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Title

Comparing Otoacoustic, Auditory-Nerve, and Behavioral Estimates of Cochlear Tuning in the Ferret

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Background

Cochlear tuning provides the initial tonotopic organization that is maintained throughout the auditory pathways at least up to primary auditory cortex. Auditory-nerve (AN) tuning curves provide a direct measure of cochlear tuning that corresponds closely to the mechanical tuning observed on the basilar membrane. Less invasive, but less direct, measures have also been proposed, including ones based on stimulus-frequency otoacoustic emissions (SFOAEs) and behavioral (notched-noise) masking. However, the correspondence between AN tuning and the more non-invasive techniques remains somewhat controversial. Here we present data using all three techniques in the same species to provide a direct test of their correspondence.

Methods

Estimates of cochlear tuning were derived from SFOAE measurements, collected in 19 ferret ears at frequencies ranging from 1 to 10 kHz. Some of the ferrets for whom SFOAEs had been collected were then tested behaviorally to derive estimates of cochlear tuning using the notched-noise method under forward or simultaneous masking with either a fixed signal level (to mimic AN measures) or fixed masker level (to match more common behavioral estimates in humans). The cochlear tuning estimates from the behavioral and SFOAE methods in ferret were compared with previously published estimates from AN tuning curves in ferrets, and with AN, SFOAE, and behavioral estimates in other species.

Results

Analysis of the SFOAE data produced estimates of cochlear tuning that were in generally good agreement with AN and SFOAE data from other small mammals, including cat, guinea-pig, and chinchilla. A preliminary analysis of the cochlear tuning estimates from the behavioral notched-noise method suggests no large or systematic deviations from the more direct physiological estimates. In all cases, estimates of tuning appear broader, by about a factor of two, than comparable estimates in humans.

Conclusions

Based on preliminary outcomes, no systematic deviations were observed between estimates of cochlear tuning from the AN, SFOAEs, and behavioral methods. If confirmed, the convergent data from all three methods in the same species provide support for the hypothesis that both SFOAEs and behavioral masking techniques can provide reasonable and non-invasive estimates of cochlear tuning. The outcomes are also consistent with the idea that human cochlear tuning (when measured in terms of frequency, as opposed to cochlear extent) is sharper than in most common mammals used for auditory research.

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