A Strategy for Proper Utilization of the Glottis and Implications of Improper Use in Trumpet Performance

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UNIVERSITY OF MIAMI

A STRATEGY FOR PROPER UTILIZATION OF THE GLOTTIS AND IMPLICATIONS OF IMPROPER USE IN TRUMPET PERFORMANCE

By

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A STRATEGY FOR PROPER UTILIZATION OF THE GLOTTIS AND IMPLICATIONS OF IMPROPER USE IN TRUMPET PERFORMANCE

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A Strategy for Proper Utilization of the Glottis and Implications of Improper Use in Trumpet Performance

Both methodologies and trumpet instructors frequently ignore the utilization of the glottis in trumpet performance. There are many trumpet players who show signs of improper glottal use when attempting to play in the high register by producing a pinched or weak sound. This occurs in both professional and beginning students who have difficulty in playing in a register they perceive to be high and generally may be caused by engaging the Valsalva maneuver. The purpose of this study is to identify problems surrounding the improper use of the glottis and develop practice strategies that promote its proper use in trumpet performance.

This research explores medical problems that may be linked to improper use of the glottis as well as both musical problems and extended techniques related to glottal activation; in addition it defines proper glottal tension in trumpet performance. Brass methodologies are consulted to discover material that covers the proper use of the glottis in performance. Trumpet instructors and professional players were also interviewed for their view of addressing these types of problems. This essay serves as a practical guide to identifying and correcting problems caused by the improper use of the glottis.
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CHAPTER ONE
INTRODUCTION

Trumpet players, from beginners to college students, are frequently impeded to some degree by tension in their bodies. Students’ thoughts, perceptions, and fear of challenges in trumpet performance often manifest in the body as tension.\(^1\) Many instructors of trumpet notice this in their students and may or may not have developed their own methods for addressing this issue. Instructors often use other aspects of playing, such as proper breathing techniques or the aesthetics of the music, in hopes of getting the students to play more relaxed with better air support.\(^2\) One specific aspect, either overlooked or not directly addressed, is the tension and control of the glottis during trumpet performance.

While focusing on other aspects of playing or using various types of imagery might work for some students, many glottal problems are not so easily solved. Evidence of this can often be seen in trumpet players. These problems can be heard in almost every middle school, high school, and college band in the United States. It may take an intensive approach, using specific exercises to help develop a conscious control of the glottis, to significantly accelerate the development of acceptable tone production.\(^3\) This process can sometimes take years of effort and determination to produce the desired result.\(^4\)


\(^4\) Ibid.
Background

The glottis is the area in the larynx that is typically associated with the production of sound and the word also refers to the space between the vocal folds.\(^5\) It is normally used for speaking, and in some languages, it is also used as a glottal stop to create a grunt, or click like sound. Another use of the glottis is to create compression in the body while performing activities such as lifting heavy items or defecating. This use of the glottis is called the Valsalva maneuver and occurs when the opening between the vocal folds (glottis) is closed, creating increased intra-abdominal and intra-thoracic pressure from forced exhalation delivered by abdominal muscles against the closed glottis.\(^6\) This maneuver causes the blood pressure to increase by trapping air in the lungs, as well as causing the great veins to collapse decreasing blood flow returning to the heart. It has also been known to cause bradycardia (slowing of the heart rate to below 60 beats per minute), dizziness, and fainting immediately after performing the maneuver.\(^7\) The Valsalva maneuver has the potential of being dangerous to those with high blood pressure and cardiovascular disease by increasing the risk of heart attack.\(^8\)

One of the most frequent issues seen among young trumpet students is tension in performance when the player perceives a passage to be more challenging. It is common for beginner students to be instructed to relax while playing, and in the process often increasing tension because of forced relaxation otherwise known as \textit{trying} to relax. When

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\(^7\) Ibid.

\(^8\) Ibid.
students attempt to relax, they create tension in other muscles, which is counterproductive. These students may also have tones that can be considered stuffy, nasal, or pinched. This is can be caused by excess tension in the throat (glottis), embouchure, or oral cavity, to make up for the lack of air velocity or volume. To increase the velocity of air volume the player can either increase the volume of airflow or constrict the passage of airflow. Younger trumpet students frequently tend to constrict the airflow.⁹

Playing trumpet is a demanding endeavor that requires physical coordination and mental control in order to perform. One unifying trait of accomplished professional trumpet players is physical efficiency in the use of performance techniques. Modern commercial trumpet playing requires performers to be very versatile and often involves performance in the upper register. This is a skill that is learned over time and cannot be accomplished without creating a high amount of compression in the body. This act of creating compression often causes younger students to use the Valsalva maneuver. However, using this maneuver cuts off the airflow at the glottis and leaves little to no airflow to vibrate the lips at the trumpet mouthpiece.

Proper utilization of the glottis is defined by the desired outcome. Any type of glottal use that results in a desired outcome is a proper use and any glottal use that creates an undesired outcome is an improper use. For example, using the glottis to create compression by setting the air before the air is released to produce a note in upper register can be a desired outcome if the production of sound is appropriate.

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⁹ Christopher M. Hullet, “The Effects of Embouchure and Breathing Instruction on Beginning Brass Students’ Performance” (DMA essay, Arizona State University, 2006), 115.
Justification

There are over 350 available theses, essays, and dissertations on trumpet playing that address various physical or physiological aspects of performance. Among this research, there is very little reference to the use of the glottis in trumpet playing except its use as an extended effect, such as a growl technique. Also, there is very little reference in trumpet methodology to practices that facilitate proper use of the glottis, nor do the references mention medical problems that can be associated with the improper use of the glottis. This study will address the improper use of the glottis in trumpet performance by consulting methodologies and providing research from other areas of study as a basis for creating strategies to promote its proper use.

Many students are impeded by their inability to control their glottal tension when playing in a register they perceive to be difficult. These students often have the skills to produce the sound with the muscles in their embouchure, but are unable to supply enough air due to the airflow being restricted by improper activation of the glottis. Many beginning trumpet players start impeding their air with the glottis before playing above second space “A” in the treble clef staff while others may play as high as third space “C” before the glottis begins to restrict the airflow. Some college trumpet students may be able to make it to 2nd ledger line “C” above the staff before the glottal tension becomes a problem. Beginners, college students, and professionals deal with this problem to varying degrees.

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Need for Study

While many methods of trumpet playing discuss tension of the throat being a problem, few give useful ideas or approaches to solving it. Keith Johnson states that, “There is little doubt that one of the most widespread problems of trumpet performance is the use of excessive muscular effort in sound production. What many players think is support is really isometric tension.”\textsuperscript{11} This is just one example of an approach that does not directly address the tension of the glottis. It is generally accepted that minimizing all tension is important to becoming a more efficient performer on any instrument. However, Johnson generalizes the occurrence of tension and offers the use of pedal tones, notes below the natural overtone series of the trumpet, as an approach to minimizing tension in the body.\textsuperscript{12}

There is very little information available in trumpet methodology addressing the proper use of the glottis. Most methodologies focus on the effects of tension, specifically referred to as \textit{throat} tension, and discuss the general need for unimpaired airflow to produce the proper tone on trumpet. A new strategy should be developed based on previous methodology and research to help promote proper glottal use during performance practices. These points are important because trumpet teachers occasionally have students with problems such as making vocal noises while playing or have difficulty playing above the staff. These types of problems involve the improper use of the glottis.

\textsuperscript{12} Ibid.
Purpose

The purpose of this study is to identify problems surrounding the improper use of the glottis and develop practice strategies that promote its proper use in trumpet performance.

Research questions:

1. What performance practices can cause medical problems related to the improper use of glottal tension?
2. What musical problems related to performance practices are linked to glottal activation and what intentional performance practices including so called extended techniques are linked to glottal activation?
3. What is the proper use of glottal tension in trumpet performance? What strategies can be used to promote healthy performance habits of glottal use?
CHAPTER TWO
LITERATURE REVIEW

Performance practices of trumpet students can lead to their success or lack of success. Body tension is a major factor in the cause of medically-related problems due to improper performance practices. This literature review will explore research relating to the use of the glottis covering three different areas: medical problems caused by the use of the glottis in brass playing; the use of the glottis and its effect on musical performance; and instrumental methods that address the use of the glottis.

Medical Problems Caused by the Use of the Glottis in Brass Playing

Up until the last decade there have been very few, if any, studies or research with musicians involving the glottis and health-related concerns caused by its use or misuse. The first study will explore evidence associated with playing high wind pressure instruments and if these pressures can be responsible for glaucomatous damage to the optic nerve. This study also provides evidence of a relationship between the Valsalva maneuver and high resistance wind instruments.

According to a research study in 2000 by Schumann, Massicotte, Connolly, Hertzmark, Mulkherji, and Kunen, research was done to determine if playing high resistance wind instruments elevates intraocular pressure. This study also looked at the differences between low resistance wind players and high resistance wind players. The high resistance wind instruments played for this study were trumpet, oboe, bassoon, and French horn. Instruments considered low wind resistance were flute, clarinet, saxophone,

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tuba, and trombone. The purpose of the study was to determine “…whether high resistance wind players have a higher incidence of glaucomatous changes than other musicians.”

The design of this study was three case reports and a cross-sectional study. There were two players of high resistance wind instruments and one player of high and low resistance wind instruments who participated in part one of the study. There were nine high resistance wind players, and twelve low resistance wind players, 24 non-wind instrument players among professional wind instrument players recruited from the Boston area who participated in part two of the study.

For part one, intraocular pressure and uveal thickness changes were measured by using pneumatonometry and ultrasound biomicroscopy on players of the oboe and trumpet, two players of the high resistance wind instruments, and a third players while playing trumpet (high resistance), clarinet and saxophone (low resistance). All of the musicians in part two of the study went through their musical and medical histories, including measurement of the intraocular pressure, Humphrey visual field testing, still-lamp examination, gonioscopy, and a dilated exam. Part one and part two of the study’s main outcomes measured intraocular pressure and uveal thickness changes, as well as visual field loss and optic nerve head appearance in all subjects.

The measurements in part one of the study by pneumatonometry revealed that intraocular pressure elevation is dependent upon the force of blowing, and ultrasound

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14 Schuman et al., 127.
15 Ibid.
16 Pneumatonometry – an instrument that uses air to measure intraocular pressures.
17 Ultrasound biomicroscopy – a type of ultrasound that makes a more detailed image of the eye.
18 Gonioscopy – an eye exam to look at the part of the eye between the cornea and iris.
19 Uveal – referring to the pigmented middle of the three layers of the eye.
20 Schuman et al., 127.
biomicroscopy showed uveal thickening associated with intraocular pressure elevation.

The extent of elevation of intraocular pressure was dependent upon the amount of resistance to the exhalation from each particular instrument. According to Schumann and others,

Part two showed that life hours of high resistance wind instrument playing had a significant relationship to abnormal visual field (P = 0.03) and corrected pattern standard deviation (CPSD) scores (P = 0.007) in univariate logistic regression and univariate linear regression, respectively. A 0.011-unit increase in CPSD for each 1000 life hours of high resistance wind playing was found.\textsuperscript{21}

The conclusion of this study shows that both high and low resistance wind instrumentalists experience a transient rise in their intraocular pressure when playing their instruments; this is a result at least in part of uveal engorgement. The extent of intraocular pressure increase is greater in high resistance wind players compared to low resistance wind players. There was a small but significantly greater increase of visual field loss (abnormal fields and increased CPSD scores) in high resistance wind musicians compared to other musicians, this was related to life hours of playing. According to Schumann and other, “The cumulative effects of long-term intermittent intraocular pressure elevation during high resistance wind instrument playing may result in glaucomatous damage, which could be misdiagnosed as normal-tension glaucoma.”\textsuperscript{22}

Another discussion in this study looks at how playing high resistance wind instruments such as the trumpet relates to the Valsalva maneuver. This study provides evidence that playing high resistance wind instruments increased intraocular pressure in a similar pattern to the Valsalva maneuver and, according to Schumann and others, “…the changes seen in the chordial engorgement demonstrated by ultrasound biomicroscopy

\textsuperscript{21} Schuman et al., 127.
\textsuperscript{22} Ibid.
also resembled the changes seen with the Valsalva maneuver. This information lends support to the controversial notion that a Valsalva maneuver is indeed involved in playing high resistance wind instruments.” 23 This study has implications for trumpet players as further evidenced by the following studies dealing with pressure being caused by partial closing of the glottis in relation to the Valsalva maneuver.

According to a study in 2002 by Chesky, Devroop, and Ford, brass players, in general, have a number of areas of the body that resist a certain amount of force. The lips have to resist pressure from the mouthpiece, which is typically applied by pressing the mouthpiece up against the lips. There is intraocular pressure caused by varying degrees of resistance at the embouchure affected by the type of mouthpiece and instrument used. 24 The purpose of this health study on brass instrumentalists was to determine the prevalence rates for these musicians to have medical problems in certain areas of the body related to performance.

Data were observed in this study from a questionnaire distributed to 739 brass instrumentalists. Among these, 227 were trumpet players, 167 were French horn players, 189 were trombone players, and 156 were low brass players. Among those questioned, 76 percent are male, and the mean for college instruction was 4.11 years. The mean number of hours of practice per day for all brass instrumentalists was 2.5 hours and on average they exercised 3.5 hours a week. Over half of trumpet players reported musculoskeletal problems.

23 Schuman et al., 132.
Non-musculoskeletal data was also taken, giving insight into the prevalence rates for blackouts, dizziness, and headaches. Those playing trumpet and French horn were more likely to have occurrences of dizziness, blackouts, and headaches than instrumentalists playing trombone or low brass. Considering that higher pitched instruments are more physically demanding, these results were expected. This prevalence was also higher in females than in males. According to the data, around 31 percent of trumpet players experienced blackouts, dizziness, or both. The data directly correlates to the use of the Valsalva maneuver or improper activation of the glottis when performing.

According to the study, the findings support the need for more research in the areas of musculoskeletal and non-musculoskeletal problems for brass instrumentalists. The evidence presented demonstrates the greater physical demands of performing on these instruments. Future studies need to focus on the biomechanics of these instruments to develop a methodology for preventing these types of problems. The authors’ hope was that this study would encourage further research to develop preventive methods or strategies to promote effective techniques for reducing medical injuries in brass players.

Another research study done in 2003 by Stasney, Beaver, and Rodriguez, indicates that playing trumpet and French horn requires increased pressure in the hypopharynx, which can lead to a hernia of the larynx. These types of “blowouts” can be bilateral or unilateral, and are observable on the external part of the neck during the exhale. Sometimes this external neck swelling is misdiagnosed as neck mass from birth.

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25 Chesky et al., 93.
26 Ibid.
This study was done in order to create strategies to help prevent these types of occurrences.

Four students from Rice University’s Shepard School of Music or the University of Houston’s Moores School of Music were recruits for this study. Three of the musicians were principal players in the Houston Symphony and professors at surrounding institutions. One of the musicians was a master’s student at Rice’s Shepherd School of Music. The four instruments tested were French horn, trumpet, trombone, and tuba. Standard mouthpieces for each instrument were fitted with a transducer to measure the air pressure within the mouthpiece. A hypopharyngeal probe was also used, inserted into the nose to measure pressures in the pharyngeal cavity on notes C1 through C4. After the measurements had been taken, a laryngoscope was used to observe the larynx and hypopharynx during instrumental performance.\(^\text{28}\)

Results from the study showed the pressure inside the mouthpiece to always be less than 25 cm H\(_2\)O for all the frequencies measured. One centimeter H\(_2\)O is the amount of pressure created by column of water one centimeter in height at standard gravity at four degrees Celsius. The pressure on the inside of the hypopharynx became greater for higher frequencies on all instruments. The horn registered 110 cm H\(_2\)O or more at frequencies greater than 512 Hz (between B and C an octave above middle C) and the trumpet registered 110 cm H\(_2\)O or more at frequencies greater than 1,024 Hz (between B and C two octaves above middle C). Poor technique and improper activation of the glottis showed a 20 percent increase in pressure for frequencies across the board.\(^\text{29}\) This poor

\(^{28}\) Stasney et al., 153.
\(^{29}\) Ibid., 154.
technique was observed through an endoscope and appeared as the larynx was contracted, vocal folds adducted, and retraction at the base of the tongue.\footnote{Stasney, et al., 155.}

The conclusion of this study suggests the same frequencies on different instruments require different hypopharyngeal pressures. Out of the four instruments tested the French horn required the highest pressures for each of the frequencies measured. There is a potential for these pressures to be too high for the underdeveloped pharynx and larynx in young instrumentalists who play horn above 512 Hz and who play trumpet above 1,024 Hz. The actual safe pressure in the pharynx is unknown for younger instrumentalists. Further investigative research should be done to determine the possible safe pressures for young students to eliminate potential for soft tissue damage.

The following study takes another look at the vocal track to see how performance of wind instruments uses the vocal folds and opening of the glottis. This study is important to the understanding of what potential impacts the adduction of the glottis can have on the vocal tract. This study took place in 2006, with the use of videolaryngoscopy.

According to the research presented by Claudia Alessandra Eckley, a specific group of individuals who display an extensive use of glottal configurations are wind instrumentalists while exhaling into their instruments. Eckley states that there are very few studies that focus on the glottal activations of these professional wind players. The research presented focuses on the functions of the vocal tract and glottal configuration of individuals performing on wind instruments.\footnote{Claudia Alessandra Eckley, “Glottic Configuration in Wind Instrument Players,” \textit{Brazilian Journal of Otorhinolaryngology} 72, no. 1 (January 2006): 46.} The goal of this research is to evaluate the larynx and the vocal tract behaviors of wind instrumentalists during performance to better understand the role of this part of the anatomy in the production of sound.
This study used ten wind instrumentalists, six male and four female, averaging forty-two and a half years in age. The subjects did not have any existing pulmonary or laryngeal diseases and their main means of making a living were playing wind instruments. The instrumentalists did not make any other type professional use of their voice. The individuals were questioned about their general vocal health while singing as well as playing a wind instrument. The subjects subsequently underwent videolaryngoscopy without topical anesthesia using a flexible optic fiber. The anatomy of the larynx and pharynx were documented followed by the individuals playing their wind instruments. The instrumentalists were examined playing a song that was undemanding followed by one considered to be technically challenging. Observations were recorded on video and analyzed at a later time. The criteria observed were: tongue base and pharynx position during exhale into the instrument; use or non-use of vibrato and the probable location of its production in the vocal tract; antero-posterior and lateral larynx diameter during exhale; and position of vestibular folds and glottis during the production of sound.

The results of the study found that eight out of the ten instrumentalists complained of throat secretions and five out of the ten complained of vocal strain when speaking after intense use of the instrument. All participants showed signs of adduction of the vocal cords during the production of tones on their instruments. Control of the airflow was related to glottal constriction and opening. A musical effect of the glottis was observed when the glottis was opening and closing in rhythmic movements to help control vibrato. Also noticed was increased side-to-side glottal tension as well as supra-glottic tension during the performance of the more difficult song. In eight of the subjects

32 Eckley, 46.
33 Ibid.
34 Ibid.
other laryngeal signs found were in arytenoid and interarytenoid edema and hyperemia, which is increased serous fluid and increased blood flow in and around the cartilage connected to the vocal folds. Five of the eight subjects had this with moderate intensity and three subjects showed mild intensity. None of the subjects had any signs of vocal cord lesions.

Eckley suggests that the limited research available on health-related problems of wind instrumentalists mostly focuses on diaphragm and embouchure (use of oromandibular muscles). The findings of this research also imply that more studies should focus on the use of the glottis or vocal tract because it has a direct effect on the control of airflow to the embouchure. The author also cites another study by Mukai in 1989 as observing direct participation of the glottis while blowing a wind instrument.

According to the case study in 2010 by Flores-Franco, Agustin, and Limas-Frescas, certain health risks are related to trumpet performance particularly in young trumpet students. The analysis in this report is focused on a young trumpet player who had been diagnosed with two different problems typically associated with trumpet performance. The purpose of this report is to inform physicians of disorders that could be misinterpreted as being caused by instrumental performance and mistaken as needing serious medical care.³⁵

A 16-year-old student went to the hospital with retrosternal and cervical pain that was followed by a swelling in the neck area. The student was practicing for a military-style band concert when the symptoms appeared. He had played trumpet for 7 years, and on average practiced 90 minutes a day during the week and sometimes 4 hours on

weekends. Neck x-rays showed that he had air present in the soft tissues of the neck and an x-ray of the chest showed a pneumomediastinum, which is a pocket of air created from a rupture in the pathway of air between the lungs and esophagus and protrudes into the area of the organs of the mediastinum. The patient was hospitalized for observation and two days later complained of hoarseness, increased salivation, and pain from swallowing. The next day the symptoms began to improve rapidly and the patient was discharged and instructed to stop playing the trumpet.\textsuperscript{36}

Two weeks later the patient was seen for a follow-up appointment where a painless compressible mass was discovered under the left side of the larynx. This mass was only visible during a modified version of the Valsalva maneuver with the glottis open. A computed tomography scan of the cervical area performed during this maneuver showed that this pocket of air might suggest a unilateral pharyngocele. One month later a laryngoscopy was done and no abnormality was found.\textsuperscript{37}

Research has shown that young trumpet players are particularly susceptible to injury caused by high intrathoracic pressure created by playing high notes on trumpet which could possibly involve the Valsalva maneuver. The greatest risk to tissues of the cervical and oral area in young trumpet players is when pressures peak and average 234 cm H\textsubscript{2}O. Spontaneous pneumomediastinum is a rare benign disorder typically found in young males without a predisposition for lung disease.\textsuperscript{38} Sometimes this disorder is associated with the use of the Valsalva maneuver and specifically in this case with trumpet performance.

\textsuperscript{36} Flores-Franco et al., 35.  
\textsuperscript{37} Ibid., 37.  
\textsuperscript{38} Ibid.
Another study detailing the effects of trumpet performance on the body focuses on the physiological effect as it relates to the use of the glottis in the process of the Valsalva maneuver. The purpose of the study done by Robertson, Federoff, and Eisensmith, was to determine how performing on trumpet affects the cardiovascular system with respect to heart rate, stroke volume, and cardiac output. Changes in heart rate occurred in both students and professionals participating in the study. The results from the study suggest that professionals perform with greater physiological efficiency.39

Involved in the study were six professional and six college trumpet players. These instrumentalists were asked to rest for one minute and then play exercises for one minute. The exercises were “designed to assess the effect of pitch and articulation.” There are great physical forces at work during trumpet performance. Other studies that have been done on the topic did not compare professional and non-professional performers. The difference between these two experience levels may show the adaptability of trumpet players to cardiovascular stress. Previous studies have shown that, generally, professional performers create greater levels of pressure; however, it is not clear if this directly relates to the increase in heart rate.40

According to the findings, cardiovascular stress is created by the required expulsion of air during trumpet playing, resulting in high levels of pressure in the thorax and oral cavity. These pressures are generally higher for trumpet than for other instruments and are directly proportional to the frequency of the pitches being played.

