Chapter 5: Normal Hearing

Objectives (1)

- Define threshold and minimum auditory sensitivity
- The normal hearing range for humans
- Define minimum audible field (MAF) and minimum audible pressure (MAP)
- Identify three primary psychophysical methods to determine threshold
- The effects of age on hearing
- List the major factors influencing auditory threshold
- The result of an audiogram
- The primary cues used in auditory localization
- The difference between air-conduction and bone-conduction

Stimulus Characteristics (1)

- Stimulus Frequency

(1) Range of sensitivity: 20 to 20,000 Hz

(2) Most sensitive frequency range: approximately 500-5,000 Hz-speech signals

(3) Human audibility curve

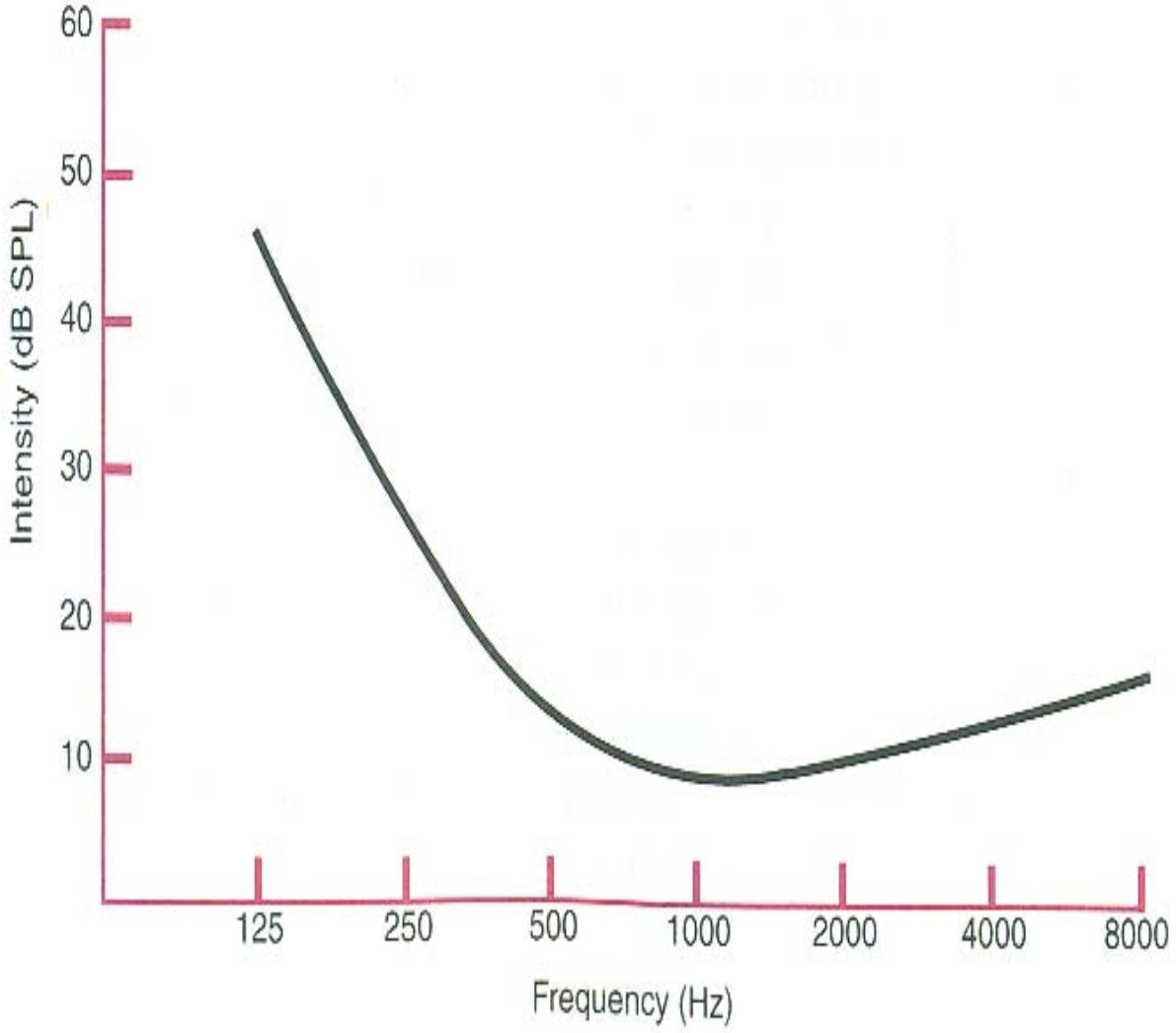
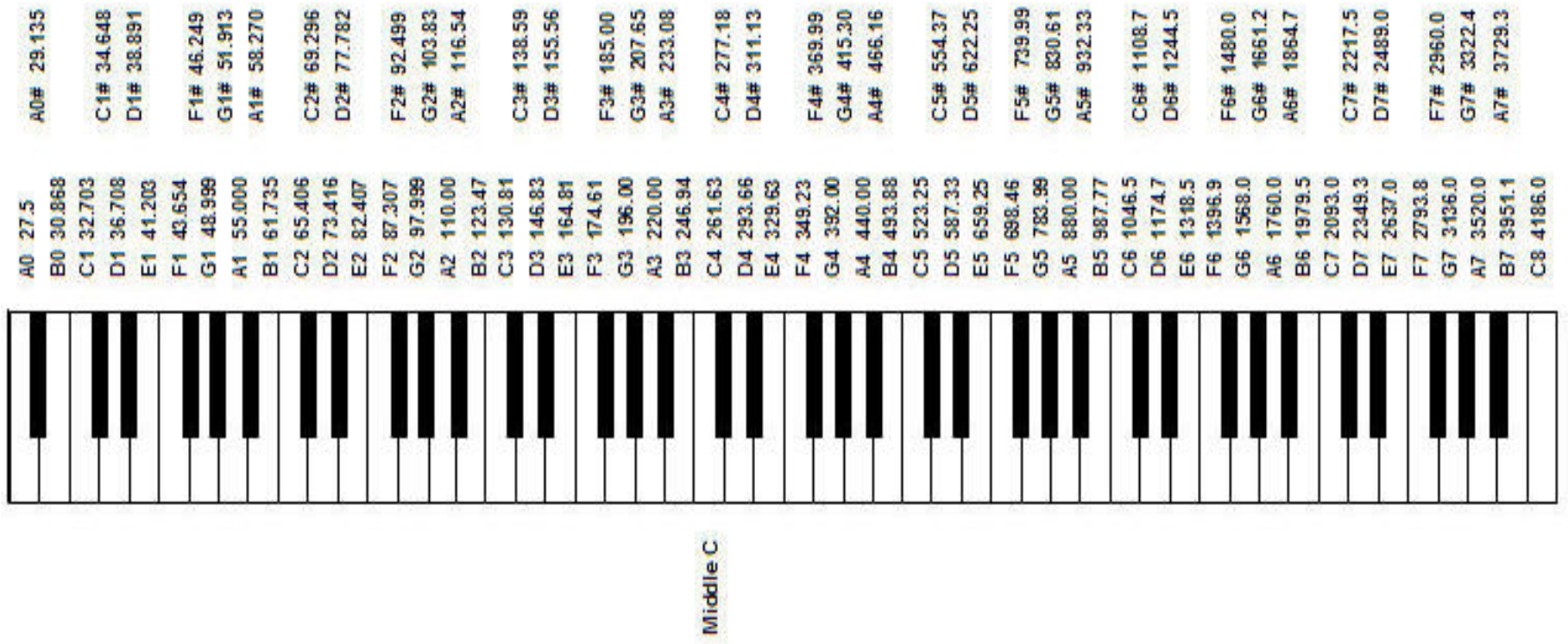


