

Rapid Dynamic Range Adaptation in the Auditory Nerve

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The auditory system operates with fine behavioral acuity over a vast range of sound pressure levels well exceeding the dynamic range of most auditory neurons. Dean et al. (*Nat. Neurosci.* 8:1684) have reported that the dynamic range of midbrain auditory neurons adapts to the distribution of sound levels in a dynamic stimulus by shifting towards the most probable level. Here we show that dynamic range adaptation also occurs in primary auditory neurons for tone and noise stimuli.

We recorded from auditory-nerve (AN) fibers in anesthetized cats in response to continuous dynamic stimuli in which the level was randomly drawn every 50 ms from a broad distribution containing a 12-dB wide high-probability region (HPR) in which levels occurred with 80% probability. We found that the steep parts of rate-level functions shift systematically towards the HPR mean level. This dynamic range adaptation differs from classic short-term adaptation, which would produce a constant rate decrement with no change in sensitivity. The rate of dynamic range shift with HPR mean level ranged from 0.1 to 0.5 dB/dB, and was not correlated with characteristic frequency or spontaneous rate. Using stimuli in which the HPR mean level switches between two values every 5 s, we further found that dynamic range adaptation occurs over just a few hundreds of milliseconds.

Dynamic range adaptation across the AN fiber population improved the precision of level coding within the HPR. However, this benefit was partially offset by increasing compression of the range of firing rates with increases in HPR mean level. Dynamic range adaptation in the AN was weaker than in the midbrain, and not sufficient to prevent a pronounced degradation in the precision of level coding above 60 dB SPL. These findings suggest that rapid adaptive processing to the sound level distribution first occurs in the auditory periphery and is enhanced along the auditory pathway.

Supported by NIH grants RO1 DC002258 and P30 DC005209.