40 Ibid., 17.
Pressures in the oral cavity can reach as high as 251 cm H₂O on B-flat trumpet and even higher on piccolo trumpet.\textsuperscript{41}

The relationship of cardiovascular function to intrathoracic pressure has been studied in relation to the use of the Valsalva maneuver, which is the blocking of the air passageway by closing the glottis, this action normally occurs when lifting heavy weights, defecating, or coughing. The authors found research indicating that cardiac response to intrathoracic pressure in tuba players performing in the high register is similar to that of the Valsalva maneuver. “Initially, blood pressure increases and heart rate decreases as a direct result of intrathoracic pressure and peripheral vasoconstriction. Baroreceptors react to produce a compensatory decrease in blood pressure and increase in heart rate, which is mediated by the autonomic system.”\textsuperscript{42} When the intrathoracic pressure is released, the heart rate slows and the blood pressure increases higher than the resting blood pressure before returning to the normal level. This response is produced with intrathoracic pressure at 40 mm Hg, which is lower than the normal pressures of trumpet playing.\textsuperscript{43}

Data were collected from the twelve trumpet players in individual sessions. The participants were fitted with electrodes from a bioelectric impedance cardiograph. They were then told to warm-up and were given a five-minute break before testing began to get baseline levels. The participants were then instructed to play two sets of one-minute exercises with one minute of rest between each exercise. These exercises were played

\textsuperscript{41} Robertson et al., 17.
\textsuperscript{42} Ibid.
\textsuperscript{43} Ibid.
along with a metronome to ensure they lasted the correct amount of time. The second exercise differed from the first by being a fourth higher in pitch.\textsuperscript{44}

The results of the study are that more experienced performers have lower resting heart rates than less experienced performers. However, it is not clear by the study if the students have more tension than the professionals, causing the increase in peripheral vascular resistance, or if the professionals’ bodies have adapted to the demands of trumpet playing.\textsuperscript{45}

All of the research studies previously presented show similar data concerning the amount of pressure involved in trumpet playing. There is a definite need for the development of specific strategies for understanding and controlling the amount of pressure created in trumpet playing and specifically the use of the glottis in regulating airflow during the exhalation needed for trumpet performance. The following studies will look at the use of the glottis in context of musical performance.

\textit{Use of the Glottis and Its Effect on Musical Performance}

One of the first articles that focuses on the musical effect of the throat on brass performance is an \textit{Instrumentalist} article written in 1957 by Vincent F. Malek entitled “The Closed Throat Shuts the Door on Musical Performance.” Malek cites that having a partially closed throat during performance to be one of the most objectionable conditions of musical performance. He feels that teachers frequently try to teach their students by imagery and he believes it is desirable as long as it works. Malek states that numerous

\textsuperscript{44} Robertson et al., 21.
\textsuperscript{45} Ibid.
students, who were considered to be better players, displayed this fault at district and state solo contests.\footnote{Vincent F. Malek, “The Closed Throat Shuts the Door on Musical Performance,” The Instrumentalist 11, no. 9 (May 1957): 34.}

Malek claims that the frequent occurrence of the closed throat cannot be easily dismissed. He states that misconceptions disseminated by the teacher of the construction and function of the throat may be the reason that there is a lack of success in students overcoming this problem. Malek believes that in order to resolve this problem that it is important for teachers to have an understanding of the physical structure of the throat so that they may employ imagery from a more comprehensive basis.\footnote{Ibid.}

Malek describes the construction of the throat:

The opening in the back on the mouth leads into the top part of the throat, which is called the pharynx. This passageway in the throat also leads to the nasal cavity. The roof of the mouth is called the palate and is divided into two portions. The fore part has a bony base and, consequently, is called the \textit{hard} palate. The rear section has no bone and is therefore termed the soft palate. Since there is nothing to constrict it, it drapes down over the opening into the throat. From its center hangs the uvula, a small mass of tissue, which further covers the opening.

Each of the two sides of the soft palate consist of two folds of muscular tissue. Since the technical name for the opening to the throat is the \textit{fauces}, these muscular folds are termed \textit{pillars of the fauces}. The front pillar is attached at its bottom to the back of the tongue, the tongue occupying the floor of the mouth. The bottom attachment of the rear pillar is to the wall of the pharynx.\footnote{Ibid.}

He claims that the pharyngeal muscles in the pillars of fauces can be contracted along with the tongue being raised in the back of the mouth causing the throat to be partially restricted. According to Malek the arching of the tongue at the back of the mouth is
something many teachers feel is necessary to play high notes on brass instruments. However, if overdone can cause the throat to be partially closed.49

Malek suggests that a reason brass players tend to be encumbered with a closed throat is due to their attempt to progress to rapidly in the beginning of their studies. Young students, who have not yet developed the skills of breath control to play the upper notes of the instruments, attempt them by “squeezing” the notes out “…through a partially closed throat.”50 As discussed earlier, when individuals attempt something they find difficult, it can also trigger the closing of the glottis by the Valsalva maneuver, which in this case also adds to the closing of the throat. According to Malek, as the students practice with this problem, it only makes it more difficult to overcome in the future. He believes the only way to overcome this habit is through effective concentrated breathing. However, he does not elaborate much other than suggesting yawning to relieve momentary tenseness in the throat.51

William Carter did a study in 1966 entitled “The Role of the Glottis in Brass Playing.” According to Carter, there is a controversy over the proper way to control the airstream for “breath control” in brass performance. There are those who believe that the only resistance between the diaphragm and the instrument is at the embouchure, while others believe that the tongue should arch in the back of the mouth as a point of resistance.52 Carter says that the most controversial theory is that of Philip Farkas’, that the first point of resistance in breath control during exhalation is found in the throat at the point called the glottis.

49 Malek, 34.
50 Ibid., 35.
51 Ibid., 36.
The use of the laryngoscope at the time was administered through the mouth, which lead Carter to search for a different approach to observe the glottis during brass playing. After with some discussion with Dr. Atis Friemanis a member of the radiology department at the Ohio State University Hospital, Carter had some preliminary X-rays taken of himself playing trombone, under the supervision of Dr. Friemanis. These preliminary X-rays showed dramatic glottal changes when changing dynamic levels from soft to loud.  

This lead Carter to develop a method for taking X-ray photos of the glottis of brass players under four conditions. These conditions were: (1) a loud high note, (2) a soft high note, (3) a loud low note, and (4) a soft low note. Carter took pictures of three orchestra brass instruments, trumpet, French horn, and trombone. Tuba players were left out due to the tubing crossing directly in front of the neck.

Using a divider, measurements were taken of the X-ray film. Carter measured the glottis at its narrowest point and the trachea (windpipe) measured at its widest point. The investigation used the ratio of glottis opening to trachea width as the comparative measure. He used this measure to eliminate variable magnification issues due to small differences between the X-ray plate and the throat, and to allow for comparisons between subjects.

Carter limited the playing extremes so as to avoid having the player use any unusual physical playing techniques. The trombone range used was 116-349 Hertz, the French horn range used was 130-392 Hertz, and the trumpet ranged used was 233-698 Hertz. Having each of the subjects play large bore instruments and large bore

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53 Carter, 77.
54 Ibid.
55 Ibid.
mouthpieces minimized the resistance variables. The notes to be played were chosen because of their availability on the open harmonic series. Pitch level was controlled by a Strobo-tuner and the volume level was controlled by the use of a Conn Dynalevel loudness level meter.\textsuperscript{56}

The subjects chosen for the study were exceptional brass players from the Ohio State University School of Music. They were selected for their ability to produce and control a legitimate quality tone production. Before the session the subjects were only told that their throats would be observed.\textsuperscript{57}

Examination of the visual X-ray photos of the glottis during the dynamic level showed a definite pattern of glottal size variation. According to the data collected, the size of the glottis opening varies with loudness level, the glottis being small for soft dynamics and being open for loud dynamics.\textsuperscript{58}

The data shows there are no practical changes in the opening of the glottis between pitch changes. This indicates that the glottis aperture has no pitch control at least in the normal playing register of brass instruments. According to the data gathered, trombone players had the most amount of glottal movement, the French horn players had the least amount of glottal movement, and the trumpet players had more glottal movement than the French horn players but less than the trombone players. Since trombone offers less resistance than trumpet, and trumpet offers less resistance than French horn, “...the data obtained support a theory describing the glottis as a semi-automatic aperture used to provide more resistance to aid the diaphragm and its related

\textsuperscript{56} Carter, 77.
\textsuperscript{57} Ibid.
\textsuperscript{58} Ibid.
musculature in controlling the inward and upward contraction of the abdominal muscles upon exhhalation.”  

Carter explains, using the median glottis opening for loud playing on trombone, which is .409, would allow the large amount of air necessary for playing these tones. The pushing power of the abdominal muscles is more important in this instance than breath control. He states that additional resistance to blow against is neither needed nor required.  

When playing soft notes on trombone the .086 opening of the glottis is more or less necessary depending on how much control the player has over adjusting the resistance to the contracting abdominal muscles. Since there is a relatively smaller amount of air required to produce soft tones and the large bore trombone and large mouthpiece offers little resistance, the partially closed glottis provides resistance to the airstream alleviating some of the responsibility of the abdominal musculature from having to control the airstream.  

The built-in resistance of the French horn most likely explains the relative inactivity of the glottis. The small mouthpipe and long complex tubing combined with small mouthpiece combine to create more impedance to the airstream allowing the job of the abdominal muscles and diaphragm to be much easier. Added resistance by varying the opening of the glottis is rendered unnecessary. However, Carter states that altering the glottis on French horn could possibly alter tone color, but does not explore this facet in the study.

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59 Carter, 77.
60 Ibid., 78.
61 Ibid.
62 Ibid.
Carter concludes by saying that Philip Farkas’ statement is correct, that brass players successfully, either unconsciously or consciously, use the opening of the glottis while performing. However, he suggests using caution in evaluating the significance and meaning of the findings of his study. Carter cautions that this subject matter falls under the realm of music and because of this, using a technique such as using the glottis as resistance for soft tones requires evaluation-based tone quality. These considerations fall outside the scope of this particular study.63

However, Carter notes there is a perceivable difference in tone quality between notes produced with a partially open glottis and a partially closed glottis. The differences being large enough that there is a debate among professionals about which sound is the best legitimate sound. This sort of question is most likely best solved in the teaching studio, where the judgment of the instructor is the most important element in the teaching process.64

According to Carter, “Physiology texts say that the glottis widens during quiet inhalation and narrows during exhalation. These movements are said to become more marked during ‘forced’ respiration.”65 Breathing to play brass instruments at high loudness levels must undoubtedly fit into the category of forced breathing. This is in contrast to normal quiet breathing when the body is at rest. Carter states, “If there is a marked narrowing of the glottis during forced exhalation, the glottis must certainly tend to narrow during the playing of loud tones on a brass instrument!”66

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63 Carter, 79.
64 Ibid.
65 Ibid.
66 Ibid.
Data from the study shows that differences in the glottal opening varied more from subject to subject on the performance of loud tones than it did for soft tones. The glottises of some players were open to a great extent for loud tones and some were open very little. This indicates that some players have been more successful than others in learning to overcome the natural tendency for the glottis to narrow during forced exhalation as in playing loud tones. Most likely this learning took place unconsciously. Being that the glottis can be controlled voluntarily and involuntarily, accomplishing this is highly feasible.\(^{67}\)

Carter states that through glottal exercises he has gained a high degree of conscious control over his glottis. He believes having this kind of awareness in playing gives both the student and the teacher tools with which to pinpoint certain aspects of problems with breath control and tone quality directly at the source. The sound and tone quality of forte or fortissimo that brass teachers have in mind when they emphasize playing with an open throat is the sound their students get when, and if, they learn to play with an open glottis, assuming all other factors of the playing are normal (e.g. embouchure, mouthpiece, instrument, etc.). Carter believes it is quite possible that a concentrated approach, utilizing exercises to encourage conscious control of the glottis, could significantly benefit the development of student brass players to perform with an acceptable and proper tone production.\(^{68}\)

The next study involves understanding a distinction between muscles of the neck and the actual vocal folds responsible for the opening of the glottis. In an ITG journal article written in 1979, when new technology was available to test muscle tension using

\(^{67}\) Carter, 79.

\(^{68}\) Ibid.
electromyography, W. Alexander Henderson addressed the need for studies using technology to clear up misconceptions and confusion disseminated by professional teachers about performance concepts. Although this study focuses on the sternocleidomastoid muscles of the neck, it is important that the author tries to make a clear distinction between tension in these muscles and glottal tension. He says, teachers often use “catchphrases” to vaguely describe some form of physical or musical concept that has no definite meaning and teachers with differing approaches insist that their way is the only correct way.69 Tension for brass players is a necessary part of performance and must be addressed in some fashion. Most brass texts mention tension in the back, embouchure, diaphragm, and general tension throughout the body. The question is how much tension is acceptable to produce results without causing physical damage or unnecessary fatigue.70

Most brass texts refer to tension in the neck or throat as detrimental to performance and they advocate playing “with a relaxed, open throat” or “don’t close the throat.”71 Students generally have a difficult time identifying with these phrases because they have no idea what the phrases mean or a concept of how to control these muscles voluntarily. Henderson suggests that there should be distinction between tension of the neck and throat, and control of the glottis, the opening in the throat.

Henderson indicates that Philip Farkas advocates manipulation of the glottis to control the airstream in his book The Art of Brass Playing. Farkas also says that this activation of the glottis should not be confused with muscle tension of the throat and neck

70 Ibid.
71 Ibid.
area. According to Henderson, Farkas states that many teachers misinterpret the concept of glottal activation as playing with “...a tight throat, a condition all teachers have carefully avoided from the inception of brass playing.”72 He continues by saying that playing with “...a “tight throat” means the forcible tightening of the neck muscles, or worse yet, the sounding of the vocal cords, resulting in a low moaning or groaning noise...”73 Henderson references Vincent Malek’s claim, to show another example of a differing opinions, that the glottis and pharyngeal muscles both cause the throat to close. According to Henderson, both Farkas and Malek, are detailed in the explanation of closing the throat and the importance of a relaxed the neck, but do not address what is necessary and what is extreme.74

Henderson quotes Irving Bush from Artistic Trumpet Technique and Study, with a more accurate description of what is undesirable tension, “The chest, throat and neck should remain in the same position and maintain a constant amount of tension while playing in the middle and low registers. Any added contraction or tension will only hinder performance... Generally, all these organs and muscles should be kept free of constriction and excessive amounts of tension.”75

In the book, The Embouchure, Maurice M. Porter, states that in reference to the glottis, “imagine you are singing while playing suggests some sort of co-ordination of the vocal cords while playing.”76 Henderson points out that Porter is speaking of the glottis and pharyngeal muscles as opposed to neck muscles. Using these examples, he points out a need to establish if tension exists in the throat and neck area during performance. After

72 Henderson, 30.
73 Ibid.
74 Ibid.
75 Ibid.
76 Ibid.
confirming that tension exists, consistent levels of tension can be recorded in professional players and these patterns can be used as markers for students who exhibit high levels of tension, to search for ways of reducing tension.

Test subjects were chosen from the 1979 International Trumpet Guild Convention held in May in Tempe, Arizona. Eighteen subjects were seated in a chair and sensors were attached to record electrical activity in the neck. Henderson used electromyogram biofeedback readings to measure the muscle tension in the sternocleidomastoid during trumpet performance. He concluded that there is increased tension when playing in the upper register and decreased tension in the lower register. Variances in tension among the individuals, prevented establishing tension norms for specific registers during performance. Henderson purports that students who exhibit tension levels in the extremes compared to his measurements should seek to minimize this tension.\(^77\)

This study defines the difference between glottal tension and pharyngeal muscles and the muscles of the sternocleidomastoid. Although the main focus is on the sternocleidomastoid, this study makes a distinction between the two sets of muscles discussed. This particular study does not give any specific means or approaches to correcting extreme use of the sternocleidomastoid.

Between 1979 and 1989 there is a gap in research on the subject of the use of the glottis in brass playing related to musical performance. Research on how the glottis reacts during performance is important to finding a link between its activity and musical problems. Laryngeal activity of trumpet players was not closely examined again until 1989 with the use of laryngoscopy.

\(^{77}\) Henderson, 35.
In 1989 Robert Ellwood Bailey did a dissertation called “An Investigation of Laryngeal Activity of Trumpet Players During the Performance of Selected Exercises.” This study was done to see what activities are actually occurring inside the laryngeal tract during the performance of trumpet on selected exercises. Bailey used an Olympus ENF type “p” pediatric fiber optic laryngoscope that was 3.7 mm in diameter with a Machida TM-22u monitor and a Machida CCV-1000 camera.78

Subjects were seated in a dentist’s style examining chair with a microphone placed in front of their trumpet bell about three feet away. The subjects were allowed to warm-up before a zylocaine solution was applied to the inner surfaces of the nasal passages as well as the posterior wall of the pharynx and as much of the laryngopharynx as possible. After the anesthetic took effect, the subjects then played the exercises in order to acclimate to playing in the condition caused by the anesthetic. The laryngoscope was then placed through the nasal passage and through the pharynx to the point above the larynx where the vocal folds could be observed.79

The movements that Bailey was observing were the following: (1) the movement of the epiglottis during the performance of each exercise, (2) the movement of the vocal folds and arytenoid cartilage which includes the changing of the size of the glottis during the performance of each exercise, and (3) the movement of the thyroid cartilage during the performance of each selected exercise.80 For the purpose of this research, the movement and changing of size of the glottis will be examined.

79 Ibid., 55.
80 Ibid., 98.
The selected exercises used in observation were, an increase in sound volume, a decrease in sound volume, no vibrato, vibrato, single tonguing, step-wise descending slurs, step-wise ascending slurs, descending lip slur, ascending lip slur, low sound volume/upper register note, high sound volume/upper register note, low sound volume/low register note, high sound volume/low register note, and descending chromatic scale. The subjects also played an excerpt of the second movement of the Haydn Trumpet Concerto. Ten trumpet players were used as subjects from Northeast Oklahoma and Wichita, Kansas areas. All subjects were above the age of consent. These subjects included college-level students, teachers, and professional players.

According to Robert Bailey, the vocal folds are the most active of the laryngeal structure compared to the epiglottis or thyroid cartilage. Evidence from the study indicates that there was a tendency for the glottal dimensions to increase when performance volume increased, and decrease when performance volume decreases. During performance with vibrato, the vocal folds held a fixed position. No conditions were put on the performers during the second exercise in relation to sound volume, which may have affected the outcome of varying glottal dimensions.81 The findings show that there is no patterned behavior related to the activity in the glottis during the production of sound with vibrato. The activity of the glottis varied in subjects ranging from flexing the vocal cords to varying fixed glottal dimensions.82

During the single-tonguing exercise, all of the subjects flexed their vocal cords. Bailey observed noticeable adduction of the vocal folds immediately before each note with abduction during sound production, adduction being when the vocal folds are flexed

81 R. Bailey, 104.
82 Ibid.
towards being closed and abduction being when the folds are open. Several subjects were observed to appear to fully adduct at the beginning of each note, but evidence showed that it was not necessary to do so for articulation.\textsuperscript{83}

There was observation of the vocal folds having a patterned tendency to flex during the step-wise descending slurs, step-wise ascending slurs, descending lip slurs, and ascending lip slurs. The vocal folds exhibited more flexing during lip slurs than during step-wise slurs. Bailey suggests that there is less movement on step-wise motion because they are assisted by the use of the valves. While playing lip slurs the performer most likely makes internal physical adjustments, which possibly increases glottal behavior.\textsuperscript{84}

Bailey has come to the conclusion that high sound volumes lead to a slight abduction of the glottis, although this relationship does not exist with all subjects. The glottis size is not influenced dramatically during the performance of high to low register changes. During the descending chromatic scale Bailey noticed that the vocal folds had a tendency to flex with the change of each note. This behavior was consistent with vocal fold behavior observed during performances of the step-wise slurring exercises.\textsuperscript{85}

According to Bailey, “…the behavior of the vocal folds during trumpet performance appears to be self-adjusting or involuntary.”\textsuperscript{86} Based on observations, he believes that the vocal folds act as a cooperating mechanism to the airstream, to aid in trumpet performance. Bailey also has concluded that there is very little patterned

\textsuperscript{83} R. Bailey, 104.
\textsuperscript{84} Ibid., 105.
\textsuperscript{85} Ibid.
\textsuperscript{86} Ibid.
behavior that transpires at the vocal folds with the exception of the observed activity during performance of the single-tongue exercise.\(^{87}\)

This study does not account for players with performance problems or evaluate the quality or characteristics of the sound produced by the subjects. Bailey also excludes investigation of pulmonary activity or any accompanying neuromuscular activity associated with performance.\(^{88}\) The following study addresses laryngeal activity in combination with the Valsava maneuver and tongue. This research study from 2004 pinpoints a musical problem associated with the glottis and tongue in producing the sound on the trumpet.

A phenomenon that has impacted trumpet players and brass players in general is what Martin Cochran describes as musical stuttering. His essay discusses the Valsalva maneuver in brass playing, which includes engaging the glottis, in a way that he describes as a disturbance of musical performance comparative to stuttering in speech. The type of disturbances he describes do involve a disruptive pattern of uncontrolled glottal tension in some of the subjects surveyed for his research. Cochran defines stuttering as disfluency, as determined by the listener, based on the severity and frequency of disruptions, prolongations, repetitions, and blocks in speech that fall outside the realm of normal fluent speech.\(^{89}\)

Distinctions can be made in fluency and disfluency in music by listening to factors such as tone, articulation, rhythmic accuracy, and dynamics. Disfluencies that occur in music can be improper or unclear articulations, bad intonation, incorrect

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\(^{87}\) R. Bailey, 105.

\(^{88}\) Ibid., 10.

