Support or Resistance? Examining Breathing Techniques in Choral Singing

by

Duane Cottrell

Editor's note: Author Duane Cottrell presented research found in this article at the 2009 ACDA National Convention in Oklahoma City. He and colleague Brian Galante co-presented an interest session titled "Tension in the Balance and Common Voice Science Issues for the Choral Conductor."

The ultimate goal of every choral rehearsal is the creation of a strong, healthy, and vibrant choral tone. Most choral conductors would agree that the foundation of good vocal tone is proper breath support.[1] However, the current pedagogy of breathing for choral singing lacks a consistent connection to both modern scientific research and historical vocal pedagogy. Historically, most early teachers of singing minimized the importance of breath "support" (the modern approach) in favor of emphasizing glottal resistance.[2] Scientifically, we are now able to see and measure vocal processes through modern technology that were a mystery even a decade ago.

Given this lack of scientific and historical integration into the current repertoire of choral pedagogy, the most commonly accepted techniques for choral breathing may be incomplete. Both modern scientific studies and historical literature re-confirm three useful principals that may help refine our pedagogy: first, that the full use of both the chest and abdomen is necessary for good breathing; second, that opposing muscular forces must be balanced during controlled expiration; and third, that good breath support is entirely dependent upon firm glottal closure.

Duane Cottrell is the director of choral activities at Portland State University, where he conducts the PSU Chamber Choir, University Choir, and teaches undergraduate and graduate conducting. Duane Cottrell dco@pdx.edu

The Science of Breathing

"Breath support" is perhaps more difficult to define than any concept in choral pedagogy. William Vennard defined breath support as good control of subglottal pressure.[3] If this is correct, then an understanding of breath support requires an understanding of the underlying concepts of both subglottal pressure and airflow. Turning a hose on at the spigot increases the flow of water. Partially obstructing the opening with your thumb increases the pressure just behind the opening. Both of these concepts work together to yield greater velocity in the water coming out of the hose. As it relates to breathing, the airflow is the measure of the volume of air passing through the vocal opening, as managed by the musculature of the rib cage and abdomen. The subglottal pressure is the measure of air pressure just below the vocal mechanism, which is managed by the laryngeal structures. Airflow is directly linked to subglottal pressure, just as in the garden hose illustration, and good vocal tone is largely a result of the right balance of subglottal pressure and airflow.[4] Increasing the airflow yields little to no result if there is insufficient resistance to increase the subglottal pressure. In order to manage subglottal pressure and airflow, singers must learn to manipulate both expiratory force and glottal resistance.

Expiratory Force

The combination of processes that works to move air out of the lungs past the vocal folds is called expiratory force. The muscular activity of the abdomen and chest, both of which are a necessary part of a well-supported tone, have been a primary focus of choral pedagogy.[5] Particularly, teaching choral singers to utilize the muscles of the abdomen to support their tone was a staple of choral pedagogy for most of the

twentieth century.[6] As part of this abdominal approach to breath support, much attention was focused on the diaphragm, which, unfortunately, has been misunderstood for years as a component of the expiratory support process.[7] The diaphragm—an inverted bowl-shaped muscle that forms the floor of the thorax and the roof of the abdominal cavity—is actually a muscle of inspiration that contracts to draw air into the lungs, and relaxes during expiration (in our case, singing).[8] The abdominal breathing method, though popular among choral conductors, robs singers of a significant amount of lung capacity and breathing power by ignoring the contribution made by the chest to a well-supported tone.

The chest, in addition to the abdomen, is a critical factor in breath support for singing.[9] The intercostal muscles of the chest are used to expand and collapse the ribcage, and have received less attention than the abdomen in the pedagogical literature of choral singing.[10] The external intercostals lift and expand the ribcage and lungs, which draws air into the lungs. During expiration, the internal intercostals contract the ribcage, collapsing the volume and forcing air out of the lungs. Because the surface area of the lungs attached to the ribcage greatly exceeds that attached to the diaphragm, utilizing the ribcage for both inspiration and expiration allows a greater volume of air to be processed. It should be noted that thoracic breathing—using the chest—is quite different from clavicular breathing, and the two should not be confused.[11] Thoracic breathing expands the chest wall outward to increase the circumference of the chest and the volume of the lungs, and does not involve the shoulders and clavicles. Choral singers could easily be taught to utilize the chest without adding unnecessary tension by raising the shoulders.

