Fall 10-20-2004

Breathing for Singers: A Comparative Analysis of Body Types and Breathing Tendencies

Jennifer Griffith Cowgill
Florida State University

THE FLORIDA STATE UNIVERSITY

SCHOOL OF MUSIC

BREATHING FOR SINGERS: A COMPARATIVE ANALYSIS OF BODY TYPES AND BREATHING TENDENCIES

By

JENNIFER GRIFFITH COWGILL

A Treatise submitted to the
School of Music
in partial fulfillment of the
requirements for the degree of
Doctor of Music

Degree Awarded
Fall semester, 2004

The members of the Committee approve the treatise of Jennifer Griffith Cowgill defended on October 20, 2004.

Larry Gerber
Professor Directing Treatise

Richard Morris
Outside Committee Member

Yvonne Ciannella
Committee Member

Roy Delp
Committee Member

The Office of Graduate Studies has verified and approved the above named committee members.

ACKNOWLEDGMENTS

There are many people who have helped make this project possible. I would like to thank my doctoral committee for their support throughout this process. Specifically, I would like to thank voice Professor Larry Gerber for his time, efforts and insights in directing this project. Thanks go to Professor of Voice Roy Delp for his contributions. Very special thanks go to Dr. Richard Morris, Professor of Communication Disorders, for inspiring me to pursue voice science and for his constant help and knowledge. A very special thank you goes to my voice teacher and mentor, Professor of Voice, Yvonne Ciannella for her never ending support, encouragement and intense knowledge which will stay with me for a lifetime.

Other thanks go to Professor Bill Thomas, Professor of Respiratory Care, at Darton College for training me to use a spirometer. Thanks go to Dr. Lindsay Carter, author of the *Heath-Carter Somatotype Instruction Manual* and Professor of Exercise and Nutritional Sciences at San Diego State University, for his help and guidance towards this project and for allowing me to use pictures from his manual. Last but not least, I would like to thank my husband Steven Cowgill for providing computer support and constant encouragement.

TABLE OF CONTENTS

List of Tables	v
List of Figures	vi
Abstract	vii
INTRODUCTION	1
1. BREATHING TECHNIQUES	4
2. METHODS	10
3. DATA RESULTS	21
4. DISCUSSION	28
CONCLUSION	32
APPENDICES	34
BIBLIOGRAPHY	41
BIOGRAPHICAL SKETCH	44

LIST OF TABLES

1. Somatotyping Results 22
2. Somatotype Calculations 35
3. Mean and Standard Deviation of Breath Movement Measurements During Singing 36
4. Spirometric Results. Mean Values for FVC, FEV, FEV/FVC and Peak flow with Standard Deviations in Parentheses 37

LIST OF FIGURES

1. Skinfold-Triceps	13
2. Skinfold-Subscapular	14
3. Skinfold-Supraspinale	14
4. Skinfold-Medial Calf	15
5. Breadth- Biepicondylar Humerus	16
6. Breadth-Biepicondylar Femur	16
7. Girth-Arm (Flexed and Tensed)	17
8. Girth-Calf (Flexed and Tensed)	17
9. Lung Capacity Measurements	24
10. Measurements of FEV/FVC Ratio	24
11. Measurements of Peak Flow	25
12. Extent of Movement During the Breath Cycle	26

ABSTRACT

Breathing for Singers: A Comparative Analysis of Body Types and Breathing Tendencies is a scientific study the purpose of which is to determine whether a correlation exists between inexperienced young singers' body types and their breathing tendencies. A group of twelve students was used for the study and underwent three groups of measurements. First their body types were determined by the method of somatotyping. This method placed them in one of three body type categories, endomorph (relative fatness), mesomorph (relative musco-skeletal) and ectomorph (relative linearity). There were four subjects placed in each group. Second, the subjects' lung function was measured by use of a spirometer to rule out any lung function problems. Finally, the participants' torsos were videotaped from a side view. The data was then uploaded onto a computer where the breath measurements of each subject were measured frame by frame in three places; chest, umbilicus and rib cage. After all of the measurements were taken they were compared to one of three breathing techniques the *appoggio*, the costal and the pancostal. Once the data was complete a comparison was made to see whether or not the singers' body types correlated with one of the three stated breathing techniques.

