ABSTRACT FOR ICA 2010 RESEARCH COMPETITION

The Effect of the Breath Builder™ on Various Lung Functions and Musical Performance Abilities of Clarinet Players- A Pilot Study

The purpose of this study was to focus on the efficacy of the Breath Builder™ (See Appendix A and B) and its effects on clarinet players' performance abilities and/or lung functions. The performance abilities measured included tone, note duration, and phrase duration. The lung function measurements were: (1) Forced Expiratory Volume in 1 second (FEV_1), starting from total lung capacity, the volume exhaled during the first second of a forced expiratory maneuver; (2) Forced Vital Capacity (FVC), the maximum breath volume or volume change of the lungs between a full inspiration to total lung capacity and a maximal expiration to residual volume; (3) Maximal Inspiratory Pressure (MIP), the measure of the power of the inspiratory muscles; (4) Maximal Inspiratory Pressure in One Second (MIP_1), the measure of the power of the inspiratory muscles during the first second of the maneuver; (5) Maximal Expiratory Pressure (MEP), measuring the power of the expiratory muscles; and (6) Maximal Expiratory Pressure in One Second (MEP_1), the measure of the power of the expiratory muscles during the first second of the maneuver.[1]

Two research questions pertaining to two major areas were investigated:

(1) Would there be any significant difference in lung function (FVC, FEV_1, MIP, MIP_1, MEP, MEP_1 [dependent variables]) by subject group or passage of time (independent variables)?

[1] These are common measurements used in the medical field to determine of lung function.

(2) Would there be any significant difference in music performance abilities (tone, note duration, and phrase duration [dependent variables]) by subject group or passage of time (independent variables)?

This cross-disciplinary study used a mixed-methods approach with a strong quantitative component and included the involvement of individuals from the following areas: music performance, music education, audio engineering, sports medicine, pulmonology and physics.

Literature Review

The medical field has performed and continues to perform research studies on the effect of breathing exercises and devices similar to the Breath Builder™ on lung function. Designated "incentive spirometers," these breathing devices are described as "a device that encourages, through visual and/or audio feedback, the performance of reproducible, sustained maximal inspiration" (Overend, 2001, p. 972). Such devices, including the Breath Builder™, are widely used in the treatment of patients with chronic obstructive pulmonary disease (COPD), to prevent postoperative pulmonary complications (PPC), and to help patients regain proper lung function after surgery. However, no studies have been conducted using the Breath Builder™ and though incentive spirometry and various breathing exercises are a common type of physical therapy for post-operative patients, controversy exists regarding their effectiveness.

Research has discussed incentive spirometry in unhealthy people, discussed the use of respiratory muscle training in healthy individuals (but did not use a breathing device), or studied healthy musicians but did not use breathing devices as a mode of respiratory exercise. A study on the Breath Builder™ and its effect on a musicians lung

functions and various performance abilities is necessary to help fill the void in research literature.

Study Methodology

Subjects for the Breath Builder™ study were recruited from the clarinet studio of a major university in the Southwest. The sample consisted of 15 clarinetists, a combination of undergraduate and graduate students, ages 18 – 27 (subjects were divided using matched pairs based on playing ability). The study was performed in two four-week phases. During Phase 1, the subjects were tested three times: the beginning of the study (pretest), during week one of the study (test), and during week four of the study (post-test). After the pretest, each subject in Experimental Group 1 was given a Breath Builder™ and a scripted demonstration of the device. Each was also given written instructions and a log to record use of the device. Members of Control Group 1 were not provided Breath Builders™ and continued their normal practice routine.

The completion of the post-test in week four marked the end of Phase 1. During Phase 2, Control Group 1 was given Breath Builders™ and relabeled Experimental Group 2 (post-test results from Control Group 1 were used as the pretest/baseline measurement for Experimental Group 2). Experimental Group 2 followed the same procedures as Experimental Group 1, giving measurements during week one (test) and week four (post-test) of the second phase.

At the end of Phase 1, Experimental Group 1 stopped using the Breath Builder™ and was relabeled Experimental Group 3. Following this cessation, the subjects were measured during week one and week four of the second phase to note any change in lung function or performance.