Scientific studies have shown that during elite classical singing, there is a complex interaction between both the thoracic and abdominal muscle groups.[12] Watson and Hixson discovered that both the rib cage and abdomen are highly active in all subjects during classical singing.[13] Inspiration begins with the contraction of the diaphragm and the relaxation of the abdominals. This is followed immediately by an expansion of the chest cavity, caused by the action of the external intercostals. This combination of abdominal and thoracic expansion is the most significant way to increase the volume of the lungs.[14] At a specific point during the breathing cycle, usually as the singer begins to sing, the balance of power shifts to the muscles of expiration. As the diaphragm relaxes slightly, the abdominals and internal intercostals contract, putting pressure on the lungs and expelling air. During expiration, the external intercostals and diaphragm remain slightly contracted in order to provide resistance to the expiratory force from the internal intercostals and abdominals. This resistance keeps the expiratory muscles from contracting too quickly and air from being forced out too rapidly. When supporting a sung tone using this method, the abdominal muscles exert pressure on the lower portion of the lungs while the intercostals are engaged to exert pressure on the upper portion of the lungs, resulting in maximum expiratory force.[15] Many choral conductors commonly employ the abdominal breathing technique, but the balanced breathing approach described here provides the singer with more direct control over airflow and subglottal pressure, and is the best method for consistent breath support.[16] Singers must be able to control and balance all these muscular forces in order to maintain the correct level of airflow and subglottal pressure. Unless choral singers are made aware of, and trained in the control of,

the muscles of both the abdomen and the chest, this kind of control is unlikely.

Glottal Resistance

Expiratory force, an essential component of supported singing, must be accompanied by appropriate resistance from the vocal folds. Glottal configuration has a significant impact on subglottal pressure, but unfortunately this concept has been conspicuously absent from the literature of choral pedagogy.[17] Without an appropriate configuration of the vocal folds, even the most "well-supported" airflow will sound breathy and weak. The limitations of this article prevent a full review of the anatomy related to glottal closure. However, firm glottal closure is the result of the contraction of two sets of laryngeal muscles – the inter-arytenoids and the lateral crico-arytenoids.[18] Contracting both sets of muscles brings the arytenoid cartilages together while the remaining three-fifths of the vocal folds oscillate.[19] Engaging only one of these sets of muscles results in either a loose glottal configuration or a posterior glottal "chink," both of which cause breathiness and weak tone quality.

Schneider and Bigenzahn report that between 1998 and 2000, 546 normal-speaking young females underwent videostroboscopic and voice range profile examinations and it was discovered that a large majority (76.2%) of subjects studied showed an incomplete glottal closure during soft phonation, both speaking and singing. When increasing the intensity, a significant percentage (34.9%) still showed incomplete closure.[20] Additional studies indicate that glottal closure is essential to a well supported tone. Sonninen reports that subglottal pressure is determined by both respiratory and glottal forces.[21] Thorpe describes that an increase in support for singers meant a raised rib cage, active ribs, a reduced airflow, and some type of glottal adjustment.[22] Austin states that the opposing forces of breath and resistance are required to make a beautiful tone.[23] Choral ensembles and individual singers would benefit greatly if choral conductors spent time working toward complete glottal closure and firm phonation as part of the breath support training process. Unless trained to do otherwise, most singers will not sing with firm glottal closure, and there is a written legacy of vocal pedagogy that supports this idea.

Breath Support in Historical Singing Treatises

Vocal pedagogy of the eighteenth and nineteenth centuries provides many valuable insights and techniques that were not carried forward in the tradition of choral singing. The Complete Treatise on the Art of Singing by Manuel Garcia II codified a great deal of vocal pedagogy and provides an appropriate starting place to examine the historical literature. Perhaps most significant to note regarding Garcia's teaching and writing is that he devoted very little time to breathing (only about one-half of a page in his Treatise) and a great deal more to the actual production of tone.[24] In spite of this absence of breathing instruction in his treatise, Garcia did suggest that singers should take a quiet breath with a raised chest and lowered diaphragm. He continued that "to advise the abdominal breathing exclusively would reduce by one half the element of strength most indispensable to the singer, the breath."[25] Garcia strongly believed that breathing power was related to glottal resistance. He advocated firm glottal closure and the use of the coup de la glotte or glottal onset in training glottal closure.[26] Following Garcia, the physician Louis Mandl (1812–81) taught the lutte vocale, or "vocal struggle."[27] This struggle, as he described it, was a balance between inspiratory and expiratory muscular forces. Francisco Lamperti (1813–92) advocated abdominal (belly-out) breathing only. He also taught reduced airflow by placing a lit candle in front of the lips of a singer. If the flame flickered, the singer was expelling too much air. Lamperti also popularized the term "appoggio," which means, "to lean," and is still in use today to describe a balanced approach to respiration that requires a high level of muscular control.[28] His son, Giovanni Lamperti (1839–1910), departed slightly from his ideas by teaching singers to use the top and bottom of the lungs. The younger Lamperti stated that the voice controls the breath, not the other way around, which is an early way of describing the role of glottal resistance in breath support. He went on to state that the breath is held back by glottal resistance and muscular tension, again similar to the later scientific concept of airflow.[29] Lamperti taught that insufficient pressure makes the tone unsteady. In his teaching, nearly 150 years old and well before modern science defined them, the principles of glottal resistance, airflow,

