A PHYSIOLOGICAL EXPLORATION AND PEDAGOGICAL INTEGRATION OF VOICE AND BRASS TUBA PHYSICAL METHODS TO ENHANCE TONE TIMBRE OR “PLAY LIKE YOU SING”

by

William D. Porter
A Dissertation
Submitted to the
Graduate Faculty
of
George Mason University
in Partial Fulfillment of
The Requirements for the Degree
of
Doctor of Musical Arts
Performance

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Date:  ____________________________________  Spring Semester 2017

George Mason University
Fairfax, VA
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DEDICATION

This dissertation is dedicated first to God, then my loving wife, Judy, and our two wonderful children and their spouses, Sandra and Greg and Bill and Emily. In addition, this work is dedicated to my parents, Jack and Ruth Porter, my in-laws, brothers, sisters, and closest friends.
ACKNOWLEDGEMENTS

Many thanks to God, my wife, close friends Christin Foley and Dr. Sarah Stoneback, our children and their families, our parents, my brother and sisters and their families, in-laws, relatives, and hundreds of supporters who have made this degree become a reality. My wonderful and loving wife, Judy, assisted me by taking care of me, our house and family while I spent long hours on the computer. Superlative thanks to Dr. Michael Nickens for encouraging me to start the DMA degree and offering assistance at every corner. Thanks to the faculty members at George Mason School of Music who have been involved with teaching me and helping along the way. Their tireless and positive uplifting efforts were wholeheartedly appreciated, and I hope I can be as good a teacher as they are in the future. Supreme thanks to one of my voice teachers, Ms. Chri sse lene Petropoulos for her encouragement in helping me and for giving me new reasons to research ways to play better. Utmost thanks also go to one of my tuba teachers, Mr. David Fedderly, who unknowingly got me started on this path many years ago. His continual encouragement and tutoring to me have been invaluable, and I am so lucky to have his influence on my tuba playing and musicianship. My warmest gratitude to the test subjects and their families and the laundry list of friends and relatives who have been my sounding board for dissertation development during the past eight years. Much gratitude to the editors of the dissertation including Dr. Karyn Mallett, Sarah Gebbia, my two sisters, Sarah Bigelow and Helen Dickey, and to my mother and father, Ruth and Jack Porter. I am sincerely grateful to my parents, my dearest friend Christin Foley, and my sister Sarah Bigelow for the huge task of proofing. Thank you to my church, Fairlington UMC, for their support of our family. Thanks to the panelists who are my friends and colleagues that volunteered their time to listen to the research recordings for analysis of timbre qualities. Finally, thanks to George Mason University for providing a platform of learning that allows veterans of the United States Armed Forces to work towards earning degrees that help us be viable and involved teachers in our communities.
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ABSTRACT

A PHYSIOLOGICAL EXPLORATION AND PEDAGOGICAL INTEGRATION OF VOICE AND BRASS TUBA PHYSICAL METHODS TO ENHANCE TONE TIMBRE OR “PLAY LIKE YOU SING”

William D. Porter II, DMA

George Mason University, 2017

Dissertation Director: Dr. Michael Nickens

This dissertation details a physiological exploration of voice and brass tuba physical methods in order to suggest a synthesized and integrated tuba training pedagogy, which may enhance tone timbre. Voice and brass tuba pedagogical methods were analyzed for similarities and differences in their approach to seven specific Vocal Physical Training Elements (VPTE): 1) posture, 2) breathing, 3) pharynx and airway openness, 4) tongue shape and movement, 5) jaw placement and movement, 6) lip aperture shape and movement, and 7) tone and timbre production (includes volume and sound quality). Further, experimental research involving student participants was conducted to determine possible implications of an integrated pedagogical approach on tuba performance. Results from this study suggest that tuba playing techniques may benefit from a synthesized voice-and-tuba pedagogical approach with regard to the training of these physical elements.
In the fall of 2010, I was assisting with a college athletic music program and enjoyed helping students of all instrumental and vocal backgrounds, both music majors and non-majors. One of the voice majors from the School of Music wanted to learn to play mellophone in the ensemble, but was told no by that student’s voice teacher. The reason given: playing mellophone would damage the student’s voice. As a 35-year professional musician and tuba and brass teacher, this was the first time I had heard such advice and I was curious to understand the logic behind it. I had received some past vocal training, but had not seen a technical vocal book or consulted a vocal pedagogy specialist. As I continued to ponder the voice teacher’s advice for the potential mellophone student over the next several months, I realized that my knowledge was based on the brass study books that have been published and from my own studies under six different well known low brass teachers, and there was much that I could learn about vocal technique and pedagogy beyond the embouchure (i.e. lips, tongue and front teeth).

Shortly after this event, a clinic offered by Ms. Chrissellene Petropoulos labeled “10 Technical Commands to Vocal Mastery” caught my eye in a flyer on a church wall. Ms. Petropoulos proclaimed guaranteed techniques for vocal production no matter what the situation or climate. I wondered if the vocal techniques offered at the clinic would also benefit brass instrument players. When I raised the question of why vocal and brass
pedagogies do not overlap in training techniques to Dr. Michael Nickens, my instructor and the Athletic Music Director of the George Mason University Pep Band, The Green Machine, he said, “Because folks love trying to keep the world separate.”1 In other words, we as brass or vocal musicians have a multitude of ways to express our message, and we are comfortable keeping our methods separate from the methods of other (even related) disciplines. However, keeping vocal and brass areas separate may inhibit our musical creativity. If students are allowed to create in different mediums, there will be a crossover of ideas and sounds that will benefit all fields. Almost immediately was the congruent thought that perhaps voice techniques could be applied to brass playing, thereby unifying the production of the brass and vocal fields. Unlike the other wind instruments (or strings and percussion), brass playing is the only wind instrument that combines air with a vibrating function from the human body (lips) just like singing (vocal folds). Why is it important to re-invent the wheel about vocal and brass pedagogy comparisons? The answer in simplest terms lies in the fact that there is still no direct connection between techniques of vocal and brass that utilize naming the same body parts in the neck and pharynx area and still no connection between explaining how or why vocal breathing is taught differently than wind instruments, YET we are taught to play like we would sing.

Ms. Petropoulos’s clinic was indeed thought provoking and thoroughly researched with viable sources backing up her techniques. I was convinced that her methods would

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help both voice and brass worlds immeasurably and contacted her about the possibilities of having her methods be the centerpiece of my doctoral dissertation project. For professional reasons, she was very receptive to collaborating with me for my project, which actually started in the fall of 2010. While I did not have the complete dissertation outline ironclad, the process began to unfold. First, I read and studied her book also titled *The 10 Technical Commands to Vocal Mastery™*. Second, I took 11 voice lessons with her over a period of five months in Spring 2011 that included playing tuba in front of her for observation of my breathing process and neck area activity. I began to understand the mechanics of the operations inside our necks between the embouchure and our lungs from a vocalist’s perspective. I further learned how vocal breathing is specific to the voice and different than what I had learned or taught from the standard brass instruction. My challenge was to apply the techniques of Ms. Petropoulos to my own tuba playing, and if the techniques helped, then to teach them to others and see if these methods could improve the physical characteristics of brass (tuba) techniques. This was new territory for me to explore, but the most exciting and important aspect was embarking on the journey of answering the question: can a musician engage concurrently in vocal and brass (tuba) physical training techniques without damaging performance? To answer this question, I have collected and analyzed technical training sources, conducted experimental research with student participants and synthesized and presented my results for future theory or practice of an integrated vocal and tuba pedagogy.
Chapters of the Dissertation

This dissertation is divided into five chapters based on the order of the journey in researching and writing this dissertation: Chapter I, Introduction and Explanation of Research Problem; Chapter II, Literature Review; Chapter III, Experimental Research Method; Chapter IV, The Results; Chapter V, Conclusion. The seven Vocal Physical Training Elements (VPTE) serve as the core training methods throughout all chapters. These seven elements were derived from the initial vocal study with Ms. Petropoulos. Although there is a myriad of study areas for singing and instrumental playing, the seven elements (VPTE) were decisively selected as the ones that impacted this author’s tuba playing significantly during the experimentation with Ms. Petropoulos and had the greatest implications for teaching other tuba players; therefore, only these elements (VPTE) were used for the research.

Chapter I, Introduction and Explanation of Research Problem, includes an introduction, a brief description of the problem being researched, a hypothesis, limitations to this project, and a short history and comparison of the beginning studies and experimentation between the first two sources (Chrissellene Petropoulos and Arnold Jacobs) used for research, which developed the VPTE. Chapter II, Literature Review, begins with the results from an unpublished raw data nationwide collegiate survey of the most popular brass and vocal pedagogies and then finishes with a literature review of those and other sources used in the research for the purpose of designing the experiments with test subjects. Chapter III, Experimental Research Method, outlines an experimental research project, which was guided with methods from the unpublished raw data survey
of collegiate instructors. The experiment was conducted to determine whether an integration of vocal and tuba pedagogy could be accomplished or not. Chapter IV, The Results, presents an analysis of the study findings according to the original research question of simultaneously being involved with a career of singing and playing tuba and euphonium. Chapter V, Conclusion, discusses implications for the research findings on future theory and practice and raises questions that remain unanswered from the research. Finally, in the discussion of results and analyses, the initial source for technique research employed in this study, *The 10 Technical Commands to Vocal Mastery™*, is expanded and generalized to posit a comparison of brass and vocal pedagogies across the seven VPTE.
CHAPTER I, INTRODUCTION AND EXPLANATION OF RESEARCH PROBLEM

Introduction

Pedagogical techniques of the vocal and brass fields have been compared for centuries starting with Girolamo dalla Casa in 1584 as one of Giovanni Gabrieli's leading cornettists at St. Mark’s Basilica, Venice, Italy. He described their aspirations as instrumentalists was to “...imitate the beautiful and imitate the human voice if possible” and that “...the breath of playing the Cornetto is most excellent in imitating the human voice.”\(^2\) Two hundred years later Johann Ernst Altenburg in 1795 instructed Baroque trumpet players to use “the human voice...as the model for all instruments...and should seek to bring forth the so-called cantabile on his instrument”.\(^3\) More recent broad comparisons of all brass with voice have emulated from sources such as *Song and Wind* by Brian Frederiksen, whose title describes the book’s approach, and, *What Every Trombone Player Needs to Know About the Body* by David Vining. Vining has a description of voice to brass delineated as “...hear the pitch as you sing and then allow the pitch to come out spontaneously when you play.”\(^4\) There has been some research done on


\(^{4}\) David Vining, *What Every Trombonist Needs to Know About the Body* (Flagstaff, AZ: Mountain Peak Music, 2010), 63.
the pedagogical techniques of each discipline and, in a few cases, how the two fields differ. The only similarities of actual physiology have been about posture, comparing vocal cords to the lips for pitch vibration, open pharynx, and tone and timbre.⁵ This study reconnoiters finding out comparisons and connections of the two fields. Outlines of the VPTE in both fields have been explored to determine if there is enough overlap to warrant further examination of similarities or differences. To better understand the anatomy being discussed for both pedagogies, the figure below exemplifies a visual aid for the shape of the lungs, larynx structure, and ribs. In particular, notice the rib tissue (more in back than front), the larynx structure on top of the trachea coming from the lungs, which houses the vocal folds and arytenoid cartilages and muscles, and the skeletal structure displaying the 11th and 12th floating lower ribs that are intrinsic to vocal quiet breathing.

Figure 1. Plastic Sculpture of Lungs, Larynx Structure, and Ribcage.⁶

⁵. Vining, 62.
Additionally, an understanding of how the voice ranges line up with the brass ranges is prudent. Vocal parts are divided into general ranges of soprano, alto, tenor and bass.

Figure 2. Chart of Vocal Ranges.  

In similar fashion, the brass family has five different instruments that cover the same ranges (euphonium is the same as trombone).

Figure 3. Chart of Brass Ranges.  

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8. The Composition Lab, “Brass Ranges” 2010 http://compositionlab.co.uk/learn.-
The figure below displays what those instruments look like.

![Instruments of the Brass Family](image)

Figure 4. Pictures of Brass Family.9

Statement of the Problem

Young tuba students today, who learn traditional methods of brass techniques, still have unfavorable habits such as slouched posture, forced air breathing, inhibited air capacity, closed pharynx areas, tonguing articulation clarity issues, unstable jaw positioning, small lip apertures, and non-resonant tone and timbre. Both vocal and tuba brass field’s current methodologies list similar physiology technique elements (VPTE)

such as posture, breathing, pharynx and airway openness, tongue shape and movement, jaw placement and movement, lip aperture shape and movement, and tone and timbre production (sound quality). Yet, despite each discipline’s pedagogical attention to these common physical elements, little experimental research has been done to explore the potential ways in which the inclusion of voice techniques might improve tuba performance. Specifically, research on the effects of an integrated and synthesized voice and tuba pedagogy on tuba performance could help students of all ages improve tuba playing techniques while gaining knowledge of singing techniques as well.

Research Questions and Hypothesis

What are the most commonly used pedagogical techniques employed by collegiate vocal and tuba instructors? Is there any overlap in terms of pedagogical techniques when addressing similar physical components for tuba and vocal performance (e.g. breathing)? How does the introduction of VPTE affect the characteristics of tuba performance (e.g. tone timbre)?

The study and application of voice pedagogical methods to tuba playing techniques may lead to the following outcomes for tuba players (VPTE): awareness of posture, maximized lung capacity, opened pharynx and airway, released freedom of tongue articulation, improved stability of jaw placement, controlled facial muscles (especially lip aperture), and a comprehensive understanding and enrichment of tone timbre.
Limitations

This project is limited in several important ways. First, the surveys conducted with vocal and brass instructors were limited to a national audience and are limited by the fact that human opinions are a basis for the methods of collecting research data. Even though the survey results for tuba referred to in Chapter II, Literature Review, show *Song and Wind* as the primary source used, there were several other opinions about top brass pedagogue sources. Similar to the brass survey, the vocal survey referred to in Chapter II offers only a national perspective, but may reflect a wider range of opinions because these colleagues were already in touch with other teachers worldwide and provide insight they have gleaned from their experiences; however, the survey is limited to those teacher’s opinions of their top sources.

Second, this study is further limited in its narrow focus on the physical aspects of voice and tuba performance rather than on musicianship. Even though the emotional expressive side of both disciplines is intrinsic to enjoyment of the music, the added discussion on the element of expression would create more experimentation and volumes than this project could support.

Third, due to time and money constraints, the experimentation phase description in Chapter III only had four research participants. However, in order to obtain a broader range of test results, the four students were different ages ranging from 12 to 20, two male and two female.

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Fourth, due to cost and availability, no Magnetic Resonance Imaging (MRI) was done as part of the research—only fiber-optic laryngoscopy.

Fifth, there are numerous vocal processes, terms and techniques not covered in this study due to the fact that the techniques are either not ever used in brass playing or did not fall directly and in practical value under the VPTE. The vocal physical elements commonly addressed in multiple vocal pedagogy books but not addressed in this study include (no particular order):

- tongue trills
- flutter tonguing
- nasal resonance
- other vowel sounds and consonants than what was needed to play the tuba
- falsetto applications of the vocal folds to the lip aperture shape
- unifying registers for male or female, chest voice, head voice (because in the tuba sources, there were no unifications of different timbres or changes in resonance taught for registers)
- *aggiustamento* (vowel modification)
- voice extension and range
- *messa di voce* (dynamic contrasts)
- vibrato
- health of the voice or lips
- EGG (electroglottography) method of breath testing
- movement of body while singing or playing the tuba
- epiglottic behavior
- resonance in the masque
- prephonation or mental thoughts of hearing the pitch as much as the sound of the vibration after going
- *sonance* or noise in the tones and timbres

Sixth, although vocal pedagogy connected with education relevant to the VPTE are affected by other organs and musculature structure improvement processes such as Alexander Technique (i.e. align posture to get rid of tension in the body)\(^\text{11}\) and the

Feldenkrais Method (i.e. conscious analysis of neuromuscular activity)\textsuperscript{12} and other types of motor training skills, this dissertation will only deal with posture, breathing and functions in the pharynx and mouth. Therefore, though Alexander Technique is briefly reviewed in Chapter II, Literature Review and Feldenkrais Method is listed in Chapter II, the decision to focus more narrowly has allowed for greater depth and examination of pharynx-related operations from voice to brass. However, to be clear, these methods and others do have a huge impact on posture and breathing and if a student wants to go further with voice to brass instruction, then study of these methods is warranted.

Lastly, the study is limited in its focus on tuba playing and exclusion of other brass instruments. While extensive research on all brass instruments is needed, the time frame and resources did not allow a complete study of other brass instruments. Also, there is some thought already in print comparing playing brass instruments with higher ranges than tuba and euphonium to vocal singing in a book by Sharon Radionoff, but nothing from her about tuba.\textsuperscript{13} In the self-experimentation phase of the research methodology, this author has already discovered how easy it is to apply Petropoulos’s methods to the middle and low range of the tuba, but not so much to the high range. The only caveat to this statement is that more training of the vocal muscles needs to happen, along with more group experimentation, to possibly demonstrate better outcomes for these ranges on tuba.

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Arnold Jacobs Research

Even before the opportunity to study with Ms. Petropoulos, this author had already been taught the methods of Arnold Jacobs (now deceased), which as will be established later in this paper, is the top brass pedagogical method used by over half of the tuba and euphonium teachers in universities nationwide. Before this author extrapolated the vocal and brass methods from the national survey, the step of comparing Petropoulos to Jacobs was an important part of the journey towards integrating the two fields for tuba playing. This author’s curiosity about the possible benefits of integrating the two pedagogies were the impetus of this dissertation and reviewing them will help the reader understand the mindset of this author in approaching the nationwide survey. A small preview of some of the literature review and later field comparisons is included in the Petropoulos/Jacobs discussion for breadth and depth of thought process.

Twelve lessons were accomplished in Fall and Spring 1984-85 with Mr. David Fedderly, a student of Arnold Jacobs for 10 years, Principal Tuba (Ret) Baltimore Symphony Orchestra, Professor of Tuba (Ret) at Peabody Institute of The Johns Hopkins University and The Julliard School and currently Professor of Tuba at the University of Maryland. He is also a main pedagogue teacher in Song and Wind.14 Likewise, Mr. Fedderly’s teachings were this author’s base for knowledge of how to do qualitative and quantitative research for this project. Therefore, to have a teacher of Mr. Fedderly’s status available to teach Mr. Jacobs’s methods was indeed a welcome boost to this author’s career and growth as a musician and tuba player. The lessons with Mr. Fedderly

introduced much thought about musical expression, but more specific to this dissertation, there were two physical points that he felt were needed: buzzing with the lips on the mouthpiece and a focus on the natural breathing process, both of which were new at the time to this author. The absence of mouthpiece buzzing training had caused a dependency on the mouthpiece as a crutch for sound production and the lack of natural breathing training was due to a common belief in the brass field during this author’s childhood for breathing called “forced air control” or “belly breathing” which is executed by expanding the abdominals for inhale and contracting them to exhale.

The buzzing helped this author focus initially on the 7th cranial nerve connection between the brain and lips for better control of the sound attacks and second, independency of the sound production process from the mouthpiece to focus on the body as a sound producing instrument.¹⁵ In contrast, natural breathing process used the method of “collapsing” the chest area associated with the exhaling process. Over time, this author changed the exhale process from an abdominal contraction to a large sighing of the air going out. However, in order to get enough velocity of air speed to produce a lip buzz, a contraction of muscle developed around the sternum area. Unknown, nor understood, by the author, this caused a lessening of air available for the exhale because of constricting and collapsing of the chest area. Back expansion breathing from vocal methods was not part of the explicit vocabulary in the lessons, although in the natural breathing process it does happen. Again, however, since the author’s interpretation of the breathing lessons was not a focus on back expansion and just frontal movement, a

¹⁵. Frederiksen, 122.
constriction of air supply developed over a period of the next 20 years because of the contraction near the sternum (which was actually upper abdominals). As this author got older, this began to manifest itself into vocal tract tension, which began to cause the vocal folds to go hoarse or raspy after playing tuba. This was not documented at a specific event and was assumed just to be a natural part of aging as a tuba player. Beyond breathing techniques, other physical elements from Arnold Jacobs were also taught and are covered in the comparison between Petropoulos and Jacobs in the following paragraphs.

Self-Experimentation with Ms. Petropoulos

Before researching the rest of this project, some hands-on training with Ms. Petropoulos seemed to be in order because her methods immediately aligned with physical elements relevant to tuba playing and seemed understandable enough to fit into this author’s own teaching techniques. Moreover, this author had not ever had any formal voice lessons, and Ms. Petropoulos was conveniently available, and her lessons counted towards one of the George Mason University DMA Advanced Pedagogy Credits. Despite some previous training with Mr. Jacobs’s methods, constant growth is a benchmark of any musician’s lifestyle and curiosity about Ms. Petropoulos’s methods was part of that lifestyle motivational interest. At that time in 2011, comparing any other source beside Mr. Jacobs’s (through Mr. Fedderly) and Ms. Petropoulos’s methods did not occur to this author, and indeed the idea of expanding the research to include other sources did not come up for several years. This explanation is important because it substantiates the entire purpose of entering into this topic for the dissertation. The
validity of comparing Petropoulos’s book against Jacob’s methods was necessary to begin the new training method and establish an in-depth look at the cultural differences between the vocal and brass fields.

Ms. Petropoulos’s book has two areas of study—Performance Mode or “...an attitude of mental objectivity”\textsuperscript{16} and a larger part based on her book title, \textit{The 10 Technical Commands to Vocal Mastery}™. Although she writes that these two areas cannot be one without the other, this dissertation’s focus is about qualifying “...a foundation of knowledge of breathing and vocal physiology”\textsuperscript{17} that will also apply to brass (tuba) production. Therefore, the focus is not centered on musicianship or on “Performance Mode”, but is about finding the VPTE that can be united in vocal and tuba performance.

When the lessons with Ms. Petropoulos became available, this author had no idea of the deficiencies that had developed in the vocal tract. This author had been a boy soprano singer in church choir, then a tenor in high school and college choirs and even a tenor vocal soloist in a high school show choir. However, the lessons with Ms. Petropoulos brought forth clarity and understanding and a profound realization that when this author uses a speaking voice, the vocal tract, and particularly the larynx, closes around the vocal folds thereby causing the voice to sound softer, dull and hard to understand. When she made this author aware of the voice constriction, the interest of why it was happening and connection to the tuba playing expanded immensely. For the

\begin{itemize}
\item[16.] Chrissellene Petropoulos, \textit{The 10 Technical Commands to Vocal Mastery}™ (Potomac, MD: Meyandro Press, 2006), 15.
\item[17.] Petropoulos, 15.
\end{itemize}
duration of the lessons with Ms. Petropoulos, the next step was to use some of the VPTE as self-experimentation for tuba playing. Each lesson was video recorded and reviewed as part of a pedagogical class under Dr. Michael Nickens. Over the course of the spring semester 2011, the following similarities and differences in Ms. Petropoulos’s voice training and this author’s Jacobs’s tuba training began to emerge.

Petropoulos versus Jacobs

Ms. Petropoulos has written and organized her own book, whereas Mr. Jacobs’s methods have been dictated and organized by his students. Because of familiarity by this author of Jacobs’s methods, the organizational structure of this comparison is approached comparing Jacobs to Petropoulos, but will cross-reference all parts of both teachers under the VPTE.

Table 1. Seven VPTE of Vocal Pedagogy: Jacobs and Petropoulos.

<table>
<thead>
<tr>
<th>VPTE</th>
<th>Characteristic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arnold Jacobs</td>
<td></td>
</tr>
<tr>
<td>Posture</td>
<td>Stand while seated</td>
</tr>
<tr>
<td>Breathing</td>
<td>Breath to expand, breathe naturally</td>
</tr>
<tr>
<td>Pharynx and Airway Openness</td>
<td>Airflow</td>
</tr>
<tr>
<td>Tongue Shape and Movement</td>
<td>Vowel shaping tool, no specific placement</td>
</tr>
<tr>
<td>Jaw Placement</td>
<td>Down and slightly forward</td>
</tr>
<tr>
<td>Lip Aperture Shape and Movement</td>
<td>Embouchure ‘oh’ shape, wide elliptical aperture</td>
</tr>
<tr>
<td>Tone and Timbre Production (sound quality)</td>
<td>Song in the mind equals song (and sound) on the instrument</td>
</tr>
<tr>
<td>Chrissellene Petropoulos</td>
<td></td>
</tr>
<tr>
<td>Posture</td>
<td>Command I, Posture—sit tall and straight</td>
</tr>
<tr>
<td>Breathing</td>
<td>Command II, Inhaling Diaphragm and External Intercostal Muscles, Command IX-Exhalation and Command X-The Diaphragm and External Intercostal</td>
</tr>
</tbody>
</table>

18
Muscles are held down and out by the Lumbar Fascia Muscles—expand to breathe, breath full unnaturally

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Tongue Shape and Movement</td>
<td>Command IV-Tip/Front Circumference of the Tongue and Command V-Back of the Tongue—vowel shaping tool, flat, down, and forward</td>
</tr>
<tr>
<td>Jaw Placement and Movement</td>
<td>Command III Jaw (Mouth and Lips)—jaw down and back</td>
</tr>
<tr>
<td>Lip Aperture Shape and Movement</td>
<td>Command III Jaw (Mouth and Lips)—no specific lip command; consonants</td>
</tr>
<tr>
<td>Tone and Timbre Production (sound quality)</td>
<td>No specific commands; <em>chiaroscuro</em></td>
</tr>
</tbody>
</table>

1-Posture. With regard to the first VPTE element, posture, Mr. Jacobs and Ms. Petropoulos have similar perspectives. Sometimes they use different wording, but both are stipulating that posture is “sit tall and straight.” The Alexander Technique book, *What Every Musician Needs to Know About the Body* by Barbara Conable\(^\text{18}\) has some more specifics to propose about the head being centered on the AO (atlanto-occipital) joint and exact alignment of the shoulders and arms over the hips. Posture is a simply stated function and this term is unified into a catch phrase of Jacobs’s—“stand while seated.” There is another source statement that aligns with Jacobs’s words—bring the instrument to the player.\(^\text{19}\)

2-Breathing. Jacobs recognizes breathing as a critical physical movement and suggests that instrumentalists breathe naturally. Mostly this involves breathing with the natural process of the thoracic area expanding upon inhale and collapsing (returning to repose position) upon exhale. He simplifies airflow as either going in or out and as slow for soft and fast for loud notes. His essential thought about breathing is to make sure that “blowing” is the fundamental action of moving wind out of the body from the lungs and not to use pressure and contraction to move the air. For this area, Mr. Jacobs and Ms. Petropoulos differ greatly. His description uses the same terms for muscles involved such as diaphragm, abdominals, intercostals and bone and cartilage terms like ribs, chest, back, sternum, and shoulders. Ms. Petropoulos uses these terms also, but adds in her unique command of breathing into six areas as depicted in Figure 1 below: 1) middle front, 2) lower front, 3) middle side, 4) lower side, 5) middle back, 6) lower back. MRI pictures of her lung area back up her method showing how natural breathing may not necessarily allow the lungs to fully inflate.

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20. Frederiksen, 100.
21. Ibid, 100.
22. Ibid, 152.
24. Petropoulos, 90.
Upon trying this method, it became readily apparent that this author’s body was not flexible in the intercostal rib areas of front, sides and back. At first, the perception of getting a full breath felt less than adequate, since the fullness effect of natural chest breathing was the most prevalent method taught through the Arnold Jacobs’s school of thought for this author. Over time, inhaling in the six areas have increased the breath capacity as the intercostal areas have become more flexible and stretch better. Mr. Jacobs also covers the process of the air going into all areas of the lungs at once, but is not explicit about six areas and there are no MRI pictures to support his thoughts. Ms. Petropoulos on the other hand shows in her MRI pictures how not breathing in six areas

25. Petropoulos, 90.
only partially fills the lungs and therefore limits the amount of air inhaled for singing. Logically, filled lungs operate the same for any wind-blown activity, whether it be singing or brass playing.

Another inhaling process that describes the pelvic region extending downward for inhaling parallel to the diaphragm is in Conable’s book. Neither Ms. Petropoulos nor Mr. Jacobs say this, and both focus on above-the-waist muscles and lung capacity.

Mr. Jacobs describes the abdominals in exhalation as an afterthought—after the thoracic cavity reduces back to its original shape of repose. While Mr. Jacobs describes the abdominals coming in, he does not advocate their voluntary muscular bringing inward motion. Through trying to practice his natural process, this author had lost use of much of the abdominal region in exhaling. To be clear, the reason this author was taught the natural exhale was because the method of “belly breathing” was the first method of exhaling being taught early in life. This resulted in a bright, blasted sound when playing loud and inconsistent and wavering tone for soft playing, which would tire out the lips and embouchure. Mr. Jacobs’s methods do not advocate “belly breathing” and while Mr. Jacobs’s methods helped greatly with changing the sound concepts by slowing the air down, making it warmer and protecting the embouchure from damage, the “natural” exhaling interpretation by this author had caused a tightness around the sternum area that left the belly sticking out and caused a collapsing of the chest area making it almost impossible to stay sitting upright when playing the tuba. This caused many problems

with embouchure stability, trying to keep good breathing going after playing a piece for more than 5-10 minutes and increased the tension around the throat and neck area.

Ms. Petropoulos speaks directly about the abdominals being an integral part of the exhalation process (she uses the word intensity). The use of the abdominals from Petropoulos’s corresponding Command IX was almost completely opposite from the Jacobs’s training. Like Jacobs, her descriptions do not say contract, but move the abs inward upon exhalation. There is a large difference in moving and contracting when a muscle is concerned because moving promotes movement without tension, whereas contraction connotes tension and breath holding along with the contraction. No other source really emphasized the abdominals moving in as being an integral part of the air exhalation process. Perhaps there is concern about the abdominals contracting and causing tension, but with the other commands of controlling the throat and neck openness muscles, that tension can be eliminated even with the abdominals intentionally moving in during exhalation. Petropoulos’s method of abdominals moving inward ties in directly with the next command for breathing.

The final command (Command X) has almost the exact same descriptions as other vocal sources with one large exception: no other source describes the lumbar fascia muscles as being the culprit for holding the ribs down and out. There are descriptions in other sources that affirm the ribs being down and out, but no word about lumbar fascia. Further, no other source describes the intentional exercising of the lumbar fascia muscles

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27. Petropoulos, 93.
28. Ibid, 93.
to complete this task. As in all of her commands, Ms. Petropoulos backs up her claims with pictures, MRI video, laryngoscope video, and real time live demonstrations in video with sound that show the commands happening. In the case of the lumbar fascia, the video plainly shows the muscle location and the movement of those muscles being exercised independently from breathing, and then applied to breathing and singing with a noticeable difference in the aural sound of the recording. Along with the six areas of inhalation, the lumbar command is the most unique for Ms. Petropoulos. Mr. Jacobs’s methods do not describe the lumbar action. Ms. Petropoulos even states that it is unnatural in her book and not the way the body was designed to be used; therefore, Mr. Jacobs’s natural method of exhalation would not include anything that is unnatural. As stated, she explicitly describes the lumbar fascia holding the ribs down and out while the abs move inward for exhalation. While this method is very difficult to do, through her MRI videos and pictures, she shows how it keeps the lungs inflated fuller and longer. This logically would be something a brass player wants for better playing.

This command is both unique and similar to other vocal descriptions of how to exhale, but is not like any of the brass methods taught to this author. Upon trying the method, this author could not do it. After much practice, the method began to take shape but the air speed was too slow to make the lips buzz to get a tuba sound. After more practice, the air speed became quicker, the length of phrases increased by two or three notes and the tension in the back of the tongue became much less thereby causing faster movement of the tongue for single and multiple tonguing passages.

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3-Pharynx and Airway Openness. Mr. Jacobs also covers Petropoulos’s areas for this element, but for brass playing the focus is mostly on the oropharynx being open. Again, Ms. Petropoulos has MRI pictures and videos and laryngoscope video of these areas to show her commands of having the soft palate and uvula up and the pharyngeal areas open. While she uses manipulation of these areas for different voice qualities and styles, in general they are to remain up and open. This particular method is usually identified with the vocal field, but in trying it with tuba playing, it helped with more airflow through the embouchure and quality of sound in the low range. The high range was more difficult, however, using some of Ms. Petropoulos’s exercises strengthened the soft palate muscles to stay up.

For the throat area, here, finally, Mr. Jacobs and Ms. Petropoulos are parallel about keeping the throat open for singing and playing. Before this Command III was understood, and as stated before, Ms. Petropoulos observed that this author talked with a closed throat and in like fashion, the sound of this author’s voice would get more closed and cloudy after playing the tuba in older age. The most important result was the discovery of tension around the vocal cords when playing the tuba. With exercise, the relaxation and muscular openness of imitating talking “woofy” (unique to Petropoulos) between playing sessions left this author’s voice more normal after playing the tuba. For the neck, Mr. Jacobs clarifies relaxing the neck for maximum breathing and playing comfort, but does not really explore it being open or how to keep it relaxed or open. Ms. Petropoulos goes into great detail with exercises designed to keep the neck muscles open and keep the trachea free from tension and air flowing freely. Again, she backs up what
she says with MRI and laryngoscope videos. Ms. Petropoulos’s description of commanding the neck to stay open has had dramatic results on this author’s ability to let airflow be consistent, therefore making long tones more steady and unwavering. In addition, this author’s voice has become clearer when speaking between playing sessions.

4-Tongue Shape and Movement. Both Petropoulos and Jacobs describe the tongue as a vowel-shaping tool for thicker airflow. In other words, the tongue does not start the air; it only assists in the consonant articulation and vowel formation for the best sound.\(^{30}\) For high brass and loud playing, the tongue is used for shaping the airflow to allow fast air.\(^{31}\) Analogous to Ms. Petropoulos, he does promote vowels being formed in the middle of the tongue. Jacobs mostly investigates tongue syllables for releasing air and using the tongue to shape the intra-oral mouth cavity for different sounds and ranges.\(^ {32}\) Understandably, Mr. Jacobs and Ms. Petropoulos would have different things to say about this function since one of the most exclusive aspects of brass playing different than singing is to use the tongue tip to articulate the different styles of notes being vibrated by the lips. Basically, Mr. Jacobs uses the syllables “tOE” and “tOO” and suggests moving the tongue tip down into a resting place behind the bottom teeth when not executing the consonant syllables for releasing air into the vibrating lips.\(^ {33}\) Ms. Petropoulos is much more exact and directive about the tongue tip being anchored at the gum line of the

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\(^{31}\) Jacobs/Nelson, 56.

\(^{32}\) Ibid, 58.

\(^{33}\) Ibid, 58.
bottom teeth. This particular idea was unique in suggesting an anchor or resting place for the tip of the tongue at the bottom gum line. Other sources also describe the same placement of the tongue, but the identifier of the exact spot between bottom teeth and gum line is not replicated in the wording. For brass players, there is a placement difference in the vertical length of the bottom teeth from top to bottom that could be a resting place for the tongue tip, so Ms. Petropoulos’s description is more exact and easy to find. The only flaw in her wording is the use of the term bottom jaw. There is only one jaw, which is the mandible that is hinged to our skull just in front of the ear tragus.

In trying this technique out on tuba, the main result was in the low range where the openness of the oral cavity and slow air flow aided in sound and ease of clarity for the onset or attack (beginning of the sound vibration from the lips) of the notes by the tongue being anchored at the bottom gum line which creates a shorter vertical stroke motion of the tongue instead of the childhood learned brass method of back and forth movement. Although more research and practice will be needed about the high range, preliminary results show the high range tuba playing is not as conducive to keeping the tongue anchored down and forward.

In conjunction with Petropoulos’s Command IV, Mr. Jacobs describes the back of the tongue and basically the whole tongue as a resonator changer and an air speed control mechanism. According to his theories, the tongue will lower for low range and raise for high range. His wisdoms do not have MRI pictures, but instead use drawings to show

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34. Petropoulos, 111.
what happens for these processes. He does not commentate about noise from the air passing over the tongue or how the tongue being used in this way may or may not cause a difference in sound. It is more about the air speed that is needed for different ranges (slow for low and fast for high) and that the intra-oral cavity should match the resonating frequency of the range that is being played by the performer. In complete opposition to Jacobs for singing, Ms. Petropoulos’s description is the only vocal source that underscores “...flat, wide and forward...” and asserts further “...to place your tongue around the entire inner perimeter of your bottom teeth...” which will assist in helping figure out if the tongue is flat or not. This had advantages in the low tuba register, but not as much in the high register. Keeping the air speed for high range required the back of the tongue to rise; however, Command IX about exhaling using the abdominals helped keep the tongue down.

5-Jaw Placement and Movement. Ms. Petropoulos and Mr. Jacobs are identical about lowering the jaw for the execution of the sound vibrations, but Mr. Jacobs advises the jaw (chin) has to go forward, which makes the teeth meet flush in the front for proper mouthpiece placement. Contrarily, Ms. Petropoulos believes the jaw should go back and never forward. Upon trying “jaw back,” this author developed a method of alignment for helping the TMJ (temporomandibular joint dysfunction) that had caused some pain difficulties in tuba playing, especially for low range. With the concept of “jaw back,” the re-positioning of the tuba led to placing the lead-pipe at a 90-degree angle to

37. Ibid, 119.
38. Frederiksen, 128.
the vertical angle of the overbite which resulted in better low register resonance and quality, less vertical movement, better cross over from range to range and less pivoting. Although Ms. Petropoulos’s “jaw back” statement is generally aligned with the openness of singing, she goes on to show in MRI pictures and descriptions how moving the jaw forward closes the trachea air pathway. If this process closes the trachea and if brass players want to keep the airway open, then it stands to reason that tuba players would want to figure out different mouthpiece placement and angle to keep the jaw down and back.

Ms. Petropoulos is very specific about the jaw going back while singing. Only one other source, a website article, justify the jaw going back.39 One other interview with opera singer, Sherrill Milnes, describes how the jaw hinge comes apart a little to sing properly, but does not contend that the jaw goes back.40 However, this author has had the pleasure of playing tuba in a band accompaniment with Sherrill Milnes and observed his facial features while he was singing, and his jaw was definitely back as well as down. To back up Mr. Milnes’s claim, there is an MRI video on Wikipedia showing the opening and closing of the jaw. The temporomandibular joint (jaw hinge just in front of the ear tragus41 which is the flap of skin that almost covers the ear canal opening) comes slightly out of hinge during opening.42

6-Lip Aperture Shape and Movement. Jacobs describes the embouchure as the lips, although the definition of embouchure is the working system of the lips, face, teeth, and tongue when referring to the production of sound for a brass instrument.\textsuperscript{43} Referencing the embouchure in a simple way, Jacobs emphasizes the communication happening to the lips through the seventh cranial nerve\textsuperscript{44} and to use a “tHO” syllable which causes the tongue to be “...low and narrow...” for the best shape and sound.\textsuperscript{45}

Even though the lips are in the same area as the embouchure, Jacobs is distinct about the shape of the lip opening in the mouthpiece as the “aperture”.\textsuperscript{46} Although the “oh” syllable from the embouchure information will help shape the aperture, the actual shape of the aperture becomes more of a wide elliptical opening all the way across the mouthpiece, while the embouchure syllable is more about setup of the breath and approach to the mouthpiece.\textsuperscript{47} He goes on to say accentuate a thick air column blown through the aperture for having the best sound.\textsuperscript{48} Ms. Petropoulos’s information about Command III, Jaw (Mouth and Lips) is covered in the VPTE fifth element—Jaw Placement and Movement and under four methodologies on the next page.

7-Tone and Timbre Production (sound quality). Jacobs’s main philosophy centers around the song in one’s head (audiation) and thinking of the sound process as “vocal

\textsuperscript{March 28, 2015).}
44. Frederiksen, 122.
45. Jacobs/Nelson, 55.
46. Ibid, 34.
47. Frederiksen, 128.
chords in the larynx of the tuba, which is the embouchure."⁴⁹ All of his physiology can be summed up into “...give [the] lips ‘song’ from the brain.”⁵⁰ Ms. Petropoulos does not have a Command about timbre, but her methods are supposed to lead to the best sound production at all times.

In conclusion of the Jacobs versus Petropoulos section, they each have their methods of backing up their pedagogical methods for brass and voice. For Mr. Jacobs, it is through visualization techniques and much use of the “song” in the head controlling the physiology of the body mechanisms to play a brass instrument. Ms. Petropoulos uses MRI pictures and videos and laryngoscope videos to show actual movements of her commands and what happens when they are not followed. Her videos also use live human subjects to show the differences in sound from using the commands or not. For this dissertation, one of the goals is to show through sound production that some of Ms. Petropoulos’s methods do help brass playing, so her follow through of using video to prove her points is also a method that will be valid for proving her methods on tuba and euphonium. On one hand, Mr. Jacobs’s methods are historical and the foundation of what most brass pedagogical sources have based their research on today and on the other hand, Ms. Petropoulos’s methods have some unique wordings and direction from the norm of the vocal field.

The other four methodologies controlling singing in Ms. Petropoulos’s 10 Commands are not described in brass playing for somewhat obvious reasons—they deal

⁴⁹. Frederiksen, 123.
with muscle and anatomy functions directly related to the vocal folds vibrating, not the lips. Those four areas are: Singing High Notes: Cricothyroid Tilt; Singing Low Notes: the Thyroarytenoid Lean; Formation of Vowels; and Formation of Consonants. The Tilt and Lean are not part of Mr. Jacobs or anyone else’s brass pedagogy discussion at all.

Ms. Petropoulos describes each of these areas as controllable. The cricothyroid muscle is pushed on or “tilted”\textsuperscript{51} by the tip of the tongue pushing down as the jaw moves downward thus stretching the vocal folds for higher notes; the thyroarytenoid muscle is “leaned”\textsuperscript{52} on by the front tip of the tongue as you sing lower, the vowels are formed in the middle of the tongue\textsuperscript{53} and the formation of the consonants is with the lips and the tip of the tongue.\textsuperscript{54} The other vocal pedagogical sources have descriptions of the cricothyroid and thyroarytenoid processes similar to Ms. Petropoulos for high and low notes, but none of them report that the process can be controlled like she does. For vowel formation, there is more variance about how this happens with some sources professing the tongue moves for certain vowels and one older source suggesting a furrow or tunneling of the tongue in the middle.\textsuperscript{55} Ms. Petropoulos is the only one that recommends all vowels are formed in the middle of the tongue and have no assistance anywhere else in the mouth. For consonants, the descriptions from other vocal sources is very similar to Ms. Petropoulos, but her insistence on having the other commands in

\begin{thebibliography}{99}

\bibitem{51} Petropoulos, 177.
\bibitem{52} Ibid, 181.
\bibitem{53} Ibid, 191.
\bibitem{54} Ibid, 197.
\end{thebibliography}
place before working on consonants negates any complications that may arise from the lips or tip of the tongue getting in the way of airflow, soft palate being up or openness of the throat or neck.  

These processes may seem at first glance to have nothing to do with playing tuba and euphonium, but this author discovered that exercising these additional commands led to awareness of the neck muscles surrounding the crico and thyro areas. However, most importantly, the shape of the tongue for vowels and consonants was directly helpful, since the process of tonguing articulations for technical tuba and euphonium notes involves shaping the middle and tip of the tongue for syllables that emulate sound results for different ranges and styles. Practicing Ms. Petropoulos’s methods for these last four areas helped isolate the muscles and shape of the neck, tongue and lips for better clarity of sound on the tuba.

Overall, the commands helped with realization and awareness of what this author’s body was actually doing. First impressions and preliminary findings were encouraging that Ms. Petropoulos’s methods were very helpful towards improving the tuba playing technique. Although some of the realizations could be disregarded as just learning more about the body, the results have been improvement of tuba technique, longer hours of playing the instrument and better health and resonance for the voice in speaking and singing. After taking these lessons, the focus of the dissertation study shifted from the broad category of vocal techniques, which involves numerous functions surrounding the mind, body and soul to being centered on the physiology of breathing

56. Petropoulos, 198.
and the specific muscle movements inside and outside the pharynx, particularly the larynx. These factors are major considerations for this author who is approaching the upper 50s in age and hopes to continue performing and teaching professionally for decades to come. The studies with Ms. Petropoulos and Mr. Jacobs produced similarities and differences that are aligned with their respective vocal and brass fields.

The Venn Diagram below shows the connecting pedagogy and the aspects of the VPTE that are researched about voice techniques that might help tuba techniques from the Petropoulos/Jacobs research.

Figure 6. Venn Diagram of Voice/Tuba Similarities—Differences, Petropoulos/Jacobs.
CHAPTER II, LITERATURE REVIEW

Unpublished Raw Data Survey

Even though this author’s first contact with detailed vocal pedagogy was Petropoulos’s clinic and book, *The 10 Technical Commands to Vocal Mastery™*, this alone was not enough to sanction a singular focus on her methods as a conduit for vocal method application to tuba playing. Likewise, this author’s own tuba instruction had used Arnold Jacobs, former Chicago Symphony Orchestra Principal Tuba and brass pedagogue, as the main tuba methodology, but had not included other viewpoints about brass pedagogy. Since the purpose of this dissertation is to encompass an overall application of voice to tuba techniques, then the research must include other vocal and brass pedagogy sources to colligate the two fields.\(^{57}\) The literature review will encompass the primary and some secondary sources from the preliminary influences on the author and from the unpublished raw data survey described below. The comparison of fields will be put into chart form in order to better cross reference what each field in the survey has to offer.

Over 150 sources were collected during preliminary research in order to merge the disparate subjects of voice and tuba pedagogy. Older historical pedagogies that are

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\(^{57}\) Dissertation Committee’s recommendation that only using Jacobs’s and Petropoulos’s methods was perhaps not broad enough to accommodate a justifiable research outcome in applying physical vocal techniques to tuba playing.
referred to by multiple vocal pedagogy sources such as Gaffurius, Tosi and Lamperti all have interesting points about how to sing, but do not cover the physiology of what is happening in the larynx. They do offer plenty of adjectives about sound and exercises to produce the sound. Manuel Garcia was the first voice teacher who researched vocal fold physiology and is credited with inventing the laryngoscope for this purpose (observation instrument for mirror viewing the vocal folds). He also attempted to describe in physiological and scientific terms what was happening inside the larynx. Since then, there have been many attempts by over 70 vocal teachers to document the science of vocal pedagogy and, with added pictures and videos to describe the larynx movements.

The path for expansion of the topic led to a choice of using the previously mentioned unpublished raw data survey of present day collegiate voice and brass teachers. This survey also helped glean the hundreds of sources that are available about vocal and brass pedagogy to a manageable number for the research project with human test subjects. It is this author’s experience that if any historical source were of great use to students, then that source would have been noted by the teachers from the survey.

To comply with using only current material from the surveys, the unpublished raw data survey was done for brass in Spring 2015 (Appendix III. Brass Survey Email,

p. 142) and the same for voice pedagogy in Winter 2015 (Appendix IV. Vocal Survey Email, p. 143) asking professional pedagogy instructors what their top teaching resources were for their students. The brass survey was only sent to tuba and euphonium (tenor tuba) instructors because this dissertation is centered on tuba and euphonium. In the tuba and euphonium field, both instruments are often taught by the same teacher at a university. From the tuba/euphonium survey, Brian Frederiksen’s *Song and Wind* about Arnold Jacobs was the main resource used by 27 of the 44 survey responses (Appendix I. Brass Survey Results, p. 138). There were four other brass pedagogical sources that were used the most. These were (in the order of popularity and including *Song and Wind*):

- *Song and Wind* by Brian Frederiksen (27 teachers)
- *The Art of Brass Playing* by Philip Farkas (12 teachers)
- *The Art of Tuba and Euphonium* by Harvey Phillips and William Winkle (8 teachers)
- *Also Sprach Arnold Jacobs* compiled by Bruce Nelson (7 teachers)
- *Practical Hints on Playing the TUBA* by Don Little (5 teachers)

In the research (Chapter III), a euphonium player was also used as a test subject, so *Practical Hints on Playing the BARITONE (Euphonium)* by Dr. Brian Bowman was also included with the other five sources as primary sources. Dr. Bowman’s book is the only baritone/euphonium specific book that is available with unique comprehensive basic fundamental terminology for those instruments. Plus, Dr. Bowman has one of the largest euphonium studios in the world with over 25 euphonium majors at the University of

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64. Dr. Brian Bowman, “Practical Hints question for my DMA,” email December 3, 2016, “The word baritone was added by the publisher along with euphonium.”
North Texas, is world renowned from his career as Principal Euphonium with the United States Navy and Air Force Bands, has done 20 solo recordings, does approximately 20 clinics, solos, and guest appearances annually and is a published author of 15 articles and three books about euphonium. All other recommendations for the remaining 43 sources were either used by one or two teachers making the sources very individualized to a particular person; therefore, they were not counted as a primary source nor were they used as part of the research for human subjects.

The voice survey was sent to whoever was listed as the voice pedagogy teacher at each university. *Your Voice: An Inside View*, either First or Second Edition by Dr. Scott McCoy was the top listed pedagogical source used by 13 of the 24 responses (Appendix II. Voice Survey Results, p. 140). There were seven other vocal pedagogical sources that were used by numerous teachers. These were (in the order of popularity and including *Your Voice: An Inside View*):

*Your Voice: An Inside View*, First and Second Edition by Dr. Scott McCoy (13 teachers)
*The Structure of Singing: System and Art in Vocal Technique*, First Edition by Richard Miller (9 teachers)
*The Functional Unity of the Singing Voice* by Barbara Doscher (6 teachers)
*The Diagnosis and Correction of Vocal Faults: A Manual for Teachers of Singing and for Choir Directors* by James C. McKinney (5 teachers)
*Bel Canto: A History of Vocal Pedagogy* by James Stark (5 teachers)
*Basics of Vocal Pedagogy*, First Edition by Clifton Ware (5 teachers)
*Vocology: The Science and Practice of Voice Habilitation* by Ingo R. Titze and Katherine Verdolini Abbott (4 teachers)

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Ms. Petropoulos book, *The Ten Technical Commands to Vocal Mastery*, was added to the list of primary sources, because it was the stimulus for this dissertation. All other recommendations for the remaining 23 sources were either used by one or two teachers, making the sources very individualized to a particular person; therefore, they were not counted as a primary source nor were they used as part of the research for human subjects.

**Literature Review**

**Brass Pedagogy Review**

Beginning with the most popular brass pedagogy is Brian Frederiksen’s *Song and Wind* (1996), which features the history and lectures of Arnold Jacobs (1915-1998), brass pedagogue for over 70 years (1932-1998). By and large, Jacobs covers most of the other brass sources’ main points. Most of his uniqueness is from being one of the older pedagogues, and the other brass pedagogies found in this dissertation research have been written since he started teaching in 1932.66

*Song and Wind* is dedicated to a chronological and detailed documentation of his life by one of his former students, Brian Frederiksen. Frederiksen begins with two forewords by brass colleagues of Jacobs, a preface, and acknowledgments from other well-known brass colleagues such as Adolph Herseth (Principal Trumpet, Chicago Symphony Orchestra [CSO], 1948-2001) and Dale Clevenger (Principal Horn, CSO, 1966-2013). Frederiksen then gives a complete history of Jacobs’s life from his early years through his studies at Curtis Institute and his professional experience before and

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66. Frederiksen, 88.
during his extensive Chicago Symphony Orchestra career (1944-1988). Included are descriptions of most of the conductors that Jacobs played under, and at the end of the book, discussion about performance procedures, instruments, Jacobs’s studio in Chicago, details about his personal tuba and mouthpieces, a discography, other brass colleague personnel listings from his career, end notes, bibliography, and two indexes. The most relevant section of the book is pages 88-149 detailing about his pedagogical methods for playing brass, particularly the tuba. While Frederiksen divides this section into 26 smaller elements, the physiological discussion can be broken into five parts to align with the VPTE that use a catch-phrase or word by Jacobs for each one: 1) posture (stand while seated), 2) breathing (breathe to expand, not expand to breathe), 3) tonguing (ordering vowels), 4) embouchure (lips and syllables), and 5) lips (aperture). This source is the foundation of brass pedagogy for all serious career brass musicians.

Philip Farkas’s book, *The Art of Brass Playing* (1989), is devoted to the pedagogy of playing a brass instrument. In eight chapters and a conclusion, Farkas efficiently defines all aspects of how to manipulate the brass pedagogical methods. He covers mouth placement for all brass instruments, shows some pictures of virtuoso player embouchures, and goes into more physiological detail than *Song and Wind*. Farkas does not quote Jacobs since they were also contemporaries in the CSO 1947-1960, but much

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67. Frederiksen, 130.
68. Ibid, 105.
69. Ibid, 128-129.
70. Ibid, 122, 127-128.
71. Ibid, 34.
of his description is similar to Jacobs except for exhaling. Farkas, a horn player, describes more of a resistance to letting the air out, but otherwise his detail is steered towards all brass instrumental playing. This source is excellent for anyone who desires to become familiar with the whole orchestral brass family of trumpet, horn, trombone and tuba.

