

Physics of the efficient production of sound in high functioning embouchures

i) Mouthpiece rim ID and the natural reserve of energy to project.

Some individuals, due to a combination of variables within the subcategories of genetics, physiology, childhood and hereditary + developed personality characteristics, are predisposed to be able to either have greater “maximum work capacity” with regards to specific elements of their bodies or to be required, before developing their full physical potential, to learn to efficiently leverage the limited quantity of “maximum work capacity that they possess. It is the balance between the 4 or 5 compression methods specifically in brass playing that determines the actual success and recognition of that success that an individual will receive.

The presence or abundance of testosterone often results in a physical use of force as a means to solve problems, greater than that of a student absent of testosterone. (Boys vs. Girls). Because males have the natural physical predisposition to a greater natural reserve of energy, the need to leverage this energy efficiently is initially less.

The correct equipment

Armed with Bach 1 1/4C and a Bach ML37 many well intentioned students begin their conservatory education with the odds stacked against them. There is an accepted combination of equipment in each micro-society of genre and geographical placement. In my experience, this is unfortunately not based upon sound principals of embouchure mechanics or even application of evidence-based pedagogy. As a result, many students not predisposed to be able to use certain equipment are made to feel that there is something wrong with them whilst others work and practice like slaves just to be accepted within their micro-community. People listen with their eyes and not their ears and blame problems or sound characteristics on equipment, as opposed to trying to help the student learn to use the equipment, their subconscious has led them to believe is right for them. In my own experience, the subconscious is right to an astounding degree!

Finding your place on “the spectrum”

Many commonly designated “diagnoses” of problems, are not only unhelpful to most players, but lack a real depth of understanding of the meaning of the term designated to the “diagnosis”. They become terms haphazardly thrown around and accepted despite no-one using them understanding what they mean. The classic example is being instructed to “support” and not to “overblow”. This is something that confuses the majority of people that use the words as well as the majority that hear them. Let me try to briefly explain the various terms and hopefully dispell some myths.

1. “**Overblowing**” is a predisposition to use of breath support due to an abundance of strength in the muscles of exhalation. This combined with a literal understanding of the word support results in what many call a “spread” or “splatty” sound that lacks control, colour and is often unpleasantly acoustically loud.
2. “**Pinching**” is a predisposition to use of lip to lip compression developed into a habit due to an abundance or lack of strength as well as lacking conceptual understanding of the most efficient use of the muscles of the embouchure. It is often a symptom of using a mouthpiece too deep and/or with an inside diameter too large.

3. **An uncharacteristically bright or dark sound** is just a predisposition developed and determined to a certain extent by the equipment and the sound ideal of the teacher/ will to play of the student.

4. **“Excess mouthpiece pressure”** is also a predisposition to being able to tolerate such pressure, and the necessity/ instinct to roll the embouchure in to be able to tolerate this.

5. **“Excessive tongue arch”** is also determined by the instruction, predisposition to tolerate internal pressure and instinct to roll both the top and bottom lips into the mouth as mouthpiece pressure and breath support are added at the appropriate quantities to create the desired (often decided by the teacher) sound and control.

Ironically all these “problems” could also be described as choices. In my opinion all of the above 5 problems are symptoms and not causes of other more fundamental problems.

Whilst we as trumpet players can try all sorts of different equipment, the best solution would be to find something that is compatible with the individual's intuitive and subconscious playing style and use of physiology. There are three main aspects involved in this: Mechanical, Acoustic and Air-Flow. They are independent of each other to a certain extent but nonetheless intrinsically linked.

ii) The Player’s interaction with the mouthpiece

The easiest way to describe the various “high functioning embouchure types” and the various variations in player/mouthpiece interaction, is to divide the different elements that affect the embouchure/ product into three groups. Despite the fact, that to a certain extent, varying heavily upon the individual to what extent, all three variables are intrinsically linked it is still useful to examine each element in isolation.

iii) Mechanical

The mechanical interaction between the player and the mouthpiece depends greatly on the individual’s maximum work capacity, their ability to leverage said work capacity in an efficient way and their natural physiological makeup.

