Reed Theory: The Timbre
Triangle and Tone Adjustment

Stuart Young

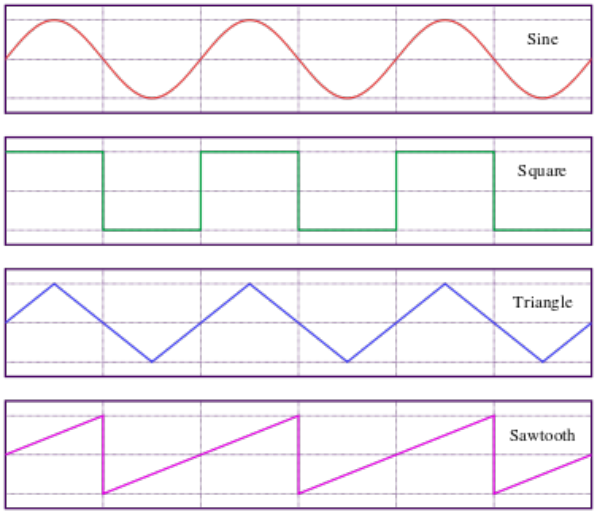
Bassoon can be separated from other members of the woodwind family by its unique timbre. **Timbre** is the quality or character of a sound that is distinct from its pitch and intensity. From what is reinforced by music educators, timbre can be defined more as the "color" of a sound. To better understand the unique "color" of a bassoon we must first discover the hidden color palette encased in a bassoon reed, by discussing fundamental physics in sound…

As any cheesy high school science teacher would elaborate, our bodies are constantly being bombarded by waves; sound waves, light waves, gravitational waves, and so forth. When it comes to sound, there are 4 major types of waves that effect our perception of timbre of a pitch: Sine waves, Square waves, Triangle waves, and Sawtooth waves.

Sine Waves

Depicted as the the simplest shape of a sound wave, **Sine Waves** have a "pure" tone quality, as shown by its smooth sinusoidal shape. The quality of the sound is almost impossible to replicate naturally, but achievable through mathematics.

Figure A



Square Waves

Square Waves, named appropriately for their shape, differ from the rest of the waves in that they only are made up of odd harmonics. This means that instead of a smooth tone, the audible quality is "distorted." Its timbre is characterized by rough, rigged harmonics, almost like a digital alarm clock.

Triangle Waves

Waves that include odd harmonics and fundamental frequencies create **Triangle Waves**. It is comparable to a square wave in its components, but at half the intensity. Triangle waves are the closest to sounding like sine waves due to its shape.

Sawtooth Waves

What is known as the most asymmetrical and complex of all the wave shapes, **Sawtooth Waves** are known for having ALL the harmonics, which can be heard by its distinct rich quality. Although the timbre is full of harmonics, the jaggedness on the skewed wave gives the "color" more of a brittle and "buzzy" quality to the sound.

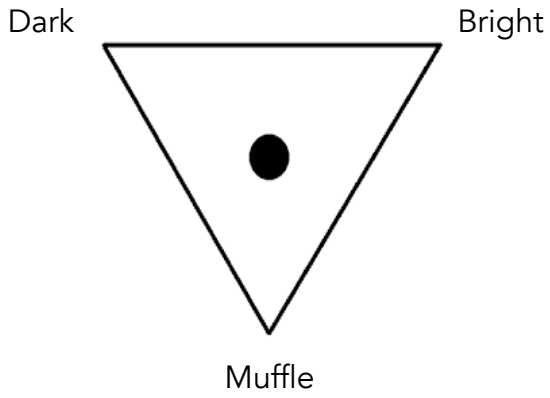
Before we put the reed on, there are instrumental factors that contribute to the timbre quality. Unlike the cylindrical bore of clarinets and flutes, which produce odd harmonics, the conical bore provides the fundamental properties of resonating all harmonics. It is because of the conical bore that a bassoon's timbre is most similar to a sawtooth wave — enriching in harmonics, yet "buzzy" in timbre quality.

Now to the reed! Ideally, bassoonists test a reed first by crowing the reed, which can tell us a lot about the reed before putting it on the instrument. Isolating only the factor of sound quality, the crow can range from a "full and dark" timbre, to "thin and muffled." All of these characteristics of the crow can be shown in Figure B.

The Timbre Triangle

With the universal strive to find a "balanced" reed, I have constructed this diagram to help display the 3 key "colors" of a reed. **The Timbre Triangle** may be used to help pinpoint where a reed's timbre is, in relation to dark and bright tones, as well as its projection. Ideally, a balanced reed is centered in the triangle, indicating that a balanced reed has all 3 characteristics.

Figure B



The dark quality is the most distinct of the 3 "colors," due to its popularity amongst bassoonists. **Dark tone** is presented with a buzzy, rich and full [with harmonics] sound. Acoustically, this tone is similar in structure to a triangle wave. The many fundamentals and audible qualities that can be picked up from a dark reed contribute to the widespread desire for this timbre amongst bassoonists.