*The Art of Tuba and Euphonium* (1992) by Harvey Phillips and William Winkle provides a published platform for Mr. Phillips becoming known as “Mr. Tuba” in the brass world. This book targets the tuba and euphonium (tenor tuba) and their eccentricities. However, rather than going into scientific detail like Mr. Jacobs, Phillips sticks with simple, easy to understand checklists for the teacher to work with a student. Most of the checklists are very similar to the other brass pedagogies with one exception. Phillips describes inhaling as filling “...the lungs with air like you would a bucket with water, from the bottom up.” Jacobs’s contrasting view is that a player should inhale in “...all sections of the lung at the same time.” Phillips’s book includes a preface, acknowledgments, eight chapters, and two large appendixes. Chapter Three focuses on pedagogy while other chapters consider history of the tuba (and euphonium), what physical considerations are needed in selection of a player and instrument, intonation problems, taking care of the instrument, and career preparation. The appendices are

73. Frederiksen, 54.
76. Phillips/Winkle, 29.
77. Jacobs/Nelson, 40.
divided into categories of materials, methods, manufacturers, illustrations, and pictures of the various versions of tubas and euphoniums over the last 240 years. Phillips’s book is an excellent guide for a career-minded tuba or euphonium player.

Bruce Nelson has done an admirable job of compiling Arnold Jacobs’s lectures into a supplement for *Song and Wind* titled *Also Sprach Arnold Jacobs: A Developmental Guide for Brass Wind Musicians* (2006). The book is outlined into six chapters, a forward, a useful study materials section, introduction, a personal testimony on how Jacobs helped Nelson, two appendices, and an index. Most of Nelson’s material, unlike the paraphrasing, editing, and storytelling that is prevalent from Frederiksen in *Song and Wind*, is direct quotations from tapes of Jacobs’s lectures. Nelson’s approach to quoting entire lectures word for word provides inclusive information that is missed in *Song and Wind*. Although only 30 pages (three chapters) out of 99 pages in the book are devoted to the exact physiology of brass playing, these pages list the parts of each chapter with catch-phrase quotes from Jacobs, so that the reader can immediately find a topic of research without having to read through whole chapters. For example, Chapter IV is labeled “Breathing”, but the chapter is divided into six sections with titles such as “Order air as external wind, not as internal pressure” or “Keep breaths full and relaxed.” The source subtitle is an extremely accurate developmental guide and is an excellent

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foundation for quickly following Jacobs’ teachings and understanding and applying them to one’s own brass playing.

Don Little’s book *Practical Hints on playing the TUBA (Bass)* (1984) was an interesting result of the survey, because most of the other sources are lengthy 150+ pages pedagogical books; yet Little condenses almost all of his practical teaching ideas into just 41 pages. Divided into 11 units instead of chapters, Little covers topics pertinent to tuba players from elementary to senior citizens such as choosing a mouthpiece, posture, breathing, the embouchure, warming-up, long tone studies, articulation, studies in scales, range and flexibility, intonation and fingerings, practicing, and—distinctively to Little—tuba care and maintenance. Under the VPTE, he repeats some of Jacob’s material but also explains some items differently. Posture is still “sit as you stand”. For breathing, Little has a few more details in describing a four-step exercise that will give the musician a good basis for breathing. Step one—inhaling a large breath and play mid-range for several seconds; step two—inhale and hold for ten seconds then play; step three—place hand on abdominal area and blow out a match held at arm’s length; and step four—inhale a large breath on beat four of a four count start and then exhale over seven counts by controlling the air with the lip opening. Other common aspects with Jacobs are a yawn inhale and breathing through the lips. Exclusive to Little are the terms “rebound of the

81. Little, 2.
82. Ibid, 5.
83. Ibid, 8-9.
84. Ibid, 8.
breath”, breathing “quietly”, and know the sound and “feel” of a proper breath. For tongue shape and movement, jaw placement and movement, lip aperture shape and movement, and tone and timbre, Little has several other adjectives for describing these processes, but no new concepts for visualizing them different than the other brass sources. He does not cover the description of pharynx and airway openness. However, for the beginning player through the most advanced, this book is a concise listing of teaching techniques and knowledge that can be instantly applied to the classroom or private lessons.

*Practical Hints on playing the BARITONE (Euphonium)* (1983) by Dr. Brian Bowman is very similar to Little’s book by the same publisher. As previously mentioned, this source was added to accommodate the euphonium player test subject in Chapter III. Bowman’s book has the same units as Little, with the added unit on bass or treble clef inimitable to euphonium players and another unit on supplementary materials like mutes, recordings, and music guides. Along with body posture, Bowman covers hand posture described as holding “a pencil between the thumb and forefingers of the right hand and roll it back and forth.” The breathing concepts of Bowman that are different than Jacobs comprise expansion of ribs all around and then adding that breathing from the diaphragm is incorrect, while a simulated yawn and blowing air

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85. Little, 8-10.
87. Bowman, 2.
88. Ibid, 9.
through the center of the lips is the same.\textsuperscript{89} Tongue shape and movement, lip aperture shape and movement, and tone and timbre production are similar to Jacobs with different adjectives. A couple of added thoughts under lip position are wetting the lips for sliding flexibility and having 2/3 to 1/3 (lip ratio) mouthpiece placement.\textsuperscript{90} Pharynx and airway openness and jaw placement and movement are not specifically mentioned, but this book, like Little’s document, is an excellent teaching and review source for the beginning to the most advanced player.

There are numerous other brass pedagogy sources listed in the bibliography, but they are either individualized among groups of brass professional tuba and euphonium teachers, or they did not have anything new enough to say about this research to warrant mixing them into the research process of Chapter III. However, a couple of the sources in the preliminary research have outlines that are methodically applicable to tuba playing as well as all brass, and also had some direct thoughts that aligned with the vocal pedagogy techniques. In chronological order, Edward Kleinhammer’s \textit{The Art of Trombone Playing} (1963)\textsuperscript{91} covers other subjects besides pedagogy, and is divided into an introduction and 16 chapters. Kleinhammer was the bass trombonist with Jacobs in the Chicago Symphony Orchestra from 1945 till 1985. Chapters two, three, nine, and ten feature the same elements as Jacobs’s five pedagogical areas. The rest of the book covers other topics such as mouthpiece practicing, ranges, exercises, intonation, rhythm, musical interpretation, and literature. He also includes trombone specific items like care of the

\textsuperscript{89} Bowman, 12-13.  
\textsuperscript{90} Ibid, 12.  
slide and slide technique. The wording of his pedagogical descriptions matches Jacobs’s descriptions, although he does not quote Jacobs, since they were contemporaries in the CSO. The most exceptional aspect of Kleinhammer’s book is Chapter Five on “Tone Quality”. He is one of the only sources that states what makes up good tone quality.

“The quality of a tone is determined by the number and intensity of overtones or partials present in the sound in addition to the fundamental. In other words, the more overtones, the richer the sound.” This is identical to the vocal view about timbre in Barbara Doscher’s book *The Functional Unity of the Singing Voice*. The average trombone player should consider this book as a first source for properly setting up good trombone playing habits and knowledge.

David Vining wrote his book *What Every Trombonist Needs to Know About the Body* (2010) in response to an idea from Barbara Conable, author of *What Every Musician Needs to Know About the Body*, but the text is also a document about his journey recovering from focal dystonia, “... a neurological movement disorder characterized by involuntary muscle contractions, which force certain parts of the body into abnormal movements or postures.” For brass players, this most often shows up in specific parts of the embouchure and causing sudden movements of the face and lip.

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92. Frederiksen, 45.
93. Kleinhammer, 36.
95. Vining, 2.
97. Vining, 1.
muscles while playing. For Vining, his embouchure would suddenly have “...an unnatural closure...” while he was playing, causing the tone to be “...abruptly cut off....”

His book includes an introduction, ten chapters, and concludes with an afterword and further reading sources. Sometimes he quotes Jacobs but includes much more detail and backs up the descriptions with 100 images of body parts. The majority of his scientific discussion still ends up with the “pitch in the brain” result-oriented product like Jacobs in *Song and Wind.* In other words, having a song in one’s brain results in a song on one’s instrument. Unique to Vining’s book is a small section titled “The Lips as Vocal Cords”, which offers detail about the lip tissue properties having mucous membranes in the skin layers that offer better vibrating surfaces. Vining goes further to say the lip skin is like the vocal cords because they are made up of “...twin infoldings of mucous membrane stretched horizontally across the larynx.” While this description appears to be saying the lips and vocal cords are similar, it does not explain the difference in the fact that the lip skin is directly attached to the muscles that move it, while the vocal folds “...are not muscles.” He does talk about similarities in the framing of the lips and vocal cords by other muscles around them, but does not explain the difference in the vocal cords being framed by ligaments; whereas, contrastingly, the lips depend on the metal mouthpiece frame to ‘isolate’ the smaller muscles in order to produce a vibrating

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100. Jacobs/Nelson, 28.
101. Frederiksen, 137.
102. Vining, 62.
103. Ibid, 61.
104. Ibid, 63.
105. Ibid, 63.
106. Ibid, 63.
surface suitable for sound being amplified by the brass instrument.\(^{107}\) This source is an excellent compilation for any brass player to study physiological brass pedagogy mechanics.

**Vocal Pedagogy Review**

The vocal review begins with the most popular vocal pedagogy by Dr. Scott McCoy author of whom has written two editions of *Your Voice: An Inside View*. The first edition (2004) is reviewed, but is practically identical to the second edition (2012).\(^{108}\) More research was done on the second edition for the comprehensive dissertation because of his additional section on the physics of sound waves and frequencies coupled with resonance. These sections were helpful for the elucidation of “world-class” sound and *chiaroscuro*, which are terms used as sound concepts for brass and voice respectively. McCoy’s book is the most technical and specific published source for vocal pedagogy, physiology, and anatomy from the preliminary and primary sources. Divided into 12 chapters, two appendixes, index and a section about the authors, this source is specialized towards a scientific viewpoint, yet is written to be understandable by the average amateur musician. More than any other source, he uses statements about physics to connect the characteristics of voice nuances with scientific terms, illustrations, and surplus explanations in small boxes during the text. McCoy also includes exercises for the average reader to aid in understanding his intellection for each of the VPTE. His book is

\(^{107}\) Jacobs/Nelson, 33.
more of a description of what happens to singers and not how they control or command their processes, but is a marvelous source for understanding the scientific part of singing.

_The Structure of Singing_ (1996) by Richard Miller was the next most used vocal source. Miller has published seven books on pedagogical training including different voice types of sopranos, tenors, baritones, and bass, and also on singing structures, the art of singing, national singing, and tools for singers. The opening of _Structures_ has a preface, acknowledgements, introduction, 17 chapters, six appendices, two glossaries, bibliography, and an index. In his preface and introduction, he explains that _The Structure of Singing_ is in response to his curiosity of how the voice structure works and then shares with others what he has discovered. He even has a separate paragraph describing how to use the book. The book begins with assessing the vocal onset and release (start and stop of sound) and ends with teaching tools and concepts and vocal health. Each chapter has practical exercises in order for readers to practice what is being written. He has superb graphics of body parts used by permission from other anatomy sources, although this makes them extremely detailed and not easily followed by the average reader. His charts for exercises and process comparisons are excellent and quick to reference with no trouble. Miller is the only source to have six appendices, and they are basically a scientific breakdown of the voice parts and their function to accompany the practical language and exercises in the chapters. Even though this source was not the most popular one in the survey, this source was mentioned in every informal interchange.

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with pre-survey university voice teachers in the preliminary gathering of information for the dissertation.

Barbara Doscher’s *The Functional Unity of the Singing Voice* (1994) was a surprise book from the survey, because this author had not heard of it from other informal preliminary conversations with vocal teachers; yet it was one of the most popular sources from the survey. This book contains a preface, an international phonetic alphabet key, introduction, nine chapters, two appendixes, bibliography, two indexes, and an author biography. The chapters cover respiration, anatomy of the larynx, phonation, posture, physical nature of sound, vocal resonance, fixed formants and vowel modification, vocal register, and functional unity. The appendices discuss vocal abuse, misuse, and vocal hygiene. Overall this book had many similarities to other vocal pedagogies, but more than most, she details exactly what should be happening with the vocal folds as they vibrate, and is the first book read by this author to distinguish the folds as opening from one end to another and not at the same time. This coincides with the diagrams that show the folds as a triangular formation. Doscher’s book could be surmised as a combination source of all the others, in that she covers all of the vocal pedagogy points but also covers the physics of sound. Additionally, she provides lists rather than paragraphs of characteristics for different singing traits such as belting, registers, heavy voice, light voice, and has a section on marking the voice (saving it during rehearsals to have a peak

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performance). Her charts are easy to read, and she lists footnote content at the end of each chapter rather than the end of each page.

The next source in popularity branches away from general pedagogy and, as is suggested by the title, jumps straight into vocal faults. *The Diagnosis & Correction of Vocal Faults* (1994) by James McKinney is an attempt at giving written ways to find vocal problems and correct them.\(^\text{111}\) The book is divided into acknowledgments, list of illustrations, introduction, 11 chapters, two appendixes on audition check list and phonetic symbols, a bibliography, and an index. Chapter topics cover diagnosis of faults, approach to vocal sound, posture, breathing and support, phonation, registration, voice classification, resonation, articulation, speaking voice, and coordination. Following through with the title, McKinney gives three processes for diagnosis: observation, self-evaluation of patient, and systematic testing by a doctor. He then helps the teacher by offering three questions the doctor should ask, with the aim of helping the vocalist in the best possible manner. These questions entail finding the symptoms, figuring out the causes, and making suggestions for remedies. The majority of this source goes beyond describing what happens when singing and tells the reader what characteristics display good singing that can be heard by the listener. Then McKinney describes in great detail how the reader-teacher-vocalist can cure or correct the fault that is read about in the book text. There are almost no charts in the book, so visualization is left to the reader with the

help of the many lists of symptoms of vocal faults. This is one of the only sources
directed towards a teacher analyzing vocal faults and fixing them.

comprehensive history of vocal pedagogy.\(^{112}\) However, the reality of the book is a
comparison of past pedagogies with Manuel Garcia (1805-1906), who was a singer, voice
pedagogue, and credited with inventing the laryngoscope in 1855.\(^{113}\) Coming in at
number five in the popularity count, the book is comprised of a preface, a nine-page
introduction that defines the term “bel canto”, seven chapters of exhaustive verbiage on
topics that are relevant to voice techniques, a 30-page appendix, and finishes with notes,
references, and an index. Stark embraces clear and concise definitions on pertinent vocal
terms like *chiaroscuro* (Italian: light and dark at the same time), onset (vocal cord
vibration), formant (resonance of the vocal tract), and has a detailed description of high
speed video showing how the sound begins in the glottis and the vocal folds open
upwards as the air comes from below.\(^{114}\) The inclusion of the video as a DVD with the
book might have greatly increased the understanding of the written descriptions, but was
not available because the book was acquired as a used book. He also covers the
cricothyroid and thyroarytenoid functions, but despite all the complexity of description,
Stark mostly describes what is happening as a person sings, and does not talk about
commanding the body parts to do certain functions like ordering air in certain parts of the

\(^{112}\) James Stark, *Bel Canto: A History of Vocal Pedagogy* (Toronto, Canada: University of
Toronto Press Inc., 2008).

\(^{113}\) Stark, xxi.

\(^{114}\) "Chiaroscuro definition," *Merriam-Webster Online Dictionary*, 2015 http://www.merriam-
body, intentionally keeping the circumference of the neck expanded, or controlling the ribs to be held out by the lumbar fascia muscles as described in Petropoulos’s book *10 Commands* from Chapter I.

Clifton Ware is also an older voice pedagogy teacher but still a popular source, coming in at number six of the primary vocal sources. His *Basics of Vocal Pedagogy: The Foundations and Process of Singing* (1998) is not as many pages as Miller, but Ware’s approach is more simplistic and straightforward. His source has a preface, then skips any acknowledgements or dedications and goes into 13 chapters followed by a glossary, bibliography, credits, and an index. Ware is different in that he starts with Philosophy and Psychology of singing, then branches into body-mind integration and continues with voice process connections and vocal physiology and technique of individual areas. The technique section begins with phonation (onset of vocal sound), registration, resonance, and articulation. The end of the book wraps the direction back into unification of the vocal process pathology, voice care, and a small chapter on vocal performance aspects such as repertoire and expression, and then finishes with thoughts on history of vocal pedagogy and teaching singing in Chapter 13. In this chapter, Ware is the only source to point out that teachers should not push children’s voices high at chest range, but should use head range to protect children’s voices. The preface has instructions for using the book and each chapter has study review questions to test the reader’s knowledge. Some chapters have exercises to demonstrate the concepts being

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116. Ware, 262.
described and the exercises are comprehensive and detailed. Chapter Four is devoted to just discussing the networking of the mind and body, and how the brain and nervous system work together. Numerous charts throughout the book clarify the text in simple black and white graphics. The highlight of the charts are the lines connecting the word titles with the anatomy in the diagram, which make the drawings clear to understand and more approachable by most people wanting to get a quicker first-hand knowledge of vocal techniques.

Next to last in the popularity vote and also the oldest vocal pedagogy source from the survey is William Vennard’s *Singing: the Mechanism and the Technique* (1967).\(^{117}\) The preliminary contacts with vocal teachers gave this source a comment of being the “old” source; however, according to those vocal teachers, Vennard was apparently one of the first to try and use scientific data to discuss the vocal singing process. This book has a preface, eight chapters, bibliography, thesaurus, and an index. The preface only has a history of how Vennard spawned the idea of the book. The whole volume is very simply put together with no extra pages or frills. Vennard is similar to Doscher in his devoting an entire chapter to acoustics. He has the paragraphs numbered for easy access and marking. His second chapter is explicitly detailed with every muscle and cartilage link identified in detail and the purpose of each. Vennard goes into huge detail of bodily processes with anatomical names for each part and then connects it to the singing function. He states that “…much of what I am saying is hard to justify scientifically, but

it comes from the subjective experience of many singers.” Chapter 7 discusses the origin of speech and has an interesting history of possibilities. In Chapter 8, he discourses about extremes of pedagogy—mechanism and holism, phonation—breathiness and tightness, registration—light and heavy, resonance—focusing and covering, articulation—words and music, and singing technique—freedom and intensity. Although Vennard is one of the only sources to add playing of brass instruments into his vocal analogies, he never converses about tuba, euphonium or horn—only trumpet and trombone. He has numerous charts and also has actual photographs of the vocal anatomy. The charts and pictures do not have titles with lines pointing to direct parts—only descriptions in paragraph form below each chart or picture, which make some of them difficult to understand. But in case the reader is having trouble following along, his thesaurus is fantastic for summarizing the book. For this author, the book sheds enlightenment that there are cartilages holding the vocal cords, and, unlike the lips, there are muscles aside from the vocal cords moving the cartilages separately.

_Vocology: The Science and Practice of Voice Habilitation_ (2012) by Ingo R. Titze and Katherine Verdolini Abbott is intensely scientific, filled with complex terms and formulas, and was not practical for the test subjects (Chapter III) in the research to read and comprehend. Yet it was listed by the survey voice teachers as one of the more popular sources to have for collegiate level learning. Starting with a short preface, it is then divided into 12 chapters, has a bibliography, and an index. Chapter One begins with

a history of vocology, and then goes the direction of balance in equilibrium, and continues with voice pathology (more than the Ware book). Next, it covers a detailed chapter on illnesses and medications and effects of those medications. This particular section is excellent for anyone wanting to reference what doctors are telling patients to take for vocal concerns. At Chapter Four, the vocal ability assessment tools begin and then branch into ways to measure the vocal instrument and physical fitness along with principals and motor learning. This source has a unique section on measuring and figuring out a voice student’s compliance or ability to be helped. The end result is surrounding a patient with sincere and thoughtful approaches focused by tuned in listening of the clinician. The last four chapters deal with more explicit physiology of breathing, resonance, vowel formation and articulation, but with more complex scientific terminology. To help the reader achieve a greater understanding of the content, each chapter closes with a summary. There are numerous charts, pictures, and graphics, and these are either in color or black and white and are very complicated. But the best picture that was useful in the research is a mid sagittal MRI view of the vocal tract (see Figure 8 in Chapter III, p. 92). This picture shows the true nature of the resonance areas that amplify the vocal folds, and gives the reader a dramatically clear understanding of why each person is different and what challenges arise for each singer to resonate in certain formants and ranges. There are some practical life application exercises in the book, but by and large, introductory study of vocal pedagogy is needed beforehand in order to comprehend the detail.
This dissertation would not be complete without a review of Petropoulos’ *10 Commands* (2006). Like the Proctor source review that follows, her book did not get listed in the survey by collegiate vocal pedagogy teachers; yet like the Proctor source being the top vocal pedagogy from Mr. Fedderly, this author’s tuba teacher, her book is the top pedagogy from her as this author’s voice teacher and whose information was the stimulus of creativity for this project. Her book is organized into a 251-page study guide of research with her own solutions to her vocal problems. She also includes three DVDs of demonstrations and Magnetic Resonance Imaging (MRI) and laryngoscope videos backing up everything she writes in print. Having studied at Indiana University, Bloomington, IN, Curtis Institute of Music in Philadelphia and Peabody Institute of Music at Johns Hopkins University, Baltimore, MD, she received contracts as an opera singer with the Vienna State Opera, Austria and then with the Kassel State Opera, Germany. Her performing career has included Austria, Germany, Italy, Greece, and the United States.\(^{120}\) During the middle of her career, she began to develop problems in her upper octave, low notes, volume and intensity, breaks and cracks in certain range areas, and sustaining a pitch or phrase.\(^{121}\) Her father was a retired otolaryngologist (Ear, Nose and Throat [ENT] surgeon), and with his help she began to study ways to repair her voice.\(^{122}\) This path led to medical study of her father’s books, then applications through trial and error of different methods of repair.\(^{123}\) She then confirmed her research by connecting with several other doctors for video of her solutions using synchronized sound

\(^{120}\) Petropoulos, 223-224.  
\(^{121}\) Ibid, 8.  
\(^{122}\) Ibid, 8.  
\(^{123}\) Ibid, 8.
dynamic Magnetic Resonance Imaging (MRI) and fiber-optic laryngoscope video clips, and then proceeded with proof that her methods would work on others through experimentation and instruction of 250 human subjects—170 female and 80 male.

Her book is divided into ten commands, four additive commanded processes, acknowledgments and research sources, and includes instruction on how to listen, how to take care of the voice, and how to speak, yell, and project vocal sound. Her instructions about listening tell the reader to “feel” the 10 Commands working because the voice cannot objectively be heard by its own singer. She devotes a large section to her own coined term, “Performance Mode”, which has the slogan “...accept, forget and proceed,” and discusses how to handle the different emotional elements of a singing career without affecting the voice. This particular topic is so important to Petropoulos that she refers to it throughout all of the discussion of her commands. However, to keep more focused on the vocal and tuba physiological comparison, discussion of Performance Mode (emotional hindrance, stage fright, mind games) will not be included.


125. Ibid, 246.
126. Petropoulos, 42.
127. Ibid, 10.
IX) Exhalation: abdominal muscles pull inward, X) The Diaphragm and External Intercostal Muscles Are Held Down and Out by the Lumbar Fascia Muscles: down and out (holding the ribs). Her other four processes that are also labeled as having the ability to command are—Singing High Notes: The Cricothyroid Tilt; Singing Low Notes: The Thyroarytenoid Lean; Formation of Vowels (middle of the tongue); Formation of Consonants (tip of the tongue). The 10 Commands and the four processes are mapped out in repetitive statements, pictures, and exercises for a student to use as a self-teaching tool. The language is somewhat elementary, but is designed to be understood by students of all ages. She is incisive about repetition and repeats the foundational statements of each command several times in each chapter to insure remembrance of the command.128 Her book title word “command” stems from the fact that she instructs the reader to understand that we have no direct control of the pitch and quality of sound muscles or the vocal apparatus, but we do have control of the mind to command these areas.129 This is an important distinction, because on the surface this statement can be compared to any other vocal pedagogy or brass source as being the same thing—our song and direction comes from the brain. However, even though Petropoulos uses some words about visual imaging, she goes into much greater emphasis on the scientific descriptions of how to directly command exact muscles,130 while many of the other preliminary (pre-survey) and primary (post-survey) sources speak more about the muscles producing the effect needed by default of the mind visualizing musicality. Additionally, Petropoulos states

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128. Petropoulos, 18.
129. Ibid, 18.
130. Ibid, 19.
unequivocally that anyone can learn her Commands—no limits—and that study and realization of her Commands will guarantee the desired results for vocal production. Formulations of a language commonly associated with brass pedagogy are easy to visualize because of Petropoulos’s laryngoscope and MRI video presentations of her voice and upper body. These are unique to her book and not found with any other vocal pedagogy source, which singles out her source as an important tool for related study of the two fields. Nonetheless, even though Petropoulos’s book was the most familiar to the author, she is not the only source that is authoritative. Why use her methods as a means for writing a dissertation? Based on research done so far, the answer lies in the manner of presentation, the concrete and explicit descriptions of the methods, and the immediate application to brass techniques without additional voice training needed. In order to prove this, Ms. Petropoulos’s book and methods were compared to seven other vocal pedagogy sources, three Body Mapping and Yoga sources just for singers, one book about the science of breath, one book about creating a singer, and four historical lineage vocal sources—all in the preliminary research. The goal in the preliminary research was to find unique aspects of her methods that were not stated in other vocal pedagogy books.

Four other vocal pedagogy sources surfaced as being a little different from Petropoulos in the preliminary research prior to the survey. These other sources have detailed scientific information about vocal pedagogy processes and represent a larger

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131. Petropoulos, 18.
132. Ibid, 249.
historical spectrum of pedagogy. Each of them influenced this author in application of voice to tuba and is listed below in the following chronological published order.

Lilli Lehmann’s *How to Sing* was written in 1902 and translated in the same year from the German by Richard Aldrich. Lehmann’s book is one of the oldest vocal pedagogy sources to be written by a working singer, which is similar to Petropoulos writing a book from her professional singing career experience in the *10 Commands*. Lehmann includes a preface and 40 chapters with 51 illustrations, but no appendix or index. Her main point is covered immediately in the preface stating that singers need to depend on their bodies for resonance and not on the venues where they perform. She goes into great detail about each area of the singing body parts, but does not have all of the scientific muscle group names listed for each function. She does talk about posture and resonance and discusses the counteraction of abdominals/diaphragm to the ribs being held down to give more air and control for longer phrases. For vowel formation, Lehmann describes a furrow shape for the middle of the tongue. Her singular technique for guaranteed voice health and for curing hoarseness is practicing what she calls the “Great Scale”, having been taught the technique from her mother. The “Great Scale” and its description of long tone exercise is easy to translate to the daily regime of long tones in tuba and euphonium playing.

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134. Lehmann, v.
135. Ibid, 27.

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From the preliminary study (pre-survey), Richard Miller’s *Training Tenor Voices* (1993) has intricate and complex statements of the different functions of singing. Miller comprises a preface, seven chapters, two appendixes, a large glossary, a bibliography, and an index. The book is limited to 165 pages, yet is one of the most expensive textbooks available at $300. Miller covers soft palate descriptions, cricothyroid and thyroarytenoid functions and uses the word “noble” as his term of endearment for posture. While tongue, jaw, larynx, and open neck functions are described, there are no commands saying the singer has control of these areas. Miller goes as far as to say that adjustments of registrations due to muscularity are “...all below the level of consciousness, and none of which are locally controllable.” With breathing, Miller describes the abdominals staying out in the position of inhaling as long as possible and moving “only at the end of respiration.” For vowel formation, Miller states that singers think they “can sing all vowels in one fixed mouth shape.” Lastly, Miller has a definition in his glossary of the vocal folds as being “...paired muscles...” Overall, Miller is extremely insightful for voice functions and his scientific and complex discussions should help pave a connection to tuba and euphonium playing; however, his books will need further study with guidance from a voice teacher to completely understand the meaning of his vocabulary.

139. Ibid, 79.
140. Ibid, 16, 26.
141. Ibid, 120.
142. Ibid, 162.
Seth Riggs’s *Singing for the Stars* (1998) is a practical study guide and progressive voice building program. This source was recommended to this author by a friend who is a professional jazz vocalist. The book has hundreds of Hollywood artist endorsement paragraphs describing Riggs as the main teacher to go to for vocal help and health. On a personal note, this source has been included, because it has been of great assistance to this author’s vocal training and experimentation. Riggs was skeptical to put his vocal methods in written form at first, but with the help of his editor, Mr. John Carratello, they were able to reproduce Riggs’s methods into an understandable form.

Riggs begins with a forward, preface, acknowledgements, a long bio, introduction, and a two-page instruction of how to use the book. By the time the dialogue of voice training starts, the reader knows many intimate details about Riggs’s life, his approach and his reasons for that approach, which help with trust and acceptance of his methods on a personal level. After the instructions, the basic principles of anatomy operation are specified and then an explanation of Riggs’s keyword for his voice production method—“speech level singing.” He is the only vocal source that uses this term and approach of singing with speech muscles; yet because his source was not mentioned in the survey, his methods were not use in the research project. Riggs’s middle section has 35 pages of exercises that are imitated on two compact discs for correct listening and comparison of method approach. Next, he has a section devoted to different conversation topics ranging from classifying voices to performers as teachers to the aging voice. Riggs finishes the

book with health of the voice, an appendix, glossary, and a compact disc index. This source is different and good for beginners to professionals, because it lays out lessons and methods in an easy to understand format with simple pictures and charts.

_The Vocal Instrument_, written by Sharon Radionoff in 2008, has a striking front cover—a picture of a brass French horn, even though the book is about the voice.\(^\text{144}\) She includes a foreword from a medical doctor supporting her information, an introduction about vocal problems, and a preface. The book has seven chapters that have many colorful and explicit illustrations that are of high quality and are in this dissertation paper as examples. At the end of the book, there is an abridged index, and at the end of each chapter are summaries and references for the reader to do more research. She defines posture clearly and has distinct words about the soft palate area and the abdominal actions. However, the most constructive part of this book is a 10-page portion of Chapter Four devoted to “Singers Who Play Other Instruments.”\(^\text{145}\) In this section, she covers what brass (trombone, trumpet and horn, but no tuba or euphonium), woodwind, guitar/keyboard, and harp instrument playing do to the vocal area of the body, and reinforces her discussion with graphic pictures of the glottis and laryngeal areas from professional brass instrumentalists. Her photographs showing what they do with their bodies to play are remarkable, and she describes how some of those bodily playing methods can damage the singer’s voice. However, she seems to accept what professional brass instrumentalists do with their pharynx and glottis areas as unchangeable. She does

\(^{144}\) Sharon Radionoff, _The Vocal Instrument_ (San Diego: Plural Publishing, 2008).
\(^{145}\) Radionoff, 133-142.
not talk about the possibility of strengthening or adapting these areas with vocal pedagogy to help playing and singing be more complementary of each other.

Two other vocal pedagogy sources are notable because of their attention to scientific detail. Again, these sources were not popular enough to include in the research project. The first is *Treatment of Voice Disorders* (2005) by Robert Thayer Sataloff, M.D, D.M.A.\(^\text{146}\) This source was not one of the most popular ones and for good reason: it is a massive, oversized 435-page encyclopedic comprehensive coverage of voice pedagogy drawn from 32 different voice teachers, otolaryngologists, pathologists, E.N.T surgeons, and other professors of various voice music areas. It begins with a forward, preface, list of contributors, and acknowledgements. The ensuing 26 chapters take the reader into a labyrinth of medical considerations for voice disorders. The unique part of Sataloff’s source is the 120-page section on surgery, vocal fold scars, laryngotracheal trauma and cricoarytenoid and cricothyroid joint injury that include actual graphically dramatic pictures of the surgeries being discussed. This section alone is worth the purchase of the book and upon viewing the pictures, might cause any vocalist to want to take good care of their voice. Sataloff concludes with a glossary, four appendices, and an index. He shares his own questionnaires he uses for patients, guidelines for practice, and sample reports. This source is included for review because of its comprehensiveness, but the physiological action of the VPTE is simpler and better outlined in the popular survey sources.

Breathing, Speech, and Song (1980) by Donald F. Proctor is another source that was not listed by any voice teacher. However, one of this author’s tuba teachers, Mr. David Fedderly, had recommended reading the book with guidance that there was the definitive explanation of how breathing naturally works and how it works for singing. Mr. Fedderly was also the only source to ask that the scientific gas law called Boyles Law be included in the descriptions and understanding of how breathing works. In short, with regards to breathing, Boyles Law says that “…in a closed space [lungs], pressure and volume are inversely related [air]. As volume decreases, pressure increases and vice versa.” All of the other sources list the Bernoulli Principle as the operating scientific law for breathing, which states that moving air has less air pressure than still air. Thus, air moving through the vocal folds pulls them closed because it has less pressure. At that point, the air pressure builds behind the fold again and forces them open. The frequency of this process is the frequency speed of the pitch being produced.

After a short preface, Proctor has 10 chapters, an index of names, and an index of topics. Unique to the source are 50 pages focused on the breathing mechanisms. Proctor uses a plethysmograph to find the exact lung capacity (measures displacement of body expansion where patient is in an enclosed box).

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149. McCoy, 105-106.
150. Proctor, 75.
He is only one of two sources (Doscher also) to state the vocal fold’s sound outside the body “…produces an ill-defined buzz like sound,” which validates the need for resonance study of the vocal tract and its irregularities. Titze’s *Vocology* has a mid sagittal MRI picture of the vocal tract that clearly shows the issues with vocal resonance chambers inside the pharynx and mouth (Chapter III, p. 92). Proctor has charts and graphs which contain specific measurements that require some extra time to digest the material. He covers some other topics like vocal health, art of singing, and detection of vocal faults, but this is not as detailed as sources such as Doscher or Sataloff. The main identifying factor that is made clear in Proctor’s book is that the elastic exhaling forces of the lungs

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151. Proctor, 75.
152. Ibid, 62
and intercostals is too great for good vocal production and therefore those same areas have to be held out to allow the air to be the right exhale speed for the best sound production. Riggs book says this differently but with the same meaning by describing how a small amount of air is needed to sound good, and if too much air is used the vocal cords will “…jam up…” and become “…tighter…to hold it [air] back.”153 If a reader has time to sift through the medical jargon in Proctor, his source can provide acute accuracy for how breathing works. The end result is his description of singing being very similar to other sources, but Proctor is able to explain why.

Other Scientific Approaches

In August, 2016, private vocal instruction became available with Professor Eugene Rabine of The Rabine Institute, Walheim, Germany.154 This author had met him through contact with the director of the ministry brass group called eurobrass (eurobrass.org) while on tour in Germany, Summer 2015. The results were learning broader horizons, but sometimes extremely different knowledge. Although he has not written a book yet, Professor Rabine’s methods impacted this author immensely—so much so that the VPTE names were reformed to more accurately describe what they meant. The pharynx and neck openness changed to pharynx and airway openness, the tongue location and shape changed to tongue shape and movement, the jaw placement changed to jaw placement and movement and the lip position and aperture openness changed to lip aperture shape and movement. Professor Rabine’s methods were learned

153. Riggs, 27.
154. Professor Eugene Rabine, “Voice Lessons,” The Rabine Institute, Walheim, Germany
too late to incorporate into the research project (Chapter III), but his clarification of some vocal terms was extremely impactful on this author’s tuba playing.

Professor Rabine’s contributions to this paper include clarifying using what we feel for repeating behavior through the autonome sensory system (non-conscious) rather than conscious thought, pushing up for posture rather than pulling up, awareness of the diaphragm as a “rib lifter” in the breathing process, pointing out that the tongue is a jaw depressor, and adding “back resonance” to tone and timbre, which is using the resonance of the vocal tract to aid in brass playing. All other VPTE areas had similar notes to the other sources, but with greater elaboration of the scientific facts according to his research.

During research of sources, three other scientific approaches to assist with making music came up for further exploration: Alexander Technique, Feldenkrais, and Motor Learning Skills. These approaches all discuss wellness of physical health and how the bodily process of music making can be acted upon to ensure a musician’s physiological comfort. The Motor Learning Skills are mostly in magazine article form and the Feldenkrais Method (body awareness and ease of tension) has several books about that process (e.g. footnote source is one of the method books). However, The Alexander Technique (body mapping) has received special attention to the point there are books written about it by musicians.

Two of the recommended Alexander Technique sources from the survey are by the same author, Barbara Conable, the founder and president of Andover Educators. Her

main source is titled *What Every Musician Needs to Know About the Body* (2000). Some of the other newer brass resource books list Conable as a cornerstone for helping musicians with their own physical performing comfort. She takes all of her material from The Alexander Technique, first developed by F.M. Alexander’s term known as “..constructive conscious control.” The book’s Alexander Technique definition centers on replacing negative muscle contractions with positive movements that include knowledge of the different joints and skeletal parts. Besides acknowledgments and general information, Conable has 12 chapters covering detailed descriptions of the skeleton and muscle groups, discussion of the brain signaling movement, material on supporting the instrument, and breathing. Her book is illustrated with clever and cartoon-like designs by her son, Benjamin Conable, which gets the meaning across, but are also entertaining for all ages. There are two extra discoveries in her book that are highlighted: 1) the sixth sense of kinesthesia and 2) pelvic floor movement in breathing. Kinesthesia is feeling what is moving in our bodies and then needing visual confirmation. The pelvic floor description traces conjunctive parallel movement with the diaphragm, and if the pelvic floor has tension, then the abdominals will have tension also and impede breathing. Ms. Conable’s book confirms and explains much of what the other vocal and brass pedagogies are saying. She goes into more detail with

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158. Ibid, 5.
159. Ibid, 45.
160. Ibid, 87.
161. Vining, 4, 51.
162. Conable, 87.
numerous illustrations, has an excellent outline of how our bodies move, and how awareness of this movement can lead to better comfort.

*The Structures and Movement of Breathing: A Primer for Choirs and Choruses* (2000), also by Conable, is a repeat of the breathing sections from her larger and more comprehensive book, *What Every Musician Needs to Know About the Body*, but with more detail on the parts of the body that move for singing. She starts with acknowledgments, instructions on how to use the book, a long foreword including reminders of awareness, alignment and breathing, and an author introduction. There are no chapters, but the 25 processes and body parts are listed in the front with page numbers, and conclude with an index. This book, like her other one, is about awareness of mapping out the bones and muscles so the singers in the choir can move more freely and be more comfortable.

To conclude the literature review section, the old treatise by Girolamo Dalla Casa (Chapter I, Introduction, p. 6), one of Giovanni Gabrieli’s leading cornetists at St. Mark’s Cathedral in Venice, Italy, 1584, summarizes one of the components of this dissertation: “...imitate the beautiful and imitate the human voice if possible.” If voice technique application strides can be made towards training brass fundamental motor skills to cause less tension, and increase timbre size while imitating or applying the physiology of voice methods, then vocal pedagogy can assist brass and particularly tuba and euphonium playing.

164. Dalla Casa, 3.
Comparison of Fields

Although the preliminary research began with *10 Commands* and *Song and Wind*, the final results include other resources for comparison in key points, demystifying general assumptions and application of practical techniques that are geared towards language for musicians. Each source has something unique to offer, yet they all overlap in several areas too. The experience of working with five different teachers in the research brought out acknowledgement among them of other teachers’ crossovers from the other instructors yet also had unique methods stemming from each instructor that would work immediately for a student during a one-on-one lesson. In other words, each instructor had methods that worked for students regardless of other source methods available. This gave credence to each instructor’s validity of methods, but did not leave the author valuing one instructor over another as the only way to study. Therefore, the results of the comparison chart and the research are drawing ideas from several methods, which create a marvelous chest of tools to use for brass and vocal training.

The chart in Appendix VI. Voice To Brass Source Comparison Chart (p. 184) on the Vocal Physical Training Elements, displays the comparisons of what each survey source field says about the VPTE. Additionally, the chart displays the similarities and differences between the two field’s comments on the same subjects. The comments that are similar are underlined, and the comments that are different or opposite are bolded. The comments that have no marking are just statements about the category from the field source without really having a favorable or an antagonistic view of the opposite field. Some statements that were the same in the voice field as the brass were not repeated in
the instruction to save time and redundancy in the research project (i.e. some statements are underlined with no comparison underlined statement in the opposite field). If the statement is underlined, then this author saw and read it in sources from both fields regardless of whether it is mentioned in both. The statements provided are what were presented to the test subjects. For a complete listing and page numbers of all comments from each survey source, please see Appendix V. Lesson Plans With Source Page Numbers, p. 144.

In the chart, the reader will notice that the comments lend themselves into different headings in the main categories. This is purely observation on the author’s part to organize these bullet statements into comparative columns that are similar to each other. The order of the VPTE in the chart is in order of importance to vocalists according to this author’s teacher, Ms. Petropoulos. Appendix V. Lesson Plans with Source Page Numbers begins with the order that was important to this author and is also how things were discussed in the brass elements. On April 26, 2017 when the vocal sources were introduced in the research, the author had a lesson and review with Ms. Petropoulos. She said the order of elements was different for vocal importance and suggested the new order of the VPTE that began starting on the fifth lesson with the research subjects. Since this dissertation concentrates on voice to brass, the order of the VPTE from Ms. Petropoulos was kept for the chart and instituted back into the abstract as the order of thought for the dissertation; however, the order of the brass sources in Appendix V displays how the VPTE were presented to the test subjects before the change in vocal importance order. There are numerous exercises that were written down for the test
subjects in the research. These are listed in Appendix V, but not in the comparison chart because the chart is about statements of knowledge and opinion. The reader can refer to Appendix V to see the exercises that are listed under each week and source. As said, the areas of each VPTE in the comparison are labeled strictly from observation by the author and are almost all from Appendix V, but are not comprehensive of the sources. The statements pulled from the survey sources were comments that jumped out to the author as pertinent and receivable by the test subjects in the research. Some of the statements were beyond their reach, but it gave them a perspective of broader implications on each field. Any professional brass player or vocalist may find comments missing from the sources that they remember as important. Again, the statements used were ones judged by this author “at the time of the research for presentation to the test subjects” as pertinent, workable, readable, and explainable.

The first category of Posture statements divide into 10 areas of head and neck, shoulders, chest, arms and hands, ribs, abdominals, back, pelvis, legs and feet, and overall posture. The comments are overall individual without connections or divisions in the statements from one field to another. Most of the comments would easily apply to each field if a teacher wanted to use them for teaching. The two biggest differences are 1) the chest is suggested to move with the breathing—it moves up for the brass field, but in the vocal field the chest stays up for the kind of breathing they teach (See Breathing—Concept Process, Appendix VI. Voice To Brass Source Comparison Chart, p. 184) and 2) the brass field says keep the inward curve of the lower back, while the voice field says straighten the small of the back. This last statement is because the kind of breathing for
vocalists involves breathing much more into the back and the inward rotation of the pelvic girdle to allow more room for the lung tissue in the back to expand. Results exhibited improvement in the test subject’s experimentation with vocal posture and can be seen in the text of Chapter IV and Appendix XV, p. 266.

Breathing is perhaps the most different area of the two fields. Although this author has talked with professionals about these differences and found that some professional brass and tuba players do use some of the vocal movements, this dissertation is about comparing the written pedagogies from the unpublished raw data survey. Even with all of the different statements, the breathing can be boiled down into one difference: the brass field says breathe to expand, and the vocal field says expand to breathe. By reading through the chart, one can see that breathe to expand involves the natural breathing process of the body expanding in whatever direction the inhale makes it do and exhaling with whatever collapses along with descriptions of listening to the sound of the breath, which denote that breathing can be heard aurally for tuba playing (and brass playing). In direct contrast, expand to breathe operates on the theory that the thorax is expanded and the air is drawn into the vacuum to equalize the inside lung pressure with the atmosphere, which denotes a quiet breathing process. Along with the quietness, the appoggio technique applies keeping the ribs expanded while exhaling to control air flow. Airspeed is the other large difference with the brass field agreeing on different speed for ranges while voice air speed stays the same. Results disclosed improvement in some test subjects but not in others when trying to incorporate the vocal breathing characteristics.
Specific details can be seen in the text of Chapter IV and Appendices XVI. p. 272 and XVII. p. 274.

The most intimate part of this research involves the pharynx and airway openness because of the analysis involving the insides of the body. As stated in Chapter III with the Research Design and Methodology (p. 82), the test subjects had laryngoscopes done while they were singing and playing. Unlike posture, breathing, and tonguing, the vocal and brass fields are remarkably similar on their thoughts about what should be happening in the pharynx and about air flow. Like breathing and tonguing, the vocal field has more description with specific muscle and cartilage names about the pharynx than the brass field. This is the same for all the vocal pedagogies describing in anatomical detail the functions and movements of the pharynx parts in order to make vocalists aware of what is happening inside their bodies where they cannot see the action. The brass field is not vocalizing, therefore, only really needs an open airway to perform. The results of the test subjects were conclusive improvement for all subjects in educating them on voice field knowledge about the pharynx and can be seen in the text of Chapter IV and Appendices XV. p. 285, XX. p. 293, XXI. p. 298, XXII. p. 311, XXIII. p. 314 and XXV. p. 320.

In the element of tongue shape and movement, there are numerous similarities of using vowels and consonants to shape the sound and airflow. The most difference between the two fields comes under the tongue position. For brass the tongue only has to be out of the way and not in a specific place and the back of the tongue is arched for faster air speed when needed. The vocal field has specific instructions to keep the tip of the tongue in touch with the bottom gum line of the jaw, which theoretically keeps the
tongue forward and down out of the way of air flow while shaping the vowels at the same
time. Like the breathing, the test subject results were good in response to vocal
applications, but not conclusive or the same for everyone. Descriptions and pictures can
be seen in the text of Chapter IV and Appendix XVIII. p. 276.

There are two main differences between the fields in the elements of jaw
placement and movement. The first is that the brass field suggests moving the jaw down
and forward both to meet the mouthpiece and with the advice that this will open the
airway. In almost complete contrast, the vocal field says move the jaw down but
backwards and that will open the airway. The vocal field even goes as far as to say the
jaw forward will inhibit air passage. The other difference is the movement for range.
These statements really are not different viewpoints, but more of a necessity for what
must happen anatomically. The brass close the jaw for high register and open it for low
register. Anything different than that will have disastrous outcomes for the student. The
vocal field is the opposite with the jaw dropping down for high range to stretch the vocal
folds by the cricothyroid muscle and going up for low range to shorten and relax the folds
by the thyroarytenoid muscles (See Appendix VI. Voice To Brass Source Comparison
Since the two fields have different body movements from each other for high and low
range, there was not a comparison done of that area. The study did have the subjects try
the jaw down and back instead of forward and this had mixed results, but mostly
favorable and can be viewed in the text of Chapter IV and Appendix XXIV. p. 317.
Lip aperture shape and movement for the brass field really does not equate the same for the vocal field. This research was completed with comparing the lips to the vocal folds, or, in other words, comparing the two sound actuators for each field. The brass field states unequivocally that lips are the same as vocal folds, but further research shows that this is not quite true. The lips have less layers than the vocal folds, and the size difference of the lips being larger along with the fact the lips are not anchored with cartilage and skeletal connections make the two anatomy comparisons different. Another small difference is that the shape of the lips is controlled by the performer regardless of range, vowels of the tongue or dynamics, whereas the shape of the vocal folds is controlled by the kinds of words, range, and dynamics being used by the performer. However, the process of vibration is similar for both fields. Both fields agree on the Bernoulli Effect causing the vibrations and the only small difference is that lips vibrate from the center out and the vocal folds more from bottom to top. Further observation of the laryngoscope videos show that the folds open and close in this direction for breathing as well as phonating. The labels of the musculature for the voice are dramatically different than the lips, therefore causing the author to do more research outside the survey sources for lip aperture shape and movement. This research has websites that are listed in Appendix V, p. 144 but not in the chart. Test subjects had some success in applying concentration of both fields to their lip aperture shape and movement and can be observed in the text of Chapter IV and Appendix XXIV, p. 317.

Timbre started out as observing tone, but, as described and cited in the text of Chapter IV, the word tone signifies a specific pitch, while timbre is the quality of the
sound being produced. The area of volume was also included in the testing of this element. For source comparisons, the two fields quickly broke into two camps: “world-class” sound and *chiaroscuro*. The truth is that they are remarkably similar, but the voice field has pages of adjectives describing exactly what characteristics need to be heard, whereas the brass field is somewhat less. The approach to achieving that desired sound was even more different between the two fields. The brass field talks much more about players listening to themselves and focusing on the sound of their tone, but not how a good tone feels. In opposition to that, the vocal field states that singers cannot hear themselves, therefore, they must depend on feel. This process necessitates the use of an outside listener such as a teacher and recording devices to make an objective judgment on the tone of a vocalist. Like most of the other VPTE elements, the vocal field has much more detail about the concepts and how to achieve good tone in *chiaroscuro*, since the approach depends on explanation from the listener to the vocalist; whereas, as said before, the brass field depends more on instructing students to listen to themselves and listen to other professionals and recordings to get the “world-class” sound in their heads and transferring that sound from their mind to their playing. Results for the test subjects were somewhat mixed in improvement until the end and can be read in the text of Chapter IV, Table 2. p. 129 and Appendices XXVI. p. 321, XXVII. p. 330 and XXVIII. p. 333.
CHAPTER III, EXPERIMENTAL RESEARCH METHOD

Background

Chapter III describes a series of qualitative and quantitative experiments with one euphonium and three tuba student human subjects using the most popular pedagogies from the unpublished raw surveys of voice to tuba playing. The experimental research took place in Spring 2016. Part of the dissertation research was to show how the VPTE approach methods can be adapted to each individual, with results of the differences being documented. For example, Appendix IX. Sample Exercise Sheet (p. 245) was one of the weeks for subject 17M, and, although similar, each subject had variations of those exercises depending on the level they were reaching in the research. Note: only the age and gender for test subjects and professional instrument for panelists will be listed in this paper. The students represented middle, high school, and college age who had received private instruction in tuba or euphonium for several years in their music programs. They were within close geographical proximity to George Mason University School of Music, Fairfax, Virginia (this author’s DMA school).

Institutional Review Board Process

(IRB—Appendix VII. IRB Approved Documents, p. 211)

Since human test subjects were to be used for the research project, the IRB at George Mason University had to give approval first. Over the course of seven weeks, the
application process went through 35 revisions and from having a full IRB board to an expedited review and approval (January-March, 2016). The full documents of the approved and stamped IRB application process are in Appendix VII. IRB Approved Documents (p. 211) and comprise IRB Application and Approval Letter, Email Recruiting Scripts, Assent, and Consent Forms. Not included in Appendix VII, but also turned in to IRB are other documents that did not need to have the approval stamp. These included:

- Porter CV
- Abstract Outline of the Dissertation Project
- Full Case Study Research Outline
- Dissertation Emails and Letters for Panelists
- Dissertation Letters for the Test Subject’s Music Directors
- Letters for Professional Participation (to the Spectral Analysis professionals who agreed to have their sound measured on the spectrograph)
- Letters for Personal Teachers (all subjects) and School Administrators (college test subject only)
- Addendum A for Minors (describes order of process approach to the minor)
- Addendum G for Audio and Photography (describes process approach for taking and using audio files and photos)
- Guidelines for In-Person Recruiting
- Patient Education Flexible Laryngoscope Chart

IRB granted approval on March 17, 2016 one week before the research started.

The following laryngoscope information that had to be reviewed by IRB and approved by the subjects and their families is from the speech pathologist who administered the laryngoscopes. The foreseeable risks or discomforts included practicing new VPTE methods of approaching and trying to play the tuba or euphonium and a little discomfort during the laryngoscope procedure. The new methods were NOT designed to interfere with the subject’s ability to perform tuba or euphonium in their band or music program. The laryngoscopes were done at Johns Hopkins Outpatient Center/Johns Hopkins Otolaryngology-Head and Neck Surgery in Baltimore and Bethesda, Maryland.
There were no risks involved with the measuring devices in the research procedures except for the laryngoscope, and that was minimal and supervised under a licensed experienced speech pathologist and a doctor. The risks for the laryngoscope were described as follows from the speech pathologist emails in writing to each subject and their families.

“...the risks include mild discomfort, gagging, vasovagal response (drop in blood pressure from over-activity of the vagus nerve due to stress) and allergic reaction to the decongestant or numbing agents. Discomfort and gagging are minimized with use of proper positioning and clear patient instructions, as well as the use of numbing medication. Mild discomfort or gagging occurs in approximately 5-10% of patient cases. There is zero probability of any gagging or discomfort because if any sign of discomfort, anxiousness or stress is observed in the subjects, then the research session will stop until, or if, the subject is recovered. Vasovagal response is very rare, and if it does occur, the procedure is discontinued and the patient is reclined and revived with the use of smelling salts as needed. Vasovagal responses are less than 1% and this pathologist has never seen an allergic response to Afrin or tetracaine in seven years of involvement of scoping procedures. Allergic reactions to medication are quite rare. These risks will be minimized with review of the patient’s medical history and allergies prior to the exam. There is a physician on site to manage any complications should they arise.”