Generally speaking, the general level of fitness, strength and physical development of an individual governs the maximum work capacity. This is a genetic and physiological piece of the puzzle that we have to accept. Larger, stronger people will most likely have a greater work capacity, and therefore a greater ability to use brute strength, without being close to the limit of their maximum work capacity. To a large extent, pain thresholds in physical exertion are greatly tied to how close an individual is to their personal maximum work capacity. So one individual’s perception of something “comfortable” or “easy” could be another’s idea of “excruciatingly painful” or “impossible” Another element of this mechanical interaction between the mouthpiece and player is the size and shape of the supportive muscular strength of the embouchure. Some people are genetically and physiologically predisposed to be able to leverage their “maximum work capacity” far more efficiently than others. These individuals have few issues using larger inside diameters of mouthpiece rim due to the fact that they are able to leverage their strength efficiently and maintain a grip between embouchure and mouthpiece.

iib) Acoustic

The acoustic element of the puzzle is the unavoidable (and to a certain extent desirable) variation in functional cup volume dependent on a register and dynamic for any given individual. Most players (even of different embouchure types) will intuitively learn a controlled collapse of the vibrating surface into the cup for notes that naturally are too low. Notes like D on the 4th line of the staff on the Bb trumpet. This controlled collapse reduces the functional cup volume of the mouthpiece and subsequently raises pitch for this note. This is an imperfect solution to an imperfect instrument (within equally tempered/ western harmonic norms). The amount that this collapse is necessary depends on the way the player balances the other means of which there are to manipulate pitch, timbre and dynamic parameters. Some players come at the problem from a very different direction, they deliberately tune lower so that they can intentionally (consciously or unconsciously) collapse most of the time they are playing. They then pull the vibrating surface out of the cup to intonate on notes that are naturally too high. Yet another imperfect solution to an imperfect instrument. To make a very large generalization: if we classify players into two categories, those with a protruding upper lip and those without, then we are able to understand why there are two so obviously different approaches to the same problem. Those with a protruding top lip find the only way to get a vibrant sound and good control of the embouchure is to learn to roll the lips in and subsequently reduce the natural impedance at repose, of the vibrating surface, so it requires less air to make it vibrate. The other approach is to deliberately allow both lips or just the predominant vibrating lip to collapse (often referred to as pucker or "letting go") into the cup to increase the natural impedance at repose, of the vibrating surface. The depth of cup most efficient for a player is hugely dependent on the group they fall into, either due to physiology or conscious/ unconscious decision to play in the respective ways.

iic) Air-flow/ Blow resistance

Governed by the backbore and throat of a mouthpiece to the greatest degree, the shoulder and average functional cup volume to a secondary degree, and the embouchure style to a tertiary degree.

As mentioned in the mechanical element of this classification, every individual has a maximum work capacity. In this element the pulmonary function and desired acoustic volume interacts closely with the players' individual maximum work capacity. If the blow resistance is too high for the dynamic and sound characteristics we wish to play with then the feeling of walking on eggshells, asphyxiation, physical pain and headaches can be symptoms. If the blow resistance is too low then the ability to support the flow of air sufficiently will be inadequate and will undoubtedly result in poor endurance, range, and sound quality. It will also lend itself to the development of bad habits in an attempt to create extra compression.