and subglottal pressure were clearly present. Finally, singing teacher William Shakespeare (1849–1931) taught a breathing method that combined rib-cage breathing with diaphragmatic breathing.[30] He also advocated the same balance of inspiratory and expiratory forces described in the lutte vocale and appoggio techniques. As Garcia before him, Shakespeare rejected the use of loose glottal closure in all singing.

An examination of vocal pedagogy from the Bel Canto period reveals that the concepts of expiratory force and glottal resistance have both been taught throughout the history of singing. Because choral conductors may be the only voice teacher many students ever have, we should consider a return to a balanced focus on glottal resistance and expiratory force as the best way to teach breath support for singing.

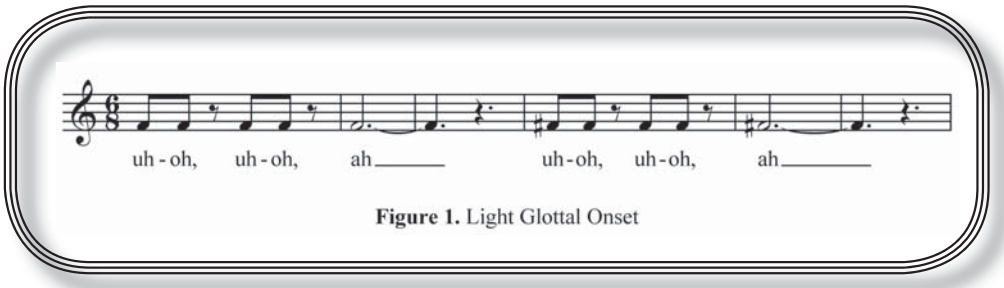

Figure 1. Light Glottal Onset

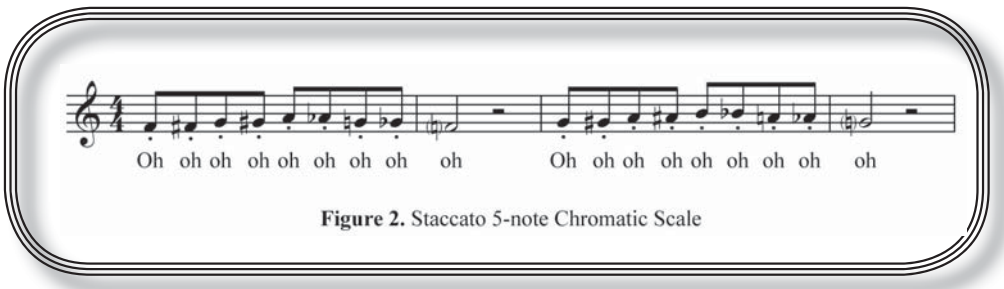

Figure 2. Staccato 5-note Chromatic Scale

Practical Considerations

If it is true that many singers are singing with loose glottal closure, then focusing on muscular support will never produce the effect on their tone we are seeking.[31] In addition to teaching the mechanics of both abdominal and thoracic breathing, and the balance between the two that is the result of appoggio, we must find ways to introduce them to the feeling of bringing the arytenoids together in firm glottal closure. Manuel Garcia (1805-1906) did this with a slightly glottal onset he called the coup de la glotte. To feel this onset, quietly speak the American English phrase, "uh-oh." This type of light glottal onset is not harmful in any way, and can be easily translated into a sung tone in a voice-building exercise (Figure 1).

