LETTER

Reply to van Hoesel: Binaural jitter with cochlear implants, improved interaural time-delay sensitivity, and normal hearing

The results for both bilateral cochlear implant (BiCI) (1) and normal-hearing (NH) listeners (2) show improvements in interaural time-delay (ITD) sensitivity when introducing irregularities in pulse timing. Following our hypothesis based on ref. 2, we called this effect "recovery from binaural adaptation" (RBA) even though we did not provide any explanation underlying this effect. We agree with van Hoesel (3) that one potential explanation for this effect could be a lower-rate signal representation at some level of auditory processing. We are currently investigating the neural mechanisms underlying the RBA effect.

The lack of improvements at 400 pps in our study is in contrast to NH data collected at the same rate in ref. 2. However, two other NH studies found either no restarting at all at 556 pps (4) or in three of five subjects at 333 pps (5). Thus, for a given pulse rate, the presence of RBA appears to be highly subject-dependent, which could explain the discrepancies between the studies.

We claimed that binaurally jittered stimulation resolves the discrepancy in rate limitation between BiCI and NH listeners in terms of the maximum pulse rate up to which ITD sensitivity is found. Comparison between the performance with pure tones in NH listeners and pulse trains in BiCI listeners as a function of frequency, as raised by van Hoesel (3), is complicated by the various differences in stimulus properties (e.g., the variable versus fixed place of stimulation for acoustic pure tones and electric pulse trains, respectively).

Bernhard Laback* and Piotr Majdak
Austrian Academy of Sciences, A-1040 Vienna, Austria

1. Laback B, Majdak P (2008) Binaural jitter improves interaural time-difference sensitivity of cochlear implantees at high pulse rates. *Proc Natl Acad Sci USA* 105:814–817.
2. Hafter ER, Buell TN (1990) Restarting the adapted binaural system. *J Acoust Soc Am* 88:806–812.
3. van Hoesel R (2008) Binaural jitter with cochlear implants, improved interaural time-delay sensitivity, and normal hearing. *Proc Natl Acad Sci USA* 105:E5I.
4. Saberi K (1996) Observer weighting of interaural delays in filtered impulses. *Percept Psychophys* 58:1037–1046.
5. Stecker GC, Hafter ER (2002) Temporal weighting in sound localization. *J Acoust Soc Am* 112:1046–1057.

Author contributions: B.L. and P.M. wrote the paper.

The authors declare no conflict of interest.

*To whom correspondence should be addressed. E-mail: bernhard.laback@oeaw.ac.at.

www.pnas.org/cgi/doi/10.1073/pnas.0805527105