FIG. 5-1

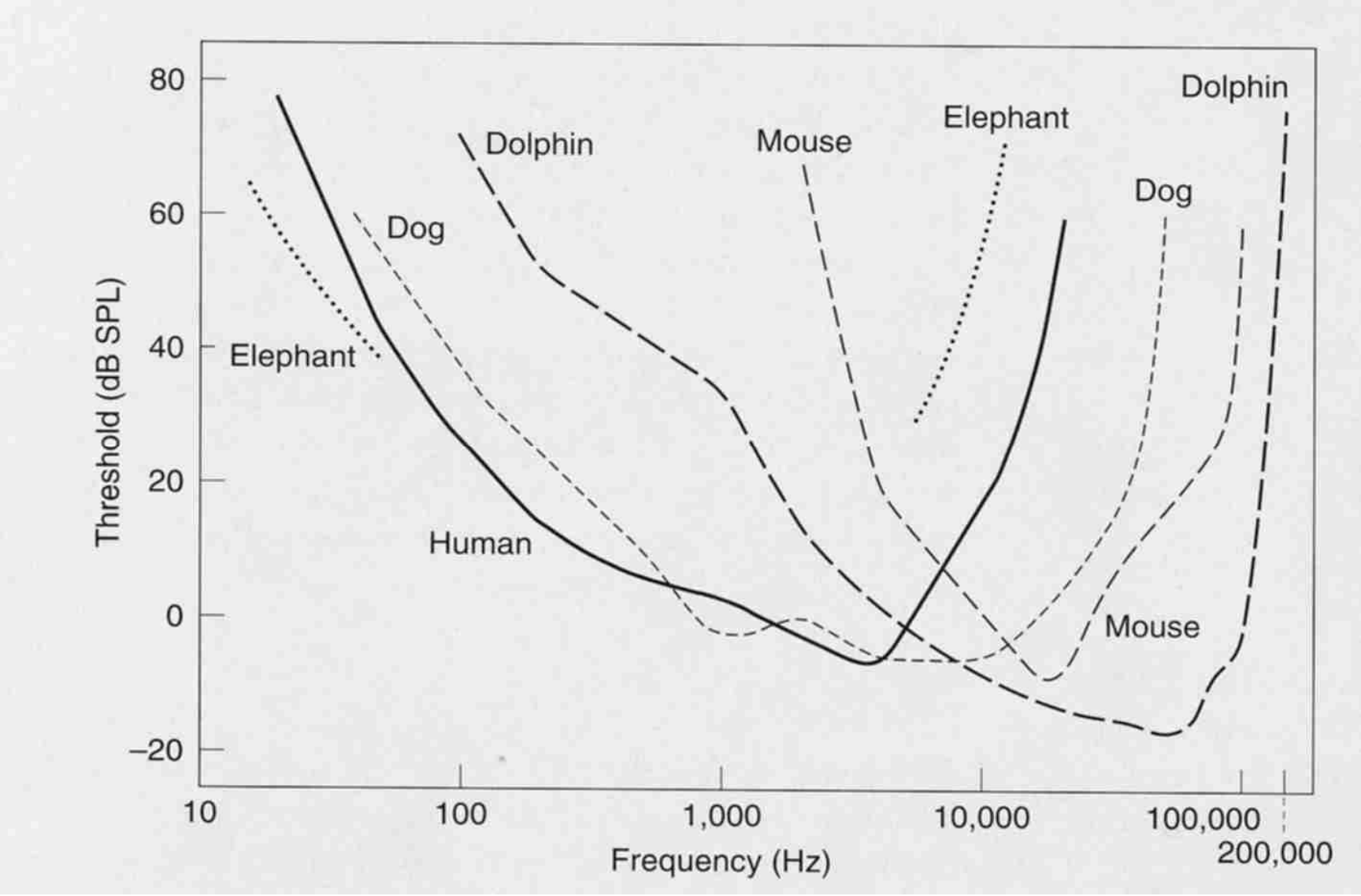
Normal human hearing. (Courtesy American National Standards Institute, 1969.)

Frequency: cycles/sec, or Hertz
(Hz, from German physicist Heinrich Hertz)

- Middle C on piano ~ 261.6 Hz
- http://en.wikipedia.org/wiki/Piano_key_frequencies



Comparative Hearing



Stimulus Characteristics (2)

- Stimulus Duration

(1) Duration of a stimulus: 10 to about 30 msec.

(2) Beyond about 300 msec, sensitivity is not affected by lengthening signal duration

(3) Patients with hearing loss: some loss of sensitivity for higher frequencies, particularly 4,000 Hz.

