Sensitivity to Interaural Time Differences in Rats

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investigate Purpose: the suitability of rats as model for binaural hearing research. **Benefits**: rats are well established models tor behaviour, electrophysiology, and molecular biology. **Problem**: it has been reported that rats can not use phase differences interaural localize sound ^[1]. (IPDs) to This would make them very different from humans and many other mammals. **Solution**: verify if rats can use ITDs to localize ongoing sound.

Rectangular Window Click Trains



Hanning Window Click Trains



Methods

Subjects: Five normal hearing female Wistar rats, 220–260g at start of training. 2-alternative Task: forced choice. Rewards: water. Punishment: 15 s timeout; alert sound at 90 dB. **Stimuli:** Click trains; average binaural level at ca. 85 dB; duration: 0.2 s; enveloped with rectangle or hanning windows. ITD range: ± 175 μs, 25 μs step size. Click rates: 50, 300, 900, 1800, 2400, 4800 Hz.

Fig. 1 Probability of responses to the right as a function of ITDs in the rats with rectangle (left panel) and hanning (right panel) window click trains at different rates. Rows: individual rats. Columns: click rates. X-axis shows ITDs in ms. ITD < 0 means the stimulus is left side leading while ITD > 0 is right side leading. Y-axis is the percentage of correct responses on the rat's right side. The slope (green dotted line) shows the sensitivity to ITDs.

Results



Conclusion

(1) Rats can use both onset and ITDs localize ongoing to sounds. stimulation For both (2) conditions (rectangle and hanning), performance ITD decreased with increasing stimulation rate. (3) The rat is a suitable model for binaural hearing research.

Fig. 2 Training setup designed for near-field sound discrimination task of rats. A: Training cage 1: USB stereo sound adapter; 2: Touch sensor; 3: Audio amplifier; 4: Web cam; 5: Water tank; 6: A pair of speakers; 7: Three capacitive solenoid valves. B: 1: Raspberry Pi; 2: ULN. C: Three water spouts located inside of the cage (arrows) and two tubes for transmitting sound. Spouts detect rat licks and deliver a water reward in case of a correct response via corresponding lateral spout. D: Rat performing 2AFC binaural discrimination task.

Reference

[1] Wesolek, C. M.; Koay, G.; Heffner, R. S. and Heffner, H. E. (2010). Laboratory rats (Rattus norvegicus) do not use binaural phase differences to localize sound, Hear. Res. 265 : 54-62.