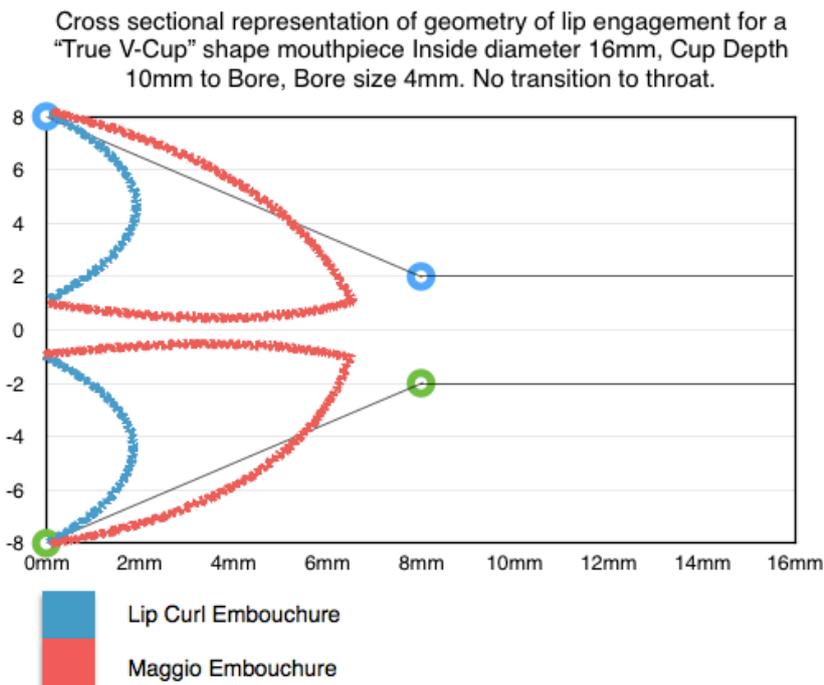
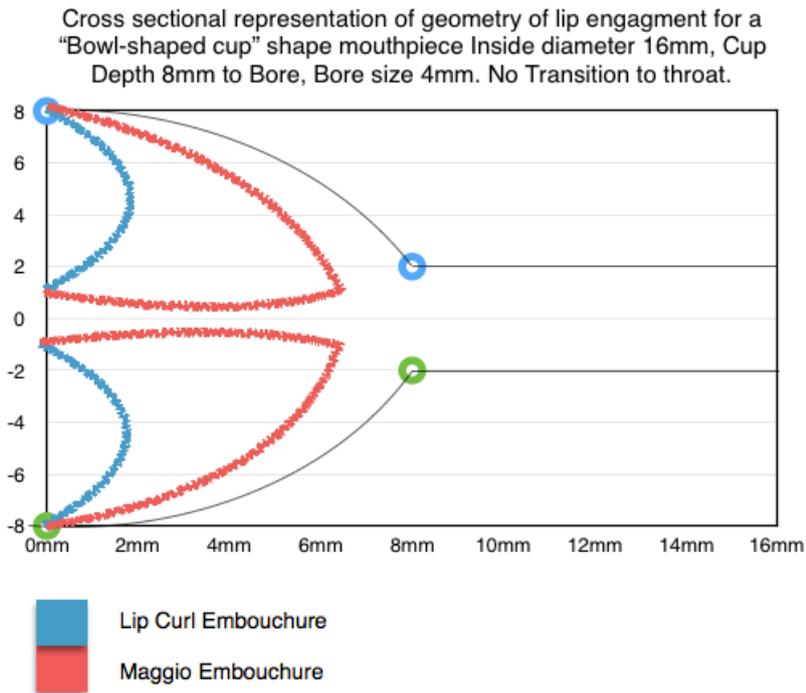
Most people accept a blow resistance dramatically too high for them and never live up to their full potential as players both dynamically or tonally. They have been taught that this is how it feels to play the trumpet and accept it. Others go in the opposite extreme and find blow resistances dramatically too low for them. These players exhibit poor endurance but refuse to return to the high blow resistance equipment that made playing physically uncomfortable and laborious.

Another observation to make is that when players make tweaks and changes to the way they play, their initial impression of whether this is an improvement or not is heavily

influenced by how their current equipment does not fit the new style of playing which is potentially better suited to their natural physiology. That is to say, a player with a protruding top lip, who has habitually developed an embouchure function of collapsing the top lip into the cup as they ascend, may not find the rolled in set particularly successful due to the mouthpiece they have chosen whilst playing in a physiologically incompatible/ limiting way. They unconsciously chose a mouthpiece (often influenced by norms, fashion as well as uninformed advice.) that allowed them limited results whilst playing in a way not suited to them.

iii) Mechanical, Acoustic and Blow resistance intertwined and explained through geometry.

In order to examine the way the embouchure influences these things in a 3 dimensional way, we will theoretically assume a backbore and throat design that offers neutral playing characteristics despite changes in cup geometry and the embouchure manipulation which causes those changes.



iv) Flat chin, Bunched Chin and perfect occlusion.

Slight variations in specific elements of physiology within the following sub-categories will determine the level of success a player experiences with any given system:

Lip position at repose, lip shape and structure, dental occlusion. There are an infinite number of combinations and variations within these sub-categories alone, and other physiological factors will undoubtedly, to a greater or lesser extent, also have an effect on the success of any given embouchure type. However, these are the easy to identify and most influential. That is to say that other variables are relatively easy to overcome once the aforementioned ones are considered and an efficient solution chosen for the individual.