MSC 1003 – Music in Civilization Spring 2017

Prof. Smey

Session 12 – Thurs, March 16

After our quiz we briefly discussed the musical dimension of *timbre* or *tone color*. We talked about the scientific basis of this phenomenon, and eventually we will do a little tour of our modern wind and string instruments and think about the sounds they make.

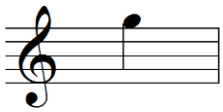
Sound = Vibration

So, on a very basic level we need to understand that sound is caused by vibrations that (usually) travel through the air. In a way they are a lot like ripples on a body of water – something causes a disturbance, those ripples travel to where you are, and you detect them.

Pitch is the highness or lowness of a sound. The pitch of a sound is determined by the *frequency* of vibrations. Frequency is measured with a unit called Hertz (abbreviated Hz), which expresses how many vibrations there are in a second. So a sound that has 100hz would vibrate 100 times in one second – that's a relatively low musical note. A fairly high musical note might vibrate around 2000 times a second.

Timbre / Tone Color

Now, let's imagine that we have a flute player and a violin player. We show them the same little scrap of music, and ask them to play it:



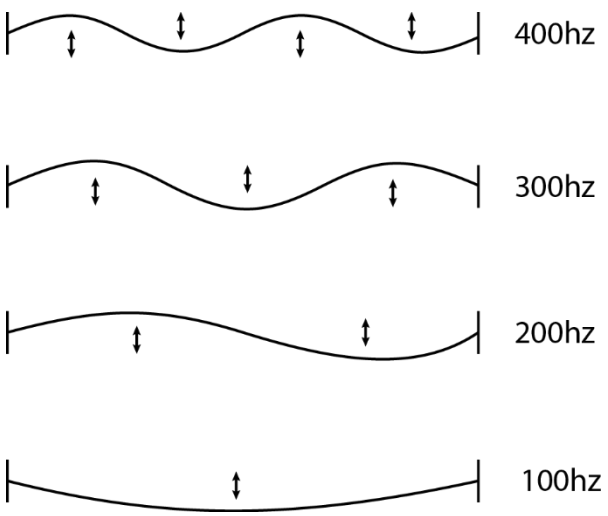
They will both play notes with the same pitch, based at the same frequency. Yet, the two notes would still sound different. The flute would sound like a flute – delicate and round and "breathy." The violin would sound a little more sharp, a little brighter and more "cutting." This is the dimension of timbre or tone color – notes can have the same pitch but a different color.

Overtones

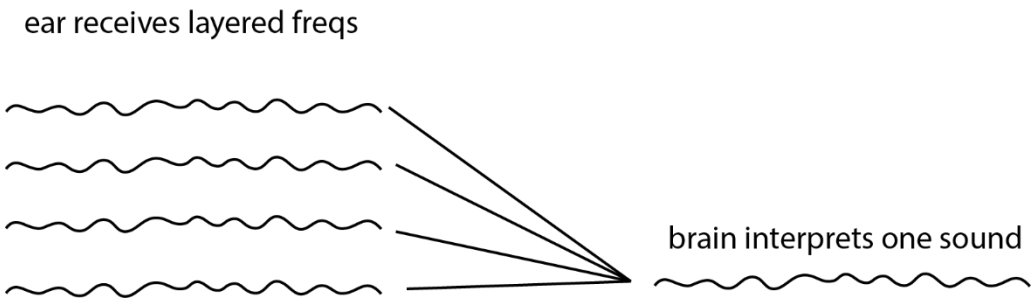
The timbre of a sound is mostly determined by its *overtones*. It turns out that things that vibrate don't just vibrate at one frequency. They also have a series of extra vibrations that vibrate at mathematically related multiples of the main frequency. These are the overtones.

Below I'll put an illustration of an imaginary string that we've plucked. At the very bottom, the string is vibrating along its whole length at 100hz. This is its *fundamental* frequency – it determines the pitch of the note we are going to hear. 100hz is a fairly relaxed frequency so this is a pretty low note.

That's not the only thing the string will do, however. It will also have a vibration that cuts the string in half, and this will be twice as fast (200hz). Another vibration that cuts the string into thirds will be three times as fast (300hz), and so on and so forth. The string actually does a very complicated dance that sends out vibrations at multiple frequencies. All physically vibrating objects do this – even your vocal chords.



So you ear is constantly exposed to these layered frequencies, and your brain has learned how to squash them down into more simple percepts. When we listen to vibrating objects we hear *one thing*, not a whole bunch of frequencies.



The brain does preserve this extra information, however, by turning it into timbre or tone color.

Basically, if there aren't a lot of overtones in the sound, it will sound kind of colorless and dull. If there are a lot of high overtones, on the other hand, the sound will be "bright." Lots of really high ones will also add a sort of buzz or sizzle.

Noise

Also, physical instruments tend to make some vibrations that aren't in this neat stack of overtones. Technically, these are classified as noise, but that doesn't mean that they aren't an important part of the sound. A guitar played with a pick, for example, will make a nice "snap" with every note. Wind instruments often have a fuzzy breath (or spit) sound, and bowed strings include a sort of scraping noise. These are part of what we like about instruments – we would miss them if they were gone!

On our blog I will link videos of some instrument sounds that are being analyzed in a frequency spectrum graph so that you can both see and hear the effect of overtones on tone color.

Learning our modern woodwind, string, and brass instruments

Soon I will put up an online lesson on the various instruments that appear in the typical orchestra, and hopefully we'll have an exercise about identifying them by ear as well.