











central nervous system (Rhode & Smith, 1986; Woolf et al., 1981). However, such a limited sample is insufficient to determine the range of abilities in mammals as a whole, and it is well established that the vertebrate auditory system is capable of phase locking up to 10 kHz because it does so in the barn owl (Sullivan & Konishi, 1984). Therefore, it should be noted that although the upper limit for the use of the phase cue may be determined by the phase-locking ability of the gerbil's auditory system, it is possible for a vertebrate to evolve an auditory system capable of phase locking at higher frequencies.

Turning to binaural intensity, it appears that this cue becomes useable by 4 kHz, as demonstrated by the improved performance in most of the gerbils at this frequency. This observation is supported by evidence based on cochlear microphonic recordings, which show that an interaural intensity difference exceeding 6 dB becomes available in gerbils at frequencies above 4 kHz (Plassmann, Kausch, Kuhn, Peetz, & Gottschalk, 1985).

The behavioral results for the gerbil are close to those for the kangaroo rat whose dip occurs  $\frac{1}{2}$  octave higher at 4 kHz and whose performance rises again by 5.6 kHz. However, these two species are in contrast to the least weasel (a species of similar interaural distance and auditory sensitivity), for which the usefulness of phase begins to fall at the same point as for the gerbil and kangaroo rat (approximately 2 kHz) but for which the intensity cue does not become useful until 16 kHz is reached, possibly owing to the much smaller pinnae of the least weasel (R. Heffner & Heffner, 1987b).

In summary, the gerbil is a species capable of using both binaural phase- and intensity-difference cues to localize sound but whose acuity is limited in comparison to other species serving as models of a mammalian auditory system in laboratory studies. The possible effect on sound localization of the recently discovered degenerative disorder in the central auditory system of the gerbil is not yet known.

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