INTRODUCTION

The fat opera singer is a stereotype so pervasive that it has spawned a cliché applied to everything from sports to politics. It has appeared in cartoons and films, on television and in books. Ask any person who is not a fan of the genre and he or she may describe opera as fat ladies with voices that can shatter glass. Like many stereotypes, it is ridiculous. Classical singers come in all shapes and sizes, and while some opera singers may carry a few extra pounds, there are also other great singers that have slight or athletic frames. It is this diversity in physical condition that can add to the challenge of teaching breathing for singing. For while all would agree that short people and tall people run with different gaits, or that the strong man lifts a 100 pound weight much easier than the weak man, it is arguable whether voice teachers attempt to tailor their student's vocal instruction based on body type or physical makeup. Classical singing, like running or lifting weights, is an unnatural and essentially athletic endeavor. The goal of this research project is to determine whether or not individuals with different body types differ in their breathing tendencies. This study will focus on breathing for singing, and will examine beginning level, young female voice students.

The first step involved in this process was to select a group of beginning young voice students and to classify them according to body type. In order to make the study as accurate as possible each subject was put through a series of measurements to determine her specific somatotype. Somatotyping, a system of placing subjects in different body types, is a method developed by William Sheldon in the 1940s. It was refined over many years by physiologists and kinesiologists, and eventually perfected by Dr. Lindsay Carter at San Diego State University. Somatotyping places individuals into three categories: endomorphs (relative fatness), mesomorphs (relative musco-skeletal robustness), and ectomorphs (relative linearity). For this study, each participant was anthropometrically measured, and placed into one of the three categories. The subject was then videotaped to determine where breath movement occurred, and if there existed a particular breathing tendency based on the specific body type.

Each subject stood with her left side facing a video camera, and sang four measures of a song. Measurements were taken at specific points on the torso where breath movement occurred during singing. These points were then correlated with a specific breathing technique, namely the *appoggio*, the costal, or the pancostal breathing technique. As a control, the singers were then given a pulmonary function test to verify normal lung capacity as well as the absence of any breathing ailments. Only young voice students within their first two years of training were used; singers who smoked were not allowed to participate in the study.

The hypothesis for this research is that a person's body type may influence breathing tendencies while singing. In years of practical experience as a singing teacher, the author has observed that breathing tendencies do vary across body somatotypes. Specifically, these pragmatic observations indicated that overweight individuals have a tendency to breathe lower in the abdominal region than those with less body fat. Conversely those individuals who were lean seemed to breathe higher in the thoracic region than those having athletic builds, who seemed to breathe more in the rib cage area.

If the hypothesis of the study is confirmed, the benefits to teaching breathing for singing could be enhanced. However, few teachers can be expected to have either the training or the tools to place their pupils into various somatotypes. The goal is to give the teacher of voice specific criteria to look for when dealing with beginning level students. If, through the application of common sense, the teacher can see that a singer is an endomorph, carrying more fat than muscle, and knows that endomorphs naturally tend to breathe in the belly rather than the chest, then the teacher has one of two options: either teach a technique that correlates with the student's specific breathing tendency, or teach the technique he or she believes to be the most efficient, regardless of the student's breathing tendency. If the teacher decides on the first option, then knowing where the breathing tendencies lie can help toward improving the student's breathing technique. This approach need not apply only to beginning singers. Singers who have had years of formal training still might need guidance, since, through poor training or poor discipline, they may have developed a breath management style that feels physically comfortable, but actually makes singing more difficult. Others may be out of practice, or may have forgotten some of their training. In these cases the teacher can quickly determine and classify the student's body type visually, and look for the origin of the breath in order to deal with the issues at hand.

