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# Why is sensitivity to interaural time differences (ITD) poorer than normal with bilateral cochlear implants? Neurophysiological considerations

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Bilateral cochlear implantation improves sound localization and speech reception in noise. Yet ITD sensitivity is clearly poorer than normal with bilateral implants, even when the stimulation bypasses the processors (which discard the temporal fine structure of the stimulus). This poor behavioral ITD sensitivity is surprising from a physiological perspective because (1) electric stimulation produces precise temporal patterns of activity in the auditory nerve, and (2) most neurons in the inferior colliculus of acutely-deafened, bilaterally-implanted cats show precise tuning to ITD of pulse trains at the appropriate intensity (Smith and Delgutte, J. Neurosci. 27:6740). We will present physiological and modeling results bearing upon two hypotheses for reconciling neural and psychophysical observations. One hypothesis is that plastic changes to the neural circuitry resulting from binaural deprivation may impair the binaural processing in long-term deafened animals (and humans), particularly if deafening occurs during the neo-natal period. Alternatively, the abnormal spatio-temporal pattern of activity across the population of binaural neurons (due in part to limited dynamic range with electric stimulation) may impair the ability of the central decoding stages to extract the ITD information available in individual binaural neurons.