Measurement Methodology

Using a spirometer and manometer, subjects provided their initial (pretest) pulmonary lung function measurements. The measurements taken were FEV_1, FVC, MIP, MIP_1, MEP and MEP_1.

The subjects' musical abilities, tone, note duration, and phrase duration, were measured through the performance of three musical examples. On the subject's right was a peak meter providing each musician a visual reference of the decibel (db) level. On the subject's left was a pair of headphones used during the third example.

The three musical examples consisted of the following: G1 (low G in the Chalumeau register), G2 (throat-tone G in the Chalumeau register), and a sustained phrase of substantial length. Each example was played and recorded three times.

For the first example, the subject was instructed to take a deep breath and sustain the note G1 at 84 db $\pm$ 1 db for as long as possible. This process was repeated for the note G2.

For the third measurement, subjects were asked to play a musical excerpt consisting of a long continuous phrase (based on the theme from the second movement of Poulenc's *Sonata for Clarinet and Bassoon*) at a tempo of sixty beats per minute. The phrase was written at such a length that the clarinetist would not successfully be able to play the entire phrase in one breath. Before playing this phrase, the subject was instructed to put on a set of headphones covering only one ear, allowing the subject to hear his/her natural sound. Through the headphones, the subject was provided a metronome click to help ensure a consistent tempo. The subject was instructed to take a large breath and to play as much of the phrase as possible. This phrase was recorded three times. The

musical example recorded for phrase duration, was also utilized for the analysis of tone. All musical excerpts were recorded in a recording studio.

Data Analysis

Once completed, the lung function and musical data were analyzed. Three judges evaluated the tone quality of the musical examples. The judges consisted of a professor of clarinet, a doctoral candidate clarinet student, and an orchestral conductor. A researcher-generated tone rubric was provided and the judges were trained in its use with musical examples. Once training was completed, the judges evaluated the musical excerpts of the study using the rubric. The results from the judges, lung function measures, and note and phrase duration were analyzed using a 2-way ANOVA with repeated measures.

Results

The two research questions investigated were:

(1) Would there be any significant difference in lung function (FVC, FEV_1, MIP, MIP_1, MEP, MEP_1 [dependent variables]) by subject group or passage of time (independent variables)?

(2) Would there be any significant difference in music performance abilities (tone, note duration, and phrase duration [dependent variables]) by subject group or passage of time (independent variables)?

In analyses addressing the first research question, no main effect differences were found by lung function. However, a significant interaction effect was found by MIP (Rao R [6,44] = 2.68; $\underline{p} < .0264$ [See Figure 1]) and MIP_1 (Rao R [6,44] = 2.44; $\underline{p} < .0401$ [See Figure 2]) such that the scores for groups using the breath builder started with the lowest pretest score (experimental group 1) and the second highest pretest score (experimental

group 2) and concluded as the second highest post-test score and highest post-test score, respectively. The control group began with the third lowest score and concluded with the third lowest score while experimental group 3, which stopped the use of the Breath Builder™, started with the highest pretest score and concluded with the lowest post-test score.

