Posture and Trumpet Playing: How Body Alignment Affects Musicians

Section I – Introduction and Literature Review

The plethora of trumpet method books available each offer one slice from a wide spectrum of exercises claimed by the author, and by extension trumpet teachers, as the best way one can improve as a player. However, each book, it seems, offers a different focus, often leaving trumpet students confused, indeed frustrated, when juxtaposing these diverse methods in trying to better themselves. The real problem lies in the fact that each author, or teacher, found what worked best to improve his own trumpet playing and proceeded to preach that as the gospel without much regard to other players' individual differences. This results in a constant state of debate in trumpet pedagogy as to the best way to teach students. In all aspects of trumpet playing, no "right way" can be settled upon because every player is different at the fundamental, physiological level.

Physiologically, every human being is different, whether from muscle strength to bone structure or from spinal curvature to lung capacity. All of these individual differences necessarily affect trumpet playing and therefore trumpet pedagogy as a whole. Along with many other technical and musical aspects of trumpet playing, instructors often address appropriate posture for optimal playing. Certainly, in teaching trumpet, most teachers desire a prescribed, foolproof method, which probably explains why a neutral approach in classes works for a wide variety of students. Trumpet students usually adopt a fairly neutral body alignment without considering individual physical differences. However, seemingly small alterations in the way a person stands can produce a drastic difference in the quality of sound exuding from the bell of the trumpet. This change can be readily heard, but currently requires investigation and explanation.

There have been many studies performed, however, showing the effects of posture changes on respiratory function. Appel et. al. found, through their investigation of numerous extreme postures, that posture did indeed affect the function of the respiratory system; in one measurement, a decrease in vital capacity of approximately eight percent occurred.[1] Furthermore, although this study is limited to standing postures, research shows that sitting in a slumped position significantly reduces both lung capacity and expiratory flow.[2] In patients with chronic obstructive pulmonary disease, for example, the feeling of breathlessness changes dramatically with altered postures.[3] Kera and Maruyama also noted the effects of gravity on respiration and proved that different postures can make the abdominal muscles more prone to gravitational pull.[4]

Although these studies used induced posture changes, naturally occurring structural differences must also directly affect respiratory function. For example, some people have two legs of the same length, whereas others may have a shorter leg. Furthermore, many people live through life unaware of the significant hyperpronation present in their feet. These seemingly unnoticed and presumably insignificant discrepancies must change respiratory function enough to influence trumpet playing.

Section II – Hypothesis

Posture directly affects a trumpet player's prowess because body alignment influences respiratory function; however, since each person differs physiologically at the structural level, the ideal standing posture for a trumpet player should be determined on an individual basis.

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[1] Marvin Appel, Andrew Childs, Elizabeth Healey, Steven Markowitz, Samuel Wong, Jere Mead, "Effect of Posture on Vital Capacity," *Journal of Applied Physiology* 61 (May 1986): 1882.

[2] Fang Lin, Sriranjani Parthasarathy, Susan Taylor, Deborah Pucci, Ronald Hendrix, Mohsen Makhsous, "Effect of Different Sitting Postures on Lung Capacity, Expiratory Flow, and Lumbar Lordosis," *Archives of Physical Medicine and Rehabilitation* 87 (2006): 504.

[3] Takeshi Kera and Hitoshi Maruyama, "The Effect of Posture on Respiratory Activity of the Abdominal Muscles," *Journal of Physiological Anthropology and Applied Human Science* 24 (Apr 2005): 259.

[4] Ibid., 263-264.

Section III - Methodology

For this project, we will use trumpet students from the Washington State University trumpet studio. The goal of this study is to determine how different foot positions affect trumpet playing, including an evaluation of postural effects on respiration. To achieve this goal, various aspects of lung capacity and trumpet performance will be measured in different postures. Since the best practical application of postural changes exists in the feet (it is easier for a trumpet player to focus on the position of the feet rather than the pelvis, for example), we will use several alterations in foot position to make measurements.