This research project is not intended to endorse any one of the three breathing techniques or to imply that every voice teacher must teach any one of the three. Each teacher must make his or her own decisions with regard to teaching breath management. This paper endorses a flexible teaching style. By recognizing that the body type of a singer could cause a tendency towards a certain breathing style, the teacher can tailor a breath management program that meets the specific needs of the student.

The goal of this research project is twofold. First, it is to explore the body type and breathing tendencies of young female singers to see if a correlation exists, and second it is to provide the teacher of voice with more information concerning young singers. Is body type important with regard to breathing tendencies? Do athletic singers breathe differently than their slim or stout counterparts? If the answer is yes, of what consequence is it to the teacher of voice? Should teachers of voice modify their teaching styles to take advantage of this information? Ultimately that is up to each individual instructor of voice. Some will undoubtedly use this information to modify their own instructions in dealing with their students. In chapter one, breathing techniques will be discussed in greater detail. In chapter two, the methodology of the study will be explained, and in chapter three the data will be presented. Finally, in the conclusion, the results of the study will be discussed.

CHAPTER ONE

BREATHING TECHNIQUES

Breathing for singing has been studied, researched and well documented by many voice pedagogues since Francesco Lamperti published his treatise on the art of singing in the 1880s. Most well known voice pedagogues agree that breathing, or breath management, is one of the most crucial technical elements in classical singing, and that breathing is fundamental to good singing and a healthy vocal technique. Richard Miller writes, "Breath management is the essential foundation for all skillful vocalism."[1] Richard Alderson believes that "breath is the foundation on which singing is established and good breathing is the basis for all good singing,"[2] while William Vennard states that "if his breathing can be improved his singing can also."[3] There is a consensus among most pedagogues that in order to ensure a healthy vocal technique, it is important for both the teacher and the student to understand breathing, as well as the anatomy and overall function of the vocal mechanism.

The vocal mechanism consists of three parts: the motor (respiratory system), the vibrator (larynx), and the resonator (vocal tract). Although an understanding of all three functions is important, particular attention should be given to the breath cycle and/or respiratory system. Without proper breathing, healthy phonation or singing cannot occur. While teachers agree that breathing is of extreme importance in singing, they debate about which breathing technique is the most effective and efficient. Some teachers rely solely on the technique they have been taught, and others may teach the technique that is most popular at the moment; therefore, a wide variety of breathing techniques can be employed. Two of the most popular techniques are the costal or intercostal breathing technique, and the *appoggio* technique. Included in this study is a third, perhaps less popular technique, the pancostal breathing technique. In his glossary of terms, Vennard defines the pancostal breathing technique as "breathing for singing while holding in the abdominals strongly, on the theory that this would maintain a high central tendon, causing

[1] Richard Miller, *Training Soprano Voices* (New York: Oxford University Press, 2000) 32.
[2] Richard Alderson, *Complete Handbook of Voice Training* (New York: Parker Publishing Co., 1979) 28.
[3] William Vennard, *Singing: the Mechanism and the Technic* (New York: Carl Fischer, 1967) 18.

the diaphragm to raise the ribs; chest breathing."[4] Alderson's definition of the costal or intercostal breathing technique is "rib breathing." He explains that "the intercostal muscles expand the rib cage and hold it except during long rests, at which time the ribs draw in to a more normal position."[5] Richard Miller writes concerning the *appoggio* technique that, "With regard to breath management, *appoggio* maintains for a remarkable period of time a posture near that which pertained at the beginning of the inspiratory phase of the breath cycle."[6] He also states that "both the epigastric and the umbilical regions should be stabilized so that a feeling of internal-external muscular balance is present. This sensation directly influences the diaphragm."[7]

Although there has been research on various breathing techniques, there has been little research done on whether outside factors affect the type of breathing technique an individual singer naturally adopts. For example does a person's body type determine the type of breathing the singer tends to use prior to formal training? This study is designed to discuss various breathing techniques and to determine whether a correlation exists between a singer's body type and breathing technique.

