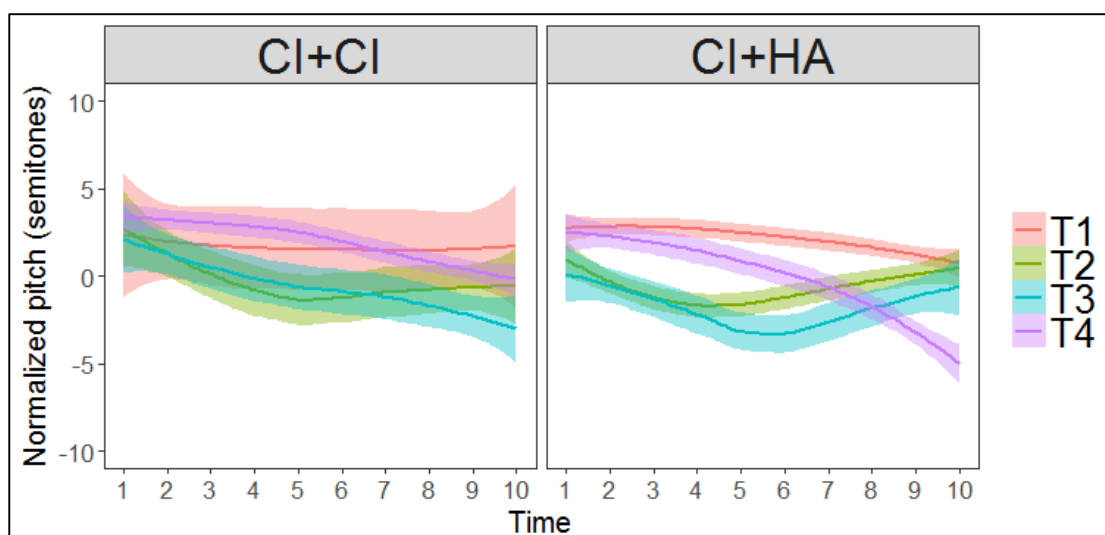


**Supplemental Material S2.** Additional analysis on children with bilateral cochlear implants (Cis).

There were seven children fitted with two CIs in this study, including four children from CI\_Imp 2-3, two children from CI\_Imp 3-4 and one child from CI\_Imp 4-5. To explore whether the implantation modality (i.e., bilateral CI+CI vs. bimodal CI+HA) would impact children’s tonal acquisition, we compared the lexical tone pitch contours of the four children with unimodal implantation from the CI\_Imp 2-3 group with other children with bimodal implantation from the same group (Figure S2-1). These children were selected to gain a better control on their ages at implantation.



**Figure S2-1.** Pitch contours of lexical tones from bilateral (CI+CI) and bimodal (CI+HA) groups.

A linear mixed model was performed on pitch slopes and curvatures with two fixed factors Modality (CI+CI and CI+HA) and Tone (T1, T2, T3 and T4) and a random factor Participant. The results showed that there was a significant interaction of Modality  $\times$  Tone on the pitch slope, suggesting that these two groups differed in the pitch slope across tones (Table S2-1).

**Table S2-1.** Results of linear mixed-regression model on pitch shape (pitch slope and curvature) of lexical tones, with two fixed factors Modality (CI+CI vs. CI+HA) and Tone (T1, T2, T3 and T4).

Parameter	Factors	df 1	df 2	<i>F</i>	<i>p</i>
Pitch slope	Modality	1	1137	0.29	.591
	<b>Tone</b>	<b>3</b>	<b>1137</b>	<b>4.31</b>	<b>&lt; .01**</b>
	<b>Modality <math>\times</math> Tone</b>	<b>3</b>	<b>1137</b>	<b>3.41</b>	<b>&lt; .05*</b>
Pitch Curvature	Modality	1	1137	0.00	.982
	<b>Tone</b>	<b>3</b>	<b>1137</b>	<b>3.40</b>	<b>&lt; .05*</b>
	Modality $\times$ Tone	3	1137	1.04	.372

The post-hoc test shows that the two groups were not different in the pitch slope of T1, T2 and T3, but the bimodal group produced T4 with a more falling pitch slope than the bilateral group (Table S2-2). This result therefore suggests that the CI+HA bimodal implantation might benefit the tonal acquisition by children with

hearing impairment. However, it should be noted that this small group is not representative of most children with CIs in China and we do not have enough children with bilateral implantation to draw a strong conclusion about bimodal benefit. Future studies with a balanced design between group is needed to explore the effect of modality on the tonal acquisition by children with hearing impairment.

**Table S2-2.** Pairwise comparisons of pitch slopes of lexical tones between children with bilateral (CI+CI) and bimodal (CI+HA) implantation in the CI\_Imp 2-3 group.

Comparison	Tone	$\beta$	<i>SE</i>	<b>df</b>	<i>t</i>	<i>p</i>
Unimodal	T1	-0.32	1.02	51.02	-0.31	.755
	T2	0.35	1.01	50.85	0.34	.734
Bimodal	T3	1.00	1.01	50.85	0.98	.330
	<b>T4</b>	<b>2.04</b>	<b>1.01</b>	<b>50.85</b>	<b>2.01</b>	<b>&lt; .05*</b>