Research Design and Methodology

Subjects were recruited in person based on this researcher's knowledge of their integrity, skills, reliability in practice habits, and receptiveness to instruction. The consent process for all subjects (underage students and adults) was conducted by this researcher with one phone call as soon as the project received IRB approval, and then two emails and one personal meeting within the week before the research began. After email review of the Parental Informed Consent Request Letter (for underage subject’s parents), Adult Informed Consent Request Letter, and Assent Letter (for underage subjects), the

personal meetings were setup for the underage subjects and their parents at their homes and a public place coffee shop for the adult to go over explanations, possible corrections, and required signatures. The signature sheets were reviewed by this researcher's supervisor, Dr. Michael Nickens and by the faculty advisor for the IRB process, Dr. Brian Wuttke, both at the School of Music, GMU. The research participation was kept confidential and not part of informal conversation with classmates or music teachers. Music teachers were informed of the research process, but were neither part of the research nor had privy to any of the research information in the 10-week duration. Music teachers, along with other music professionals and music publications will have access to the research results after the dissertation is published. Anonymity of subject information was protected and only this researcher was each subject’s contact for the research. Rather than having two groups labeled as “control” and “test”, the group’s tuba and euphonium playing techniques were measured at the beginning of the research with the devices listed in Appendix VIII. Devices For Research (p. 238), and then the most common VPTE survey voice and brass pedagogies and techniques were implemented. Different sources were used from the survey every week with three weeks on brass and five weeks on voice and one week of review after each field study. As the instruction progressed, the effects were measured identically for each subject to see if there was any change in the VPTE from beginning to end of the research. With permission, audio recordings were made of all tests for referencing of volume and timbre (tone quality) documentation accuracy. Most of the lessons for the underage subjects were taught at their home and the college age test subject was taught at his university in one of the
practice rooms (Appendix IX. Sample Exercise Sheet, p. 245; Appendix X. Recording Location Dimensions, p. 247). Note: the injury prevention goals in the IRB application were discontinued due to discovery of separate research needed to accomplish them.

Lesson Study Approach and Testing

Each weekly lesson was approached in the following manner:

- review previous week’s findings (except for the first week)
- measure breathing
- measure timbre
- review survey sources for the week
- discuss, demonstrate, apply, and practice any VPTE differences from the previous week (See Appendix V, p. 144)
- provide new survey source material along with a practice assignment sheet to the test subject

The other VPTE of posture, pharynx and airway openness, tongue shape and movement, jaw placement and movement, and lip aperture shape and movement were only tested at the beginning and end of the research. Each test subject was expected to practice the weekly survey source material and playing assignments 30 minutes daily. These lesson plans were designed to allow subjects to continue to participate fully in their ensembles without causing undue stress from the research exercise practice and, if possible, to improve their ensemble playing.

Students were instructed by the author over a period of ten weeks with weekly lessons in the VPTE vocal and tuba or euphonium playing techniques extrapolated from the most popular published sources that were selected from the unpublished survey. Ten hours of instruction and 30 hours of individual practice were expected per case study along with two hours per case study for measurements at the beginning and the end of the research. Eight hours to accomplish two laryngoscope procedures were expected per
case study—one at the beginning and one at the end of the research. Two hours of personal meeting time was expected and two hours review of forms and letters.

This author taught the subjects each of the survey source VPTE approach methods. Even though the research is about integrating the VPTE into tuba playing, the instruction began with the brass and followed by the vocal elements, because the tuba and euphonium playing subjects were more familiar with the brass elements as a starting point. Review of the instruction methods took place in separate lessons with this author and Ms. Petropoulos and Mr. Fedderly. Additionally, there were review sessions with three of the voice faculty and one of the music education faculty from George Mason University, Fairfax, VA (GMU). Application of voice techniques to tuba or euphonium playing were taught under the VPTE headings:

1) posture
2) breathing
3) pharynx and airway openness
4) tongue shape and movement
5) jaw placement and movement
6) lip aperture shape and movement
7) tone and timbre production (sound quality)

The names of these elements were changed slightly from the beginning of the research project due to lessons last August 2016 with Mr. Eugene Rabine of the Rabine Institute, Walheim, Germany. In these lessons and through Mr. Rabine’s research presentations, he convinced this researcher that the descriptions in the titles were not accurate in the scientific world. The order of the elements also changed from the beginning of the

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research because of the review April 26, 2016 lesson with Ms. Petropoulos who convinced this author that the order had to coincide with what was important to a vocalist in order to be understood by them. Therefore, for scientific and vocal understanding reasons, the names and order of the VPTE are referred to from this point forward by the names listed above and in the abstract.

These elements overlap some in all areas, but the sound vibration concept included an additional comparison to air speed (vocal cords to lips). A series of exercises derived from suggestions in the survey sources was drawn up for the students to sing, play, and practice the methods common to both voice and brass (Appendix V. Lesson Plans With Source Page Numbers, p. 144). Each approach used musical material of legato slurred and technical tongued exercises that demanded utilization of the physiology from both voice and brass conceptualizations (Appendix IX. Sample Exercise Sheet, p. 245). Only one of the subjects, 17M, changed to playing a different exercise and solo at the end of the research, but this was because he had been working more on the solo for a recital than the etudes for the research. Part of the instruction through vocal techniques showed ways to protect the soft tissues of the pharynx and particularly the larynx. Each session’s playing excerpts were recorded for review (with permission) and the final measurements for tone and timbre were done by a panel of tuba and euphonium professionals from military bands in Washington, DC and a couple of universities in the

Posture

At the beginning and end of the research, each test subject’s posture image was created by shining a flashlight from the side of the subject to project his/her shadow image on a blank white wall. Next, a photograph with this researcher’s iPhone camera was taken of that shadow image from the middle of the back and up over their head in five different positions: no instrument posture, instrument posture, and playing posture of three different range octaves. An outside source created a black and white drawing of the shadow image pictures. Despite the drawings looking a little bit skewed from an accurate image of the subjects, the drawings gave this researcher a good idea of the neck curve and shoulder position of each test subject and how it changed over the course of 10 weeks. The posture elements that were taught are listed by source in Appendix V. Lesson Plans With Source Page Numbers, p. 144. Note: all iPhone pictures, videos, and sound recordings from all testing of any element were downloaded to the hard drive computer for the project, and then deleted from the iPhone memory to avoid accidental fraud access or posting online.

Breathing

Most of the breathing measurement devices were revealed in the preliminary research from processes in *Song and Wind*. No subjects with asthma or any other respiratory illnesses were asked to participate in the research. Note: there are other more expensive devices available at hospitals and medical facilities, but the chosen devices
were used for two reasons. First was the fact that some hospital devices are much too expensive to be used by the average student and not as portable. Second, the goal was to measure the students with devices they could use themselves after the research was over. For sanitary reasons, each student was given free of charge his/her own set of devices to keep for the testing. All three devices were purchased by this author and through a reputable music store, because the devices have become standard for music teachers and costs averaged $20 for each breathing device (Appendix VIII. Devices For Research, p. 238). Students were measured eight out of the ten weeks for breathing capacities and airflow rates. The two unmeasured weeks were because this researcher or the subjects were sick. All of the breathing instruments described in the research procedures are non-invasive and therefore were administered by this researcher who owns all of the breathing measuring devices and has used them many times in past music instruction.

In order to measure breathing capacities, a volumetric exerciser was incorporated (Appendix VIII. Devices For Research, p. 238). The Volumetric Exerciser (VE) measures breath capacity in milliliters within a maximum of five liters and is used on hospital patients to show their breathing capacities during recovery after surgery and other illnesses. The subject did this test by first exhaling all of his/her air past the “zero point”. This was done by contracting and moving the abdominals inward to squeeze out as much air as possible.168 Second, the student would place the mouthpiece (attached to the plastic hose going to the device) in his/her mouth and inhale slowly through a plastic tube connected to the VE. The inhalation activates a plastic yellow float to rise inside a

168. Frederiksen, 117.
clear enclosed tube between two lines marked “best” on the device. Inhaling too slowly or too fast negates the measurement accuracy, therefore, the subject had to keep the float between the “best” lines. The subject was able to visually see a larger yellow piston ascend vertically as he/she inhaled. The piston stopped when the inhalation was completed thereby showing the measurement from a written scale adjacent to a vertical liter chart on the side of the piston tube. Each student inhaled two to three times per lesson through the VE to validate consistent inhaling capacity.

Airflow ability was measured with an incentive spirometer (Appendix VIII.
Devices For Research, 242). The Incentive Spirometer, or Inspiron (Indpirx), is a device used to give respiratory patients a visual demonstration of how much airflow they can move when they inhale. While this was designed for inhalation, if turned upside down, the measurement gauge on the device can be used for exhalation with the tuba or euphonium mouthpiece. The subject inserted his/her plastic mouthpiece into the plastic breathing tube, inhaled outside the mouthpiece and then exhaled buzzing through the mouthpiece and the plastic tube and watched a small plastic ball inside a small vertical cylinder move up for each exercise. The plastic mouthpiece was used instead of the brass mouthpiece because it fit easily into the plastic tube without damaging the device. The subject’s aperture openness and breathing habits were reflected in his/her ability to keep the ball floating during buzzing. Different ranges were also buzzed to observe the same motion of the floating ball. During the first lesson, a baseline was measured by adjusting the gauge to allow the subject to keep the ball afloat five times. The first increment was pre-set by this researcher according to prior experience with that subject’s breathing
ability. Throughout the weeks, ranges of buzzing and repetitions were adjusted according to each student’s aptitude to practice inhales and exhales at least ten times once a day.

In order to exercise and build muscle strength for inhaling and exhaling, a device known as the Breath Builder was used for visually observing the different physical characteristics of airflow (Appendix VIII, Devices For Research, p. 238). This device was used by placing the larger plastic tube on the nozzle at the top of the device. Then the student was instructed to inhale and exhale while keeping the ping pong ball at the top of the cylinder. To establish a baseline during the first lesson, each student was instructed to put his/her fingers over the different sized holes in the top of the device, which would cause the maneuver to be easy for the large hole and more difficult for the smaller hole. Further resistance was added by putting a finger over two of the different sized holes simultaneously on the top of the cylinder. After that each student was given a set of repetitions and instructions about which holes to cover for weekly practice to help exercise his/her inhaling and exhalting muscles. With each week’s focus on different source breathing techniques, the students could then practice the descriptions with the breath builder to see if those techniques worked better or worse. This process built respiration muscles for both singing and playing a wind instrument, and these devices were able to demonstrate whether the different techniques helped maximize the total air capacity or not by visually observing bodily movement of the inhalation and exhalation muscles.
Pharynx and Airway Openness

Measuring pharynx and airway openness was a multi-stage process that first started with wanting to get MRI pictures and videos of the pharynx and larynx at work while singing and playing tuba. Pharynx and larynx MRI video is already available but not on tuba.\textsuperscript{169} Additionally, the brass and vocal MRI material that this researcher found only records what actually happens with the brass and vocal musicians, but does not record what happens when the player or vocalist tries to integrate the VPTE physiological approach of singing techniques to brass playing. There are also some laryngoscope videos and pictures available of the vocal folds and glottis movement, but again, the videos just record what happens and do not record VPTE physiological integration of voice techniques applied to brass playing.\textsuperscript{170} Functional Magnetic Resonance Imaging (fMRI) pictures and video potentials were researched at locations from the Krasnow Institute at George Mason University, the Houston Methodist Medical Center in Houston, TX, and the Max Planck Institute (MPI) in Gottingen, Germany. Unfortunately, the fMRI possibilities were not obtainable due to high cost, availability, and schedule.

Since the MRI path fizzled out, VPTE Pharynx and Airway Openness and Lip Aperture Shape and Movement comparing vocal folds to lip aperture formation were done with laryngoscope video at Johns Hopkins Outpatient Centers/Johns Hopkins


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Laryngoscope procedures of other people singing and playing compared to the test subjects singing and playing was not accurate in representing how the test subjects were doing, because people’s vocal tracts are so different from each other, and the VPTE were being tested on these four subjects described in the research in Chapter IV.

Notice in the figure below a Mid Sagittal Section from a three-dimensional airway scan obtained by an MRI, the vocal tract is not a perfect round shape and the possibilities of different shapes per person are infinite.

![Figure 8. Mid Sagittal Section Airway MRI.](image)

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Laryngoscope procedures for each student were used to videotape the glottis while singing and then while playing the brass instrument. The results were compared before and after the research. A speech pathologist that had done some vocal clinics at GMU volunteered her time to help with this research.

The process involved the following steps. First, each test subject was driven twice (beginning and end of research) with his/her parent (except for the college adult) by the researcher to the laryngoscope location of Baltimore or Bethesda, depending on where the pathologist was working that day. This involved about one and a half hour drive each way because of traffic and the test always took place in the early weekday evening. Second, upon arrival at the test site, a thorough explanation by the pathologist about the process was given, and the subject was given plenty of time to absorb the information and respond with any questions. The subject’s mothers (except for the college adult) were also present. The pathologist’s personal manner and demeanor was exemplary and helped keep everyone relaxed and attentive to the procedure. The subjects were awake, in a comfortable seated position, and they were given the option of using Afrin nasal spray and tetracaine numbing agent prior to procedure in the nasal passage being used and to make the procedure more comfortable (Appendix XIV. Laryngoscope Process Pictures, p. 261). Third, while the numbing agents were working, the fiber-optic scope was inserted into either the right or left side of the subject’s mouth, depending on the position of the tuba or euphonium, the position of the pathologist standing at her screen, and upon the size of the office as to what was easiest (Appendix XIV. Laryngoscope Process Pictures, p. 261). The mouth videos were done first with this step.
(Appendix XI. Laryngoscope Exercises, p. 248). Fourth, the fiber optic scope was inserted into whichever of the nostrils was the clearest for that day (test subjects sometimes had sniffles or mucous in their noses), and then the scope was fed cautiously and slowly down through the naso-pharynx and into the oro-pharynx till the pathologist had a clear view of the vocal folds (Appendix XIV. Laryngoscope Process Pictures, p. 261; Appendix XII. Fiber-Optic Insertion Pictures, p. 258). When the pathologist was ready, each test subject performed a set of exercises in singing and playing their instrument (Appendix XI. Laryngoscope Exercises, p. 248). These exercises were video recorded and reviewed by the researcher and the test subject for characteristics of vocal fold operation and airway openness. Additionally, the pathologist added occasional comments about the epiglottis movement, arytenoid muscles that were moving the folds, and position of the back of the tongue. When each test visit was accomplished, the fiber optic scope was retracted; everyone went safely back home and all subjects recovered very well without getting sick or any ill side effects. Most of them did homework in the car on the way home and had snacks and water. Each test was recorded with the microphone that was inside the fiber optic scope, but to observe acoustical differences outside the larynx, almost each visit was also recorded with a live outside recording device. In the end, this was not needed as an observable difference, because the research already had recordings of the long tones and etudes that were listened to by the panel. The laryngoscope procedure was used to observe only differences in the movement of the larynx, glottis, pharyngeal walls, and the back of the tongue.
Tongue Shape and Movement

These measurements were taken with laryngoscope video done at Johns Hopkins Outpatient Center/Johns Hopkins Otolaryngology-Head and Neck Surgery in Baltimore, MD or Bethesda, MD at the beginning and end of the research. The goal was to see if the tip and arch of the tongue would change using vocal techniques to refine brass playing techniques. Originally, measuring tongue shape and movement was not a thought process for this research, because a way to measure it visually was not known. The original plan was to teach tongue shapes and listen to the timbre to record different sounds with different shapes from the sources. However, during the preliminary research, this author discovered a saxophone fibro-optic video done inside the mouth where the scope had been inserted through the side corner of the mouth and then video taken of the tongue movements. The results were enough to convince this researcher it might work on tuba and euphonium. The decision to try it along with the larynx and glottis videos of VPTE Pharynx and Airway Openness was made in the proposal to the Johns Hopkins facilities; thus, the speech pathologist agreed to help us with this procedure. Upon inserting the fiber-optic laryngoscope into the side of the test subject’s mouth, we soon discovered that this was a little awkward trying to play a tuba or euphonium with a small obstruction. However, with a little practice, all test subjects were able to make it work and the measuring commenced. Several different exercises were executed for the first measurement including slurring and tonguing scales for as many octaves as the student

could play and slurring and tonguing arpeggios. For the college student and this researcher multiple tonguing exercises for several octave scale patterns were also completed. These exercises were expanded in range and variety for the second measurement at the end of the research (Appendix XI. Laryngoscope Exercises, 252).

Jaw Placement and Movement

Jaw placement and movement was first intended to be measured with the shadow pictures showing different ranges being played. The end result of this process was insignificant. Instead the jaw placement and movement was observed live and in person by the researcher through the lip aperture videos with the clear mouthpieces at the beginning and the end of the research to display jaw placement and movement. The outcomes are described in Chapter IV, The Results and displayed by this author in Appendix XXIV. Lip Aperture And Jaw Placement, p. 317.

Lip Aperture Shape and Movement

The lip and vocal cord regions are discussed from the standpoint of being the vibration source even though the anatomical tissues are a little different. Remember from Chapter II that David Vining said the lip membrane covering was like the vocal cord membrane covering, but further research of the vocal folds shows they have three layers to them and, unlike the lips that are part of the oris orbicularis muscles structure with no cartilages, the vocal cords have muscles and cartilages that move them.173 The testing for lip aperture (the space between the lips) was done with a clear plastic mouthpiece bought

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from Kelly Mouthpiece Company, because the lips can be seen for pictures. Like the sanitary and cost reasons for the breathing devices, each student was given free of charge his/her own clear mouthpiece to keep for the testing (cost was $37 each for this author). In order to use the mouthpieces without them fogging, each mouthpiece had to be run under the hottest water from a faucet and then immediately used in playing and video recording. Each student was given a small set of scales, arpeggiations and octave exercises to play depending on their skill level. The teaching of the lip shape and movement was mostly from the brass pedagogies with some discussion about how the vocal cords rotated and became thicker for low notes and thinner for high notes from the vocal pedagogies (Appendix VI. Voice To Brass Source Comparison Chart, p. 184 and Appendix V. Lesson Plans With Source Page Numbers, p. 144). The pictures and measurements of the clear mouthpiece lip aperture shapes were done with this researcher’s iPhone camera. Video and photographs of the lips and any observable changes in the aperture opening (space between the lips) were videotaped with permission by this researcher’s iPhone camera for research observation at the beginning and end of the research. Due to privacy reasons, no student subject pictures outside the body are published in this dissertation—only this researcher’s pictures are used for result demonstration. Additionally, contrary to the statements in the IRB Application, no shadow pictures were done of the lip aperture photographs, because the observable differences were negligible.
Tone and Timbre

The main point of this dissertation is about sound quality produced in brass playing, particularly the tuba. This can be boiled down into two terms—“world-class” (brass field) and *chiaroscuro* (vocal field). The term “world-class” was initially heard by this researcher as a first step pedagogical tool for success on tuba at the 1992 International Tuba/Euphonium Conference, University of Kentucky and, since then, observations have been noticed in books and articles as well as conversations with colleagues at regional and international conferences.\(^\text{174}\) The definition of “world-class” is “among the best in the world.”\(^\text{175}\) Adjectives such as best virtues of clarity and power, resonance, consistency through tessitura, agile, yet projecting and expressive are common feedback comments used by the professionals with whom this author has been involved.

In the vocal world, the ideal sound of a singing voice is called *chiaroscuro*.\(^\text{176}\) The definition according to Merriam-Webster online is a “pictorial representation in terms of light and shade without regard to color” that is Italian in origin from 1686 and combined from two words: *chiaro* or clear plus *oscur* or obscure and dark.\(^\text{177}\) A description of *chiaroscuro* from several vocal sources is best summed up as: “Ideal tone is balanced (between all the resonating cavities of the vocal tract), free flowing (free from tension and constrictions), resonant (with all the overtones present and a “ring”), pure


\(^{176}\) Stark, 56.

(the timbre is not made to be something that it isn’t naturally), and supported (by good, steady breath pressure).”

Based on current recordings and live performances heard by this researcher at the International Tuba/Euphonium Conference 2014 in Bloomington, IN, the North East Regional Tuba/Euphonium Conference 2015 in Ithaca, New York, and the International Tuba/Euphonium Conference 2016 in Knoxville, TN, there is a trend of the chiascuro concept applied to professional “world-class” tuba playing from performing solo and single tuba excerpts on a large, woofy 4/4 of 5/4 CC or BBb tuba to a preference of hearing this music on a smaller, more clear but still large sounding F tuba. The combined clarity and weight of power with the F tuba provides a concept of chiascuro for tuba that can be compared aurally to what is desired on any sized tuba. For professional euphonium, the timbre concepts still lean more towards the darker side of “world class” and do not have as much light and dark qualities simultaneously in the sound. However, recordings of tuba and euphonium playing do not compare to the live sound for resonance of the harmonic frequencies and sound pressure levels exerted. Therefore, the dissertation experiments and recordings were made for proof of the results, but are coupled with a strong disclaimer about actual aural sound being superior when hearing the result in live performance. The recording of the lecture recital that accompanied this dissertation was also used as a point of control for the test group, because the lecture recital demonstrated the desired result of each VPTE approach from the research.

Rather than go with this author’s own opinion about the test subjects “world class” sound, a panel of experts from the Washington DC military bands and two universities in other parts of the United States were procured to listen to the recordings of the lesson material for long tone decibel readings in their different ranges and volumes. They also listened to the legato and technical etudes that the students prepared during the research. The panelists had a list of tone and timbre parameters from the McCoy book to check for adjectives that describe *chiaroscuro* in the voice field and the panelists already knew adjectives from their own brass training to describe “world-class” sound.179 Research results of the test group were duplicated and presented at this author’s lecture recital, Monday, October 3, 2016 at GMU Harris Theater.

Recordings of the long tones were made almost weekly, but the panel was only asked to listen to one from each end of the research window of 10 weeks. The legato and technical etudes were recorded two weeks into the research for each subject to give them time to prepare the etude to a suitable playable level. The etudes were also recorded on the last session of each test subject. The recordings were done on film recording equipment with either a TASCAM DR-60DmkII Portable Recorder or a TASCAM DR-70D Portable Recorder both for portability, and because they were recommended by an audio expert known by this researcher (Appendix VIII. Devices For Research, p. 238). External microphones were Shure KSM 141 Cardioid Stereo Pair (Appendix VIII. Devices For Research, p. 238). The recording location was the same place as the lesson (Appendix X. Recording Location Dimensions, p. 247)—personal homes for the three

underage students and the college practice room for the college subject. The microphone distance from each subject was about 6-8 feet for each recording. Obviously, the recording was affected by the room acoustics, but since the recordings were done in the same place for almost each student, the results were consistent in their aural outcome. Although it would have been preferable to have identical instruments and mouthpieces, this was not economically feasible. Therefore, the before and after recordings were played on what the students already owned (Appendix XIII. Instruments And Mouthpieces, p. 260). Except for the last recordings of subject 17F, the plastic mouthpieces were not used in the long tones and etude recordings, but were used for the lip aperture and jaw videos and observations.

The long tones and the etudes were measured with a Spectrum Analyzer - Real Time Sound Frequency Analyzer by Onyx Apps from this researcher’s iPhone. The Spectrum Analyzer used to measure harmonic frequency resonances was discovered in conversations with colleagues at GMU about this project, and was the best tool for measuring the difference in timbre sound quality. As each long tone was executed, the researcher snapped a screen shot of the spectral readout. The first few weeks were done using the Octave Real Time Analyzer part of the app and the last few weeks were using the FFT Analyzer, because it showed the individual harmonic frequency lines of the sound (Appendix VIII. Devices For Research, p. 238). Additionally, the first lesson and the last three used the iPhone microphone and the rest were using an AKG D112 MKII bass drum microphone (Appendix VIII. Devices For Research, p. 238) that plugged into the iPhone, which also lowered the decibel level for the recordings. The readings are
therefore a little different between the two microphones that were used. The etude spectrographs were recorded with a Sony DCR-SR68 Handycam (Appendix VIII. Devices For Research, p. 238) video camera, which videotaped the spectral readout on the analyzer. Representing them in the paper is practically impossible with still shots, but upon observation, the subjects displayed more overall harmonic richness in their second recordings of the etudes. Note: all recordings made on the film recording equipment or the Sony Handycam were downloaded onto the hard drive computer for this project, and then deleted from the memory of those recording devices.

A Radio Shack Sound Level meter was used to show differences in volume from the different long tone exercises (also called a decibel meter—measures sound pressure levels and volume, Appendix VIII. Devices For Research, p. 238). Recordings of singing and tuba playing were made of all test subjects, but do not compare to the live sound for resonance of the harmonic frequencies and sound pressure levels exerted. Although recordings were made for proof of the experimentation, once more this author inserts a strong disclaimer here about acoustic versus recorded sound—it is not acoustically the same.
CHAPTER IV, THE RESULTS

Posture
(Appendix XV. Posture Measurements, p. 266)

As read in the literature review and from Appendix V. Lesson Plans With Source Page Numbers (p. 144), ideal posture for both fields are analogous even though the actual postures of tuba and euphonium players may vary. The review of the instrument posture images did not reveal anything different from the playing range pictures, therefore only the images of no instrument posture and with instrument posture were used in the results decisions. The measurements include the following areas: head position (forward or back), head tilt (down or up), neck curve (rounded or straight), and shoulder placement (slouched or straight). Note: for each first measurement, the subjects were not coached on posture, just told to stand as they felt was natural. For the second measurements, they were reminded of certain aspects of VPTE posture from both brass and vocal pedagogies, but were not coached nor were multiple pictures taken till the posture was better.

12F went from head being tilted forward and up, neck curved forward and shoulders slouched to head being more level and balanced, neck curve being more vertically aligned and the shoulders being straighter both without and with the tuba. 17F already had quite a bit of awareness of posture as a vocalist, therefore, no perceptible change was observed in the head, neck or shoulders without or with her euphonium. 17M had his head tilted down and forward, neck curved forward and down and shoulders
rounded at first. At the end, both without and with his tuba, his head was more straight up and level, neck more supportive of his head and shoulders and straighter while keeping his chest up. 20M displayed a level head but jutting forward with a curved neck and rounded shoulders for the first measurement without his tuba. For the second measurement without his tuba, he brought his head up more erect, neck more aligned underneath and shoulders in good broad position and keeping his chest up. His first measurement with the tuba was different in that he brought his head down to the tuba with his neck curved and shoulders sloped forward. His second measurement with tuba was amply more erect head and neck curve straighter, but shoulders still a little rounded. This researcher’s first measurement without the tuba had his head tilted up, neck curved up, and shoulders back past vertical alignment. The second measurement without tuba had his head brought more level, but neck still a little curved too much, and the shoulders a little slouched. With the tuba, this researcher had his head aligned over the AO (atlanto-occipital) joint, but the whole top half of his body was leaning forward. The second measurement brought the tuba up, had his head more level to promote a 90-degree angle to the mouthpiece and neck curve more supportive of his head, but the shoulders were still leaning forward. Part of this could be this researcher’s long career as a tuba player carrying a sousaphone on his left shoulder and carrying his tuba in a gig bag on his shoulders for over 35 years. The end result was that all test subjects had balanced head position being more level and more in orientation with their AO joint (not so far leaning forward or tilted up to high), had straighter curvature of the neck, not so slouched in curvature of the shoulders, and had improved body frame alignment.
In some ways, breathing is the same for both fields and in some it is not (Appendix V. Lesson Plans With Source Page Numbers, p. 144). In order to measure differences in the two fields, the previously described devices of the volumetric exerciser and incentive spirometer were used. 12F experienced a lower capacity as the vocal pedagogies were introduced and then stabilized towards the end of the study. 12F’s lowest readings were due to illness. 17F became ill several times, so although she was a vocalist and already knew about the vocal breathing aspect, the readings were a little disjunctive due to whether she was ill or not; however, she rose back to her highest reading near the end of the 10 weeks. 17M dropped dramatically after vocal pedagogies were introduced, but like 12F and 17F, was able to go back up at the end of the research project. 20M dropped a little when vocal pedagogies were presented, but maintained a steady intake capacity reading and then rose back to match and go above the reading from the brass pedagogy at the first part of the project. This researcher dropped at first, but then rose by over a full liter as vocal pedagogy methods were being studied. Part of this was already being trained in those breathing techniques, but does not explain why the readings dropped again right after that; however, the measurements stayed low with the lowest one being in mid-May because this researcher became very ill in the middle of that month. The result for the subjects was overall improvement using the volumetric exerciser in expanding breath capacity with some test subjects showing more than others. The lowered measurements were usually because the student was sick that week.
One final measurement taken in January 2017 of all subjects showed marked improvement of lung capacity in 12F, 17M and this researcher, with 17F and 20M remaining as high as their last June reading when breathing with the quiet vocal methods (Appendix XVI. Volumetric Measurements, p. 272).

The incentive spirometer (Inspiron) was measured on the subject’s ability to keep the ball afloat with buzzing the exercises given in the assignments (Appendix IX. Sample Exercise Sheet, p. 245). Therefore, the beginning readings were not very stable as they got used to what they could or could not do. With the advent of vocal techniques, the measurements evened out to be more stable. Although not a lot of improvement showed with 12F, 20M or this researcher, 12F and 17M were able to improve their ability to move to a higher gauge setting. In general, the introduction of vocal breathing did not reduce the amount of air inhaled or exhaled even when the number of repetitions increased through the project endurance. The vocal quiet breathing helped each student relax and take in more air when they were concentrating on that method, and helped them relax and be able to do more repetitions and more easily for the incentive spirometer and breath builder. This caused them to be less stressed with tension in their neck, upper chest, and shoulders. The testing helped prove that perhaps the two fields could produce the same amount of air for playing, but the method of vocal approach would help the students last longer, not work so hard and get optimum use of their lung capacity.
The measurable differences in pharynx and airway openness were photographed as still pictures from the video displaying different glottis characteristics on the octaves. Pictures of the test subject’s laryngoscope glottis areas are published only by permission of each subject and their families. Although there is a large amount of internal parts to be labeled in the larynx, the pictures only have the basics of epiglottis, vocal folds, arytenoid muscles and cartilages, and pharyngeal walls as the most noticeable traits in the photographs.
There is some variance in the closeness of the camera and the color of the pictures, because the research was being done on three different laryngoscope machines over the course of the study. Each subject had a different reaction to dealing with the fiber-optic scope down into their throat. As each subject did their testing, some common areas of question and observation began to develop. First, did the epiglottis (esophagus covering flap) stay towards the anterior (front) out of the way or did it close to the posterior (back) over the vocal folds (glottis)? Second, did the vocal folds (glottis) “flap” adducted (closed) and abducted (open) rapidly for each change of pitch in lip phonation.
or did the glottis stay abducted (open)? Third, did the arytenoid muscles and cartilages stay rounded out of the way of the air passage through the glottis? Fourth, did the arytenoids close over the folds obscuring them from sight by constriction of the supraglottis (area just above the glottis or vocal folds), which also inhibited the airflow? Fifth, were the pharyngeal walls open and towards the posterior from the glottis structure or were they closed around it, which made the airway more constricted? In order to compare “closed” and “open” throat, please observe the following pictures from this researcher demonstrating the difference.

![Constricted Supraglottis View](image1) ![Open Supraglottis View](image2)

Figure 10. Demonstration of Closed and Open Throat. Porter, 9-26-16.

Each subject was instructed first to sing in order to get images of their larynx to compare to the instrument playing images. Note: only 17F was a trained vocalist; therefore, the rest of the subjects, including this researcher, did not have “operatic” open larynxes for singing. However, the research project needed a common platform with which to make comparisons, so singing was chosen to connect the dots between the
common to the uncommon (singing to playing a tuba or euphonium instrument).

Beginning with 12F, in both laryngoscopes, she had very good anterior epiglottis position for inhaling, posterior position for singing, and a more anterior position for playing tuba, although somewhat more posterior for the high registers. Of course, for singing, the folds were adducted for phonation in both measurements, but the folds were abducted for playing tuba with a larger amount of fixated openness for the second measurement after the study. Likewise, her arytenoids curled over her folds for singing in both measurements making them almost invisible from supraglottis constriction (more pronounced for higher notes than lower), but were more pulled away from the folds for the first tuba playing measurement and were even further off the vocal cords for the second tuba measurement. 12F had much more openness of the entire pharyngeal area when playing tuba and improved dramatically from the first laryngoscope measurement to the second in both slurring and tonguing. She demonstrated amazing ability to keep her vocal folds abducted during phonation of the lip buzz and her vocal cords did not “flap” closed for every change in pitch on tuba.

Not surprisingly, being a vocalist, 17F had very good anterior position of the epiglottis for inhaling and singing in both measurements. Her vocal folds were clearly in view even for her highest sung notes, and her arytenoids were in good position for singing well. Similarly, the pharyngeal walls held away from the glottis, but were better for the second measurement than the first. Contrastingly, 17F displayed a rather constricted supraglottis even for inhaling when playing euphonium. For the first measurement in euphonium playing, the folds were almost invisible, again from
supraglottis constriction, and the arytenoids were almost completely pulled forward over them. This became extreme when going to the highest Bb5 in range. The second measurement was somewhat better with a more anterior epiglottis position, folds that were visible and showed some separation for airflow (although were barely more open than for phonation), and the arytenoids were not as drawn forward. Through the study of focusing on physically making her larynx operate for playing euphonium like her singing, 17F was able to partially dispense with the extremely tight constriction of her entire pharyngeal area for playing euphonium. Her characteristics were similar for both slurring and tonguing, but she demonstrated hard “flapping” of the vocal cords for every change of pitch while playing.

17M had very good epiglottis and pharyngeal openness for all measurements while inhaling. For singing in the first measurement, however, he quickly moved the epiglottis towards the posterior, folds almost disappeared and arytenoids completely disappeared from supraglottis constriction, and the pharyngeal walls constricted dramatically. The second singing measurement was markedly improved with anterior epiglottis position and vocal folds and arytenoids in full view. The pharyngeal walls were more open than the first measurement, but still constricted which gave 17M a tight sounding voice when singing. His playing measurements were similar with good inhale openness, posterior position of the epiglottis for the first measurement, and anterior position for the second. Vocal folds and arytenoids were covered for the first from supraglottis constriction and in full view for the second. His tuba playing pharyngeal wall position in the first measurement was even more constricted than his singing, but he
was able to greatly open the walls for the second measurement. These characteristics were consistent for slurring and tonguing, but he also had some “flapping” of the vocal folds for each pitch played.

20M had fantastic epiglottis anterior position for all inhales of singing and playing. His first singing measurement quickly brought the epiglottis towards the posterior along with his tongue, although it improved a little more anterior for the second measurement. Likewise, the first measurement vocal folds were tense with the arytenoids pulling forward over them, but were better in the second measurement. The photographs plainly display how the pharyngeal walls would draw together due to the supraglottis constriction and almost covering the glottis for singing, which caused the pathologist to force the fiber-optic scope down a little further to get a view of them. The resulting pictures showed the arytenoids curled up over the folds obstructing them and the airflow. Fortunately, 20M’s tuba playing was just the opposite. There was some improvement on the second measurement, but both measurements showed good anterior epiglottis position even when tonguing, full view and open supraglottis of the vocal folds, good posterior position of the arytenoids, and pharyngeal walls that were open enough to allow good airflow through the glottis. 20M had virtually no “flap” of his vocal cords while playing the tuba.

This researcher demonstrated good pharyngeal openness on the inhales for both singing and playing, but despite being a trained musician, and as stated in the Self-Experimentation with Ms. Petropoulos (p. 16), the singing went downhill with posterior epiglottis position, arytenoids pulled over the folds and the pharyngeal walls closed
around the structures. There was some improvement in the second measurement to the point that the folds could be seen with a little better pharyngeal openness around the epiglottis and arytenoids. The first measurement did not show any improvement in the larynx positioning and its parts for playing tuba, yet this researcher has made a living playing tuba and somehow air still does flow through the glottis. However, the study project did allow improvement, especially in the anterior position of the epiglottis, and the vocal folds were more open for airflow in the second measurement. Ironically, the researcher had tremendous movement of “flapping” vocal cords for each pitch change while slurring and single tonguing to the point that in the first measurement, the folds looked like they were phonating even though it was not actually happening. The second measurement demonstrated better static openness of the folds, but still had some “flapping.” There was more supraglottis constriction for the extreme high ranges, but both 20M and this researcher also had supraglottis closure for the pedal ranges. They had more openness in the middle ranges with improvement of openness in this researcher for the second measurement.

All subjects did buzzing the mouthpiece for the second measurement to help observe the larynx action. As seen in Appendix XX. Glottis Activity Buzzing, p. 293, 12F was about the same pharyngeal openness for both buzzing and playing. 17F, being a trained vocalist, was better while singing, but her buzzing supraglottis position was much more open than her actual playing euphonium; therefore, the future training will be her taking the action of the singing and buzzing pharyngeal openness into her playing. 17M was slightly more open for buzzing. 20M was about the same for both buzzing and
playing. This researcher was more open for buzzing than for playing. Like 17F, this researcher will benefit from taking the pharyngeal action of buzzing into the tuba playing for better airflow and openness and less tension of the larynx.

Another test by 20M and this researcher was videotaping the larynx and glottis while multiple tonguing. As seen in Appendix XXII. Glottis Activity Multiple Tonguing, p. 311, compared to his playing, 20M was vividly more closed (even more than singing) with the epiglottis pulled towards the posterior, vocal folds and arytenoids invisible from supraglottis constriction, and the pharyngeal walls pulled around the larynx structure to the point that there was no visibility of the vocal folds. In the high range, the epiglottis was almost touching the pharyngeal back wall. Contrastingly, this researcher had better static anterior position of the epiglottis, vocal folds and arytenoids were in almost complete view and the pharyngeal walls more open than either his singing or his normal slurring and single tonguing of playing the tuba. Again, this researcher will benefit with training of the of multiple tonguing airflow feeling along with buzzing into his singing and regular playing of the tuba.

In describing the “flap” of the vocal folds (rapid adduction and abduction of the glottis), this is apparently a natural phenomenon for brass players as they change pitches. Out of all the videos taken, this trait was the most surprising for playing our instruments. Why would the vocal folds adduct when they are not actually phonating? There are MRI videos from a study on focal dystonia done at the Max Planck Institute, Gottingen, Germany (recorded with permission Summer 2015), which show how a brass horn player’s glottis naturally closes during slurring movements of intervals (Appendix XXIII.
Radionoff And Max Planck, p. 314). However, the Institute did not, at that time, try to ask the client to change what they were doing while playing. The Radionoff book explained that if current high brass procedures are used for singing, then damage to the vocal cords could possibly occur (Appendix XXIII. Radionoff And Max Planck, p. 314). Her pictures demonstrate how current professional brass playing techniques cause the vocal folds to either be covered by supraglottis constriction or the arytenoids covered over the folds when playing brass. Although some might find the following statement slightly humorous, the research findings from comparing the Radionoff and Max Planck photos to the tuba glottis photos from the test subject research make the possibility of playing tuba the best option for a vocalist to have parallel performing careers in singing and playing brass.

One of the resolutions of this dissertation was to train and suggest that the subjects intentionally manipulate their vocal folds when playing their instrument. The proven ability to “vocally” open the pharyngeal area, allow the larynx to be lower and keep the vocal folds from adducting for each air speed (i.e. pitch) change gives credence to the possibility of a vocal student playing tuba or euphonium as long as they know what could happen to their vocal tract (particularly the folds) and how to manipulate the tract to keep the folds from being damaged.

The results of these tests were conclusive that application of the combined vocal and brass methodologies was of assistance to the test subjects improved playing with relaxation and easier airflow inside their pharyngeal area. Noticeable characteristics were

more openness of the oro-pharynx and pharyngeal walls surrounding the glottis, better exposure of the vocal folds by the arytenoid cartilages and muscles, improved epiglottis action out of the way of the singing and playing process, the back of the tongue more towards the anterior out of the airway, and most notable was the “flapping” of the vocal folds with each pitch change becoming less active and reposing more abducted during playing of the brass instrument. The result is encouraging for musicians to be able to manipulate their glottis through physiological vocal movement while trying to play brass instruments, particularly the euphonium and tuba.

Tongue Shape and Movement
(Appendix XVIII. Tongue Shape And Movement, p. 276)

Slurred and single tongued scale patterns and arpeggio exercises were used in the video recordings of measuring the tongue shape and movement results. Pictures of the test subject’s laryngoscope mouth areas are published only by permission of each subject and their families. The arpeggios that were done in the laryngoscopes really showed no difference on the videos of tongue placement, and the multiple tongued exercises completely obscured the camera lens with the tongue action. Measurements of the slurred and single tongued scale patterns were clearer and included several different octaves in tongue shape, placement of the tongue tip, lip aperture placement from the inside of the mouth, and width of the teeth. Whether the tongue was moving back and forth or up and down was observable in the videos, but unless the entire video were shown frame by frame, there is not a way to show this movement in the paper; therefore, this movement is shown more by the tongue tip placement. Except for this researcher, the first measurement in middle range habitually had the tongues of 17F, 17M, and 20M
curled under or upward, tongues bunched up towards the back of the mouth and tongue tips curled under or upward. 12F was also somewhat this way, but slightly less with a flatter tongue and more forward. The amount of lip curl for higher range was ok with everyone. Teeth width varied from being a good width for 12F, 20M, and this researcher, and more closed for 17F and 17M. The second measurement showed improvement in the middle range for all four student subjects in tongue shape being a little flatter and the tip more forward. The lips generally were not pulled inward as far as the first measurement. Teeth width was slightly greater for 12F, 20M, and 17F, while 17M and this researcher remained about the same.

All subjects were keeping the tongue tip well back of the lower teeth gum line for slurring, moving it back and forth for articulated notes and were raising the tongue for high registers and lowering it a little for lower registers. One reason for the tongue being arched and back is from training we all receive as brass players from early ages—open our mouth and keep our tongue down; however, tongue down translates into tongue back and down. As the voice pathologist pointed out during our laryngoscopes, the sung “oh” syllable initially causes the tongue to go down and “back” which will make it bunch up in the back of the mouth. The forward and flat “oh” was taught to this researcher by Mr. Fedderly as an imitation of saying the syllable “ah” like the accent from the country of England, which will cause the tongue to move forward some. Ms. Petropoulos also had this suggestion in her teaching for pharynx openness. Surprisingly, the pedal notes played by 12F, 17F, 20M, and this researcher showed a noticeable arch in the tongue shape and a dramatic pulling of the tip back under the tongue. 17M did not play pedal
notes. The extreme high registers for all subjects displayed high arched tongues, which are normal for making the air go faster, but everyone was able to keep the arch a little lower for the second measurement. On the whole, for the first measurement of tongue shape observation, the vowel syllable was supposed to be “oh” from the Arnold Jacobs material, which is the point all test subjects started. In the beginning, the subjects were unable to keep the tongue shape in a lowered “oh” for playing like they were for singing, but with the practice of the VPTE research sources and quiet breathing, this got better during the second measurement. Tongue movement, from back and forth to vertical, improved in conjunction with the practice of making the tip repose at the lower teeth gum line from the vocal studies and with the suggestion of starting the tongue tip from the point of the sound source buzz between the teeth and lips by this researcher. There is one other brass source discovered after the research that illustrates the point of contact for beginning the articulation.
For pedal notes, the college test subject and this researcher were able to produce a fuller tone with the tongue reposing a little lower and the tip more towards the gum line. A by-product of all of this measuring from inside the mouth was being able to see the inside of the lips move out for low range and move inward for high range which falls in line with the brass teaching of Jacobs. Overall, all test subjects were able to improve their tongue movement to be more efficient and steadier in shape, placement, and movement, which helped with less noisy timbre, shorter, quicker, and cleaner distances between repose and note articulations.

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182. Frederiksen, 125-126.
Jaw Placement and Movement  
(Appendix XXIV. Lip Aperture And Jaw Placement, p. 317,  
XXV. Singing Embouchure, p. 320)

Pictures of the jaw placement and movement were observed using the lip aperture shape and movement pictures. This includes whether the jaw was down or up, back or forward and whether the chin bunched up under the mouthpiece. 12F did not have much change in the study, because she already had a good jaw placement of down and flat, but she improved her ability to open her jaw for low register and not bunch her chin or move her jaw forward as much in the high register. 17F kept her jaw in good position for both ends of the study, but had a tendency to close the jaw for low register, open it for middle register and then keep it open for high register. This corresponds to her pooched lips for low register, but, as said, her ability to move her aperture inward in the bottom lip for high register improved. 17M had tremendous forward placement of the jaw that only got more forward and bunched as he played higher. He showed the most dramatic change of all subjects by starting low range at the end of the project with his jaw down and flatter and not bunching as much as he went higher in range. 20M had excellent jaw position for both measurements with a down and back placement for all registers except for a slight pushing forward in the very high register; however, his jaw position improved in the high register for the second measurement and was not as far forward. This researcher had corresponding jaw movement to 20M, and had the jaw pulled down for the pedal register, then brought up a little for low middle register, but then opened and flattened the jaw as he went higher. No bunching of the chin occurred. The second measurement showed similar motion but not as distinct and was smoother between registers.
The end result was improved placement of the mouthpiece on the embouchure as more centered, which allowed all the test subject jaws not to thrust forward for the second measurement like it did for the first measurement. Also, the test subjects, especially the three tuba players, were able to display more space between the nose and the mouthpiece for low range which gave them better lower lip response, a more open and rich sound and allowed the room to move for high range. The VPTE vocal study of just being aware of trying the jaw down and back helped to cause experimentation and practice by the test subjects, which resulted in some success of technique fluidity. This researcher had already discovered this method from practice as a masters degree college student when the jaw movement for scales was revealed to be different and less efficient than octave exercises. When the octave jaw movement was copied for scales, the resulting efficiency, rich timbre, and smoothness of articulation between ranges caused this researcher to switch to the octave jaw movement for all playing. The research with vocal techniques validated this discovery and added to the ability to transfer it to singing. Overall the students were able to produce a warmer more robust timbre, had more stable head and jaw position between ranges and demonstrated less upper body pivoting.

Lip Aperture Shape and Movement
(Appendix XXIV. Lip Aperture And Jaw Placement, p. 317
XXV. Singing Embouchure, p. 320)

Pictures of the lip aperture shape and movement were observed using a video recording from this researcher’s iPhone and then edited out still pictures for the dissertation paper. Pictures of the subjects are not published due to privacy reasons, but this researcher’s pictures are published to demonstrate the characteristics being discussed.
The lip aperture shape and movement are described below in areas of shape, air direction, and the corners of the lips, and the pictures are for different octaves to show the shapes and movement. Each subject was recorded playing scales as many octaves as they knew or could execute. In order to compare the playing embouchure with the singing embouchure, they were also recorded singing a scale that fit their voice range.

12F began and ended the study with a good singing embouchure for the one octave she sang her Bb scale without much change of the “oh” syllable. But for playing, she had a very loose low register and was not getting a good lip vibration, had a good middle and high register, but with her left corner hanging out some and the corners going back as she played higher. Her highest note, Bb4, had her corners down and back dramatically. At the end of the study, her low playing register had developed to be more centered with even vibration on both lips, her middle register was also more centered, and the left corner had come inward and forward, but her corners were still pulling back for the highest notes. Air direction for all ranges was characteristic of good tuba playing with going up for low range and going down for high range.

17F had an excellent singing embouchure for both ends of the study, with slightly more openness at the second measurement. However, she had a tendency to push her lips into the mouthpiece both at the beginning and the end of the study, which created a nice sound in the low register, but as she got higher this caused the sound to thin out. She also had a tendency to pull her corners back as she went higher, but the corners came a little more forward at the end of the study. Air direction was good for the low range with
going up, but did not go down for high range until the last few notes leading into Bb5. This improved slightly as the study was completed.

17M’s singing embouchure was very good with a nice round “oh” shape to the lip aperture. His future goal will be to move that aperture opening into the mouthpiece for playing. He began the study with an extremely closed aperture, although slightly better in the middle range. Corners were invisible inside the mouthpiece and the air direction basically going straight all the time. He changed range by adjusting the lips being mashed together or loosening them. By the end of the study, he had opened the aperture all the way across the mouthpiece (therefore getting a better timbre), had his corners pulled out a little from the mouthpiece and in a nice firm set for playing, and the air direction was going up for low notes and down for high notes.

20M had a rather closed “oh” singing embouchure that resembled more of an “uh” syllable at the beginning of the study, but got a little better at the end and showed a more rounded “oh” shape. He was and still is an obviously developed and mature player, and when the study began had corners that were set up close to the mouthpiece, but still visible. His aperture had an opening most of the way across the mouthpiece, and the air direction changed smoothly going up for low register and down for high register. At the end of the study, his traits were even more pronounced with an aperture that was clearly visible across the mouthpiece, the corners in great position for flexibility except a little back in the high register, and the air direction again smoothly changing direction for the different ranges.
This researcher had a reasonably good “oh” singing embouchure at the first measurement, but improved to have more of a vertical opening in the syllable by the end of the study. When playing tuba, he first had a one lip pedal register aperture, which had to be shifted to a two-lip aperture after about three notes of the C scale. This caused the bottom lip to be “mushed” into the bottom of the mouthpiece until the middle range was played as part of the scale. From there this researcher had excellent aperture opening, firm forward corners and air direction that transitioned from low to high range and back down. The end of the study produced a pedal register that could be played with both lips and no shift going into the middle range. This helped the corners stay in place throughout a five-octave range with excellent aperture opening all the way across the mouthpiece and air direction transitioning smoothly between all ranges. His euphonium playing had lips pushed into the mouthpiece for the low registers like 17F, an aperture space that got a little bigger across the 10 weeks, and corners that went from pulled down and back some to a little more forward and set into the support of the high register.

Not surprisingly, the lip shape and movement improved for all subjects from being rather closed up and not moving at the beginning measurements to more open, fluid, and moving for the second and last measurements. However, part of this was not just the brass pedagogy describing the movement but with all the concentration on vocal breathing and openness of pharynx and airway. Each student exhibited an obvious deeper and calmer breath approach to playing, which helped open the lip aperture. This larger opening gave them room to move their lips from out for lower range to in for higher range and vice versa. For this researcher, this study helped the pedal notes be played
with both lips and not just one lip as in the past. Overall, each test subject dramatically improved their ability to produce a warmer deeper sound because of a broader elliptical shape across the mouthpiece with the lip aperture buzz more augmented, which allowed more air flow and freed up the lips to move with increased flexibility between ranges.

Tone and Timbre

Measuring timbre became a subjective process due to several reasons. First, the spectral analysis app on this researcher’s iPhone was used with the Octave RTA spectrum analyzer and then the FFT Plot analyzer. The switch to FFT was because it showed better frequency lines of the harmonics of the sound. Second, the input mic for the spectral analysis began with the iPhone mic, then swapped to the D112 (Appendix VIII. Devices For Research, p. 238), then back to the iPhone. The D112 was tried because of its facility to pick up low frequencies better, but the D112 showed the frequencies too low in decibels that displayed on the screen thus making it hard to get a full reading of the measurements. The separate decibel meter reading measurement processes were also changed part of the way through the process from C fast weighting to C slow weighting, because the C fast was too quick to get an accurate reading of the volume being played. However, to warrant the process of spectral analyzing being valid, a quick look at each subject’s charts is useful. Each chart only shows the Bb2 (12F, 17M), Bb3 (17F), or C2 (20M and researcher) tone being played, because publishing the remaining octaves that were measured would take up more pages than it is worth. The decibel meter readings show three different volumes of the octaves tested. The goal was to get the subjects to
use vocal back breathing to demonstrate a higher decibel reading and display a richer spectral sound that did not sound brash and bright. Similar to the volumetric and Inspiron measurements becoming less when vocal pedagogies were introduced, there was a slight drop in harmonic richness at the same point for spectral analysis and less volume for decibel meter readings, although the spectral analysis was more observable. One reason for the decibel readings not adding up to the timbre difference is from a lesson with Professor Eugene Rabine. In his lifelong research of vocal techniques, he stated that “…the embouchure and air pressure can accentuate higher frequencies in harmonic structure, which can give the perception of being louder, but the decibel meter may not change.”

This researcher was blessed to get several professional spectral readings from his colleagues and friends to compare with the subject findings. Even though the professional colleagues do not consciously use vocal back breathing, they do practice Arnold Jacobs’s breathing habits along with other methods they have learned—some of which involve the vocal breathing techniques. The aperture shape of these professionals is second to none in being an elliptical shape open all the way across the mouthpiece with jaw position and corners fully set for tone stability, but in a relaxed manner. Tongue shape and pharynx characteristics were not measured with the professionals, but with their degree of success, this research is valid just comparing the students to them. They have all practiced their art to an extremely high degree and their timbre is considered to

183. Professor Eugene Rabine, Lesson at The Rabine Institute, Walheim, Germany, August 17, 2016.
be among the best—truly “world class” (Appendix XXVIII. Professional Spectral Analysis, p. 333). The subjects did show some increase in harmonic richness toward the end of the study and especially with the measurement taken seven months after the study. Compare the January 2017 spectral analysis charts, both with high chest breathing (natural) and vocal back breathing (unnatural) from the subjects to the Appendix XXVIII. Professional Spectral Analysis (p. 333) pictures. There it is easy to observe that each subject was beginning to make progress with his or her sound timbre quality.