It is imperative that the singer and the teacher of singing understand how the vocal mechanism functions in order to practice healthy vocal habits. The vocal mechanism is a tripartite instrument that consists of three interdependent parts. These are the motor or actuator, the vibrator, and the resonator. The actuator or respiratory system is the source of power for the vocal mechanism, and is the wind supply. The vibrator consists of the vocal cords, which turn the energy of the actuator into a series of compression and rarefaction waves that are caused by the vibration of the vocal cords.[8] The resonator is the vocal tract, and its function is to shape the vibrations from the larynx into intelligible speech, to improve the timbre of the voice and increase its intensity.[9] Teachers and students of singing need to understand that all three of these elements play a significant role in the act of singing. No one element can be separated from the others for healthy singing to occur.

The respiratory system is the motor of the voice and "without respiration none of the other elements of singing would function."[10] Just as a car needs its motor to function, the vocal

[4] William Vennard, *Singing: the Mechanism and the Technic* (New York: Carl Fischer, 1967), 243.
[5] Richard Alderson, *Complete Handbook of Voice Training* (New York: Parker Publishing Company, 1979), 36.
[6] Richard Miller, *Training Soprano Voices* (New York: Oxford University Press, 2000), 24.
[7] Ibid. 24.
[8] William Vennard, *Singing: the Mechanism and the Technic* (New York: Carl Fischer, 1967), 14.
[9] Ibid. 15.
[10] Richard Alderson, *Complete Handbook of Voice Training* (New York: Parker Publishing Company, 1979), 28.

mechanism needs its motor or respiratory system to function. The focus of the research will be on the respiratory system.

According to Miller, the simple definition of respiration is "the breath cycle; the exchange of internal and external gases."[11] Respiration is a complex physiological process that consists of a cycle of two phases, the inspiratory phase or inhalation and the expiratory phase or exhalation. During the inspiratory phase, the diaphragm contracts and moves downward, increasing the volume of the thorax thus allowing the lungs to expand and fill with air. At the same time, the external intercostal muscles contract and cause the rib cage and sternum to elevate. During the expiratory phase or exhalation the internal intercostal muscles draw the ribs inward as air is released from the lungs. The external intercostals, acting as antagonists to the internal intercostals, hold the rib cage up and out during singing, although less so during speech. During exhalation, the diaphragm relaxes, and returns it to its resting position as the air is expelled from the lungs.

Normal breathing patterns happen without conscious control. Quiet breathing occurs without conscious effort, with the depth and duration varying according to the body's needs. Although speech breathing also occurs without conscious effort, it differs from quiet breathing in the relative duration of inhalation and exhalation, in the volume of air expelled, and in the degree of muscular activity. In normal speech patterns, the natural cycle of respiration provides a sufficient amount of air for everyday speech. In singing, because of the demand put on the vocal mechanism during phonation, the expiratory phase of breathing must be treated differently than when speaking.

Most voice pedagogues agree that there should be expansion of the thoracic area during the inspiratory phase of respiration, but there is still some disagreement on the best method of breathing during phonation, or the expiratory phase. The disagreement about what happens during the respiratory cycle is the reason that various breathing techniques are taught. Three techniques currently in use are the *appoggio* technique, the pancostal breathing technique, and the costal breathing technique. Each addresses use of different muscles during phonation.