(4) Persons with cochlear damages: reduced temporal integration

(5) Temporal integration function: a change in threshold as the duration of a stimulus changes

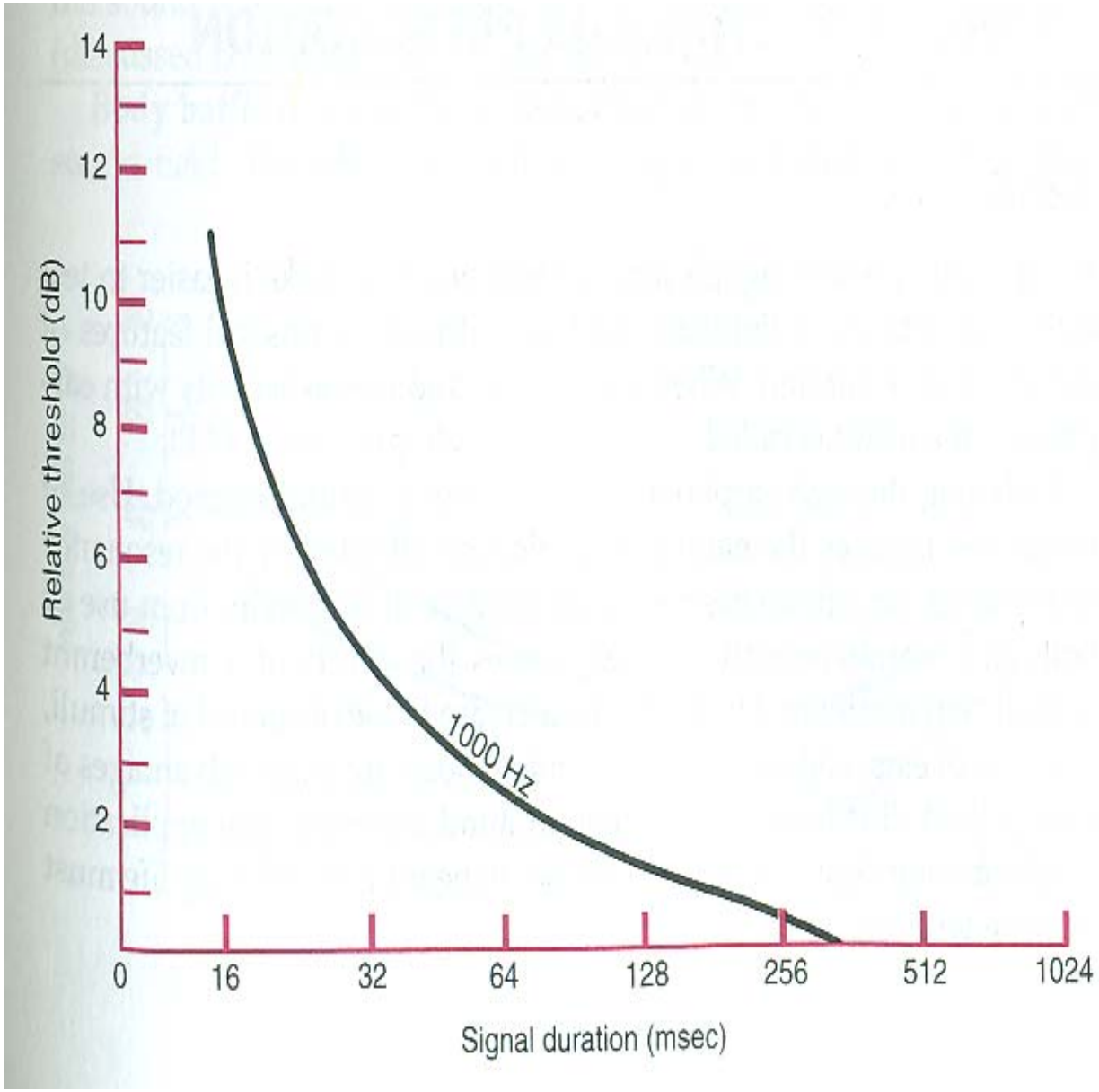


FIG. 5-2

Temporal integration (summation) function for persons with normal hearing. (From Deutsch LJ, Richards AM: *Elementary hearing science*, Boston, 1979, Allyn & Bacon.)