Subjects will assume thirty-six different foot positions in four categories: eversion/inversion, abduction/adduction, plantarflexion/dorsiflexion, and induced leg length discrepancy.[5] The first three categories follow the movement of the foot on each of the three axes, and the fourth uses the feet to alter pelvic position. For each different position, a control, or position of no alteration (for example zero degrees) will be used. For abduction and adduction, four increments of 15 degrees will be implemented, covering measurements from 15 to 60 degrees in each direction (see Fig. 1). Functional Foot Prints®, manufactured by Balanced Body, will be used to mark exact intervals of the specified degree measurements. Eversion and inversion (corresponding to hypersupination and hyperpronation, respectively) will be measured in four increments of five degrees each, ranging from five to twenty degrees in both directions (see Fig. 2). Bailey Adjustable Incline Boards, manufactured by Collins, Inc., will be used to induce eversion and inversion. Plantarflexion and dorsiflexion (raising and lowering the heel) will be measured using four ten-degree increments in both directions for a range of ten to forty degrees (see Fig. 3) using the Professional Multi-Slant Board manufactured by Exertools.

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[5] Margareta Nordin and Victor H. Frankel, *Basic Biomechanics of the Musculoskeletal System,* 3d ed. (Maryland: Lippincott Williams and Wilkins, 2001), 226.

Finally, leg length discrepancy will be induced using increments of three millimeters from three to twelve millimeters on both feet. Heel lifts manufactured by GW Heel Lift, Inc. at the specified heights will be used on solid ground to induce leg length discrepancy.

In each of the thirty-six feet positions, six measurements will be made: three on the trumpet, and three dealing directly with the respiratory system. The first measurement on the trumpet (range) will be found simply by having the subject play up the scale chromatically as high as one can go. For this test especially, testing in each category will need to be separated by days because of fatigue. The second trumpet measurement will identify and evaluate the overtones present in the sound, for which a recording studio, spectrometer, and sound analysis software will be implemented. This test measures the richness of a player's sound. Finally, on the trumpet, the sound volume will be measured using a decibel meter. For the respiratory function tests, we will measure the forced vital capacity (FVC), peak expiratory flow (PEF), and forced expired volume in one second (FEV_1), all of which directly relate to the function of the respiratory system. The FVC, quantified using a spirometer, measures the maximum amount, in liters, forcibly expired after a full inspiration. The PEF, found using a peak flow meter, measures the speed in liters per second of air exiting the lungs at the beginning of forced expiration. FEV_1, measured with a spirometer, is the amount of air, in liters, expired in one second. All three tests are standard for analyzing respiratory function. The procedure for each test will be performed as per the American Thoracic Society guidelines.[6] An important calculation, the FEV_1% is found through the ratio of FEV_1/FVC, and a normal adult range is 70-80%.[7] For a summary of all the tests to be performed, see Table 1.

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[6] M. R. Miller and others, Series "ATS/ERS Task Force: Standardisation of Lung Function Testing" number 2, *European Respiratory Journal* 26, no. 2 (2005): 323.

[7] Michael C. F. Pain, "Basic Tests of Respiratory Function." *Australian Prescriber* 23 (2000): 10-2.

Since the focus of this study is to examine individual differences in posture rather than how well a player adapts to changes in instruments, each subject will use his own mouthpiece (because mouthpieces are chosen based on a person's physiology) and trumpet. Although different sets of equipment will introduce other variables, for a trumpet player to adopt posture as well as equipment changes would introduce far more extraneous variables to the study. Therefore, for the trumpet measurements, a difference test from the neutral position will be used to eliminate the influence of these variables. To avoid the possibility of outside factors such as fatigue influencing our results, each participant will perform the tests in random order.

The data analysis will include scatter plots and regression. Each measurement (three trumpet and three respiratory) in each category (four different types of induced posture change) will be considered as a separate experiment, resulting in a total of 24 separate analyses.

Section IV – Expected Results and Conclusions

We expect a two-fold finding: (1) that posture makes a difference when playing the trumpet, primarily because posture directly relates to respiratory function, and (2) that the best posture a trumpet player should use varies by the individual because each person has structural differences.[8] From this study, we expect to conclude that each trumpet player needs to find his ideal posture based on individual structural differences and implement it for peak playing ability.

In the greater field of trumpet instruction, this research would encourage trumpet players to be more conscious of posture while they play, in order to produce the best sound possible. Furthermore, teachers, rather than prescribing a general posture, should work with students to determine the ideal posture for each individual.