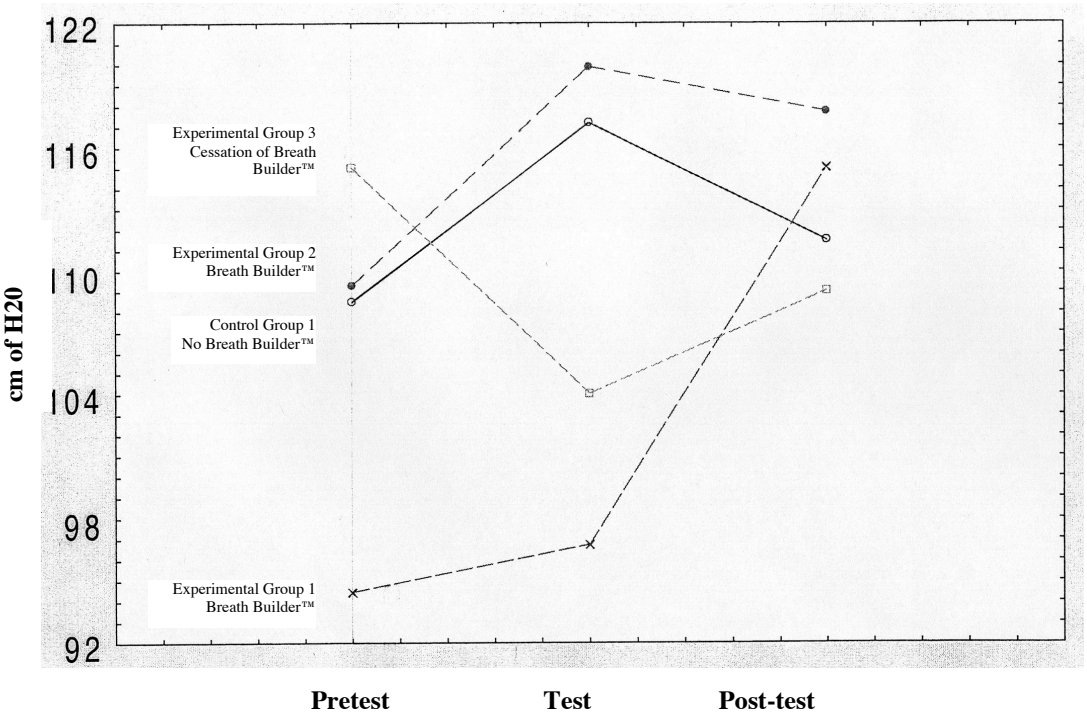


Figure 1: MIP Interaction Effect

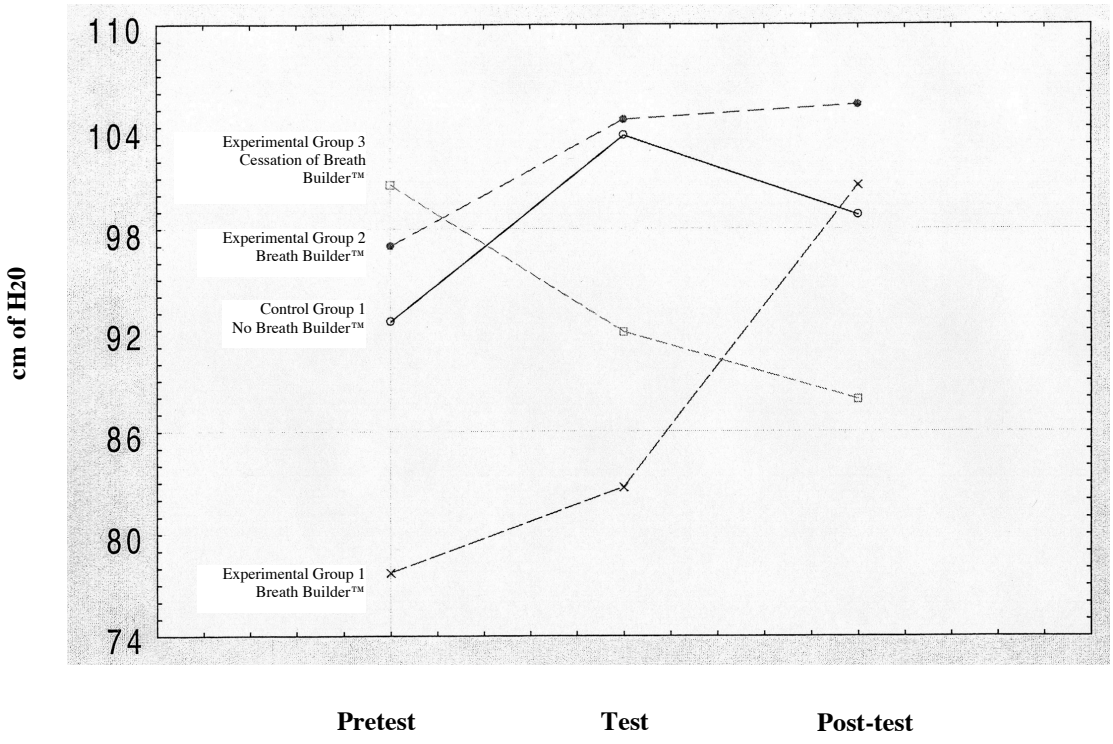


Figure 2: MIP_1 Interaction Effect

In analyses addressing the second research question, no significant main effect or interaction effect differences were found by music performance abilities.