Stimulus Characteristics (3)

- Stimulus Intensity

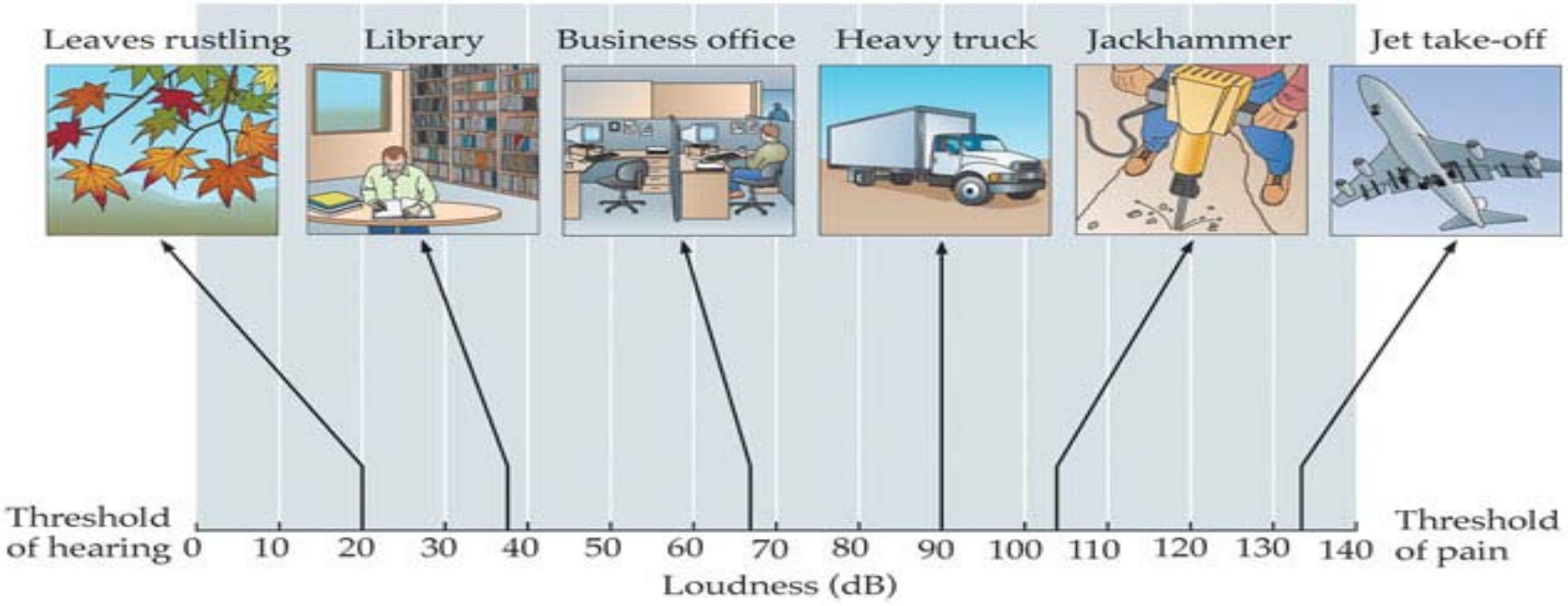
(1) 10 to 100 dB SPL

(2) Comfortable listening level (approximately 40 dB)

(3) Uncomfortable loudness level (approximately 90 dB)

(4) A 50 dB range of efficiently usable hearing

Amplitude Range



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Methods of Stimulus Presentation (1)

- Earphones

(1) Minimum audible pressure (MAP)

(2) Not a natural method

(3) Disadvantages: reduced natural amplification provided by the resonance of the outer ear, eliminating the slight increase in sensitivity, eliminating the effects of a reverberant acoustic environment.

(4) Advantages: the increased ease of control of stimuli, isolation of ears, and reduction of ambient noise

Methods of Stimulus Presentation (2)

- Speakers

(1) Sound field testing

(2) Minimum audible field (MAF): more sensitive than MAP by 6 to 10 dB

(3) Several other contributing acoustic effects:

(4) Reverberation: incident sound-the sound coming directly from a speaker, reflected sound. Incident and reflected sound can interact

(5) Head shadow: a reduction of sound level at the ear on the far side of the sound source

