Chapter 10

**THE AUDITORY SYSTEM**

1. Usually we think of the amplitude of a sound as determining its loudness, and the frequency of the sound as determining its pitch. However, consider the situation of listening to a pure tone at 500Hz and gradually decreasing the frequency while keeping the amplitude (dB level) fixed and constant. The tone will decrease in pitch, but also decrease in perceived loudness. What does this mean?

*Hints and discussion: This example can be used to demonstrate (especially useful if you have an oscilloscope or pure tone generator for classroom demonstration purposes) that the relationship between amplitude and loudness, and between frequency and pitch, is not as simple as it might at first seem.*

1. The book notes that pure tones are virtually non-existent in nature, and rather most sounds are actually complex. You might notice that much of the research on basic auditory function entails pure tones. What might be any advantages or disadvantages of using pure tones in auditory research?

*Hints and discussion: This question can be used to encourage critical thinking about scientific methodology. Students might find the disadvantages apparent: issues of ecological validity and the generalizability of results using pure-tones to every day auditory function. Advantages may be less apparent, but here the instructor can show how simplifying the stimuli can make it easier to manipulate and control variables. For example, the research on frequency coding on the basilar membrane is easier to understand when using pure tones, and then one can show how the frequency of a complex tone is coded, understood as the synthesis of the component frequencies. But if only complex tones were used in such research, the complex response of the basilar membrane would not be discernible.*

1. In the chapter on color vision, we discussed how it seems impossible to describe the experience of “red” in words. It is similarly difficult to describe the experience of a musical note (e.g., a B-flat) in words. Do you find any similar attributes between color and pitch?

*Hints and discussion: Noting that frequency is the inverse of wavelength, it can be shown that color and pitch are determined by the spectral properties of the stimulus (light and sound waves, respectively). This may also be a good opportunity to introduce the topic of synesthesia, and while rare, some people will report musical sounds as having a color (there are of course many other types of synesthetic experience). Students can be polled as to whether they have ever had synesthetic experiences.*

1. An early 19th century physiological, Georg Muller, suggested that the nature of sensory experience was determined by the sensory nerves; this was called the Doctrine of Specific Nerve Energies. Muller suggested that auditory sensations such as the pitch and loudness of sounds were experienced because of the specific energy of the auditory nerve, and that no matter how this nerve was stimulated, the result would be the experience of a sound with a pitch and loudness. He then suggested a thought experiment: what would happen if one were able to attach the auditory nerves to the eyes, and the optic nerves to the ears?

*Hints and discussion: Following Muller’s Doctrine, the suggestion is that we would then hear light (that is, experience light waves as sounds) and see sound (that is, experience sound waves as visual sensations). The discussion can extend to talking about how the properties of light might become encoded as sound and how the activity of the rods and cone might play into this (e.g., would the trichromatic cone system be responsible for encoding light wavelengths as pitch?). This question can serve as a follow-on to discussing synesthesia, but also helps students think critically about the relationship between physiological (nervous) activity and perceptual experiences.*