\(^{89}\) Martin Edmond Cochran, “A Comparison of the Behavior and Characteristics of Speech Stuttering with Musical Stuttering (i.e. Valsalva Maneuver) in Brass Players” (DMA essay, University of Alabama, 2004), 1.
rhythms, missed notes, unsteady tempo, and improper use of the air support. Cochran states that these disfluencies are typically only mildly disruptive in music performance, and are considered to be “normal” disfluent behaviors, even though they are involuntary, they are typically caused by the improper or lack of fundamental skills by the performer.\textsuperscript{90}

Musical stuttering is classified as being more than just basic musical disfluency. The frequency and severity of musical disfluency must be unusually high and totally disruptive to the flow of a musical phrase. During the normal process of brass playing the performer inhales air into the lungs and then immediately exhales the air between the lips causing them to vibrate. Immediately before exhalation, the tongue acts as a valve to release the air as it is placed behind the front top teeth. The tongue retracts to start the sound with an articulation as in the syllable “t.” Then the amplification of the instrument produces a tone from the vibration of the lips.\textsuperscript{91} When musical stuttering occurs, this physical process is interrupted after normal inhalation and the tongue becomes locked into place behind the teeth. Tension is created by pressure built up in the mouth, throat, chest, and abdomen. If the desired syllable is “toh” it could be replaced with short repetitions as in “t-t-toh.” In certain situations, the performer blocks the air completely and has to restart the breathing process to play.\textsuperscript{92} Performers who experience this may create mental stress for themselves in fear of not being able to produce the first note of a passage without being interrupted by musical stuttering. These performers are physically and mentally aware, but unable to control the disturbance. According to Cochran’s survey

\textsuperscript{90} Cochran, 2. 
\textsuperscript{91} Ibid. 
\textsuperscript{92} Ibid., 3.
data there were subjects who involved the Valsalva maneuver (engaging the closure of the glottis) in the process of musical stuttering.\textsuperscript{93}

The onset of musical stuttering according to Cochran, takes place in teenagers and adults who have attained a high level of musical proficiency on their instrument, whereas the onset of stuttering in speech tends to start in early childhood. At onset, there are similarities of rapid learning in the development of speech and rapid learning in the development of musical concepts. While there is debate whether environmental factors are a trigger for the onset of speech stuttering, studies have found a tendency for parents to be perfectionists and to have high standards for their children. Cochran notes that this is interesting compared to the onset of musical stuttering that occurs when students are in college under the demands of having their performance under continual critical analysis by a professor.\textsuperscript{94}

Cochran suggests a few techniques to help solve musical stuttering. The first pedagogical technique focuses on the constriction of the glottis caused by the engagement of the Valsalva maneuver. Cochran feels that breathing in too quickly with tension in the chest and throat area can cause the brain to trigger the Valsalva maneuver resulting in the obstruction of the airflow. He advocates the use of breathing exercises that foster relaxed, smooth, continuous, and uninterrupted airflow to help resolve these kinds of problems.\textsuperscript{95}

Another exercise, that focuses on the physical, which can be used to treat musical stuttering, is the use of breath attacks. According to the responses of Cochran’s survey, many of the participants use breath attacks to help stop the blocking behavior. To create a breath attack, the performer does not use the tongue to start the note as normal, only the

\textsuperscript{93} Cochran, 46. 
\textsuperscript{94} Ibid., 8. 
\textsuperscript{95} Ibid., 46.
movement of the air creates the sound. This typically helps reduce the blocking behavior for two reasons. The first reason is eliminating the use of the tongue because it can be a major root of the problem. The second reason is that by using breath attacks, like with breathing exercises, the performer builds upon smooth and continuous airflow.\(^9^6\) In order to create a pure tone and simulate an articulated attack with the breath alone, the performer must use the proper airflow. Alternating between breath attacks and articulated attacks helps the player transition into using uninterrupted airflow during articulation. Focusing more on the production of tone quality helps take the focus off the mechanics of articulation.\(^9^7\)

The approaches presented are aimed at changing the player’s physical conditioning which will eventually lead to changes in outlook on musical stuttering. The next exercises are useful for attempting to change the player’s mental outlook on performing. The player may first use a metronome or other rhythmic stimulus to develop an internal sense of movement when playing. This encourages the physical exercises of continuous airflow. Upon removal of the metronome, the player has an internal rhythmic pulse to provide stimulus to aid in musical fluency.\(^9^8\)

Visualization is another technique that helps with fluency. An example would be visualizing a conductor to alleviate mental stress associated with starting a note. Other forms of visualization lean more toward focus on imagining a beautiful sound or musical phrase to help decrease the stuttering. The focus is no longer on mechanics but has moved to communication, allowing the player to no longer have the feeling of attempting

\(^{96}\) Cochran, 47.
\(^{97}\) Ibid.
\(^{98}\) Ibid.
to play every note perfectly. This results in a decrease of anxiety for the performer and increases their musical fluency.\(^99\)

Cochran believes that these suggestions may be helpful for some musicians. However, he states that further research should help devise a method for the treatment of musical stuttering. Cochran suggests that until a method is devised, the best solution for controlling musical stuttering is by prevention. Environmental factors play a large role in affecting developing musicians, especially the teacher’s influence. Cochran promotes the pedagogy of Arnold Jacobs. This method focuses less on the mechanics of playing and more on the communicative and aural aspects of music.\(^100\) Approaching problems created by the reduced opening of the glottis may also be solved by this philosophy.

There are also constructive voluntary uses of glottal tension in trumpet performance. David Hickman’s book, *Pedagogy: A Compendium of Modern Teaching Techniques* from 2006, describes a way in which the glottis can be used to create vibrato. He refers to this type of vibrato as *throat vibrato* and relates it to the type of vibrato vocalists’ use with vibrating vocal cords. *Throat vibrato* can create a pleasing sound by changing the size of the glottis in a similar way that vocalists use vibrato, however this does not usually change the pitch, but often adds a slight tremolo sound that can enhance the intensity of a musical phrase.\(^101\)

In 2009, Amy Cherry did a study on the extended techniques of modern trumpet performance.\(^102\) This study discusses many different techniques, but for purposes of this

\(^99\) Cochran, 48.  
\(^100\) Ibid.  
\(^102\) Amy K. Cherry, “Extended Techniques in Trumpet Performance and Pedagogy” (DMA essay, University of Cincinnati, 2009), iii.
literature review, the focus will be on techniques that involve the use of glottal tension.\textsuperscript{103}

The first of these techniques she addresses is multiphonics, or what Cherry describes as singing and playing simultaneously; the creation of a chord by using glottal tension to sing and create a chord on what is normally a monophonic instrument. According to Cherry’s research, the use of multiphonics has been around since the 19\textsuperscript{th} century.\textsuperscript{104}

Another, but similar, technique used that engages the glottis is a vocalization referred to as growling. This technique requires the vocal cords to be used as in singing, but has more of a gritty and raspy sound that is most commonly used in louder playing in the lower register.\textsuperscript{105} It is also noted in both the David Hickman book, \textit{Pedagogy: A Compendium of Modern Teaching Techniques}, and in Cherry’s study that often a player will choose to use a growl technique if for some reason the performer cannot employ the flutter-tongue technique, which is a rapid movement of the tip of the tongue similar to the rolled “r” sound in other languages.\textsuperscript{106}

These types of voluntary and involuntary manipulations are important to understand for the effect they have on sound production. The following section of literature review will look at glottal tension from a pedagogical point of view. These books and methodologies will shed some light on approaches and methods of study to ingrain positive habits to help solve unintended uses of glottal tension.

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\textsuperscript{103} Cherry, iii.
\textsuperscript{104} Ibid., 37.
\textsuperscript{105} Ibid., 48.
\textsuperscript{106} Ibid., 56.
Instrumental Methods that Address the Use of the Glottis

One of the first mentions of the glottis, in the use of brass playing, occurred in the writings of world-renowned horn soloist and educator, Philip Farkas in 1956. In his chapter on breathing he describes four points of resistance in horn playing. He states that in order to achieve steady air pressure there must be resistance for the player to blow against. One point of resistance that is predetermined is the combination of horn and mouthpiece. Farkas notes that the hole in the mouthpiece is a determining factor of resistance and it must remained fixed during performance. The second point of resistance that he describes, “…largely unchangeable, is the lip aperture. Since the size and resistance of this opening is responsible for producing the pitch of various notes with the best possible tone quality, it must necessarily adjust for that purpose alone and, therefore, is not a reliable source of deliberate resistance.”

Another point of resistance Farkas describes is when the tongue is drawn back as in an “E” formation or as in saying “K.” This creates resistance at the arch of the back of the tongue. Finally, he introduces the last form of resistance, “The other controlled resistance point is the one I consider the most useful, although some players will probably disagree. Many of our finest players use it consciously, and I believe that even those who disagree with it in principle nevertheless use it unconsciously.” Farkas states that horn players have the ability to control opening of the “voice box” or the larynx, which is the opening of the glottis. He goes on to say that horn players have the ability to completely shut off the air, completely open it, or hold it at any point between open and

108 Ibid.
109 Ibid.
closed. Farkas clarifies that he does not imply using the closing of the vocal cords to create vibration or sound. He states, “The resistance to which I refer can be observed when coughing. Just before the actual cough, notice that the air passage is completely shut off and is only partly opened during the cough. This furnishes the resistance necessary to ‘clear the throat.’ The same valve is called into action when talking in a whisper.”

Farkas recommends actively practicing using the glottis as a valve to close off the air completely. Then slowly open the glottis so that air can move more freely. The goal is to observe the diaphragm as it loses its grip and the resistance at the larynx is reduced. The next step is to exhale with the glottis wide open and gradually close it until it is completely closed. Farkas states, “Somewhere in this graduated series of openings is the correct resistance for any given note at any specific volume. Practice and ‘trial and error’ are the necessary requirements for learning to use this resistance.”

Once the use of this resistance has become automatic, according to Farkas, it should be used on a note starting at pianissimo and building a crescendo to forte. The player should feel a rapid increase in air pressure as is necessary to sustain the note evenly. He then says, “As the pressure increases, the resistance in the larynx and arched tongue (and also the lip-aperture) gradually relax to accommodate the increasing volume of air. Most players use the diaphragm correctly when playing forte.” The most important dynamics to use the combination of diaphragm support and resistance on are notes that fall between pianissimo and piano. Farkas states that when executed properly by the performer, “…the power of this air pressure (plus the careful limiting of the

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110 Farkas, 29.
111 Ibid.
112 Ibid., 30.
amount escaping) will result in a soft, ringing tone which ‘floats’ on the air with remarkably little effort...”¹¹³ However, there is a danger of confusing this control of the glottis with the control of other throat and neck muscles. He states that the other muscles around the neck and throat should not be tense and that practice of these exercises should include checking the neck with the fingers to make sure it is relaxed. Farkas concludes this section by saying that care should be taken that the muscles of the shoulders are also relaxed because it is difficult to tense the neck without including the shoulders in the process.¹¹⁴

Bud Brisbois wrote a methodology with Lennie Niehaus in 1964 called Trumpet Today: A Planned Program for Building the High Register: Nine Recorded Solos Included. Brisbois emphasizes that learning to play in the upper register is not difficult if a trumpet player follows a planned program, but states that if the wrong approach is used it can be extremely difficult. He notes that playing in the upper register skillfully should feel as natural as playing in the low and middle registers.¹¹⁵ Brisbois also believes the most important factor in learning to play in the upper register is desire and two essential techniques are proper breathing and proper diaphragm use.¹¹⁶ Musical exercises for developing proper breathing and diaphragm use are presented in his book.

Proper breathing is essential according to Brisbois. He states that the player must fill both his lungs and diaphragm area to a “comfortable capacity,” only then will the player be able to “set the air” for performance.¹¹⁷ Brisbois refers to gripping the air before

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¹¹³ Farkas, 30.
¹¹⁴ Ibid.
¹¹⁶ Ibid.
¹¹⁷ Ibid.
exhaling or “setting the air” by contracting the muscles around the diaphragm area. His example suggests the proper way to set the air is to compress the air with the muscles surrounding the diaphragm as if you were preparing to be punched in the stomach.  

Brisbois gives further advice to the student that “setting-the-air” should be practiced correctly without playing the instrument before attempting the “Warm-Up” or “Lesson One.” Through concentrated effort, the air must be set before playing either low or high notes; this technique will become a correct and natural way to play. For the middle and low registers only a moderate amount of tension should be applied to the diaphragm area. The first musical exercises in the book focus on the middle and low register to develop proper breathing and “diaphragm-setting technique.” Brisbois feels that it is necessary to build a proper foundation for playing in the upper register and eventually to develop the ability to know the exact degree of tension needed to produce each note throughout the range of the trumpet. He states that for a high note the air has to be “…gripped firmly setting the air with more tension.” Brisbois suggests that by patiently following the prescribed lessons in his book, the student will develop the ability to know the amount of tension for each note up to high “D,” and be able to work up to this note without anxiety.

Practicing in this method revolves around attacks and lip slurs. Brisbois suggests that the player use “TA” for low notes and “EEE” for high notes while keeping the corners of the mouth firm. He advocates soft playing during warm-up and emphasizes

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118 Brisbois, 3.
119 Ibid.
120 Ibid.
121 Ibid.
122 Ibid.
123 Ibid., 4.
that the student should be careful not to play louder than forte, always playing with a controlled sound. This method does not offer any other explanation of the use of the tongue or glottis. However, the use of the glottis can be inferred in the explanation of “gripping” or “setting the air” where he describes compressing the air as if preparing to be punched in the stomach.\textsuperscript{124} This description most likely implies the activation of the glottis in a response such as its use in the Valsalva maneuver.

Scott Englebright and Donny Dyess wrote a trumpet method in 2000 to describe their approach to trumpet playing from the perspective of lead trumpet playing. Their description of breathing and the use of the glottis is the most comprehensive to date. In this method Englebright and Dyess discuss their approach to breathing and suggest that the player should “…maintain a level of relaxation slightly above unconsciousness (except your abdominal muscles and your corners (which are usually as tight as possible)).”\textsuperscript{125} The corners they are referring to are the corners of the embouchure.

They also advocate breathing practice without the horn and the back held straight, taking in as much air as possible through the mouth. The player should feel a stretching pressure inside of the rib cage that is comfortable and relaxed. They suggest that the shoulders should rise on their own, and after the lungs are full, the player should raise the shoulders a couple more inches to allow for a greater intake of air. Once the player’s lungs are full of air, they advise holding the air in for a few seconds while keeping the throat open using the abdominal and thoracic muscles to hold in the air. Also, they

\textsuperscript{124} Brisbois, 3.
\textsuperscript{125} Scott Englebright and Donny Dyess, \textit{The Tasteebros Way: All the Secrets to Playing the Trumpet the Easy Way} (Denton, TX: Tasteebros Publishing, 2000), 13.
promote the practice of taking in air and holding it in by closing off the throat (i.e. closing the glottis).\textsuperscript{126}

Englebright and Dyess believe this to be an important part of performing in the upper register. The next step in this process is to take in the air, close the throat, and create compression of the air by tightening the abdominal muscles, forcing the air towards the head.\textsuperscript{127} The analogy they use is a balloon being squeezed at one end and the air being forced to the end that is not being squeezed. They advocate letting the throat (i.e. the glottis) take the force of the compression and not the corners of the lips. The last step in the process is to release the air by opening the glottis, allowing the air to be expelled at a high velocity.\textsuperscript{128}

Englebright and Dyess suggest that once these processes are mastered the “...air speed can be regulated using your throat and abdominal muscles.”\textsuperscript{129} They suggest that these muscles will be able to control how high the player is able to play. On lower notes, they state that super-compression is not needed, but promote blocking semi-compressed air for lower notes with the middle part of the tongue at the first premolar after the canine teeth, instead of using the glottis.\textsuperscript{130} They emphasize that the embouchure should not be involved in holding back the air, but the compression should do all the work when the air is exhaled.

Englebright and Dyess explain further the closing of the throat by using the analogy of the throat (i.e. glottis) as a valve that controls the airflow to the embouchure. They explain that for high and loud notes, the glottis is completely open and the air is

\textsuperscript{126} Englebright, 14.
\textsuperscript{127} Ibid.
\textsuperscript{128} Ibid.
\textsuperscript{129} Ibid., 15.
\textsuperscript{130} Ibid.
pushed out quickly to vibrate the embouchure. However, the throat takes the force of the compressed air until it is released, and it will not be closed enough to create a ‘pinched’ sound.\textsuperscript{131}

Using the glottis to over-compress the air before its release ensures that the air is doing all the work and makes playing easier. “The same applies when using the tongue to stop the air.”\textsuperscript{132} They advocate that the more compression used the faster the air is expelled and this should be used to regulate which register is being played. Englebright and Dyess use the analogy of preparing to be hit by a little kid in the stomach for low notes and by a boxer for high notes. Faster air will be produced preparing for a boxer’s punch because the abdominal muscles will be much tighter. They reemphasize that the throat (i.e. glottis) not be used to pinch the air, but to regulate it. They describe a “pinched” sound as a “small, tight, whining sound.”\textsuperscript{133}

Englebright and Dyess suggest that the player can use either the abdominal muscles or the throat and tongue to start and stop the air. They feel that the throat and tongue are less likely to suffer from fatigue even though they use both the abdominal muscles and the throat and tongue when playing.\textsuperscript{134} They emphasize that when they make reference to closing the throat they are not referring to the tightening of the external muscles of the neck, they are referring to the vocal cords (i.e. glottis) only. An example they give is coughing, when the air is inhaled and compressed behind the glottis before it is released.\textsuperscript{135}

\textsuperscript{131} Englebright, 18.
\textsuperscript{132} Ibid., 19.
\textsuperscript{133} Ibid., 20.
\textsuperscript{134} Ibid., 22.
\textsuperscript{135} Ibid.
A theme of correcting problems with the glottis continues to circle back on correct breathing. Breathing is most fundamental part of brass performance; it is the fuel that ultimately creates sound production. Pilafian and Sheridan put it simply, as air creates vibration, vibration creates sound. The Breathing Gym, written in 2002, is included in the literature review as methodology that gets the body back to a neutral place in preparation to play with relaxed breathing.

Playing trumpet, or other brass instruments, requires more air than we normally use in everyday breathing. The more air used the more vibration created and this equals more sound production. The less air used the less vibration produced and this equals less sound. These exercises provide a strategy for control and efficiency of breath as well as improving sound production.

The exercises can be used as a warm-up routine, mid practice session as focusing exercise, or to target specific aspects of playing such as articulation, dynamics, and phrasing. Pilafian and Sheridan have divided them into five types of exercises:

1. Stretches: Stretching exercises allow the areas around the lungs and abdominal area to be loosened; creating more flexibility of the muscles required for breathing.

2. Flow Studies: these exercises are geared towards simulating breathing necessary for wind instruments. Moving air without resistance or tension is the main goal of this exercise, sometimes moving the air for long periods of time and sometimes moving the air quickly.

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137 Ibid.
3. Therapies: These exercises are used to inspire better airflow. Deliberately creating problems to conquer, such as resistance or suspension, helps accomplishes these goals. Therapies can also be used to solve tension that students may experience during flow studies.

4. Strength and Flexibility: These exercises are geared towards stretching the lungs to maximum capacity all the way down to completely empty. Over time the player will be able to use this increased range of breathing during performance.

5. Breathing for the brain: these exercises are geared towards creating focus and concentration.138

The beginning exercise that Pilafin and Sheridan suggest is “tension and release.”139 The student should sigh a few times, then take a good breath and sigh loudly. A variation of this exercise is to take a deep breath and tense the arms, shoulders, and fist, then exhale and explode the tension and air. The body should fall into a relaxed position of correct posture upon release.

The second exercise is a flow study “six-seven-eight-nine-ten” and is described as follows:

Breathe in for six counts and out for six count. When inhaling, raise arms up and out at your sides until they reach directly over your head when full. Bring your arms down and out at your sides until they are hanging at your sides at the end of the count. Repeat smoothly for 7 counts. Increase the count (thus slowing the breathing) to 8, 9, and 10. Increase to greater counts for added breathing virtuosity. (quarter note equals 72)140

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138 Pilafian, 5.
139 Ibid., 8.
140 Ibid.
These flow studies are purposed to simulate proper breathing for brass performance. The addition of the arms during this study allows the player to feel the rib cage expanding during inhale and falling during exhalation. The count is purposely slow to imitate the needed airflow for playing a brass instrument seeing that this breathing is above average from normal everyday activities. A variation of this exercise is increasing the number of counts gradually from thirty to as high as sixty. The goal for this variation is to attain the highest levels of control. Progress to this level should happen over time to sustain interest and safety.

The third exercise is “flow awareness,” which includes taking the second exercise and adding movements to help simulate different dynamic levels. They suggest using a “Bow and Arrow” movement for fortissimo air, “Toss the Darts” movement as mezzo forte air, and “Float Paper Airplanes” movement for pianissimo air. This flow awareness exercise helps demonstrate the musical use of airflow by creating the feeling of moving the air as it relates to the different dynamic levels.

Pilafian and Sheridan give important advice on correct form for executing these types of exercises. Correct shape of the mouth must be maintained for unrestricted airflow and the student should shape the mouth as if saying “Oh” or “Whoa.” The student should breathe evenly and constant over the entire count. They advise that the air should constantly be in motion, either breathing in or out, but never holding it. The

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141 Pilafian, 9.
142 Ibid.
143 Ibid.
144 Ibid.
change in airflow direction should always be smooth between inhalation and exhalation, and breathing should always feel easy and relaxed as possible.\textsuperscript{145}

The fourth exercise is referred to as “inhale therapy.”\textsuperscript{146} Pilafian and Sheridan describe the exercise as creating extreme resistance or suction during inhalation by placing the back of the hand in front of the mouth to block airflow. The hand should be quickly removed creating a “pop” sound, allowing a quick, deep inhale. Exhalation should occur smoothly and this exercise should be repeated four to six times. The purpose of this exercise is to stimulate the abdominal muscles. The muscles are forced to work harder which results in awareness and more efficient use of abdominal muscles during normal breathing.\textsuperscript{147}

This exercise can be varied to focus attention on specific muscle areas. During the suction on the back of the hand, expand the lower abdomen for two counts followed by the expanding the lower back for two counts then quickly remove the hand. This exercise should be repeated four to six times. A second variation of this exercise is to expand the lower abdomen for two counts, the lower back for two counts, the upper front of the abdomen for two counts, and the upper back for two counts. The hand should quickly be removed to allow for quick, deep inhalation, followed by smooth exhalation. This exercise should also be repeated four to six times.\textsuperscript{148}

One other variation of this exercise is to create a slight leak in the suction. The hand should be over the mouth, but the air should be leaking in slightly. Full inhale should take place in three seconds under this pressure. During the suction part of this

\textsuperscript{145} Pilafian, 9.
\textsuperscript{146} Ibid.
\textsuperscript{147} Ibid., 10
\textsuperscript{148} Ibid.
exercise the student should feel strain on both the abdominal muscles and in the area of the throat. Immediately after removal of the resistance, the student should be focused on the inhalation being open and resistance-free.\textsuperscript{149}

The fifth exercise Pilafian and Sheridan call “exhale therapy.”\textsuperscript{150} The student should breathe in smoothly for four counts, followed by suspending the air for four counts. The student should then exhale for four counts expelling only half the air, suspend the air for one count, then blow the remaining air out squeezing the abdomen tight. This exercise should be performed three times, attempting to breathe gradually deeper with each consecutive inhalation. When the air is suspended it is not held in with a point of resistance such as with the tongue or glottis. The mouth and the air passageway should remain completely open during the suspension of the air.\textsuperscript{151} A variation that Pilafian and Sheridan suggest, “Breathe in for sixteen counts – slowly, evenly and smoothly. Suspend the breathing for four counts. Then explode the air out in one huge chunk vocalizing with the throat and compressing the abdominal muscles.”\textsuperscript{152}

The sixth exercise presented is “oral shape therapy.”\textsuperscript{153} In this exercise the student uses an “oh” shaped mouth, inhaling in eighth notes for four counts followed by exhaling in eighth notes for four counts, then inhale quarter note triplets for four counts followed by exhaling quarter note triplets for four counts, then inhale quarter notes for four counts followed by exhaling quarter notes for four counts, then inhaling half notes for four counts followed by exhaling half notes for four counts, and finally inhale a whole note for four counts followed by exhaling a whole note for four counts. One variation on this

\textsuperscript{149} Pilafian, 11.  
\textsuperscript{150} Ibid.  
\textsuperscript{151} Ibid.  
\textsuperscript{152} Ibid., 12.  
\textsuperscript{153} Ibid.
exercise is to do the same exercise starting with sixteenth notes four counts each followed by eighth note triplets four counts each and continue playing the exercise all the way through. A second variation is to play the sixth exercise with whole notes and play the exercise in reverse. See example 2.0 below for the written exercise.