(6) Boby baffle: the acoustic effect of the body's presence in the sound field

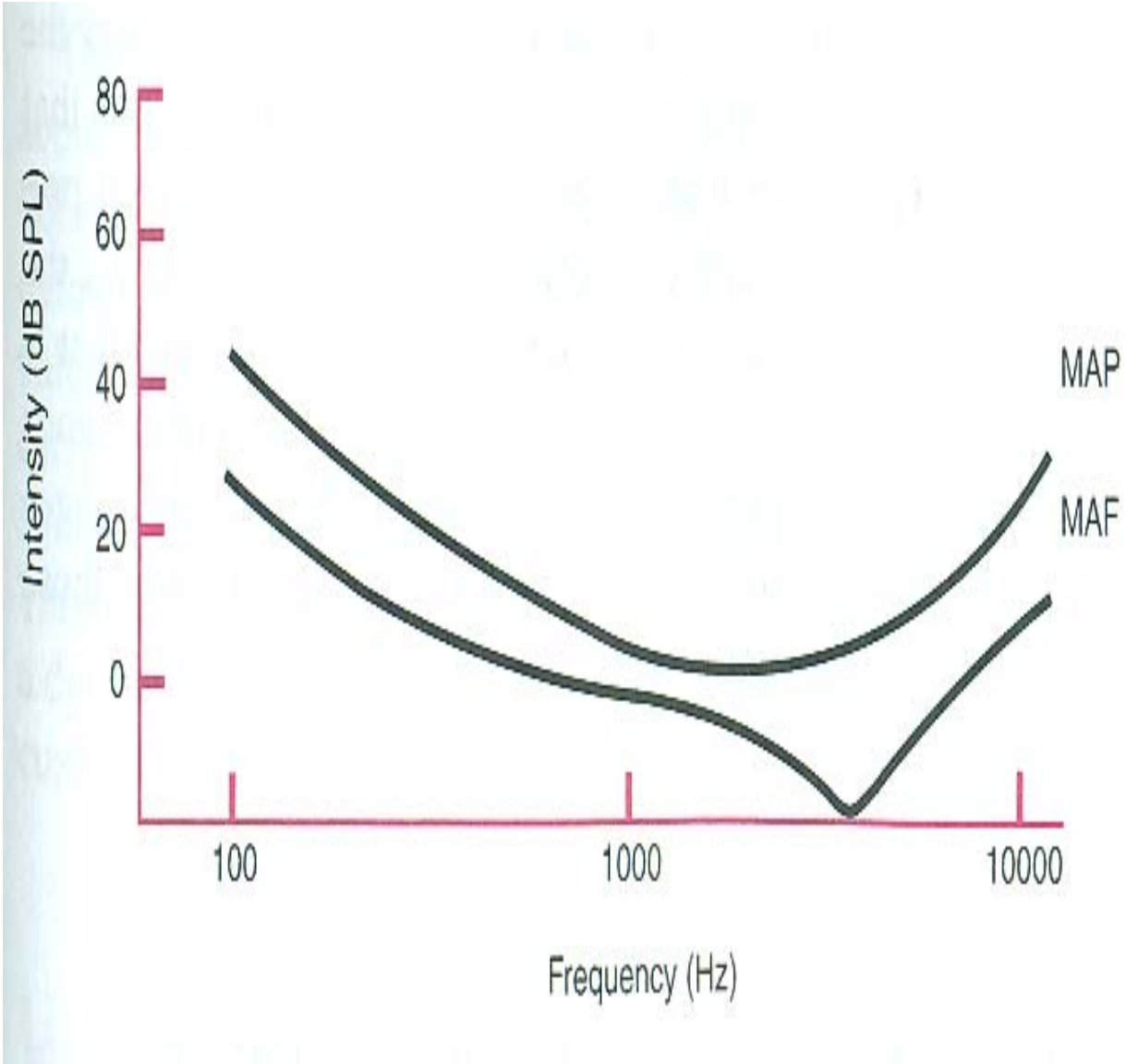

FIG. 5-3

Minimum audible pressure (MAP) and minimum audible field (MAF) audibility curves.

Assessment of Auditory Sensitivity (1)

- Method of Limits

(1) Changing one parameter of the auditory stimulus (intensity)

(2) Descending approach: decreasing intensity between presentations until it is inaudible

(3) Ascending approach: increasing intensity between presentations until it is audible

(4) Descending approach is 3 to 4 dB more sensitive than ascending approach

Assessment of Auditory Sensitivity (2)

- Method of Adjustment

(1) Having the subject adjust some parameters (intensity) to a point where it is barely audible.

