Musical Illusions and Paradoxes Lab

RealSimPLE Project*
Ryan J. Cassidy and Julius O. Smith III
Center for Computer Research in Music and Acoustics (CCRMA), and the
Department of Electrical Engineering
Stanford University
Stanford, CA

Abstract

This exploratory laboratory activity guides the student through an explanation of and experiments relating to selected musical illusions and paradoxes.

Contents

1 Summary of Objectives 2
2 Background and Theory 2
3 Equipment and Materials 2
4 Procedure 3
  4.1 Tritone Paradox ............................................................. 3
  4.2 Behave So Strangely ....................................................... 3
5 Acknowledgements 3

*Work supported by the Wallenberg Global Learning Network
1 Summary of Objectives

- To understand and experiment with the tritone paradox.
- To learn about and experiment with an example of the potential ambiguity between speech and music.

2 Background and Theory

In music, there are certain types of sounds, and patterns of sounds, which are perceived ambiguously. In other words, certain individuals might perceive one pattern or sound, while other individuals might perceive another. More interestingly, an individual may perceive a stimulus as one pattern at one moment, then another pattern the next. As an example in visual perception, Figure 1 shows an image in which two different objects may be perceived. What object do you see in the image?

![Figure 1: Illusion with visual ambiguity.](image_url)

3 Equipment and Materials

For this laboratory, you will need:

- A PC or Mac with an Internet connection and an audio device of reasonable fidelity. For the audio system, a pair of powered desktop speakers should suffice, though it may also be worthwhile to conduct the listening through headphones.
- A group of 4 students to record perceptions.
- Writing space for your observations.
4 Procedure

4.1 Tritone Paradox

In the tritone paradox, a pair of tones is played, one after the other. The tones are computer generated, and have been prepared in such a way that it is not immediately clear in which octave either tone lies.

1. To download the sounds for this section, click on the following online link:

2. If you are using speakers, have each person in your group prepare to record his/her impressions. If you are using headphones, each person in the group should take turns listening to the recording. Before commencing the tests below, have your instructor adjust the volume so that the sound clips are heard at a comfortable level, which should, if anything, be on the soft side of comfortable listening.

3. You will hear 6 pairs of tones, one pair after the other. For each pair, try to determine which of the two tones is higher in pitch. If the first tone is higher, write a downward arrow to indicate the tone pair forms a descending pattern. If, however, the second tone is higher, write an upward arrow to indicate the tone pair forms an ascending pattern.

4. You may wish to play the recording more than once to be sure of your observations.

5. After everyone in your group has listened to the clip and recorded observations, compare your results. Did all members of the group hear the tone pairs in the same way?

4.2 Behave So Strangely

In this section, you will briefly examine the sometimes ambiguous nature between speech and singing.

1. Download the following sound clip:

2. As in the previous section, play the clip until all members of your group have been able to hear it. While you should initially hear the spoken text as regular speech, the repetition of the text should result, amazingly, in the speech acquiring a sort of sung quality. Can you hear this effect?

5 Acknowledgements

The authors would like to thank Prof. Diana Deutsch of the UCSD Department of Psychology for graciously allowing the re-use of examples from her CDs, “Musical Illusions and Paradoxes,” and “Phantom Words and Other Curiosities.”

\(^1\text{http://ccrma.stanford.edu/realsimple/mus_illus/tritone.wav}^1\)