12F’s progress in spectral analysis began to pick up speed about May 11, but really became richer in the last two measurements. These increased in the January 2017 measurements. The decibel meter readings show a slight drop after the vocal pedagogies, but stay consistent after that. 17F began to show more harmonic richness May 23. The bigger spectrum on June 9 was due to the volume being a little louder with too much forced air, but the subject was able to maintain that richness with the same volume thereafter with vocal back breathing. The decibel meter readings really did not change for 17F in any of the octaves. 17M showed improvement beginning about the same time of May 22 with a slight drop in richness on June 7. The subject had to be reminded about vocal back breathing and with some more coaching, the January 2017 readings were immensely better. Decibel meter readings consistently dropped for 17M, but mostly because he started with a very bright, brash sound and ended up with a warm, rounded sound. His ending tone had a better spectral reading at the end than at the beginning. 20M had a very nice spectral timbre from the beginning, which improved even more, culminating in a reading in January that rivaled the professionals. His decibel meter
readings were very stable throughout the study. This researcher’s spectral readings were also very good throughout the study with better richness near the end. His decibel readings were about the same from beginning to end.

Overall the long tone timbres were improved in harmonic fullness, but had varying results on the actual decibel meter tests. Most of this was because the quiet inhale and exhale of the vocal breathing methods have a slower airflow, which is at first hard to get the lips buzzing in the metal mouthpiece of the tuba or euphonium. With practice, the test subjects were able to move the air with the physical action of a vocalist, but at the speed needed to get the lips buzzing, which enabled them to keep their volumes stable and almost as high as the original brass tuba breathing methods and with better timbre, especially the college student. The timbre readings were more conclusive than the decibel readings, showing that the kind of exhale that is associated with vocal breathing produced more harmonics in the sound; therefore, the tone and timbre was enriched and had more projection power with less effort.

A third part of the timbre measurements was the recorded portions of the long tones and etudes being listened to by a panel of brass tuba and euphonium professionals from the Washington DC military bands and a couple of national universities. Each panelist was sent a list of 29 recordings consisting of the long tones and etudes from all subjects recorded both at the beginning and the end of the research. The panelists listened to them and made comments of yes or no on improvement and how the subjects
improved using adjectives the panelists already knew from their own brass training and from trying to use the vocal adjective directory from McCoy’s book listed here:\textsuperscript{184}

- Bright/Dark
- Twang/Loft
- Forward/Back
- Lyric/Dramatic
- Clear/Breathy
- Clean/Raspy
- Healthy/Damaged
- Conversational/Ringing
- Nasal/Non-Nasal
- Free/Forced
- Vibrant/Straight Tone
- Wobble/Flutter
- In-tune/Out-of-tune
- Good Diction/Poor Diction (this can be switched to articulation instead of diction)
- Stylistic/Non-stylistic

The overall response was that each student and this researcher had better-quality timbre of the long tone measurements, improved articulation clarity and projection of timbre in the etudes, and enhanced harmonic richness for all tests. The table below displays the results of the panel.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|}
\hline
Subject & Panelist #1 Tuba & Panelist #2 Tuba & Panelist #3 Tuba & Panelist #4 Euphonium/Tuba \\
\hline
DMSA = Decibel Meter & Listening Equipment: Grado Prestige SR80 headphones & Listening Equipment: Sennheiser In-Ear Buds & Listening Equipment: AKG K240 Professional Studio Headphones & Listening Equipment: Sony Playstation 3 Pulse Wireless Stereo Headset (Surround) \\
Spectral Analyzer & & & & \\
Etude = music that subject worked on during the research & Improve Apr to Jun & Improve Apr-Jun & Improve Apr-Jun & Improve Apr-Jun \\
\hline
Y or N Adjectives & Y or N Adjectives & Y or N Adjectives & Y or N Adjectives & \\
\hline
\end{tabular}
\caption{Panel Results of Test Subject Recordings.}
\end{table}

\textsuperscript{184. McCoy, 1-7.}
<table>
<thead>
<tr>
<th>12F DMSA</th>
<th>N at pp</th>
<th>Wobbly/out of tune</th>
<th>Y</th>
<th>More control/more confident sound/bigger sound, healthier</th>
<th>N</th>
<th>More wobble/out of tune</th>
<th>Y</th>
<th>Darker/less wobble/healthier/more consistent &amp; supported tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>12F Etude Legato &amp; Tech</td>
<td>Y</td>
<td>Tone improved/clearer/more control/better pitch/improved articulation</td>
<td>Y</td>
<td>Clearer/darker/more ringing sound/fatter sound/better articulation &amp; diction</td>
<td>Y</td>
<td>Clearer</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>17F DMSA</td>
<td>Y</td>
<td>Improved tone/clearer/straighter in higher octaves</td>
<td>N</td>
<td>Y</td>
<td>Still raspy/immature/nasal Clearer sound</td>
<td>N</td>
<td>Lacks centering &amp; has overblowing</td>
<td>Y</td>
</tr>
<tr>
<td>17F Legato Etude</td>
<td>Y</td>
<td>Better style/more lyric</td>
<td>Y</td>
<td>Much more style/clearer less thin &amp; raspy/better diction</td>
<td>Y</td>
<td>Resonates instrument/more ringing &amp; in tune</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>17F Tech Etude</td>
<td>Y &amp; N</td>
<td>Improved control/articulation/better style, but still nasal &amp; forced/pinched</td>
<td>Y</td>
<td>Clearer with more style/diction &amp; articulation better/clearer sound</td>
<td>Y</td>
<td>Centers pitches better, more consistent articulation &amp; style/good diction</td>
<td>Y</td>
<td>Stylistic/good consistent articulation</td>
</tr>
<tr>
<td>17M DMSA</td>
<td>Y &amp; N</td>
<td>Subtle improvements if any</td>
<td>Y</td>
<td>Bit More open sound/not as forced/brighter sound/bit clearer &amp; clean</td>
<td>N</td>
<td>Nasal/forced</td>
<td>Y</td>
<td>Healthy/free vibrant</td>
</tr>
<tr>
<td>17M Legato Etude</td>
<td>N</td>
<td>Immature sound/musical shortcomings Slight improvements in articulation &amp; accuracy</td>
<td>N</td>
<td>Pinched sound/pecky articulation</td>
<td>N</td>
<td>Lacks consistency of tone/poor diction/lacks style (musical intent)</td>
<td>Y</td>
<td>More open sound</td>
</tr>
<tr>
<td>17M Tech Etude</td>
<td>Combined comments from Legato Etude</td>
<td>Combined comments from Legato Etude</td>
<td>Y</td>
<td>Good articulation/more consistent tone as it relates to articulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20M DMSA</td>
<td>Y</td>
<td>Darker/more robust sound</td>
<td>Y</td>
<td>Louder/controlled tone/level &amp; not wavy/less pinched &amp; stronger/free flowing sound</td>
<td>Y</td>
<td>Less forced tone/free tone</td>
<td>Y</td>
<td>Free/healthy/more resonant/more consistency/more high overtones</td>
</tr>
<tr>
<td>20M Legato Etude</td>
<td>Y</td>
<td>Better articulation &amp; style/better connections between notes</td>
<td>Y</td>
<td>Much better style &amp; musicianship/more open tone/stronger &amp; cleaner sound/darker</td>
<td>Y</td>
<td>Slurs are more fluid/phrase shape more developed/more stylistic</td>
<td>Y</td>
<td>Certain registers Smooth/connected/lyric, more unbroken tone between notes Middle registers not speaking as well between notes</td>
</tr>
<tr>
<td>20M Tech Etude</td>
<td>Y</td>
<td>Improved sound/darker/more focused/greater surety/confidence</td>
<td>N</td>
<td>Y</td>
<td>Still bit forced/still not clear/still thin &amp; not vibrant Diction is better/more stylistic &amp; musical</td>
<td>Y</td>
<td>Tone &amp; buzz is more in resonant center of each pitch/more vibrant &amp; clear</td>
<td>Y</td>
</tr>
<tr>
<td>Porter Euph DMSA</td>
<td>Y</td>
<td>More open &amp; free</td>
<td>Y</td>
<td>Bit more confident sound/articulation is better/tone is straight</td>
<td>Y</td>
<td>More ringing and louder</td>
<td>Y</td>
<td>More free/steady/vibrant/most improved at softer dynamics</td>
</tr>
<tr>
<td>Porter Tuba DMSA</td>
<td>Y</td>
<td>Slightly freer &amp; clearer—room buzz made this difficult to hear</td>
<td>Y</td>
<td>Possibly more open tone/louds and softs have more contrast</td>
<td>Y</td>
<td>Resonance more consistent/more ringing</td>
<td>Y</td>
<td>Clean/free/vibrant, but not a marked improvement in tone</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>Improved style &amp; lyricism</td>
<td>Y</td>
<td>Space between notes is clearer &amp; more solid/phrases are longer/more stylistic</td>
<td>N</td>
<td>Sounds the same as Apr</td>
<td>Y</td>
<td>Connected/lyric/tone more unbroken between notes &amp; slurs</td>
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<tr>
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</tr>
<tr>
<td></td>
<td>Y</td>
<td>Cleaner articulation/clearer/more musically focused</td>
<td>Y</td>
<td>More resonance/more core/better style &amp; phrasing/not as woofy &amp; thin</td>
<td>Y</td>
<td>Tone &amp; buzz are more resonant in center of each pitch/more vibrant &amp; clear</td>
<td>Y</td>
<td>Rich/resonant/free/air support not inhibited by articulation as much</td>
</tr>
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Obviously, there are a few discrepancies between panelists, but here is a synopsis of the table. 12F and 17F were split on the long tone improvement, but had a majority vote on etude improvement. 17M was split on the long tones, but was a “no” on the etude portion. This is probably because he did not practice the assigned project etude and had to swap to a recital solo he had just started working on at the last minute. Both 20M and this researcher were almost unanimous for improvement in their recordings. The panel listening was more effective than the other timbre measurements. Just like in the professional music world of both voice and brass, the real sign of improvement came down to the human ear listening and making decisions on the progress.
CHAPTER V, CONCLUSION

Breathe, sing, buzz, play—that is the approach of today’s brass pedagogy. However, musicians who do not sing really have no concept of what good singing technique is, so their vocal techniques might change the pitch and tone for the worse. In order to help those non-singing musicians, there needs to be training in vocal technique in order to best emulate the lyrical and shaping quality so highly prized among all musicians. To an instrumentalist who is not trained in vocal techniques, the wind instrument approach of playing like we sing can only be about the aural sound of shaping nuance and phrase articulation as a vocalist does it and not about mimicking what the vocalist does physically. Therefore again, unless a brass player has had vocal training, they can only guess and create their own methods to try and sound like a vocalist. Does this really help? Does it create a lasting technique for expressing music like a vocalist?

The results of this project could perhaps be a bridge between the two fields, because the integration of the VPTE is practical for the brass player. This project has suggested that explicit detailed attention to specific body part movements has the potential for quicker learning, which could lead to more universal approach of pedagogical instruction about technique in performance. If the brass technique method includes vocal techniques, then the brass student could be instructed to *play like they sing*.
Anecdotally, a colleague of mine and I have experienced the usefulness of this approach. We each had a tuba and euphonium student who had trouble playing their instrument well. Our solution was instructing them to sing the tuba or euphonium music with the same physical attributes they use to play. The students already knew the brass view of the VPTE from their private instruction. When they applied the VPTE to their singing (even though not a trained vocalist), they had more upright posture, breathed deeper, opened up their pharynx, lowered their tongue, kept their jaw down and back, engaged their voice with better vibration of the vocal folds, produced a singing timbre that was better than their speaking voice, and began to show more lyricism in their efforts to sing the music. Then each of our students was asked to play with the same VPTE characteristics of their singing (which they had just copied from their tuba and euphonium physical technique). The improved posture, breathing, openness and relaxation of the pharynx, lowered tongue position, jaw placement and movement, more lip aperture vibrating surface, and larger timbre resonance enhanced their phrase shape, articulation clarity, and musical expression. Another method I have tried is having my tuba and euphonium students mimic an opera singer’s habits while they are trying to sing the musical passage. Then they were instructed to copy the mimicked physical traits of the opera singing on their instrument while playing. The results were improvement of the VPTE on their instrument timbre. While this is only one precursory example of the VPTE success, it is motivating to think of the potential applicability for pedagogical teaching. More research is needed to establish a more substantial scientific connection of using the VPTE on tuba and euphonium playing, but the preliminary results could shorten
the learning time of becoming good musicians on tuba and euphonium by connecting the
*song in their heads to the song on the instrument*.\(^{185}\)

My playing goal from this dissertation was first to be able to produce a “world-
class” sound on any note of the tuba register that anyone and everyone agrees is “world-
class”; second, to be able to know what a “world-class” sound is on another brass
instrument and how to reproduce it; and third, to be able to sing beautifully and well in
between sessions playing the tuba, because I know the mechanics of each methodology.
My teaching goal was to use the knowledge gained from this study to better teach college
music education students how to teach the five brass instruments with more efficiency
and with quicker results. Parallel to that would be helping non-brass students quickly
understand connections of brass to their own medium, differences in the two, and
safeguards for enjoyment of both. For my own teaching, I now strive to have a treasure
chest of vocal and brass pedagogical tools including sources, ideas, and solutions that
allow a diagnosis and solution of a student’s physical playing problems in less than five
minutes from first observance.

Preliminary research discussions with vocal and brass colleagues from the United
States and Germany has already produced much interest in finding the answers to the
questions in this dissertation; therefore, finding these answers could have wide-ranging
inferences to the same colleagues for integrating vocal and tuba pedagogies.

Future implications of this project are first intended to open a door of
conversation between vocal and brass pedagogues. While the results may appear to be

\(^{185}\) Frederiksen, 138-139.
the same as what was always thought in those colleagues’ minds, at least a window of broader learning will be available for anyone wanting to pursue the topic further. Possible ideas for accomplishing this communication are rendering the results in condensed form to the vocal and brass field trade journals, presenting clinics and lectures on the VPTE at music education conferences, and writing a pedagogy book targeted at integrating the VPTE into both vocal and brass (tuba and euphonium) pedagogy.

Second, the practical purpose of this study is to answer the question about a musician performing concurrently with voice and brass and provide a basis for improvement of professional brass playing on the tuba and possibly on other brass instruments as well. Performers could do this because they would know how to control and command the necessary muscles and techniques for excellent performance in both fields without damaging their voices or lips. My experience has been that vocal education majors without VPTE training are the tensest and closed up embouchure students trying to play brass instruments, which potentially could damage their glottal areas and their lips and embouchure. One of the goals and result of this dissertation is to help them use their vocal methods for making their brass playing better and most importantly, know how to control those methods for both fields without damaging their voice.

The study and application of voice pedagogical methods to tuba playing techniques in this project resulted in awareness of consistent posture balance and alignment, maximum use of lung capacity, more openness of the pharynx, neck and other muscles surrounding the glottis, release of the tongue to have a more efficient shape and
move freely for articulation, more stable jaw placement and movement, augmented buzzing surface and freedom to move the lip aperture inside the mouthpiece easier, better control of the face muscles, and lastly, better connections between the bodily resonances and the sounds on tuba for increased projection and enhanced timbre. Many professional tuba and euphonium players begin to fade their playing out around age 70 and definitely notice a decline in ability. This may be because of traditional brass playing methods that they learned as young people. However, the knowledge of VPTE helping tuba and euphonium playing could protect individuals from injury and provide decades of playing, possibly well past the current average of about 70 years old. Similarly, when vocalists want to play or teach tuba and euphonium in the public-school music programs, it will be imperative to know the differences between the two mediums in order to prevent damage to the glottis or lips. Additionally, they will need to know the complex processes of breathing, pharynx and airway openness, tongue and jaw placement and, most especially, how to control the muscles around the glottis to keep that area free from tension. They will obviously get instruction on voice techniques from their own vocal training; however, most music education vocal majors in the United States are required to take collegiate level brass methods classes and be able to teach students how to play all brass instruments. In the American public school system classroom, that will require demonstration by them—the teacher—in order to help students, connect their voice to brass.
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APPENDIX I. BRASS SURVEY RESULTS

Main Pedagogical Brass Survey Answers

111 contacts from 109 schools. 44 responded = 40%. 49 different sources listed. Only sources with five or more recommendations were used in the research. Combining Main and Secondary Source with the most recommendations:

Song and Wind by Brian Frederiksen = 27
The Art of Brass Playing by Philip Farkas = 12
The Art of Tuba and Euphonium by Harvey Phillips and William Winkle = 8
Also Sprach Arnold Jacobs compiled by Bruce Nelson = 7
Practical Hints on Playing the Tuba by Don Little = 5
(Practical Hints on Playing the Baritone (Euphonium) by Dr. Brian Bowman)

No other sources were overwhelmingly popular. Five other secondary sources also stemmed from Arnold Jacobs as the main influence or were documents about him. Brass Singers = 2, Jacob’s Special Studies in Hal Leonard = 1, Legacy of a Master = 2, Musical Performance by Kohut = 1, Portrait of an Artist = 2

Primary Sources (named as primary sources by the survey respondents)
A Treatise on the Tuba by Donald Stouffer – I
Also Sprach Arnold Jacobs – II
The Art of Brass Playing – III-III-III-III
The Art of Tuba and Euphonium – III-III-III
The Encyclopedia of the Pivot System by Donald Reinhardt – II
Mr. Tuba, Harvey Phillips – II
Practical Hints on Playing the Tuba by Donald Little – III
Song and Wind – III-III-III-III-III-III-III-III

Secondary Sources (named as secondary sources by the survey respondents)
A Whole New Mind by Daniel Pink – I
Almost Live Videos of Arnold Jacobs – I
Arban – II
The Art of Trumpet Playing by Keith Johnson – I
Audition Success by Don Greene – I
Blazevich – I
Bobo’s Mastering the Tuba by Roger Bobo – I
Body Mapping – I
Bordogni – II
Brass Performance and Pedagogy by Keith Johnson – II
The Brass Player’s Cookbook by Kenneth Amis – I
Brass Singers by Luis Louibriel – II
The Breathing Books by David Vining – I
The Breathing Gym by Patrick and Sam Pilafian – II
Breathing, Speech and Song by Donald Proctor – I
The Celestine Prophecy by James Redfield – I
Concorne – I
Fight Fear and Win by Don Greene – I
The Four Agreements by Miguel Ruiz – I
Gray’s Anatomy – I
Jacob’s Special Studies Hal Leonard Advanced – I
Inner Game of Tennis by Timothy Galwey – II
Legacy of a Master by Dee Stewart (Jacobs) – II
Low Brass Guide by John Griffiths – I
Melodious Etudes for Trombone, Bks I, II, III by Marco Bordogni and transcribed and arranged by Johannes Rochut – I
Musical Excellence by Aaron Williamon – I
Musical Performance: Learning Theory and Pedagogy by Daniel Kohut (dedicated to Jacobs) – II
Performance Success by Don Greene – I
Portrait of an Artist CD (Jacobs) – II
The Practice of Practice by Jonathan Harnum – I
A Soprano On Her Head by Eloise Ristad – II
Remington Warm Up Studies by Emory Remington – II
Remington Trombone Choir CD – I
The Science and Psychology of Music Performance by Parncutt-MacPeherson – I
Seven Habits of Highly Effective People by Stephen Covey – I
Simply Singing by Brad Edwards – I
Sound In Motion by David McGill – I
The Talent Code by Daniel Coyle – I
Trumpet Pedagogy by David Hickman – I
Trumpet Technique by Frank Capos – I
The Whole Musician by Susan Bruckner – I
APPENDIX II. VOCAL SURVEY RESULTS

Main Pedagogical Vocal Survey Answers

113 contacts from 109 schools. 24 responded = 22%. 32 different sources listed. Only sources with four or more recommendations were used in the research. Combining Main and Secondary Source the sources with the most recommendations:

Your Voice: An Inside View by Scott McCoy = 13
The Structure of Singing by Richard Miller = 9
The Functional Unity of the Singing Voice by Barbara Doscher = 6
The Diagnosis and Correction of Vocal Faults by James McKinney = 5
Bel Canto: A History of Vocal Pedagogy by James Stark = 5
Basics of Vocal Pedagogy by Clifton Ware = 5
Singing: The Mechanism and the Technic by William Vennard = 5
Vocology by Ingo Titze and Katherine Verdolini Abbott = 4

Chrissellene Petropoulos – The Ten Technical Commands to Vocal Mastery™-will be used since that source was the stimulus for this dissertation study.

Primary Sources (named as primary sources by the survey respondents)
Doscher-The Functionality Unity of the Singing Voice – III
McCoy – IIIII-III-I
McKinney – IIIII-
Miller-Structure – III
Phillips-Teaching Kids to Sing – I
Stark - IIIII
Ware – III
Blades-Zeller-A Spectrum of Voices – I

Secondary Source (named as secondary sources by the survey respondents)
Appelman-The Science of Vocal Pedagogy – I
Blades-Zeller-A Spectrum of Voices – I
Bozeman-Practical Vocal Acoustics – II
Bunch Dayme-Dynamics of the Singing Voice – II
Doscher-The Functionality Unity of the Singing Voice – III
Doscher and Nix-From Studio to Stage: Repertoire for the Voice – I
Lamperti-Vocal Wisdom – I
Lehmann – I
Malde – I
McCoy – II
Miller-National Schools of Singing – I
Miller-Structure – III
Miller-Solutions for Singers – I
Miller-Training Tenors – I
NATS Journals and Vocal Pedagogy Journals – I
Radionoff – I
Reid-articles-listed by Ian Howell – I
Sataloff-Drexel University Faculty – I
Smith-The Naked Voice – I
Smith/Sataloff-Choral Pedagogy – I
Sundburg-Research Aspects on Singing – I
Titze-Principles of Voice Production – III
Titze/Verdolini Abbott-Vocology: The Science and Practice of Voice Habilitation – III
Vennard (Carl Fischer)-Singing: The Mechanism and Technique – III
Verdolini Abbott-Lessac-Madsen Resonant Voice Therapy – I
Wall/Caldwell-Breathing DVD – II
Ware – I
APPENDIX III. BRASS SURVEY EMAIL

Email sent Spring 2015: 111 contacts from 109 schools. 44 responded = 40%. 49 different sources listed. Sources in the email were brass pedagogical books this author already knew about in advance of the unpublished survey.

Title: 30 Seconds to Dave Porter’s DMA

Content:
Dear friends and colleagues,

I am writing to ask your help with my DMA degree dissertation research. My working topic is "Physical Characteristic Comparisons of Vocal Techniques to Brass Playing Techniques with emphasis on playing the Tuba." Please scan the following titles and give me feedback to two questions: Are any of these books your main pedagogical source and if so which one? If not, do you have a favorite book or source you use for teaching? Please send me a short note in the next week if possible.

Many thanks, David Porter
CMSgt (Ret) USAF Band, Washington, DC; DMA Student and Adjunct Class Brass and Tuba, George Mason University, Fairfax, VA; Low Brass Teacher, Northern Virginia

In no particular order:
Arnold Jacobs:  Song and Wind by Brian Frederiksen, Edited by John Taylor
Mr. Tuba, Harvey Phillips by Harvey Phillips, forward by David Baker, Chapter 18 "On Being a Teacher"
The Art of Tuba and Euphonium Playing by Harvey Phillips and William Winkle
The Art of Brass Playing by Philip Farkas
Practical Hints on Playing the Tuba by Donald C. Little in collaboration with James D. Ployhar
A Treatise on the Tuba by Donald W. Stouffer, pp. 223-228
The Encyclopedia of the Pivot System for All Cupped Mouthpieces by Donald Reinhardt
APPENDIX IV. VOCAL SURVEY EMAIL

Email sent Winter 2015: 113 contacts from 109 schools. 24 responded = 22%. 32 different sources listed. Sources in the email were voice pedagogy books this author already knew about in advance of the unpublished survey.

Title: 30 Seconds to David Porter’s DMA

Content:
Dear colleagues,
I am writing you or whomever is the vocal pedagogy person at your school to ask your help with my DMA degree dissertation research. My working topic is "The Physiological Exploration and Synthesis of Vocal Pedagogy Applied to Tuba Techniques." Please scan the following titles and give me feedback to two questions: Are any of these books your main voice pedagogical source and if so which one? If not, do you have a favorite book or source you use for teaching? Please send me a short note in the next week if possible. This information will only be used in the dissertation as unpublished raw data. Your name or school will not be printed in the final paper.

In no particular order:
Lehmann, Lilli. *How to Sing*.
McCoy, Scott. *Your Voice: An Inside View*.
Petropoulos, Chrissellene. *The 10 Commands to Vocal Mastery*.
Radionoff, Sharon. *The Vocal Instrument*.
Ware, Clifton. *Basics of Vocal Pedagogy*.

Many thanks, David Porter
CMSgt (Ret) USAF Band, Washington, DC; DMA Tuba Performance Student and Adjunct Professor Class Brass, Tuba/Euphonium Ensemble, Applied Tuba, Graduate Assistant Green Machine, George Mason University, Fairfax, VA; Principal Tuba, The McLean Orchestra and The National Brass Quintet; Low Brass Teacher, Northern Virginia
Sources below are listed in the order of popularity from the unpublished raw data survey and in the order, they were presented to the test subject. Each source has the page numbers listed for each bullet statement rather than having individual footnotes. The test subjects were not given the page numbers, but were shown the source book, charts and pictures to help illustrate some of the points. Bullet statements are not comprehensive of the source material, nor are they all the notes that were taken by the author for each source, but statements were selected for readability and understandability of the test subjects to accomplish in one week’s time between lessons. Some sources say the same things, so common statements were not repeated for every source to save space; therefore, only different statements or different wordings were written down.

First Lesson

Read the following quotes and paraphrased sentences from Arnold Jacobs in Song and Wind.


Posture
- stand while seated, 130
- string pulling up like a puppet on a string, 130
- retain inward curve of lower back, 131
- stand from the hips, 131

Breathing

Exercises:
- Openness-ah, oh, ooh then inhale, 133
- Eliminate Pressure-say one, two, three with a resonant voice, 133
- Slow breath-move arms up to simulate air inhale and down for exhale speed of a visual effect, 134

Quotes:
- Breath to expand, don’t expand to breath, 105
- Yawn is a good feeling of inhalation, 101
- Allow upper chest to expand, 105
Inhale: Diaphragm goes up and down, 107
- Pulling and contracting the abs not good—too much tension, 108
- Lower air pressure in lungs and air is drawn in, 107
- Avoid dipping below the zero line causes throat to close, 117
- High range: low flow/high pressure, 122
- Low range: high flow/low pressure, 122

Tongue Location and Shape
Exercises:
- Open—say ah, oh, ooh, 127
Quotes:
- Blow to lips, not the tongue, 127
- Use vowels to shape the tongue for best sound and articulation, 128
- Use vowels tAH or tOO, 128
- Releases: use tAH or tOO, 128

Pharynx and Neck Openness
- open pharynx (throat) same as open mouth, 101
- an open throat is a relaxed throat, 102

Lip Aperture and Shape
Quotes:
- Lips same as vocal folds, 123
- 7th cranial nerve sends message to lips—5th cranial nerve sends message back, 122
- Lips vibrate from the center outward, 123
- Lips out for low notes and in for high notes—however no tightness or they won’t vibrate, 125
- Take low buzz feeling of lips buzzing into the high register, 126

Jaw Placement
Quotes:
- Says moving chin forward will open airway, 128 (Mr. Porter respectfully disagrees)

Second Lesson

Read the following quotes and paraphrased sentences from Arnold Jacobs in
Also Sprach Arnold Jacobs

This source put ahead of the others because it is tied so closely with Song and Wind.
Jacobs book summarized:  Play music to learn technique, not the other way around, 66
Think child-like thoughts for playing music, 68

Posture
- If chin is up or down, then the airway is narrowed, 35
- Stay tall while playing, 36
- High chest relaxes ab wall, 44
- No conscious shoulders, but allow them to move with the chest, 47

Breathing
Exercises:
- Blow air against the back of your hand through your lips, 37
Quotes:
- 85% song, 15% wind
- Pressure without wind is possible, 37
- “Oh” with lips—listen to sound of air moving freely, 37
- Bernoulli Principle calls the throat a narrow passageway—point is to keep the throat openness, 38
- Waste air, 38
- A change in the thorax must happen for breath, not in the abs, 38
- Think wind, not pressure, 39
- Abs coming in should be a result of blowing, not a cause, 40
- When blowing past repose, that is difficult, 41
- At end of a phrase, you should have air inside you still, so it is easy to breathe again, 42
- If playing is hard work, the breathing muscles are fighting each other, 44
- Blow and suck air through the lips as a thought process, 44
- Tongue, breath and lips all start at the same time, 57

Tongue
- “t” is faster than “d”, 55
- Vowels create air flow, 55
- Tongue, breath and lips all start at the same time, 57
- Tongue does not produce the sound, 57

Pharynx and Neck Openness
- If we play by pressure, then the larynx will close as we run out of breath, 39

Lip Position and Aperture Openness
Exercises:
- Do physical exercise while buzzing, 30
- Focus lips for air—say: pa, pa, pa, 40
Quotes:
- Trained lips will not resist air under pressure, 28
- Some mouthpiece pressure is needed to isolate lip muscles inside the mouthpiece so they can vibrate, 33
- Don’t form the embouchure with corners, but form with aperture radiating outward, 33
- Order vibration, not shape, but lips are in elliptical shape, 34
- Keep inner embouchure loose and outer firm, 34
- Transfer ease of low range to high range, 39
- Tongue, breath and lips all start at the same time, 37

Tone and Timbre
- Remember sound of mechanics, not the feel, 18

Read the following quotes and paraphrased sentences from *The Art of Brass Playing*

Breathing
- Exhalation air must be let out slowly through 6 points of resistance, 61
  - glottis
  - back of tongue
  - tip of tongue
  - aperture
  - mouthpiece
  - instrument

Tongue
- “Oh”, 43
- Back of tongue for slurring—arching for slurring, 63
- Lips vibration and tongue coordinate together, 45

Pharynx and neck openness
- Glottis—whisper “oh” 10-15 feet away to feel it, 61
- Glottis is elliptical when closed and vibrating, 40
- Glottis is a valve, but no tight neck, 62

Lip Position and Aperture openness
- Mouthpiece angle:
  - same direction as the air, 9
  - distribute mouthpiece pressure, 9
right angle to the teeth, 9

- Tuba = 50/50 upper and lower lips (quote from Daniel Perantoni that the author heard when in college and been teaching—however, it turns out upon further reading of the sources that neither Song and Wind or The Art of Brass Playing say this—they both say the embouchure placement does not have to be centered for tuba because of so much space in the mouthpiece [124 for Song and Wind and 34 for The Art of Brass Playing]—needless to say, the author and his teachers have always started with 50/50 as a starting place for students)
  - Horns/trombones = 2/3-1/3 upper and lower lips, 33
  - Trumpets = 1/3-2/3 upper and lower lips, 34
  - Keep lips buzzing between slurred notes, 52
  - Lips vibration and tongue coordinate together, 45
  - Teeth kept separate, arch the chin in a U shape, avoid the smile, corners kept in, 39

Jaw Placement
- Two positions: Repose and forward, 7
- No bunched chin, 18

Third Lesson


Author believes that tuba (and euphonium) are more vocal than metal. Endorses the concept of “vocalizing” scales and arpeggios much the same way as a singer vocalizes, 30

Show chart on page 32!!!

Posture
- Shoulders remain in normal, relaxed (unraised position throughout breathing process), 22
- Relaxed posture, but erect, 23 & 29
- Avoid pulling your instrument in to inhibit inhalation, 24

Breathing
- 90 percent of tone production depends on air supply and support of the airstream, 21
- Use natural breathing, 21
- Inhalation—open throat, contract diaphragm, expand chest and upper torso, 22
- Containment—glottis is used to contain air in lungs, diaphragm is contracted,
chest and torso remain fully expanded, 22

- Exhalation—glottis is opened to control release of air (without muscle constriction in the throat), diaphragm resumes normal position as pressure is equalized by air being exhaled, chest and upper torso reduce to normal size, 22
- Control of speed and air is determined by musical needs such as dynamics, tone quality, phrasing and interpretation, 22
- Breathe to bottom of lungs like filling up a bucket with water (Jacobs disputes this), 24
- Keep midsection pliable, 24
- Upper range: air goes gradually down, 27
- Lower range: air goes gradually up, 27
- Avoid bad habits of too much [air] pressure [and embouchure pressure] by building slowly (register breaks—separate embouchure for low/middle/high registers and puffed cheeks, flabby embouchure), 28
- Pitch relationship: airstream goes the opposite direction of the range being played, 29
- For release and ending of notes, simply stop the air without closing the throat, mouth, or lips and without cutting off the air with the tongue, 30

**Tongue Location and Shape**
- Tongue down in a relaxed and out-of-the-way position, 29 & 35
- Use vowels “ah” low register, “ou” or “oh” middle register, “ee” high register, 30
- Tongue is a release valve for air, not an air starter or driver, 31
- Tongue articulation is in front of the air, 31
- Tongue movement is usually up and down, but in and out through the lips in extreme lower register may happen, 33-34
- Breath articulation is viable in the extreme low register, 35

**Pharynx and neck openness**
- Open throat, no muscle tension, 23

**Lip Position and Aperture Openness**
- The other 10 percent of tone production is provided by the embouchure, 21
- Opening in the lips is caused by the moving air stream, 26
- Upper range: lips closer to teeth especially lower jaw, 27
- Lower range: lips come away from lower teeth, especially lower jaw, 27
- Avoid smiling in the upper register—purse lips in the center and slight pulling of the corners, 25 & 27
- Upper lip remains as a constant (retains basic shape, regardless of range, and changes tension minimally, except in extreme upper range), while the lower lip serves as a variable (changing in shape, thickness, and tension (larger, thicker looser when approaching the low register and thinner, and tauter when
approaching the upper register), 26 & 29
- 60/40 mouthpiece placement, 26

**Jaw placement**
- Exercise:
  - center a coin (nickel) flat between the lips, and hold the coin in that position for one minute (the coin must remain horizontal without tipping), 26
- Upper range: jaw up, 27
- Lower range: jaw down and forward, 27
- Pitch relationship: jaw down for lower range and up for high range, 27
- Chin remains flat (pointed down and slightly forward), 27
- Avoid tendency to puff cheeks in lower register, 27
- There should not be movement of the jaw for every tongued articulation, 34
- Flexible movement of the lower jaw from one register to another is facilitated by keeping the upper rim “anchored” on the upper lip, 27

**Timbre**
- No specific timbre comments discerned

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Read the following quotes and paraphrased sentences from *Practical Hints on Playing the Tuba*


**Posture**
- Sit as you stand, relaxed and not tension in the shoulders, 5

**Breathing**
- Exercise:
  - Inhale a large breath, then immediately play a mid-range note for several seconds; Repeat step one, only this time hold in the air for ten seconds before laying the note; Repeat step one again exactly as you did the first time. You will notice that it is more comfortable to play off of the “rebound of the breath”, 9
  - Place your hand on the abdominal area and blow out a match held an arm’s length away. A quick, light contraction of the abdominal muscles will be felt. A similar action normally occurs when the tuba is blown. Avoid inducing unnecessary tension in this area., 9
  - Inhale on beat four—exhale over seven counts by controlling the air with the lip opening. Repeat., 9
  - Play off of the rebound of the breath, 9
  - Breathe full, 10
– Allow shoulders to move naturally, 8
– Yawn inhale, 8
– Breath through the lips, 8
– Breath with the top lip maintaining contact, 8
– Breath quiet (but with a whoosh sound—comment found in re-reading this page January 8, 2017), 8
– Know the sound and feel of a proper breath, 10
– Make the breath part of the music, 10

Tongue Location and Shape
– Speech patterns of “tu”, “ta” or “toe”, 16
– Tongue makes brief contact with the palate to break the air flow—causes a slight increase in air compression which sets the lips in motion upon the tongue release, 16
– Tongue is an articulator, not a tone producer, 16
– Ideally tongue should not touch the teeth or lips, 16
– Tongue does not normally end notes, 16
– Tongue action should be brisk and quick, 16
– Tongue should be up and down more than back and forth, 16
– Use the tip of the tongue, 16
– Avoid chewing of the jaw when tonguing, 17
– End sound with a “hoe” syllable, not the tongue, 16

Lip Position and Aperture Openness (Embouchure)
– Form an “emm” with the lips, 10
– Slight pucker to the lips, 10
– Teeth should be separated, 10
– Corners of the mouth firm, 10
– Corners drawn gently against the teeth but never in to a smile. 10-11
– Avoid excess tension, 11
– Correct sound is the best guide to embouchure formation, just like speech patterns, 11
– 50/50 mouthpiece placement, 12
– Small amount of pressure to maintain a sufficient seal between the lips and the mouthpiece to prevent air from escaping around the sides (rim) of the mouthpiece, so there is little reality to a “no pressure” system of brass playing, 12

Jaw Placement
– Jaw is thrust slightly out, and the chin should be firm and somewhat pointed—never bunch up the chin, 11
– Avoid chewing of the jaw when tonguing, 17
Tone and Timbre

- Supported sound is a sound request, not a physical sensation., 9
- Supported sound on the tuba is a full, vibrant tone resulting physically from the proper coordination of embouchure and air, and esthetically from the concept of sound within the musician, the tuba player, 9

Read the following quotes and paraphrased sentences from Practical Hints on Playing the Euphonium


Posture

- Hand Posture Exercise:
  - Hand position—Hold a pencil between the thumb and forefingers of the right hand and roll it back and forth. This will demonstrate where the fingers have the most control and strength and is the basis for determining how to place the fingers on the valves. Place the middle of the first joint of the fingers on the valves so that the center pad of the finger rests squarely on the valve button. Keep fingers curved. Don’t hold the instrument with the right hand. Push valves rapidly and firmly. Don’t let the fingers pop up too far above the valve buttons while playing., 9
  - Bring the instrument to you, 8
  - Keep back straight, don’t slouch, be erect, 8
  - Left hand should be firm and strong, not hanging, 10

Breathing

- Exercise:
  - Put hands on rib cage and breath—after full breath chest cavity is expanded all around the body, 12-13
  - Take a full breath and then take more short breaths to expand the lungs, 13
  - Floating feel—stand in a door frame and press the backs of your hands against the door frame just below waist level. Hold that position until your hands begin to shake a little from the muscle strain. Turn sideways and feel the “floating” reaction in the arms. This is the same for producing a well-supported tone on the euphonium. Try to feel as if each tone is approached from the top, not scooping up from below., 13
  - Ribs should be felt to expand all around and in the back when inhaling, 13
  - Blow air through the center of the lips, 10
  - Deep breath, 12
  - Breathing from the diaphragm is incorrect—abs move without breathing, 13
  - Breathe through the mouth, 13
  - Yawn to simulate inhale feeling, 13
Air goes down for high range and straight for lower range, 19
Practice “shooting” the air at objects for different ranges and notes, 19

Tongue Placement
- For “attack” place tip of tongue behind the top teeth so it seals air, 14
- After release, tongue goes to bottom of the mouth as if saying “toooh”, 14
- Don’t let sound be too harsh or explode, 14
- Don’t let tongue go between teeth, 14
- Use “toooh” to “doooh” for more legato, 14
- No chewing or moving the chin for each note of tonguing, 14
- Arch the tongue for ranges: “toe” for low, “tah” for middle and “tee” for high ranges, 20

Lip Position and Aperture Openness
- Exercise:
  - Blow through the lips and gradually bring the lips together around the air hole until you fill a little tickle or buzzing feeling, 10
  - Say “hmmmmm” to set, 10
  - Three points to a good embouchure—two firm corners and a flat chin, 10
  - Firm embouchure leaves the lips free to move independently, 11
  - 2/3 to 1/3 mouthpiece placement, 11
  - Avoid puffing the cheeks, bunching up the lower lip, stretching the mouth corners, 10
  - Avoid bunching the lips too much to the center which will produce a muffled tone quality and not allow the lips to vibrate freely, 11
  - Says wet lips will help with sliding flexibility, 11
  - Make a smaller aperture for high range than low range, 19
  - Think more pressure on the lower lip and less on the upper lip for high range, 19
  - Think more pressure on the upper lip and less on the lower lip for low range, 19

Tone and Timbre
- Good tone must be full sounding, 21
- No leaks, double vibrations or other sounds, 21
- If sound is too thin, think of a hot potato in the mouth, 21
- Slur a passage first then tongue to help eliminate tone problem in technical passages, 21
- Listen to good recordings and live euphonium good tone sounds, 21-22

Week Four
Say, explain, and review methods from the six Brass Pedagogical Methods
Week Five

Read the following quotes and paraphrased sentences from

*The 10 Technical Commands to Vocal Mastery™*


Re-order research areas according to vocal importance—Petropoulos lesson 4-26-16

Change tone to volume because that is really what is being measured

- posture
- breathing
- pharynx and neck openness
- tongue location and shape
- jaw placement
- lip position and aperture openness
- volume
- timbre

Posture (Mr. P—same goes for tuba and euphonium playing)

- correct posture is voluntary and must be controlled, 63
- posture will enable you to put your body in many positions and still maintain function of the breathing and vocal apparatus, 63
- 1-feet-shoulder width apart (women even with shoulders, men slightly wider than shoulders, 64
- 2-knees—never locked (try different positions—do not “lose” height, 64
- 3-sitting and hip areas—slightly tucked under avoiding swayback posture, allows for proper alignment and deeper breathing in the back (point the underside of your sitting area towards the ground—keep front and back rib areas as straight as possible—DO NOT hold the abdominal muscles in, 65
- 4-shoulder—during inhalation never rise and during exhalation never curl forward, 64
- 5-head-level, eyes looking straight ahead; chin never pushed down or out; head never too far up or down, right or left; beware of height of music stand or singing partner—do not allow them to alter head position, 64
- 6-hand positions—arms and hands relaxed, down at your sides and always touching the sides of your legs; arms bent, with hands together in a relaxed, clasped position across belly button area; holding text or music up in front of you; holding a microphone; FOR EXPRESSION: once you have mastered optimal posture, your hands will become an extension of your vocal expression (for learning purposes, it is better to have hands in one of the first two positions to avoid unnecessary muscle tension), 64 & 66
- **exercise**: practice looking in a full-length mirror and identify posture parts, 65
Breathing

- the natural function for the breathing apparatus cannot alone meet the demands set upon it for singing/speaking, 75 (Mr. P—same goes for long phrase tuba and euphonium playing)
- the natural function of the breathing apparatus is too high and shallow for the singer, 75
- correct breathing must be a consciously controlled skill, 75
- inhaling correctly involves the absolute balance, coordination, and control of the respiratory muscles, 75
- diaphragm goes down, and the external intercostal muscles expand downward, outward, and slightly upward, 76
- Inhale into 6 areas: 76
  - lower front—ribs 12-9, abdominal area down and out—do not inhale into the stomach;
  - middle front—ribs 8-5 above abdominal area down and out and up;
  - lower sides, right and left, ribs 12-9, (beside abdominal areas) down and out;
  - middles sides, right and left, ribs 8-5 (beside the area equal to the sternum);
  - lower back —ribs 12-9, (behind abdominal area) down and out;
  - middle back—ribs 8-5, (behind the sternum area) down and out and up
- breath through mouth and nose for best results, 84
- ribs 12-9 are waistline, 76 & 79
- ribs 8-5 are above waistline, 76 & 79
- ribs 1-4 are in collarbone area—do not breathe into that area, 76 & 79
- exercise: command the air to go into the 6 areas separately, one at a time, then combinations of the areas, then all at once, 92

Show pictures on pages 76-79 and page 86 and page 90

Exhalation

- lower and middle abdominals are 50% of the process—pull inward and upward—causes a thin airy sound—moves a LOT of air at once, 93-94
- diaphragm and external intercostal muscles are held down and out by the lumbar fascia muscles simultaneously with the external oblique and rectus abdominal muscles pulling inward—causes the diaphragm to remain taut and not rise freely—creates absolute control of airflow, 157
- exercise: inhale and pump abs and flip lips in short staccato segments, 100
- exercise: put hands on lower middle and sides of back below ribs and feel lumbars holding down and out, From Spring 2011 Lessons and accompanying DVDs for Command Nine
Show picture page 158 and 159

– air speed for voice and brass is the same for different dynamics in concept—slow for soft and fast for loud, From Spring 2011 Lessons
– air speed for voice and brass is different for different ranges in concept—voice air stays the same for low or high whereas brass uses faster air for high and slower air for low, From Spring 2011 Lessons

**Pharynx and neck openness**
– non-nasal – airflow vibrates on roof of mouth in different areas depending on range, 124
– nasal – airflow vibrates through nose—uvula down, 125
– exercise: say hat for uvula down and hot for uvula up—go back and forth, 127
– exercise: say “my throat is closed” and “my throat is open”, From Spring 2011 Lessons (Mr. P – now put this into practice when playing the tuba and euphonium and feel the difference and listen to the sound)

– Throat
  – entire interior circumference of the throat must remain expanded—this creates space for the vocal folds to stretch—rounder, fuller tone quality, 135
  – extrinsic muscles responsible for fixation, elevation, and lowering the position of the larynx, 137
  – intrinsic muscles responsible for opening and closing of the glottis, 137
  – exercise: inhale and say or sing huh-huh-huh or heh-heh-heh with a “woofy” too-opened sound—make sure starting with an “h” start and not onset. 141
  – exercise: stick tongue out and do closed and open throat, From Spring 2011 Lessons

Show picture page 136 and page 137

– Base of neck
  – entire interior base of the neck must remain expanded—creates space, 148

Show picture on page 148 and page 150

– air being pushed through causes tension, 149

**Tongue location and shape**
– entire front circumference of the tongue must rest between the bottom gum and tooth line to prevent it from sliding backwards, 110
− when the tongue falls back, it pushes on the epiglottis, which in turn presses down on the vocal cords, restricting them, 116
− when the tongue falls back it restricts the airflow, 111

Show page 110 picture

− Back of tongue must be flat, wide, and forward, controlling it from rising upward or falling backward during sound production and not interfere with any portion of the larynx, 116

Show page 116 picture and page 119 and page 123

− Vowels are to be formed in the middle of the tongue 112 (Mr. P—not with the lips)
− Consonants are formed with the tip of the tongue 112 (Mr. P—just like in tuba and euphonium playing)

Show pictures on page 190 and 191 and 196

− exercise: practice sticking tongue out when inhaling and keep back of tongue forward, From Spring 2011 Lessons

  Jaw Placement
− drop downward and slightly back position, 103
− dropping the jaw without control of the interior of your nasal and pharyngeal areas closes the throat and neck areas—this closes the airway, 102
− the jaw should not move right or left, 105

Show page 103 picture and page 104

− exercise: practice sticking jaw out and down and then practice pulling it back and down—notice difference in breathing and sound only if the throat is kept open, From Spring 2011 Lessons

Direct vocal fold and singing applications that could help with tuba and euphonium playing (additional websites added)

  Lips position and shape (vs vocal folds)
− folds stretch for high ranges but if lips do that we get a thin bright sound (Porter)
− folds shorten and thicken for lower ranges but if lips do that we get a low sound that is closed off (Porter)
− Vocal Folds size of a dime in women and size of a nickel in men
https://www.youtube.com/watch?v=mJedwz_r2Pc
− accessed April 25, 2016
- Cricothyroid Tilt to stretch vocal cords (closing glottis) and Thyroarytenoid Lean to loosen vocal cords (opening glottis)
- Watch video: https://www.youtube.com/watch?v=b89RSYCaUBo
- accessed April 25, 2016
- Vocal cords are behind Adam’s apple—open in the back in a V shape
- V at top of Adam’s apple is top of thyroarytenoid cartilage https://www.youtube.com/watch?v=P2pLJfWUjc8
- accessed Apr 25, 2016
- exercise: practicing buzzing lips into a mirror and watch them for different ranges—ALLOW them to roll out and become thicker for low notes and roll in and become thinner for high notes—NOTE: vocal cords have cricothyroids to stretch them for high range and thyroarytenoids to shorten them for low range (see Miller, Structures below). Lips have zygomatic (smiling) and buccinator (flattens cheek) and risorius (smile without crinkling at the eyes) along with depressor anguli-oris (frowning) muscles and other fascial muscles to stretch or shorten lips, BUT unlike vocal cords, lips also have to roll out (low range) and in (high range). Vocal cords are framed for vibration by the arytenoid muscles and cartilages they are attached to (see Miller, Structures below). Lips are framed by oris orbicularis and other facial muscles and by the mouthpiece. For low range, we want the lips to get thicker and roll out and pucker forward (mentalis—pouting with oris orbicularis), but for high range (for best sound) we want lips to not stretch side to side to become thin, just roll inward (levator labii) and blow down. However, throat must be open for air, and jaw must be kept down, back and forward (masseter muscle). (Porter)
  accessed April 11 2016
  accessed April 11 2016
  accessed April 11 2016
  accessed April 11 2016
  accessed April 11 2016
  accessed April 11 2016
  accessed April 11 2016
Week Six

Read the following quotes and paraphrased sentences from *Your Voice: An Inside View*

Re-order research areas according to vocal importance—Petropoulos lesson 4-26-16
Change tone to volume because that is really what is being measured
posture
breathing
pharynx and neck openness
tongue location and shape
jaw placement
lip position and aperture openness
volume
timbre

Add two exercises to Petropoulos notes
1-put thumb on back top of mouth—that is where soft palate is—can it stay raised? If not, push up while singing, From Spring 2011 Lessons
2-put little finger on middle of tongue—can tongue stay down while singing? If not, push down while singing, From Spring 2011 Lessons
Think of both of these for playing tuba and euphonium.

