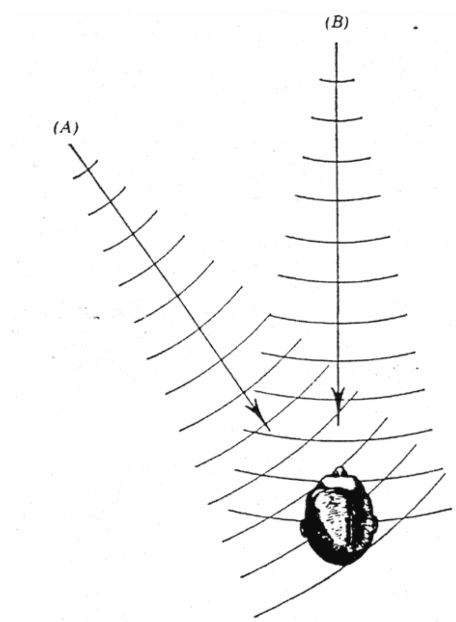
AUDITORY LOCALIZATION

1. The Need to Locate Sounds

    First, why do we need to localize sounds?

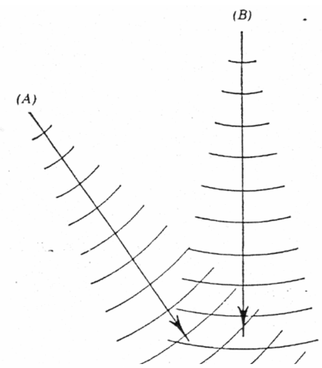
    Both bottom-up and top-down processes at work.



2. Demo

3. Recall
    a) Sound
    b) The Auditory System
    c) The Ear
        i. Pinna shapes sound. How?
        ii. Middle ear shapes sound. How?
    d) Neural Pathways
        i. How does(do) the neural pathway(s) affect sound perception?
    e) Cortex Regions
        i. Wernicke's area of temporal lobe
        ii. Brocca's area in the frontal lobe

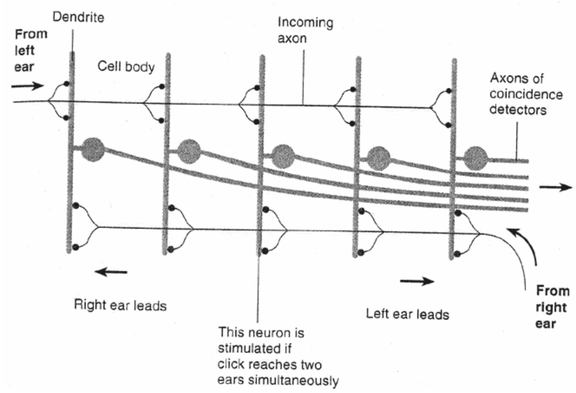
4. Monaural Location Cues
   a) Level (Loudness) Differences



5. Binaural Location Cues

   a) Interaural Time Differences

      i. Coincidence detectors.



      ii. The effectiveness of ITDs is limited to about 3000Hz.

      iii. The location of the neurons that detect ITDs is in the superior olivary nucleus, or superior olivary complex, in the medulla.

      iv. Cone of Confusion

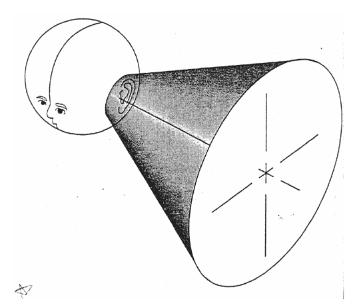


FIGURE 10.17 The cone of confusion, a conical plane defining locations where a sound source would produce the same value of interaural time difference or the same value of interaural intensity difference.

   b) Interaural Phase Differences
      - For frequencies below 1000 Hz, we can also detect "phase" differences in the sounds

c) Interaural Level (Intensity) Differences

i. Head shadow

ii. Greater than about 1000 Hz

iii. Size (of the head) matters

iv. Neurons that detect ILDs in the superior olivary nucleus

d) Spectral Cues

i. Spectral characteristics of a sound are used to localize it.

ii. Front-back reversals.

e) Cue Combination

i. Below 1000 Hz: Phase Differences & Time Differences

ii. Between 1000 – 3000: Time & Intensity Differences

iii. Above 3000: Intensity Differences

iv. Spectral cues play a role in all frequency ranges.

6. Top Down Cues

a) ILDs and ITDs are really low-level, brainstem sound processing cues. Spectral cues rely on learning, but not so much on knowledge.

b) We can also use knowledge to help localize a sound.

7. Mis-Location

a) Why do we mis-locate sounds in the following situations?

i. Sounds directly in front vs. directly in back?

ii. Sounds in a room with lots of echoes?

iii. Sounds played over headphones?