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[8] Sam Khamis and Ziva Yizhar, "Effect of Feet Hyperpronation on Pelvic Alignment in a Standing Position," *Gait and Posture* 25 (Jan 2007): 132-133.

Section V – Annotated Bibliography

Appel, Marvin, Andrew Childs, Elizabeth Healey, Steven Markowitz, Samuel Wong, Jere Mead. "Effect of Posture on Vital Capacity." *Journal of Applied Physiology* 61 (May 1986): 1882-1884.
This article is extremely valuable in showing how extreme postures affect the function of the respiratory system. The researchers investigated the effect of five different postures on respiratory function. Results varied as the assumed posture such that the arms supported all the body weight saw improved vital capacity, while the partial sit-up position saw a decrease (~8%) in vital capacity. Although the postures are extreme, and such extremes will not be implemented in this study, these data can be used to show the important link between posture and breathing. One posture of interest is the "nearly maximal spinal extension (lean backward as far as possible)" because many trumpet players, especially jazz musicians, including Maynard, adopt this kind of spinal extension when they get really into what they're playing. I would like to find more research on this posture.

Hanson, Frank E. III. "Trumpet Timbre: A Comparative Investigation of the Tone Quality of Two Professional C Trumpets." DMA diss., Ohio State University, 1988.
Hanson does an in-depth analysis of sound and tone quality of tones played on the trumpet. I will use this dissertation for information on ways to analyze sound, and investigate updated versions of the software he used in performing the analyses presented here. Components of analyzing sound, such as amplitude and frequency graphs are discussed in detail. Also, Hanson presents methods for measuring and analyzing many aspects of a single tone.

Kera, Takeshi and Hitoshi Maruyama. "The Effect of Posture on Respiratory Activity of the Abdominal Muscles." *Journal of Physiological Anthropology and Applied Human Science* 24 (Apr 2005): 259-265.
Although this is an article on Chronic Obstructive Pulmonary Disease (COPD), an illness in which patients inherently suffer shortness of breath, the discoveries here will nonetheless serve to prove my point. When these patients feel short of breath, different body positions have been shown to reduce the feeling of panic. They have, therefore, proposed better positions for COPD patients. Of otherwise notable importance, this study also puts forth the importance of gravity in respiration; in certain positions gravity affects the respiratory system more than in others.

Khamis, Sam and Ziva Yizhar. "Effect of Feet Hyperpronation on Pelvic Alignment in a Standing Position." *Gait and Posture* 25 (Jan 2007): 127-34.
This article is very helpful for showing the correlation between feet position and pelvic position. Since other articles I have found illustrate the impact of pelvic (and by extension back) positions have on respiratory function, this article makes the connection between foot position in particular and respiration. It contains good methodology for induced hyperpronation (wedges), which I will use in this study, and a good overall explanation of what happens with hyperpronation. I will use the same methodology for hypersupination.

Lin, Fang, Sriranjani Parthasarathy, Susan Taylor, Deborah Pucci, Ronald Hendrix, Mohsen Makhsous. "Effect of Different Sitting Postures on Lung Capacity, Expiratory Flow, and Lumbar Lordosis." *Archives of Physical Medicine and Rehabilitation* 87 (2006): 504-9.
This study investigated lung capacity and expiratory flow in different sitting postures. Standing posture was used as a control. They found that both the lung capacity and expiratory flow decreased significantly when subjects assumed both sitting and slumped positions as compared to the standing position. One of their named hypotheses was that "body posture affects the lung capacity and expiratory flow" (p. 504). Although our study will be using only variations on standing positions, the point is clear that body posture does affect respiratory function.

M. R. Miller, J. Hankinson, V. Brusasco, F. Burgos, R. Casaburi, A. Coates, R. Crapo, P. Enright, C. P. M. van der Grinten, P. Gustafsson, R. Jensen, D. C. Johnson, N. MacIntyre, R. McKay, D. Navajas, O. F. Pedersen, R. Pellegrino, G. Viegi and J. Wanger. Series "ATS/ERS Task Force: Standardisation of Lung Function Testing" number 2. *European Respiratory Journal* 26, no. 2 (2005): 319-338.
This article contains the standards set forth by the American Thoracic Society and the European Respiratory Society in an effort to standardize testing of the respiratory system. Especially helpful are the detailed directions for testing measurements such as the FEV and vital capacity, which I will use in this study.