Example 2.0 Oral Therapy Exercise

Monitoring the flow is introduced to exercises. Holding the hand perpendicular to the lips allows the player to hear a resonant sound of the air going around the hand during inhalation. If the airflow is too weak then the player will know there is not enough air moving. To monitor exhalation, the hand can be held out parallel to the lip at arms length to check for smooth and even airflow being expelled. These methods of monitoring the

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154 Pilafian, 12.
air should be used occasionally with the breathing exercises to ensure that the air is being inhaled and exhaled properly.\textsuperscript{155}

The seventh exercise introduced is to “shorten inhalation.”\textsuperscript{156} During this exercise the player breathes in for four counts and out for four counts. This should be repeated once, followed by breathing in for two counts and out for four counts. This should be repeated once, followed by breathing in for one count and out for four counts. This pattern should be repeated for twenty seconds. The quarter note should equal sixty to eighty beats a minute and one repetition a day should be added until the pattern can be performed for one minute without discomfort or severe dizziness.\textsuperscript{157}

Shortening the inhalation is a variation of the exercise using the following count structure: four counts in and four counts out, three in and five out, three in and six out, two in and seven out, two in and eight out, one in and nine out, and one in and ten out. “The longer exhalations simulate the airflow of softer dynamics.”\textsuperscript{158}

The eighth exercise is called “shorten the exhalation.”\textsuperscript{159} The student should inhale for four counts and exhale for four counts, then repeat. Inhale for four counts and out for two counts, then repeat. Inhale for four counts and exhale for one count. The pattern of the exercise should be repeated for twenty seconds. Gradually increase the four and one pattern as long as it is comfortable. Continue to add one repetition a day until the pattern can be repeated for one minute without discomfort or severe dizziness.\textsuperscript{160} The tempo should be between sixty and eighty beats per minute.

\textsuperscript{155} Pilafian, 13.
\textsuperscript{156} Ibid.
\textsuperscript{157} Ibid.
\textsuperscript{158} Ibid., 14.
\textsuperscript{159} Ibid.
\textsuperscript{160} Ibid.
The purpose of this exercise is to keep the amount of exhaled air the same as the count shortens. The airflow rate should be much higher at the end of this exercise than what would be used in performance in order to strengthen the abdominal muscles. The oral shape should remain the same for this exercise and it gives the student a large opening for the air to move.\textsuperscript{161}

This exercise can be varied by using the following counts: Inhale for four counts and out for four counts, in for five counts and out for three counts, in for seven counts and out for two counts, in for eight counts and out for two counts, in for nine counts and out for one count, and in for ten counts and out for one count.\textsuperscript{162}

Example 2.1 Flow Studies Hand Visualization\textsuperscript{163}

The ninth exercise is “shorten inhalation and exhalation.”\textsuperscript{164} The student should inhale for four counts and exhale for four counts. This should be repeated once followed by inhale for two counts and exhale for two counts. This should be repeated once followed by inhale for one count and exhale for one count. The pattern should be

\textsuperscript{161} Pilafian, 14.
\textsuperscript{162} Ibid.
\textsuperscript{163} Ibid., 15.
\textsuperscript{164} Ibid.
repeated for twenty seconds and, the one in and one out, should be gradually increased daily as long as comfortable. The goal for this pattern is to add repetition over time until it can be done for one minute without discomfort or severe dizziness.\footnote{Pilafian, 15.}

This exercise is not just physical it is also mental. The idea is to remain calm and relaxed, especially as dizziness starts to occur. The student should “relax in to the discomfort.”\footnote{Ibid.} Students who practice this exercise will gain resistance to hyperventilation. This exercise will get easier as the student allows the body to accommodate.\footnote{Ibid.}

This exercise should be varied using the following count structure: inhale four counts and exhale four counts and repeat, inhale three counts and exhale four counts and repeat, inhale two counts and exhale two counts then repeat, inhale one count and exhale one count. Then inhale and exhale in eighth notes eight times followed by one in and one out four times. Then inhale and exhale in sixteenth notes for eight to sixteen times followed by one in and one out, two in and two out, and rest breathing through the nose for twenty counts followed by a loud sigh.\footnote{Ibid.}

The tenth exercise is a “quick breath exercise.”\footnote{Ibid.} Each exercise should begin with a four beat inhalation. The following lines in Example 2.3 should be repeated four times each.

\footnote{Pilafian, 15.}
\footnote{Ibid.}
\footnote{Ibid.}
\footnote{Ibid.}
\footnote{Ibid.}
\footnote{Ibid.}
Example 2.3 Quick Breath Exercise\textsuperscript{170}

The purpose of this exercise is to create smooth effortless inhalation. This exercise takes great coordination. This is effective for preparing to breathe in music where a passage has no built-in place to breathe. “The focus of this exercise is to produce fast, efficient, frictionless inhalation and then deliver smooth walls of air upon exhalation.”\textsuperscript{171}

\textsuperscript{170} Pilafian, 16.
\textsuperscript{171} Ibid.
The eleventh exercise is called “flow check patterns.” This exercise should be done with the student holding the palm in front of his face to feel the airstream while using the following rhythmic sequences shown in Example 2.4.

Example 2.4 Flow Check Patterns

During each exercise the student should tongue each note and keep the airflow moving. Each phrase should use one breath. The student should use the palm of the hand at elbow length to check the airstream and gradually move it to full arms length. This exercise should be used with common tunes, for example, folk songs such as Yankee Doodle and excerpts of pieces the student is currently learning. “This exercise allows for

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172 Pilafian, 17.
173 Ibid.
practical application of the quick breath exercise when each line is repeated several times.”

The twelfth exercise is “five in, fifteen hold, five out.” The student inhales for five counts. The air is then suspended for fifteen counts while sipping air every few seconds to top off the lung capacity. This suspension of air is done with holding the expansion of the abdominal muscle and not with the closing of the glottis. This exercise should be done three times with the goal of taking in more air each time and emptying more each time. The purpose of this exercise is to build strength and flexibility. The muscles are stretched on inhalation and compressed during exhalation working the muscle groups in both directions. Like the previous exercises the mouth should be formed as if saying “Oh” or “Whoa” during inhalation.

The thirteenth exercise is “power breaths.” The student inhales for one count and exhales for one count. This exercise starts with the palms together and arms straight out in front of the body. On the inhalation, the arms should move slightly up to the side of the body. During exhalation, the palms should be pressed firmly together as if squeezing an object. Begin this exercise by doing four repetitions and gradually working up to ten over time. The metronome marking should be set to sixty to eighty-eight beats a minute. This exercise is supposed to work out the muscles involved in breathing, building both strength and flexibility. The muscles groups are worked in both directions. Example 2.5 shows the correct movement for power breaths.

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174 Pilafian, 17.
175 Ibid., 18.
176 Ibid.
177 Ibid.
178 Ibid.
179 Ibid.
Example 2.5 Power Breathing

The power breath exercise should be varied. The student should do the same exercise, but inhale for one count and exhale for two counts. This should create longer compression in the arms and in the abdomen. The inhalation should also be subdivided by eighths, eighth note triplets, and sixteenths.

The fourteenth exercise is called “in, sip, sip – out, push, push.” The student should inhale to full capacity in one count and top off capacity in two sips. This is followed by exhaling comfortably empty in one count, then pushing out all the remaining air in two counts. This pattern should be repeated for twenty seconds. The tempo should be slow eighth notes at one hundred ten beats a minute. This should feel like a slow six/eight time signature.

The purpose of this exercise is similar to the previous exercise. It is designed to work the muscle groups on both inhalation and exhalation. Mastery of this exercise will

\[^{180}\text{Pilafian, 19.}\]
\[^{181}\text{Ibid.}\]
\[^{182}\text{Ibid., 20.}\]
\[^{183}\text{Ibid.}\]
allow the mechanics of the muscles to act naturally when the student’s mental focus shifts to the embouchure. Like previous exercises the mouth should form an “Oh” of “Whoa” shape during inhalation. The student should never hold the air, it should always be moving in or out. See Example 2.6 for movements that should accompany this exercise.\textsuperscript{184}

Example 2.6 Motions for In, Sip, Sip – Out, Push, Push\textsuperscript{185}

\textsuperscript{184} Pilafian, 20.
\textsuperscript{185} Ibid.
\textsuperscript{186} Ibid., 21.

The fifteenth exercise is “throw the ball.”\textsuperscript{186} The student should inhale to full capacity in one count and then sip for two counts followed by a smooth exhale in one complete motion to empty the lungs and create a tight abdominal squeeze. This exercise
should be done with a motion of winding up of an imaginary ball and throwing it. The motion should be like an over-hand pitch and on exhale the hand should be stretched outward as the air is squeezed empty from the lungs.\textsuperscript{187}

The purpose of this exercise is similar to the previous exercise. It is used to build muscle and flexibility by stretching the muscles on inhalation and contracting them on exhalation. “This flexibility will allow muscles that enclose the lungs to act in a natural ‘bellows’ effect when the mental focus is at the lips. The exhalation is combined into one motion to increase the workout to the abdominal muscles.”\textsuperscript{188} See Example 2.7 for the correct motion for this exercise.

Example 2.7 Motions for Throw the Ball\textsuperscript{189}

\textsuperscript{187} Pilafian, 21.
\textsuperscript{188} Ibid.
\textsuperscript{189} Ibid.
The sixteenth exercise is called “power bow and arrow.” The student should inhale to full capacity in one count and exhale completely empty in one count. During the exercise the student should imagine shooting a bow and arrow. “Both the stretch and the compression should be smooth and deliberate.” The student should extend the bow arm on exhalation and continue pushing forward while squeezing out every last bit of air.

The purpose of this exercise, like the previous, is building strength and flexibility. The muscle groups are stretched on both inhalation and contracted on exhalation. By combining the inhalation and exhalation into one smooth motion each direction, this increases the abdominal muscles’ workout. Exercises fifteen and sixteen should have a hissing sound at the end so that the student can tell when they are completely empty. Like previous exercises the air should always be moving in or out and should never be held. See Example 2.8 for the proper motion.

Example 2.8 Motion for Bow and Arrow Exercise

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190 Pilafian, 21.
191 Ibid., 22.
192 Ibid.
193 Ibid.
194 Ibid.
The seventeenth exercise is called “follow your breath.” The student should breathe in through the nose and out with the mouth at a normal relaxed pace. The student should sit quietly for a few minutes and just be aware of the breath without attempting to control it. The exhalation should be thought of as the first part and the inhalation as the second part of the breath. This is the reverse of normal thinking. “However, one of the ways we can increase our ability to use our given lung capacity is to increase the range of motion on the exhalation.” This exercise is like a warm-up exercise and it helps clear the mind and allows the student to focus. This type of exercise could be used anytime during the day to bring the mind to a quiet and focused place.

The eighteenth and final exercise is called “six – six – six.” The student should inhale for six counts, then hold for six counts, and exhale for six counts. The holding of the breath should be a suspension of the air using the abdominal muscles. The air should not be closed off at the glottis as if a person was holding their breath to jump into a body of water. This exercise should be done at sixty beats per minute. The purpose of this exercise is to focus the brain, which is important to the process of creating music.

This exercise should be done in the same manner as previous exercises. This exercise can be used anytime during the day that the student feels tired. Exhalation should be smooth and even for the entire count in order to get the best results out of the exercise.

This exercise should be varied by using the following count patterns: The first pattern is referred to as “one:one:one” and breathing should be in counts of six-six-six.

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195 Pilafian, 23.
196 Ibid.
197 Ibid.
198 Ibid.
199 Ibid.
eight-eight-eight, ten-ten-ten, and fifteen-fifteen.\textsuperscript{200} The second pattern is referred to as “one:two:one” and breathing should be in counts of six-twelve-six, eight-sixteen-eight, ten-twenty-ten, and fifteen-thirty-fifteen. The third pattern is “one:four:one” and breathing should be in counts of six-twenty-four-six, eight-thirty two-eight, ten-forty-ten, and fifteen-sixty-fifteen.\textsuperscript{201} The fourth and final variation is called the “energizing breath.”\textsuperscript{202} The student inhales four counts in through the nose, suspends the air for seven counts, and exhales for eight counts through the mouth at quarter note tempo equals one hundred forty four. This final exercise should have “…the tongue held in a yogic position, (like saying the letter “L”). This position will create a whooshing sound upon exhalation.”\textsuperscript{203}

Pilafian and Sheridan also include some stretches for loosening the muscles involved in breathing. They suggest beginning with one or more of these stretches before starting the breathing exercises. The first stretch they advocate is the “trunk twist.”\textsuperscript{204} The student spreads the feet shoulder width apart and raises hands to shoulder level while gently twisting back and forth. The student should then raise the hands higher above the head during this stretch.\textsuperscript{205}

The second stretch they suggest is the “flop over.”\textsuperscript{206} The student bends over at the waist and breathes deeply. Upon each exhale the student’s arms and head should get closer to the floor. During inhalation the students upper body may raise slightly.

\textsuperscript{200} Pilafian, 24.
\textsuperscript{201} Ibid.
\textsuperscript{202} Ibid.
\textsuperscript{203} Ibid.
\textsuperscript{204} Ibid., 25.
\textsuperscript{205} Ibid.
\textsuperscript{206} Ibid., 26.
purpose of this stretch is to make the student aware of the body parts that are used during deep breathing as the body rises and falls.\textsuperscript{207}

The third stretch is called the “two-way stretch.”\textsuperscript{208} The student reaches as high as possible with the hands above the head. At the same time the student pushes down into the floor with their heels. The most benefit is gained from this stretch when the upward and downward movement is exaggerated.\textsuperscript{209}

The fourth stretch is called the “wrist grab.”\textsuperscript{210} This exercise has the arms behind the back while grabbing the right wrist with the left hand. The student then gently pulls the right wrist to the left while simultaneously leaning the head to the left. While taking four deep breaths, move the head and the wrist farther to the left each time. The student should then take four more deep breaths while leaning the upper body farther left each time. The student should also sigh loudly when exhaling making the stretch deeper upon each exhale. Then the student should stand up straight grabbing the left wrist with the right hand and repeat the exercise leaning to the right.\textsuperscript{211}

The fifth stretch is the “elbow grab.”\textsuperscript{212} This is a common stretch where the student puts the left elbow behind the head and grabs it with the right hand. Then the student gently pulls the elbow to the right. While taking four deep breaths, the elbow should be pulled farther to the right each time. Then the student should take four more deep breaths while leaning the upper body farther to the right each time. The student

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{207} Pilafian, 26.
\item \textsuperscript{208} Ibid.
\item \textsuperscript{209} Ibid.
\item \textsuperscript{210} Ibid., 27.
\item \textsuperscript{211} Ibid.
\item \textsuperscript{212} Ibid., 28.
\end{itemize}
\end{footnotesize}
should also sigh loudly when exhaling making the stretch deeper upon each exhale. The student should repeat the exercise with the right elbow moving the body to the left.\footnote{Pilafian, 28.}

The final stretch is the “whole body stretch.”\footnote{Ibid., 29.} The student should interlock the fingers behind the back. Then breathe deeply tightening the shoulder blades upon inhale and loosening them on exhale. The fingers should be kept interlocked behind the back while the student bends over at the waist. The hands should rise behind the back. The student should commence deep breathing and allow the head to get closer to the floor upon each exhale.\footnote{Ibid.}

These exercises and stretches are like therapy to get the body back to a neutral point of relaxed breathing. It is easier to correct problems of glottal tension if one understands relaxed breathing. Pilafian and Sheridan’s method has a large number of exercises that provide constructive ways of practicing correct breathing, which will make an impact on a person learning to properly use the glottis in performance.

The following study is the most complete source for studying the method of trumpet player Bobby Shew and his widely used breathing approach called the \textit{wedge breath}. Stephen Roach writes, in 2004, in his doctoral of arts essay on Bobby Shew, that Shew acknowledges a controversy over part of his \textit{wedge} breathing technique.\footnote{Stephen Warren Roach, “Bobby Shew: His Life, Performance Career, and Pedagogical Methodology” (DA essay, University of Northern Colorado, 2004), 95.} Shew believes the reason behind this controversy is that some brass pedagogues believe that having a student raise the shoulders on inhale would add the stress of unnecessary physical tension in the area of the throat, with the possibility of inadvertently causing the throat to be closed off by the glottis. However, Shew believes that it would be cheating a
student out of twenty-five to thirty-five percent of air capacity if the student was told never to lift the shoulders on inhale.\textsuperscript{217}

Roach explains Shew’s six steps of the wedge breathing as follows: Step one involves expanding the abdominal area, approximately around the navel, more slightly forward and outward. The abdominal muscles should remain relaxed and not tense during this step as the muscles are pushed outward. This step allows room for the diaphragm to drop slightly which draws air into the bottom part of the lungs. It is important the player not take in too much air during this first step.\textsuperscript{218}

Step two involves the placement of the wedge. Shew describes it like imagining a doorstop being placed under a door to hold it in place. Recommending the word “who” to be pronounced silently during inhalation, the abdominal muscles are contracted inward on a horizontal plane avoiding lifting the muscles towards the diaphragm. He claims necessary tension is to be added to get the abdominal muscles to move inward, but cautions that not too much muscle tension be added at this step in the process. Too much tension at this step will prohibit the body taking in the full amount air on the next step.

The third step involves filling the lungs to full capacity and completing the breath. The shoulders must be raised upward. This should happen as a natural smooth motion while avoiding pulling the shoulders back or pulling them forward towards the chest. This allows pressure to be taken off the top of the lungs, enabling them to expand and increase the lung capacity overall.\textsuperscript{219}

The fourth step in the wedge breathing technique is described as an isometric grip in the abdominal area. More isometric tension is applied in the abdominal area from step

\textsuperscript{217} Roach, 95.  
\textsuperscript{218} Ibid., 93.  
\textsuperscript{219} Ibid., 94.
two. This is similar to the description of “setting the air” by Bud Brisbois. Roach also quotes Shew explaining that people use these muscles in everyday life such as when pushing heavy objects, lifting weights, or in other sports activities. This isometric tension described by Shew is basically a description of the Valsalva maneuver. Shew then uses Brisbois’ analogy of gripping the air as if a student was about to be punched by an individual.\textsuperscript{220} “Gripping the air” provides “the wedge” with the compression of air and creates extreme levels of power and intensity when needed.

The fifth step in this breathing technique is to lower the shoulders back to the original playing position. This position may vary based on the horn angle, mouthpiece positions, and the amount of compression this being used. The amount of compression that will be used in this breath depends on the playing situation. Playing lead trumpet in a big band requires more compression than playing in an orchestra, wind ensemble, or brass quintet. By bringing the shoulders down more pressure is put on the chest cavity and top of lungs.\textsuperscript{221}

The sixth and final step of the wedge breath is the exhalation of air. Shew has a specific approach to aid in developing the correct position of the embouchure muscles for releasing the air. He suggests placing the tongue between the lips, set the embouchure, and propel the air with high velocity as if spitting a grain of rice across the room. Shew believes that the setting of the embouchure in this manner should take place at the end of step three, during step five, or just prior to the exhale in step 6.\textsuperscript{222}

Using the tongue in the manner described above will help strengthen the muscles surrounding the aperture as the wedge breath is too strong for these muscles. These steps

\textsuperscript{220} Roach, 95.
\textsuperscript{221} Ibid., 96.
\textsuperscript{222} Ibid.
allow the player to take in the maximum amount of air into the lungs and expel the air at a high velocity. Shew’s prescribed method for practicing the six steps: (1) Do the six-step exercise sixty times a day for twenty-one days without skipping a day. These could be separated into two sessions a day and it is possible to add more repetitions but it is important to do these exercises for twenty-one days. (2) Close your eyes while doing the exercise to help internalize the routine. (3) Eliminate pauses in between the steps as quickly as possible making the breath ones smooth motion. This should be done in slow motion gradually speeding up the process until all six steps take one second.

After the steps have been learned over time, the player will be able to modify the breath to suit their individual needs. These exercises should increase lung capacity as well as help with glottal closure during exhalation. The high velocity of air that is exhaled for the wedge can only happen with the glottis fully open.