The *appoggio* technique comes from the historic Italian school of singing, and its name comes from the verb *appoggiare,* which means "to lean against or to be in contact with."[12] Miller teaches this technique and states that "*Appoggio* is a system for combining and balancing

[11] Richard Miller, *The Structure of Singing* (New York: Schirmer Books, 1986), 308.
[12] Richard Miller, *Training Soprano Voices* (New York: Oxford University Press, 2000), 32.

muscles and organs of the trunk and neck, controlling their relationships to the supraglottal resonators, so that no exaggerated function of any one of them upsets the whole."[13]

The basic philosophy of the *appoggio* technique is that the singer should remain stabilized during phonation and maintain the inspiratory position while singing. To facilitate this technique, the sternum (breastbone), umbilicus (navel) and epigastric regions (area between the sternum and navel), as well as the lateral planes (areas on both sides of umbilicus), move outward during inhalation. The diaphragm pushes downward and expands the lower thorax; simultaneously, the external intercostals elevate the ribs and sternum. These actions increase the volume of the lungs allowing them to fill with air. During the expiratory stage there is a slight inward movement upon the initial onset of singing but the overall expansion remains stable throughout the singing phase, gently moving inward towards the end of the phrase. This allows for the release and renewal of the breath.

Grouped in the same family as the *appoggio* technique is diaphragmatic or abdominal breathing. This breathing technique is closely related to the *appoggio* technique. In both the *appoggio* technique and diaphragmatic breathing, the epigastric region expands upon inhalation; however, during exhalation, or phonation, the diaphragmatic technique places more emphasis on the "in and up" movement of the lower abdominal area than does the *appoggio* technique.

The pancostal breathing technique follows the typical pattern of respiration in its inspiratory phase, but during the expiratory phase, the abdominal muscles are pulled in tightly. In contrast, the *appoggio* and costal techniques require that the epigastrium remain stabilized throughout the expiratory phase. Pulling in on the abdomen tightens the abdominal muscles and pulls them inward towards the pubic bone. According to William Vennard, Lilli Lehmann used this technique throughout her career. [14] The technique is controversial, with some pedagogues arguing that it is counterproductive and creates unnecessary tension.

Costal breathing, sometimes called intercostal breathing or rib breathing, occurs when the singer expands his or her ribs during inhalation and keeps stabilized while singing. This technique is based on the idea that stabilizing the expansion of the rib cage will better control the diaphragm. During inhalation, the external intercostals pull the rib cage out and hold it steady, allowing the lungs to fill with air. During exhalation or phonation, the external intercostals hold the rib cage steady, thus helping to support the upper torso and allowing the diaphragm to relax.

[13] Richard Miller, *The Structure of Singing* (New York: Schirmer Books, 1986), 23.
[14] William Vennard, *Singing the Mechanism and the Technic* (New York: Carl Fischer, 1967), 24.

The basis of this technique is that the rib cage plays a significant role in steadying the body and keeping the expansion that is needed during phonation. Although both the costal and the *appoggio* techniques are similar, in that the body maintains expansion while singing, the costal technique differs slightly by emphasizing movement of the ribs instead of the movement of the epigastrium.

While there is some debate among voice pedagogues as to which of these techniques is the most efficient for singing, it is the general consensus among Vennard, Alderson and Miller that a form of breathing that maintains the stabilization of the epigastric region is the most efficient. Proponents of *appoggio* and costal techniques agree that the torso must remain in an expanded posture during the singing of a phrase, that is, during the expiratory phase of breathing. The pancostal breathing technique states that the abdominal area should be pulled in tightly while singing a phrase. Most voice teachers agree that during inhalation the singer's thoracic and abdominal regions expand. Miller states that the *appoggio* technique is the most efficient technique for breathing.[15] Vennard believes that a combination of diaphragmatic and rib breathing is the most effective means of breathing.[16] Alderson feels that all of these techniques must be combined for effective breathing and also states that the most effective breathing method is the one which helps the individual student sing the most effectively. He believes that no single method is perfect for all singers,[17] saying that "describing the different breathing techniques is somewhat like separating the aspects of walking."[18] He feels that it is virtually impossible to separate rib breathing from diaphragmatic breathing because these structures are in close proximity with each other and they move and work together in the breathing process. They must work together just as the legs and feet work together in order for a person to walk. All three pedagogues agree that the pancostal method of breathing is inefficient in singing and yields less productive results.