The association of the term "bright" in music refers to something that cuts across ensembles and has a tendency to play sharp. The reason for this "cutting" depiction is the **bright tone**; missing some of the overtones and lower harmonics. It'll sound the upper harmonics in the overtone series, while the lack of lower harmonics produce a "nasally" quality to the sound.

Last is **muffle**, which is the dampening ability to make a vibrant reed sound less vibrant. When a reed is vibrant it can be unstable and difficult to control in response and intonation. Some have described this sound as being "spread." By muffling the vibrancy, pitch and intonation will be "focused," but it will take away projection, as well as buzz and brightness.

Other characteristics of timbre in a reed include vibrancy, intensity, and pitch. Because these characteristics cannot be adjusted on the reed, I exclude these from the triangle. **Vibrancy** is dependent on the natural growth and age of the cane, and we can only dampen or muffle, the vibrancy, — we cannot increase vibrancy. **Intensity** is a characteristic that is adjusted by the performer, by increasing the amount of air being used. **Pitch** is also dependent on the performer and their embouchure, as well as other factors including bocal size and temperature. Again, vibrancy, intensity, and pitch are other qualities that are unique to the reed's timbre, but adjusting the reed using The Timbre Triangle will directly impact the quality of the tone.

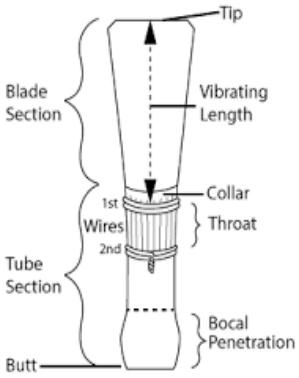
Tone Adjustment

Figure C

There are many ways to adjust the reed in timbre. First, we will isolate specific parts on a reed for controlling key "colors" and then discuss how manipulating those parts can alter the timbre.

Starting from the tip, we can look at the shape of the tip opening and determine bright and dark (and buzzy) tones. Figure C shows which shape produces which timbre. If a reed needs to be darker, you can do several things: 1) Pinch the corners and lightly wiggle them until you get a similar dark shape. 2) Scrape the corners of the tip. 3) Generally having a wider reed tip.
For a reed to be brighter in tone: 1) Sand the sides, narrow the tip width. 2) Tighten the first wire. 3) Generally having a smaller, lighter blade.

Figure D

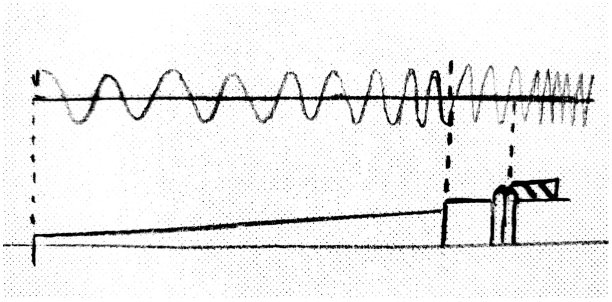


Throat shape is another factor in timbre distinction. A wider throat produces a darker sound. The **Air Gap Ratio**, as presented by **Thomas Palmer**, is the ratio of the height of the first wire and the width of the blade's edges. By adjusting the first wire (and the air gap ratio) resistance and dampening are affected. In regards to tone "color" a more open first wire is less muffled and produces a darker tone. Closing the first wire adds a muffled quality to the sound, but makes the reed more responsive in the process.

Areas of Low and High Frequencies

On a bassoon reed, the frequencies from low to high start from the tip. The lower harmonic resonances can be adjusted at the tip, due to its shape and thickness compared to the rest of the reed. Similar to the bars on a marimba, the bigger the block of wood and how thin the bar is, the lower the pitch is. The same can be put into context comparing the spine to the higher bars on a marimba; they're shorter, thicker, and produce higher frequencies. Because of the distribution of thickness over surface area from the tip to the collar, the propagating wavelengths can be mapped out, as seen in Figure E…

Figure E



The first and second wires dampen the vibrations from carrying through the rest of the tube. With the first wire having the most effect in dampening the vibrations from the blade, the response of high notes become easier as the first wire is tightened. In return, however, this makes the throat narrow, yielding a sharper and brighter tone.

Conclusion

As bassoonists continue to work and develop the perfect "can do all" reed, the methodology behind the Timbre Triangle will help improve a reed's core tone. Although there are qualities of a reed that cannot be adjusted directly, using the Timbre Triangle method will help improve the underlaying acoustic properties of a reed and achieve both a harmonic and mathematical equilibrium.

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Project Blue Studios, May 2021

Citations

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4). Palmer, Thomas H., *A Study of the Air Gap Between Blades of a Reed*: (The Journal, International Double Reed Society, No. 4, 1976).

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