Another variation on this technique was described by Homer Henley.[32] By singing groups of five semitones in sharply struck staccato, the vocal folds are made to re-engage with each note, rather than remain loosely adducted in a legato gesture. Again, the light glottal onset is the key, as using an aspirate 'h' will not likely yield the type of closure desired (Figure 2).

Using this type of onset in performance is not recommended, but by utilizing the light glottal onset during voice-building, singers can learn to feel the sensation of a firm glottal closure, which is likely to translate into firmer, clearer tone quality in all their singing.

Firm glottal closure must, of course, be coupled with a well-supported column of air. The amount of literature on training choral singers to support the airflow with muscular control is voluminous, and therefore unnecessary to repeat in this article. However, it is worthwhile to note that compliant singers may be constricting their chests in a raised or expanded position in order to follow a choral conductor's instructions to use only the abdomen to breathe. It could be beneficial to instruct singers that the chest should expand and collapse freely while sing-

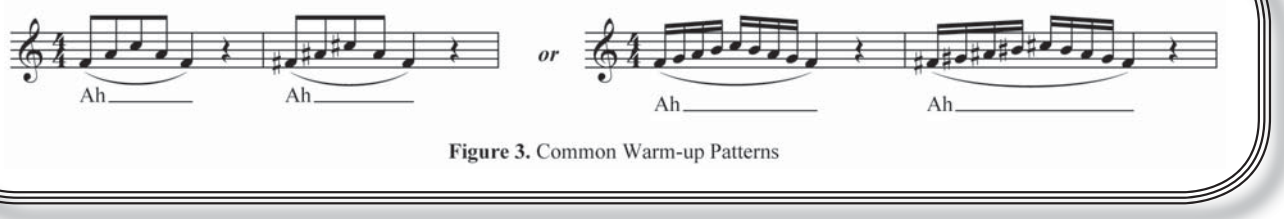

Figure 3. Common Warm-up Patterns

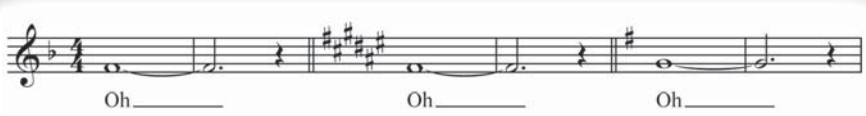

Figure 4. The Sustained Tone

ing, making a conscious effort not to raise the shoulders or clavicles. This may greatly expand their support capacity. In any case, it is important to remember that breathing is one area of singing that can be improved by consistent and methodical training.[33]

One final application of these concepts to the choral rehearsal is the use of the sustained tone in voice building. Many choral rehearsals begin with the all-too familiar arpeggiated or scalar "warm-up" patterns (Figure 3). Because of the rapid pitch changes, particularly intervallic changes, these exercises often make it difficult for a singer to coordinate proper management of breath with the production of good tone, and were often reserved for more advanced training in historical singing treatises (Figure 3).

By contrast, many methods of training such as those by Franz Abt, Frederick Root, or D.A. Clippinger begin instead with a long sustained tone on a vowel more conducive to a low laryngeal posture (Figure 4).[34] Beginning with a sustained tone and vowel allows a singer to concentrate on breath management and tone production, making corrections and adjustments as necessary.

Austin states the benefit of such an approach is "[the coordination of] the breath and the resistance offered by the vocal folds."[35] By using a sustained tone in voice-building sessions before each rehearsal, choral conductors are standing on the foundation of centuries of vocal pedagogy, and, as a result, choral singers reap the benefits of increased glottal resistance and greater breath support, leading to a more beautiful tone and the ability to sustain a legato phrase.

Conclusion

The pedagogy of today's choral conductor is an inherited legacy handed down from twentieth-century figures John Finley Williamson and William J. Finn, and influenced along the way by Wilhelm Ehmann and many others.[36] We all tend to "teach the way we were taught," but there appears to be little connection between the great vocal pedagogues of the eighteenth and nineteenth centuries, modern research in voice science, and the choral methods of today. Historical writings and contemporary research together clarify three important

concepts related to breathing for singing:

- that the use of the chest is just as vital as the abdomen;
- the balance of inspiratory and expiratory forces known as appoggio is perhaps more critical than the amount of expiratory force; and
- the concept of breath support is just as much a matter of glottal resistance as it is muscular expiratory force.[37]

As choral conductors, we are indebted to the great choral pedagogues that preceded us. However, if we limit ourselves and our teaching to that which we were taught, or that which was passed down to us, we miss out on a great number of time-tested and effective pedagogical principles in use long before the twentieth century. In addition to historical pedagogical literature, there is a wealth of new information being discovered every year regarding the voice and how it works. Choral conductors would be wise to keep abreast of current developments, in addition to building an historical foundation to their teaching by reading the work of the great pedagogues of the past. Doing so can only help our choirs sing better.