(2) Tracking threshold

Assessment of Auditory Sensitivity (3)

- Method of Constant Stimuli

(1) Two-alternative forced-choice procedure

(2) Percentage of time each level of stimulus was detected

(3) Threshold: 50% response level

SIDE NOTES

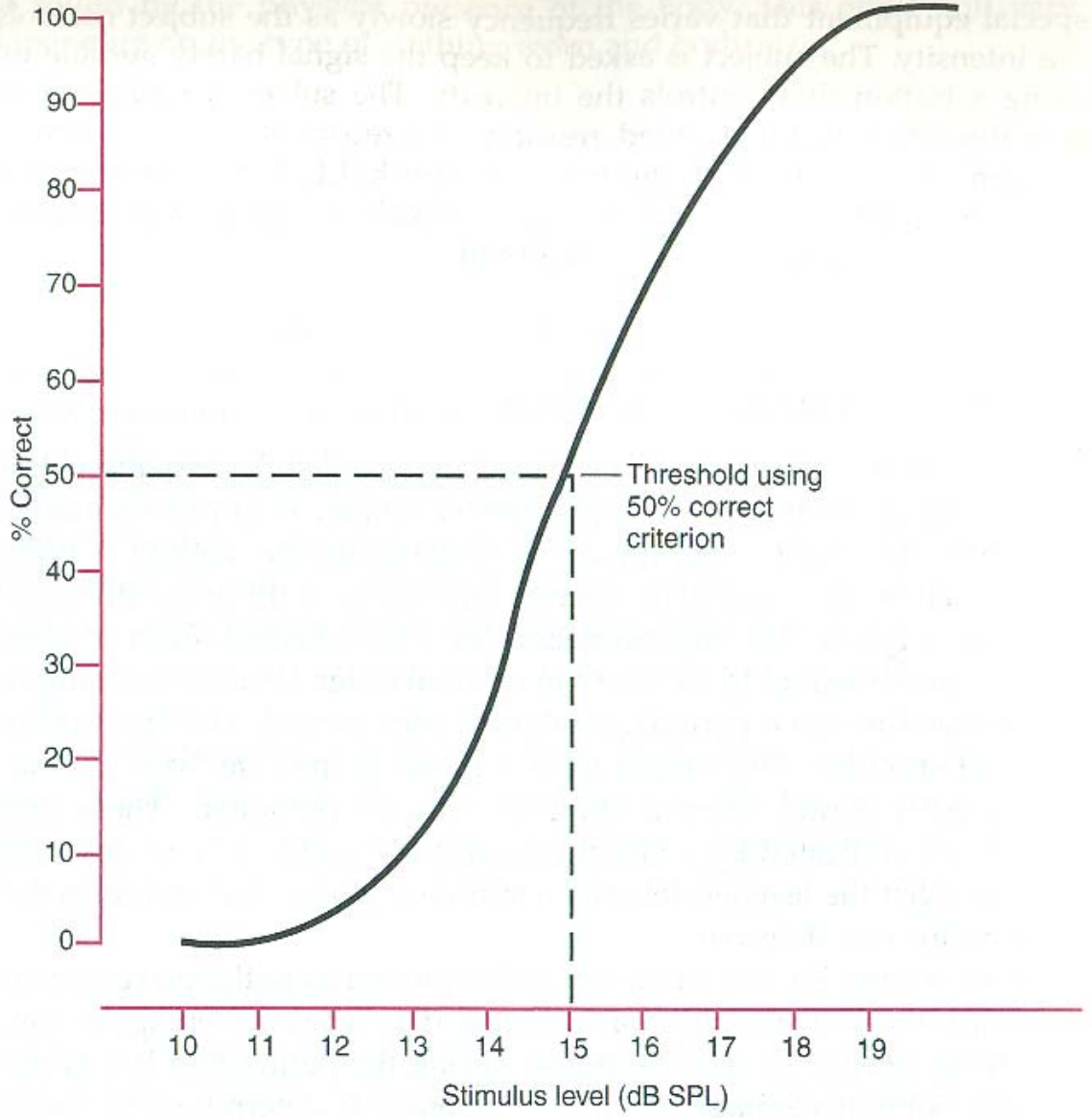

FIG. 5-4

Method of constant stimuli.