Conclusion

Breath control is a vital skill essential to all wind musicians. With this understanding, Harold Hansen invented the Breath Builder™ to aid his students. The significant interaction effect for the lung function measurements of MIP and MIP_1 demonstrates that subjects using the Breath Builder™ improved in inspiratory muscle strength. In addition, after cessation of the Breath Builder™ inspiratory muscle strength decreased in Experimental Group 3, losing some, but not all of the gains made while using the Breath Builder™. Until now, no studies had been conducted on breathing devices and musicians. The results of this study demonstrate that further research on the Breath Builder™ and other such devices is warranted and should be conducted. This

seminal research may serve both performers and pedagogues in that as a result of this study, this technique may be more readily adopted and used by musicians to help improve performance.

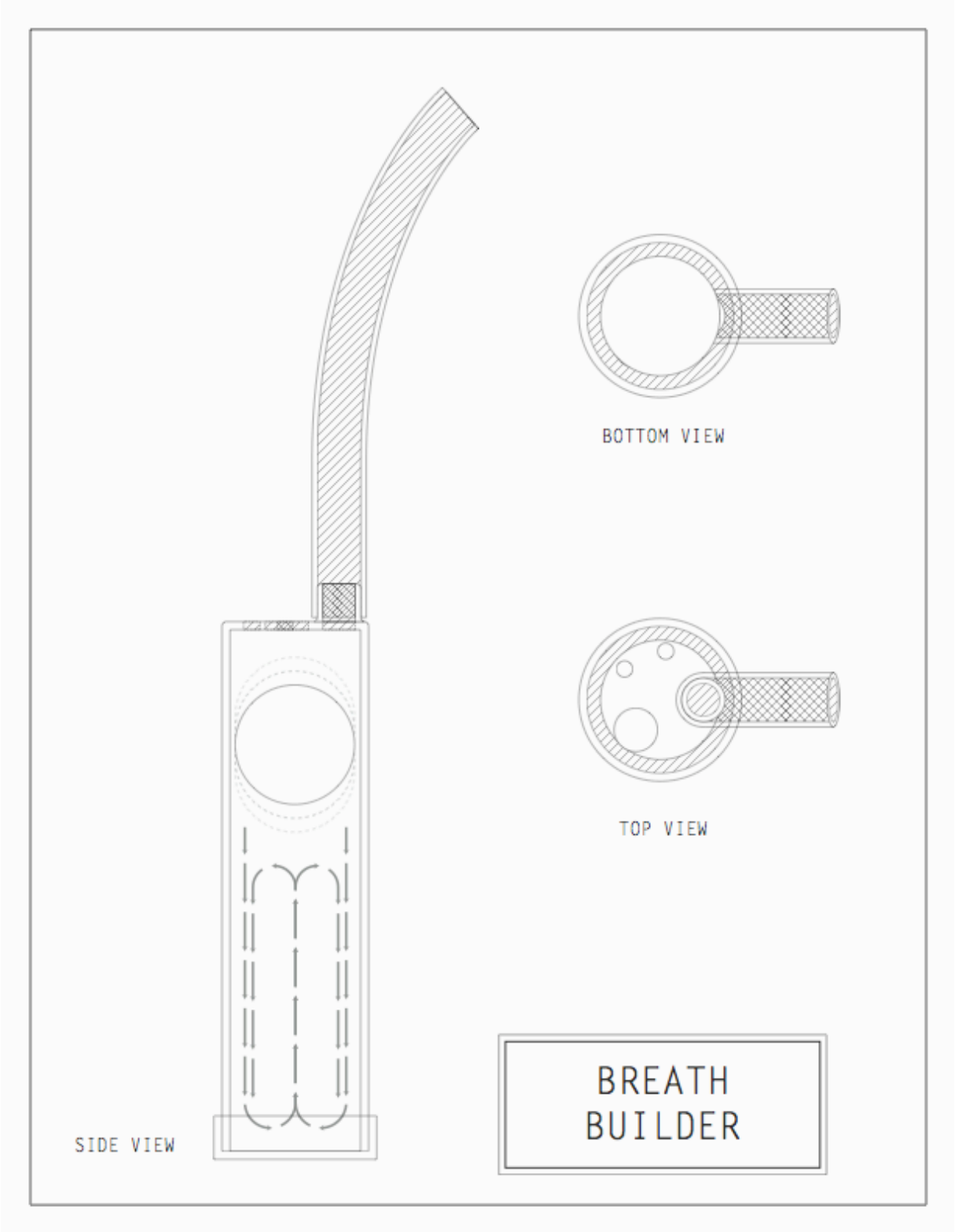
APPENDIX A

THE BREATH BUILDER™

RDG Woodwinds (2004). *Breath Builder*. Retrieved November 24, 2008, from http://www.rdgwoodwinds.com/product_info.php?products_id=412