Posture
– Thorax, abs, neck, internal posterior abs, pelvis, Chapter 7 combined
– Optimal alignment: plug ears—hum—move head up and down and forward and back: when the hum is loudest, that is the best alignment 172 (Mr. P. = maybe for playing tuba and euphonium too)

Breathing
– Lungs are organs and cannot move on their own, 82
– Coupled to thorax by serous membrane that causes lungs and thorax to adhere to each other—thorax moves so does lungs, 82
– McCoy says expand to breathe (opposite of Jacobs) = quiet breath!!!, 82
**Exercise:** breathe to expand (makes noise) / expand to breathe (makes no noise), Porter
– Diaphragm attaches to sternum anterior and back to posterior ribs 7-12, 83
– Inhale is external intercostals and diaphragm, 85

Show charts pages 85-86
Show charts page 108-109
- Exhale is internal intercostals, abdominals, lumbar region (lower back), 86
- Breath control is a laryngeal function—glottis is an air valve (added January 9, 2017 to clarify—McCoy credits McKinney, *The Diagnosis and Correction of Vocal Faults* (1994) with this analogy; McCoy also quotes McKinney that breath support is a pulmonary function between the muscles of inspiration and expiration that control air pressure supplied to the larynx; breath control is a laryngeal function because, like Farkas in *The Art of Brass Playing*, McCoy calls the vocal folds (glottis) an air valve that regulates airflow through the larynx—the lower the flow rate, the higher the efficiency; or, as McCoy says, breath support enables beautiful sounds and breath control enables these sounds to last for long phrases, 88-89)
- Clavicular breathing—raising shoulders (not good), 89
- Thoracic breathing—ribs 6-12 (not much chest inhale) mostly circumference of thorax, 90
- Other inspiratory and expiratory muscles are not being covered—just the global main muscles, Porter decision
- Gluteus maximus or pelvic muscle is the largest but use for breathing is disputed in different sources so will not be covered, McCoy explains his take on page 96, Porter decision

**Breathing terms**

- TLC = total lung capacity (every ounce that fits into the lungs) (Adult women usually have 3-5 liters and adult men usually have 4-7 liters), 97
- RV = reserve volume (air left inside after exhale), 97
- VC = vital capacity (air that is used for singing and playing), 97
- TV = tidal volume (amount of air that is exchanged depending on volume and phrase length), 97
- Well filled lungs are elastic enough to exhale at first, but expiratory muscles needed to finish exhalation, 98
- Pulmonary system capable of much more pressure than needed for phonation (Mr. P. = and lip buzz), 97

**Exercise:** are we thinking of inhale/exhale with whole thorax? Porter decision
- Bernoulli Effect: behind the opening (glottis, lips) pressure increases, velocity decreases; ahead of opening pressure decreases, velocity increases, 105 & 106

**Pharynx and Neck**

- Close quotient = amount of time glottis is closed vs open in a cycle, 114
- Open and throat = keep open by relaxing, 119
- Muscles that keep the larynx down are hooked sternum to thyroid and shoulders to larynx—not tension there keeps the larynx down, 121
- Larynx lowers when inhaling—keep it there by relaxing the larynx for best singing 122 (Mr. P. and playing tuba and euphonium)
Tongue Location and Shape
- Hyoglossus pulls tongue down, 159
- Genioglossus pulls tongue forward, 159
- Styloglossus pulls tongue up, 159
- Palatoglossus raises posterior of tongue and/or lowers soft palate, 159
- Levator Palati – pulls soft palate up, 160

Jaw Placement
- Opening jaw could elevate the larynx—have to be careful not to do that, 164

Show chart on page 173

Lips and Aperture Shape and Location
Vocal folds (Mr. P. = and lips) have four physical actions, 110
- 1-adduction (closing)
- 2-abduction (opening)
- 3-thickening
- 4-thinning
- Mr. P. = we don’t have false lips to vibrate or help like vocal folds—all or nothing—false vocal fold reference in book, 112
- Onset = beginning of sound, 113
- Offset = release of sound, 113

Exercise: sing and then stop voice = how did air feel? Play and stop sound = how did air feel?
- Louder volumes, the vocal folds thicken and contact area widens (Mr. P. = same for lips). Here is how it happens: louder glottal resistance close quotient results in crisper cessation of air flow and amplitude of sound waves = laryngeal tension and breath pressure—the balance is to keep louder and in tune because pitch will naturally want to higher and sharper—the louder volume is the more the glottis closes (CT muscles pull to stretch and TA muscles counter with tension for thickening). Summary=louder volume is accomplished by folds (and lips) actually increasing their tension and closing completely and sometimes hard., 114 & 116
- Ossification = cartilage gradually transferring to bone (young people have more flexible cartilages than adults), 117

Timbre (unique pattern of overtones)
- Qualities convey character of music 1 & 2 (Mr. P. - these can also apply to tuba sound)
- bright / dark = high overtones vs low over tones 2 (Mr. P. balance of these is chiaroscuro or world class)
- twang / loft = bright vs lifting, 2
- forward / back = cheek/mask vs swallowed, 2
- lyric / dramatic = lighter vs darker, 3
- clear / breathy = vocal chords closing completely vs not closing completely, 3
- clean / raspy = no extra noise vs scraping or gravelly (breathiness is white noise / raspy is coarse), 3
- healthy / damaged = no extra noise vs extra noise, 3
- conversational / ringing = no projection of high overtones vs projection of high overtones
- nasal / non-nasal = open port vs closed port (pinched nose changes timbre / pinched nose does not change timbre), 4
- free / forced = ease of effort vs impression of being taxed, 4
- vibrant / straight = vibrato (pitch and loudness and steady oscillation) vs straight (no change) and bandwidth in cents, 5
- wobble / flutter = slow vibrato vs fast vibrato, 5
- in tune / out of tune, 6
- good diction / poor diction = clear enunciation, articulation and vowels vs mushy, covered articulation, incorrect vowel shapes, 6
- stylistically correct / stylistically incorrect = historical perspective vs no relevance, 6

See chart on pages 8-9—may use for evaluation by panel of tone quality and timbre descriptions

Sound (time & distance)
- wave (frequency = number of cycles passing by / period = time lapse between cycles passing by / distance = physical space measurement between the cycles), 17
- forward compression / back rarefraction, 17
- sine wave = zero pressure, 18
- properties of a sound wave, 18
- 1-frequency (pitch measurement)
- 2-amplitude (loudness)
- 3-spectral envelope (timbre/color)
- 4-duration (one cycle = period)

Frequency [Hertz or HZ] (objective) and Pitch (Subjective), 18
- raise pitch by 50% is a Perfect 5th, 18
- raise by 6% is a half-step (6% of 1,000 is greater than 6% of 100—therefore why so hard to hold low notes steady because 6% of 100 is a lot of frequency cycle to maneuver), 18
- 0-1,000 is six octaves, 19
- 1,000-2,000 is less than an octave—takes much more air speed to produce higher frequencies, 19
short wavelengths can be reflected easy / long wavelengths cannot and go around object, 19

Amplitude (decibel or loudness—magnitude of compression and rarefaction in one cycle), 20
- 4x further away decreases by 16 (loudness goes away quickly further out you get), 20
- 2x closer increases by 4 (loudness increases less quickly closer you get), 20
- harmonics lose amplitude the higher they go—no diction heard (no harmonics in sound) [Mr. P. = why higher note articulations don’t sound as separated as lower ones unless effort is made to interrupt sound clearly), 23
- human can hear 0-1db, 20
- 120 db = sound is felt as well as heard, 20
- 170 db = sound can be lethal, 20
- speech must be at least 20 db higher than ambient noise to be understood, 20
- double db is more pressure but not louder—double db is minimal more loudness, 21
- Higher pitches harder to do quietly because amplification resonance rises at 6 db per octave, 23

Spectral Envelope
Harmonics, 21 & 22
P8, P5, P4, M3, m3, M2, M2, M2, M2, m2
1,2,3,4,5,6,7,8,9,10,11
Exercise: push piano key down silently and play octave below—will hear silent key sounding, 22
- Inharmonic tones = result of damaged cords 22 (Mr. P. = maybe lips??)

Exercise: voice overtones = sing /i/ and move to /u/ and listen to change in sound 22
(Mr. P. = do the same on tuba and euphonium with different lip positions)

Resonance
- Resonance needs four things: power source (air), vibrator (glottis or lips), resonator (vocal tract or vocal tract/brass instrument, articulator, 26
- Resonance is:
- 1-intensification (amplification) and enrichment (timbre change), 26
- 2-supplementary vibration (something other than sound source—little to big vibrations—sympathetic vibrations), 26
- Forced resonance—vibrator directly makes something else vibrate like glottis to head/chest 27 (Mr. P.) lips to mouthpiece: has no effect on volume or timbre
- Free resonance (sympathetic)--hollow and have sound wave exit end of tube, 27
- Trachea, larynx and vocal tract all resonators; also, piriform sinus is a free resonator, 28
Sound waves hit air and return—when joined with a second wave just like it, the wave eventually gets strong enough to exit the tube and we have a standing wave 28 & 29 (sound wave that has sufficient strength to exit the tube)

- Resonance = one cycle of vibration is the same as time required to travel 4x the length of resonator tube = standing wave, 33 & 34
- Vocal tract is 17.5 cm long (about 14 inches) – first space to be resonated, 34
- Musical resonance = intensity and enrichment of musical tone with supplementary vibrations, 26
- Mr. P. = more lip vibrating stronger sound source synchronize quicker to cause standing wave to exit

Questions to ponder from Mr. P. = Glottal sound produced the same as lips, but lips have a brass tube and mouthpiece with a vocal tract as a back resonator = does vocal formants (where voice rings the strongest) determine individual’s strength resonance on brass instruments? Can vocal timbres of resonance peaks vowel sounds coincide with sound on brass if throat is shaped the same (singing schwa e and /i/)?

Exercise: use “eh” for open exercise—most open soft palate is lifted and nasal port is closed. 43 (Mr. P. = use mouth shape of hummed resonances for tuba and euphonium in that register)

- Belting voice has higher harmonics in it than Classical voice, 155

Exercise from Mr. P. = play F2 soft then loud and let lips go with brightness in sound—then play F2 soft and loud and keep lips in same shape and don’t let them get bright—measure with a decibel meter—what is the difference????

Week Seven

Read following quotes and paraphrased sentences from

*The Structure of Singing*


New heading order per researcher lesson w/Petropoulos in APR 2016 to coincide with vocalists

- posture
- breathing
- pharynx and neck openness
- tongue location and shape
- jaw placement
- lip position and aperture openness

164
volume
timbre

Posture
- Posture need not be altered for the renewal of the breath, 25
- Exercise - recline on a flat surface, relationship of head, neck and shoulders equal a ‘noble’ standing position ..note that breathing is completely quiet... ...note that forceful expulsion of lower abs make ribs collapse, 30

Breathing
- appoggio definition in breathing: maintain for as long as possible the position of the beginning of the inspiratory phase of the breath cycle, 24
- Silent inspiration is the hallmark of appoggio, 25
- The same breath coordination of the appoggio technique occurs whether a complete breath is taken within a split second or paced over a longer period, whether through nose or mouth, 38
- During powerful sustained singing, the larynx is subjected to subglottic pressure. The singer must learn to be schizophrenic, engaging the respiratory musculature for heavy duty while not pressing the laryngeal valve. Indeed, freedom at the glottis can be present in the long phrase only if breath emission is controlled in the epigastric-umbilical (upper central abs) and costal regions (area just underneath ribs below chest), 108
- The inhalation just before the sostenuto phrase is taken in exactly the same quiet, efficient, quick manner as in the onset vocalise, 114
- both the internal and external intercostals are active in elevating the ribs, 262
- The diaphragm is incapable of providing sensation regarding its precise movements or its exact position within the torso, 262-263
- Diaphragmatic ascent is considerably slower (and therefore more desirable) during the expiratory phases of the breath cycle when the appoggio technique is used, 265
- The lung adapts itself to the wall of the chest activity. Although the lungs are the most important organs of respiration, their movement is dependent on the action of the musculature around them. Lung volume is governed by the total action of the thoracic cage in which the lungs are housed, 269
- When control of breath emission is given over almost entirely to the muscles of the flank and lower abdomen, the chest tends to collapse because the ribs are not able to maintain sufficient distention in the presence of misplaced abdominal pressures. When the pectoral musculature is assigned the task of controlling the breath, the lack of abdominal muscle interaction with the diaphragm results in the diaphragm’s rapid ascent. Any system of breath management that permits the sternum to lower will invite collapse of the thoracic cage, 278
Pharynx and Neck Openness

- open throat or *gola aperta*, 58
- To breathe as though inhaling deeply the fragrance of a rose is to accomplish the buccopharyngeal position of *gola aperta*, in direct contrast to techniques of the open throat achieved through the yawn, 60
- velum is soft palate, 59
- levator palatini muscle is responsible for soft palate (velum) being raised, 68
- If the singer is already in the “noble” position, very little descent of the larynx takes place upon inhalation. In any event, following the slight descent that accompanies inspiration, the larynx should then remain in a stabilized position. It should neither ascend nor descend, either for pitch or power, beyond the minimal requirements of vowel and consonant articulation. It should stay “put.”, 153

Tongue Location and Shape

- tongue at rest “When one is in a state of repose, without exaggerated respiratory activity, the tongue is relaxed in the mouth, with its blade (both the tip and the forward sides) in easy contact with the lower teeth.”, 69
- Miller has several positions of the tongue to support different vowel combinations. Tongue raises and lowers according to the depth of the vowel and following speech patterns of vowel pronunciation., 70-78
- It is not possible to set a basic posture of mouth, lips, tongue, and jaw through which all vowels are to be sung, without distorting most (or all of them). The jaw and the tongue are not in the same positions throughout all vowel sounds in speech, 74
- It is essential that the tongue be in contact with the lower teeth without dropping down to the floor of the mouth at the roots of the teeth, 81

Jaw Placement

- jaw does not hang, 59

Lip Position and Aperture Openness

- onset—the initiation of vocal sound from the vocal cords, 1
- balanced onset: between whisper and hard attack is best for “…dynamic muscle equilibrium…”, 4
- Mr. P = same goes for the lips—they should be positioned between loose blowing in the wind and tight closed
- wonderful laryngoscope pictures of glottis in different onsets, 6

Show page 6 chart

- release (sound ending) balance is the same as the onset=between soft and hard for the best sound, 18
- Bernoulli principle defined “…holds that when a gas or a liquid is in motion, less
than normal pressure is exerted on the surrounding environment.” “In exhalation, the velocity of the air stream increases as it passes through the constriction of the glottal chink, and the vocal folds are sucked toward each other.”, 22-23

- Mr. P=air movement lowers air pressure and draws the vocal folds together for inhalation thereby causing noise==we have to practice holding folds open for quiet breath
- vocal folds are elastic, 23
- The ability to relax the glottis, and to renew breath capacity at whatever rate of occurrence, is fundamental to dynamic, flexible muscle adjustments in singing, 37

Compare the following muscle movements of glottis to lips (refer to last part of fifth lesson for some terms and definitions)

Show page 288
- lateral cricoarytenoid muscles (abduction) move vocal folds apart, 253
- posterior cricoarytenoid muscles (adduction) bring the vocal folds together, 253-254
- thyroarytenoid muscles – relaxation and shortening of vocal folds, 253
- cricothyroid muscle “…elongates and tenses the vocal folds, 255

Show charts and lists pages 281-282, 285-286

Mr. P separate research below

What we want
Oh syllable and elliptical shape for playing tuba and euphonium
orbicularis oris – compresses, contracts and protrudes the lips
accessed April 11, 2016
levator labii – lifts upper lip
accessed April 11, 2016
depressor labii – lowers the bottom lip
http://www.healthline.com/human-body-maps/depressor-labii-inferioris
accessed April 11, 2016
risorius – retracts the angles of the mouth like starting a smile—just enough to be firm and only for middle to high register
http://www.healthline.com/human-body-maps/risorius-muscle
accessed April 11, 2016
buccinator – alters the shape of the cheeks (can keep cheeks close to the teeth)
http://www.healthline.com/human-body-maps/buccinator
accessed April 11, 2016
lateral pterygoid – opens the lower jaw (needed to hold the oh)
What we do not want

risorius – retracts the angles of the mouth like starting a smile—too much of this muscle action—just enough to be firm

zygomatic – pulls angles of the mouth upward and backward

orbicularis oculi – closes eyelids and causes squinting along with zygomatic muscles

depressor anguli oris – lowers angles of the mouth

platysma – neck muscle that depresses the jaw and lips and tenses the skin of the neck like a grimace

mentalis – raises the lower lip and makes it stick out and causes wrinkling of the chin skin

Timbre

Voce chiusa (closed voice) describes a timbre in all parts of the range with a desirable balance of low and high harmonic partials. Voce chiusa produces the chiaroscuro (light-dark) timbre in which both brilliance and depth are present in any area of the vocal scale., 156

Mr. P = “world class” is the sound term in the brass world that is often thought to be the same character of timbre

The same character of tone should be possible for the singer in both loud and soft passages, unless there is purposeful intent to change the timbre for coloristic reasons, 172
**Week Eight**

Read following quotes and paraphrased sentences from *The Functional Unity of the Singing Voice*


**General Statements**
- may be months or years before abuse is detected, 217
- child development shape in muscles has a tendency to stay that way for a long time, 242

**Posture**
- head position affects pharynx and neck openness, 54-55
- erect head, 71
- chest comfortable high and rib cage open, 71
- shoulders slightly back, relaxed and down, 71
- arms hang loosely and don’t invade chest area, 71
- sitting area rests in a suspended position below the rib cage, 71
- stand buoyantly; weight on the heels; balance above the arch of the foot to take advantage of this tiny trampoline, 71

**Breathing**
- 11 & 12 ribs floating; attach to spine, but not rib cage, 7

**Pharynx and neck openness**
- the larynx is fast in response and high in fatigue, xvi
- cricothyroid sits on the trachea, 24-25
- vocal intensity adjustments: blow within and above larynx. 64 Mr. P = add to that tongue, mouth shape, vowel shape and within aperture opening for lips = 6 areas of adjustment
- three sections of pharynx: naso, oro, laryngeal, 108-109
- constrictors: tongue hump, space between tongue and roof of mouth, length of vocal tract (determined by position of larynx and lip rounding), 117
- cricothyroid vs vocalis (thyroarytenoid), 42
  stretched shortening
  thinned thickened
  sharpened rounded

**Tongue location and shape**
- tongue: tip lies against bottom teeth, 113

Exercise – put tongue out as far as it will go; draw it back quickly so that tip lies loosely
against the lower front teeth; push forward with the tip of tongue; return to original position—good for the “th’ consonant sound, 115

- constrictors: tongue hump, space between tongue and roof of mouth, length of vocal tract (determined by position of larynx and lip rounding), 117
- no one rule for tongue, soft palate, lips or jaw, 125
- only breakable rule is that these articulators must shape the vocal tract so that resonating space can vibrate sympathetically with the sound waves coming from the vocal folds, 125
- two major formant shapers: tongue front and back and tongue up and down, 145-146

**Jaw Placement**
- must be aligned, 121 & 122
- clavicular causes jaw tension, 122

**Lip Position and aperture openness**
- aerodynamic: brass players say “sweet” tone front of fold sucked together faster than back during fast breathing and loud the folds are bowed out to allow more air, 59
- phonation: avoid breathy attack and glottis plosive 61 (Mr. P = same for lips)
- low range: folds close and open bottom up; high range: folds close and open more evenly 62 (Mr. P = Arnold Jacobs says lips start the buzz in the center)
- fundamental frequency and intensity of a sound
  - fold tension or glottal resistance, 64
  - aerodynamic power (subglottal pressure and air flow), 64
  - length of cords, 64
  - mass of cords, 64
  - Mr. P = same for lips
- voice is a double reed instrument, 107
- teeth show more for front vowels than back ones, 124

**Timbre & Volume**
- wavelength calculation: divide 1130 (speed of sound feet per second) by frequency hummed = wavelength, 86
- waves in phase produce twice as much amplitude as two parts combined (2+2=8); out of phase cancels each other out, 90-91 (Mr. P = same for tuba/euph—resonance to lip tissue ratio to think about)

Show page 90-91 and 94-95

- the more partials, the more enriching, 97
- acoustical laws governing resonances, 98
volume: size of the cavity—larger lower/smaller higher, 103
aperture size (opening in a solid wall or surface): neck—longer and narrower produces lower, flat wide produces higher, 103
Mr. P = oh syllable produces longer aperture
texture of the walls: soft lower, hard higher, 103
Mr. P = higher harmonics of tuba sound win in hard area
conductivity factor: coupling between resonators achieved by articulators—tongue, soft palate, jaw (there is the McCoy fourth attribute of sound), 103 pharynx and mouth main resonators, 107

Show chart on page 108

sound source (folds) + supraglottal resonance tract have an effect on each other, 127
larynx/soft palate: when larynx goes up, soft palate goes down and vice versa, 126
loudness: longer closure of glottis with wider amplitude and stronger upper partials, 126
Female register
female pure head voice (middle): palate lift, epiglottis fully raised, chink glottis slightly open, low larynx, ventricular widens, rich in partials, 180
female chest: folds full, broad, vibrate all the way across, 180
female whistle: more from air whistling than the vibrations of folds, subglottal high 182 Mr. P = squeal on high notes
girls middle: mixture of chest voice and high voice, 182
Male register
chest: glottis closed 40% of cycle, rich upper overtones, 182
head: mix heavy and light, chiaroscuro, low larynx, elevate soft palate, more closed and rounded mouth, constant trans glottal air, 182
falsetto: relaxed vocalis, stretched crico, incomplete closure of vocal cords along entire length, increase air flow, decrease pressure, few upper partials, 182
false to head: sudden closure along fold length, decrease air, increase subglottal pressure, longer closed cycle, 182
growl register: firm glottal closure, long closure time, minimal air, vocalis activity unopposed, crico at rest, ventricular diminished, 182
Mr. P = like lips fluttering—low register

Belt
speaking register upward, high amplitude, tongue base elevated, larynx elevated, narrow pharyngeal diameter, closed ventricular, epiglottis tilted over larynx, high energy, high vocalis activity, high extrinsic active, no soft dynamics, no mix in coloring, 189
operatic voice riches in low range, belt thin in low range, 189
– cycle closed 70%, says long lasting belters are nasal, 189
– blending registers
  – vocal tract altered in ways: laryngeal positioning, shaping of oral-pharyngeal cavities (tongue placement, jaw opening, embouchure alterations, relative tension and lift of soft palate), 193
  – air management, laryngeal positioning and resonance coupling determine register and blending, 193

Mr. P = other thoughts that came to mind during the reading of this book
– no tongue for glottis
– create sounds from vowel shaping with the tongue
– one long resonator between trachea and end of horn
– air pressure behind lips, not glottis since that is where the vibration is
– lips moist like glottis makes playing smoother
– holding ribs down and out might reduce high notes glottal pressure and closing

Read the following quotes and paraphrased sentences from *Basics of Vocal Pedagogy*

**General Comments**

Five steps in vocal process (also lists the same three as Miller—motor, vibrator, resonator), 54
1-volition (brain)
2-respiration
3-phonation
4-resonation
5-articulation

**Posture**

Exercise: back up against the wall; place one hand behind the small of back and the other behind the neck; tuck the posterior slightly to avoid a swayback and to balance the pelvic area; chest remains comfortably high but not pushed out and upward in the manner of a soldier at attention. The rib cage is also slightly outward; shoulders hang loose and arms dangling; neck is erect but not rigid; head is balanced on top of the spinal column like a bowl turned upside down and balanced on the tip of a pencil., 50

**Breathing**

– The elastic recoil of the diaphragm and lungs are responsible for exhalation in quiet breathing. Note that in quiet breathing, inspiration requires only the involuntary contraction of the diaphragm, and expiration is an entirely passive process., 80
– intercostals help in inhale and exhale and create a constant air pressure subglottal, 80
3 things being pedagogically not correct—diaphragm not consciously controlled, no supporting from the diaphragm and cannot feel the diaphragm with hands, 82

- four processes of breathing: inspiration, suspension, expiration, recovery, 83
- four methods of breathing: high torso, middle torso, low torso, middle and low torso and saying that last one is the best for singers, 84
- Breathing exercises: Blowing Out, Lying Down, Panting, Sitting and Leaning, Standing, Bending, Bending and Blowing Out an Intense Flame, Sniffing, Chest Expansion, 86-88
- To prevent the collapse of the respiratory system at the beginning of singing and to maintain a coordinated balance between inspiratory and expiratory forces, the following image might be helpful: While singing a phrase or exercise, imagine that by the actions of your rib cage—plus the muscles surrounding the waist and back—you are able to keep the walls of the room from collapsing inwards., 89
- Breath Tone exercises: Hissing, Deep Breathing with Tone, Abdominal Muscle Response, Breathe-Sing, Hook-Up Manipulation, Bounce-Jiggle, Pulsating and Staccati, 89-91

Pharynx and neck openness
- exercises to feel open larynx: chewing slowly; swallowing, then feel relaxation of muscles after; inhaling through mouth like a surprise breath; sighing of contentment, 143
- lowered larynx elongates the vocal tract and raising shortens it—aka different resonating frequencies, 143

p 144 and 145 great charts!
- “...if he lowers his larynx and rounds his lips, in effect lengthening his vocal tract, he drops his formants to ‘catch’ several of the harmonics in his formants, and the strength of those harmonics will be enhanced, adding considerable acoustic power to his overall spectrum.”, 150
- extrinsic laryngeal muscles: strap muscles of the neck are capable of raising and lowering the larynx which affects singing, 103
- vocal tract alignment can be “imagined” by “(1) taking a drink of water, (2) smelling a rose..., (3) smiling inwardly,... (4) beginning to sneeze, (5) beginning a pleasant yawn-sigh, and (6) holding the breath while swimming underwater., 152

Tongue location and shape
- The normal placement of the tongue tip is slightly touching the lower teeth and dental ridge, never curled up in to the mouth or pulled back., 144
- genioglossus muscles and hyoglossus muscle which are both connected to the larynx as supplemental larynx “elevators”--thus a stiffening, raising, or thrusting of the tongue muscles causes the larynx to rise or move forward, 144
- tongue moves up and down for vowels, 161
**Jaw placement**

Exercise for too lateral (wide) a singing face: place both hands vertically on each cheek and the chin so that the jaw is slightly lowered and lips are relaxed and oval shaped. Vocalize. 148 Same for tuba and euphonium.

- The correct way to completely open the mouth when singing high notes is to relax the muscles that raise the mandible, and allow the jaw to swing down on its hinge at the condyle (the point where it intersects with the skull slightly forward of the ears). This can be experienced by placing your fingers in this area and dropping the jaw until a slight indentation is felt. The larynx then lowers and the throat feels relaxed and open., 146
- Generally speaking, when the mouth is forced open beyond an approximate two-finger width, excessive tension, particularly in the muscles under the jaw, is created., 146
- Centuries of trial and error by singers have demonstrated that a lowered jaw usually creates more favorable resonance characteristics in the vocal tract, especially when singing notes above B4., 148
- Jaw should drop for ascending pitches and should move according to register or vowels being sung, 187

**Lip position and aperture openness**

Exercises to show how vocal folds oscillate: paper blowing (hold two sheets of paper vertically in front of mouth and blow—they should vibrate (flutter), lip buzz/hum (bmmmm), trumpet mimicking (like it says), 95

p 98 great chart and explanation of thyro, crico and arytenoids
- False folds may function for coughing or gagging
p 99 great chart of cross section of vocal fold and explanation of material in them
p 100 great chart of vocal fold parts
p 100-104 great charts!!!

- The primary reason for rounding the lips is to shape ‘rounded vowels,’ such as ‘oo’ and ‘oh.’ 147 But Mr. P says we don’t round them for these vowels.
- Wide smiling, accomplished with the risorius and buccinator muscles, does not usually provide the best configuration for the vocal tract resonator., 148

**Timbre and Volume**

- Formant is the natural resonating frequency—length of vocal tract affects people’s voices timbre and register, 137

p138-139 great charts!!!!
The trachea is a hollow tube with a reasonable hard surface, and it does qualify as a resonator, but it is involuntary.

- larynx a small resonator.
- laryngopharynx and oropharynx are main resonators.
- nasal resonance available.
- singers cannot hear themselves as others do—the resonating chambers in our heads go through bone where sound travels slower—500 feet per second versus 1,300 feet per second in air—which means lower frequencies are enhanced and higher frequencies are less—“...why singers sound ‘boomier’ to themselves.”

Mr. P says same for tuba and euphonium.

Read the following quotes and paraphrased sentences from

*Singing: the Mechanism and the Technique*


**General Comments**

- Vennard has three elements of a musical instrument: actuator, vibrator, resonator.
- A poor player may not get the proper tension in his lips for the desired pitch, and the instrument will still sound, but the intonation and the quality will be better if the vibrator and resonator area exactly in tune.”

**Posture**

- “..head erect, chest high, pelvis tipped so that the ‘tail is tucked in.” Tail tucked is contrary to Miller.,
- advocates the ‘rag doll’ exercise.

**Breathing**

- Exhausted athletes heave their shoulders and upper chests (and incidentally their phonation is uncontrolled under such conditions).
- best breathing for singing is a combination of rib and diaphragmatic.
- The external intercostal muscles are therefore *inspiratory*, because pulling the ribs upward will increase both diameters of the thorax.
- General movement in the upper part of the thorax should be avoided.
- three types of breathing: first one is clavicular, chest and shoulder breathing.
- Correct breathing may be summarized with the three adverbs, ‘in, down, and out.’
- second type of breathing is costal, or rib breathing.
- third type is diaphragmatic-abdominal or belly breathing.
- diaphragm is muscle of inhalation—abdominal muscles are muscles of exhalation—“The diaphragm does *not* ‘support the tone.” “The diaphragm steadies the tone, but it does not *support* it.”
“...let the intercostals and the diaphragm resist the abdominals so that the exhalation will be so slow and steady you will scarcely be aware of it.”, 34
- It is not only the amount of air in the lungs that determines whether or not you will be forced to take another breath; but also, the purity of the air. When oxidization has progressed to a certain level, the phrenic nerve automatically contracts the diaphragm.”, 34
- It is not the air, it is the carbon dioxide content of the air. 34 Jacobs confirms this

Exercises:  
1- inhale slowly, while counting five; hold the breath while counting ten; exhale slowly, while counting five; repeat indefinitely, 35

p 91 great charts showing Bernoulli effect with different dynamics and falsetto and full voice!!!
p 107 great chart!!!! showing low, medium and high larynx!!!!
p 108 chart for showing difference in swallowing and yawning openness

Pharynx and neck openness

p 50-51 good charts!!

- Vennard states word meanings for the four larynx cartilages: cricoid meaning Greek ‘ring’, thyroid meaning ‘shield’, arytenoid meaning ‘ladle’ and “...epiglottis, a leaf-shaped lid for the voice-box., 52-53

p 54 great chart of thyro and crico functions

- Vennard introduces a new term called “conus elasticus” which he describes as parts underneath the vocal folds, 55
- In most animals, and in most untrained singers, phonation is always initiated with a general tightening process and an elevation of the larynx. “But the tone produced is poor.”, 108
- Forcing the larynx down is futile....singers must let the larynx “...remain down,” instead of forcing down, 109
- three ways of naturally making the larynx descend: inhalation, yawning and after swallowing, 109
- It is only at the beginning of this act [yawning] that the throat is right for singing., 109

Tongue location and shape

- In keeping the blade of the tongue forward, touching the lower teeth, there should be no pressure against them., 113

p 114 great chart of tongue position for different things and mouth openness
p 127 shows great chart of “...five ‘pure’ vowels....” ‘Oh’ is one of them!!!! Oh and Oo have lower harmonics in their sounds (around 256 to 600) and no highs!!!!
The tongue must be loose and relaxed in the floor of the mouth., 156

**Jaw placement**

- a tight jaw is a symptom of a tight throat, 117
- A good reason for dropping the jaw as far as possible is that this pulls the tongue farther out of the pharynx., 118

**Lip position and aperture openness**

- The vocal vibrator may aptly be compared to the lips of a trumpeter., 15
- He describes the air pressure forcing the lips open and then the Bernoulli effect causing them to close. He says that “...brass players prefer a different concept, which I believe is based on the Bernoulli Effect., 15
- “The ‘buzz’ principle emphasizes lip tension, but if one emphasizes the aerodynamic effect which Bernoulli described it results in a more delicate adjustment of the embouchure, and consequently a subtler tone with no loss of power and other requisites.”, 15
- two concepts of vibration—the aspirate (air moving, arytenoids closing and Bernoulli effect all synching for a good sound attack) and the glottal plosive (glottis closing first the air pressure forcing open and then Bernoulli effect), 42
- Mr. P there are cartilages holding and being the vocal cords that have muscles moving the cartilages separately—lips don’t have those cartilages and muscles moving them
- Oh and Oo lowest parts of vowel triangle “formed with the lips: low larynx”, 135
- Mr. P—why do any other vowel? If having trouble forming these, then inside of mouth not open enough or just not used to placing tongue with trying to buzz on a mouthpiece too
- The other letters, A, I and O, are characteristic diphthongs, in which the true vowel is commenced, and then the jaw closes on it, making it...vanishing..., 176

**Timbre & Volume**

- we have five terms and definitions now: tone – the pitch being played (McCoy, 18), timbre – the quality of that pitch (McCoy, 22), resonance – sympathetic (vibrating in sympathy with the originating frequency)(McCoy, 26) or forced (amplification of an originating frequency) vibrations from a frequency (McCoy, 27), sonance – noise in the sound (Vennard, 235)
- Vennard maintains that trachea and bronchi resonance exists when the glottis is open as the rarefaction and compression waves sound in both directions from the glottis “.compression wave is created above the glottis, the pressure below the glottis is decreased: that is, a rarefaction wave is formed: and *vice versa.*,”, 86
- sinuses – he says are not really resonators for the voice, 94
- recap of resonators: nose not good and is controllable. Larynx good and is not controllable, but “…student should listen for ‘2800,’ (frequency) and then to keep it in every tone he produces.” (talking about a ‘ring’ to the tone). Pharynx and

177
Buccal cavities controllable and should be trained, 96

...increased flow of air will increase the loudness of the tone and also will raise the pitch. The pitch will go up because the greater flow of air will heighten the suction of the Bernoulli Effect,... Vennard also says louder too—even if staying on the same pitch more air increases the Bernoulli Effect—Vennard saying the larynx muscle toning (practice and in shape) will help with the pitch holding fast while getting louder—Mr. P: holding the oh and not causing lips to pull in against the increased air flow resulting in louder timbre but not changing characteristics, 59

Exercise to show cricothyroids in action—push in on Adam’s Apple and hear pitch lower as you push and go higher as you let up, 60

**Week Nine**


**Posture**

- body, actuator (breathing), vibrators (folds), resonators (tract), singer, audience, health of individual functions best when aligned, 33-34
- arriving at good posture: general bending and stretching, roll head, roll shoulder, shake hands back and forth hanging, raise heels, nod head back and forth, flop jaw up and down, bubble air between lips, pretend chewing large bits of food, bend over slowly and rise up slowly, 35-36
- description of good posture: feet slightly separated with one toe ahead of the other; legs have no rigidity and in a vertical line with head, trunk and legs; knees loose and ready to move; hips and sitting area conform to vertical line; lower abs held in comfortably; upper abs free to move for breathing; back is standing tall and stretched spine, spread broad, straighten small of back—pulls in sitting area; chest comfortably high; shoulders rolled back slightly and dropped; arms and hands no tension; head centered over shoulders, 40

Exercise: do Alexander Technique Bobble Head (Mr. P from Summer 2011, Alexander Technique Session by Lea Pearson at the MasterWorks Festival, Winona Lake, IN.)

- seated posture: sit as you stand (Jacobs, *Song and Wind*, 130)

Exercise: stand back against wall heels 6-8 inches from wall, put hand behind small of back straighten and lower till no space—keep that alignment (refers to Alexander technique), 41
Breathing

- breathing for life is a slow intake, quick release, wait period, 46
- breathing for singing is conscious control: inhale, setting up, control exhale, recovery, 48
- inhale for singing: small a flower, yawn, put mouth in same position as drinking water—posture for breathing is chest up, lower abs in upper abs free; diaphragm is attached higher in front than back therefore front expansion easier—singer should focus on that 48-49 (Fedderly and Jacobs similar)
- suspension is setting and breath should be suspended (even though he says don’t hold), 50
- controlled exhale: keep ribs out, 51
- recovery: muscles relax, 52
- catch breath: drop jaw and open air passages, 53
- breath support: muscles moving air, 54
- breath control: controlling air flow, 54

Pharynx and neck openness

Show chart page 68-69 and 72-73

- Good singing adjectives: freely produced, pleasant, loud enough, rich ringing and resonant, energy flow smoothly, consistent, vibrant, flex expressive, 77
- Good singing process: chest never collapses, no too long phrases, efficient, do not pull in diaphragm, 81-82 credit to Christy Expressive Singing, Chapter 2 page 35
- Bad singing adjectives: constricted, strident, too loud, hoarse, breathy, weak, inconsistent, shaky, 77
- wasted air is wasted tone and should be avoided 82 (different than Jacobs)

Tongue location and shape

- Consonants are restricted speech sounds, contain noise elements, subordinate to vowels in sonority, define borders of vowels, not nucleus of sound but are sound interrupters or sound stoppers, 143
- Two groups of consonants: require vocal fold oscillation and ones that don’t which are pairs that articulate in the same position but have different vocal attributes, 144
  - voiced: b,d,g,v,w,z
  - voiceless: p,t,k,f,hw,s
- Mr. P = this is important for brass playing! There are other types of consonants, but those are the ones brass players deal with—give some thought to difference in what is taught and what is actually happening
- Other consonant classifiers: the way sound is produced and by the place of articulator position
  - fricative: breath through small aperture: v,f,z,s,h,o, 144
- **Plosive:** stop plosives: p, t, k, 144
- **Nasal:** (through nasal cavity), 145
- **Aspirate (breathy),** 145
- **Dental:** tip of tongue to upper teeth, 145
- **Tongue:** touching alveolar ridge just behind upper teeth: d, t, n, l or approaching it: z, s, 145
- **Back of tongue to soft palate:** g, k, n, 145

- **Vowels:** unrestricted speech sounds; capable of being sustained; normally are voiced sounds; basic building material of vocal tone; definite shape or form by articulators, 145
- **Tongue is primary differentiator of vowels; lips are second,** 146

Mr. P. Exercise: play a long tone and move tongue closer to teeth then move to back of mouth and listen to differences in tone

- **Tongue articulation:** tongue leaves resting place, references the consonant start and rebounds back to resting place for d, t, l, 154 & 156
- **Articulation of vowels provides flow of tone; consonants interrupt flow of tone,** 157

Exercise: Warmup routine: bending, stretching; release tension shoulders, neck and throat; descending 5 note scales in half step patterns; arpeggios, half step patterns, 180

**Jaw placement**

- **Lower jaw:** free from tension—beginning of a yawn—down first, then swing back, 152

Exercise: sing yah, yah, yah while resting tongue on lower gum line, 152

**Lip position and aperture openness**

- **Register:** series of tones (pitches) produced in same vibratory pattern of folds and having same quality—like the harmonic series 93 adapted from a definition in *The American College Dictionary* footnote 2 (Mr. P.: what registers do we have in tuba and euphonium?)
- **Vocal fry**—air bubbling through is pedal range register, 94
- **Modal register**—most used voice area: low, mid, high; 96 Mr. P=cash register
- **Falsetto**—only ligament edge vibrates: 100 gives credit to Vennard p. 67 Mr. P don’t have this register on tuba and euphonium, do we?
- **Whistle register:** starts at Soprano hi C6 and goes to C7 or G7: epiglottis closes over larynx, 105

**Volume**

- **Corrections for hypoactivity (under active):** hum, louder, lifting exercise, imitate an opera singer, good posture and breathing, breath support, project, emoting, listen to good singers, vocalize forward vowels –i, l, er, imitating tight sound to
show wrong way, 82-86

Timbre

- Resonator factors: size, shape, type of opening, composition and thickness of walls, surface, combined resonators, 121
- Vocal resonation: chest (resonates but doesn’t influence external sound), tracheal tree (resonates on Eb4—impedes smoothness through this range), oral cavity, nasal cavity, sinuses (resonate but don’t influence external sound), 123-129
- Vowels are phenomenon of resonance: identity depends on presence of strong partials located in specified frequency bands, 142
- Beginning of a yawn: opens pathway for noiseless inhale; positions larynx low without tension; increases size of throat; relaxes muscles of articulators, 131
- Soft palate has muscles that can worked independently, 132

Exercise: Oral Cavity: pull lips back and sing /a/; pull lips over teeth; protrude lips and sing; drop jaw and hear and notice ease of production (tuba lips!!)

- Sound too bright—larynx is up, 140
- beginning of a yawn to fix, 140
- put finger on thyroid notch and do mental exercises to help larynx down when it starts to rise, 11
- Sound is too dark—larynx is down, 141
- stick tongue out over lower lip, 142
- Singing high notes: more energy, more space, more depth, 182
- Singing low notes: less energy, less space, less depth, 182
  - Energy, 182
  - More space for high (Mr. P opposite for brass) open oral cavity, 183
  - Depth: imagine deeper richer on each tone 183 (Jacobs take low buzz into high buzz)
  - Use catching a bowling ball for high notes, 184
  - Use catching a coin for lowest notes (Mr. P same for tuba), 184
  - Think down for a high note, 185
- Avoid for high singing (Mr. P says for high tuba euph playing also): reaching mentally up; reaching physically up by raising chin or tilting head back, lifting shoulders, elevating larynx, forcing chest up; pulling too strongly on abs—too much breath pressure; pulling back corners of mouth in operatic smile, 185
- Avoid for low singing (Mr. P says for low tuba euph playing also): reaching down mentally; reaching down physically, pulling chin down against throat, tilting head forward, depressing larynx; using too much support—low notes need release of support; mouth too open—low notes need less space; letting sound become breathy or dark, 185
- Lining up of voice: chiaroscuro, vowels, horizontal and vertical; tongue in one place, 186

181
Read the following quotes and paraphrased sentences from
*Bel Canto: A History of Vocal Pedagogy*

**Breathing**
- appoggio: quiet inhale—breath pressure and phonation equilibrium, 118

**Pharynx and neck openness**
- larynx lowered for covered, messa di voce (crescendo/diminuendo) and classical voice, 257

Show charts on pages 240-241 and 242-243 for spectra graph of loose and firm vocal folds (Mr. P = can be the same for the lips?)

**Timbre**
- voice tract adjustable; chiaroscuro is best for carrying, 55-56

Read the following quotes and paraphrased sentences from
*Vocology: The Science and Practice of Voice Habilitation*

**How to Train (Practice)**, 232
- Augmented feedback – called teaching: instructing two things
- knowledge of performance
- knowledge of results
- Timing is important: better to give feedback right after than during concurrent action
- Variability is better
- Random better than blocked
- Parts versus the whole: break it up then put it together
- Consistent response
- Distributed over time
- Continuity

**Breathing**
Exercise: blow through lips like blowing out a candle; next blow through lips same speed but with wide open lips; next blow through lips same speed but with lips closed. Was air speed and projection the same for all? Point: There is a best solution for air projection ratio to mouth and lip aperture opening, 257
- glottal resistance equals lip resistance, 257
– appoggio (Italian for “leaning”) is elastic collapse (Jacobs uses this)—from regal or noble posture this process keeps ribs out (Mr. P = don’t collapse down or collapse of air will be a stifled exhale), 261

Exercise: dangle bending over and breath – ribs have to do the work, 262

Pharynx and neck openness
– laryngeal massage show page, 210

Tongue location and shape
– rules for modifying vowel, 353s
  – formant frequency decrease as tract is lengthened and lip is rounded; increases with lip widening
  – oral restriction lowers 1st formant and raises 2nd
  – pharynx restriction raises 1st formant and lowers 2nd

Lip position and aperture openness
– vocal folds have five layers that vibrate one at a time from soft to loud and vice versa, 42
– Mr. P = lips have basically three before hitting muscle

Show picture page 65— aerodynamic stress: laryngoele: bulging of larynx: akin to trumpet and oboe players
Exercise: exhale on a “ho” with lips to flutter open then change to closed in mid exhale to “splutter” ==which is better sound? 269 (Mr. P tongue coordinates the lip start==point: hold lips open to start not closed for better sound)

– vocal fold vibrations without a tract would sound like lips with just a mouthpiece, 300

Volume
– use a decibel meter for a voice range profile 329 (Mr. P. do the same for tuba and euph)

Timbre
Show chart on p 159 – 3D resonance airway

**Week Ten**
**Say, explain, and review methods from the nine Vocal Pedagogical Methods**
Brass and Vocal Pedagogy Field Similarities and Differences on the Seven Vocal Physical Training Elements

Underlined comments mean similar viewpoints; bold comments mean different viewpoints

<table>
<thead>
<tr>
<th>Brass Field Description</th>
<th>Voice Field Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Posture (standing and sitting)</strong></td>
<td></td>
</tr>
<tr>
<td>HEAD AND NECK</td>
<td>HEAD AND NECK</td>
</tr>
<tr>
<td>if chin is up or down, then the airway is narrowed</td>
<td>head level</td>
</tr>
<tr>
<td></td>
<td>head erect</td>
</tr>
<tr>
<td></td>
<td>head centered over shoulders</td>
</tr>
<tr>
<td></td>
<td>head position affects pharynx and neck openness</td>
</tr>
<tr>
<td>SHOULDER</td>
<td>SHOULDER</td>
</tr>
<tr>
<td>no conscious shoulders, but allow them to move with the chest</td>
<td>shoulders slightly back, relaxed and down</td>
</tr>
<tr>
<td>shoulders remain in normal, relaxed (unraised position throughout breathing process)</td>
<td></td>
</tr>
<tr>
<td>CHEST</td>
<td>CHEST</td>
</tr>
<tr>
<td>high chest relaxes ab wall (only for inhale—chest collapse for exhale)</td>
<td>chest high</td>
</tr>
<tr>
<td></td>
<td>chest comfortably high (for inhale and exhale)</td>
</tr>
<tr>
<td></td>
<td>posture for breathing is chest up</td>
</tr>
<tr>
<td>ARMS AND HANDS</td>
<td>ARMS AND HANDS</td>
</tr>
<tr>
<td>keep fingers curved</td>
<td>arms hang loosely and don’t invade chest area</td>
</tr>
<tr>
<td>don’t hold the instrument with the right hand</td>
<td>arms and hands no tension</td>
</tr>
<tr>
<td>don’t let the fingers pop up too far above the valve buttons while playing left hand should be firm and strong, not hanging</td>
<td></td>
</tr>
</tbody>
</table>
RIBS
let back and ribs expand (for inhale only, exhale is collapse)

ABDOMINALS
relaxed movement inward

BACK
retain inward curve of lower back

PELVIS
No discernable comments for this section

LEGS AND FEET
Brass players are usually sitting when performing, so not much said about legs and feet

OVERALL POSTURE
sit as you stand
pulling up like puppet on a string bring instrument to you, avoid pulling your instrument in to inhibit inhalation

Breathing

CONCEPT PROCESS
breath to expand, don’t expand to breath
yawn is a good feeling of inhalation
use natural breathing
waste air
lower air pressure in lungs and air is drawn in
avoid dipping below the zero line

CONCEPT PROCESS
expand to breathe; quiet breath
yawn, put mouth in same position as drinking water
correct vocal breathing may be summarized with the three adverbs, ‘in, down, and out’
the natural function for the breathing apparatus cannot alone meet the demands set upon it for singing/speaking
when blowing past repose, that is difficult
deep breath
85% song, 15% wind
if playing is hard work, the breathing muscles are fighting each other
tongue, breath and lips all start at the same time
breathe to bottom of lungs like filling up a bucket with water (from Phillips—Jacobs disputes this)
play off of the rebound of the breath
avoid bad habits of too much [air] pressure [and embouchure pressure] by building slowly (register breaks—separate embouchure for low/middle/high registers and puffed cheeks, flabby embouchure)

the natural function of the breathing apparatus is too high and shallow for the singer
breathing for singing is conscious control: inhale, setting up, control exhale, recovery
breath support: muscles moving air
breath control: controlling air flow
good singing process: chest never collapses, no too long phrases, efficient, do not pull in diaphragm
correct breathing must be a consciously controlled skill
wasted air is wasted tone and should be avoided
best breathing for singing is a combination of rib and diaphragmatic

four processes of breathing: inspiration, suspension, expiration, recovery
four methods of breathing: high torso, middle torso, low torso, middle and low torso (best for singers)
exhausted athletes heave their shoulders and upper chests (and incidentally their phonation is uncontrolled under such conditions)
three types of breathing that exist: first clavicular—chest and shoulder breathing
second type of breathing is costal, or rib breathing
third type is diaphragmatic-abdominal or belly breathing
breathing for life is a slow intake, quick release, wait period

INHALATION
blow and suck air through the lips as a thought process
sound of the breath
breath quiet (but with a whoosh sound)
know the sound and feel of a proper breath
listen to sound of air moving freely
let back and ribs expand

INHALATION
breath through mouth and nose for best results
inhale for singing: feeling is like smelling a flower
inhaling correctly involves the absolute balance, coordination, and control of the respiratory muscles
appoggio definition in breathing: maintain for as long as possible the
position of the beginning of the inspiratory phase of the breath cycle
Silent inspiration is the hallmark of *appoggio*
the same breath coordination of the *appoggio* technique occurs whether a complete breath is taken within a split second or paced over a longer period, whether through nose or mouth
the inhalation just before the sostenuto phrase is taken in exactly the same quiet, efficient, quick manner as in the onset vocalise
note that in quiet breathing, inspiration requires only the involuntary contraction of the diaphragm
Inhale into 6 areas:
lower front—ribs 12-9, abdominal area
down and out—do not inhale into the stomach;
middle front—ribs 8-5 above abdominal area down and out and up
lower sides, right and left, ribs 12-9, (beside abdominal areas) down and out
middles sides, right and left, ribs 8-5 (beside the area equal to the sternum)
lower back—ribs 12-9, (behind abdominal area) down and out
middle back—ribs 8-5, (behind the sternum area) down and out and up
inhale is external intercostals & diaphragm

EXHALATION
*diaphragm resumes normal position as pressure is equalized by air being exhaled*
*listen to sound of air moving freely exhale is collapse*

EXHALATION
*Exhale is internal intercostals, abdominals, lumbar region (lower back)*
*the elastic recoil of the diaphragm and lungs are responsible for exhalation in quiet breathing*
expiration is an entirely passive process in quiet breathing
let the intercostals and the diaphragm resist the abdominals so that the exhalation will be so slow and steady you will scarcely be aware of it
| RELEASE OF NOTES | controlled exhale: keep ribs out  
| recovery: muscles relax |
| for release and ending of notes, simply stop the air without closing the throat, mouth, or lips and without cutting off the air with the tongue | RELEASE OF NOTES  
| Not much said about release of notes in the vocal pedagogies |
| CHEMICAL BALANCE | CHEMICAL BALANCE |
| Hyperventilation due to lack of oxygen and surplus of carbon dioxide | it is not only the amount of air in the lungs that determines whether or not you will be forced to take another breath; but also, the purity of the air; when oxidization has progressed to a certain level, the phrenic nerve automatically contracts the diaphragm it is not the air, it is the carbon dioxide content of the air; Jacobs confirms this |
| CAPACITY | CAPACITY |
| at end of a phrase, you should have air inside you still, so it is easy to breathe again | lung volume is governed by the total action of the thoracic cage in which the lungs are housed |
| PRESSURE | PRESSURE |
| pressure without wind is possible Bernoulli Principle (slow air has more pressure than fast air) think wind, not pressure avoid bad habits of too much [air] pressure [and embouchure pressure] by building slowly (register breaks—separate embouchure for low/middle/high registers and puffed cheeks, flabby embouchure) air pressure behind lips, not glottis since that is where the vibration is | Bernoulli Effect; behind the opening (glottis, lips) pressure increases, velocity decreases; ahead of opening pressure decreases, velocity increases intercostals create a constant air pressure subglottal during powerful sustained singing, the larynx is subjected to subglottic pressure; the singer must learn to be schizophrenic, engaging the respiratory musculature for heavy duty while not pressing the laryngeal valve; indeed, freedom at the glottis can be present in the long phrase only if breath emission is controlled in the epigastric-umbilical (upper central abs) and costal regions (area just underneath ribs below chest) |
| AIR SPEED | AIR SPEED |
| high range: low flow/high pressure  
low range: high flow/low pressure | air speed for voice and brass is the same for different dynamics in concept—slow for soft and fast for loud  
air speed for voice and brass is different for different ranges in concept—voice air stays |
<table>
<thead>
<tr>
<th><strong>EMBOUCHURE/MOUTH</strong></th>
<th><strong>EMBOUCHURE/MOUTH</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>breath with the top lip maintaining contact</td>
<td>breath through mouth and nose for best results</td>
</tr>
<tr>
<td><strong>blow air through the center of the lips</strong></td>
<td>yawn, put mouth in same position as drinking water</td>
</tr>
<tr>
<td>“Oh” with lips</td>
<td>catch breath: drop jaw and open air passages</td>
</tr>
<tr>
<td>yawn is a good feeling of inhalation</td>
<td>glottal resistance equals lip resistance</td>
</tr>
<tr>
<td>breathe through the mouth</td>
<td>beginning of a yawn</td>
</tr>
<tr>
<td>avoid bad habits of too much [air] pressure [and embouchure pressure] by building slowly (register breaks—separate embouchure for low/middle/high registers and puffed cheeks, flabby embouchure)</td>
<td><strong>PHARYNX</strong></td>
</tr>
<tr>
<td><strong>PHARYNX</strong></td>
<td>breath control is a laryngeal function—glottis is an air valve</td>
</tr>
<tr>
<td>6 points of resistance—glottis, back of tongue, tip of tongue, aperture, mouthpiece, instrument</td>
<td>suspension is setting and breath should be suspended</td>
</tr>
<tr>
<td>open throat for inhalation</td>
<td>glottal resistance equals lip resistance</td>
</tr>
<tr>
<td>containment—glottis is used to contain air in lungs</td>
<td><strong>DIAPHRAGM</strong></td>
</tr>
<tr>
<td>exhalation—glottis is opened to control release of air (without muscle constriction in the throat)</td>
<td>diaphragm goes up and down for inhalation</td>
</tr>
<tr>
<td><strong>DIAPHRAGM</strong></td>
<td>for exhalation, diaphragm and external intercostal muscles are held down and out by the lumbar fascia muscles simultaneously with the external oblique and rectus abdominal muscles pulling inward—causes the diaphragm to remain taut and not rise freely—creates absolute control of airflow</td>
</tr>
<tr>
<td>diaphragm goes up and down</td>
<td>diaphragm attaches to sternum anterior and back to posterior ribs 7-12</td>
</tr>
<tr>
<td>contract diaphragm for inhalation</td>
<td>diaphragm is incapable of providing sensation regarding its precise movements or its exact position within the torso</td>
</tr>
<tr>
<td>diaphragm contracted for containment</td>
<td>diaphragmatic ascent is considerably slower (and therefore more desirable) during the expiratory phases of the breath cycle when the appoggio technique</td>
</tr>
<tr>
<td>diaphragm resumes normal position as pressure is equalized by air being exhaled</td>
<td>during the expiratory phases of the breath cycle when the appoggio technique</td>
</tr>
</tbody>
</table>
**SHOULDERS**

- Shoulders remain in normal, relaxed (unraised position throughout breathing process)

**CHEST**

- Allow upper chest to expand
- **Expand chest and upper torso for inhalation**
- Chest and torso remain fully expanded for containment
- Chest and upper torso reduce to normal size for exhalation

**ABDOMINALS**

- Pulling and contracting the abdominals not good—too much tension
- Abdominals coming in should be a result of blowing, not a cause
- Shoulders remain in normal, relaxed (unraised position throughout breathing process)
- Breathing from the diaphragm is incorrect—abdominals can move without breathing

