The Representation of Interaural Time Differences in High-Frequency Auditory Cortex.

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Abstract:

Early representations of auditory features often involve neuronal populations whose tuning is substantially wider than behavioral discrimination thresholds. Although behavioral discrimination performance can be sometimes achieved by single neurons when using the appropriate part of their (wide) tuning curves, neurons that encode the resulting high-acuity representations have rarely been described. Here we demonstrate the existence of neurons with extremely narrow tuning for interaural time differences (ITDs), a major physical cue for the azimuth of sound sources. The tuning width of ITD-tuned brainstem neurons is mostly determined by the properties of their acoustic input, and may be 10-100 times wider than behavioral thresholds. In contrast, we show that tuning widths of some neurons in the primary auditory cortex in the cat high-frequency auditory cortex (measured using transposed stimulus) can be very sharp and approach behavioral thresholds. Furthermore, while best ITDs of brainstem neurons often lie outside the range of naturally encountered ITDs (the ethological range), the range of best ITDs of the narrowly tuned cortical neurons corresponds well to the ethological range. Thus, our results suggest that the auditory cortex contains a high-resolution representation of ITDs that explicitly decodes the widely tuned brainstem representations.

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