APPENDIX B

2-D TECHNICAL ILLUSTRATION OF THE BREATH BUILDER™



REFERENCES

Agostini, P., Calvert, R., Subramanian, H., Naidu, B. (2008). Is incentive spirometry effective following thoracic surgery? *Interactive CardioVascular and Thoracic Surgery, 7*(2), 297-300.

Akgün N, & Ozgönül H. (1967). Lung volumes in wind instrument (zurna) players. *The American Review of Respiratory Disease, 96*(5), 946-51.

Allen, S. W. (1973). Breath control. *The Instrumentalist, 28*(3), 51-53.

Basoglu, O.K., Atasever, A., Bacakoglu, F. (2005). The efficacy of incentive spirometry in patients with COPD. *Respirology, 10*(3), 349-53.

Bouhuys, A. (1964). Lung volumes and breathing patterns in wind-instrument players. *Journal of Applied Physiology, 19*, 967-965.

Bouhuys, A. (1969). Physiology and musical instruments. *Nature*, *221*, 1199-1204.

Bouhuys, A. (1965). Sound-power production in wind instruments. *Journal of the Acoustical Society of America, 37*(3), 453-456.

Bouhuys, A. & van Lennep, H. J. (1962). Effect of body posture on the lungs. *Journal of Applied Physiology, 17,* 38-42.

Brymer, J. (1976). *Clarinet*. New York: Schrimer Books.

Celli, B.R., Rodriguez, K.S., & Snider, G.L. (1984). A controlled trial of intermittent positive pressure breathing, incentive spirometry, and deep breathing exercises in preventing pulmonary complications after abdominal surgery. *American Review of Respiratory Disease, 130*, 12–15.

Coates, J. E., Chinn, D. J., & Miller, M.R. (2006) *Lung Function-Physiology, Measurement and Application in Medicine*. (6th Ed.). Malden, MA: Blackwell Publishing.

Deniz, O., Savci, S., Tozkoparan, E., Ince, D. I., Ucar, M. & Ciftci, Faruk. (2006). Reduced pulmonary function in wind instrument players. *Archives of Medical Research, 37*, 506-510.

Dull, J.L. & Dull, W.L (1983). Are maximal inspiratory breathing exercises or incentive spirometry better than early mobilization after cardiopulmonary bypass? *Physical Therapy,* 63, 655–659.

Fouse, S. B. (1980). Breath control exercises. *The Instrumentalist, 34*(6), 36-39.

Frederickson, B. (1996). *Arnold Jacobs: Song and Wind*. United States of America: WindSong Press Limited.

Frederickson, B. personal communication, February 7, 2008.

Frederickson, B. (n.d.). *Wind Song Press*. Retrieved April 2008, from http://www.windsongpress.com

Gale, G.D. & Sanders, D.E. (1980). Incentive spirometry: Its value after cardiac surgery. *Canadian Anaesthetists' Society Journal,* 27, 475–480.

Gilbert, T. (1998). Breathing difficulties in wind players. *Maryland Medical Journal Jan.,* 23-27.

Gething, A.D., Williams, M., Davies, B. (2004). Inspiratory resistive loading improves cycling capacity: A placebo controlled trial. *British Journal of Sports Medicine, 38*(6), 730-7.

Griffiths, L.A., McConnell, A.K. (2007). The influence of inspiratory and expiratory muscle training upon rowing performance. *European Journal of Applied Physiology, 99*(5), 457-66.

Grocock, R. G. (1957). Articulating the brasses, a symposium: Part II, breath support and tone placement considerations. *The Instrumentalist, 12*(1), 87-88.