**RIBS**

- Ribs should be felt to expand all around

---

**is used**

- Not correct—diaphragm not consciously controlled, no supporting from the diaphragm and cannot feel the diaphragm with hands
- Diaphragm does not support the tone
- Diaphragm steadies the tone
- Diaphragm is attached higher in front than back therefore front expansion easier—singer should focus on that (Fedderly and Jacobs similar)

**SHOULDERS**

- Clavicular breathing—raising shoulders (not good)

**CHEST**

- See Posture—Chest for chest movement
- No collapsing of chest

**ABDOMINALS**

- Lower and middle abdominals are 50% of the exhalation process—pull inward and upward
- Lower abdominals in upper abs free
- Abdominals are muscles of exhalation

**RIBS**

- Ribs 12-9 are waistline
- Ribs 8-5 are above waistline
- Ribs 1-4 are in collarbone area—do not breathe into that area
- Both the internal and external intercostals are active in elevating the ribs
- 11th & 12th ribs float, attach to spine, but not to rib cage
- *Appoggio* (Italian for “leaning”) is elastic
collapse (Jacobs uses this); **from regal or noble posture this process keeps ribs out**

<table>
<thead>
<tr>
<th>BACK</th>
<th>See Breathing—Thorax and see Breathing—Inhalation</th>
</tr>
</thead>
<tbody>
<tr>
<td>expand in the back when inhaling</td>
<td>BACK</td>
</tr>
</tbody>
</table>

**THORAX**

keep midsection pliable change in the thorax must happen for breath, not in the abs

<table>
<thead>
<tr>
<th>external intercostal muscles expand downward, outward, and slightly upward</th>
<th>external intercostal muscles expand downward, outward, and slightly upward</th>
</tr>
</thead>
<tbody>
<tr>
<td>lungs are organs and cannot move on their own—coupled to thorax by serous membrane that causes lungs and thorax to adhere to each other—thorax moves so does lungs</td>
<td>lungs are organs and cannot move on their own—coupled to thorax by serous membrane that causes lungs and thorax to adhere to each other—thorax moves so does lungs</td>
</tr>
</tbody>
</table>

**thoracic breathing**—ribs 6-12 (not much chest inhale) mostly circumference of thorax

when control of breath emission is given over almost entirely to the muscles of the flank and lower abdomen, the chest tends to collapse because the ribs are not able to maintain sufficient distention in the presence of misplaced abdominal pressures; when the pectoral musculature is assigned the task of controlling the breath, the lack of abdominal muscle interaction with the diaphragm results in the diaphragm’s rapid ascent; any system of breath management that permits the sternum to lower will invite collapse of the thoracic cage general movement in the upper part of the thorax should be avoided middle & lower torso best method—balance between inhale & exhale

**RANGE**

upper range: air goes gradually down lower range: air goes gradually up

<table>
<thead>
<tr>
<th>direction of air not talked about much in the vocal pedagogies</th>
<th>direction of air not talked about much in the vocal pedagogies</th>
</tr>
</thead>
<tbody>
<tr>
<td>See Breathing—Air Speed for other statements</td>
<td>See Breathing—Air Speed for other statements</td>
</tr>
</tbody>
</table>

**PELVIC AREA**

not discussed as a separate area for breathing, but the Conable book that includes Alexander Technique that brass musicians use has thoughts many brass musicians use about the pelvic girdle

<p>| gluteus maximus or pelvic muscle is the largest used for breathing but is disputed in different sources | gluteus maximus or pelvic muscle is the largest used for breathing but is disputed in different sources |</p>
<table>
<thead>
<tr>
<th>Pharynx and Airway Openness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONCEPTS</strong></td>
</tr>
<tr>
<td>open pharynx same as open mouth</td>
</tr>
<tr>
<td><strong>AIRWAY</strong></td>
</tr>
<tr>
<td>See Breathing—Concept Process</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>RESONANCE</strong></td>
</tr>
<tr>
<td>No comments about resonance directly related to pharynx other than open airway and throat</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td><strong>THROAT</strong></td>
</tr>
<tr>
<td>open throat is a relaxed throat</td>
</tr>
<tr>
<td>open throat, no muscle tension</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td><strong>NECK</strong></td>
</tr>
<tr>
<td>no tight neck</td>
</tr>
<tr>
<td>SOFT PALATE</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>No specific comments about the soft palate</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LARYNX</th>
<th>LARYNX</th>
</tr>
</thead>
<tbody>
<tr>
<td>See Pharynx—Pressure</td>
<td>lowering the position of the larynx: larynx lowers when inhaling—keep it there by relaxing the larynx for best singing if the singer is already in the “noble” position, very little descent of the larynx takes place upon inhalation; in any event, following the slight descent that accompanies inspiration, the larynx should then remain in a stabilized position; it should neither ascend nor descend, either for pitch or power, beyond the minimal requirements of vowel and consonant articulation; it should stay “put” the larynx is fast in response and high in fatigue lowered larynx elongates the vocal tract and raising shortens it—aka different resonating frequencies in most animals, and in most untrained singers, phonation is always initiated with a general tightening process and an elevation of the larynx. “But the tone produced is poor.” forcing the larynx down is futile; singers must let the larynx remain down, instead of forcing down three ways of naturally making the larynx descend: inhalation, yawning and after swallowing larynx lowered for covered, messa di voce (crescendo/diminuendo) and classical voice</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GLOTTIS</th>
<th>GLOTTIS</th>
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</thead>
</table>
| **glottis is a valve**
glottis—whisper “oh” 10-15 feet away to feel it glottis is elliptical when closed and vibrating | See Lip Aperture Shape and Movement—Glottis |

<table>
<thead>
<tr>
<th>RESISTANCE POINTS</th>
<th>RESISTANCE POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>See Breathing—Pharynx</td>
<td>constrictors: tongue hump, space between tongue and roof of mouth, length of vocal</td>
</tr>
<tr>
<td>PRESSURE</td>
<td>tract (determined by position of larynx and lip rounding)</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>PRESSURE pressure will close larynx as we run out of breath</td>
<td>PRESSURE See Breathing—Pressure</td>
</tr>
<tr>
<td>VOCAL TRACT</td>
<td>VOCAL TRACT vocal tract alignment can be “imagined” by “(1) taking a drink of water, (2) smelling a rose..., (3) smiling inwardly..., (4) beginning to sneeze, (5) beginning a pleasant yawn-sigh, and (6) holding the breath while swimming underwater</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>MUSCULATURE AND PARTS extrinsic muscles responsible for fixation, elevation, and lowering the position of the larynx</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>intrinsic muscles responsible for opening and closing of the glottis</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>muscles that keep the larynx down are hooked sternum to thyroid and shoulders to larynx—no tension there keeps the larynx down</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>velum is soft palate</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>levator palatini muscle is responsible for soft palate (velum) being raised</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>cricothyroid sits on the trachea three sections of pharynx: naso, oro, laryngeal</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>cricothyroid vs vocalis (thyroarytenoid) stretched shortening thinned thickened sharpened rounded</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>extrinsic laryngeal muscles: strap muscles of the neck are cable of raising and lowering the larynx which affect singing</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>word meanings for the four larynx cartilages: cricoid meaning Greek ‘ring’, thyroid meaning ‘shield’, arytenoid meaning ‘ladle’ and “...epiglottis, a leaf-shaped lid for the voice-box</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>new term called “conus elasticus” which are parts underneath the vocal folds</td>
</tr>
<tr>
<td>MUSCULATURE AND PARTS</td>
<td>genioglossus muscles and hyoglossus muscle which are both connected to the</td>
</tr>
</tbody>
</table>
larynx as supplemental larynx ‘elevators’—
thus a stiffening, raising, or thrusting of the
tongue muscles causes the larynx to rise or
move forward

<table>
<thead>
<tr>
<th>Concept</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tongue Shape and Movement</td>
<td></td>
</tr>
<tr>
<td>CONCEPTS</td>
<td>tongue, breath and lips all start at the same time</td>
</tr>
<tr>
<td></td>
<td>tongue does not produce the sound</td>
</tr>
<tr>
<td></td>
<td>tongue is a release valve for air, not an air starter or driver</td>
</tr>
<tr>
<td></td>
<td>ideally tongue should not touch the teeth or lips</td>
</tr>
<tr>
<td>FRONT POSITION</td>
<td>tongue down in a relaxed and out-of-the-way position</td>
</tr>
<tr>
<td></td>
<td>after release, tongue goes to bottom of the mouth as if saying “toooh”</td>
</tr>
<tr>
<td></td>
<td>don’t let tongue go between teeth</td>
</tr>
<tr>
<td>BACK POSITION</td>
<td>back of tongue arch for slurring</td>
</tr>
<tr>
<td></td>
<td>back of tongue must be flat, wide, and forward, controlling it from rising upward or falling backward during sound production and not interfere with any portion of the larynx</td>
</tr>
</tbody>
</table>

CONCEPTS
no one rule for tongue, soft palate, lips or jaw

FRONT POSITION
entire front circumference of the tongue must rest between the bottom gum and tooth line to prevent it from sliding backwards |
<p>| it is essential that the tongue be in contact with the lower teeth without dropping down to the floor of the mouth at the roots of the teeth |
| when the tongue falls back, it pushes on the epiglottis, which in turn presses down on the vocal cords, restricting them |
| when the tongue falls back it restricts the airflow |
| when one is in a state of repose, without exaggerated respiratory activity, the tongue is relaxed in the mouth, with its blade (both the tip and the forward sides) in easy contact with the lower teeth |
| the normal placement of the tongue tip is slightly touching the lower teeth and dental ridge, never curled up in to the mouth or pulled back |</p>
<table>
<thead>
<tr>
<th>TIP</th>
<th>in general, tip of tongue for voice is used to articulate consonants—moves up and down</th>
</tr>
</thead>
<tbody>
<tr>
<td>use tip &amp; move up &amp; down consonants are formed with the tip of the tongue for “attack” place tip of tongue behind the top teeth so it seals air</td>
<td></td>
</tr>
<tr>
<td>VOWELS use vowels to shape the tongue for best sound and articulation use vowels tAH or tOO releases: use tAH or tOO “t” is faster than “d” vowels create airflow use vowels “ah” low register, “ou” or “oh” middle register, “ee” high register speech patterns of “tu”, “ta” or “toe” end sound with a “hoe” syllable, not the tongue use “toooh” to “doooh” for more legato arch the tongue for ranges: “toe” for low, “tah” for middle and “tee” for high ranges</td>
<td></td>
</tr>
<tr>
<td>VOWELS tongue shapes vowels tongue raises and lowers according to the depth of the vowel and following speech patterns of vowel pronunciation it is not possible to set a basic posture of mouth, lips, tongue, and jaw through which all vowels are to be sung, without distorting most (or all of them the jaw and the tongue are not in the same positions throughout all vowel sounds in speech tongue is primary differentiator of vowels; lips are second articulation of vowels provides flow of tone rules for modifying vowel: formant frequency decrease as tract is lengthened and lip is rounded; increases with lip widening Vowels are to be formed in the middle of the tongue vowels: unrestricted speech sounds; capable of being sustained; normally are voiced sounds; basic building material of vocal tone; definite shape or form by articulators</td>
<td></td>
</tr>
<tr>
<td>CONSONANTS use vowels tAH or tOO releases: use tAH or tOO “t” is faster than “d”</td>
<td></td>
</tr>
<tr>
<td>CONSONANTS consonants are restricted speech sounds, contain noise elements, subordinate to vowels in sonority, define borders of vowels, not nucleus of sound but are sound interrupters or sound stoppers two groups of consonants: require vocal fold oscillation and ones that don’t which are pairs that articulate in the same position but have different vocal attributes: voiced: b,d,g,v,w,z and voiceless: p,t,k,f,hw,s other consonant classifiers: the way sound is produced and by the place of articulator</td>
<td></td>
</tr>
<tr>
<td><strong>ARTICULATION</strong></td>
<td><strong>ARTICULATION</strong></td>
</tr>
<tr>
<td>------------------</td>
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</tr>
<tr>
<td>tongue articulation is in front of the air breath articulation is viable in the extreme low register</td>
<td>tongue articulation: tongue leaves resting place, references the consonant start and rebounds back to resting place for d,t,l</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>MOVEMENT</strong></th>
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</tr>
</thead>
<tbody>
<tr>
<td>tongue movement is usually up and down, but in and out through the lips in extreme lower register may happen tongue makes brief contact with the palate to break the air flow—causes a slight increase in air compression which sets the lips in motion upon the tongue release tongue action should be brisk and quick tongue should be up and down more than back and forth</td>
<td>tongue moves up and down for vowels</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>AIR AND TONGUE</strong></th>
<th><strong>AIR AND TONGUE</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>blow to lips, not the tongue</td>
<td>air is thought to be coming from thorax, so no concepts about blowing of air in the mouth or to the lips or tongue—lips and tongue are shapers, not air receivers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>RESONANCE</strong></th>
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</tr>
</thead>
<tbody>
<tr>
<td>tongue is not considered to shape frequencies inside the head, only for better resonance in the instrument and has no specific comments about tongue with resonance</td>
<td>front &amp; back of tongue shape formants prominent frequency resonances only breakable rule is that these articulators must shape the vocal tract so that resonating space can vibrate sympathetically with the sound saves coming from the vocal folds two major formant shapers: tongue front and back and tongue up and down oral restriction lowers 1(^{st}) formant and raises 2(^{nd})</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>RESISTANCE POINTS</strong></th>
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</tr>
</thead>
<tbody>
<tr>
<td>See Breathing—Pharynx</td>
<td>constrictors: tongue hump, space between tongue and roof of mouth, length of vocal tract (determined by position of larynx and</td>
</tr>
<tr>
<td>MUSCULATURE</td>
<td>lip rounding)</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Tongue muscles are not described with scientific specific names or individual parts</td>
<td>five different muscles operate the tongue knowing there are several muscles that operate the tongue can help with focusing on which muscle does what for movement Hyoglossus pulls tongue down Genioglossus pulls tongue forward Styloglossus pulls tongue up Palatoglossus raises posterior of tongue and/or lowers soft palate genioglossus muscles and hyoglossus muscle which are both connected to the larynx as supplemental larynx “elevators” -- thus a stiffening, raising, or thrusting of the tongue muscles causes the larynx to rise or move forward</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRESSURE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>tongue is used in various ways for styles of the front of the notes</td>
<td>in keeping the blade of the tongue forward, touching the lower teeth, there should be no pressure against them</td>
</tr>
</tbody>
</table>

**Jaw Placement and Movement**

<table>
<thead>
<tr>
<th>JAW POSITION</th>
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</tr>
</thead>
<tbody>
<tr>
<td>two positions: repose and forward jaw is thrust slightly out</td>
<td>jaw does not hang, but is lowered &amp; back; drops for high notes dropping the jaw without control of the interior of your nasal and pharyngeal areas closes the throat and neck areas—this closes the airway good reason for dropping the jaw as far as possible is that this pulls the tongue farther out of the pharynx down first, then swing back the jaw and the tongue are not in the same positions throughout all vowel sounds in speech</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHIN</th>
<th>CHIN</th>
</tr>
</thead>
<tbody>
<tr>
<td>chin forward will open airway chin remains flat (pointed down and slightly forward) chin should be firm and somewhat pointed—never bunch the chin arch the chin in a U shape</td>
<td>No specific comments about the chin</td>
</tr>
</tbody>
</table>
three points to a good embouchure—
two firm corners and a flat chin

<table>
<thead>
<tr>
<th>RANGE</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>pitch relationship: jaw down for lower range and up for high range</em></td>
<td><em>jaw should drop for ascending pitches and should move according to register or vowels being sung</em></td>
</tr>
<tr>
<td>flexible movement of the lower jaw from one register to another is facilitated by keeping the upper (mouthpiece) rim “anchored” on the upper lip</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CHEEKS AND FACE</th>
<th>CHEEKS AND FACE SURROUNDING JAW</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>avoid tendency to puff cheeks in lower register</em></td>
<td><em>No specific comments</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOVEMENT</th>
<th>MOVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>there should not be movement of the jaw for every tongued articulation and the avoid chewing of the jaw when tonguing</em></td>
<td><em>the jaw should not move right or left opening jaw could elevate the larynx—have to be careful not to do that the correct way to completely open the mouth when singing high notes is to relax the muscles that raise the mandible, and allow the jaw to swing down on its hinge at the <em>condoyle</em> (the point where it intersects with the skull slightly forward of the ears); this can be experienced by placing your fingers in this area and dropping the jaw until a slight indentation is felt; the larynx then lowers and the throat feels relaxed and open</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TENSION</th>
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</tr>
</thead>
<tbody>
<tr>
<td><em>No specific comments about tension in the jaw</em></td>
<td><em>clavicular causes jaw tension generally speaking, when the mouth is forced open beyond an approximate two-finger width, excessive tension, particularly in the muscles under the jaw, is created a tight jaw is a symptom of a tight throat lower jaw: free from tension—beginning of a yawn</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESONANCE</th>
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</tr>
</thead>
<tbody>
<tr>
<td><em>No specific comments about resonance connected to the jaw</em></td>
<td><em>centuries of trial and error by singers have demonstrated that a lowered jaw usually creates more favorable resonance characteristics in the vocal tract, especially when singing notes above B4</em></td>
</tr>
<tr>
<td>Lip Aperture Shape and Movement</td>
<td>Glottis Aperture Shape and Movement</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td><strong>CONCEPT</strong>&lt;br&gt;<strong>Lips same as vocal folds</strong>&lt;br&gt;tongue, breath and lips all start at the same time&lt;br&gt;the other 10 percent of tone production is provided by the embouchure&lt;br&gt;avoid excess tension&lt;br&gt;<strong>Correct sound is the best guide to embouchure formation, just like speech patterns</strong></td>
<td><strong>CONCEPT</strong>&lt;br&gt;(compare to glottis descriptions): folds close, open, thicken and thin with changing ranges &amp; dynamics; folds positioned between whisper &amp; hard attack for onset&lt;br&gt;&lt;strong&gt;Voice is a double reed instrument&lt;/strong&gt;&lt;br&gt;Bernoulli principle defined: holds that when a gas or a liquid is in motion, less than normal pressure is exerted on the surrounding environment; in exhalation, the velocity of the air stream increases as it passes through the constriction of the glottal chink, and the vocal folds are sucked toward each other&lt;br&gt;the ability to relax the glottis, and to renew breath capacity at whatever rate of occurrence, is fundamental to dynamic, flexible muscle adjustments in singing&lt;br&gt;fundamental frequency and intensity of a sound&lt;br&gt;– fold tension or glottal resistance&lt;br&gt;– aerodynamic power (subglottal pressure and air flow)&lt;br&gt;– length of cords&lt;br&gt;– mass of cords&lt;br&gt;the vocal vibrator may aptly be compared to the lips of a trumpeter</td>
</tr>
<tr>
<td><strong>AIRWAY</strong>&lt;br&gt;&lt;em&gt;Opening in the lips (exhale) is caused by the moving air stream&lt;/em&gt;</td>
<td><strong>AIRWAY</strong>&lt;br&gt;aerodynamic: brass players say “sweet” tone front of fold sucked together faster than back during fast breathing and loud the folds are bowed out to allow more air</td>
</tr>
<tr>
<td><strong>LIP APERTURE SHAPE</strong>&lt;br&gt;do not form the embouchure with corners, but form with aperture radiating outward&lt;br&gt;order vibration, not shape, but lips are in elliptical shape</td>
<td><strong>GLOTTIS APERTURE SHAPE</strong>&lt;br&gt;glottal resistance equals lip resistance (&lt;em&gt;and shape&lt;/em&gt;)</td>
</tr>
</tbody>
</table>
keep inner embouchure loose and outer firm
avoid the smile
corners kept in
**form an “emm” with the lips**
slight pucker to the lips
corners of the mouth firm
corners drawn gently against the teeth but never in to a smile
three points to a good embouchure—
two firm corners and a flat chin
firm embouchure leaves the lips free to move independently
avoid puffing the cheeks, bunching up the lower lip, stretching the mouth corners
avoid bunching the lips too much to the center which will produce a muffled tone quality and not allow the lips to vibrate freely
wet lips will help with sliding flexibility
**LIP MOVEMENT GENERAL**
upper lip remains as a constant (retains basic shape, regardless of range, and changes tension minimally, except in extreme upper range)

**GLOTTIS MOVEMENT GENERAL**
Vocal folds
- 1-adduction (closing)
- 2-abduction (opening)
- 3-thickening
- 4-thinning
- Onset = beginning of sound
  - Offset = release of sound

**LIP MOVEMENT—HIGH RANGE**
Lips in for high notes—however no tightness or they won’t vibrate
upper range: lips closer to teeth especially lower jaw
avoid smiling in the upper register—
purse lips in the center and slight pulling of the corners
make a smaller aperture for high range than low range

**GLOTTIS MOVEMENT—HIGH RANGE**
**high range: folds close and open more evenly**
folds stretch for high ranges (but if lips do that we get a thin bright sound)
think more pressure on the lower lip and less on the upper lip for high range

<table>
<thead>
<tr>
<th>LIP MOVEMENT—LOW RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>lips out for low notes</td>
</tr>
<tr>
<td>lower range: lips come away from lower teeth, especially lower jaw</td>
</tr>
<tr>
<td>lower lip serves as a variable (changing in shape, thickness, and tension—larger, thicker looser when approaching the low register and thinner, and tauter when approaching the upper register)</td>
</tr>
<tr>
<td>make a smaller aperture for high range than low range</td>
</tr>
<tr>
<td>think more pressure on the upper lip and less on the lower lip for low range</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GLOTTIS MOVEMENT—LOW RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>low range: folds close and open bottom up</td>
</tr>
<tr>
<td>folds shorten and thicken for lower ranges (but if lips do that we get a low sound that is closed off)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LIP MOVEMENT—DYNAMICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>No specific comments about what lips do with different dynamics—only talks about air speed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GLOTTIS MOVEMENT—DYNAMICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>louder volumes the vocal folds thicken and contact area widens; here is how it happens: louder glottal resistance close quotient results in crisper cessation of air flow and amplitude of sound waves = laryngeal tension and breath pressure—the balance is to keep louder and in tune because pitch will naturally want to higher and sharper—the louder volume is the more the glottis closes (CT muscles pull to stretch and TA muscles counter with tension for thickening); summary=louder volume is accomplished by folds (and lips) actually increasing their tension and closing completely and sometimes hard balanced onset: between whisper and hard attack is best for dynamic muscle equilibrium vocal folds have five layers that vibrate one at a time from soft to loud and vice versa</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>LIP VOWELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>See Tongue Shape and Movement—Vowels</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GLOTTIS VOWELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oh and Oo lowest parts of vowel triangle: formed with the lips: low larynx the other letters, A, I and O, are characteristic diphthongs, in which the true vowel is commenced, and then the jaw closes on it, making it vanishing</td>
</tr>
<tr>
<td>LIP BUZZ START</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>lips vibrate from the center outward</td>
</tr>
<tr>
<td>take low buzz feeling of lips buzzing into the high register</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LIP BUZZ GENERAL</th>
<th>GLOTTIS VIBRATION GENERAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>keep lips buzzing between slurred notes</td>
<td>the ‘buzz’ principle emphasizes lip tension, but if one emphasizes the aerodynamic effect which Bernoulli described it results in a more delicate adjustment of the embouchure, and consequently a subtler tone with no loss of power and other requisites.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GLOTTIS ONSET (BUZZ)</th>
<th>GLOTTIS VIBRATION GENERAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>phonation: avoid breathy attack and glottis plosive</td>
<td>the ‘buzz’ principle emphasizes lip tension, but if one emphasizes the aerodynamic effect which Bernoulli described it results in a more delicate adjustment of the embouchure, and consequently a subtler tone with no loss of power and other requisites.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LIP BUZZ RELEASE</th>
<th>GLOTTIS OFFSET (BUZZ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>end sound with a “hoe” syllable, not the tongue</td>
<td>release (sound ending) balance is the same as the onset=between soft and hard for the best sound</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEETH PLACEMENT</th>
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</tr>
</thead>
<tbody>
<tr>
<td>teeth kept separate</td>
<td>teeth show more for front vowels than back ones</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RESISTANCE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>trained lips will not resist air under pressure</td>
<td>glottal resistance equals lip resistance (and shape)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PRESSURE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>trained lips will not resist air under pressure</td>
<td>air pressure forcing the lips open and then the Bernoulli effect causing them to close: brass players prefer a different concept, which (author believes) is based on the Bernoulli Effect</td>
</tr>
<tr>
<td>some mouthpiece pressure is needed to isolate lip muscles inside the mouthpiece so they can vibrate distribute mouthpiece pressure</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOUTHPIECE PLACEMENT</th>
<th>GLOTTIS PLACEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>mouthpiece angle: same direction as the air right angle to the teeth</td>
<td>No specific comments since glottis is fixed by cartilages and skeletal placement</td>
</tr>
<tr>
<td>tuba = 50/50 upper and lower lips</td>
<td></td>
</tr>
<tr>
<td>horns/trombone/ (and euphoniums) = 2/3-1/3 upper and lower lips</td>
<td></td>
</tr>
<tr>
<td>Trumpets = 1/3-2/3 upper and lower lips</td>
<td>MUSCULATURE</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>60/40 mouthpiece placement</td>
<td>vocal folds have five layers that vibrate one at a time from soft to loud and vice versa</td>
</tr>
<tr>
<td><strong>MUSCULATURE</strong></td>
<td>vocal folds size of a dime in women and size of a nickel in men</td>
</tr>
<tr>
<td>lips have basically three layers before hitting muscle</td>
<td>ossification = cartilage gradually transferring to bone (young people have more flexible cartilages than adults)</td>
</tr>
<tr>
<td></td>
<td>vocal folds are elastic</td>
</tr>
<tr>
<td></td>
<td>lateral cricoarytenoid muscles (abduction) move vocal folds apart</td>
</tr>
<tr>
<td></td>
<td>posterior cricoarytenoid muscles (adduction) bring the vocal folds together</td>
</tr>
<tr>
<td></td>
<td>thyroarytenoid muscles – relaxation and shortening of vocal folds</td>
</tr>
<tr>
<td></td>
<td>cricothyroid muscle elongates and tenses the vocal folds</td>
</tr>
<tr>
<td></td>
<td>false folds may function for coughing or gagging</td>
</tr>
<tr>
<td></td>
<td>cricothyroid tilt to stretch vocal cords (closing glottis) and thyroarytenoid lean to loosen vocal cords (opening glottis)</td>
</tr>
<tr>
<td></td>
<td>vocal cords are behind Adam’s apple—open in the back in a V shape</td>
</tr>
<tr>
<td></td>
<td>V at top of Adam’s apple is top of thyroarytenoid cartilage</td>
</tr>
<tr>
<td><strong>NEUROLOGICAL</strong></td>
<td>No specific information taken down for test subject research</td>
</tr>
<tr>
<td>7th cranial nerve sends message to lips--5th cranial nerve sends message back</td>
<td><strong>NEUROLOGICAL</strong></td>
</tr>
<tr>
<td></td>
<td><strong>PORTER SEPARATE RESEARCH BELOW</strong></td>
</tr>
<tr>
<td></td>
<td>Not from survey sources.</td>
</tr>
<tr>
<td></td>
<td>This is a clarification of what is happening with facial muscles for brass playing.</td>
</tr>
<tr>
<td></td>
<td>What we want</td>
</tr>
<tr>
<td></td>
<td>Oh syllable and elliptical shape for playing tuba and euphonium</td>
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<td></td>
<td><strong>PORTER SEPARATE RESEARCH BELOW</strong></td>
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<td></td>
<td>Not from survey sources.</td>
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<td></td>
<td>This is a clarification of what is happening with facial muscles for brass playing.</td>
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<td></td>
<td>Lips position and shape (vs vocal folds)</td>
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<td></td>
<td>NOTE: vocal cords have cricothyroids to stretch them for high range and thyroarytenoids to shorten them for low range (see Miller, Structures). Lips have zygomatic (smiling) and buccinator (flattens...</td>
</tr>
</tbody>
</table>
orbicularis oris – compresses, contracts and protrudes the lips
levator labii – lifts upper lip
depressor labii – lowers the bottom lip
risorius – retracts the angles of the mouth like starting a smile—just enough to be firm and only for middle to high register
buccinator – alters the shape of the cheeks (can keep cheeks close to the teeth)
lateral pterygoid – opens the lower jaw (needed to hold the oh)
sternohyoid – lowers the hyoid bone (located under jaw)

What we do not want

risorius – retracts the angles of the mouth like starting a smile—too much of this muscle action—just enough to be firm
zygomatic – pulls angles of the mouth upward and backward
orbicularis oculi – closes eyelids and causes squinting along with zygomatic muscles
depressor anguli oris – lowers angles of the mouth
platysma – neck muscle that depresses the jaw and lips and tenses the skin of the neck like a grimace
mentalis – raises the lower lip and makes it stick out and causes wrinkling of the chin skin

cheek) and risorius (smile without crinkling at the eyes) along with depressor anguli-oris (frowning) muscles and other fascial muscles to stretch or shorten lips. Vocal cords are framed for vibration by the arytenoid muscles and cartilages they are attached to (see Miller, Structures). Lips are framed by oris orbicularis and other facial muscles and by the mouthpiece. For low range, we want the lips to get thicker and roll out and pucker forward (mentalis—pouting with oris orbicularis), but for high range (for best sound) we want lips to not stretch side to side to become thin, just roll inward (levator labii) to and blow down. However, throat must be open for air and jaw must be kept down, back (masseter muscle).

Tone and Timbre Production (sound quality)

CONCEPTS

world class sound
“world class” is the sound term in the brass world that is often thought to be the same character of timbre as chiaroscuro
remember sound of mechanics, not

CONCEPTS

chiaroscuro—desirable balance of light & dark; the more partials, the more enriching;
**the feel**
supported sound is a sound request, not a physical sensation
more partials, more enriching

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<tr>
<th>DESCRIPTIVE ADJECTIVES</th>
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<tr>
<td>supported sound on the tuba is a full, vibrant tone resulting physically from the proper coordination of embouchure and air, and esthetically from the concept of sound within the musician, the tuba player do not let sound be too harsh or explode no leaks, double vibrations or other sounds</td>
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<tr>
<th>DESCRIPTIVE ADJECTIVES</th>
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<tr>
<td>numerous adjectives—bright/dark, twang/loft, forward/back, lyric/dramatic, clear/breathy, clean/raspy, healthy/damaged, conversational/ringing, nasal/non-nasal, free/forced, vibrant/straight, wobble/flutter; <em>voce chiusa</em> (closed voice) describes a timbre in all parts of the range with a desirable balance of low and high harmonic partials; <em>voce chiusa</em> produces the chiaroscuro (light-dark) timbre in which both brilliance and depth are present in any area of the vocal scale</td>
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<th>METHODS</th>
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<tr>
<td>slur a passage first then tongue to help eliminate tone problem in technical passages if sound is too thin, think of a hot potato in the mouth listen to good recordings and live euphonium (and tuba) good tone sounds</td>
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<th>METHODS</th>
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<td>singers cannot hear themselves—sound through bone slower than air; resonance basic knowledge of the characteristics of a sound wave and descriptive terms will help in understanding how sound works coming from the voice (observation of the McCoy book) recap of resonators: nose not good and is controllable; larynx good and is not controllable, but student should listen for ‘2800,’ (frequency) and then to keep it in every tone produced (talking about a ‘ring’</td>
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</table>
to the tone); pharynx and buccal cavities controllable and should be trained sound too bright—larynx is up, beginning of a yawn to fix; put finger on thyroid notch and do mental exercises to help larynx down when it starts to rise sound is too dark—larynx is down, stick tongue out over lower lip **more space for high open oral cavity** lining up of voice: chiaroscuro, vowels, horizontal and vertical; tongue in one place voice tract adjustable; chiaroscuro is best for carrying

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<th>RANGE</th>
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<td>No comments on range pertaining to timbre other than world class sound</td>
<td>singing high notes: more energy, more space, more depth singing low notes: less energy, less space, less depth <strong>use catching a bowling ball for high notes</strong> use catching a coin for lowest notes think down for a high note avoid for high singing—reaching mentally up; reaching physically up by raising chin or tilting head back, lifting shoulders, elevating larynx, forcing chest up; pulling too strongly on abs—too much breath pressure; pulling back corners of mouth in operatic smile avoid for low singing—reaching down mentally; reaching down physically, pulling chin down against throat, tilting head forward, depressing larynx; using too much support—low notes need release of support; mouth too open—low notes need less space; letting sound become breathy or dark</td>
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<tr>
<th>RESONANCE</th>
<th>RESONANCE</th>
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<tr>
<td>take low buzz into high buzz</td>
<td>resonance needs four things: power source (air), vibrator (glottis or lips), resonator (vocal tract or vocal tract/brass instrument, articulator resonance is: intensification (amplification) and enrichment (timbre change) supplementary vibration (something other</td>
</tr>
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</table>
than sound source—little to big vibrations—sympathetic vibrations)
forced resonance—vibrator directly makes something else vibrate like glottis to head/chest
free resonance (sympathetic)—hollow and have sound wave exit end of tube trachea, larynx and vocal tract all resonators; also, piriform sinus is a free resonator
resonance = one cycle of vibration is the same as time required to travel 4x the length of resonator tube = standing wave vocal tract is 17.5 cm long (about 14 inches) – first space to be resonated
musical resonance = intensity and enrichment of musical tone with supplementary vibrations
acoustical laws governing resonances
volume: size of the cavity—larger lower/smaller higher
aperture size (opening in a solid wall or surface): neck—longer and narrower produces lower, flat wide produces higher
texture of the walls: soft lower, hard higher conductivity factor: coupling between resonators achieved by articulators—tongue, soft palate, jaw (there is the McCoy fourth attribute of sound)
pharynx and mouth main resonators one long resonator between trachea and end of horn
formant is the natural resonating frequency—length of vocal tract affects people’s voices timbre and register
trachea is a hollow tube with a reasonable hard surface, and it does qualify as a resonator. but it is involuntary larynx a small resonator laryngopharynx and oropharynx are main resonators
nasal resonance available—contrasting in some vocal pedagogies
resonator factors: size, shape, type of
<table>
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<tr>
<th>Opening, composition and thickness of walls, surface, combined resonators</th>
<th>Vocal resonation: chest (resonates but doesn’t influence external sound), tracheal tree (resonates on Eb4—impedes smoothness through this range), oral cavity, nasal cavity, sinuses (resonate but don’t influence external sound) depth: imagine deeper richer on each tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>DYNAMICS No comments on dynamics pertaining to timbre other than world class sound</td>
<td>DYNAMICS the same <em>character</em> of tone should be possible for the singer in both loud and soft passages, unless there is purposeful intent to change the timbre for coloristic reasons loudness: longer closure of glottis with wider amplitude and stronger upper partials increased flow of air will increase the loudness of the tone and also will raise the pitch; the pitch will go up because the greater flow of air will heighten the suction of the Bernoulli Effect—louder too—even if staying on the same pitch, more air increases the Bernoulli Effect—larynx muscle toning (practice and in shape) will help with the pitch holding fast while getting louder</td>
</tr>
<tr>
<td>PHYSICS No comments on physics pertaining to timbre other than world class sound</td>
<td>PHYSICS sound waves hit air and return—when joined with a second wave just like it, the wave eventually gets strong enough to exit the tube and we have a standing wave (sound wave that has sufficient strength to exit the tube) singers cannot hear themselves as others do—the resonating chambers in our heads go through bone where sound travels slower—500 feet per second versus 1,300 feet per second in air—which means lower frequencies are enhanced and higher frequencies are less—why singers sound ‘boomier’ to themselves trachea and bronchi resonance exists when the glottis is open as the rarefaction and compression waves sound in both directions</td>
</tr>
</tbody>
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from the glottis; compression wave is created above the glottis, the pressure below the glottis is decreased: that is, a rarefaction wave is formed: and *vice versa*. Sinuses are not really resonators for the voice.

<table>
<thead>
<tr>
<th>BODY ANATOMY</th>
<th>BODY ANATOMY</th>
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<tr>
<td>No comments on body anatomy pertaining to timbre other than world class sound</td>
<td>sound source (folds) + supraglottal resonance tract have an effect on each other larynx/soft palate: when larynx goes up, soft palate goes down and <em>vice versa</em>. Beginning of a yawn: opens pathway for noiseless inhale; positions larynx low without tension; increases size of throat; relaxes muscles of articulators soft palate has muscles that can worked independently.</td>
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<tr>
<th>VOWELS</th>
<th>VOWELS</th>
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<tbody>
<tr>
<td>No comments on vowels pertaining to timbre other than world class sound and the tongue shaping the vowels</td>
<td>Vowels are phenomenon of resonance: identity depends on presence of strong partials located in specified frequency bands.</td>
</tr>
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APPENDIX VII. IRB APPROVED DOCUMENTS

IRB Application Final Approved Version 3-3-16

Instructions:
- CITI certification ([www.citiprogram.org](http://www.citiprogram.org)) must be completed for all team members at the time of application submission.
- Complete all sections and required addenda. Submit one complete package via IRBNet.
- Projects with funding/proposed funding must include a copy of the grant application or proposal.
- Research may not begin until you have received notification of IRB approval.
- Handwritten and incomplete forms cannot be accepted.

| 1. Study Title: The Physiological Exploration and Synthesis of Vocal Pedagogy Applied to Tuba Techniques |
|---|---|---|---|---|
| 2. Study Investigators | | | |
| A. Principal Investigator (must be faculty/staff and meet PI Eligibility, [University Policy 4012](#)) | | | |
| Name: Brian Wuttke | Department: School of Music | | |
| Mail Stop: | Phone: 703-993-1380 | E-mail: bwuttke@gmu.edu | |
| B. Co-Investigator/Student Researcher | | | |
| Name: William D. Porter | Department: School of Music | | |
| Mail Stop/Address: | Phone: 703-503-7982 | | |
| E-mail: wporter@gmu.edu | | | |
| C. Are there additional team members? No ☐ Yes ☐ | If yes, complete Addendum J to list additional team members | | |
| D. Do any investigators or team members have conflicts of interest related to the research? No ☐ Yes ☐ | If yes, explain | | |
| 3. Study Type: | Faculty/Staff Research ☒ | Doctoral Dissertation ☐ | Masters Thesis ☐ |
| | Student Project (Specify ☐ Grad or ☒ Undergrad) | | |
| 4. Complete Description of the Study Procedures | | | |

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A. Describe the aims and specific purpose of the study: Traditional teaching methods of tuba technique still find young tuba students needing help with dispensing unfavorable playing characteristics such as forced air breathing, inhibited air capacity, tonguing articulation issues, closed pharynx areas and sticking their jaw out for equalizing the teeth on the mouthpiece. These same undesired techniques could cause repetitive motion injuries over time. Perhaps vocal techniques could help them achieve better success. For the continuing research of improved tuba techniques, applying voice techniques to tuba playing is new. Learning the occupations as two separate physiological techniques leaves musicians to figure out similarities and differences on their own. Preliminary research has shown that without proper knowledge of the pedagogy associated with vocal and brass fields, musicians could potentially damage their vocal cords or lips when playing high brass. Primary to both fields is researching the scientific facts for knowledgeable application. For tuba students, the end result could be more satisfying because of the ability to use vocal techniques for safer and longer lasting playing.

B. Provide a COMPLETE description of the study procedures in the sequence they will occur including the amount of time each procedure will take (attach all surveys, questionnaires, standardized assessment tools, interview questions, focus group questions/prompts or other instruments of data collection): The research will be qualitative experiments with one group of three or four tuba student human subjects and maybe one euphonium (tenor tuba) student human subject. The number depends on the success of recruiting students. The approach to these students will be labeled as a Comparative Case Study. This part of the dissertation is planned for Spring 2016. Because we are talking about training motor skills and not changing professional habits, the students would represent middle and high school and college age that are within easy geographical proximity to George Mason University School of Music, Fairfax, VA. These students will already know how to play tuba from their instruction in school music programs and private lessons. Rather than having two groups labeled as “control” and “experimental”, the group’s tuba playing techniques will be measured at the beginning of this phase with the devices listed below and then “experimented” with the most common voice and brass methods. These methods will be the same for all students regardless of age or gender. As the instruction progresses, the effects will be measured in the same way to see if there is any change for better or worse tone (pitch/quality/strength) and timbre (character of sound) on the tuba. No names will be used in the solutions, just age and gender from the tests. With permission, audio recordings will be made of all tests for referencing of documentation accuracy but will not be used for representation of the actual sound in the body of the dissertation.

Students will be instructed by the author over a period of ten weeks with weekly lessons in the most common vocal and tuba playing techniques acquired from research of the sources in the Proposal Bibliography. The author has more than 35-years’ experience as a private brass teacher and has taken private voice lessons and periodically had voice instruction over the past 30 years. Part of the research is to see if the author can communicate the vocal and brass techniques found in the research to the test group of students. The group will be individually taught each of the approach methods by this author and the recordings and measurement results may have at least one and maybe two observations of the group done by experts of the respective fields. These may include Mr. David Fedderly (Retired Principal Tuba, The Baltimore Symphony; Professor, Peabody Conservatory, University of Maryland;
student of Arnold Jacobs for 10 years), Ms. Chrissellene Petropoulos, Voice Teacher, Potomac, MD, voice and brass faculty from George Mason University. Application of voice techniques to tuba playing will be taught under the following headings: Posture, Breathing, Tongue Location and Shape, Pharynx and Neck Openness, Lip Position and Aperture Openness and Jaw Placement. These formulations may overlap in areas such as posture, breathing, tongue placement, sound vibration concept compared to air speed (vocal cord shape to lip aperture shape), lip position, throat and neck openness and jaw placement. A series of exercises will be drawn up for the students to play and practice the methods common to both voice and brass. Each approach will use the same musical material of legato slurred and technical tongued exercises that will demand utilization of the physiology from both conceptualizations. These same exercises will be sung using the same methods. Additionally, instruction about repetitive motion habits will be addressed as to whether the methods the students have already acquired might lead to injury later in life or not. Part of the instruction will be to show the students through voice techniques ways to protect the soft tissues of the pharynx and neck. Practice time outside of the lessons will be limited so as not to have the students take up habits that are not conducive to the techniques in the sessions and also because the students will have other musical requirements to practice for their school. Each session will be recorded (with permission) for review, but the final measurements for tone and timbre will be from a panel of professional musicians. Copious notes and records will be kept on each case study as to progress, differences between subjects and other observations.

Students will be measured once at the beginning of the ten-week instruction and once at the end of the ten-week instruction for some devices and every week for others. Please see the attached Case Study chart for frequency of individual measurements. Most of the measurement devices revealed in the preliminary research are from processes in pedagogy books titled “10 Commands” and “Song and Wind”, but any other measurement devices found along the way will be amended into the IRB application process. Please note that no subjects with asthma or any other respiratory illnesses will be asked to participate in the research. The following devices will be used once at the beginning and end of each lesson during the research. Each device, except for the laryngoscope, has been used by the researcher in teaching students over the past 35 years, are common devices for brass teachers to have in their studios, do not require doctor approval or application to use them on students and are non-invasive. The Volumetric Exerciser measures breath capacity in milliliters within a maximum of five liters. The subject does this test by breathing in through a plastic tube connected to the VE, which then activates a plastic piston to rise inside a clear enclosed tube. The subject can visually see the piston move as they inhale and the piston stops when the inhalation is completed thereby showing the measurement from a written scale on the side of the piston tube. The Incentive Spirometer, or Inspiron (Inspirx), is a device used to give respiratory patients a visual demonstration of how much air they can inhale. While this was designed for inhalation, if it is turned upside down, it can also be used for exhalation. There is a gauge to adjust resistance and the Inspiron can also be used in conjunction with tuba mouthpiece practice. The subject inhales and exhales through a plastic tube and watches a small plastic ball inside a small cylinder move up and down for measurement. The Breath Builder Isometric Exerciser is a breath training device that uses a plastic cylinder with a ping pong ball inside of the tube. The subject blows into a plastic tube attached to the cylinder and raises the ball to the top of the tube. The goal is to keep the ball
up whether inhaling or exhaling. Further resistance can be added by putting a finger over two different sized holes in the top of the cylinder. This process builds respiration muscles for either singing or playing a wind instrument. The Decibel Meter measures sound volume levels in increments ranging from 50 to 126 decibels. The subject plays the tuba or sings into a microphone on the device. The device then displays a decibel level that is being emitted from the sound the subject is producing. This measurement will allow subjects to visually see the volume they are producing and correlate that volume recognition through their ears to their brain. The Spectrum Analyzer is a device that measures frequencies of the sound that its microphone picks up. There are two SA’s that will be used, both as apps on an iPhone 6. This process will utilize accurate measurements of the harmonic makeup of each tone produced whether singing or playing the tuba by displaying the frequencies in both bar and line graphs and these measurements can be saved as screen shots and then put into the research documentation. These devices will show the differences in tone and timbre for each subject over the ten-week period. Recordings will be done with a Tonal Tuner iPhone app that makes recordings that are exported as email attachments. These can then be saved for listening by the researcher or the advisory panel mentioned in paragraph four, section 4B. Recordings will also be done with a TASCAM Model DR-60D mkII Portable Digital Recorder for DSLR, an AKG D112MK2 microphone and two Shure KSM 141 Dual Pattern microphones. These files will be uploaded into the researcher's computer and saved for listening by the researcher and the advisory panel. Clear tuba mouthpieces will be used for photographs of the lip aperture shape and then a black and white outline drawn of that picture. Actual photographs of the real lip tissue will not be published in the research paper. The pictures and measuring's of the posture and clear mouthpiece lip aperture shapes will be done with an iPhone camera which can then be downloaded for observation by the researcher and advisory panel mentioned in paragraph four, section 4B. For tongue placement, pharynx openness and vocal folds, laryngoscope video will be done at Johns Hopkins Medical Center, Baltimore, MD or in Bethesda, MD. For the laryngoscope, the following description from the administering pathologist listed in 5D gives the details about the procedure. The patient will undergo indirect video laryngoscopy with a flexible laryngoscope. They will be awake, in a comfortable seated position, and they will be given the option of using Afrin nasal spray and tetracaine numbing agent prior to the procedure to make the procedure more comfortable. This procedure will last approximately 5 minutes.

Recordings of singing and tuba playing do not compare to the live sound for resonance of the harmonic frequencies and sound pressure levels exerted. Although recordings will be made for proof of the experimentation, there will also be a strong disclaimer about acoustic verses recorded sound. However, due to confidentiality and privacy, recordings will be used to exhibit the tone and timbre of the students and judged at the beginning and the end of the instruction by a live panel of qualified experts in tuba from GMU, surrounding area military bands and local orchestras (see attached recruiting letter). The panelists will have a list of tone and timbre parameters to check for from adjectives derived from research on “chiarosuro” in the voice field and “world-class” sound in the brass field. Both of these terms have proven to be common terms in each field for describing the “ideal” sound. The lecture recital that accompanies this dissertation will be used as a point of control for live verses recorded sound, singing methods applicable to tuba technique and other intricacies of cross over methods. The research plan is to duplicate the research results on the test group
and present the findings at the lecture recital. Even though the test group will have diverse student personnel, part of the dissertation research is to reveal how the approach methods can be adapted to fit each individual, with consequences being documented as to the differences.

C. Describe the target population (age, sex, ethnic background, health status, etc.): See Part B

1. Summarize the inclusion/exclusion criteria for participation in the study: Getting a spectrum of middle school age to college age will go further towards realizations of vocal applications to tuba playing because each age group develops at different speeds and think of their vocal and tuba playing techniques differently. No subjects with asthma or other respiratory illnesses will be asked to participate in the research.

2. Are there any enrollment restrictions based on gender, pregnancy, race or ethnic origins?
   
   ☐ Yes ☒ No If yes, please describe the process and reasons for restriction(s):

3. Do you have a relationship to any participants that could unduly influence them to participate (including a teacher/student relationship)? ☒ Yes ☐ No If yes, please describe the relationship and how you will manage any possibility of undue influence: I am a private lesson teacher to the middle school and high school students, but not the college student. Undue influence will be managed by following a methodical outline of teaching techniques to them. No pressure will be said or implied for the outcome. The purpose of the research is to see what happens with voice to tuba application. Only their age and gender will be used in the research written reports.

4. Estimated number of subjects (may use a range): 3-4

5. Estimated amount of total participation time per subject: 10 hours of instruction, and 30 hours of individual practice per case study. Two hours per case study for measurements at the beginning and the end of the research. Eight hours to accomplish two laryngoscope procedures per case study--one at the beginning and one at the end of the research. Two hours of personal meet time is expected. Two hours review of forms and letters time is expected.

D. Where will the study occur (list all study sites and collaborators)? Instruction of vocal and tuba techniques for middle school and high school students: Researcher residence, 8622 Kenilworth Drive, Springfield, VA with parents present for the middle and high school student. OR at the student residence depending on logistics and schedule. Parents will be present for all lessons. Each student taught separately to protect privacy and confidentiality.

Instruction of vocal and tuba techniques for college student: George Mason University, School of Music, 4400 University Drive, MSN, 3E3, Fairfax, VA 22030

E. Describe other approvals that have been/will be sought prior to study initiation (facility authorizations, biosafety review, IRB approval from collaborating institutions, approval from public school system IRBs, etc.): No other approvals sought or needed. Research will not be done in any secondary public school system.

5. Recruitment and Consent
   A. Describe the processes used for selecting subjects and the methods of recruitment including when, how, and by whom the subjects will be recruited (attach all recruitment materials including flyers, emails, SONA posting, scripts, etc.)? Three or four case studies of students will be conducted in this research. Most of the ages of people receiving detailed tuba instruction in the United States are usually in secondary school and college. Subjects will be recruited based on the researcher's own knowledge of their integrity and skills as a reliable and compatible student to the research. This initial phase of the research would not be valid if the students were randomly recruited and then turned out to be unreliable in their practice habits or receptive to instruction by the researcher. All subjects will be recruited in person, then by email with letters attached. Please see attached recruiting phone guidelines and email scripts for minors and adults.

   B. Describe the consent process including how and where the consent will take place, who will conduct the consent process, information that will be discussed with and distributed to subjects, and how participants will indicate consent even if a waiver of signature is being requested below (attach all consent documents): The consent process for all subjects (underage students and adults) will be conducted with one phone call as soon as the project receives IRB approval and then two possible emails and possibly two personal meetings within the week before the research is to begin. The personal meetings will happen at either theirs or the researchers home or at a public place like a restaurant or coffee shop. The researcher will conduct the consent process. After email review of the attached Parental Informed Consent Request Letter (for underage subjects), Adult Informed Consent Request Letter and Assent Letter (for underage subjects), the personal meetings will be setup for explanations, possible corrections and signatures. A second personal meeting will only happen if there are corrections to the letters and forms due to subject concerns. The parental signature and their child's signature will be required. The adult college student's signature will be required. The signature sheets will be reviewed by the researcher's supervisor, Dr. Michael Nickens and by the faculty advisor for the IRB process, Dr. Brian Wuttke, both at the School of Music, GMU.

   C. Is a waiver of signature on the Informed Consent being requested? ☐Yes ☒No
      If yes, complete the following:
      1. This waiver is being sought because (check one):
         ☐ The only record linking the subject and the research would be the consent document AND the principal risk would be potential harm resulting from a breach of confidentiality.
         ☐ The research presents no more than minimal risk of harm to subjects AND involves no procedure for which written consent is normally required outside of the research context.
      2. Explain why the waiver of signature is being requested: N/A

- Privacy & Confidentiality
A. How will you protect the privacy of the participants and the confidentiality of the data obtained? The research participation will be kept confidential and not part of informal conversation with classmates or music teachers at the subject’s school by the researcher. Music teachers will be informed of the research process, but will not be part of the research or have privy to any of the research information in the 10-week duration. After the dissertation is done, music teachers, along with other music professionals and music publications will have access to the research results, but there is no risk to the subject personally since only age and gender at the time of the research will be used in the research report. Additionally, subject information will not be shared with other research subjects, nor will they know who is participating. Only the researcher will be the subject contact for the research. Subjects can also call the researcher's advisor at GMU, Dr. Michael Nickens, Director of Athletic Bands and also an Applied Tuba Instructor (703-993-1380 and mnickens@gmu.edu). Subjects may contact the George Mason University Office of Research Integrity & Assurance at 703-993-4121 if they have questions or comments regarding their rights as a participant in the research.

B. What individually identifiable information will be collected? Only the age and gender of each subject.

C. Where will the data be stored (Copies of records must be stored on Mason property—for example, in the PI’s office)? Copies of the Data will be stored at GMU in the Dissertation and Research Advisor's Office, Dr. Michael Nickens, School of Music.

D. How long will the data be stored (data must be retained for at least 5 years after the study ends)?

There are no plans to dispose of the data

E. What, if any, are the final plans for disposition/ destruction of the data? There are no plans to dispose of the data.