In 2006, David Hickman, a trumpet professor currently on faculty at Arizona State University, writes in Pedagogy: A Compendium of Modern Teaching Techniques that

Many trumpeters have experienced light-headedness or even black-outs from playing loud, high passages. This is sometimes a result of the neck muscles tightening and partially cutting off the blood supply to the brain. Another contributing factor may be increased pressure in the chest, producing a Valsalva maneuver resulting in reduced output from the heart. A Valsalva maneuver is an expiratory effort against a closed glottis (open space between the vocal cords) which increases pressure within the thoracic (chest) cavity and thereby impedes venous return of blood to the heart.223

The above quote is an example of a musical disruption by the body blacking out and the performer no longer being able to play. Hickman also states that playing loud in

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general is not enough to cause a trumpet player to pass out; blackouts typically occur when a trumpet player has to hold loud, long passages until air is depleted from the lungs. The only advice that he gives about blacking out is to maintain a solid standing or sitting position to avoid falling if dizziness or blackout occurs and to make sure that the head is in a balanced posture along with a normal position of the shoulders in order to keep the neck in a relaxed position.\textsuperscript{224}

Another improper use of the glottis, which produces an undesired musical effect, is when the trumpet performer makes grunting noises. Hickman believes that most trumpet players make slight grunting noises, particularly when fast single tonguing is involved. Hickman notes that it is not a major problem because rarely is the grunting heard farther than twenty feet away. According to Hickman, this grunting can be caused by, “excessive muscle tension in the upper chest and neck, fatigued muscles controlling the larynx, or ‘articulating’ in the throat by allowing the ‘T’ or ‘K’ syllables to be too far back in the oral cavity.”\textsuperscript{225}

Grunting can occur without being fatigued and in this case Hickman recommends the following as remedies:

Connect rapid notes by lengthening them as much as possible. This keeps the throat open and does not allow the vocal cords to open and close with each note. Articulate “Ts” and “Ks” in the front of the mouth near the teeth. Keep the head and neck in good posture so that the neck muscles are as relaxed as possible. Relax the upper chest and shoulders. Connect inhalations with exhalations to avoid “locking” the air with the larynx.\textsuperscript{226}

Hickman also addresses the topic of stuttering attacks describing them as a psychological condition occurring in players who have difficulty producing the initial

\textsuperscript{224} Hickman, 240.  
\textsuperscript{225} Ibid., 224.  
\textsuperscript{226} Ibid.
notes of phrases. These conditions typically occur on notes that begin phrases after a long rest. Stuttering attacks are also related to stuttering words and are usually caused by the person consciously thinking about the mechanics of articulation.\textsuperscript{227} Hickman finds it interesting that when an individual’s mind is thinking about something other than the mechanics (physical movement of the tongue) the individual can usually start the phrases without stuttering attacks. He feels that the performer must find creative ways of distracting the mind by focusing on other aspects of performance. His examples are:

(1) “hearing” the first note respond perfectly in the mind just at the instant of playing the note, (2) nodding the bell as a visual cue, (3) using breath attacks on first notes of passages during practice, (4) tapping a toe or heel at the exact instant of playing the first notes of a passage during practice, (5) keeping the air constantly moving during inhalation and exhalation so that the larynx does not “lock” the air, (6) blowing air as if extinguishing a candle held at arm’s length, the student should sense all air movement outside his or her body, when air flow is visualized in this way, mechanics of playing are automatic, (7) mentally counting off tempo and entrance\textsuperscript{228}

Hickman notes that stuttering most frequently occurs when players are going through embouchure changes, mouthpiece changes, or learning a different technique of articulating. He says stuttering should “…be expected to continue until new brain signals are mastered.”\textsuperscript{229} The student should be told to remain patient and the stuttering should disappear in time, “—usually within a couple of weeks.”\textsuperscript{230}

Hickman has also written a section on unwanted neck and chest tension citing that these areas of tension are associated with arching the tongue at the back of the mouth causing airflow to be choked off. He says correcting faulty posture and developing full,
relaxed breathing, and arching the tongue in the correct manner are ways to relieve tension in the neck and throat. Hickman does not mention the role of the glottis in neck tension, nor does he describe the proper way to arch the tongue in this section.

According to Wayne Bailey and others, in the 2008 book *Teaching Brass: A Resource Manual*, proper breath control and support is essential to producing an acceptable tone on any brass instrument. They discuss how speed and steady air column is essential to producing the necessary vibration at the embouchure. Bailey and others, suggest that for all brass teachers, understanding all the body parts involved in the breathing process is important to diagnose and solve breath-control problems.

According to Bailey and others, the dome-shaped structure comprised of muscle and membrane that separates the chest cavity from the abdominal cavity is called the diaphragm. “During inhalation, the diaphragm contracts downward and flattens out, allowing the chest cavity to expand vertically. This contraction of the diaphragm allows the lungs to expand and take in air. The diaphragm actually relaxes during exhalation, returning to its dome shape and reducing the volume of the chest cavity.”

Another part of the body involved in the breathing process is the thorax or chest cavity. Bailey and others purport that the chest cavity is capable of expansion horizontally by enlarging the thorax (rib-cage). The muscles controlling and connecting the thorax are termed “intercostal” muscles; when these muscles contract the thorax expands in volume. Since both the intercostal muscles and the diaphragm are connected, they create both horizontal and vertical expansion when they are contracted.

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231 Hickman, 223.
233 Ibid.
234 Ibid.
235 Ibid.
simultaneously. Bailey and others believe that most physical effort is exerted during inhalation and that both sets of muscles are relaxed during proper exhalation.236

According to Bailey and others points of resistance can occur in the air column during exhalation, but should not occur during inhalation. They describe three points of resistance during exhalation as the glottis, the tongue, and the aperture.237 The glottis being the first point of resistance during exhalation, they describe it as the space created between the opening and closing of the vocal cords. The size of the glottis changes during ordinary behaviors such as in talking, coughing, or sighing. Bailey and others, say that most brass pedagogues advocate playing with an open glottis to create the least amount of resistance at that point.238 The tongue is to be considered the second point of resistance during both inhalation and exhalation. By changing the shape of the tongue in the front or back, the player can create a varying degree of resistance from slight resistance to total resistance of the air column.239 The last point of resistance to the air column during exhale is at the aperture, which is the opening between the lips created by the air column. The size of the aperture depends on the speed and volume of airflow as well as the amount of tension in the lips. According to Bailey and others, “Proper control of these three resistance points… is essential for good tone production.”

Another important aspect to breathing is developing good posture, according to Bailey. The main reason for good posture is having the body in a relaxed and ideal

236 W. Bailey, 5.
237 Ibid.
238 Ibid.
239 Ibid.
position to allow all the muscles of the lungs, diaphragm, and thorax to function optimally. Bailey and others, suggest that

When sitting, the student should sit forward with the back away from the chair, the feet flat on the floor, and the spine upright, non-curvilinear position. In assuming this position, the student must be careful not to raise the chest too high or allow any muscles to become rigid.

When standing, the student should avoid slouching or tensing the chest and abdominal areas. Twisting or contracting of the chest and abdominal areas reduces the air capacity of the lungs.

Once the posture is addressed, the focus shifts to breathing.

Breathing involves two motions, inhalation and exhalation. The first motion discussed is inhalation. Bailey and others advocate always inhaling through the mouth with the glottis open and the tongue low in the mouth and out of the way so that the inhaled air encounters zero resistance. They suggest that, “The inhalation should be a very rapid intake of a large quantity of air. The simultaneous contraction of the diaphragm and intercostal muscles allows for a ‘deep’ breath that fills the lungs. When inhaling, the player should feel as if the lungs are filled from the bottom first, then upward.”

Bailey and others advocate using analogies due to the abstract nature of discussing the process of proper breathing. One analogy suggests that the student should feel as though they are growing taller, without raising the shoulders, to achieve the vertical and horizontal expansion of the thorax. Another analogy is for the student to imagine the oral cavity and glottis being big enough to swallow an orange or baseball, in order provide the inhaling air column with no obstruction. Visualizing filling a glass of

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240 W. Bailey, 6.
241 Ibid.
242 Ibid.
243 Ibid., 8.
water from the bottom up during inhalation might be useful. Bailey and others state,

“Proper inhalation might feel like a rapid, silent gasp of air or a deep yawn.”

They also advocate using any analogy to help create thoughts or openness or relaxation of the air passages.

The second motion discussed is exhalation and Bailey et al. state that, “The air should not be held in the lungs after inhalation; exhalation should begin immediately.”

Exhalation should be a smooth and steady column of air projected into the instrument in order to produce a proper steady tone. The student should relax the intercostal muscles and the diaphragm, and in order to create a smooth flow of air the abdominal muscles should be contracted around the waist. They state, “The speed with which the air column is released helps regulate the volume of tone and the speed of the vibrations of the lips.”

A suggested exercise is holding the hand out in front of the mouth at arms length so the student will feel the air striking their hand when blowing air through the embouchure.

There are common problems that occur with breath control according to Bailey and others. They suggest that the most common problem is clavicular breathing, which is a very shallow breath that takes place in the upper-chest and raises the clavicles during inhalation. This type of breathing can be evident if the student raises their chest or shoulders during inhalation. According to Bailey and others, another common problem noticed among students is the retention of air (depleted of oxygen) in the lungs, which

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244 W. Bailey, 6.
245 Ibid.
246 Ibid.
247 Ibid., 7.
248 Ibid.
249 Ibid.
can “…lead to tension in the chest and abdominal muscles or even to hyperventilation.”  

This type of breathing typically occurs with high brass players who inhale more air before they have expelled all the air in their lungs. Bailey and others suggest the student take larger and fewer breaths to help eliminate this problem.

“Setting” the breath is another common problem found among high brass players. Bailey and others find that players often pause after inhalation and hold the breath before starting the exhalation. They suggest that there should always be a smooth immediate turnaround of air during the inhalation and exhalation process. The air column should never stop moving in the process of breathing for playing an instrument. They also state that it is common for air columns to move too slowly, caused by resistance in the throat (glottis), tongue, or by the abdominal muscles. Bailey and others claim that this is often referred to as *squeezing* the tone. They claim that because the air column is weak and unsupported, the player should be encouraged to relax the throat, the tongue should be on the bottom of the mouth, and the air column should be released faster.

The following exercises are suggestions by Bailey and others to help improve inhalation and exhalation:

1. Slow inhalation exercise: (a) Place the hands on the sides of the waist in order to feel the horizontal expansion achieved in correct inhalation. (b) Slowly inhale, filling the lungs. The student should feel the stomach area expand, first from the bottom and then upward to the chest cavity. (c) Exhale in a rapid “sigh” with no resistance points.  
2. Rapid inhalation exercise: Repeat exercise 1 with rapid inhalation.  
3. Inhale for eight counts at a speed equivalent to a metronome setting of 100. Exhale through the embouchure (with no lip vibration) for a duration of sixteen counts. Repeat, decreasing the duration of exhalation by two counts until exhalation reaches the point of eight counts.  
4. Repeat exercises three

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250 W. Bailey, 7.  
251 Ibid.  
252 Ibid.  
253 Ibid.
with the duration of inhalation equal to six, four, and two counts, and finally one count.254

These exercises should help the brass student find, that even though this process of breathing is not considered normal breathing, the inhalation-exhalation process can feel natural. Bailey and others state that, “A new breathing method is not needed; simply learning to enhance the natural breathing method to expand lung capacity will suffice to achieve proper breath control.”255 They also suggest modeling as an effective way of teaching the student these exercises rather than focusing on the specifics of breathing.

In the chapter relating to trumpet in Teaching Brass: A Resource Manual, Bailey and others suggest that developing breath control for trumpet should be learned in a relaxed manner.256 He believes the only point at which the air column should encounter any kind of resistance is at the embouchure. Siebert continues by saying that during exhalation the tongue, throat (glottis), and abdominal muscles should be fully relaxed, which in turn allows for the diaphragm to be relaxed.257 According to Siebert, “A ‘breathing tube’ can be used to teach relaxed inhalation. Simply a short ¾-inch PVC (polyvinyl chloride) pipe, it can be found at any hardware store. Putting one end between the teeth and breathing deeply drops the Adam’s apple and opens the throat.”258

Allen Vizzutti, a well-known performer and technical master of the trumpet, published a method in 2009 called High Notes for Trumpet that emphasizes a rethinking of traditional concepts. He has laid out a list of facts that he believes are true about

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254 W. Bailey, 8.
255 Ibid.
256 Ibid., 29.
257 Ibid.
258 Ibid.
trumpet, one of them states, “You can’t open your throat so don’t try.”259 He goes on to say, “More accurately stated I mean, you can’t follow a command to open your throat. Attempting to open your throat by manipulating muscles will only create tension and cause you to choke. I’d say that’s pretty far from the desired result. Breathe as described earlier and don’t focus on your throat. When you breathe in and blow out in a relaxed way your throat will open.”260

Frank Campos wrote an article, in 2013, on how to teach breathing and reduce tension. He posits that the most effective strategy to teach breathing from trumpet performance is using exercises through repetition of a skill with good form until it becomes automatic.261 These types of exercises would need to reinforce natural, efficient, and effective ways to support the airstream. The most important key to performing on any wind instrument is to have physical control over breathing. Practicing a simple breathing exercise every day for months can produce substantial improvements in range, endurance, power, control, and sound production.262

Campos states that by putting the weight of performance on the stronger respiratory muscles, many persistent problems of tone production will be resolved. He believes that there are many misconceptions in the pedagogy of breathing for wind instruments and states that by employing “…breathing exercises, the breath itself shows us the correct technique.”263 Campos suggests that when students are given simple breathing exercises, it is not necessary to discuss the muscles involved in respiration. He

259 Allen Vizzutti, High Notes for Trumpet (Seattle: Village Place Music, 2009), 11.
260 Ibid., 12.
262 Ibid.
263 Ibid.
states that the most effective exercise to improve overall performance in wind instrumentalists that he has encountered is called “timed panting.” Campos describes panting as follows:

Sitting or standing holding your instrument as if playing, pant through the nose (by sniffing rapidly in and out) for as long as you can without stopping. Four to six “in and out” sniffs per second is the rate. Many students will not be able to do this for more than five seconds the first time they try it. Get in at least one session of panting each day, preferably right before you play your instrument. Aim for thirty seconds of nearly continuous panting. When you can do that, go for a minute, then two or even three minutes after many months. Do not push or overdo this or any other breathing exercise. If you are working with students, let everyone know to stop panting and put the instrument in the lap at the first sign of dizziness, and let the students with asthma or illness know that they can sit this out.

He goes on to explain that the students are engaging muscles around the lungs when doing these exercises; these muscles are used for inhalation and exhalation. By using these muscles as opposed to lower abdominal muscles that are much farther away from the lungs, the students will be less likely to trigger the Valsalva maneuver. He feels that it is unnecessary to discuss these details in greater depth with students and that if the student establishes a habit of practicing the exercise daily, “…it will work its magic on them.”

Breathing through the nose when playing the trumpet is not a normal procedure, and while the practice of panting through the mouth might be valuable, there are specific benefits to breathing through the nose. According to Campos, there is less chance of hyperventilation when panting through the nose and the body eventually learns the most efficient posture to move the air between the nose and lungs without obstruction. “When

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264 Campos, 41.
265 Ibid.
266 Ibid., 42.
we do a little panting everyday over many months, the body develops a new feeling of strength and ease."\textsuperscript{267} Eventually, a stronger and more stable posture will be developed along with being more efficient and energized. However, Campos states that, if the exercises are discontinued, the control and level of strength will drop relatively quickly back to where they were before the daily panting exercises were started.\textsuperscript{268}

Band directors, according to Campos, can benefit from the timed panting exercises by incorporating them into the beginning of rehearsals by increasing energy and refreshing students mentally and physically. Campos suggests having the ensemble play a big passage, followed by fifteen seconds of panting, then have them play the passage again and note the difference between the two performances.\textsuperscript{269} The students should pay careful attention to the sound of their voice; after panting it should sound more resonant. After spending some time practicing panting the students will start to hear the richness and more resonant sound coming from their own instruments and some may even benefit from an easier high register.\textsuperscript{270}

These methodologies and studies all provide strategies to promote proper glottal use in trumpet performance. Most of these strategies are based on the fundamentals of proper breathing. Some of the methodologies suggest learning to actively control the glottis in order to regulate airflow for performance. In conclusion, these strategies are beneficial for creating a method to promote performance practices for proper glottal use.

\textsuperscript{267} Campos, 42.  
\textsuperscript{268} Ibid.  
\textsuperscript{269} Ibid.  
\textsuperscript{270} Ibid.
CHAPTER THREE

METHOD

The purpose of this study is to examine research and brass methodologies to create a strategy for addressing the proper use of the glottis in trumpet performance. Various research studies are consulted to determine what performance practices can cause medical problems relating to the improper activation of the glottis and the effect of high velocity air pressure on the soft tissues of the larynx and pharynx, as well as the effect these pressures may have on other bodily functions such as blood pressure and heart rate. The use of the Valsalva maneuver is studied to show whether there is a connection between this maneuver and damage to the previously referenced soft tissues. Research is also examined to find any information that may lead to possible approaches for reducing or controlling glottal activation during trumpet performance.

Performance practices are examined in research to discover musical problems associated with the use of the glottis. This includes difficulty in producing a proper tone or inability to play up to second ledger line “C” above the treble clef staff attributed to improper glottal activation. Methodologies and studies are discussed which demonstrate the activation of glottal tension in extended techniques to create growling or multiphonics. Other positive uses of glottal activation are explored for creating high compression in upper register trumpet performance.

Brass methodologies are consulted to see what material covers the proper use of the glottis in performance. Different aspects of glottal activation are explored as to the effectiveness of their use throughout the range of the trumpet and for achieving different sounds with extended techniques. Efforts are made to explain the types of approaches to
deal with problems caused by the glottis in order to produce an effective strategy. One approach might work for one person but might not be effective for everyone. Every effort is made to find the best approach for a standard methodology to address the problem in an efficient and strategic way.

Some brass pedagogues may have their own ways of instructing students who have problems with unwanted glottal tension. Generally, most teachers consider any glottal activation to be harmful in the quest for more relaxed performance practices. The strategies for correcting improper glottal use are divided into two separate approaches. The first strategy is categorized as using a breathing approach based on continual movement of air during inhalation and exhalation. The second strategy is categorized as using a breathing approach based on setting the air before exhalation.

Trumpet pedagogues are interviewed through correspondence in order to compile data related to correcting the improper use of the glottis in trumpet performance. Subjects answered a survey based on their knowledge and high level of performance on trumpet. All of these subjects \(N = 10\) perform professionally and teach trumpet at a high level. Some of the interviewees \(n = 5\) perform classical or orchestral music at a high level and the others \(n = 5\) play lead trumpet almost exclusively. The questions are divided into two topics pedagogical questions and performance questions. The transcripts of survey questions are organized in the appendix by interview number.

The importance of addressing the improper use of the glottis cannot be understated as a problem among trumpet players. There is a desire for some young trumpet students to be able to play above third space “C” and others to play in the upper register to create excitement. If attempted with improper use of the glottis this can cause
pain, discomfort, injury, or even loss of interest due to lack of improvement. By analyzing research and different approaches to addressing these issues, an efficient methodology for addressing glottal tension will be devised to help correct this common problem among trumpet players.
CHAPTER FOUR
RESULTS

The purpose of this study is to identify problems surrounding the improper use of the glottis and develop practice strategies that promote its proper use in trumpet performance. The research questions asked are important to understanding problems surrounding the glottis and how it is used, and defining the appropriate use of the glottis in trumpet performance. In order to answer the research questions for this study, research related to the use of the glottis was investigated to gain an understanding into how the glottis responds during the playing of trumpet and other related brass instruments.

The first part of this study examines research related to medical problems associated with playing trumpet and other brass instruments. The first research question: What performance practices can cause medical problems related to the improper use of glottal tension? The following are performance practices that can cause medical problems related to the improper use of glottal tension.

When students first learn to play the trumpet they are usually taught first how to sit with proper posture for performance. They are taught how to hold the instrument and are coached on how to take a deep breath. They are taught how to buzz the lips to create a sound on the mouthpiece and then the instrument. These performance practices are fundamental in creating a proper sound on the trumpet. However, there are other factors that influence these performance practices that cause tension and improper use of the glottis.

The first performance practice that can cause medical problems is improper breathing technique. When a student breathes improperly they tend to compensate for a
lack of airflow and often they unconsciously employ the glottis to alter the airspeed. This also tends to create tension in the upper body and neck. Proper breathing is the most important aspect of performance practices used for trumpet playing. Similarly, because of lack airflow and the perception of playing something difficult can cause the Valsalva maneuver to be triggered.

The second performance practice that can cause medical problems is poor posture. There are different factors that influence poor posture. One factor is laziness. Another is the visual perception of the proper way to play. Students have so many outlets to watch videos of performers. Their favorite player may not be the best model of how to play the instrument the most efficient way. It may work for that player but it could lead to problems when the students try to visually emulate what the player is doing. Example 4.1 shows Miles Davis leaning way back at the hips with the head tilted down. While this position may look cool, it is far from ideal for playing efficiently.

Another performance practice that can cause medical problems is attempting to play something more difficult than the student is capable. This is frequently a mental problem when performing. When a player perceives a passage to be high and difficult to perform, sometimes that can be enough to trigger the Valsalva maneuver during the performance. This can cause the player to have dizziness or even blackout. If the performer is required to play lead in a large jazz ensemble, poor choice of equipment for playing upper register trumpet can also contribute to the difficulty. Playing improper equipment can cause the body to compensate by creating unnecessary tension especially in the upper body, neck, and glottis.
Using the above mentioned performance practices can cause a number of medical problems. Glaucomatous damage to the optic nerve, pharyngoeles, laryngoeles, pneumomediastinum, effects on the cardiovascular system, blackouts, and dizziness can all be linked to improper performance practices. The important factor in the findings about medical problems is that they are caused by higher than normal pressures in the thoracic cavity, larynx, pharynx, and oral cavity. The closing of the glottis in the process of the Valsalva maneuver may be the underlying cause of these medical problems. Whether the glottal use is activated unconsciously or consciously, these pressures are

created by trumpet performance, the player should be aware of these conditions in order to help prevent these types of problems. However, most of these problems are benign and do not warrant serious medical attention or an individual to stop playing trumpet unless they are in severe pain.

The second part of this research study examines research related to musical problems that could be linked to the improper use of the glottis. The second research question: What musical problems related to performance practices are linked to glottal activation and what intentional performance practices including so called *extended techniques* are linked to glottal activation? The following is derived from research involving wanted or unwanted musical effects caused by the use of the glottis.

The first musical problem related to performance practices that is linked to glottal activation is producing a thin or weak tone. Trumpet students may have a tendency to *squeeze* or *pinch* out certain notes of upper register before they have developed the control of creating compression to play those notes. Younger students may have this same problem attempting to play in the staff. *Squeezing* notes is an undesirable thin tone quality in brass performance and usually implies an adduction of the vocal folds causing the glottis to become partially closed.

These musical problems of unwanted tone quality usually start when the student attempts to progress rapidly beyond his learned abilities. As students continually play incorrectly, they quickly develop habits. It can take years to relearn good habits to create the proper tone quality.
William Carter’s findings in physiology texts indicate that during natural breathing the glottis widens on inhalation and narrows during exhalation.\textsuperscript{272} These movements can become more pronounced during forced breathing. Creating compression for playing a high brass instrument most certainly falls under the category of forced respiration. The implication here is that great brass players must learn how or naturally overcome this natural tendency to narrow the glottis on forced exhalation. It would be advantageous for the brass teacher to have an understanding of the glottis and what it feels like to consciously use the opening of the glottis in order to better help students who have these types of problems.