The question is whether these breathing techniques, which elongate the body's natural breathing patterns, are learned, or whether young, beginning level singers have tendencies toward one or the other because of outside factors. For example, does body type contribute to the way a person breathes while singing? Although these techniques are mostly learned, are there tendencies toward one or the other of the techniques based on body type? If so, can the

[15] Richard Miller, *The Structure of Singing* (New York: Schirmer Books, 1986), 24.
[16] William Vennard, *Singing: the Mechanism and the Technic* (New York: Carl Fischer, 1967), 24.
[17] Richard Alderson, *Complete Handbook of Voice Training* (New York: Parker Publishing Company, 1979), 55.
[18] Ibid.34.

breathing tendencies of singers be measured and yield results correlating body type and breathing tendency? Also, if body type does correlate with breathing technique, does it mean that that particular technique is the most efficient for that individual? Although there is extensive research regarding different breathing techniques used by singers, little has been done which examines whether an outside factor such as a singer's body type could determine which breathing technique a singer is most inherently apt to practice. Because the purpose of this research is to measure natural rather than learned tendencies, beginning level young singers were used. The subjects were observed to determine whether their breathing tendencies inclined toward the *appoggio,* costal or pancostal technique, and whether or not body type has any correlation with these techniques.

CHAPTER TWO

METHODS

Subject Selection

A group of thirty volunteers underwent the somatotyping process. Of those, twelve were found who matched the criteria for extreme endomorph, mesomorph and ectomorph. These twelve completed the full research project.

Participants

The participants, all Caucasian sopranos, ranged in age from 18 to 22 years. All were within their first two years of vocal study, all in good health and with no known vocal, speech or lung ailments at the time the measurements were taken. They each completed a questionnaire (see appendix A) to confirm three things, namely, that they had no more than two years of vocal training, that they had no lung problems, and that they were not smokers. Each subject participated in three sets of measurements. The first group of measurements determined the subject's body type using the somatotyping technique of measurement. The second group of measurements assessed whether the subject's breathing tendencies correlated to stated breathing techniques, and the third group of measurements determined lung capacity and lung function.

Procedures

Somatotyping.

Somatotyping, a method of classifying body shape and composition, was originally developed by the American psychologist William Sheldon in the 1940s. Sheldon conducted a study of 46,000 males and rated them, placing them into three main categories which he designated as endomorphs, mesomorphs and ectomorphs according to their body shape and to the fat, muscle and leanness of each subject. Endomorphs were those who were overweight and had a higher percentage of body fat than muscle mass. Mesomorphs were muscular and had a higher percentage of muscle mass than body fat, while ectomorphs were very thin and had little percentage of body fat or muscle mass. Sheldon developed a rating system with three scales, one for each somatotype. The numbers on each scale ranged from one to seven, with seven being the highest. The three scales rated the amount of endomorphy first, the amount of mesomorphy second, and the amount of ectomorphy last. Most individuals measured high in two of the three categories. For example with a rating of 7-6-1 a subject could be called a mesomorphic endomorph. This is because the amount of endomorphy is slightly higher than the amount of mesomorphy. There are extreme cases where the subjects rated very high in only one somatotype rating and are labeled as only one somatotype. For example, if a subject measured 1-1-7 they would be an ectomorph because they have the highest amount of ectomorphy.[19]

In 1980, Dr. Lindsay Carter, Professor of Exercise and Nutritional Sciences at San Diego State University, published *The Heath-Carter Anthropometric Somatotype Instruction Manual.* Carter wrote the manual to help train young scientists to measure somatotypes using a mathematical formula developed by him.

---

[19] James and Tyra Arraj, "Tracking the Elusive Human, Volume 1," Inner Explorations, http://www.innerexplorations.com/catpsy/3.htm.