F. Will results of the research be shared with the participants? ☑Yes ☐No If yes, describe how this will be accomplished:

G. Will individually identifiable information be shared with anyone outside of the research team (If yes, please explain and be sure to include this information in the consent form)? ☑Yes ☐No If yes, please explain:

H. Does the research involve possible disclosure by participants of intent to harm themselves or others or possible disclosure of child abuse or neglect? (If yes, please explain and be sure to include this information in the consent form)? ☑Yes ☐No If yes, please explain:

- Risks

A. Summarize the nature & amount of risk if any (include side effects, stress, discomfort, physical risks, psychological and social risks): The foreseeable risks or discomforts include practicing new methods of approaching and trying to play the tuba and a little discomfort during the laryngoscope procedure. The new methods will NOT interfere with subject’s ability to perform tuba in their band or music program. The laryngoscope will be take place at Johns Hopkins Outpatient Center/Johns Hopkins Otolaryngology-Head and Neck Surgery. Ms. Kristine Teets, Speech Language Pathologist and Assistant of Otolaryngology-Head and Neck Surgery, Laryngoscope Operator and Administrator, 443-997-6467, 601 N. Caroline Street, Baltimore, MD 21287, http://www.hopkinsmedicine.org/otolaryngology/specialty_areas/voice_center/experts.htm
I. The research lessons will be audio recorded for researcher study and to document any noticeable differences in tone and timbre. All of the instruments described in the Research Procedures are non-invasive (except for the laryngoscope) and therefore will be administered by the researcher. He also owns all of the measuring devices (except for the laryngoscope) and has used them many times in past music instruction. There are no risks involved with the measuring devices in the Research Procedures except for the laryngoscope and that is minimal and supervised under a licensed experienced speech pathologist and a doctor. The risks for the laryngoscope are described as follows from the speech pathologist listed in 5D:

Risks include the risk of mild discomfort, gagging, vasovagal response (drop in blood pressure from over activity of the vagus nerve due to stress) and allergic reaction to the decongestant or numbing agents. Discomfort and gagging will be minimized with use of proper positioning and clear patient instructions, as well as the use of numbing medication. Mild discomfort or gagging occurs in approximately 5-10% of patient cases. There are no psychological or social risks with any part of this study. The research participation will be kept confidential and not part of informal conversation with classmates or music teachers at the subject’s schools. Music teachers will be informed of the research process, but will not be part of the research or have privy to any of the research information in the 10-week duration. After the dissertation is done, music teachers, along with other music professionals and music publications will have access to the research results, but there is no risk to subjects personally since only age and gender at the time of the research will be used in the research report. If underage consent and assent is not obtained, then the researcher will select two more college students to complete the study. For the lessons that happen in the researcher’s home, the parents will be required to be in attendance and the researcher already has a Business Insurance Policy for teaching in the home from State Farm Insurance.

B. Estimate the probability if any (e.g. not likely, likely, etc.) that a given harm may/will occur and its severity: Zero probability because if any sign of discomfort, anxiousness or stress is observed in the subjects, then the research session will stop until, or if, the subject is recovered. Additionally, here are further comments from the speech pathologist listed in 5D: Vasovagal response is very rare; if it does occur, the procedure is discontinued and the patient is reclined and revived with the use of smelling salts as needed. Allergic reactions to medication are also quite rare. These risks will be minimized with review of the patient’s medical history and allergies prior to the exam. There will be a physician on site to manage any complications should they arise.

C. What procedure(s) will be utilized to prevent/minimize any potential risks? See 7A and B. Also, from the speech pathologist in 5D: Vasovagal responses is less than 1% and she has never seen an allergic response to Afrin or tetracaine in 7 years of involvement with scooping procedures.

- **Benefits**
  A. Describe any probable benefits (if any) of the research for the subject(s) (Do not address compensation in this section): Future implications of this project are first intended to help tuba players improve the physical mechanics of playing better tone and timbre and preventing repetitive motion injuries. While the results of this study may turn out to be the same as what was always thought in the brass and vocal pedagogy field, at least a window of broader learning will be available for anyone wanting to pursue the topic further. The goal is to help students use vocal methods for better tuba playing and prevent injury and
most importantly, know how to control those methods for both fields. Another outcome of this study is for voice students to play tuba if they would like because they would know how to control and command the necessary muscles and techniques for excellent performance in both fields without damaging their voices or lips. The resolutions of this project could also be published in the discipline journals both as a conversation starter and as a helpful tool for teachers everywhere to use for their student’s benefit.

B. Describe the benefits to society and general knowledge the study is likely to yield:
The study and application of voice pedagogical methods to tuba playing techniques will result in enhanced posture awareness and consistency, maximum use of lung capacity, better control of the face muscles, release of the tongue to move more freely for articulation, more openness of the pharynx, neck and other muscles surrounding the glottis, freedom to move the lip aperture inside the mouthpiece easier, better use of jaw placement and finally, knowledge for prevention of repetitive motion injury. Many professional tuba players begin to fade their playing out around age 70 and definitely notice a decline in ability. This may be because of traditional brass playing methods they learned as young people. However, the knowledge of voice techniques helping tuba playing could protect individuals from injury and provide decades of tuba playing, possibly well past the current average of about 70 years old. Opening a door of conversation between vocal and tuba pedagogues could provide a basis for improvement of professional tuba playing and possibly of other brass instruments as well. Similarly, when vocalists want to play or teach tuba in the public-school music programs, it will be imperative to know the differences between the two mediums in order to prevent damage to the glottis or lips. Additionally, they will need to know the complex processes of breathing, pharynx and neck openness, tongue and jaw placement and most especially how to control the muscles around the glottis to keep that area free from tension. They will obviously get instruction on voice techniques from their own vocal training; however, most music education vocal majors in the United States are required to take collegiate level brass methods classes and be able to teach students how to play all brass instruments. In the American public school system classroom, that will require demonstration by them—the teacher.

- Financial Information
  A. Is there any internal or external funding or proposed funding for this project? □ Yes □ No
     If yes, funding agency and OSP # (if external funding) (attach grant application)

  B. Are there financial costs to the subjects? □ Yes □ No  If yes, please explain: The laryngoscope procedures are free to the subjects and their families.

  C. Will subjects be paid or otherwise compensated for research participation? □ Yes □ No
     If yes, please respond to the following questions:
     1. Describe the nature of any compensation to subjects (cash, gifts, research credits, etc.): The instruction lessons will be free to the subjects. The clear tuba mouthpieces and any other materials required for the study will be free of charge to the subjects. The laryngoscope procedures are gratis to the subjects and the research courtesy of Ms. Teets.
     2. Provide a dollar amount/research credit amount, if applicable: This would equal $500 each if they were to pay for regular private lesson instruction. The clear tuba mouthpieces would equal $40 each, the Breath Builders equal $20 per person. The Volumetric Exerciser
equals $20 per person and the Inspiron Incentive Spirometer equals $17 per person. These costs are gratis to the subjects.

3. When and how is the compensation provided to the subject? An attendance record will be kept and shown to the subjects. Materials will be distributed at the beginning of the research.

4. Describe partial compensation if the subject does not complete the study: If the subject does not complete the study, no other compensation will be offered other than the free lessons instruction they have already received.

5. If research credit, what is the non-research alternative to research participation? N/A

- **Special Topics**
  - Will the study involve minors? ☒Yes ☐No
  - If yes, complete addendum A
  - Will the study involve prisoners? ☐Yes ☒No
  - If yes, complete addendum B
  - Will the study specifically target pregnant women, fetuses, or neonates? ☒Yes ☐No
  - If yes, complete addendum C
  - Will the study involve FDA regulated drugs (other than the use of approved drugs in the course of medical practice)? ☐Yes ☒No
  - If yes, complete addendum D
  - Will the study involve evaluation of the safety or effectiveness of FDA regulated devices? ☒Yes ☐No
  - If yes, complete addendum E
  - Will false or misleading information be presented to subjects (deception)? ☐Yes ☒No
  - If yes, complete addendum F
  - Will participants be audio or videotaped? ☐Yes ☒No
  - If yes, complete addendum G
  - Will the research involve other potentially vulnerable participants (e.g. disabled or addicted individuals, populations engaging in illegal behavior)? ☒Yes ☐No
  - If yes, complete addendum H
  - Will the research be conducted outside of the United States? ☐Yes ☒No
  - If yes, complete addendum I

- **Investigator Certification**

  I certify that the information provided in this project is correct and that no other procedures will be used in this protocol. I agree to conduct this research as described in the attached supporting documents. I will request and receive approval from the IRB for changes prior to implementing these changes. I will comply with all IRB policies and procedures in the conduct of this research. I will be responsible for ensuring that the work of my co-investigator(s)/student researcher(s) complies with this protocol. I understand that I am ultimately responsible for the entire conduct of this research.
IRB Approval Letter
Office of Research Integrity and Assurance

Research Hall, 4400 University Drive, MS 6D5, Fairfax, Virginia 22030 Phone: 703-993-5445; Fax: 703-993-9590

DATE: March 17, 2016  TO: Brian Wuttke, B.M., M.M. and Ph.D.--all in Music
Education from the University of Miami FROM: George Mason University IRB Project
Title: [859163-1] The Physiological Exploration and Synthesis of Singing Techniques
Applied to Tuba Techniques

SUBMISSION TYPE: New Project  ACTION: APPROVED APPROVAL DATE: March
17, 2016 EXPIRATION DATE: March 16, 2017 REVIEW TYPE: Expedited Review
REVIEW TYPE: Expedited review category #4 & 7

Thank you for your submission of New Project materials for this project. The George
Mason University IRB has APPROVED your submission. This submission has received
Expedited Review based on applicable federal regulations. Please remember that all
research must be conducted as described in the submitted materials. Please remember that
informed consent is a process beginning with a description of the project and insurance of
participant understanding followed by a signed consent form. Informed consent must
continue throughout the project via a dialogue between the researcher and research
participant. Federal regulations require that each participant receives a copy of the
consent document. Please note that any revision to previously approved materials must be
approved by the IRB prior to initiation. Please use the appropriate revision forms for this
procedure. All UNANTICIPATED PROBLEMS involving risks to subjects or others and
SERIOUS and UNEXPECTED adverse events must be reported promptly to the Office
of Research Integrity & Assurance (ORIA). Please use the appropriate reporting forms
for this procedure. All FDA and sponsor reporting requirements should also be followed
(if applicable). All NON-COMPLIANCE issues or COMPLAINTS regarding this project
must be reported promptly to the ORIA. The anniversary date of this study is March 16,
2017. This project requires continuing review by this committee on an annual basis. You
may not collect data beyond this date without prior IRB approval. A continuing review
form must be completed and submitted to the ORIA at least 30 days prior to the
anniversary date or upon completion of this project. Prior to the anniversary date, the
ORIA will send you a reminder regarding continuing review procedures.

Please note that all research records must be retained for a minimum of five years, or as
described in your submission, after the completion of the project. If you have any
questions, please contact Karen Motsinger at 703-993-4208 or kmotsing@gmu.edu.
Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within George Mason University IRB's records.

Email Recruiting Script for Minors
The Physiological Exploration and Synthesis of Vocal Pedagogy Applied to Tuba Techniques By David Porter

Email Script for Recruiting Follow up of Minor Subjects and Their Parents

Dear (name of Family),

This is the email with the written letters and forms that we talked about over the phone on (date). Please take some time and review the forms in detail. We will go over them with more explanation at our first in-person meeting.

Thank you in advance for your time to help me with this amazing adventure. This particular topic has not been researched for tuba and voice combined application, so it is exciting to include you in on a new research project.

If everything looks good to you, let us set up a meeting to review and possibly sign the forms in person. If you have any concerns or changes that need to be made, we can discuss that at our meeting. If there are changes, I will re-send the forms back to you for review before having a signature meeting. I will then have the signatures and forms reviewed by my supervisors before we start the research project. You will get hard copies of the signed forms for your records and if you wish I can send you electronic forms. Please be looking at your calendars for the best times to go to Johns Hopkins for the two laryngoscopes and for our weekly lessons.

Sincerely, David Porter CMSgt (Ret) USAF Band, Washington, DC; DMA Tuba Performance Student and Adjunct Professor Class Brass, Tuba/Euphonium Ensemble, Applied Tuba, Graduate Assistant Green Machine, George Mason University, Fairfax, VA; Principal Tuba, The McLean Orchestra and The National Brass Quintet; Low Brass Teacher, Northern Virginia

IRB: For Official Use Only
Project Number: 859163-1 Date Approved: 3/17/16 Approval Expiration Date: 3/16/17
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Email Recruiting Script for Adults
The Physiological Exploration and Synthesis of Vocal Pedagogy Applied to Tuba Techniques By David Porter

Email Script for Recruiting Follow up of Adults

Dear (name of Family),

This is the email with the written letters and forms that we talked about in person over the phone on (date). Please take some time and review the forms in detail. We will go over them with more explanation at our first in-person meeting.

Thank you in advance for your time to help me with this amazing adventure. This particular topic has not been researched for tuba and voice combined application, so it is exciting to include you in on a new research project.

If everything looks good to you, let us set up a meeting to review and possibly sign the forms in person. If you have any concerns or changes that need to be made, we can discuss that at our meeting. If there are changes, I will re-send the forms back to you for review before having a signature meeting. I will then have the signatures and forms reviewed by my supervisors before we start the research project. You will get hard copies of the signed forms for your records and if you wish I can send you electronic forms. Please be looking at your calendars for the best times to go to Johns Hopkins for the two laryngoscopes and for our weekly lessons.

Sincerely, David Porter
CMSgt (Ret) USAF Band, Washington, DC; DMA Tuba Performance Student and Adjunct Professor Class Brass, Tuba/Euphonium Ensemble, Applied Tuba, Graduate Assistant Green Machine, George Mason University, Fairfax, VA; Principal Tuba, The McLean Orchestra and The National Brass Quintet; Low Brass Teacher, Northern Virginia

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Project Number: 859163-1 Date Approved: 3/17/16 Approval Expiration Date: 3/16/17
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Assent Request
The Physiological Exploration and Synthesis of Vocal Pedagogy Applied to Tuba Techniques By David Porter

ASSENT FORM (Children Aged 12-17)
My name is David Porter and I am from George Mason University, School of Music, Fairfax, VA.

I want you to talk to you about a research study I am doing. In our study, we want to learn more about how vocal techniques can improve tone and timbre for tuba playing and possibly prevent repetitive motion injuries from playing the tuba. Your parents have already agreed that you may take part in the study, so feel free to talk with them about it before you decide whether you want to join the study.

What will happen to me in the study? I would like you to participate because I believe that vocal techniques could help tuba playing in all students and I want to see if this hypothesis helps you also. If you would like to participate in the study, you will be asked to take 10 one hour private lessons which will have voice and traditional tuba playing techniques taught to you by me. The lessons will either be taught at my residence, 8622 Kenilworth Drive, Springfield, VA or at your home. Your parents will be present for all lessons. At the beginning and end of these lessons, you will be measured with a variety of devices in the following areas: posture, breathing, tongue location and shape, throat and neck openness, lip position and openness and jaw placement. During the lessons, we will cover a variety of musical exercises that are designed to cover both vocal and tuba playing techniques as well as work on your graded music material in your school.

What are the risks? I have used all of these devices before (except for the laryngoscopy) and there is no risk to you in these measurements. The only possible discomfort would be from a procedure called laryngoscopy which involves putting a lighted camera down your nose to show your throat while you breathe, sing and play tuba. The laryngoscope will be done by a speech pathologist with seven years’ experience and a doctor will be available if needed. You will get to see the camera images on a video screen. If at any time during these measurements you are uncomfortable and do not want to continue, then you will be allowed to stop the measurements with no questions asked to you. If you decide to begin the measurements again, that will be fine.

What are the benefits? The benefits of vocal techniques helping your tuba playing could help you improve your sound, your posture, breathing, articulation syllable clarity, throat and neck openness and could help
prevent injury which will allow you to play tuba long into later life such as past 70 and 80 years old.

Will anyone know that I am in the study? Besides the measurements, I am collecting audio samples of the measurements and lessons. I am also collecting photos of posture and lip aperture shape and all of the laryngoscope videos, but these will not be identified with your identifying picture. You, your parents, your music teacher and myself are the only ones that will know you are involved. The recordings and measurements will be viewed by professional musician panelists, but only your age and gender will be used to identify the results. Your picture or your name will NOT be used in the research reports.

What if I do not want to participate or decide later to withdraw? Being in this study is voluntary. You don’t have to be in this study if you don’t want to or you can stop being in the study at any time.

Will I receive anything for being in the study? The 10 lessons will be free of charge and no additional lesson will be charged during the two-month study period. Additionally, measurement devices and materials will be provided to you at no charge.

Who can I talk to about this study? If you have questions about the study or have any problems, you can talk to your parents, or call my advisor, Dr. Michael Nickens (mnickens@gmu.edu), or the Faculty Advisor for the research approval, Dr. Brian Wuttke (bwuttke@gmu.edu) both at 703-993-1380. If you have questions about the study but want to talk to someone else who is not a part of the study, you can call the Office of Research Integrity & Assurance at George Mason University at 703-993-4121. Your signature below means that you have read the above information about the study, have had a chance to ask questions to help you understand what you will do in this study, and you are willing to be in the study. Before signing this form, go over in great detail the Informed Consent Form for Minors that I have sent to your parents. Your signature also means that you have been told that you can change your mind later if you want to.

___________________________________________
Child’s Name (printed) and Signature     Date

Parental Informed Consent Request
The Physiological Exploration and Synthesis of Vocal Pedagogy Applied to Tuba Techniques By David Porter PARENTAL INFORMED CONSENT FORM RESEARCH
PROCEDURES This research is being conducted to explore the possibilities of vocal techniques helping tuba playing. If you agree to allow your child to participate, they will become assigned a case study number and only referred to in the research reports by number, age and gender. They will be asked to have an hour lesson each week for 10 weeks. All lessons will be either at my residence, 8622 Kenilworth Drive, Springfield, VA or at your home depending on logistics and scheduling. You will need to be present during all of the lessons. During these lessons, they will be taught both vocal and brass pedagogical methods that have been gleaned to be the most common techniques from the brass and vocal pedagogy fields. At the beginning and end of the research lessons, your child will be measured in the following areas in their singing and tuba playing: posture (with photographs and shadow drawing), tongue location and shape (fiber-optic laryngoscope), pharynx openness—the membrane-lined cavity behind the nose and mouth, connecting them to the esophagus (fiber-optic laryngoscope), throat and neck openness and vocal fold shape (fiber-optic laryngoscope) and last, lip position and aperture openness (clear tuba mouthpiece, photographs and shadow drawing). Each device, except for the laryngoscope, are common devices for brass teachers to have in their studios, do not require doctor approval or application to use them on students and are non-invasive. Your child’s total time for this research is two hours review of forms and letters, two hours of personal meeting time, 10 hours of instruction, 30 hours of individual practice, two hours for measurements at the beginning and end of the research (one hour each end) and eight hours to accomplish two laryngoscope procedures—one at the beginning and one at the end of the research. A grand total of 54 hours of time for the research project is expected for your child. Your personal time as a parent is two hours review of forms and letters, two hours of personal meeting time, 10 hours of instruction, two hours for measurements at the beginning and end of the research (one hour each end) and eight hours to accomplish two laryngoscope procedures—one at the beginning and one at the end of the research. A grand total of 24 hours of time for the research project is expected for you personally.

Posture will be measured with a camera taking a picture of your child’s playing posture. A black and white outline will be drawn of your child’s posture. All photos WILL NOT be used in the research report, but results of posture differences will be described with the drawn outlines.

Tongue Location and Shape will be measured and video photographed with a fiber-optic laryngoscope (see RISK below about laryngoscopes).

Pharynx, Throat and Neck Openness and Vocal Fold Shape will be measured with videos of your child’s pharynx and throat areas using the laryngoscope procedure.
Jaw Placement will be done with photographs and shadow drawings of your child’s jaw position when playing the tuba only at the beginning and end of the ten-week period.

Lip Position and Aperture Openness will be measured with photos of your child’s lips from outside a clear tuba mouthpiece (provided). A black and white outline will be drawn of your lips. These photos WILL NOT be used in the research report, but results of lip aperture shape differences will be described with the drawn outlines.

Breathing will be measured weekly at the lessons with three devices. The Incentive Spirometer, or Inspiron [Inspirx®], is a device used to give respiratory patients a visual demonstration of how much air they can inhale. While this was designed for inhalation, if it is turned upside down, it can also be used for exhalation. There is a gauge to adjust resistance and the Inspiron can also be used in conjunction with tuba mouthpiece practice. Weekly measurements will also happen with a Volumetric Exerciser. The Volumetric Exerciser measures breath capacity in milliliters within a maximum of 5 liters. The subject completes this test by breathing in through a plastic tube connected to the VE, which then activates a plastic piston to rise inside a clear enclosed tube. The subject can visually see the piston move as they inhale and the piston stops when the inhalation is completed thereby showing the measurement from a written scale on the side of the piston tube. Additionally, your child will be given a Breath Builder to help build their inhalation and exhalation muscles. The Breath Builder Isometric Exerciser is a breath training device that uses plastic cylinder with a ping pong ball inside of the tube. The subject blows into a plastic tube attached to the cylinder and raises the ball to the top of the tube. The goal is to keep the ball up whether inhaling or exhaling. Further resistance can be added by putting a finger over two different sized holes in the top of the cylinder. This process builds respiration muscles for either singing or playing a wind instrument.

Tone and Timbre will be measured weekly by having your child sing and play their tuba into a microphone that is connected to a Decibel Meter (volume) and a Spectrum Analyzer (tone and timbre). All measurements will culminate in a recording of tone and timbre through a series of specific music exercises designed to limit the measurements to certain pitches, yet covering the full range of the tuba. The Decibel Meter measures sound volume levels in increments ranging from 50 to 126 decibels. The subject plays the tuba or sings into a microphone on the device. The device then displays a decibel level that is being emitted from the sound the subject is producing. This measurement will allow subjects to visually see the volume they are producing and correlate that
volume recognition through their ears to their brain. The Spectrum Analyzer is a device that measures frequencies of the sound that its microphone picks up. There are two SA’s that will be used, both as apps on an iPhone 6. This process will utilize accurate measurements of the harmonic makeup of each tone produced whether singing or playing the tuba by displaying the frequencies in both bar and line graphs and these measurements can be saved as screen shots and then put into the research documentation. This device will show the differences in tone and timbre for each subject over the ten-week period.

Recordings will be done with a Tonal Tuner iPhone app that makes recordings that are exported as email attachments and a TASCAM DR60D mkII digital recorder with an AKG D112MK2 microphone whose files can be stored on a computer. These can then be saved for listening by the researcher or the advisory panel that will listen to recordings at the end of the 10-week period for comments on the tone and timbre of each subject. Identification of the subjects will NOT be revealed to the panel. All photos will not be used in the written report, but the shadow drawings and descriptions of the photo content will be used for each subject.

RISKS The foreseeable risks or discomforts include practicing new methods of approaching and trying playing the tuba and a little discomfort during the laryngoscope procedure. The new methods will NOT interfere with your child’s ability to perform tuba in their band or music program. The laryngoscope will be take place at Johns Hopkins Outpatient Center/Johns Hopkins Otolaryngology-Head and Neck Surgery. Ms. Kristine Teets, Speech Language Pathologist and Assistant of Otolaryngology-Head and Neck Surgery, Laryngoscope Operator and Administrator, 443-997-6467 or 410-955-1080, Option 2, 601 N. Caroline Street, Baltimore, MD 21287, http://www.hopkinsmedicine.org/otolaryngology/specialty_areas/voice_center/experts.html OR 6420 Rockledge Drive, Suite 4920, Bethesda, MD 20817, 301-896-3330, www.hopkinsmedicine.org/profiles/results/directory/profile/7508680/kristine-teets. The research lessons will be audio taped for researcher study and to document any noticeable differences in tone and timbre. The laryngoscopes will be done at Johns Hopkins Medical Center in Baltimore, MD or at Bethesda, MD and administered and supervised by Ms. Kristine Teets, Speech Pathologist at the JHMC Otolaryngology Department and supervised by a licensed physician on site. For each of the two visits, you and your child...
along with me, the researcher, will make an appointment after 6 pm on a weeknight to go up and have this done. I will drive us as a courtesy to save gas. This procedure involves putting a fiber-optic tube with a camera on the end down the subject’s nose to look at their throat and mouth and vocal folds. They will be awake, in a comfortable seated position, and they will be given the option using Afrin nasal spray and tetracaine numbing agent prior to the procedure to make the procedure more comfortable. This procedure will last approximately 5-10 minutes. Risks include the risk of mild discomfort, gagging, vasovagal response and allergic reaction to decongestant or numbing agents. Discomfort and gagging will be minimized with use of proper positioning and clear patient instructions, as well as the use of numbing medication. Mild discomfort or gagging occurs in approximately 5-10% of patient cases. Vasovagal response (drop in blood pressure from over reaction of the vagus nerve due to stress) is very rare; if it does occur, the procedure is discontinued and the patient is reclined and revived with the use of smelling salts as needed. Allergic reactions to medication are also quite rare. These risks will be minimized with review of the patient’s medical history and allergies prior to the exam. In the seven years Mrs. Teets has been doing laryngoscopes, she has stated that vasovagal responses happen less than one percent in all cases and she has never seen a reaction to Afrin or tetracaine. There will be a physician on site to manage any complications should they arise. There are no psychological or social risks with any part of this study. The research participation will be kept confidential and not part of informal conversation with classmates or music teachers at your school. Your child’s music teacher will be informed of the research process, but will not be part of the research or have

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privy to any of the research information in the 10-week duration. After the dissertation is done, music teachers, along with other music professionals and music publications will have access to the research results, but there is no risk to your child personally since only their age at the time of the research and their gender will be used in the research report.

Neither GMU nor the investigators have funds available for payment of medical treatment for injuries that your child may sustain while participating in this research. Should your child need medical care, you or your insurance carrier will be responsible for payment of the expenses required for medical treatment.

BENEFITS The possible benefits to you and your child include future implications of this project that are first intended to help your child, the tuba player, improve the physical
mechanics of playing better tone and timbre and preventing repetitive motion injuries. Your child and your family will have full access and receive the printed research report. While the results of this study may turn out to be the same as what was always thought in the brass pedagogy field, at least a window of broader learning will be available for anyone wanting to pursue the topic further. The goal is to help students use vocal methods for better tuba playing and prevent injury and most importantly, know how to control those methods for both fields. Another outcome of this study is for voice students to play tuba if they would like because they would know how to control and command the necessary muscles and techniques for excellent performance in both fields without damaging their voices or lips. The resolutions of this project could also be published in the discipline journals both as a conversation starter and as a helpful tool for teachers everywhere to use for their student’s benefit.

CONFIDENTIALITY The data in this study will be confidential. Only age and gender will be used in reporting the research in a dissertation and its supervisors and with any published information of the research results. No other identifiable data will be used about your child from this research. This data method of age and gender will also be the only way the researcher will be able to link the individual results of the research to your child. Although the researcher knows you as an individual, that information will not be written down in the research data, and therefore, not included in the research report.

PARTICIPATION Your child’s participation is voluntary, and you may withdraw your child from the study at any time and for any reason. Individuals with asthma or other respiratory illnesses may not take part in this study. If your child decides not to participate or if they withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party. All materials needed for the research will be provided at no cost to you and your child. The laryngoscope will be an indirect flexible viewing tube that is passed through the nose and guided to the vocal cords, or larynx. Fiber-optic cables permit a physician to directly inspect the nose, throat, and larynx for abnormalities. Laryngoscopy is typically performed in a doctor’s office using local anesthesia. The trips to accomplish the laryngoscope will be four hours each and the procedure will only take about 10 minutes. Please see the attached Patient Education Flexible Laryngoscopy document. There will be no cost to you or your child for this procedure.
DISPOSITION AND STORAGE The ultimate disposition of this material is to accompany the dissertation of the title above, and be used as supportive data for publication of trade journals and articles and in teaching methods of the researcher for tuba students. Only age and gender will be used in reporting the research in a dissertation and its supervisors and with any published information of the research results. The final storage of the research materials will be with the researcher on a Seagate backup drive and copies of the materials will be kept at the GMU School of Music in the researcher’s supervisor’s office, Dr. Michael Nickens, on a separate Seagate backup drive.

CONTACT This research is being conducted by David Porter, School of Music, George Mason University at George Mason University, School of Music, and at Mr. Porter’s residence in Springfield, VA. He may be reached at Cell: 703-598-5977 or Home: 703-593-7982 and Emails: wdaep@aol.com and wporter@gmu.edu for questions or to report a research-related problem. Mr. Porter’s faculty advisor’s name is Dr. Michael Nickens, Director of Athletic Bands and also an Applied Tuba Instructor at GMU (703-993-1380 and mnickens@gmu.edu). You can also call Dr. Brian Wuttke, Faculty Advisor for the research approval at GMU (703-993-1380 and bwuttke@gmu.edu). You may contact the George Mason University Office of Research Integrity & Assurance at 703-993-4121 if you have questions or comments regarding your child’s rights as a participant in the research.

This research has been reviewed according to George Mason University procedures governing your child’s participation in this research.

CONSENT I have read this form, all of my questions have been answered by the research staff, and I agree for my (our) child to participate in this study.

_______________________________________________ Parental Name and Signature
_______________________________________________ Date of Signature
_______________________________________________ Parental Name and Signature
_______________________________________________ Date of Signature

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Adult Informed Consent Request
The Physiological Exploration and Synthesis of Vocal Pedagogy Applied to Tuba Techniques By David Porter ADULT INFORMED CONSENT FORM RESEARCH PROCEDURES This research is being conducted to explore the possibilities of vocal
techniques helping tuba playing. If you agree to participate, you will become assigned a case study number and only referred to in the research reports by number, age and gender. You will be asked to have an hour lesson each week for 10 weeks. These lessons will take place at the George Mason University School of Music. During these lessons, you will be taught both vocal and brass pedagogical methods that have been gleaned to be the most common techniques from the brass and vocal pedagogy fields. At the beginning and end of the research lessons, you will be measured in the following areas of singing and tuba playing: posture (with photographs and shadow drawing), tongue location and shape (fiber-optic laryngoscope), pharynx openness—the membrane-lined cavity behind the nose and mouth, connecting them to the esophagus (fiber-optic laryngoscope), throat and neck openness and vocal fold shape (fiber-optic laryngoscope) and last, lip position and openness (clear tuba mouthpiece, photographs and shadow drawing). Each device, except for the laryngoscope, are common devices for brass teachers to have in their studios, do not require doctor approval or application to use them on students and are non-invasive. Your total time for this research is two hours review of forms and letters, two hours of personal meeting time, 10 hours of instruction, 30 hours of individual practice, two hours for measurements at the beginning and end of the research (one hour each end) and eight hours to accomplish two laryngoscope procedures—one at the beginning and one at the end of the research. A grand total of 54 hours of time for the research project is expected.

Posture will be measured with a camera taking a picture of your playing posture. A black and white outline will be drawn of your posture. All photos WILL NOT be used in the research report, but results of posture differences will be described with the drawn outlines.

Tongue Location and Shape will be measured and video photographed with a fiber-optic laryngoscope (see RISK below about laryngoscopes).

Pharynx Openness and Throat and Neck Openness will be measured with videos of your pharynx and throat areas using the laryngoscope procedure.

Jaw Placement will be done with photographs and shadow drawings of your jaw position when playing the tuba only at the beginning and end of the ten-week period.

Lip Position and Openness will be measured with photos of your lips from outside a clear tuba mouthpiece (provided). A black and white outline will be drawn of your lips. These photos WILL NOT be used in the research report, but results of lip aperture shape differences will be described with the drawn outlines.

Office of Research Integrity & Assurance
Breathing will be measured weekly at the lesson with three devices. The Incentive Spirometer, or Inspiron [Inspirx®], is a device used to give respiratory patients a visual demonstration of how much air they can inhale. While this was designed for inhalation, if it is turned upside down, it can also be used for exhalation. There is a gauge to adjust resistance and the Inspiron can also be used in conjunction with tuba mouthpiece practice. Weekly measurements will also happen with a Volumetric Exerciser. The Volumetric Exerciser measures breath capacity in milliliters within a maximum of 5 liters. The subject completes this test by breathing in through a plastic tube connected to the VE, which then activates a plastic piston to rise inside a clear enclosed tube. The subject can visually see the piston move as they inhale and the piston stops when the inhalation is completed thereby showing the measurement from a written scale on the side of the piston tube. Additionally, you will be given a Breath Builder to help build your inhalation and exhalation muscles. The Breath Builder Isometric Exerciser is a breath training device that uses plastic cylinder with a ping pong ball inside of the tube. The subject blows into a plastic tube attached to the cylinder and raises the ball to the top of the tube. The goal is to keep the ball up whether inhaling or exhaling. Further resistance can be added by putting a finger over two different sized holes in the top of the cylinder. This process builds respiration muscles for either singing or playing a wind instrument.

Tone and Timbre will be measured weekly by having you sing and play your tuba into a microphone that is connected to a Decibel Meter (volume) and a Spectrum Analyzer (tone and timbre). All measurements will culminate in a recording of tone and timbre through a series of specific music exercises designed to limit the measurements to certain pitches, yet covering the full range of the tuba. The Decibel Meter measures sound volume levels in increments ranging from 50 to 126 decibels. The subject plays the tuba or sings into a microphone on the device. The device then displays a decibel level that is being emitted from the sound the subject is producing. This measurement will allow subjects to visually see the volume they are producing and correlate that volume recognition through their ears to their brain. The Spectrum Analyzer is a device that measures frequencies of the sound that its microphone picks up. There are two SA’s that will be used, both as apps on an iPhone 6. This process will utilize accurate measurements of the harmonic makeup of each tone produced whether singing or playing the tuba by displaying the frequencies in both bar and line graphs and these measurements can be saved as screen shots and then put into the research documentation. This device will show the differences in tone and timbre for each subject over the ten-week period.
Recordings will be done with a Tonal Tuner iPhone app that makes recordings that are exported as email attachments and a TASCAM DR60D mkII digital recorder whose files can be stored on a computer. An AKG D112MK2 microphone and two Shure KSM 141 Dual Pattern microphones will be used for sound signal pickup. These files can then be saved for listening by the researcher or the advisory panel that will listen to recordings at the end of the 10-week period for comments on the tone and timbre of each subject. Identification of the subjects will NOT be revealed to the panel. All photos will not be used in the written report, but the shadow drawings and descriptions of the photo content will be used for each subject.

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RISKS The foreseeable risks or discomforts include practicing new methods of approaching and trying playing the tuba and a little discomfort during the laryngoscope procedure. The new methods will NOT interfere with your ability to perform tuba in your band or music program. The laryngoscope will be take place at Johns Hopkins Outpatient Center/Johns Hopkins Otolaryngology-Head and Neck Surgery. Ms. Kristine Teets, Speech Language Pathologist and Assistant of Otolaryngology-Head and Neck Surgery, Laryngoscope Operator and Administrator, 443-997-6467 or 410-955-1080, Option 2, 601 N. Caroline Street, Baltimore, MD 21287, http://www.hopkinsmedicine.org/otolaryngology/specialty_areas/voice_center/experts.html OR 6420 Rockledge Drive, Suite 4920, Bethesda, MD 20817, 301-896-3330, www.hopkinsmedicine.org/profiles/results/directory/profile/7508680/kristine-teets. The research lessons will be audio taped for researcher study and to document any noticeable differences in tone and timbre. The laryngoscopes will be done at Johns Hopkins Medical Center in Baltimore, MD or at Bethesda, MD and administered and supervised by Ms. Kristine Teets, Speech Pathologist at the JHMC Otolaryngology Department and supervised by a licensed physician on site. For each the two visits, you, along with me, the researcher, will make an appointment after 6 pm on a weeknight to go up and have this done. I will drive us as a courtesy to save gas. This procedure involves putting a fiber-optic tube with a camera on the end down the subject’s nose to look at their throat and mouth and vocal folds. You will be awake, in a comfortable seated position, and you will be given the option using Afrin nasal spray and tetracaine numbing agent prior to the procedure to make the procedure more comfortable. This procedure will last approximately 5-10 minutes. Risks include the risk of mild discomfort, gagging, vasovagal response and allergic reaction to decongestant or numbing agents. Discomfort and gagging will be minimized with use of proper positioning and clear patient
instructions, as well as the use of numbing medication. Mild discomfort or gagging occurs in approximately 5-10% of patient cases. Vasovagal response (drop in blood pressure from over reaction of the vagus nerve due to stress) is very rare; if it does occur, the procedure is discontinued and the patient is reclined and revived with the use of smelling salts as needed. Allergic reactions to medication are also quite rare. These risks will be minimized with review of the patient’s medical history and allergies prior to the exam. In the seven years Mrs. Teets has been doing laryngoscopes, she has stated that vasovagal responses happen less than one percent in all cases and she has never seen a reaction to Afrin or tetracaine. There will be a physician on site to manage any complications should they arise. There are no psychological or social risks with any part of this study. The research participation will be kept confidential and not part of informal conversation with classmates or music teachers at your school. Your music teacher will be informed of the research process, but will not be part of the research or have privy to any of the research information in the 10-week duration. After the dissertation is done, music teachers, along with other music professionals and music publications will have access to the research results, but there is no risk to you personally since only your age at the time of the research and your gender will be used in the research report.

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Neither GMU nor the investigators have funds available for payment of medical treatment for injuries that you may sustain while participating in this research. Should you need medical care, you or your insurance carrier will be responsible for payment of the expenses required for medical treatment.

BENEFITS The possible benefits to you include future implications of this project that are first intended to help you, the tuba player, improve the physical mechanics of playing better tone and timbre and preventing repetitive motion injuries. Your will have full access and receive of the printed research report. While the results of this study may turn out to be the same as what was always thought in the brass pedagogy field, at least a window of broader learning will be available for anyone wanting to pursue the topic further. The goal is to help students use vocal methods for better tuba playing and prevent injury and most importantly, know how to control those methods for both fields. Another outcome of this study is for voice students to play tuba if they would like because they would know how to control and command the necessary muscles and techniques for excellent performance in both fields without damaging their voices or lips. The resolutions of this project could also be published in the discipline journals both as a
conversation starter and as a helpful tool for teachers everywhere to use for their student’s benefit.

CONFIDENTIALITY The data in this study will be confidential. Only age and gender will be used in reporting the research in a dissertation and its supervisors and with any published information of the research results. No other identifiable data will be used about you from this research. This data method of age and gender will also be the only way the researcher will be able to link the individual results of the research to you. Although the researcher knows you as an individual, that information will not be written down in the research data, and therefore, not included in the research report.

PARTICIPATION Your participation is voluntary, and you may withdraw from the study at any time and for any reason. Individuals with asthma or other respiratory illnesses may not take part in this study. If you decide not to participate or if you withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party. All materials needed for the research will be provided at no cost to you. The laryngoscope will be an indirect flexible viewing tube that is passed through the nose and guided to the vocal cords, or larynx. Fiber-optic cables permit a physician to directly inspect the nose, throat, and larynx for abnormalities. Laryngoscopy is typically performed in a doctor’s office using local anesthesia. The trips to accomplish the laryngoscope will be four hours each and the procedure will only take about 10 minutes. Please see the attached Patient Education Flexible Laryngoscopy document. There will be no cost to you for this procedure.

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DISPOSITION AND STORAGE The ultimate disposition of this material is to accompany the dissertation of the title above, and be used as supportive data for publication of trade journals and articles and in teaching methods of the researcher for tuba students. Only age and gender will be used in reporting the research in a dissertation and its supervisors and with any published information of the research results. The final storage of the research materials will be with the researcher on a Seagate backup drive and copies of the materials will be kept at the GMU School of Music in the researcher’s supervisor’s office, Dr. Michael Nickens, on a separate Seagate backup drive.

CONTACT This research is being conducted by David Porter, School of Music, George Mason University at George Mason University, School of Music, and at Mr. Porter’s residence in Springfield, VA. He may be reached at Cell: 703-598-5977 or Home: 703-
This research has been reviewed according to George Mason University procedures governing your participation in this research.

CONSENT I have read this form, all of my questions have been answered by the research staff, and I agree to participate in this study.

__________________________ Name __________________________ Date of Signature

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APPENDIX VIII. DEVICES FOR RESEARCH

(Parenthetical Information is where the idea came from, not where it was bought)

Volumetric Exerciser (Song and Wind)

Deep breathing exercise has been shown to be vitally important to your respiratory fitness. Deep breaths are necessary to reach and expand the small air sacs of your lungs. Your VOLDYNE Volumetric Exerciser measures the volume of air you inspire and shows you how effectively you are filling your lungs with each inhalation.

https://www.exmed.net/p-3686-hudson-rci-voldyne-5000-incentive-spirometer.aspx
accessed March 3 2016
Inspiron Incentive Spirometer (Inspiron-Song and Wind)

The incentive spirometer, or Inspiron [Inspirx®], is a device used to give respiratory patients a visual demonstration of how much air they can inhale. While this was designed for inhalation, if it is turned upside down, it can also be used for exhalation. There is a gauge to adjust resistance and the Inspiron can also be used in conjunction with mouthpiece practice.

accessed March 3 2016

Breath Builder (Song and Wind)

1. Hold Breath Builder firmly in hand.
2. Place lips firmly over inhale-exhale tube.
3. Take a deep breath. Completely fill your lungs, your stomach should expand.
4. Blow hard into tube until ball inside cylinder rises to top.
5. When ball is all the way up in the cylinder, immediately inhale hard enough to keep ball at top of cylinder.

When you can do this easily, place index finger over one hole at top of cylinder and repeat the above process.
When you can do this with ease, place your index finger over two holes and repeat. You will find that when you start covering the holes, the exercise gets tougher.
ONE HOLE IN THE CYLINDER MUST ALWAYS BE OPEN!

http://breathbuilder1.tripod.com/id1.html
accessed March 3 2016
Radio Shack Decibel Meter (David Fedderly)

Features used with this Decibel Meter for Research Testing
A and C Weightings—lets you check compliance with safety regulations and make an acoustic analysis.
Slow and Fast Response Settings—let you check peak and average noise levels.

Weighting
Set Weighting to weight the sound measurement for a particular frequency range. When set to A, the meter primarily measure frequencies in the 500-10,000 Hz range, which is the area of greatest sensitivity to the human ear. When set to C, the meter measures uniformly over the frequency range from 32-10,000 Hz giving an indication of the overall sound level.

Response
The Response selector has two settings: Fast and Slow. In the Fast position, the meter reacts quickly to changes in the sound level, showing you the peak sound levels present in the environment. In the Slow position, the meter is damped and indicates an average-value sound level. The effect of brief sound peaks in minimized in the Slow position.

http://support.radioshack.com/support_audio/doc72/72441.pdf
accessed March 3 2016
Tuba Clear Mouthpiece (Porter)

http://www.kellymouthpieces.com/km50/index.asp
accessed January 4 2017

TASCAM DR-60DmkII Portable Recorder (Optimum Audio)

https://www.bhphotovideo.com/images/images2500x2500/tascam_dr_60mkii_portable_recorder_for_dslr_1084690.jpg
accessed January 18 2017

TASCAM DR-70D Portable Recorder (Optimum Audio)

https://www.bhphotovideo.com/images/images2500x2500/tascam_dr_70d_4_channel_audio_recording_1086798.jpg
accessed January 18 2017
Shure KSM 141 Cardioid Stereo Pair (Optimum Audio)

http://smhttp.41820.nexcesscdn.net/8016262/magento/media/catalog/product/cache/1/image/9df78eab33525d08d6e5fb8d27136e95/s/h/shr-ksm141slst_1.jpg
accessed January 18 2017

Spectrum Analyzer by ONYX (GMU Faculty)

http://spectrumanalyzerapp.com/
accessed March 3 2016

Features use with the Spectrum Analyzer for Research Testing

Octave Band RTA (Real-Time Analyzer)

Octave RTA splits the audible range into frequency bands. It supports ISO Octave band from Full to 1/6 Octave. The graphic named Modern mode was used—where the whole spectrum is represented by a colorful analog graph (continuous visible light spectrum from red to violet).
FFT Plot (Fast Fourier Transform)

FFT module plots real-time raw spectrum graph. It is useful for detailed analysis and isolating particular frequencies. Options include FFT Size, Averaging Mode, Logarithmic or Linear Frequency Scale, and FFT Window function (Hamming, Blackman, or Rectangular).

AKG D112 MkII (Dr. Michael Nickens)

accessed January 18 2017
Sony DCR-SR68 Handycam (Porter)

http://c.shld.net/rpx/i/s/i/spin/image/spin_prod_460017701?wid=800&hei=800&op_sharpen=1
accessed January 18 2017
APPENDIX IX. SAMPLE EXERCISE SHEET

Scale Exercises All Subjects
1-whole notes, one note per pitch, two octaves on a major scale ascending
2-half notes, two notes per pitch, two octaves on a major scale descending
3-quarter notes, four notes per pitch, two octaves on a major scale ascending
4-eighth notes, eight notes per pitch, two octaves on a major scale descending
5-triplet notes, twelve notes per pitch, two octaves on a major scale ascending
6-sixteenth notes, sixteen notes per pitch, two octaves on a major scale descending

Melodic Legato and Technical Etudes for each subject age category—singing and playing
middle school subject: Getchell V2, 78, p 8, Legato Portion and Technical Portion
high school subject: Blazhevich 21, p 28, Legato and Blazhevich 1, p 29, 2nd half, Technical
high school subject (euphonium-tenor tuba): Fink 18, p 22, Legato and Blazhevich 67, p 37, Technical
college adult subject: Blazhevich 40, Legato and Cimera 30, p 16, Technical

Sample of Weekly Exercise Assignment

Breath Builder: Keep the ball up at all times
Inhale and Exhale 10X with large plastic tube no holes covered
Inhale and Exhale 10X with large plastic tube and cover one small hole
Inhale and Exhale 10X with large plastic tube and cover the large hole
Inhale and Exhale 10X with large plastic tube and cover one small hole and the large hole

Incentive Spirometer: Gauge set on 4, mouthpiece inserted into tube, device held upside down
- Inhale like on breath builder, but outside of mouthpiece, then buzz into mouthpiece and keep ball at top as long as possible. Let ball drop and repeat. Do this 10X. Start experimenting with different pitches and what it takes with the air to make ball stay up. Ranges-4xLow, 4xMedium, 4xHigh. Do two octave scales and don’t let ball bounce.

Practice Exercises
1-whole notes, one note per pitch, two octaves on a major scale ascending
2-half notes, two notes per pitch, two octaves on a major scale descending
3-quarter notes, four notes per pitch, two octaves on a major scale ascending
4-eighth notes, eight notes per pitch, two octaves on a major scale descending
5-triplet notes, twelve notes per pitch, two octaves on a major scale ascending
6-sixteenth notes, sixteen notes per pitch, two octaves on a major scale descending

Scales
Study Book
Recital Solo
Song for second laryngoscope visit—Jingle Bells—playing and singing
Two Dissertation Exercises
APPENDIX X. RECORDING LOCATION DIMENSIONS

12F
Recording in downstairs family rec room—room has carpet, pool table, other sports equipment and is adjoined to the TV entertainment room. Dimensions were 7.7x23.6x18. Mics were set @6 feet from the bell with height set just above the bell edge.

17F
First Two Weeks
Recording in Subject’s Mom’s hotel family room area where they had to stay for the night. Carpeted and lots of furniture. Dimensions were 23x14x8. Mics @5 feet from the bell with height set just above the bell edge.
Rest of testing period
Recording in Subject’s Mom’s new apartment living room area carpeted with very little furniture. Dimensions were 23x18x18 Cathedral ceiling. Mics @6 feet from the bell with height set just above the bell edge.

17M
Recording in subject’s basement family room—no reverb and room was carpeted with furniture. Dimensions were 7’10”x18’6”x11’9”. Mics were set @5 feet from the bell with height set just above the bell edge.

20M
Recording in Room MTB 2006, GMU—room has tile floor, acoustic tile on walls—grand piano in the room. Dimensions were 14x12.9xwith sloping roof 10’to 11’. Mics were set @6 feet from the bell with height set just above the bell edge
Fourth week
Recording in Room MTB 2009, GMU—room has tile floor, acoustic tile on walls—grand piano in the room. Dimensions were12x9. 9xsloping roof 10’-11’. Mics were set @6 feet from the bell with height set just above the bell edge.

Porter
Recording in researcher’s living room. Room has hardwood floors, furniture, sloped cathedral ceiling. Dimensions 23x17.7’10”x12’ sloping roof. Microphones were anywhere from two feet to 6-7 feet away from bell.
APPENDIX XI. LARYNGOSCOPE EXERCISES

Plans below were followed in the initial approach to the procedure. Singing scales were sometimes a little off pitch with some subjects. Some exercises changed due to ideas happening spontaneously at the procedure.

12F

April 6, 2016 Baltimore, MD
Mouth Scope
Slurred Bb scale from Bb2-Bb4 ascending and descending / Tongued Bb scale from Bb2-Bb4 ascending and descending for both. Rhythm pattern was quarter, then 6 eighths at about 60mm
Laryngoscope
Sing “oh” syllable a Bb scale one octave Bb4-Bb5 ascending and descending
Sing “oh” syllable a Bb scale one octave Bb4-Bb5 ascending and descending hard vocal onsets
Play tuba “oh” syllable a Bb scale two octaves Bb2-Bb4 ascending and descending slurred.
Play tuba “oh” syllable a Bb scale two octaves Bb2-Bb4 ascending and descending tongued.
Play tuba “oh” syllable a flexibility exercise Bb2-F2-Bb3 ascending and descending three times slurred.

Laryngoscope Routine for last week of Wednesday May 25, 2016 Baltimore, MD
subjects hold instruments in lap and mouthpiece ready to go
- dynamics will happen with flow of the exercises -

Time totals (not counting scope setup and insertion and space between each exercise):
  – Subject 12F: (485 seconds) 8.08 minutes

Scope in the side of the mouth (playing the tuba)(scales MM=80)
play three octave Bb scale slurring ascending—goal is to keep tongue down and use thorax exhale muscles to drive the air speed
play three octave Bb scale tonguing descending—medium marcato—goal is to keep tongue coming down to “rest” behind lower front teeth/gum line between each note and keep back of tongue flat—use the tip to articulate the notes
play slurred arpeggio exercise Bb2-F2-Bb3 ascending and descending three times
play tongued arpeggio exercise Bb2-F2-Bb3 ascending and descending three times

Scope in the nasal passage to look at vocal chords (need to get scope as close as possible)(scales MM=80)
subjects will use natural voice they are accustomed to singing with

sing two octave scale starting on G3 to include chest and head voice crossing and mixture on a pitch comfortable for each individual subject (to be determined) slurring ascending—goal is to keep glottis fully visible by opening throat, neck and laryngopharynx areas and to keep thyroarytenoid muscles from closing for each note but only change gradually as the larynx intrinsic muscles adjust the vocal folds for range vibration
sing two octave scale starting on G5 to include chest and head voice crossing and mixture with onsets descending—goal is to keep glottis fully visible by opening throat, neck and laryngopharynx areas and to keep thyroarytenoid muscles keeping glottis open between each onset
free buzz two octave Bb scale slurring ascending using visualizers—goal is to keep glottis in full view without closure of the vocal folds in-between notes
free buzz two octave Bb scale tonguing descending using visualizers—medium marcato—using visualizers—goal is to keep glottis in full view without closure of the vocal folds inbetween notes

play three octave Bb scale slurring ascending—goal is to keep tongue down and use thorax exhale muscles to drive the air speed
play three octave Bb scale tonguing descending—medium marcato—goal is to keep tongue coming down to “rest” behind lower front teeth/gum line between each note and keep back of tongue flat—use the tip to articulate the notes
play slurred arpeggio exercise Bb2-F2-Bb3 ascending and descending three times
play tongued arpeggio exercise Bb2-F2-Bb3 ascending and descending three times

sing Amazing Grace (1 verse) with words starting on C (key of F)—goal is to keep glottis in full view with an open throat and laryngopharynx
buzz Amazing Grace on mouthpiece starting on C (key of F)—goal is to keep glottis in full view with an open throat and laryngopharynx
play Amazing Grace on tuba starting on C (key of F)—goal is to keep glottis in full view with an open throat and laryngopharynx
April 7, 2016 Baltimore, MD
Mouth Scope
Oh syllable: Tongued Bb scale from Bb3-Bb5 ascending and descending. Rhythm pattern was quarter notes at about 72mm
Larynx Scope
Sang “ah” and “oh” Bb scale two octaves Bb4-Bb6 ascending and descending
Sang “ah” and “oh” Bb scale two octaves Bb4-Bb6 ascending and descending hard vocal onset
Played euphonium “oh” syllable a Bb scale two octaves ascending Bb3-Bb5 and three octaves descending Bb5-Bb2 slurred
Played euphonium “oh” syllable a Bb scale two octaves ascending and three octaves descending Bb5-Bb2 tongued
Played euphonium “oh” syllable a flexibility exercise from Bb3-F3-Bb4-F3-Bb3 ascending and descending two times slurred

Laryngoscope Routine for Thursday, May 26, 2016 Bethesda, MD
subjects hold instruments in lap and mouthpiece ready to go

Time totals (not counting scope setup and insertion and space between each exercise):
- Subject 17F: (485 seconds) 8.08 minutes

Scope in the side of the mouth (playing the euphonium)(scales MM=80)
play two octave Bb scale slurring ascending—goal is to keep tongue down and use thorax exhale muscles to drive the air speed.
play three octave Bb scale tonguing descending—medium marcato, then legato—goal is to keep tongue coming down to “rest” behind lower front teeth/gum line between each note and keep back of tongue flat—use the tip to articulate the notes.
play slurred arpeggio exercise Bb3-F3-Bb4 ascending and descending three times
play tongued arpeggio exercise Bb3-F3-Bb4 ascending and descending three times

Scope in the nasal passage to look at vocal chords (need to get scope as close as possible)(scales MM=80)
sing two octave scale to include chest and head voice crossing and mixture on a pitch comfortable for each individual subject (to be determined) slurring ascending starting on F3—goal is to keep glottis fully visible by opening throat, neck and laryngopharynx areas and to keep thyroarytenoid muscles from closing for each note but only change gradually as the larynx intrinsic muscles adjust the vocal folds for range vibration.