NOTES

[1] Gerald F. Darrow, *Four Decades of Choral Training* (Metuchen, N.J.: The Scarecrow Press, Inc., 1975), 49.

[2] Stephen F. Austin, "Two-headed Llamas and the lutte vocale," *Journal of Singing* 62, no. 1 (September/October 2005): 85.

[3] William Vennard, *Singing: The Mechanism and the Technic* (New York: Carl Fischer, 1967).

[4] Scott McCoy, *Your Voice: An Inside View* (Princeton, NJ: Inside View Press, 2005), 97.

[5] Darrow, 50.

[6] Ibid., 54.

[7] Ibid., 52.

[8] McCoy, 87.

[9] Monica Thomasson and Johan Sundberg, "Consistency of Phonatory Breathing Patterns in Professional Operatic Singers," *Journal of Voice* 13, no. 4 (December 1999): 540.

[10] Darrow, 56.

[11] Richard Miller, *The Structure of Singing* (New York: Schirmer, 1986), 28–29.

[12] Aatto Sonninen, A.-M. Laukkanen, K. Karma, and P. Hurme, "Evaluation of Support in Singing," *Journal of Voice* 19, no. 2 (June 2005): 234.

[13] Peter J Watson and Thomas J. Hixon, "Respiratory Kinematics in Classical (Opera) Singers," *Journal of Speech and Hearing Research* 28 (1985): 112.

[14] Monica Thomasson and Johan Sundberg, "Consistency of Breathing Patterns in Professional Operatic Singers," *Journal of Voice*

Bibliography

Abt, Franz. *Practical Singing Tutor.* New York: Schirmer, 1893

Austin, Stephen F. "Two-headed Llamas and the lutte vocale," *Journal of Singing* 62, no. 1 (September/October 2005): 85–89.

Austin, Stephen F. "First Things First," *Journal of Singing* 64, no. 1 (September/October 2007): 89–93.

Clippinger, D.A., *The Clippinger Class Method of Voice Production.* Philadelphia: Oliver Ditson, 1932.

Darrow, Gerald F. *Four Decades of Choral Training.* Metuchen, N.J.: The Scarecrow Press, Inc., 1975.

Ehman, Wilhelm. *Choral Directing.* Minneapolis: Augsburg, 1968.

Emmons, Shirlee. *Prescriptions for Choral Excellence.* Oxford: Oxford University Press, 2006.

Garcia, Manuel. *A Complete Treatise on the Art of Singing: Part One,* translated and edited by Donald Paschke. New York: Da Capo Press, 1984.

Henley, Homer. "Garcia's Second Discovery." *Etude* 49, no. 5 (May, 1931): 360–61.

Lundy, Donna S., Soham Roy, Roy R. Casiano,, Joseph Evans, Paula A. Sullivan, and Jun W. Xue, "Relationship Between Aerodynamic Measures of Glottal Efficiency and Stroboscopic Findings in Asymptomatic Singing Students." *Journal of Voice* 14, no. 2 (June 2000): 178–83.

McCoy, Scott. *Your Voice: An Inside View,* Princeton, NJ: Inside View Press, 2005.

Miller, Richard. *The Structure of Singing.* New York: Schirmer, 1986.

Phillips, Kenneth H. and Randall E. Aitchison, "Effects of Psychomotor Instruction on Elementary General Music Students' Singing Performance." *Journal of Research in Music Education* 45, no. 2 (Summer 1997):185–96.

15, no. 3 (September 2001): 377.

[15] Peter J Watson, Jeannette D. Hoit, Robert W. Lansing, and Thomas J. Hixon, "Abdominal Muscle Activity During Classical Singing," *Journal of Voice* 3, no. 1 (March 1989): 31

[16] Sonninen, 236.

[17] Darrow, 50.

[18] Duane Cottrell, "Voice Science in the Choral Rehearsal: Examining Glottal Onset," *The Choral Scholar* 1, no.1 (Spring 2009): 38.

[19] James Stark, *Bel Canto: A History of Vocal Pedagogy* (Toronto: University of Toronto Press, 1999), 11.

