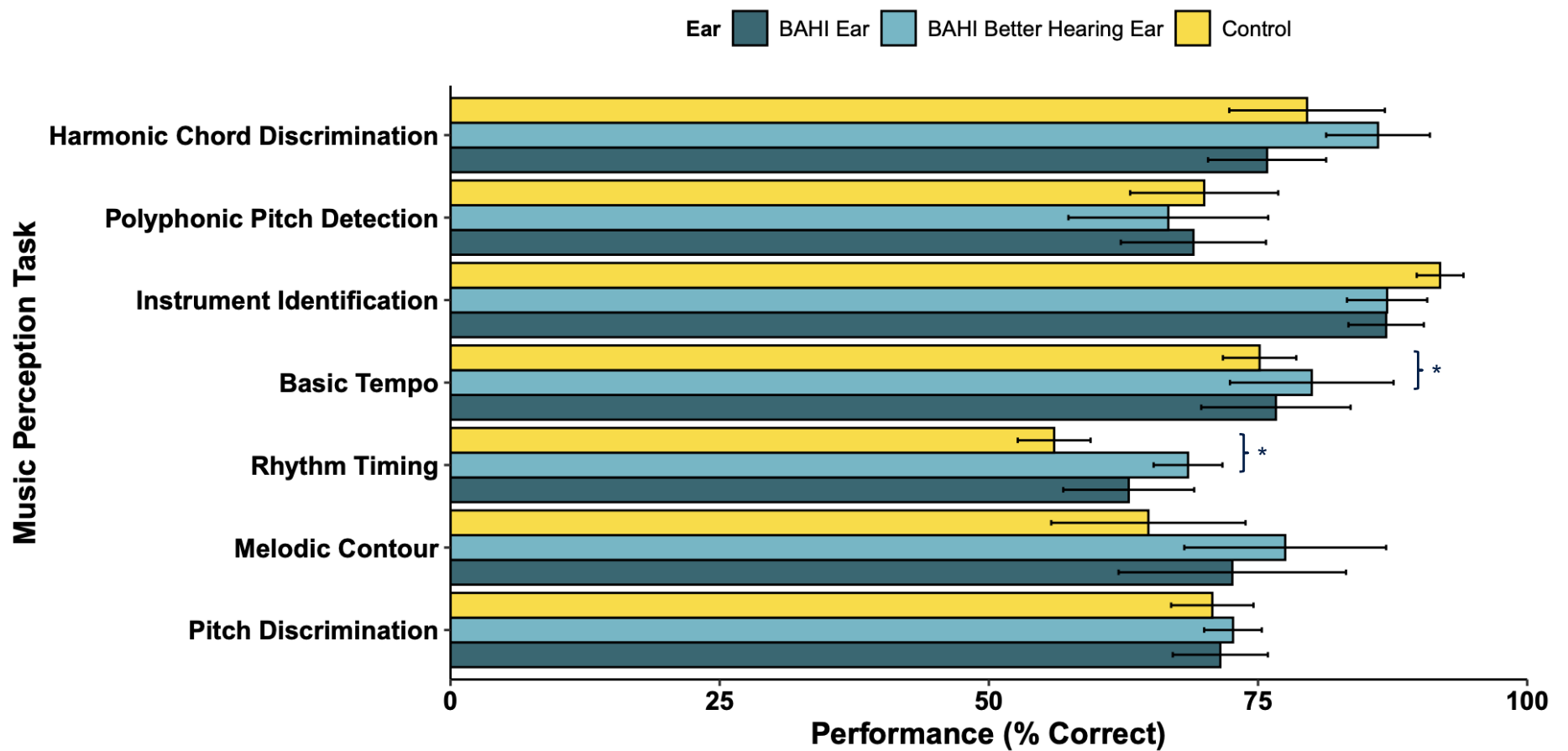
Second

Third



Age/Sex	HL Etiology	Indication	BAHI ear WRS	BAHI ear SRT	Better hearing ear WRS	Better hearing ear SRT	Device
57/M	EAC atresia	MHL	44%	95 dB HL	100%	15 dB HL	Cochlear Baha 4
71/F	SSNHL	SSD	96%	50 dB HL	100%	10 dB HL	Cochlear Baha 3
51/F	CSOM	MHL	100%	70 dB HL	100%	60 dB HL	Cochlear Baha 4
67/F	Otosclerosis	MHL	100%	60 dB HL	100%	30 dB HL	Cochlear Baha 3
59/M	SSNHL	SSD	0%	80 dB HL	100%	20 dB HL	Cochlear Baha BP 100
67/F	Traumatic ossicular dislocation	SSD	0%	120 dB HL	100%	10 dB HL	Cochlear Baha Attract
27/F	Tympanosclerosis	CHL	92%	50 dB HL	96%	5 dB HL	Oticon Ponto 3
40/M	VS	SSD	0%	120 dB HL	100%	15 dB HL	Oticon Ponto 4
80/F	Otosclerosis	MHL	46%	95 dB HL	100%	25 dB HL	Oticon Ponto 3
47/M	CSOM	MHL	92%	85 dB HL	92%	80 dB HL	Oticon Ponto Plus
39/M	Meniere's	SSD	36%	60 dB HL	100%	5 dB HL	Oticon Ponto 4
30/F	Unknown	SSD	0%	65 dB HL	100%	10 dB HL	Oticon Ponto 3
33/F	EAC atresia	CHL	N/A*	N/A*	100%	10 dB HL	Oticon Ponto 4
24/F	EAC atresia	CHL	96%	70 dB HL	100%	60 dB HL	Oticon Ponto 3
54/M	CSOM	MHL	96%	55 dB HL	100%	10 dB HL	Oticon Ponto 3
51/M	Meniere's	SNHL	0%	105 dB HL	76%	55 dB HL	Oticon Ponto 4
52/F	Cholesteatoma	MHL	96%	50 dB HL	100%	30 dB HL	Oticon Ponto 4
42/F	VS	SSD	0%	110 dB HL	100%	5 dB HL	Oticon Ponto 4

Audiometric Test	Result
Avg. air-conducted PTA of BAHI ear, dB HL	80 [69-92]
Avg. air-bone gap, BAHI ear, dB HL	39 [27-51]
Avg. air-conducted PTA of better hearing ear, dB HL	22 [13-30]
Word recognition score (BAHI ear), %	53 [31-75]
Word recognition score (better hearing ear), %	98 [97-98]
Speech Reception Threshold (BAHI ear), dB HL	79 [68-90]
Speech Reception threshold (better hearing ear), dB HL	25 [14-36]



Results

- No difference between Cochlear versus Oticon BAHl users except with instrument identification performance
 - Cochlear 80% vs Oticon 96%, $p = 0.006$
- No difference between “in-person open-speaker” versus “remote testing direct-connect” testing modalities

Conclusions

- BAHI ears perform comparatively well to NH ears on basic music perception tasks
- Oticon BAHI users perform better than Cochlear BAHI users on instrument identification tasks
- Future studies should incorporate more challenging music perception tasks & sound quality assessments

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Thank you!