Healthwise (n.d.). *Information and resources: Lung function tests*. Retrieved July 2007, from http://www.webmd.com/

Hegvik, Arthur (1970). An interview with Anthony Gigliotti. *Woodwind Anthology*, *2*, 180-186.

Holm, C. P. (1997). *Correctives to breathing hindrances in flute performance, with emphasis on the Alexander technique.* (Doctoral Dissertation, Southern Baptist Theological Seminary, 1997). Retrieved from ProQuest Digital Dissertations. **(**AAT 3101834**)**

Jacobs, A. (2007). *Legacy of an artist*. [CD]. Tempe, AZ: Summit Records.

Jacobs, A. (2000). *Portrait of an artist*. [CD]. Tempe, AZ: Summit Records.

Johnson, K. personal communication, February 28, 2008.

Kelly, K. (1983). Medical-musical analysis: The dynamics of breathing with Arnold Jacobs and David Cugell, M.D. *The Instrumentalist*, *38*(5), 6-12.

Lakin, R. (1969). Basic respiration for wind playing. *The Instrumentalist, 23*(9), 48-51.

Laurie Visual Etudes v. Chesebrough Ponds Inc. 473 F. Supp. 951 (S.D. N.Y. 1979).

Laurie Visual Etudes v. Chesebrough Ponds Inc. 105 Misc. 2d 413, 432 N.Y.S. 2dn 457 (1980).

Laurie Visual Etudes v. Chesebrough Ponds Inc. 83 A.D. 2d 505, 441 N.Y.S. 2nd 88 (1981).

Leuba, C. (1980). A new look at breath support. *The Instrumentalist, 34*(9), 68-71.

Lucia, R. M. (1993). *The effects of playing a musical wind instrument in asthmatic teenagers*. (Doctoral dissertation, Columbia University Teacher's College, 1993). Retrieved from ProQuest Digital Dissertations. (AAT 9400578)

Matte, P., Jacquet, M., Van Dyck, M., et al. (2000). Effects of conventional physiotherapy, continuous positive airway pressure and non-invasive ventilatory support with bi-level positive airway pressure after coronary artery bypass grafting. *Acta Anaesthesiologica Scandinavica, 44*, 75–81.

Mazzeo, R. (1981). *The Clarinet: Excellence and Artistry*. Sherman Oaks, CA: Alfred Publishing.

McArdle, W., Katch, F.I., Katch, V.L. (1996) *Exercise physiology: energy, nutrition, and human performance, (4th ed.)*. Baltimore, MD: Williams & Wilkins.

McCarthren, D. (1962) Special Problems of Single Reed Instruments. *Woodwind Anthology , 2,* 93.

McIntosh, J. M. and Thomas, J. A. (1994). Are incentive spirometry, intermittent positive pressure breathing, and deep breathing exercises effective in the prevention of postoperative pulmonary complications after abdominal surgery? *Physical Therapy*, *74*(1), 3-16.

Mosby's medical, nursing, and allied health dictionary, (6th ed.). (2002). St. Louis, MO: Mosby Inc.

Nelson, B. (2006). *Also Sprach Arnold Jacobs: A Developmental Guide for Brass Wind Musicians*. Buchloe, Germany: Polymnia Press.

Overend, T. J., Anderson, C. M., Lucy, S. D., Bhatia, C., Jonsson, B. I. & Timmermans, C. (2001). The effect of incentive spirometry on postoperative pulmonary complications : A systematic review. *Chest, 120*, 971-978.

Parreira, V.F., Tomich, G.M., Britto, R.R. & Sampaio, R.F. (2005). Assessment of tidal volume and thoracoabdominal motion using volume and flow-oriented incentive

spirometers in healthy subjects. *Journal of Medical and Biological Research, 38,* 1105-1112.

Phillips, K. H. (1985). The effects of group breath-control training on the singing ability of elementary students. *Journal of Research in Music Education*, *33*(3), 179-191.

Pino, D. (1980). *The Clarinet and Clarinet Playing*. New York: Charles Scribner's Sons.

Pullen, R. L. Jr. (2003). Teaching bedside incentive spirometry. *Nursing*, from http://findarticles.com/

Quanjer, P. H. (n.d.). Become and expert in expirometry. Retrieved March 16, 2008, from http://www.spirxpert.com/.