There are students who have musical problems with using the vocal cords and create extra sounds in tone production. There are also students who can be heard grunting while they play or even use the glottis as a tonguing mechanism. Using the glottis in this way can create an uncharacteristic sound on trumpet and can severely slow down the speed of articulated musical passages.

Another performance problem that has an adverse effect on playing is musical stuttering. This phenomenon generally happens to brass players and occurs when the glottis and tongue are activated in a way similar to the Valsalva maneuver. It is most comparative to stuttering in speech. According to a study by Robert Cochran, to be musical stuttering the frequency and severity of musical disfluency must be unusually high and totally disruptive to the flow of a musical phrase.\textsuperscript{273}


\textsuperscript{273} Martin Edmond Cochran, “A Comparison of the Behavior and Characteristics of Speech Stuttering with Musical Stuttering (i.e. Valsalva Maneuver) in Brass Players” (DMA essay, University of Alabama, 2004), 1.
Normally when a brass player plays they breathe in and exhale starting the note with an articulation by the tongue on a desired syllable such as “toh” causing immediate release of air and sounding of a note. Musical stuttering involves tension built up in the chest, abdomen, vocal cords, and mouth. When it occurs the start of the note does not begin immediately, it is delayed possibly with multiple short repetitions such as in “t-t-toh.” Another possibility is that the air is blocked completely and the breathing process has to be completely restarted in order to perform.

Performers dealing with musical stuttering may create mental stress for themselves because of the fear of not being able to produce the first note of a passage. These players are both mentally and physically aware, but unable to control the disturbance in the airflow. The onset of musical stuttering tends to take place in teenagers and young adults who have attained a moderate level of musical proficiency on their instrument. Another factor contributing to musical stuttering seems to be when the performers are in college under critical analysis by a professor or other respected musical figure. This implies that fear may be a major factor in the trigger of this debilitating musical problem.

The following are intentional performance practices using the glottis for extended techniques. One such technique is a rare but effective form of vibrato. Throat vibrato relates to a type of vibrato vocalists use with vibrating vocal cords. This vibrato can create a pleasing sound by changing the size of the glottis in a similar way that vocalists use vibrato, however this does not usually change the pitch, but often adds a slight tremolo sound that can enhance the intensity of a musical phrase.274

A second technique created by the use of the glottis is multiphonics. This process involves engaging the vocal cords to create another pitch while simultaneously playing the trumpet. The player is able to create a chord on the trumpet, which is normally a monophonic instrument. This technique has been around since the 19th century.\textsuperscript{275}

The third and similar glottal technique to multiphonics is growling. It differs by using the vocal cords to create a gritty and raspy sound that is more commonly used as an expressive device in jazz trumpet performance. This technique is also often used for a substitute for flutter-tongue for players who are not able to flutter the tip of their tongue. This type of voluntary use of the glottis and vocal cords is important to understand for the effect they have on sound production.

Another performance practice used by many lead players and those needing to create lots of compression for playing in the upper register on trumpet is setting the air. Methodologies focused on lead trumpet playing and breathing for high compression discuss gripping or setting the air before its release. This implies creating isometric tension in the abdominal area against a point of resistance before exhalation. If used correctly, the glottis can provide a great release of high velocity air needed for upper register performance (third ledger line “E” above treble clef staff and above). Unlike the squeezing or pinching of notes described earlier, when the air is released the glottis immediately becomes fully open.

All of the musical problems related to performance practices above are related to the use of the glottis, either consciously or unconsciously. These problems develop either because of fear, or trying to play music for which they have not developed enough

\textsuperscript{275} Amy K. Cherry, “Extended Techniques in Trumpet Performance and Pedagogy” (DMA essay, University of Cincinnati, 2009), 37.
technique to perform. Some of these problems even develop during the learning of new or different techniques. However, control and use of the glottis can be advantageous for extended musical techniques, creating high compression, and correcting bad habits.

The final part of the study examines methodologies and articles related to trumpet performance and teaching pedagogy. The third research question is in two parts: What is the proper use of glottal tension in trumpet performance? What strategies can be used to promote healthy performance habits of glottal use? The following is based on research of pedagogy and methods that promote healthy habits and utilization of the glottis in trumpet performance.

Most brass pedagogues advocate playing with an open glottis to create the least amount of resistance at that point. However, there are others who state that the glottis is a vital mechanism to control airflow during trumpet performance. Both approaches to glottal use can be efficient and can be considered proper glottal use.

Many times the player is not aware of what is happening at the glottis during performance, but studies show activity during times of playing that indicate it is normal. Robert Bailey’s study shows observations of the glottis changing during different aspects of trumpet performance. Glottal behaviors also respond differently based on instrument resistance. The vocal folds, which control the glottis, are the most active laryngeal structure compared to the epiglottis or thyroid cartilage. Generally, when playing brass instruments, the glottis tends to be more open when playing loud notes and its dimensions tend to decrease on softer notes.

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The vocal folds tend to move unconsciously when playing to manipulate the airstream to compensate for the lack of the use of valves. This is important because it does show that the glottis reacts to certain changes or demands of trumpet performance. However, the study by Bailey shows very little patterned behavior of the glottis for all subjects, except during the single-tonguing exercise.277 The findings also show that it is not necessary for the glottis to be active during articulation, but most of the time its activity has some effect on the musical aspects of trumpet performance.

There are two main approaches to the proper use of the glottis in trumpet performance. The first approach to proper glottal use is setting the air. Proper breathing requires filling the lungs to a comfortable capacity in order for the player to properly set the air for performance. Setting the air is gripping the air before exhalation by contracting the muscles surrounding the diaphragm as if the player was to be punched in the stomach. This analogy most likely employs the Valsalva maneuver to stop the air with the glottis. This creates the required compression for performance in the upper register and upon a tongue articulation and quick opening of the glottis, creates an explosion of high velocity air. Many lead trumpet players feel this is the best way to create the proper compression for playing.278

Some of the players who advocate this approach also take it a step further by saying the glottis should be used to regulate the airflow during the entire exhale. Farkas advocates its use for playing soft passages.279 By keeping the glottis partially closed in an optimal position for correct tone quality, regulating the airflow for trumpet performance

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277 R. Bailey, 105.
is a proper use of the glottis. However, this may be a technique that should be explored once the player has achieved a certain level of proficiency on the instrument.

The second approach to proper glottal use is that the glottis should be relaxed as possible during trumpet performance. Advocates of this methodology view setting the air as detrimental to the breathing process. They state that the air should always be moving either in or out and it should never stop or be set during proper breathing. There is a quick, smooth change of air direction between inhalation and exhalation unencumbered by the relaxed opening of the glottis. See Table 3.1 for survey results on the perception of glottal use during trumpet performance.

Table 3.1
Professional Performance Questions 1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Active</th>
<th>Relaxed</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>Not sure</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Relaxed</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Relaxed</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Relaxed</td>
<td>My perception is that the throat is relaxed and in its proper position due to my training as a musician. The reality may be that my glottis might be in a different position. But to me, it feels “open”.</td>
</tr>
<tr>
<td>5</td>
<td>Active</td>
<td></td>
<td>When I perform, I’m keenly aware of the glottis and its activity. I consider it part of the mechanism that regulates the air to the embouchure. I feel that it is very active.</td>
</tr>
<tr>
<td>6</td>
<td>Active</td>
<td></td>
<td>When I play, the glottis is never relaxed. It’s always in a slightly contracted state, even playing the lowest, softest note. For me, it is like forming the embouchure. Having it slightly closed to start gives me increased air speed with no effort. This free air speed helps me with attacks, tone consistency, and pitch (all registers).</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Relaxed</td>
<td>Inactive</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Relaxed</td>
<td></td>
</tr>
</tbody>
</table>

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I perceive it to be slightly active but I try to play with it relaxed as much as possible. I myself had to break the habit of playing with the Glottis being too active, so I am very aware of how it feels.

I use it (close it gently) for some types of note cut offs. It is otherwise held slightly open, not totally relaxed, but open.

The following are strategies to promote performance habits of healthy glottal use.

The first strategies will rely on the approach of constantly moving air as part of the breathing technique. Proper breathing is the foundation of healthy and proper glottal use.

Sam Pilafian and Patrick Sheridan’s exercises found in *The Breathing Gym* are an optimal starting point for trumpet students at all levels. Being able to incorporate what relaxed breathing feels like into trumpet playing is important to healthy glottal use. The following exercises are helpful in getting the student started from a neutral place to build proper breathing technique for trumpet performance.

Flow studies are exercises that provide a simulation of breathing necessary for trumpet performance. Moving air without resistance is the main goal of these exercises, sometimes moving the air for long periods of time and sometimes moving the air quickly. Therapies are exercises used to inspire better airflow. Deliberately creating problems to conquer, such as resistance or suspension, helps accomplish these goals. Strength and flexibility exercises are aimed at stretching the lungs to maximum capacity all the way down to completely empty. Over time the player will be able to use this increased range of breathing during performance. Breathing for the brain are exercises that are aimed at creating focus and concentration. Details of these exercises can be found in the Chapter Four Literature Review.
A similar strategy that aligns with the approach of constantly moving air uses analogies for breathing, posture, and addressing problems with the glottis. One example of an analogy is telling a student to imagine growing taller, without raising the shoulders, to achieve vertical and horizontal expansion of the thorax. Another analogy is to have the student imagine their glottis and oral cavity are big enough to swallow a baseball or orange. These analogies are intended to help the student achieve greater relaxation and breath control during performance. Often too little airflow can create poor sound production caused by activating a point of resistance such as the glottis to make up for the lack of airflow in creating compression.

The following are exercises to help a student enhance the natural breathing process of expanded lung capacity to achieve necessary breath control for trumpet performance.

1. Slow inspiration exercise, the student should place the hands on the waist at the sides so as to feel the necessary expansion for correct inhalation. During the slow inhalation the student should feel the abdomen expand from the bottom up to the chest cavity. The exercise ends with rapid exhalation as in a sigh with no resistance points engaged.

2. Rapid inspiration exercise, this is the same exercise as the first but, it starts with rapid inhalation.

3. Timed breathing exercise is where the inhalation takes place over eight counts at a metronome marking of 100 and exhalation takes place over sixteen counts blowing through the embouchure without creating a buzz. This exercise

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should be repeated while decreasing the number of counts during exhalation by two until it reaches eight counts.

4. The third exercise should be repeated altering the duration of inhalation to equal six, four, two, and eventually one count.

Modeling these exercises may be an effective way to teach them to a student rather than focusing on breathing specifics.

Sometimes a device is used as a strategy to help students develop the correct feeling and form correct habits for performance. A short three-quarters of an inch pipe made of acrylic or some other non-hazardous material can be used as a breathing tube by inserting it into the mouth between the teeth. This will flatten the tongue and lower the Adam’s apple and open the glottis.\(^\text{282}\) Using a breathing tube to practice any of the breathing exercises suggested would be helpful in learning to form positive performance practice without the trumpet. Once a student learns the feeling of using the breathing tube, it is essential to transfer that feeling to performance on the instrument.

Another strategy to develop proper breathing and encourage healthy glottal usage is a simple breathing exercise. This exercise is aimed to develop the muscles naturally involved in breathing without explanation of the breathing mechanism. Timed panting is where a student holds their instrument as normal and breathe rapidly sniffing in and out through their nose at a rate of four to six times per second. The exercise should be done as long as possible without stopping. Gradual goals should be set at thirty seconds of continuous panting to start, followed by one minute, and then possibly as many as three minutes after months of practice. This exercise should be done at least once a day every

\(^{282}\) W. Bailey, 8.
day preferably right before playing. By engaging the muscles involved in normal inhalation and exhalation, the Valsalva maneuver is less likely to be triggered.  

When problems occur such as grunting noises during performance the above strategies should be supplemented. Some trumpet players grunt when they perform fast single tonguing. This grunting is not a major musical problem due to the fact that these grunts cannot be heard over twenty feet away. However, this type of grunting can be caused by fatigued muscles controlling the larynx, articulating in the throat by moving the articulation syllables ‘T’ or ‘K’ too far back in the oral cavity, or excessive tension in the neck and upper chest.

The following are strategies for correcting glottal problems linked to stuttering that are not related to fatigue:

1. Lengthen rapid notes as much as possible. This will keep the vocal cords from rapidly opening and closing with each note.
2. Articulate forward in the oral cavity near the teeth.
3. Keep good posture in the head and neck to allow neck muscles to be relaxed.
4. Upper chest and shoulders should be relaxed.
5. Keep inhalation and exhalation connected to avoid locking the air with the glottis.

Other glottal problems may be more invasive and may require another strategy for promotion of proper glottal use. Stutter attacks are a psychological condition that occurs in players who have difficulty producing the initial notes of phrases. These conditions

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usually occur on notes that begin phrases after long rests and are closely related to stuttering words. Hickman believes the player consciously thinking about the mechanics of articulation usually causes this condition.\footnote{Hickman, 224.}

Approaching this problem usually involves distracting the brain so that the player is thinking about something other than just the mechanics. The following are strategies used to focus the brain on other aspects of performance:

1. The player should hear the note in the mind at exactly the same time the note is performed.
2. Conduct or move the bell up and down as a visual cue.
3. During practice, use breath attacks on the first notes of passages.
4. During practice, tap a toe or heel at the exact same time as the first notes of a passage.
5. The air should constantly be in motion during inhalation and exhalation to keep the air from being locked at the larynx (glottis).
6. Sense the airflow outside the body by holding the hand at arm’s length and blowing air as if extinguishing a flame.
7. Mentally count off the tempo for the entrance to be performed.

Stuttering problems usually appear most frequently when players are going through embouchure changes, mouthpiece changes, or learning a different articulation technique. These changes require the mastering of new brain signals, but until they are mastered the stuttering will most likely continue.\footnote{Ibid., 223.} Students with this problem should be
encouraged to be patient. Using the above strategies will help solve this problem over time.

The following strategies for healthy habits of glottal use are approached from the concept of *setting the air*. These strategies should be only used after the student has developed proper relaxed breathing with uninterrupted airflow. These strategies will give the student another tool for regulating airflow and creating high compression for upper register performance.

The first strategy is Bobby Shew’s method of breathing called the “Wedge” breath. The six steps of this breath are as follows:

1. Inhale expanding the area near the navel slightly forward and outward.
2. The placement of “the wedge” happens by silently saying “who” and inhaling slightly while adding tension to the abdominal muscles bringing horizontally inward towards the diaphragm.
3. Inhale more naturally raising the shoulders straight up to take in more air.
4. “Grip” the air with the abdominal muscles to create compression in the lungs this is an isometric grip.
5. Lower the shoulders back to the original playing position.
6. Exhale releasing the air by withdrawing the tongue from between the lips.\(^{287}\)

Shew’s prescribed method for practicing the six steps: (1) Do the six-step exercise sixty times a day for twenty-one days without skipping a day. These could be separated into two sessions a day and it is possible to add more repetitions but it is important to do these exercises for twenty-one days. (2) Close your eyes while doing the exercise to help

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internalize the routine. (3) Eliminate pauses in between the steps as quickly as possible making the breath ones smooth motion. This should be done in slow motion gradually speeding up the process until all six steps take one second.\textsuperscript{288}

This breathing formula is a strategy to learn how to maximize air intake and create high compression, high velocity airflow. This strategy is important in the utilization of the glottis because the \textit{gripping} isometric tension may be accomplished with the glottis and the only way to create high velocity airflow is with the glottis completely open. Many professional players use this type of breathing with their own modifications to suit their playing situation and the way they play the trumpet.

The next strategy used to promote healthy performance habits of glottal use is also based on \textit{setting the air}. Practice of this strategy should occur first breathing away from the instrument with the body in a relaxed state just above unconsciousness. The entire body should be in this relaxed state except for the abdominal muscles and the corners of the embouchure. Posture is important, with the back held straight, and the player should take in as much air as possible through the mouth. There should be a stretching pressure inside the ribcage that is both comfortable and relaxed. The shoulders naturally rise with the intake of air and after the lungs are full, the player should raise the shoulders a couple more inches to allow for a greater intake of air.\textsuperscript{289}

Before the release of air, the player should hold in the air for a few seconds while keeping the glottis open, using the abdominal muscles and thoracic muscles to hold in the air. The next step is to inhale the air the same way as before, but hold the air in for a few seconds with a closed glottis and create compression by tightening the abdominal

\begin{itemize}
\item \textsuperscript{288} Roach, 95.
\item \textsuperscript{289} Scott Englebright and Donny Dyess, \textit{The Tasteebros Way: All the Secrets to Playing the Trumpet the Easy Way} (Denton, TX: Tasteebros Publishing, 2000), 14.
\end{itemize}
muscles, forcing the air towards the head. This exercise has the glottis taking the full force of compression created by the abdominal muscles rather than the embouchure corners. The last step in this exercise is to release the air by opening the glottis, allowing the air to be expelled at high velocity.290

Once these two exercises are mastered the abdominal muscles and the glottis can regulate the airspeed. For lower notes the semi-compressed air can be regulated with the middle part of the tongue at the first premolar after the canine teeth instead of using the glottis. The embouchure should not be involved in holding back air, but the compression should do all the work when the air is exhaled.

The glottis is used as if imagining that it is a valve to control the airflow to the embouchure. However, the glottis is completely open on high and loud notes with the air moving fast. The glottis takes the full force of compressed air until it is released, and when it is opened it will not be closed enough to create a pinched sound.291 Using the glottis to over-compress the air before its release ensures that the air is doing all the work and makes playing easier. This also applies when using the tongue to stop the air. Using more compression creates faster air to be expelled and thereby produces notes in a higher register. The airspeed is used to control which register is being played.

All of these strategies are essential in building a foundation for proper glottal use. However, there are other strategies that can supplement proper posture and breathing exercises. See Table 3.2 for survey results on strategies for learning to create compression with correct glottal use.

290 Englebright, 14.
291 Ibid., 19.
Table 3.2
Pedagogical Question 2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Relaxed breath</td>
</tr>
<tr>
<td>2</td>
<td>I have all students make a sound on the leadpipe alone by letting air pass thru the lips and not blowing air - let the leadpipe tell the lips what to do</td>
</tr>
<tr>
<td>3</td>
<td>Slurring most things with a strong tone and airflow before adding articulation</td>
</tr>
<tr>
<td>4</td>
<td>I utilize “the complete yoga breath” that was taught to me by Bobby Shew who learned it from Maynard Ferguson. Compression is part abdominal use as well as a focused aperture to generate the desired frequency.</td>
</tr>
<tr>
<td>5</td>
<td>I think it’s very important that the approach in creating compression is slow and incremental. Being able to control the glottal aperture throughout the entire range of the instrument is vital. I have my students begin to play soft long tones in the upper register. If the glottis is too open, this will help show the inefficiencies (tone will be spread, often under pitch). If the glottis is too closed, the students will feel too much backpressure and produce more of a pinched sound. I have my students play gradual ascending and descending chromaticism of a minor third interval with each repetition starting a half-step higher. The goal is to focus on the connection between generating compression and glottal aperture.</td>
</tr>
<tr>
<td>6</td>
<td>With me, glottis involvement is automatic, and closely associated with compression. When I teach, I have students play up a 2nd line G up an octave without changing horn angle, mouthpiece placement, amount of mouthpiece pressure, etc. I have them compress all the way up. Then, I have them do the same, but decrease mouthpiece pressure. Then, C to high C, etc. Demonstration is done by getting them to blow out a match at varying distances away to indicate air speed/compression needed for higher and lower notes (jacoby).</td>
</tr>
<tr>
<td>7</td>
<td>While I’m not familiar with glottal activation, I focus on the Wedge (yoga) breath to create compression. I play octave glissandos to get a feel for playing with more compression.</td>
</tr>
<tr>
<td>8</td>
<td>Hmmm… I have never had that problem and haven’t had a student with that particular problem. I like to encourage a relaxed breath.</td>
</tr>
<tr>
<td>9</td>
<td>I play very very softly on a G in the staff. This makes the aperture tighten and is very very similar to the action when playing in the upper register. Also I try to keep the lips as soft and supple as possible. I also focus on making sure my chops are together when I actually start playing. Nose breathing can help with that. Breath attacks. The Reinhardt Studies are a huge plus with this as well.</td>
</tr>
<tr>
<td>10</td>
<td>A. whisper tones in all registers B. mouthpiece buzzing C. breath attacks D. playing notes with the wrong fingering but the correct pitch.</td>
</tr>
</tbody>
</table>
All of the strategies presented in the results provide a method for correcting improper performance practices of student trumpet players. Some pedagogues teach students to focus on an ideal sound in order to let the body find a way to create the desired sound. However, this approach does not always fix improper technique. Most of the strategies presented here are basic fundamentals that will help create a better foundation for healthy performance habits of glottal use.  

See Appendix C and D for the answers to other survey questions related to the use of the glottis in trumpet performance.
CHAPTER FIVE

DISCUSSION AND CONCLUSION

The purpose of this study is to identify problems surrounding the improper use of the glottis and develop practice strategies that promote its proper use in trumpet performance.

Research questions:

1. What performance practices can cause medical problems related to the improper use of glottal tension?

2. What musical problems related to performance practices are linked to glottal activation and what intentional performance practices including so-called extended techniques are linked to glottal activation?

3. What is the proper use of glottal tension in trumpet performance? What strategies can be used to promote healthy performance habits of glottal use?

The research questions asked are important to understanding problems related to the glottis and defining the appropriate use of the glottis in trumpet performance. In order to answer the research questions for this study, research studies related to the use of the glottis are investigated to gain an understanding into how the glottis responds during the playing of trumpet and other related brass instruments.

Many students are unconsciously impeded by their glottis when playing in a register they perceive to be difficult. Often, these students have the skills to produce the sound with the muscles in their embouchure, but are not able to supply enough air due to the airflow being restricted by improper activation of the glottis. While some college
students may be able to play as high as 2\textsuperscript{nd} ledger line “C” before the glottis begins to constrict the airflow, many beginning trumpet players may start obstructing the air before reaching second space “A” in the treble clef staff. Others students may reach as high as third space “C” before the glottal tension begins restricting the airflow. As previously stated, beginners, college students, and professionals deal with this problem to varying degrees.

While many methods of trumpet playing discuss tension of the \textit{throat} being a problem, few give useful ideas or approaches to solving it. Most of these methodologies completely avoid discussion of the glottis in a direct context. Methodologies and research for this study were chosen to better define proper glottal utilization and identify different approaches and techniques for its use.

