To Be Presented at the Acoustical Society of America Meeting
Salt Lake City, June 2007

Evolution of mammalian hearing. Henry E. Heffner (Dept. of Psychology MS 948, Univ. of Toledo, 2801 W. Bancroft St., Toledo, OH 43606), Henry.Heffner@utoledo.edu) and Rickye S. Heffner (Univ. of Toledo, Toledo, OH 43606).

The comparative study of mammals reveals systematic differences in their hearing abilities. First, the ability to hear above 10 kHz (which apparently evolved for using pinna cues to localize sound) varies inversely with the size of an animal's head such that smaller animals usually have better high-frequency hearing than larger ones. Second, low-frequency hearing ability is bimodally distributed: Although most mammals can hear below 125 Hz, about one third do not hear much below 500 Hz and probably do not use temporal coding for pitch perception. Third, sound localization acuity varies directly with the width of the field of best vision, indicating that a major source of evolutionary pressure on hearing is to direct the eyes to the source of a sound. Finally, while some mammals do not use the binaural time-difference locus cue and a few others do not use the binaural intensity difference cue, it is likely that all mammals that possess pinnae use pinna locus cues to localize sound. Taken together, these findings suggest that some of the hearing abilities of extinct mammals may be inferred from fossil evidence bearing on their head size, eyes, and the presence of pinnae.

Sound localization and its relation to vision in large and small new-world bats. Gimseong Koay (Univ. of Toledo, Toledo, OH 43606), Henry E. Heffner (Univ. of Toledo, Toledo, OH 43606), and Rickye S. Heffner (Dept. of Psychology MS 948, Univ. of Toledo, 2801 W. Bancroft St., Toledo, OH 43606, Rickye.Heffner@utoledo.edu)

Passive sound-localization acuity (minimum audible angle) for brief noise bursts was determined behaviorally for two species of New-world bats (Phyllostomidae): *Phyllostomus hastatus*, a large bat that eats fruit and preys on other vertebrates, and *Carollia perspicillata*, a small species that eats fruit and nectar. Both use echolocation calls of very low intensity for orientation and obstacle avoidance. The mean minimum audible angle for two *P. hastatus* was 9 degrees, and that for two *C. perspicillata* was 14.8 degrees. This places their passive sound-localization acuity near the mean for mammals. Sound localization varies widely among mammals and the best predictor of a species' acuity remains the width of the field of best vision ($r = .89$, $p < .0001$). Neither of these bats nor the other three bat species tested so far deviates from the relationship between sound-localization and vision, suggesting that despite their specialization for echolocation, the use of hearing to direct the eyes to the source of a sound still serves as the major source of evolutionary selective pressure for passive sound localization.

Laboratory rats do not use binaural time cues to localize sound. Christina M. Wesolek* Gimseong Koay, and Henry E. Heffner (Dept. of Psychology MS 948, Univ. of Toledo, 2801 W. Bancroft St., Toledo, OH 43606), Henry.Heffner@utoledo.edu)

The use of binaural time and intensity cues to localize sound can be investigated by determining the ability of a subject to localize pure tones in a free-field. Specifically, the ability to localize low-frequency tones, which do not produce an intensity difference at the two ears, demonstrates the use of the binaural phase (time) cue whereas the ability to localize high-frequency tones, to which the auditory system cannot phase lock, demonstrates the use of the binaural intensity-difference cue. Because previous studies of the laboratory rat (*Rattus norvegicus*) disagreed on the highest frequency that could be localized using binaural phase difference, the ability of rats to localize pure tones was reexamined. The results indicated that, contrary to previous studies, laboratory rats are not able to localize low-frequency tones even when they are amplitude modulated. Thus, it appears that laboratory rats are unable to use the binaural time-difference cue to localize sound. Because the previous studies were conducted before the widespread availability of spectrum analyzers, it is possible that their results were due to the presence of high-frequency harmonics in their low-frequency tones. These results have relevance for the anatomical and physiological study of binaural processing in laboratory rats.

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Comparison of behavioral and auditory brainstem measures of hearing loss in rats exposed to loud sound**.** Gimseong Koay (Univ. of Toledo, Toledo, OH 43606), and Henry E. Heffner (Dept. of Psychology MS 948, Univ. of Toledo, 2801 W. Bancroft St., Toledo, OH 43606), Henry.Heffner@utoledo.edu)

Behavioral thresholds for 400-ms pure-tone pulses (2/s, 10 ms rise-decay) were determined for monaural rats using the method of conditioned suppression. Auditory brainstem response (ABR) thresholds for 1-ms tone pulses (27.7/s, 0.5 ms rise-decay) were determined in the same animals for the same frequencies (2, 4, 8, 16, and 45 kHz). A hearing loss was then induced by exposing an isoflurane-anesthetized animal to a loud tone (110 or 120 dB) for 10 minutes. A behavioral pure-tone threshold was determined one hour after exposure followed immediately by an ABR threshold for the same frequency. The animals were retested on subsequent days until their thresholds stabilized. So far (n=10), no simple relationship has been found between the ABR-estimated hearing loss and the actual hearing loss. Although the ABR tended to overestimate the hearing loss, the range of both over- and under-estimates was more than 25 dB. The difference between the two measures may be because of the different stimulus parameters used in the two procedures or because the ABR is a measure of neural synchrony as well as absolute sensitivity. Work is in progress to determine if a more reliable estimate of sensorineural hearing loss can be obtained from the ABR.