Nordin, Margareta and Victor H. Frankel. *Basic Biomechanics of the Musculoskeletal System,* 3d ed. Maryland: Lippincott Williams and Wilkins, 2001.
This book contains much necessary background information on basic biomechanics and principles. I have and will continue to use this book for terminology and explanations in the field. Especially helpful are the illustrations of how different joints move. Nordin and Frankel do a great job presenting the information in understandable terms, and cover all the bases needed in the present study.

Pain, Michael C. F. "Basic Tests of Respiratory Function." *Australian Prescriber* 23 (2000): 10-2.
This article contains good reference data and information on standards for respiratory function testing. It has definitions such as FEV_1*% useful for this study.*

Stewart, M. Dee, collector. *Arnold Jacobs—The Legacy of a Master*. Illinois: The Instrumentalist Publishing Company, 1987.
This book provides a biography of someone upheld as one of the best musicians of our time. Mr. Jacobs also was one of the musicians most concerned with breathing, and eventually coined the term "song and wind" as a descriptor of his musical philosophy. He would have students in lessons practice breathing techniques and had a large collection of equipment to measure respiratory function. His extensive work in the area of respiration illustrates its importance in playing wind instruments. The epilogue has a great reprint of an article on the mechanics of breathing.

Figure 1: Abduction and Adduction

Abduction

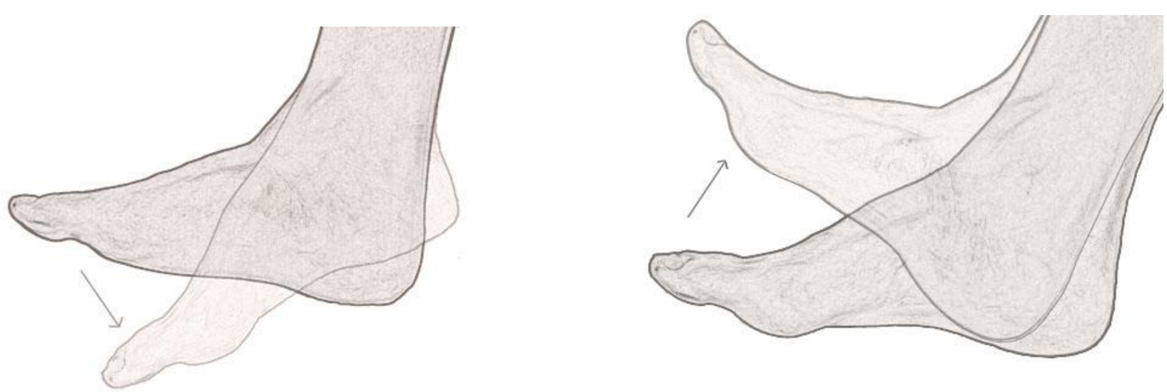
Adduction

Figure 2: Eversion and Inversion

Eversion

Inversion

Figure 3: Plantarflexion and Dorsiflexion



Plantarflexion

Dorsiflexion

Table 1: Summary of Experiments						
	Trumpet Measurements			**Respiratory Function Measurements**		
	Range	Overtones	Dynamics	FVC	PEF	FEV_1
Eversion/Inversion						
20˚ E						
15˚ E						
10˚ E						
5˚ E						
0˚						
5˚ I						
10˚ I						
15˚ I						
20˚ I						
Abduction/Adduction						
60˚ Ab						
45˚ Ab						
30˚ Ab						
15˚ Ab						
0˚						
15˚ Ad						
30˚ Ad						
45˚ Ad						
60˚ Ad						
Plantar/Dorsiflexion						
40˚ P						
30˚ P						
20˚ P						
10˚ P						
0˚						
10˚ D						
20˚ D						
30˚ D						
40˚ D						
Leg Length						
12 mm R						
9 mm R						
6 mm R						
3 mm R						
0 mm						
3 mm L						
6 mm L						
9 mm L						
12 mm L						