\textit{Discussion}

Performance practices were identified as causes to improper use of the glottis in trumpet playing resulting in medical problems. The most fundamental performance practice that causes these problems is improper breathing technique. Students who have this problem tend to unconsciously employ the glottis to compensate for poor air support. By doing this, the students create more high pressure and tension in the body.

Another performance practice that causes improper use of the glottis is poor posture. Students may imitate visual observations of other players, which may cause them to form bad habits, especially if they have not been taught properly. Laziness may also play a factor in these improper performance practices. Another incorrect performance practice is psychological. When a player perceives something to be difficult in a music
passage during performance it can trigger the Valslva maneuver in a similar way as lifting a heavy weight.

There are also musical problems related to performance practices that are linked to glottal activation. These problems are poor or weak tone quality caused by *pinching* notes with the glottis, creating unwanted sounds or improper articulation with the glottis, and musical stuttering, which is a psychological activation of the glottis. The latter typically occurs when a player has some technique and is attempting to learn a new concept, sometimes under the stress of performing in the presence someone they respect.

Research findings show that most brass players use the glottis unconsciously to help with different aspects of trumpet playing. Most of the time the glottis remains open for free movement of airflow. However, frequently when single-tonguing, the glottis is unconsciously engaged to aid the player in some way for performance. The glottis also tends to be more closed for softer notes and remains open for louder notes.

Creating certain *extended techniques* with the glottis are also possible and are proper uses of the glottis. These techniques include throat vibrato, multiphonics, and growling. Other players also use the glottis as a mechanism to regulate airflow either by closing it to create compression before starting a note, or to partially close it to create the proper tone and volume for a particular music passage.

There are two main differing concepts regarding the proper usage of the glottis and correct breathing. One of these strategies advocates a relaxed glottis during breathing and the other uses the activation of the glottis in the process for breathing. The first concept is that breathing should have a smooth transition between inhale and exhale with
the air constantly in motion. The second concept is that in order to create compression for high register playing there must be a *setting* or *gripping* of the air before its release.

Average trumpet performance, where there is not much upper register playing, can rely on the first strategy. The air remains moving at all times in an effort to always keep the glottis in a relaxed position. Any trumpet player having difficulties with the glottis *pinching* the air should start with these types of exercises, specifically those by Sam Pilafian and Patrick Sheridan. *Timed panting* may also be a strategy to helping relax the glottis. If the player is still having problems, implementing the use of a ¾-inch breathing tube may be useful for getting the correct feeling of relaxation while practicing breathing exercises. Transitioning this feeling to the trumpet is paramount for correcting the problem.

Trumpet performance requiring greater compression can also use this concept, but many lead trumpet players prefer the second strategy for *setting the air* before its release. These types of players actively use the glottis as a valve for controlling airflow and students should only attempt this method after mastering the breath with a smooth transition between inhalation and exhalation with the air constantly moving. Understanding how to use and implement both strategies gives the student more flexibility in finding a solution to using the proper glottal tension.

All the subjects from the studies researched were considered to be college-level, teachers, or professional players. These studies do not account for trumpet players who have problems with extreme upper register or young students who have problems playing in normal upper register caused by constricting the airflow at the glottis. Further research
should be done to find out what percentage of high school students have problems playing caused by straining in the throat.

Examining laryngeal activity of students who have problems caused by the glottis would be important for learning the differences in performance practices between students who have problems and professionals who are playing with the desired outcome. Further research should also be done taking into account the players who know they are actively are using their glottis to regulate airflow.

Results from the survey on use of the glottis in trumpet performance for this study, show that two thirds of the trumpet teachers believe they have students with problems caused by the glottis. One interviewee states that almost every beginning or intermediate student has this problem. Another interviewee states that he can hear other trumpet players sitting next to him with glottal problems during performance and he believes the problem to be more pervasive than many trumpet teachers realize. Transcripts of the complete survey can be found in the appendix as well as in the form of tables.

Conclusion

Implications of this research study show there is a need for trumpet pedagogues to be able to recognize glottal problems in their students and have a method for correcting these problems. It is evident by the results of the survey for this study that not all teachers and performers are familiar with problems caused by the glottis and some have never heard the term. This study can enlighten many to the prevalence of improper glottal use and provide a proper strategy to correct these problems in trumpet performance.
In conclusion, this essay provides trumpet players of all levels who are frequently impeded by the improper use of the glottis, a strategy for correcting these problems. Over a period of time, with dedicated practice, a student’s thoughts, perceptions, and fear of challenges in trumpet performance will no longer have a compromising effect on the glottis. It is important that instructors and students have an understanding of the function of this laryngeal activity and physiology. This understanding allows the teacher and student to make more informed musical decisions while creating a better chance for producing the desired outcome in trumpet performance.
REFERENCES


APPENDIX A

SURVEY QUESTIONS

Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?

6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?

Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?

2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

5. Have you ever used any type of devices to help with the relaxation of the glottis?
APPENDIX B

INFORMED CONSENT FORM

Study #: 20140151

Approval Date: 3/17/2014 Expiration Date:

Research Study

Your participation is needed for a research study on the proper utilization of the glottis in trumpet performance.

The purpose of this study is to identify problems surrounding the improper use of the glottis and develop practice strategies that promote its proper use in trumpet performance.

While there is evidence of the use of glottis in performance, there is very little documentation on its proper use. Sometimes the glottis is referred to in trumpet methods as being the open or closed throat.

The questions in the survey pertain to methods and approaches used to promote proper utilization of the glottis in trumpet performance. The survey will take about 10 minutes to complete.

The information you provide will be anonymous and no personal information will be transmitted. No risks or direct benefits are expected for your participation.

Please answer all the questions in the Word document file attached to the best of your ability and email them back to me by March 24, 2014. If you feel you have answered a question in a previous question, please note under which question it was answered. If you feel you are not qualified to answer a question, please put N/A.

If you would like a copy of my D.M.A. essay upon completion, please let me know and I will be happy to share it with you.

Thank you for your participation. Completion and return of the survey is considered your consent to participate.

Sincerely,
Ryan Chapman
D.M.A. Candidate
Studio Music and Jazz
University of Miami

If you have any questions about your rights as a research subject, please contact the University of Miami Human Subjects Research Office at 305-243-3195 or hsro@med.miami.edu.
APPENDIX C
SURVEY QUESTIONS TRANSCRIPTS

INTERVIEW NO. 1
Via E-mail – March 19, 2014

Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?
   Yes

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?
   Relaxed breath

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?
   No

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)
   Yes

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?
   Perhaps

6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?
   More support from the diaphragm

Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?
   Not sure
2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

   Yes

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

   No

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

   No

5. Have you ever used any type of devices to help with the relaxation of the glottis?

   No
INTERVIEW NO. 2
Via E-mail – March 19, 2014

Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?

   Yes

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

   I have all students make a sound on the leadpipe alone by letting air pass thru the lips and not blowing air - let the leadpipe tell the lips what to do

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?

   The leadpipe (without the tuning slide in)

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)

   I have not taught beginners

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?

   Yes - caused by back up of the air – overblowing

6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?

   Learning to play with less air - not forcing the notes to come out but allowing the notes to be produced. By breathing lower and removing tension in the upper body - by not blowing hard - if you tap your mouthpiece while it is in the horn, that makes a sound - how much air can be going in there?

Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?
Relaxed

2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

Learned

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

It may help with compression

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

Yes - but again for me this was caused by over blowing

5. Have you ever used any type of devices to help with the relaxation of the glottis?

Again I used the leadpipe sometimes or the Berp
INTERVIEW NO. 3
Via E-mail – March 19, 2014

Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?

   Yes

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

   Slurring most things with a strong tone and airflow before adding articulation

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?

   ¾ inch PVC tube to capture the correct inhalation of breath for trumpet playing. Also the Warburton PETE

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)

   “ugh” sound when articulating is the only problem I have witnessed that is tied directly to the glottis

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?

   Yes. Almost always caused by physical and mental tension in trumpet playing

6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?

   Breath attacks on initial attacks helps to free up the release of air and then once they are comfortable, they can go back and add the articulation with the same follow through of air. Working on relaxing the grip on the trumpet, arms, and upper body helps to free up air and helps open up the upper register
Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?

   Relaxed

2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

   Had to learn. I always worried about tone and pitch first and foremost. I still believe that the upper register will naturally improve the better your fundamentals sound. I am not a lead player and feel that some of the range of a lead trumpet is “God given”. Some of us, no matter what, will never be able to do this! But, we can certainly maximize our “legit” potential in the upper register by the correct use of air and careful attention to tone and pitch and how we approach upper notes with our air.

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

   Never thought about it

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

   Never thought about it

5. Have you ever used any type of devices to help with the relaxation of the glottis?

   No
INTERVIEW NO. 4
Via E-mail – March 20, 2014

Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?

Yes, I do spend a majority of my lesson time with my students on proper breathing and blowing through the instrument.

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

I utilize “the complete yoga breath” that was taught to me by Bobby Shew who learned it from Maynard Ferguson. Compression is part abdominal use as well as a focused aperture to generate the desired frequency.

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?

I have used a few things to help the student understand the correct feeling for trumpet playing. These would be balloons and breathing exercises for breathing, breathing tubes, mouthpiece buzzing as well as the use of the BERP. If you need further explanation, don’t hesitate to ask.

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)

Yes. Many times I had them divert attention to the throat and have them work towards an open inhalation and exhalation. Some people also call this using warm air as if you were to fog up a mirror (but not to the extreme as to sound like Darth Vader). The feeling of fogging up a mirror usually helps the student to feel the air and throat position in its correct placement. With the use of a breathing tube, or through breathing exercises, I have them try to remain as relaxed in the throat and neck in order to achieve the desired level of blow as possible.

With students using a glottal stop for articulations, I would have my students work towards understanding how the articulation should work in its ideal setting. Say the word “Tah” or “Dah” and understand where the tongue (not the throat) is striking when these words are spoken. Once the student pronounces these words correctly, I have them attempt to place the tongue in the same position and work towards getting as consistent a sound as they can with the tongue striking in the correct position. The usual feeling is that it is
uncomfortable or strange to them. I then have the student work an “air pattern” where they work to make the air pattern happen with the “T” or “D” consonant as they tongue. If they can succeed in this manner, the rest would then come with direct application to the instrument.

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?

Yes! A thousand times yes. The issue is that they have achieved some level of success by the Valsalva maneuver and feel that utilizing that series of muscle movements is the correct way to do it. Or, watching videos on YouTube has also provided them with a “visual” representation of how to do it. Some players demonstrate the upper register by leaning back, squatting down or some type of upper body or torso manipulation in order to play in the upper register. This, in turn, then shows the student “How to do it”, but not really explain that the contortion isn’t the proper way to do it, but that persons way of doing it. If you watched Maynard Ferguson play, you would see him take a big breath and then lean back (what it appeared to look like) in order to play the notes he did. In the wrong hands, the students equate what they see (or saw on a video) as the definitive version of how they should play.

Once the student began to understand how the air is supposed to move, and how the body is to be “prepared”, they then have a better grasp of the desired result. And, inevitably, the upper register is easier to play without resorting to some type of contortion in order to do so.

6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?

The methods that I have utilized with my students have been a few. I will attempt to illustrate them to you here.

   Using a dollar bill, I have the student go to a wall and hold the bill on it. I then have the student take the “yoga breath” (that I learned from Bobby Shew) and have them try 5-10 repetitions of the breath before I have them use the bill. Once the air is moving properly with the correct amount of compression, I then ask them to let go of the dollar bill from the wall at the same moment that they blow the stream of air to catch the bill before it falls to the floor. If the bill stays against the wall, that is one correct use of the yoga exhale. The air moves fast, but there should be little to no tension in the body when this occurs.

2. “Isolated Pitches” aka “Target Practice”.
Here I ascend up the chromatic scale from a note of my choosing with the understanding that the student should play this isolated note 3-5 times in a row (with rest between each pitch) to find the correct placement of the tongue, the lip shape, the jaw position as well as the airflow needed to get the note to respond correctly. If they “chip” a note 2 or more times during the repetition, then that is as far as we will go for that particular session.

3. “Ascending Perfect Fourth Exercise”.  
I used this exercise to help me get better acclimated to playing upstairs in a jazz ensemble setting. Typically, the lead trumpet has an option of playing a high note above the ensemble within reason and character of the chart. I have used the interval of a perfect fourth to help illustrate this to my students. I have them start on a tuning C and ascend to an F above the C thus creating the interval of the Perfect fourth. We then proceed by half step until we reach our “limit” or “ceiling”. The idea is to move the air fast enough in order to get the upper note to respond by means of the air speed and lip tension.

4. “Melodic Patterns”  
Play melodies upstairs as often as possible. It would do the student a great deal of good if they can perform melodies in the upper register with ease and make it sound like music rather than “Stupid Human Tricks”, or as my former teachers would say “High Notes, for High Notes Sake”. If you can capture the musical intent of the melody in the altissimo register and still create excitement through the tune. If you can play music in the upper register and not make it sound like it is a high note, but an extension of your register, then you are halfway to the destination.

Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?

   My perception is that the throat is relaxed and in its proper position due to my training as a musician. The reality may be that my glottis might be in a different position. But to me, it feels “open”.

2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

   I was not naturally gifted to play in the upper register, so my ability was done through hard work and practice, and because it sounded cool to me. Listening to Maynard and Buddy Rich Big Band recordings gave me plenty of awe-inspiring moments and motivation during my youth to help me keep
my eyes on the prize. My teachers were not prolific high note players, so all of my knowledge came from trial and error and my curious nature.

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

I would say yes, but I am not actively thinking about glottal manipulation in order to play in the upper register. I do what I need to do in order to get the notes to speak. I guess that I would say my tongue is arched a little bit higher when I do play in the upper register to assist with the air speed, but not with my glottis.

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

No. If I did have a pinched sound, I would say that it was caused by mouthpiece pressure more than anything else. I have noticed some students squeezing and pressing to play upstairs, but for me personally, I have not noticed that. I would get head rushes when playing high, I guess that was partially caused by my squeezing my body to make compression. Inevitably I would “black out” (though not often enough for me to be concerned about it) and would then try another way to correct the issue.

5. Have you ever used any type of devices to help with the relaxation of the glottis?

Visual imagery would be my best answer. Imagine that you had a hard boiled egg inside your mouth keeping everything open inside. Imagine you had a piece of a very hot baked potato that you needed to cool off very quickly. Or staying “tall” inside the mouth as you play. A physical device I would use would also be a breathing tube with a ¾ inch inner diameter and a 1-inch outer diameter. I would take a few breaths on this tube to help remind me of how my breath should feel in all registers.
INTERVIEW NO. 5
Via E-mail – March 22, 2014

Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?

   Yes. Breathing correctly and basic technique is the first and most fundamental aspect to playing any brass instrument.

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

   I think it’s very important that the approach in creating compression is slow and incremental. Being able to control the glottal aperture throughout the entire range of the instrument is vital.

   I have my students begin to play soft long tones in the upper register. If the glottis is too open, this will help show the inefficiencies (tone will be spread, often under pitch). If the glottis is too closed, the students will feel too much backpressure and produce more of a pinched sound.

   I have my students play gradual ascending and descending chromaticism of a minor third interval with each repetition starting a half-step higher. The goal is to focus on the connection between generating compression and glottal aperture.

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?

   No

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)

   Yes

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?

   Yes
6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?

**With the more advanced students the same principles apply. I will make the exercises more difficult with larger intervals and the use of exaggerated dynamics.**

Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?

   **When I perform, I’m keenly aware of the glottis and its activity. I consider it part of the mechanism that regulates the air to the embouchure. I feel that it is very active.**

2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

   **It was something I had to learn.**

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

   **When I’m performing in the upper register the glottis is directly related in creating compression efficiently. It is a vital part of controlling compression.**

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

   **It wasn’t a particular problem when I was learning what role the glottis played in helping generate efficiency and compression. I never experienced a pinched sound solely due to improper glottis regulation.**

5. Have you ever used any type of devices to help with the relaxation of the glottis?

   **Other than playing exercises, no.**
INTERVIEW NO. 6
Via E-mail – March 23, 2014

Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?

   Of course. When done properly, breathing can simplify trumpet playing. Breathing is the main focus of any teaching I do. Accuracy, pitch, flexibility, flow studies, range, tone, etc are improved by breathing/playing a certain way.

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

   With me, glottis involvement is automatic, and closely associated with compression. When I teach, I have students play up a 2nd line G up an octave without changing horn angle, mouthpiece placement, amount of mouthpiece pressure, etc. I have them compress all the way up. Then, I have them do the same, but decrease mouthpiece pressure. Then, C to high C, etc. Demonstration is done by getting them to blow out a match at varying distances away to indicate air speed/compression needed for higher and lower notes (jacoby).

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?

   I was required to purchase a ‘breath builder’, which was nothing more than a clear cylinder, a straw, and ping pong ball. I don’t think I ever used it outside of lessons. School had a great way of teaching me how to do what I could already do, but in a complicated way.

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)

   I have had students who ‘pinch’ using their embouchure, but I haven’t had any student consciously aware of the glottis, where it was, or what it did.

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?

   Not in my studio. I never mentioned the glottis to anyone other than ‘seasoned’ players with a solid understanding of what they were doing while
playing.

6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?

N/A

Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?

When I play, the glottis is never relaxed. It’s always in a slightly contracted state, even playing the lowest, softest note. For me, it is like forming the embouchure. Having it slightly closed to start gives me increased air speed with no effort. This free air speed helps me with attacks, tone consistency, and pitch (all registers).

2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

I learned a lot by watching people play. The foundation was there, but by watching some, and talking to others, I came up with my own approach from information I gathered centered around what I knew I was doing physiologically. Aside from this ‘fine tuning’, I have never had difficulty playing in the upper register. It’s sort of my comfort zone.

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

When I play, I use the glottis to control the compressed air subconsciously. I never knew what I was doing until I began asking other players. My airstream is increased at the glottis, at the embouchure, and, when necessary, at the arch of the tongue (when tired).

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

I never have had any problems. I haven’t changed the way I have played since starting trumpet, so have never had the glottis interfere with playing. I assumed that everyone played the way I did, and that everyone restricted their airstream using the glottis. Once in college, I realized this wasn’t the case.

5. Have you ever used any type of devices to help with the relaxation of the glottis?
I never have; however, after a lot of playing, I’ll hum low, soft tones to prevent my throat from being sore the following day. Doing so helps relax/massage the glottis.
INTERVIEW NO. 7
Via E-mail – March 23, 2014

Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?
   Yes.

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?
   While I’m not familiar with glottal activation, I focus on the Wedge (yoga) breath to create compression. I play octave glissandos to get a feel for playing with more compression.

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?
   I've used the Warburton PETE to develop embochure corner strength.

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)
   No.

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?
   Not that I know of.

6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?
   N/A

Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?
   Inactive.
2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

   I feel that I naturally could play to a high G, but learned how to utilize resistance and play on shallow mouthpieces that enable me to play higher notes efficiently.

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

   No.

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

   No. When I was first learning the wedge, and had much more air/compression than I was used to, I did try to play high in my practice and strained my throat (glottis?). So I did have to learn to play more open in my throat since I had more compression from my new found breath control.

5. Have you ever used any type of devices to help with the relaxation of the glottis?

   No.
INTERVIEW NO. 8
Via E-mail – March 23, 2014

Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?

   Fundamentals are a huge part of my teaching as sound is always number 1. Staying the same as far as embouchure is also very important in my teaching philosophy.

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

   Hmmm… I have never had that problem and haven’t had a student with that particular problem. I like to encourage a relaxed breath.

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?

   I use visualizers but not necessarily any breathing apparatus.

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)

   I really have not encountered any of this…

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?

   Sorry I really know nothing about this stuff.

6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?

   N/A

Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?

   Relaxed
2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

   I don't feel that I create compression. I try to let the mouthpiece and lead pipe combination work in balance with the air support I use.

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

   I am not really sure…

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

   No

5. Have you ever used any type of devices to help with the relaxation of the glottis?

   No
Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?

   Yes. It is paramount. When things aren't working for ANY reason, a return to fundamentals will help.

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

   I play very very softly on a G in the staff. This makes the aperture tighten and is very very similar to the action when playing in the upper register. Also I try to keep the lips as soft and supple as possible. I also focus on making sure my chops are together when I actually start playing. Nose breathing can help with that. Breath attacks. The Reinhardt Studies are a huge plus with this as well.

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?

   The P.E.T.E by Warburton. Also I do a pencil exercise as prescribed in the Costello/Stevens Method.

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)

   Yes... several times I have had to explain the differences to kids in clinics or lessons.

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?

   Absolutely! Many times I could hear what was going on with guys sitting next to me that were struggling due to that very problem. I think it is much more pervasive than people think it is.

6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?

   I have them do the exercises I listed above and to try to FEEL the difference between that way of playing and the other using the glottis. It is a very
difficult problem to overcome because once it sets in it becomes a habit. Breaking that habit is hard, but possible.

Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?

   I perceive it to be slightly active but I try to play with it relaxed as much as possible. I myself had to break the habit of playing with the Glottis being too active, so I am very aware of how it feels.

2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

   I was able to create compression at a young age but then studied a certain system that caused me to play way too open. I have had to “unlearn” this for many years...

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

   I think it is best to keep it as relaxed as possible and create the compression at the chops. I don’t think it is possible to create ALL the compression you need there, so the Glottis comes into play. But the more you can shift that equation to the chops side of things, the better.

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

   Not so much a pinched sound as playing too open and with too big of an aperture, creating flexibility issues and volume issues. I was using a massive column of air and pushing it very hard to make it go faster. It wasn't until later that I realized the difference the actual aperture can make in the whole process and how much less air it takes than I thought before. Chris La Barbera, Roger Ingram and Lynn Nicholson and many other great players and teachers helped me see this difference.

5. Have you ever used any type of devices to help with the relaxation of the glottis?

   I think that learning the FEEL of playing with no participation of the Glottis (or very little, anyway) is the best way. I think working on compression in the aperture will help with this. The P.E.T.E is an excellent tool.
I had a bit of an epiphany a few years ago and realized that you can really break down a Double High C to a math solution. Let's give a DHC a value of 100 and say that A+B+C+D=100. Now A, B, C, and D are different factors like air speed, aperture, tongue arch, Glottis tension. They could be other things too, I guess, but lets use these for now. If a DHC equals 100 then those 4 variables have to equal 100, right? But here is the thing: There are literally thousands of combinations of those 4 variables that will produce 100 (a DHC). Example: A=25, B=25, C=35, D=15… together they still produce 100 (DHC). So… some people use more tongue arch, some more chop tension, some almost exclusively use aperture. Some upstream, some downstream. There is no single way to do it. There is a single way for you to do it and sound exactly like you want to, though, in the most efficient way. I hope this puts in perspective my ideas about it clearly.
INTERVIEW NO. 10
Via E-mail – March 24, 2014

Pedagogical questions

1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?

