Comment

Comment by Kollmeier

In CI-Users the dynamic range is highly reduced and comparatively small monaural intensity JNDs result, that are only partially compensated for by the AGC (or dynamic compression) of the speech processor. Hence, CI users may still use comparatively small interaural level differences in the dynamic input signals you are using for performing the localization task, even if the high frequencies are eliminated. In my opinion, you can therefore not rule out ILD-based localization for low frequencies. Do you have an estimate of the (monaural or binaural) intensity JND of your subjects for dynamically varying stimuli (i.e. parts of the stimuli that do not directly activate the AGC)?

Reply:

Birger Kollmeier's comment refers to some new data that we presented in the talk at Dourdan, but that are not included in the written manuscript. Briefly, we reasoned that localization performance with a low-pass noise stimulus, for which interaural level differences (ILDs) would be much reduced, would enable us, by comparing performance to that obtained with a broadband stimulus, to address the relative contribution of ILDs and interaural temporal differences (ITDs) to localization performance by bilateral cochlear implant wearers. Accordingly, we obtained data from six subjects in a followup condition in which the stimulus was a 1000-Hz low-pass noise (skirts nominally 135 dB/octave). Three of the six subjects performed as well or better with the low-pass noise as with the wideband noise, leading us to conclude that ILD cues may not be the sole cues underlying these subjects' performance.

We have done some preliminary measurements of the acoustic levels that arrive to the cochlear implant processors worn at the subject's two ears. These levels were obtained after processing by the front-end AGC circuits, which were fully activated by the nominal 62-dB SPL stimulus. For the 1000-Hz low-pass noise presented from an azimuth of +90°, there is still a small ILD (on the order of 1-3 dB). Thus, Dr. Kollmeier is correct that we cannot fully rule out subjects' use of ILD cues in this task, especially given the high sensitivity that has been shown by some bilateral implant users to electrically presented ILDs (van Hoesel and Tyler 2003; Long *et al*. 2003). Interestingly, however, no study that we are aware of has measured ILDs in these subjects using *acoustic* stimuli.

In any case, we feel that the fact that providing a broadband stimulus with a much greater magnitude of ILD does not (in 3/6 subjects) lead to improved localization performance supports our preliminary conclusion that ILDs are not the *only* cues underlying performance. In order to reach a more definitive answer to the question, we are currently measuring ILD thresholds in our implanted subjects, using the same acoustic signals as employed in the localization task.

Long, C. J., Eddington, D. K., Colburn, H. S., and Rabinowitz, W. M. (2003) Binaural sensitivity as a function of interaural electrode position with a bilateral cochlear implant user. J. Acoust. Soc. Am. 114, 1565-1574.
van Hoesel, R. J. M., and Tyler, R. S. (2003) Speech perception, localization, and lateralization with bilateral cochlear implants. J. Acoust. Soc. Am. 113, 1617-1630.