



From Tempo+ to Opus2

what can music tests tell us about processor upgrades?



Rachel M. van Besouw & Mary L. Graseder

Background

Music tests for quantifying the music perception abilities of cochlear implant users are currently being developed and trialled at the South of England Cochlear Implant Centre. In addition to measures of speech perception, tests of rhythm and pitch have been administered to Med-EI C40+ implant users before and after upgrading from the Tempo+ (with CIS+) to the Opus2 (with FSP) processor, with the aims of:

- comparing device performance
- evaluating the potential of music tests for informing processor upgrades and tuning

Methods

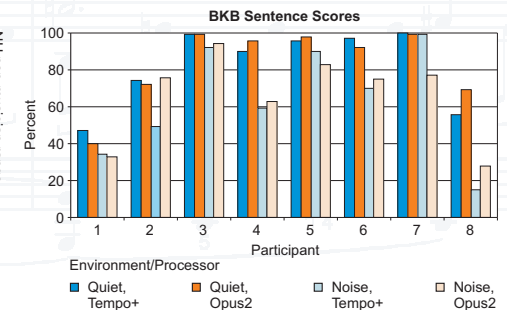
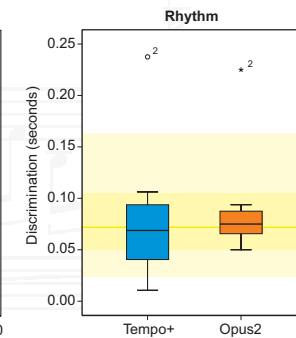
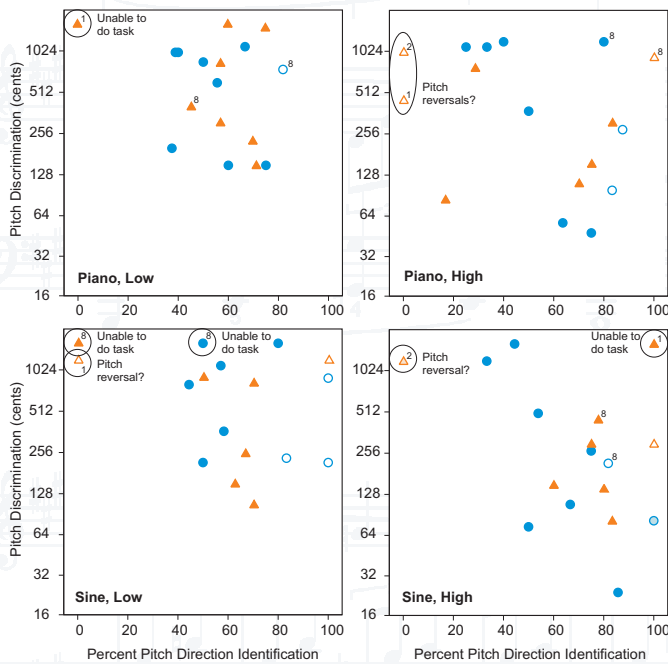
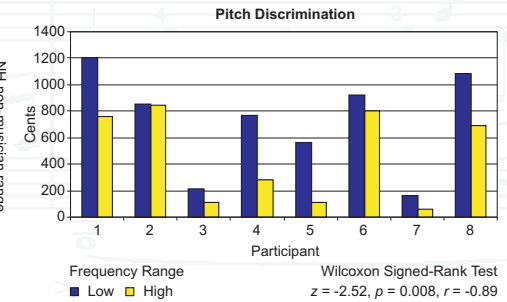
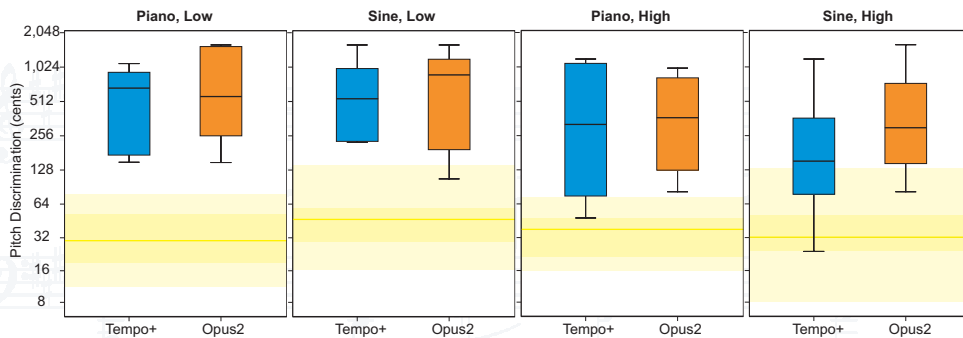
Nine[†] adult C40+ cochlear implant users (5 female, 4 male)
 Tested before upgrade and a minimum of 6 weeks after upgrade
 Av. age 50.3 years (± 18.6 SD), no prior music training, mixed level of ability

Tests:

- Rhythm (side stick)
- Pitch discrimination with additional pitch direction task (sine/piano stimuli) for low (A3-F4) and high (A5-F6) notes
- BKB sentences in quiet
- BKB in noise (10dB SNR)



Results



Kendall's tau: BKB Quiet & Pitch Discrimination

Processor	Note range	Correlation coefficient	p value
Tempo+	Low	$r = -0.889^{**}$	$p < 0.001$
	High	$r = -0.833^{**}$	$p = 0.001$
Opus2	Low	$r = -0.546^*$	$p = 0.031$
	High	$r = -0.546^*$	$p = 0.031$

Pearson's r: BKB Noise & Pitch Discrimination

Processor	Note range	Correlation coefficient	p value
Tempo+	Low	$r = -0.984^{**}$	$p < 0.001$
	High	$r = -0.911^{**}$	$p < 0.001$
Opus2	Low	$r = -0.291$	$p = 0.242$
	High	$r = -0.151$	$p = 0.361$

Pitch Direction ID Score Probability
 ○ < 0.05 ● ≥ 0.05 ○ > 0.05 with score 4/4 or 0/4
 Processor Type
 ● Tempo+ ▲ Opus2

Case Study: Participant 8

Session	No. active electrodes	Implant frequency range (Hz)	Sine low (cents)	Sine high (cents)	BKB quiet	BKB noise
1 (Tempo+)	8	300 - 8500	1600	216	56%	15%
2 (Opus2)	8 (2 FSP)	100 - 8500	1600	450	69%	28%
3 (Opus2)	6 (2 FSP)	100 - 8500	275	400	78%	48%*

*Significant increase in BKB score

Conclusions

- Rhythm, pitch and speech perception scores comparable for Tempo+ (with CIS+) and Opus2 (with FSP).
- Rhythm ability comparable to normal hearing (NH) non-musicians.
- Pitch discrimination in higher frequency range better than in lower frequency range.
- Pitch direction identification difficult for cochlear implant users.
- Speech and pitch discrimination measures correlated.
- Music perception tests can provide important additional measures for tuning and assessing impact of changes to implant strategies.