In 1986, Jeannette D. Hoit and Thomas Hixon wrote *Body Type and Speech Breathing* which was published in the *Journal of Speech and Hearing Research*. This study measured twelve subjects and placed them into somatotype groups using Carter's formula. For the purpose of their study they needed subjects that displayed prominence in one component of body type.[20] They needed extreme endomorphs, mesomorphs and ectomorphs. In accordance with the formula, (see pages 18-19 of this document) prominence of ectomorphy or mesomorphy was assigned as "a rating of at least three points higher… than the other two components rated." Endomorph prominence, however, was given only half a point higher as a primary component than the other two somatotypes. As stated in Hoit and Hixon's article, "A more lenient criterion for endomorph prominence was required because of difficulty in finding individuals with high endomorphy rating accompanied by relatively low mesomorphy rating."[21]

The Heath-Carter Anthropometric Somatotype Instruction Manual was also used. Carter defined somatotyping as "the quantification of the present shape and composition of the human body."[22] He explained that it is expressed in Sheldon's three-number rating representing endomorphy (relative fatness), mesomorphy (relative musculo-skeletal robustness), and ectomorphy (relative linearity or slenderness of a physique). Endomorphs, who when measured have a higher percentage of body fat than muscle mass or leanness, tend toward a roundness in physique rather than one of muscularity or leanness. Mesomorphs when measured have more muscle mass than body fat and have larger bone structures. Ectomorphs when measured are typically quite lean and have little body fat and little muscle mass.[23]

There are two methods, namely, the photoscopic and the anthropometric, which may be used to obtain the somatotype of an individual. For the present study the anthropometric method was used. This method requires the measurement of ten dimensions, including stretch stature or height, body mass or weight, four skinfolds (triceps, subscapular, supraspinale, medial calf) to determine body fat percentages, two bone breadths (biepicondylar humerus and femur) to determine muscle mass percentages, and two limb girths (arm flexed and tensed, calf).[24]

---

[20] Jeannette Hoit and Thomas Hixon, "Body Type and Speech Breathing," *Journal of Speech and Hearing Research,* no. 29 (1986): 314.
[21] Ibid.
[22] J.E.L. Carter, *The Heath-Carter Anthropometric Somatotype* (San Diego: J.E.L. Carter, 1980), 2.
[22] J.E.L. Carter, *The Heath-Carter Anthropometric Somatotype* (San Diego: J.E.L. Carter, 1980), 2.
[23] Ibid.
[24] Ibid.3.

The endomorphic measurements consisted of measuring the percentage of fat of each subject by use of a skin caliper. Four endomorphic measurements were taken each at the level of the triceps, (Figure 1), the shoulder blade (Figure 2), the waist (Figure 3), and the calf (Figure 4). This measuring technique consists of raising a fold of skin and subcutaneous tissue and pinching it firmly between the thumb and forefinger and away from the underlying muscle at the marked site.[25] The skin caliper is then placed one centimeter below the pinched skin to measure the body fat percentage. During a period of two weeks, each subject was measured three separate times at each of the four places, and the mean of each of the four measurements was used to determine the rating of each. The measurements as used in the present study are depicted in the following set of figures.


Figure 1: Skinfold-Triceps. Photo from *Anthropometry Illustrated* with permission from Rosscraft.

[25] Ibid.


Figure 2: Skinfold-Subscapular. Photo from *Anthropometry Illustrated* with permission from Rosscraft.

Figure 3: Skinfold-Supraspinale. Photo from *Anthropometry Illustrated* with permission from Rosscraft.