250
sing two octave scale to include chest and head voice crossing and mixture with onsets
descending starting on F5—goal is to keep glottis fully visible by opening throat, neck
and laryngopharynx areas and to keep thyroarytenoid muscles keeping glottis open
between each onset.
free buzz two octave F scale slurring ascending using visualizers—goal is to keep glottis
in full view without closure of the vocal folds in-between notes.
free buzz two octave F scale tonguing descending using visualizers—medium marcato,
then legato—goal is to keep glottis in full view without closure of the vocal folds in-
between notes.
play two octave Bb scale slurring ascending—goal is to keep tongue down and use thorax
exhale muscles to drive the air speed.
play three octave Bb scale tonguing descending—medium marcato—goal is to keep
tongue coming down to “rest” behind lower front teeth/gum line between each note and
keep back of tongue flat—use the tip to articulate the notes.
play slurred arpeggio exercise Bb2-F2-Bb3 ascending and descending three times
play tongued arpeggio exercise Bb2-F2-Bb3 ascending and descending three times
sing Good Night Moon with words (30 seconds)—goal is to keep glottis in full view with
an open throat and laryngopharynx.
buzz Good Night Moon on mouthpiece (30 seconds)—goal is to keep glottis in full view
with an open throat and laryngopharynx.
play Good Night Moon on euphonium—goal is to keep glottis in full view with an open
throat and laryngopharynx.

17M

March 29, 2016 Baltimore, MD
Mouth scope
Oh syllable: Tongued Bb scale from Bb2-Bb3 ascending and descending. Rhythm pattern
was quarter, then 6 eighths at about 60mm
Larynx scope
Sang “oh” syllable a Bb scale one octave Bb3 to Bb4 ascending and descending slurred
Sang “oh” syllable a Bb scale one octave Bb3 to Bb4 ascending and descending hard
donsets
Played tuba “oh” syllable a Bb scale one octave from Bb2-Bb3 ascending and descending
slurred
Played tuba “oh” syllable a Bb scale one octave from Bb2-Bb3 ascending and descending
tongued
Played tuba “oh” syllable a Bb scale two octaves from Bb2-Bb4 ascending and
descending tongued

251
Laryngoscope Routine for Tuesday, May 24, 2016 Baltimore, MD

subjects hold instruments in lap and mouthpiece ready to go

Time totals (not counting scope setup and insertion and space between each exercise):
- Subject 17M: (395 seconds) 6.58 minutes

Scope in the side of the mouth (playing the tuba)(scales MM=80)
play two octave Bb slurring ascending—goal is to keep tongue down and use thorax exhale muscles to drive the air speed.
play two octave Bb scale tonguing descending—medium marcato—goal is to keep tongue coming down to “rest” behind lower front teeth/gum line between each note and keep back of tongue flat—use the tip to articulate the notes.
play slurred arpeggio exercise Bb2-F2-Bb3 ascending and descending three times
play tongued arpeggio exercise Bb2-F2-Bb3 ascending and descending three times

Scope in the nasal passage to look at vocal chords (need to get scope as close as possible)(scales MM=80)
subjects will use natural voice they are accustomed to singing with

sing two octave scale on Oh syllable Bb3-Bb5 to include chest and head voice crossing and mixture on a pitch comfortable for each individual subject (to be determined) slurring ascending starting on Bb3—goal is to keep glottis fully visible by opening throat, neck and laryngopharynx areas and to keep thyroarytenoid muscles from closing for each note but only change gradually as the larynx intrinsic muscles adjust the vocal folds for range vibration.
sing two octave scale on Oh syllable to include chest and head voice crossing and mixture with onsets descending starting on Bb5—goal is to keep glottis fully visible by opening throat, neck and laryngopharynx areas and to keep thyroarytenoid muscles keeping glottis open between each onset.
free buzz one octave Bb3-Bb4 scale slurring ascending using visualizers—goal is to keep glottis in full view without closure of the vocal folds in-between notes.
free buzz one octave Bb3-Bb4 scale tonguing descending using visualizers—medium marcato—using visualizers—goal is to keep glottis in full view without closure of the vocal folds in-between notes.
play on tuba two octave Bb scale slurring ascending—goal is to keep tongue down and use thorax exhale muscles to drive the air speed.
play on tuba two octave Bb scale tonguing descending—medium marcato—goal is to keep tongue coming down to “rest” behind lower front teeth/gum line between each note and keep back of tongue flat—use the tip to articulate the notes.
play slurred arpeggio exercise Bb2-F2-Bb3 ascending and descending three times
play tongued arpeggio exercise Bb2-F2-Bb3 ascending and descending three times
sing Jingle Bells with words starting on D3—goal is to keep glottis in full view with an open throat and laryngopharynx.
buzz Jingle Bells on mouthpiece starting on D3—goal is to keep glottis in full view with an open throat and laryngopharynx.
play Jingle Bells on tuba starting on D3—goal is to keep glottis in full view with an open throat and laryngopharynx.

20M

April 8, 2016 Baltimore, MD
Mouth scope
Played C scale three octaves from C2-C4 ascending and C4-C1 descending. Rhythm pattern was quarter notes at about 60 mm.
Larynx scope
Sang “oh” syllable a Bb scale from Bb3-Bb5 ascending and descending slurred
Sang “oh” syllable a Bb scale from Bb3-Bb5 ascending and descending hard vocal onsets
Played tuba “oh” syllable a C scale from C2-C4 ascending and C4-C1 descending slurred
Played tuba “oh” syllable a C scale from C2-C4 ascending and C4-C1 descending tongued
Played tuba “oh” syllable an arpeggio from C2-G2-C3 three times slurred

Laryngoscope Routine for Monday, May 23, 2016 Bethesda, MD
subjects hold instruments in lap and mouthpiece ready to go

Time totals (not counting scope setup and insertion and space between each exercise):
  - Subject 20M: (573 seconds) 9.55 minutes

Scope in the side of the mouth (playing the tuba and euphonium)(scales MM=80)
play three octave C scale slurring ascending—goal is to keep tongue down and use thorax exhale muscles to drive the air speed.
play three octave C scale tonguing descending—medium marcato—goal is to keep tongue coming down to “rest” behind lower front teeth/gum line between each note and keep back of tongue flat—use the tip to articulate the notes.
play slurred arpeggio exercise C2-G2-C2-E2-G3-E2-C2-G2-C1 ascending and descending two times
play tongued arpeggio exercise C2-G2-C2-E2-G3-E2-C2-G2-C1 ascending and descending two times
Subject 20M will do a three octave F scale (MM=160) doing multiple tonguing—triple ascending and double descending versions

Scope in the nasal passage to look at vocal chords (need to get scope as close as
possible)(scales MM=80)
subjects will use natural voice they are accustomed to singing with

ing two octave scale oh syllable to include chest and head voice crossing and mixture on
a pitch comfortable for each individual subject (to be determined) slurring ascending
starting on C—goal is to keep glottis fully visible by opening throat, neck and
laryngopharynx areas and to keep thyroarytenoid muscles from closing for each note but
only change gradually as the larynx intrinsic muscles adjust the vocal folds for range
vibration.

ing two octave scale oh syllable to include chest and head voice crossing and mixture
with onsets descending starting on C—goal is to keep glottis fully visible by opening
throat, neck and laryngopharynx areas and to keep thyroarytenoid muscles keeping glottis
open between each onset.
free buzz two octave C scale slurring ascending using visualizers—goal is to keep glottis
in full view without closure of the vocal folds in-between notes. Subject couldn’t see
video screen
free buzz two octave C scale tonguing descending using visualizers—medium marcato—
goal is to keep glottis in full view without closure of the vocal folds in-between notes.
play three octave C scale slurring ascending—goal is to keep tongue down and use thorax
exhale muscles to drive the air speed.
play three octave C scale tonguing descending—medium marcato—goal is to keep
tongue coming down to “rest” behind lower front teeth/gum line between each note and
keep back of tongue flat—use the tip to articulate the notes.
play slurred arpeggio exercise C2-G2-C2-E2-G3-E2-C2-G2-C1 ascending and
descending two times
play tongued arpeggio exercise C2-G2-C2-E2-G3-E2-C2-G2-C1 ascending and
descending two times
Subject 20M will do a three octave F scale (MM=160) doing multiple tonguing—triple
ascending and double descending versions
sing “Wher’er” with words starting on G—goal is to keep glottis in full view with an
open throat and laryngopharynx.
Buzz “Wher’er” on mouthpiece starting on G—goal is to keep glottis in full view with an
open throat and laryngopharynx.
play “Wher’er” on tuba starting on G—goal is to keep glottis in full view with an open
throat and laryngopharynx.
Porter

April 6, 2016 Baltimore, MD
Mouth scope tuba
Slurred C scale from C2-C5 ascending and C5-C1 descending / Tongued C scale from C2-C5 ascending and C5-C1 descending. Rhythm pattern was eighth and sixteenth pattern at about 72 mm until the last low octave where the pattern slowed down.
Mouth scope euphonium
Slurred Bb scale from Bb3-Bb5 ascending and Bb5-Bb2 descending / Tongued Bb scale from Bb3-Bb5 ascending and Bb5-Bb2 descending. Rhythm pattern was eighth and sixteenth pattern at about 72 mm until the last low octave where the pattern slowed down
Larynx scope singing
Sang “oh” syllable a Bb scale one octave Bb3-C4 ascending and descending slurred
Sang “Ee” syllable a Bb scale one octave Bb3-Bb4 ascending and descending slurred because glottis was so closed that pathologist could not see the vocal cords
Sang “oh” syllable a Bb scale one octave Bb3-Bb4 ascending and descending hard vocal onsets

Larynx scope tuba
Played tuba: Slurred C scale from C2-C5 ascending and C5-C1 descending / Tongued C scale from C2-C5 ascending and C5-C1 descending / Flexibility Exercise—C2-G2-C3 ascending and descending three times / Flexibility Exercise—G2-C3-G2-E3-C3-G3-E3-C3 three times and ending on C2

Larynx scope euphonium
Played euphonium: Slurred Bb scale from Bb3-Bb5 ascending and Bb5-Bb2-F1 descending / Tongued Bb scale from Bb3-Bb5 ascending and Bb5-Bb2-F1 descending / Flexibility Exercise—Bb3-F3-Bb4 ascending and descending three times / Flexibility Exercise—F3-Bb4-F3-D4-Bb4-F4-D4-Bb4 three times and ending on Bb2

Laryngoscope Routine for Wednesday May, 25 2016 Baltimore, MD
Take microphone to record the sound from “outside” the laryngoscope—pre-assemble microphone stand to carry up to testing area; subjects hold instruments in lap and mouthpiece ready to go
- dynamics will happen with flow of the exercises -

Time totals (not counting scope setup and insertion and space between each exercise):
- Subject 17M: (395 seconds) 6.58 minutes
- Subject 12F and 17F: (485 seconds) 8.08 minutes
- Subject 20M: (573 seconds) 9.55 minutes
- Researcher: (1,450 seconds) 24.17 minutes
Scope in the side of the mouth (playing the tuba and euphonium)(scales MM=80)
play 3.5 octave Bb euphonium scale and five octave C tuba scale slurring ascending—
goal is to keep tongue down and use thorax exhale muscles to drive the air speed
play 3.5 octave Bb euphonium scale and five octave C tuba scale tonguing descending—
medium marcato—goal is to keep tongue coming down to “rest” behind lower front


teeth/gum line between each note and keep back of tongue flat—use the tip to articulate
the notes
play 3.5 tuba octave scale and 2.5 euphonium octave scale (MM=160) doing multiple
tonguing— triple ascending and double descending versions both tuba and euphonium
play slurred arpeggio flexibility exercise on tuba—C2-E2-G2-E2-C2-G1-C2-E2-G2-C3-
G2-E2-C2-E2-G2-E2-C3-G2-E2-G2-C2one time and ending on C2 for tuba
play tongued arpeggio flexibility exercise on tuba— C2-E2-G2-E2-C2-G1-C2-E2-G2-
C3-G2-E2-C2-E2-G2-C3-G2-E2-G2-C2one time and ending on C2 for tuba
play slurred flexibility exercise on euphonium—Bb2-D2-F3-D2-Bb2-F2-Bb2-D2-F3-
Bb3-F3-D2-Bb2-D2-F3-D2-Bb3-F3-D2-Bb2—one time and ending on Bb2
play tongued flexibility exercise on euphonium—Bb2-D2-F3-D2-Bb2-F2-Bb2-D2-F3-
Bb3-F3-D2-Bb2-D2-F3-D2-Bb3-F3-D2-F3-Bb2 one time and ending on Bb2
play slurred octaves flexibility ascending and descending on G scale tuba and F scale
euphonium
play tongued octaves flexibility ascending and descending on G scale tuba and F scale
euphonium

Scope in the nasal passage to look at vocal chords (need to get scope as close as
possible)(scales MM=80)

researcher will do singing scales and song twice—once with imitation of “operatic” voice
and once with imitation of “pop” voice

sing two octave scale starting on C3 with an “oh” syllable to include chest and head voice
crossing and mixture on a pitch comfortable for each individual subject (to be
determined) slurring ascending—goal is to keep glottis fully visible by opening throat,
neck and laryngopharynx areas and to keep thyroarytenoid muscles from closing for each
note but only change gradually as the larynx intrinsic muscles adjust the vocal folds for
range vibration
sing two octave scale starting on C5 with an “oh” syllable to include chest and head voice
crossing and mixture with onsets descending—goal is to keep glottis fully visible by
opening throat, neck and laryngopharynx areas and to keep thyroarytenoid muscles
keeping glottis open between each onset
free buzz two octave Bb euphonium scale and three octave C tuba scale slurring
ascending using visualizers—goal is to keep glottis in full view without closure of the
vocal folds in between notes
free buzz two octave Bb euphonium scale and three octave C tuba scale tonguing descending using visualizers—medium marcato—goal is to keep glottis in full view without closure of the vocal folds in-between notes
Play 3.5 octave Bb scale on euphonium and five octave G scale on tuba slurring ascending—goal is to keep tongue down and use thorax exhale muscles to drive the air speed.
Play 3.5 octave Bb scale on euphonium and five octave G scale on tuba tonguing descending—medium marcato—goal is to keep tongue coming down to “rest” behind lower front teeth/gum line between each note and keep back of tongue flat—use the tip to articulate the notes
play slurred arpeggio flexibility exercise—C2-E2-G2-E2-C2-G1-C2-E2-G2-C3-G2-E2-C2-E2-G2-E2-C3-G2-E2-G2-C2 one time and ending on C2 for tuba
play tongued arpeggio flexibility exercise—C2-E2-G2-E2-C2-G1-C2-E2-G2-C3-G2-E2-C2-E2-G2-E2-C3-G2-E2-G2-C2 one time and ending on C2 for tuba
play slurred flexibility exercise—Bb2-D2-F3-D2-Bb2-F2-Bb2-D2-F3-Bb3-F3-D2-Bb2-D2-F3-D2-Bb3-F3-D2-F3-Bb2 one time and ending on Bb2 for euphonium
play tongued flexibility exercise—Bb2-D2-F3-D2-Bb2-F2-Bb2-D2-F3-Bb3-F3-D2-Bb2-D2-F3-D2-Bb3-F3-D2-F3-Bb2 one time and ending on Bb2 for euphonium
play 3.5 octave tuba scale and 2.5 octave euphonium scale (MM=160) doing multiple tonguing—triple ascending and double descending versions both tuba and euphonium
play slurred octaves flexibility ascending and descending on G scale tuba and F scale euphonium and also C tuba scale and Bb euphonium scale
play tongued octaves flexibility ascending and descending on G scale tuba and F scale euphonium and also C tuba scale and Bb euphonium scale
sing It Is Well (1 verse) starting on G3 with words once with pop voice and once classical voice—goal is to keep glottis in full view with an open throat and laryngopharynx.
buzz It Is Well (1 verse) starting on G2 and G3 mouthpiece—goal is to keep glottis in full view with an open throat and laryngopharynx
play It Is Well (1 verse) starting on G2 and G3 on tuba and G2 and G3 on euphonium—goal is to keep glottis in full view with an open throat and laryngopharynx
APPENDIX XII. FIBER-OPTIC INSERTION PICTURES

Porter 9-26 17

Read Left to right, top to bottom—Laryngoscope path going to the vocal folds

1-4 entrance into the left nostril

5-8 Entrance into the naso-pharynx, past the nasal septum (left side #1) and turbinates (right side #2), and then down into the top of the oro-pharynx\(^{186}\)

9-11 Travel past the adenoids, then the torus taubarius (opening to the eustachian tube)\textsuperscript{187}

12-15 Journey ends when the fiber-optic scope is just above the vocal cords

APPENDIX XIII. INSTRUMENTS AND MOUTHPIECES

12F
4/4 Yamaha Four Valve Piston Upright BBb Lacquered Tuba and a Bach 24AW mouthpiece

17F
Besson Sovereign BBb967 Silver 4 valve Compensating and a Giddings &Webster Danny Helseth Solo Model Euphonium Mouthpiece

17M
4/4 Yamaha Rotary Valve #641 BBb Lacquered Tuba and a PT50 mouthpiece

20M
Hirsbrunner HP6, 5/4 CC, 5 rotary valve, Silver Tuba and a Doug Elliot TU126 Mouthpiece

Porter
B&S PT-4 4/4 CC 5V rotary silver tuba for tuba playing samples and a Loud Mouthpiece

LM-7
Mack Brass Silver Euphonium EU1150 Compensating for euphonium playing samples and a Giddings &Webster Danny Helseth Solo Model Euphonium Mouthpiece
APPENDIX XIV. LARYNGOSCOPE PROCESS PICTURES

Fiber-optic Laryngoscope

https://www.google.com/search?q=fiber+optic+laryngoscope+images&espv=2&biw=1226&bih=651&tbm=isch&imgil=GeHrr6OM7ji--M%253A%253Bm_Lmp0AiVhJqZM%253Bhttp%25253A%25252F%25252Fwww.olym
mpus.co.nz%25252FProduct%25252FDetail%25252F57%25252FENF-XP-Pediatric-
Fiber-optic-RhinoLaryngoscope&source=iu&pf=m&fir=GeHrr6OM7ji--M%253A%25252FProduct%25252FDetail%25252F57%25252FENF-XP-Pediatric-
Fiber-optic-RhinoLaryngoscope&source=iu&pf=m&fir=GeHrr6OM7ji--
accessed May 5 2016
Fiber Optic Image Process

accessed January 4 2017

Flexible Fiberoptic Laryngoscopy
The nose is numbed with a topical nasal spray and then a small fiberoptic scope is passed down through the nose which allows for complete visualization of the larynx (voice box)

Normal

- Vestibular fold (ventricle)
- True vocal cords
- Trachea
- Esophagus
David Porter Fiber-Optic Process, April 6 2016. 1-Ready to be scoped; hanker chief is for drainage from nose if needed (picture 1). 2-a local anesthetic is applied to the nostril that is most clear for the fiber optic laryngoscope (picture 2).

3-the scope is put into the mouth to measure what the tongue is doing (picture 1). The side chosen was always whichever was closest to the pathologist and the fiber optic scope. 4-the video screen in the second picture shows a successful mouth insertion (picture 2).
5-Next, playing on tuba and euphonium was executed for video recording the tongue shape and movement. Picture 1-Side view tuba. Picture 2-Front view tuba. Picture 3-Front view euphonium

6-Next, the fiber optic scope was inserted into the right nostril. Again, the nostril that was the clearest for each test subject was used each time. The pathologist had us sniff each nostril to determine which one had the best air flow which also meant that the scope would pass more freely down the nasal passage.
Tuba front view

Tuba side view

Euphonium front view
APPENDIX XV. POSTURE MEASUREMENTS

Shadow drawings are intentionally rough to protect subject identity, but allow visual observation of posture differences in head position (forward or back), head tilt (down or up), neck curve (rounded or straight) and shoulder placement (slouched or straight).

12F Posture No Tuba 4-10-16 / 6-16-16

- Head forward & tilted up
- Neck curved forward
- Shoulders slouched & rounded

- Head more back over body axis balanced on AO joint & tilted more level
- Neck curve more aligned over body vertical axis
- Shoulders straighter & aligned with body vertical axis
12F Posture with Tuba 4-10-16 / 6-16-16

(the reaching up for 4-10-16 was not because the subject could not reach the tuba—it was just the way she perceived playing the tuba)

17F Posture No Euphonium 4-17-16 / 6-15-16

(subject was already a vocal student so beginning posture was actually better because of her vocal awareness)
17F with Euphonium 4-17-16 / 6-15-16

No perceptible change in head, neck or shoulder position due to vocal posture awareness

Better 90-degree mouthpiece angle

17M No Tuba 4-4-16 / 6-7-16

Head tilted down & forward

Neck curved forward & down

Shoulders rounded & slouched

Head more erect & level on Atlanto-occipital (AO) joint

Neck straighter and supporting head

Shoulders more straight keeping chest up
17M with Tuba 4-4-16 / 6-7-16

(the 4-4-16 drawing looks skewed because the flashlight was shining at a sharp angle due to the location tried in the subject’s home compared to the improved image for 6-7-16; the slouch of the shoulders and head tilted down is still prevalent on the 4-4-16 image; note: subject does not have naturally slumped shoulders)

20M Posture No Tuba 4-8-16 / 6-7-16
**20M Posture with Tuba 4-8-16 / 6-7-16**

Head turned down to tuba
- Neck curved forward; crimping front of neck
- Shoulders sloped forward

Head erect & in alignment over AO joint
- Neck curve under head & supportive; front of neck angle better
- Shoulders still rounded but not as much

**Porter Posture No Tuba 4-12-16 / 6-16-16**

Head tilted far up
- Neck curved up to follow head
- Shoulders held back past body vertical axis alignment

Head more level although a little forward; airway more open
- Neck curved forward to stay under head
- Shoulders a little slouched
Porter Posture with Tuba 4-12-16 / 6-16-16

Head aligned over AO joint but whole top half of body leaning forward

Neck curve aligned but forward with top half of body

Shoulders a little slouched

Head more level to promote 90-degree angle to mouthpiece

Neck curve more supportive of head

Shoulders straight but leaning forward with top half of body
APPENDIX XVI. VOLUMETRIC MEASUREMENTS

(Zero numbers had no measurement taken that week due to source review or illnesses)
APPENDIX XVII. INSPIRON MEASUREMENTS

(Zero numbers had no measurement taken that week due to source review or illnesses)
17M Inspiron Chart

Gauge Number vs. Lesson Dates

20M Inspiron Chart

Gauge Number vs. Lesson Dates

Porter Inspiron Chart

Gauge Number vs. Measurement Dates
APPENDIX XVIII. TONGUE SHAPE AND MOVEMENT

Tongue shape and placement, tip of tongue position, lip position, teeth width

12F Tongue Shape and Movement

4-6-16
Bb2 Tongue forward but a little high; tip of tongue forward but a little behind lower gum line; lower lip turned out; teeth almost a little finger’s width apart
Bb3 Tongue a little further back, still a little high; tip of tongue a little further back; lower lip beginning to turn in; teeth still wide
Bb4 Tongue a little higher; back of tongue arched; tip of tongue back well behind lower gum line; lower lip turned in; teeth more closed

5-25-16
Bb1 Tongue forward but very arched—student is trying to get air to move faster—still some training to do for making the air slower; tip of tongue up against the bottom gum line; both lips turned out and fluffy; teeth very far apart
Bb2 Tongue somewhat arched but lower than 4-6-16; tip of tongue up against the bottom gum line; bottom lip turned out the same; teeth wider than 4-6-16
Bb3 Tongue still arched and going back a little; tip starting to pull away from bottom gum line; bottom lip curled inward; teeth width good
Bb4 Tongue still arched but not as high; tip of tongue well back away from bottom gum line, more than 4-6-16; bottom lip turned in; teeth more closed than lower octaves but more open than 4-6-16
17F Tongue Shape and Movement

4-7-16
Bb2 Tongue well back behind bottom gum line to the back molars; tip of tongue curled up; teeth not quite a little finger’s width apart; lips turned out
Bb3 Tongue a little farther forward, but still back of gum line and tip curled up; teeth almost closed; lips still turned out
Bb4 Tongue pulled very far back; tip curled up; bottom lip starting to come in; teeth a little wider
Bb5 Tongue almost back as far as Bb2 and tip curled up; teeth same width as Bb2; bottom lip pulled in
5-26-16
Bb2 Tongue a little farther forward than 4-7-16, but tip is now curled down and more level; teeth not quite a little finger’s width apart; lips turned out
Bb3 Tongue up and back a little farther than Bb2 5-26-16, tip is turned up; teeth a little farther apart than Bb3 from 4-7-16; lips are turned out
Bb4 Tongue still bunched up but lower than 4-7-16; tip is curled under; bottom lip curled inward but not as much as 4-7-16; teeth width about the same
Bb5 Tongue arched and back, but tip is curled down—more typical of high range air funneling; teeth about the same as Bb5, 4-7-16; bottom lip curled in but not as far as 4-7-16—this may indicate that subject had more strength in the lips by 5-26-16
17M Tongue Shape and Movement

3-29-16 (only played one octave scale for first test)
Bb2 Tongue curled underneath itself and pulled back very far to molars; tip of tongue almost underneath the tongue; lips turned out; teeth almost a little finger’s width apart
Bb3 Tongue a little flatter and forward; tip of tongue almost to bottom gum line; lips turned out; teeth a little more closed

Bb2

Bb3

5-24-16
Bb2 Tongue shape a little flatter and not as balled up; tip of tongue elevated but reaching towards bottom gum line; lips turned out; teeth a full little finger’s width apart
Bb3 Tongue curled and arched; tip of tongue pointing down but closer to bottom gum line; bottom lip turned in a little; teeth further apart than on 3-29-16
Bb4 Tongue flatter and furled; tip of tongue pointing forward and almost touching bottom gum line; bottom lip pulled inward; teeth further apart than for Bb3

Bb2

Bb3

Bb4
20M Tongue Shape and Placement

4-8-16
C1 Tongue bunched back resting right before molars; tip of tongue pointing down; lips turned out; teeth a little finger’s width apart
C2 Tongue still bunched up and arched but a little farther forward; tip of tongue still pointing down; bottom lip starting to come inward; teeth still wide apart
C3 Tongue a little flatter, still arched; tip of tongue a little farther forward; bottom lip same place as C2; teeth still wide apart
C4 Tongue arched very high; tip elevated off of floor of mouth and not close to bottom gum line; bottom lip curled inward; teeth still wide though

5-23-16
C1 Tongue is flatter and not as bunched; tip is laying more in the floor of the mouth closer to bottom gum line; lips turned out and very visible due to teeth being very far apart
C2 Tongue is flatter still showing less of the gum; tip is resting at bottom gum line; bottom lip is still out; teeth wide apart again
C3 Tongue still flatter than 4-8-16; tip is resting at gum line; bottom lip a little inward; teeth still wide apart
C4 Tongue arched; tip pulled back from bottom gum line; bottom lip pulled very far inward; teeth still wide but slightly more closed than C3
Porter Tuba Tongue Shape and Placement

4-6-16
C1 Tongue is bunched in an arch and pulled back; tip is curled under; lips are turned out; teeth are very wide even though can’t be seen in the picture
C2 Tongue is not as arched and moving forward; tip is moving towards bottom gum line; lips are visible; teeth still wide
C3 Tongue is flat and furrowed; tip is touching bottom gum line all the way around the mouth (Petropoulos); lips are visible but not out or in; teeth apart, but not a lot
C4 Tongue still flat but rising; tip is still on bottom gum line; lips more inward; teeth closed more but still same width as C3
C5 Tongue pushed all the way up into front of mouth; tip is curled under and touching bottom gum line; lips are pulled inward even though can’t be seen; teeth are apart, but not a lot
5-25-16
G -1 Tongue very arched forward; tip touching bottom gum line; lips turned out and loose; teeth not as wide as G1
G1 Tongue arched forward; tip touching bottom gum line; lips are turned out; teeth very far apart
G2 Tongue flat and furrowed; tip touching bottom gum line; lips pulled inward a little but ok; teeth a little more closed
G3 Tongue arched some but as flat as C3 on 4-6-16; tip is touching bottom gum line all the way around the mouth; bottom lip starting to pull inward; teeth apart but not a lot
G4 Tongue is flat and slightly back; tip is pushed against the bottom gum line; bottom lip is curled inward; teeth slightly more closed than G3
G5 Tongue is completely blocking front of mouth; tip is up above the bottom gum line touching top of bottom teeth (not seen); lips are curled inward (not seen); teeth are open (not seen)
Porter Euphonium Tongue Shape and Placement

4-6-16

Bb2 Tongue bunched and arched but forward; tip is almost touching bottom gum line; lips are turned out; teeth are little finger’s width apart

Bb3 Tongue flat and forward; tip touching bottom gum line all the way around the mouth; bottom lip pulling inward; teeth apart but not much

Bb4 Tongue flatter flat; tip touching the bottom gum line all the way around; bottom lip curled inward a little more; teeth just as wide ad Bb3

Bb5 Tongue arched and bunched like the Bb2 but more forward; tip is touching bottom gum line; lips are curled inward; teeth a little wider than Bb3
5-25-16
Bb2 Tongue is arched some but flatter than 4-6-16; tip is in same place as 4-6-16 almost touching bottom gum line; lips are turned out; teeth are little finger’s width apart
Bb3 Tongue is arched higher than 4-6-16; tip is in full contact with bottom gum line all the way around the mouth; lips not curled inward yet (shows improvement in strength); teeth about the same distance apart as Bb2 (airflow better)
Bb4 Tongue arched; tip curled under more than B3; bottom lip curled and visible same as 4-6-16; teeth width slightly more closed than 4-6-16
Bb5 Tongue is fully arched and filling mouth cavity; tip is turned down in contact with bottom gum line; lips are still not curled inward but bottom lip is pulled inward some; teeth still apart

Bb2

Bb3

Bb4

Bb5
APPENDIX XVIX. GLOTTIS ACTIVITY SINGING

“Oh” syllable being sung; epiglottis position; vocal folds’ position; arytenoids position; pharyngeal walls position

12F

- very good anterior epiglottis position for inhaling
- somewhat posterior position for first measurement and very far towards posterior for second measurement
- of course, the folds were adducted for phonation of the folds in both measurements
- arytenoids curled over her folds for singing for both measurements making them almost invisible from supraglottis constriction for the second measurement (more pronounced for higher notes than lower
- pharyngeal walls closed but more so for second measurement

4-6-16
Singing Inhale
Singing Bb4
Singing Bb5
5-25-16
Singing Inhale

Singing F3

Singing F4

Singing F5
very good anterior position of the epiglottis for inhaling and singing in both measurements
- vocal folds were clearly in view even for her highest sung notes
- arytenoids were in good position for singing well
- pharyngeal walls held away from the glottis, but were better for the second measurement than the first

4-7-16
Singing Inhale

Singing Bb4

Singing Bb5

Singing Bb6

5-26-16
Singing Inhale

Singing C4
very good epiglottis and larynx openness for all measurements while inhaling
singing in the first measurement, however, he quickly moved the epiglottis
towards the posterior
folds almost disappeared from supraglottis constriction
arytenoids completely disappeared
and the pharyngeal walls constricted dramatically
second singing measurement was markedly improved with anterior epiglottis
position
vocal folds and arytenoids in full view
pharyngeal walls were more open than the first measurement, but still constricted
which gave 17M a tight sounding voice when singing

3-29-16
Singing Inhale  Singing Bb3  Singing Bb4
- fantastic epiglottis anterior position for all inhales of singing and playing
- first measurement singing quickly brought the epiglottis towards the posterior along with his tongue, although it improved a little more towards the anterior for the second measurement
- first measurement vocal folds were tense with the arytenoids pulling over them, but was better in the second measurement; arytenoids still up over the folds obstructing them and the airflow
- pharyngeal walls drawn in almost covering the glottis for singing which cause the pathologist to force the fiber-optic scope down a little further to get a view of them

4-8-16
Singing Inhale
Singing Bb3
Singing Bb4
Singing Bb5
Porter

- good openness on the inhales for both singing and playing  
- singing went downhill with posterior epiglottis, vocal folds constricted, arytenoids pulled over the folds and the pharyngeal walls pulled closed around the structures  
- some improvement in the second measurement to the point that the folds could be seen with a little better openness from the epiglottis and arytenoids
APPENDIX XX. GLOTTIS ACTIVITY BUZZING

12F

- about the same for buzzing and playing—pharyngeal walls stayed open and glottis stayed abducted

5-25-16
Buzzing Inhale

Buzzing Slurred Bb2  Buzzing Slurred Bb3  Buzzing Slurred Bb4
Buzzing Tongued, Bb2  Buzzing Tongued Bb3  Buzzing Tongued Bb4
- being a trained vocalist, had better opening of pharyngeal walls while singing, but her buzzing was much more open and folds somewhat abducted than her actual playing on euphonium; therefore, the future training will be her taking the action of the singing and buzzing larynx and applying that to her playing.

5-26-16
Buzzing Inhale

Buzzing Slurred F2
Buzzing Slurred F3
Buzzed Slurred F4

Buzzing Tongued F2
Buzzing Tongued F3
Buzzing Tongued F4
17M

- slightly more open pharyngeal walls for buzzing—folds slightly abducted

5-24-16
Buzzing Inhale

Buzzing Slurred Bb2
Buzzing Slurred Bb3
Buzzing Slurred Bb4

Buzzing Tongued Bb2
Buzzing Tongued Bb3
Buzzing Tongued Bb4
- about the same for buzzing and playing—pharyngeal walls stayed open and glottis stayed abducted

5-23-16
Buzzing Inhale

Buzzing Slurring C2  Buzzing Slurring C3  Buzzing Slurring C4

Buzzing Tongued C2  Buzzing Tongued C3  Buzzing Tongued C4

Porter

- researcher had more open pharyngeal walls for buzzing than for playing; folds somewhat abducted; like 17F, the researcher will benefit from taking the action of buzzing into the tuba playing for better airflow and openness and less tension of the larynx

5-25-16
Buzzing Inhale
APPENDIX XXI. GLOTTIS ACTIVITY PLAYING

12F

- very good anterior epiglottis position for inhaling
- very anterior epiglottis position for playing tuba, although somewhat more towards the posterior for the high registers
- folds were open for playing tuba with a larger amount of fixated openness for the second measurement after the study
- arytenoids were more pulled back for the first tuba playing measurement and were even more back and off the vocal cords for the second tuba measurement
- much more openness of the entire pharyngeal area when playing tuba and improved dramatically from the first laryngoscope measurement to the second in both slurring and tonguing; she demonstrated amazing ability to keep her vocal folds abducted during phonation of the lip buzz and her vocal cords did not “flap” closed for every note like they would for vocal hard onsets

4-6-16
Playing Inhale

Playing Slurred Bb2  Playing Slurred Bb3  Playing Slurred Bb4
Playing Tongued Bb2

Playing Tongued Bb3

Playing Tongued Bb4

5-25-16
Playing Inhale

Playing Slurred Bb2

Playing Slurred Bb3

Playing Slurred Bb4

Playing Tongued Bb1

Playing Tongued Bb2
17F

- displayed a rather closed pharyngeal area in general even for inhaling when playing euphonium
- first measurement, the folds were almost invisible due to supraglottis constriction and because the arytenoids were almost completely pulled forward over them; this became extreme when going to the highest Bb5 in range
- second measurement was somewhat better with a more anterior epiglottis position, folds that were visible and showed some abduction for airflow (although were barely more abducted than phonation) and the arytenoids were not as drawn forward
- through the study of focusing on physically making her larynx operate for playing euphonium like her singing, 17F was able to partially dispense with the extremely tight constriction of her entire pharyngeal area for playing euphonium
- characteristics were similar for both slurring and tonguing, but she demonstrated hard “flapping” of the vocal cords for every change of pitch while playing.

4-7-16
Playing Inhale
Playing Slurred Bb2

Playing Slurred Bb3

Playing Slurred Bb4

Playing Slurred Bb5

Playing Tongued Bb2

Playing Tongued Bb3

Playing Tongued Bb4

Playing Tongued Bb5
5-26-16

Playing Inhale

Playing Slurred Bb3

Playing Slurred Bb4

Playing Slurred Bb5

Playing Tongued Bb2

Playing Tongued Bb3

Playing Tongued Bb4

Playing Slurred Bb5
- good inhale abduction and pharyngeal area openness
- posterior epiglottis position for the first measurement and anterior position for the second
- vocal folds and arytenoids covered by supraglottis constriction for the first and in full view for the second
- tuba playing pharyngeal wall position in the first measurement was even more constricted than his singing, but he was able to greatly open the walls for the second measurement
- characteristics were consistent for slurring and tonguing, but he also had some “flapping” of the vocal folds for each pitch played

3-29-16
(subject did not play slurred scales, only tongued, so picture is taken after the note is sounding)
5-24-16
Playing Inhale

Playing Slurred Bb2  Playing Slurred Bb3  Playing Slurred Bb4

Playing Tongued Bb2  Playing Tongued Bb3  Playing Tongued Bb4
20M

- very good pharyngeal openness and fold abduction on the inhales of both measurements
- both measurements showed good anterior epiglottis position even when tonguing; some improvement on the second measurement
- full view and abduction of the vocal folds
- good posterior position of the arytenoids and pharyngeal walls that were open enough to allow good airflow through the glottis
- had virtually no “flap” of his vocal cords while playing the tuba

4-8-16
Playing Inhale

Playing Slurred C1  Playing Slurred C2

Playing Slurred C3  Playing Slurred C4
Playing Tongued C1

Playing Tongued C2

Playing Tongued C3

Playing Tongued C4

5-23-16
Playing Inhale

Playing Slurred C1

Playing Slurred C2
- first measurement had supraglottis constriction and adducted folds for playing tuba, yet somehow the researcher has made a living playing tuba and somehow air still does flow through the glottis
- study project did exhibit improvement especially in the anterior position of the epiglottis and vocal folds being more abducted for airflow in the second measurement
- ironically, the researcher had tremendous movement of “flapping” of the vocal cords for each pitch change while slurring and single tonguing to the point that in the first measurement, the folds looked like they were phonating even though it was not actually happening; the second measurement demonstrated better static abduction of the folds, but still had some “flapping”
there was more constriction for the extreme high ranges, but both 20M and the researcher had more closure for the pedal ranges too with more openness in the middle ranges with improvement of openness in the researcher for the second measurement
Playing Tongued C3
Playing Tongued C4
Playing Tongued C5

5-25-16
Playing Inhale

Playing Slurring G -1
Playing Slurring G1
<table>
<thead>
<tr>
<th>Playing Slurring G2</th>
<th>Playing Slurring G3</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
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<tr>
<td>Playing Slurring G4</td>
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<td><img src="image3.png" alt="Image" /></td>
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<tr>
<td>Playing Tongued G -1</td>
<td>Playing Tongued G1</td>
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<tr>
<td><img src="image5.png" alt="Image" /></td>
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<tr>
<td>Playing Tongued G2</td>
<td>Playing Tongued G3</td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
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<tr>
<td>Playing Tongued G4</td>
<td>Playing Tongued G5</td>
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<tr>
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<td><img src="image10.png" alt="Image" /></td>
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APPENDIX XXII. GLOTTIS ACTIVITY MULTIPLE TONGUING

20M

- compared to his playing, 20M was vividly more closed in the pharyngeal area (even more than singing) with the epiglottis pulled towards the posterior, vocal folds and arytenoids invisible from supraglottis constriction and the pharyngeal walls pulled around the larynx structure to the point that there was no visibility of the vocal folds and in the high range, the epiglottis was almost touching the pharyngeal posterior wall

5-23-16
Multiple Tonguing Inhale

![Multiple Tonguing Inhale](image)

Triple Tonguing F1

Triple Tonguing F2
- researcher had better static anterior position of the epiglottis, vocal folds and arytenoids were in almost complete view and the pharyngeal walls more open than either his singing or his normal slurring and single tonguing of playing the tuba; again, the researcher will benefit with training of the airflow feeling of multiple tonguing along with buzzing into his singing and regular playing of the tuba
5-25-16
Multiple Tonguing Inhale

Triple Tonguing F1   Triple Tonguing C2   Triple Tonguing C3

Triple Tonguing C4   Triple Tonguing C5

Double Tonguing F1   Double Tonguing C2   Double Tonguing C3

Double Tonguing C4   Double Tonguing C5
APPENDIX XXIII. RADIONOFF AND MAX PLANCK

Singing Glottis

Whisper Glottis

Trumpet Glottis

Bad Trumpet Glottis

Horn Glottis

Trombone Glottis

188. Radionoff, 134-138.
MRI Setup—test subject is positioned on the MRI platform. A non-ferrous, non-magnetic horn bell with a plastic hose and plastic mouthpiece has been made for the subject to play on.

Test subject in position for playing tests.

Panel ready to view testing

Horn Player Vocal Folds and Tract View from underneath the patient

At repose

Inhale, notice pharyngeal area enlarges for inhaling

---

189. Max Planck Institute, Gottingen, Germany (with permission Summer 2015).
Onset of lip vibration—folds adduct also

Between Pitch Intervals, folds abduct while player is slurring between intervals—air still going, but obviously interrupted by glottis
APPENDIX XXIV. LIP APERTURE AND JAW PLACEMENT

Lip Aperture Shape; Air Direction, Jaw Placement, Chin, Corners

Porter Tuba

4-20-16
C1 Aperture open across whole mouthpiece; air going up; jaw down—chin flat—corners pushed around mouthpiece
C2 Aperture open across mouthpiece; air going slightly up; jaw up a little and back; corners forward, but lower lip pushed into the mouthpiece
C3 Aperture open across mouthpiece; air direction straight; jaw down—chin flat—corners forward and firm
C4 Aperture has space but moving down into lower part of the mouthpiece; air direction going down; jaw down and flat; corners forward and set
C5 Aperture has space but pushed down into bottom of mouthpiece; air direction down; jaw down and chin flat—corners tucked and a little tense
6-16-16
C1 Aperture very open and both lips engaged; air direction up; jaw down but not stretched—chin a little bunched—corners not a flabby as 4-20-16
C2 Aperture very open across mouthpiece, more than 4-20-16; air direction going up; jaw down and flat; corners forward and lower lip not as pushed into mouthpiece as 4-20-16
C3 Aperture open across mouthpiece; air direction a little down; jaw down—chin flat—corners forward and both lips visible in the corners
C4 Aperture has space; air direction going down; jaw down and flat; corners firm and set, but maybe a little back
C5 Aperture has more space in the middle; air going down; jaw down and chin flat—corners forward and both lips visible in the corners
Porter Euphonium

4-20-16
Bb2 Aperture open across mouthpiece; air direction up; jaw not down enough, chin flat, corners pushed forward—lips pushed forward; trying to play with loose flabby lips instead of jaw down
Bb3 Aperture open in the middle; air direction going straight; jaw down, chin flat, corners pulled a little far back
Bb4 Aperture open in the middle; air direction somewhat straight; jaw down and flat; corners pulled a little too far down
Bb5 Aperture a little open in the middle; air direction down; jaw down, chin a little bunched; corners pulled back and down

6-16-16
Bb2 Aperture open across mouthpiece and vertically wide; air direction going up; jaw down, chin flat, corners a little pushed forward, but lips are much more engaged and open
Bb3 Aperture open more across mouthpiece; air direction straight; jaw down, chin flat, corners forward more
Bb4 Aperture has space across mouthpiece; air direction going down; jaw flat and down; corners pulled down and a little down
Bb5 Aperture has more space in the middle; air direction down; jaw down, chin flat, corners are trying to be forward, but still back some
APPENDIX XXV. SINGING EMBOUCHURE

Porter

4-20-16
- moderate oh shape for singing C3; what cannot be seen is tongue being in place behind lower teeth gun line

6-16-16
- good oh shape for singing C3; improved lower jaw and head position more level
APPENDIX XXVI. SPECTRAL ANALYSIS

F=forte in volume

12F
Brass Sources Introduced
12F Bb2 f, April 10
12F Bb2 f, April 13

Vocal Sources Introduced
12F Bb2 f, April 20
12F Bb2 f, April 27
12F Bb2 f, May 4
12F Bb2 f, May 11
High Chest Breathing

12F Bb2 f, May 15

12F Bb2 f, June 16

12F Bb2 f, January 15, 2017

Vocal Back Breathing

17F

Brass Sources Introduced

17F Bb 3 f, April 14

17F Bb 3 f, April 21
Vocal Sources Introduced

17F Bb 3 f, May 1
17F Bb 3 f, May 15
17F Bb 3 f, May 23
17F Bb 3 f, June 9
17F Bb 3 f, June 15

17F Bb3 f, January 12, 2017
High Chest Breathing

Vocal Back Breathing
Brass Sources Introduced

17M Bb2 f, April 4

17M Bb2 f, April 12

Vocal Sources Introduced

17M Bb2 f, April 18

17M Bb2 f, April 30

17M Bb2 f, May 3

17M Bb2 f, May 22

17M Bb2 f, June 7
17M Bb2 f, January 13, 2017
High Chest Breathing

Vocal Back Breathing

20M

Brass Sources Introduced

20M C 2 f, April 8

20M C 2 f, April 12

Vocal Sources Introduced

20M C 2 f, April 15

20M C 2 f, April 22
20M C 2 f, April 29

20M C 2 f, May 11

20M C 2 f, June 7

20M C2 f, January 15, 2017
High Chest Breathing

Vocal Back Breathing
Porter Tuba

Brass Pedagogies Introduced
Porter C2 F, April 12, Tuba

![Graph of Brass Pedagogies Introduced]

Vocal Pedagogies Introduced
Porter C2 F, April 20, Tuba

Porter C2 F, May 11, Tuba

Porter C2 F, June 16, Tuba
Porter C2 F, January 17, 2017
High Chest Breathing

Vocal Back Breathing

Porter Euphonium
Brass Pedagogies Introduced
Porter Bb3 F, April 12 Euphonium

Vocal Pedagogies Introduced
Porter Bb3 F, April 17, Euphonium
Porter Bb3 F, June 16, Euphonium
APPENDIX XXVII. DECIBEL METER

12F Decibel Meter Bb2

17F Decibel Meter Bb3
Porter Decibel Meter Euphonium Bb3

<table>
<thead>
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<tr>
<td>Early Apr</td>
<td></td>
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<tr>
<td>17-Apr</td>
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<td>16-Jun</td>
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- Bb3 pp
- Bb3 f
- Bb3 ff
APPENDIX XXVIII. PROFESSIONAL SPECTRAL ANALYSIS

Dave Fedderly, Retired Principal Tuba Baltimore Symphony Orchestra, Lecturer Tuba University of Maryland, Owner Baltimore Brass Company

Tuba: Ursus Meinl Weston 3225, silver, 4 piston valve, thumb fifth rotor
Mouthpiece: Canadian Brass Arnold Jacobs Helleberg Gold Plated
Location: David’s office, Baltimore Brass Company, Baltimore, MD

C2 f, 5-11-16
Gene Pokorny, Principal Tuba Chicago Symphony Orchestra

Tuba: York CC 5/4 silver plated
Mouthpiece: Laskey 30H mouthpiece
Location: Greenroom, backstage, the University of Tennessee, Clarence Brown Theater

C2 f, 5-30-16
Dr. Michael Nickens, Athletic Music Director, Tuba Professor, George Mason University, Fairfax, VA

CC Tuba: PT6 Silver, 4 piston, 5th rotor
Mouthpiece: Doug Elliott Custom
Location: Choral Room, George Mason University

C2 f, 6-15-16
F Tuba: Yamaha YEB621 Silver, 4 piston, 5th rotor
Mouthpiece: Yamaha Japan 67C4
Location: Choral Room, George Mason University

F2 f, 6-15-16
Dr. Brian Bowman Retired Principal Euphonium, United States Air Force Band, Coordinator of Brass and Regent’s Professor of Euphonium University of North Texas

Euphonium: Willson compensating silver
Mouthpiece: Brian Bowman BB1
Location: Living room, Brian’s son’s home

Bb3 f, 6-9-16
David Werden, Retired Principal Euphonium, The United States Coast Guard Band, Computer Consultant, Freelance musician, living in MN

Euphonium: Adams E1 with sterling silver bell compensating
   Mouthpiece: Dennis Wick 4AL
   Location: Sousaphone room, the University of Tennessee

Bb3 f, 6-4-16
Mark Jenkins, Principal Euphonium, United States Military Band, Washington, DC

Euphonium: Wilson silver Compensating
Mouthpiece: Stainless steel Giddings and Webster EXL
Location: Room MTB 2028, George Mason University

Bb3 f, 6-13-16
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Articles, Papers, Interviews and Presentations


BIOGRAPHY

William Davidson (David) Porter

Principal Tuba, The McLean Orchestra and McLean Orchestra Brass Quintet; Principal Tuba, The National Brass Quintet and The King Street Brass Quintet; Faculty, The MasterWorks Festival; Adjunct Position, George Mason University: Class Brass, Applied Tuba, Tuba/Euphonium Ensemble Instructor; Graduate Assistant Green Machine; Low Brass Instructor, Northern Virginia

William D. (David) Porter is a retired CMSgt from The United States Air Force Band, Washington D.C. During his 24 year-career there, he played tuba with The Concert Band, The Ceremonial Brass and The Symphony Orchestra. He also made appearances with The Airmen of Note, The Singing Sergeants and various chamber groups. David was the Non-Commissioned Officer-in-Charge of The Dixieland Band and was Principal Tuba with the USAF Band Tower Brass Quintet.

Having grown up in Tennessee, David graduated from Alcoa High School in 1976 under the tutelage of Roy Holder. His high school tuba teachers were Ronnie Spencer and Michael Kincaid. David's collegiate tuba teachers have been Professor R. Winston Morris (TTU), Dr. Karl Hinterbichler (UNM), and currently Dr. Michael Nickens (GMU). His other teachers have been Mr. David Fedderly, Retired Principal Tuba, Baltimore Symphony Orchestra, the late Dr. Milton Stevens, Principal Trombone, National Symphony Orchestra, and currently studying with Mr. Gene Pokorny, Principal Tuba, Chicago Symphony Orchestra. His voice teachers have been and are currently Ms. Chrissellene Petropoulos, Vocal Mastery, Potomac, MD and Professor Eugene Rabine, The Rabine Institute, Walheim, Germany.

Besides the USAF Band, David has performed as Principal Tuba with The New Mexico Brass Quintet and The New Mexico Symphony Orchestra and substituted with The Maryland Symphony Orchestra. He is currently Principal Tuba with The McLean Orchestra. His other performing experiences include many solo appearances with the USAF Concert Band and Chamber Series, touring with Tim Zimmerman and The King's Brass (2010-2015), with eurobrass (2013-2017), performing with Camerata and King Street Brass Quintets, National Brass Quintet (current), and The McLean Orchestra Brass Quintet (current) and many other chamber and orchestra ensembles throughout the Washington DC Metropolitan area.
His very active teaching career of over 35 years includes college clinics, high school band camps, sectionals and clinics, middle school and elementary sectionals and clinics, and teaching Drum and Bugle Corps Brass. He currently teaches 34 tuba and euphonium students weekly from six different schools in Fairfax County, VA and has had students gain scholarships at over 16 different major universities. As well as Adjunct Instructor at GMU teaching Brass Methods, Tuba and Euphonium Ensemble and Applied Tuba, he is also the Graduate Assistant for “The Green Machine”, the 180-member athletic music ensemble at GMU. David’s other tuba faculty positions include the MasterWorks Festival, a Christian performing artist camp in Cedarville, OH and at the 2016 Encuentro Filarmonico Centroamericano, a college student orchestra camp encounter in Tegucigalpa, Honduras.

David's professional memberships include the International Tuba Euphonium Association, American Federation of Musicians, Phi Mu Alpha, National Honor Society, Phi Kappa Phi Honor Fraternity, and Kappa Kappa Psi National Honorary Band Fraternity. His other interests consist of volunteering as a youth counselor at Fairlington UMC and exercising. David is married to wife, Judy, and they are parents to children Sandra (married to husband Greg) and Bill (married to wife Emily).