RCJournal.com (1991). AARC clinical practice guideline: incentive spirometry. *Respiratory Care 36*(12), 1402-1405. Retrieved October13, 2007, from http://www.rcjournal.com/.

Renieri, N. personal communication, April 27, 2008.

Ricksten, S-E., Bengtsson, A., Soderberg, C., et al. (1986). Effects of periodic positive airway pressure by mask on postoperative pulmonary function. *Chest,* 89, 774–781.

Romanini, W., Muller, A.P., Carvalho, K.A., et al. (2007). The effects of intermittent positive pressure and incentive spirometry in the postoperative of myocardial revascularization. *Arquivos Brasileiros de Cardiologia, 89*(2), 94-9, 105-10.

Schwieger, I., Gamulin, Z., Forster, A., et al. (1986). Absence of benefit of incentive spirometry in low-risk patients undergoing elective cholecystectomy: A controlled randomized study. *Chest,* 89, 652–656.

Sehmann, K. H. (2000). The effects of breath management instruction on the performance of elementary brass players. *Journal of Research in Music Education*, *48*:2, 136-150.

Sheel, W. A. (2002). Respiratory muscle training in healthy individuals. *Sports Medicine, 32*:9, 567-581.

Stanley, D. A. (1975). Breathing techniques for the tuba player. *The Instrumentalist, 30*(3), 55-57.

Stock, M.C., Downs, J.B., Cooper, R.B., et al. (1984). Comparison of continuous positive airway pressure, incentive spirometry, and conservative therapy after cardiac operations. *Crititcal Care Medicine, 12*, 969–972.

Stock, M.C., Downs, J.B., Gauer, P.K., et al. (1985). Prevention of postoperative pulmonary complications with CPAP, incentive spirometry, and conservative therapy. *Chest, 87*, 151–157.

Stone, Dr. W. H. (1874). On wind pressure in the human lungs during performance on wind instruments. *Proceedings of the Physical Society of London, 1*, 13-14.

Stubbins, W. H. (1965). *The Art of Clarinetistry*. Ann Arbor: Ann Arbor Publishers.

Swanson, P. J. (2004). Using the breath builder. Retrieved October 17, 2007, from http://www.hickeys.com/cgi/search.cgi/.

Thurston, F. (1956). *Clarinet Technique*. London: Oxford University Press.

Tose, G. (1962). *Artistic Clarinet-Technique and Study*. Hollywood, CA: Highland Music Company.

Underwood, K. personal communication, March 2, 2008.

University of Pittsburgh Medical Center (2004). Incentive spirometry. Retrieved October 18, 2007, from http://patienteducation.upmc.com/.

Verges, S., Boutellier, U. & Spengler, C. M. (2008). Effect of respiratory muscle endurance training on respiratory sensations, respiratory control and exercise performance: A 15-year experience. *Respiratory Physiology & Neurobiology, 161,* 16–22.

Walker, K. E. (1989). Teaching young flutists breath control. *The Instrumentalist, 43*(6), 56.

Waln, G. (1978) Relaxed concentration: An interview with Mitchell Lurie. *Woodwind Anthology , 2,* 274-277.

Weindler, J. & Kiefer, Dr. R.-T. (2001). The efficacy of postoperative incentive spirometry is influenced by the device-specific imposed work of breathing. *Chest*, 119,1858-1864.

Weisberg, Arthur (1975). *The Art of Wind Playing*. New York: Schirmer Books.

West, Charles (1979). Preventing Reed Warpage. *Woodwind Anthology*, *2*, 309.

Weston, Pamela (1976). *The Clarinet Teacher's Companion*. London: Breitkopf and Hartel Ltd.

Westwood, K., Griffin, M., Roberts, K., et al. (2007). Incentive spirometry decreases respiratory complications following major abdominal surgery. *Surgeon, 5*(6), 339-42.

Willaman, Robert (1954). *The Clarinet and Clarinet Playing*. New York: Carl Fischer.

Wylegala, J. A., Pendergast, D. R., Gosselin, L. E., Warkander, D. E. & Lundgren, C. E. G. (2007). Respiratory muscle training improves swimming endurance in divers. *European Journal of Applied Physiology, 99*, 393-404.