   I make my students stand during lessons, and this solves a lot of issues immediately. We talk about anatomy and breathing as necessary, but it seems like it is always necessary. Students like to breathe high and feel full, which almost immediately causes throat tension.

2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

   A. whisper tones in all registers  B. mouthpiece buzzing  C. breath attacks  D. playing notes with the wrong fingering but the correct pitch.

3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?

   Not successfully.

4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)

   Almost EVERY beginning or intermediate student has this problem.

5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?

   Yes

6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?

   First of all, you need chops. If the embouchure isn’t strong, good air won’t matter enough. I talk about using a “hint of a yawn”. In other words, the base of the tongue has to be placed slightly forward from its relaxed position, to be forward of the trachea. We can’t play in a yawning position very successfully, but we should be in a hint of a yawn position.
Professional performance questions

1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?

   I use it (close it gently) for some types of note cut offs. It is otherwise held slightly open, not totally relaxed, but open.

2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

   I had to learn and I am still learning.

3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

   No. As soon as we start to do this, we start to sound like we are playing high notes.

4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

   Yes, very much so.

5. Have you ever used any type of devices to help with the relaxation of the glottis?

   No
**APPENDIX D**

**SURVEY QUESTIONS IN TABLES**

Table D1
Pedagogical Question 1. Do you advocate using an approach of focusing on breathing and fundamentals as a part of your teaching?

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Yes</th>
<th>No</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td></td>
<td>I do spend a majority of my lesson time with my students on proper breathing and blowing through the instrument.</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td></td>
<td>Breathing correctly and basic technique is the first and most fundamental aspect to playing any brass instrument.</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td></td>
<td>When done properly, breathing can simplify trumpet playing. Breathing is the main focus of any teaching I do. Accuracy, pitch, flexibility, flow studies, range, tone, etc are improved by breathing/playing a certain way.</td>
</tr>
<tr>
<td>7</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Yes</td>
<td></td>
<td>Fundamentals are a huge part of my teaching as sound is always number 1. Staying the same as far as embouchure is also very important in my teaching philosophy.</td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
<td></td>
<td>It is paramount. When things aren't working for ANY reason, a return to fundamentals will help.</td>
</tr>
<tr>
<td>10</td>
<td>Yes</td>
<td></td>
<td>I make my students stand during lessons, and this solves a lot of issues immediately. We talk about anatomy and breathing as necessary, but it seems like it is always necessary. Students like to breathe high and feel full, which almost immediately causes throat tension.</td>
</tr>
</tbody>
</table>
Table D2
Pedagogical Question 2. What types of exercises do you use to address creating compression without creating unwanted glottal activation?

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Answers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Relaxed breath</td>
</tr>
<tr>
<td>2</td>
<td>I have all students make a sound on the leadpipe alone by letting air pass thru the lips and not blowing air - let the leadpipe tell the lips what to do</td>
</tr>
<tr>
<td>3</td>
<td>Slurring most things with a strong tone and airflow before adding articulation</td>
</tr>
<tr>
<td>4</td>
<td>I utilize “the complete yoga breath” that was taught to me by Bobby Shew who learned it from Maynard Ferguson. Compression is part abdominal use as well as a focused aperture to generate the desired frequency.</td>
</tr>
<tr>
<td>5</td>
<td>I think it’s very important that the approach in creating compression is slow and incremental. Being able to control the glottal aperture throughout the entire range of the instrument is vital. I have my students begin to play soft long tones in the upper register. If the glottis is too open, this will help show the inefficiencies (tone will be spread, often under pitch). If the glottis is too closed, the students will feel too much backpressure and produce more of a pinched sound. I have my students play gradual ascending and descending chromaticism of a minor third interval with each repetition starting a half-step higher. The goal is to focus on the connection between generating compression and glottal aperture.</td>
</tr>
<tr>
<td>6</td>
<td>With me, glottis involvement is automatic, and closely associated with compression. When I teach, I have students play up a 2nd line G up an octave without changing horn angle, mouthpiece placement, amount of mouthpiece pressure, etc. I have them compress all the way up. Then, I have them do the same, but decrease mouthpiece pressure. Then, C to high C, etc. Demonstration is done by getting them to blow out a match at varying distances away to indicate air speed/compression needed for higher and lower notes (jacoby).</td>
</tr>
<tr>
<td>7</td>
<td>While I'm not familiar with glottal activation, I focus on the Wedge (yoga) breath to create compression. I play octave glissandos to get a feel for playing with more compression.</td>
</tr>
<tr>
<td>8</td>
<td>Hmmm… I have never had that problem and haven’t had a student with that particular problem. I like to encourage a relaxed breath.</td>
</tr>
<tr>
<td>9</td>
<td>I play very very softly on a G in the staff. This makes the aperture tighten and is very very similar to the action when playing in the upper register. Also I try to keep the lips as soft and supple as possible. I also focus on making sure my chops are together when I actually start playing. Nose breathing can help with that. Breath attacks. The Reinhardt Studies are a huge plus with this as well.</td>
</tr>
<tr>
<td>10</td>
<td>A. whisper tones in all registers B. mouthpiece buzzing C. breath attacks D. playing notes with the wrong fingering but the correct pitch.</td>
</tr>
</tbody>
</table>
Table D3
Pedagogical Question 3. Have you ever used any type of devices to help get the correct feeling for trumpet playing?

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Yes</th>
<th>No</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td></td>
<td>The leadpipe (without the tuning slide in)</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td></td>
<td>¾ inch PVC tube to capture the correct inhalation of breath for trumpet playing. Also the Warburton PETE</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td></td>
<td>I have used a few things to help the student understand the correct feeling for trumpet playing. These would be balloons and breathing exercises for breathing, breathing tubes, mouthpiece buzzing as well as the use of the BERP. If you need further explanation, don’t hesitate to ask.</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td></td>
<td>I was required to purchase a ‘breath builder’, which was nothing more than a clear cylinder, a straw, and ping pong ball. I don’t think I ever used it outside of lessons. School had a great way of teaching me how to do what I could already do, but in a complicated way.</td>
</tr>
<tr>
<td>7</td>
<td>Yes</td>
<td></td>
<td>I've used the Warburton PETE to develop embouchure corner strength.</td>
</tr>
<tr>
<td>8</td>
<td>Yes</td>
<td></td>
<td>I use visualizers but not necessarily any breathing apparatus.</td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
<td></td>
<td>The P.E.T.E by Warburton. Also I do a pencil exercise as prescribed in the Costello/Stevens Method.</td>
</tr>
<tr>
<td>10</td>
<td>Yes</td>
<td></td>
<td>Not successfully.</td>
</tr>
</tbody>
</table>
Table D4
Pedagogical Questions 4. Have you ever had beginning or intermediate students with problems that you believed were caused by the glottis? (e.g. articulation with the glottis, pinched air caused by the glottis, or not being able to play above a second line “G”)

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Yes/No</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>I have not taught beginners</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>“ugh” sound when articulating is the only problem I have witnessed that is tied directly to the glottis</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>Many times I had them divert attention to the throat and have them work towards an open inhalation and exhalation. Some people also call this using warm air as if you were to fog up a mirror (but not to the extreme as to sound like Darth Vader). The feeling of fogging up a mirror usually helps the student to feel the air and throat position in its correct placement. With the use of a breathing tube, or through breathing exercises, I have them try to remain as relaxed in the throat and neck in order to achieve the desired level of blow as possible. With students using a glottal stop for articulations, I would have my students work towards understanding how the articulation should work in its ideal setting. Say the word “Tah” or “Dah” and understand where the tongue (not the throat) is striking when these words are spoken. Once the student pronounces these words correctly, I have them attempt to place the tongue in the same position and work towards getting as consistent a sound as they can with the tongue striking in the correct position. The usual feeling is that it is uncomfortable or strange to them. I then have the student work an “air pattern” where they work to make the air pattern happen with the “T” or “D” consonant as they tongue. If they can succeed in this manner, the rest would then come with direct application to the instrument.</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>I have had students who ‘pinch’ using their embouchure, but I haven’t had any student consciously aware of the glottis, where it was, or what it did.</td>
</tr>
<tr>
<td>7</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
<td>Many times I could hear what was going on with guys sitting next to me that were struggling due to that very problem. I think it is much more pervasive than people think it is.</td>
</tr>
<tr>
<td>10</td>
<td>Yes</td>
<td>Almost EVERY beginning or intermediate student has this problem.</td>
</tr>
</tbody>
</table>
Table D5

Pedagogical Question 5. Have you ever had more advanced young students with problems playing in the upper register that you suspected were caused by improper or over activation of the glottis in a similar way as the Valsalva maneuver?

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Yes</th>
<th>No</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Yes</td>
<td>Perhaps</td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td></td>
<td>Caused by back up of the air – overblowing</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td></td>
<td>Almost always caused by physical and mental tension in trumpet playing</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td></td>
<td>A thousand times yes. The issue is that they have achieved some level of success by the Valsalva maneuver and feel that utilizing that series of muscle movements is the correct way to do it. Or, watching videos on YouTube has also provided them with a “visual” representation of how to do it. Some players demonstrate the upper register by leaning back, squatting down or some type of upper body or torso manipulation in order to play in the upper register. This, in turn, then shows the student “How to do it”, but not really explain that the contortion isn’t the proper way to do it, but that persons way of doing it. If you watched Maynard Ferguson play, you would see him take a big breath and then lean back (what it appeared to look like) in order to play the notes he did. In the wrong hands, the students equate what they see (or saw on a video) as the definitive version of how they should play. Once the student began to understand how the air is supposed to move, and how the body is to be “prepared”, they then have a better grasp of the desired result. And, inevitably, the upper register is easier to play without resorting to some type of contortion in order to do so.</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Yes</td>
<td>I never mentioned the glottis to anyone other than ‘seasoned’ players with a solid understanding of what they were doing while playing.</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>No</td>
<td>Not that I know of.</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>No</td>
<td>Sorry I really know nothing about this stuff</td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
<td></td>
<td>Absolutely! Many times I could hear what was going on with guys sitting next to me that were struggling due to that very problem. I think it is much more pervasive than people think it is.</td>
</tr>
<tr>
<td>10</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table D6
Pedagogical Question 6. What methods or approaches have you used to help your students correct these types of problems involving the improper activation of the glottis?

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>More support from the diaphragm</td>
</tr>
<tr>
<td>2</td>
<td>Learning to play with less air - not forcing the notes to come out but allowing the notes to be produced. By breathing lower and removing tension in the upper body - by not blowing hard - if you tap your mouthpiece while it is in the horn, that makes a sound - how much air can be going in there?</td>
</tr>
<tr>
<td>3</td>
<td>Breath attacks on initial attacks helps to free up the release of air and then once they are comfortable, they can go back and add the articulation with the same follow through of air. Working on relaxing the grip on the trumpet, arms, and upper body helps to free up air and helps open up the upper register</td>
</tr>
</tbody>
</table>
| 4             | “The Dollar Bill” Test. Using a dollar bill, I have the student go to a wall and hold the bill on it. I then have the student take the “yoga breath” (that I learned form Bobby Shew) and have them try 5-10 repetitions of the breath before I have them use the bill. Once the air is moving properly with the correct amount of compression, I then ask them to let go of the dollar bill from the wall at the same moment that they blow the stream of air to catch the bill before it falls to the floor. If the bill stays against the wall, that is one correct use of the yoga exhale. The air moves fast, but there should be little to no tension in the body when this occurs. “Isolated Pitches” aka “Target Practice”. Here I ascend up the chromatic scale from a note of my choosing with the understanding that the student should play this isolated note 3-5 times in a row (with rest between each pitch) to find the correct placement of the tongue, the lip shape, the jaw position as well as the airflow needed to get the note to respond correctly. If they “chip” a note 2 or more times during the repetition, then that is as far as we will go for that particular session. “Ascending Perfect Fourth Exercise”. I used this exercise to help me get better acclimated to playing upstairs in a jazz ensemble setting. Typically, the lead trumpet has an option of playing a high note above the ensemble within reason and character of the chart. I have used the interval of a perfect fourth to help illustrate this to my students. I have them start on a tuning C and ascend to an F above the C thus creating the interval of the Perfect fourth. We then proceed by half step until we reach our “limit” or “ceiling”. The idea is to move the air fast enough in order to get the upper note to respond by means of the air speed and lip tension. “Melodic Patterns” Play melodies upstairs as often as possible. It would do the student a great deal of good if they can perform melodies in the upper register with ease and make it sound like music rather than “Stupid Human Tricks”, or as my former teachers would say “High Notes, for High Notes Sake”. If you can capture the musical intent of the melody in the altissimo register and still create
excitement through the tune. If you can play music in the upper register and not make it sound like it is a high note, but an extension of your register, then you are halfway to the destination.

<table>
<thead>
<tr>
<th>5</th>
<th>With the more advanced students the same principles apply. I will make the exercises more difficult with larger intervals and the use of exaggerated dynamics.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>N/A</td>
</tr>
<tr>
<td>7</td>
<td>N/A</td>
</tr>
<tr>
<td>8</td>
<td>N/A</td>
</tr>
<tr>
<td>9</td>
<td>I have them do the exercises I listed above and to try to FEEL the difference between that way of playing and the other using the glottis. It is a very difficult problem to overcome because once it sets in it becomes a habit. Breaking that habit is hard, but possible.</td>
</tr>
<tr>
<td>10</td>
<td>First of all, you need chops. If the embouchure isn’t strong, good air won’t matter enough. I talk about using a “hint of a yawn”. In other words, the base of the tongue has to be placed slightly forward from its relaxed position, to be forward of the trachea. We can’t play in a yawning position very successfully, but we should be in a hint of a yawn position.</td>
</tr>
</tbody>
</table>
Table D7
Professional Performance Questions 1. When performing on trumpet, do you feel like that your glottis is inactive or do you perceive it to be relaxed?

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Active</th>
<th>Relaxed</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Not sure</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Relaxed</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Relaxed</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Relaxed</td>
<td>My perception is that the throat is relaxed and in its proper position due to my training as a musician. The reality may be that my glottis might be in a different position. But to me, it feels “open”.</td>
</tr>
<tr>
<td>5</td>
<td>Active</td>
<td></td>
<td>When I perform, I’m keenly aware of the glottis and its activity. I consider it part of the mechanism that regulates the air to the embouchure. I feel that it is very active.</td>
</tr>
<tr>
<td>6</td>
<td>Active</td>
<td></td>
<td>When I play, the glottis is never relaxed. It’s always in a slightly contracted state, even playing the lowest, softest note. For me, it is like forming the embouchure. Having it slightly closed to start gives me increased air speed with no effort. This free air speed helps me with attacks, tone consistency, and pitch (all registers).</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Relaxed</td>
<td>Inactive</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Relaxed</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Active</td>
<td></td>
<td>I perceive it to be slightly active but I try to play with it relaxed as much as possible. I myself had to break the habit of playing with the Glottis being too active, so I am very aware of how it feels.</td>
</tr>
<tr>
<td>10</td>
<td>Active</td>
<td></td>
<td>I use it (close it gently) for some types of note cut offs. It is otherwise held slightly open, not totally relaxed, but open.</td>
</tr>
</tbody>
</table>
Table D8
Professional Performance Question 2. Have you always naturally been able to create the compression needed to play in the upper register on trumpet or was it something that you had to learn?

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Yes</th>
<th>No</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>No</td>
<td></td>
<td>Learned</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td></td>
<td>Had to learn. I always worried about tone and pitch first and foremost. I still believe that the upper register will naturally improve the better your fundamentals sound. I am not a lead player and feel that some of the range of a lead trumpet is “God given”. Some of us, no matter what, will never be able to do this! But, we can certainly maximize our “legit” potential in the upper register by the correct use of air and careful attention to tone and pitch and how we approach upper notes with our air.</td>
</tr>
<tr>
<td>4</td>
<td>No</td>
<td></td>
<td>I was not naturally gifted to play in the upper register, so my ability was done through hard work and practice, and because it sounded cool to me. Listening to Maynard and Buddy Rich Big Band recordings gave me plenty of awe-inspiring moments and motivation during my youth to help me keep my eyes on the prize. My teachers were not prolific high note players, so all of my knowledge came from trial and error and my curious nature.</td>
</tr>
<tr>
<td>5</td>
<td>No</td>
<td></td>
<td>It was something I had to learn.</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td></td>
<td>I learned a lot by watching people play. The foundation was there, but by watching some, and talking to others, I came up with my own approach from information I gathered centered around what I knew I was doing physiologically. Aside from this ‘fine tuning’, I have never had difficulty playing in the upper register. It’s sort of my comfort zone.</td>
</tr>
<tr>
<td>7</td>
<td>Yes</td>
<td></td>
<td>I feel that I naturally could play to a high G, but learned how to utilize resistance and play on shallow mouthpieces that enable me to play higher notes efficiently.</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>I don't feel that I create compression. I try to let the mouthpiece and lead pipe combination work in balance with the air support I use.</td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
<td></td>
<td>I was able to create compression at a young age but then studied a certain system that caused me to play way too open. I have had to “unlearn” this for many years...</td>
</tr>
<tr>
<td>10</td>
<td>No</td>
<td></td>
<td>I had to learn and I am still learning.</td>
</tr>
</tbody>
</table>
Table D9
Professional Performance Question 3. When performing in the upper register do you feel that you activate the glottis intentionally in someway to create compression either to start the air or to keep it partly engaged to control compression?

<table>
<thead>
<tr>
<th>Interview No.</th>
<th>Yes</th>
<th>No</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>No</td>
<td>It may help with compression</td>
</tr>
<tr>
<td>3</td>
<td>Yes</td>
<td>Yes</td>
<td>Never thought about it</td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>No</td>
<td>I would say yes, but I am not actively thinking about glottal manipulation in order to play in the upper register. I do what I need to do in order to get the notes to speak. I guess that I would say my tongue is arched a little bit higher when I do play in the upper register to assist with the air speed, but not with my glottis.</td>
</tr>
<tr>
<td>5</td>
<td>Yes</td>
<td>No</td>
<td>When I’m performing in the upper register the glottis is directly related in creating compression efficiently. It is a vital part of controlling compression.</td>
</tr>
<tr>
<td>6</td>
<td>Yes</td>
<td>No</td>
<td>When I play, I use the glottis to control the compressed air subconsciously. I never knew what I was doing until I began asking other players. My airstream is increased at the glottis, at the embouchure, and, when necessary, at the arch of the tongue (when tired).</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>No</td>
<td>I am not really sure...</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Yes</td>
<td>I think it is best to keep it as relaxed as possible and create the compression at the chops. I don't think it is possible to create ALL the compression you need there, so the Glottis comes into play. But the more you can shift that equation to the chops side of things, the better.</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>No</td>
<td>No. As soon as we start to do this, we start to sound like we are playing high notes.</td>
</tr>
</tbody>
</table>
Table D10
Professional Performance Question 4. When learning to play in the upper register on trumpet did you ever have difficulty with the glottis restricting the airflow causing a “pinched” sound?

<table>
<thead>
<tr>
<th>Interview No.</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>No</td>
<td>but again for me this was caused by over blowing</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>Never thought about it</td>
</tr>
<tr>
<td>4</td>
<td>No</td>
<td></td>
<td>If I did have a pinched sound, I would say that it was caused by mouthpiece pressure more than anything else. I have noticed some students squeezing and pressing to play upstairs, but for me personally, I have not noticed that. I would get head rushes when playing high, I guess that was partially caused by my squeezing my body to make compression. Inevitably I would “black out” (though not often enough for me to be concerned about it) and would then try another way to correct the issue.</td>
</tr>
<tr>
<td>5</td>
<td>No</td>
<td></td>
<td>It wasn’t a particular problem when I was learning what role the glottis played in helping generate efficiency and compression. I never experienced a pinched sound solely due to improper glottis regulation.</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td></td>
<td>I never have had any problems. I haven’t changed the way I have played since starting trumpet, so have never had the glottis interfere with playing. I assumed that everyone played the way I did, and that everyone restricted their airstream using the glottis. Once in college, I realized this wasn’t the case.</td>
</tr>
<tr>
<td>7</td>
<td>No</td>
<td></td>
<td>When I was first learning the wedge, and had much more air/compression than I was used to, I did try to play high in my practice and strained my throat (glottis?). So I did have to learn to play more open in my throat since I had more compression from my new found breath control.</td>
</tr>
<tr>
<td>8</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>No</td>
<td></td>
<td>Not so much a pinched sound as playing too open and with too big of an aperture, creating flexibility issues and volume issues. I was using a massive column of air and pushing it very hard to make it go faster. It wasn't until later that I realized the difference the actual aperture can make in the whole process and how much less air it takes than I thought before. Chris La Barbera, Roger Ingram and Lynn Nicholson and many other great players and teachers helped me see this difference.</td>
</tr>
<tr>
<td>10</td>
<td>Yes</td>
<td>No</td>
<td>Yes, very much so.</td>
</tr>
</tbody>
</table>
### Table D11

Professional Performance Question 5. Have you ever used any type of devices to help with the relaxation of the glottis?

<table>
<thead>
<tr>
<th>Interview No.</th>
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<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Yes</td>
<td>No</td>
<td>Again I used the leadpipe sometimes or the Berp</td>
</tr>
<tr>
<td>3</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Yes</td>
<td>No</td>
<td>Visual imagery would be my best answer. Imagine that you had a hard boiled egg inside your mouth keeping everything open inside. Imagine you had a piece of a very hot baked potato that you needed to cool off very quickly. Or staying “tall” inside the mouth as you play. A physical device I would use would also be a breathing tube with a ¾ inch inner diameter and a 1-inch outer diameter. I would take a few breaths on this tube to help remind me of how my breath should feel in all registers.</td>
</tr>
<tr>
<td>5</td>
<td>No</td>
<td></td>
<td>Other than playing exercises, no.</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td></td>
<td>I never have; however, after a lot of playing, I’ll hum low, soft tones to prevent my throat from being sore the following day. Doing so helps relax/massage the glottis.</td>
</tr>
<tr>
<td>7</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Yes</td>
<td>No</td>
<td>I think that learning the FEEL of playing with no participation of the Glottis (or very little, anyway) is the best way. I think working on compression in the aperture will help with this. The P.E.T.E is an excellent tool.</td>
</tr>
<tr>
<td>10</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>