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Science of Music

This project investigates the change in pitch of a violin and cello as environmental temperature changes. As a musician, I wanted to explore the physics of sound made by stringed instruments, and wanted to understand why I have to constantly re-tune my instrument as I go from outdoors to indoors and vice-versa. Pitch is the human ear's perception of sound whereas frequency is the actual measurement, and pitch and frequency are directly related to each other. Therefore by studying the frequency of the sound produced by the instrument the impact of temperature can be characterized.

The hypothesis is that when the instrument, such as the violin gets warmer, the strings loosen due to thermal expansion, resulting in a lower pitch. The reverse happens due to cooling. In order to study this we need to be able to measure the frequency being produced. After extensive search for a way to measure the frequency, an application software (app) was chosen. After perfectly tuning the instruments at room temperature (70°F) the instruments were placed in hotter and colder environments (such as the garage), and the frequency of the sound produced by the A string was measured. This process was repeated three times.

The detailed analysis of the report revealed that when the temperature became warmer (95°F) the frequency decreased by 2% on the violin and 1.3% on the cello. When the temperature became colder (45°F) the frequency increased by 1.1% on the violin and increased 0.9% on the cello. This proves the hypothesis correct. In the music world musicians can be now be aware of the quantitative effect of temperature on instrument sound, and how when you are outside, expect to have the need to adjust the tuning, to compensate for the temperature.