3.9.2.3: Other Interesting Auditory Phenomena

Most musical instruments produce a combination of frequencies that change in amplitude as the note is played. These transitory pitches are called ***attack frequencies*** and they sometimes enable us to tell the difference between different instruments. When music is played backwards, particularly on stringed instruments it often sounds very strange because the attack frequencies occur in the wrong place. Our perception of timbre is determined not only by harmonics, intensity and duration as we have discussed previously, but also by the attack frequencies. Here are YouTubes of a piano played backwards; one, two.

The following is a list of other examples where our ears are fooled into perceiving something that isn't actually present. Definitions and examples of several of them can be found at Wikipedia or Richard Waren's site.

> **Note**
>
> Many of these effects can only be heard using high quality headphones.

- ***Shepard's Illusion***. The illusion of a continuously rising (or falling) scale of notes. YouTube example. The continuous version of Shepard's Illusion is called the ***Risset rhythm***.
- ***The Octave Illusion***. Two notes an octave apart are played alternating back and forth between each ear (eg. 400 Hz to left ear, 800 Hz to right ear, then switch). Most listeners perceive a the low tone in one ear and a high frequency tone in the other (instead of back and forth). Which ear depends on handedness (right handed people hear the high note in the right ear). Wikipedia (with sound sample).
- ***Deutsch's Scale Illusion***. If a two different patterns of notes which alternate up and down in pitch are played simultaneously to each ear the perception of a rising scale is heard.
- ***Glissando illusion***. An instrument or voice can be made to appear to change from one side of a stereo output to the other by simultaneously playing a sine wave that is shifting in pitch.
- ***Continuity of Tones***. If you interrupt a continuous rising tone with a brief burst of noise your perception will be that the tone did not stop during the break.
- ***McGurk effect***. Your vision affects what you think you hear. For example if you see a set of lips forming the sound "ga" while you are hearing the sound "ba" you will perceive the sound "da". There are many other examples where visual clues affect what you think you hear; YouTube example.
- ***Context effects***. The sound immediately preceding a sound may affect the how the second sound is perceived. For example "al" plus "da" sounds like "al ga" but "ar" plus "da" sounds like "ar da". Similar to this is prior information affects what you hear: YouTube example
- ***Chromatic Auditory Illusion***. Alternating pitches may be perceived as two scales going in opposite directions.
- ***Melody illusion***. Keeping the same notes but changing their octave can make a melody unrecognizable; YouTube example.

Video/Audio examples:

- Many auditory illusions are demonstrated in YouTube videos.
- The Auditory Neuroscience Website is a wonderful source of sound samples and videos of various auditory illusions, demonstrations of acoustic phenomena and indepth discussions of hearing loss.
- List of auditory examples demonstrated in class.
- A list of auditory CDs along with a description of each. You may be able to find others in a search on Amazon.
- Sonification is the process of making data audible in order to detect patterns in a large data set. Technical link: Sonificaiton Handbook.