[20] Berit Schneider and Wolfgang Bigenzahn, "Influence of Glottal Closure Configuration on Vocal Efficacy in Young Normal-speaking Women," *Journal of Voice* 17, No. 4 (December 2004): 478.

[21] Sonninen, 236.

[22] C. William Thorpe, Stephen J. Cala, Janice Chapman, and Pamela J. Davis, "Patterns of Breath Support in Projection of the Singing Voice," *Journal of Voice* 15, no. 1 (March 2001): 103.

[23] Stephen F. Austin, "First Things First," *Journal of Singing* 64, no. 1 (September/October 2007): 92.

[24] Stark, 97.

[25] Garcia, Manuel. "A Complete Treatise on the Art of Singing: Part One," translated and edited by Donald Paschke (New York: Da Capo Press, 1984), 33.

[26] Cottrell, 36–40.

[27] Austin 2007, 87.

[28] Stark, 102.

[29] Stark, 104.

[30] Stark, 105.

[31] Donna S. Lundy, Soham Roy, Roy R. Casiano, Joseph Evans, Paula A. Sullivan, and Jun W. Xue, "Relationship Between Aerodynamic Measures of Glottal Efficiency and Stroboscopic Findings in Asymptomatic Singing Students," *Journal of Voice* 14, no. 2 (June 2000): 183.

[32] Homer Henley, "Garcia's Second Discovery," *Etude* 49, no. 5 (May, 1931): 361.

[33] Kenneth H Phillips and Randall E. Aitchison, "Effects of Psychomotor Instruction on Elementary General Music Students Singing Performance," *Journal of Research in Music Education* 45, no. 2 (Summer 1997): 195.

[34] Franz Abt, Practical *Singing Tutor* (New York: Schirmer, 1893); F.W. Root, School of Singing (Chicago: Geo. F. Root & Sons, 1873); D.A. Clippinger, *The Clippinger Class Method of Voice Production* (Philadelphia: Oliver Ditson, 1932).

[35] Austin 2007, 92.

[36] Gerald F. Darrow, *Four Decades of Choral Training* (Metuchen, N.J.: The Scarecrow Press, Inc., 1975);Wilhelm Ehman, *Choral Directing* (Minneapolis: Augsburg, 1968).

[37] Shirlee Emmons, *Prescriptions for Choral Excellence* (Oxford: Oxford University Press, 2006), 19.

Root, F.W. *School of Singing*. Chicago: Geo. F. Root & Sons, 1873.

Schneider, Berit, and Wolfgang Bigenzahn, "Influence of Glottal Closure Configuration on Vocal Efficacy in Young Normal-speaking Women." *Journal of Voice* 17, no. 4 (December 2004): 468–80.

Sonninen, Aatto, A.-M. Laukkanen, K. Karma, and P. Hurme, "Evaluation of Support in Singing." *Journal of Voice* 19, no. 2 (June 2005): 223–37.

Stark, James. *Bel Canto: A History of Vocal Pedagogy*. Toronto: University of Toronto Press, 1999.

Thomasson, Monica and Johan Sundberg, "Consistency of Phonatory Breathing Patterns in Professional Operatic Singers." *Journal of Voice* 13, no. 4 (December 1999): 529–41.

Thomasson, Monica and Johan Sundberg, "Consistency of Breathing Patterns in Professional Operatic Singers." *Journal of Voice* 15, no. 3 (September 2001): 373–83.

Thorpe, C. William, Stephen J. Cala, Janice Chapman, and Pamela J. Davis, "Patterns of Breath Support in Projection of the Singing Voice." *Journal of Voice* 15, no. 1 (March 2001):86–104.

Vennard, William. *Singing: The Mechanism and the Technic*. New York: Carl Fischer, 1967.

Watson, Peter J. and Thomas J. Hixon, "Respiratory Kinematics in Classical (Opera) Singers." *Journal of Speech and Hearing Research* 28 (1985): 104–22.

Watson, Peter J., Jeannette D. Hoit, Robert W. Lansing, and Thomas J. Hixon, "Abdominal Muscle Activity During Classical Singing." *Journal of Voice* 3, no. 1 (March 1989): 24–31.

Watson, Peter J., Thomas J. Hixon, Elaine T. Stathopoulos, and Daniel R. Sullivan, "Respiratory Kinematics in Female Classical Singers." *Journal of Voice* 4, no. 2 (June 1990): 120–28.