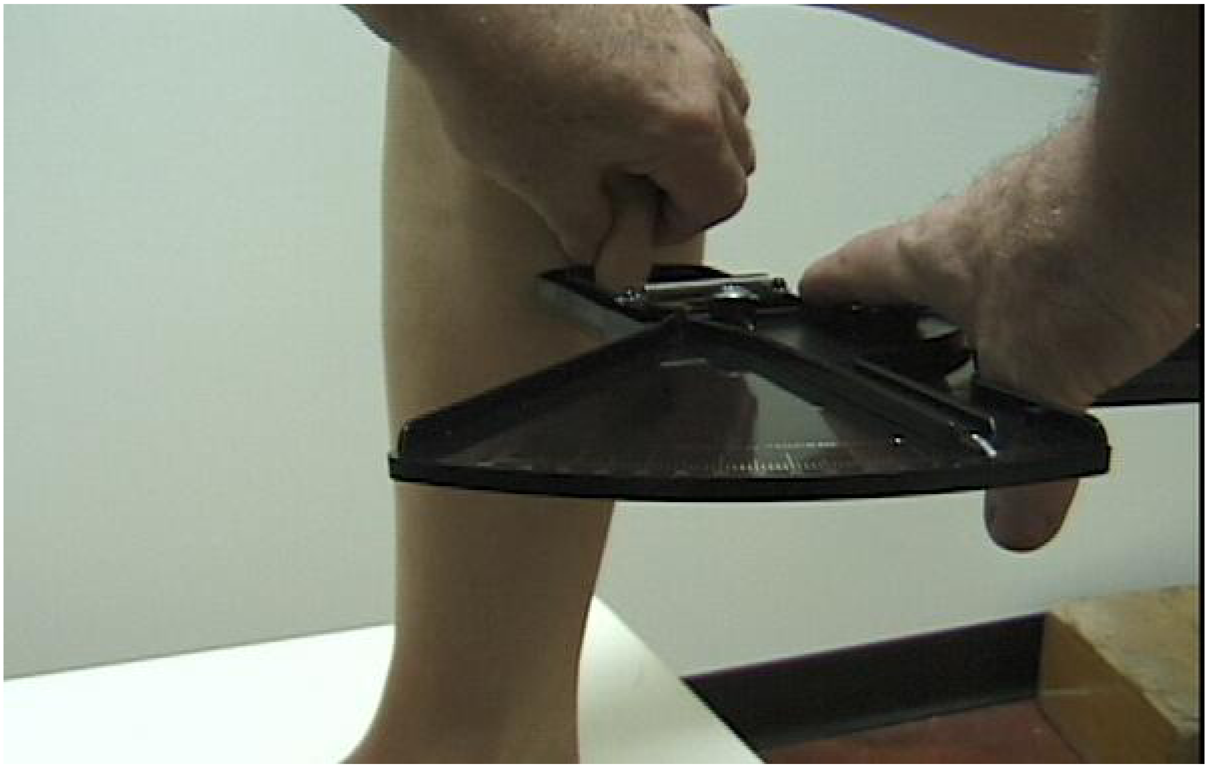

Figure 4: Skinfold-Medial Calf. Photo from *Anthropometry Illustrated* with permission from Rosscraft.

The mesomorphic measurements were taken by use of a sliding steel caliper and measuring tape. The caliper measured the widths of the humerus (Figure 5) and femur (Figure 6) in centimeters. As illustrated by the photos below, these measurements were taken by applying the caliper at angles bisecting the angle of the elbow and femur. The measuring tape was used to measure the girth of flexed and tensed biceps and calf. The greatest girth of the arm and calf were measured.[26]

[26] Ibid. 4.

Figure 5: Breadth-Biepicondylar Humerus. Photo from *Anthropometry Illustrated* with permission from Rosscraft.

Figure 6: Breadth-Biepicondylar Femur. Photo from *Anthropometry Illustrated* with permission from Rosscraft.

Figure 7: Girth-Arm (Flexed and Tensed). Photo from *Anthropometry Illustrated* with permission from Rosscraft.

Figure 8: Girth-Calf (Flexed and Tensed). Photo from *Anthropometry Illustrated* with permission from Rosscraft.

The ectomorphic measurement was calculated by the use of a measuring tape and physician's scale. The physician's scale measured the participant's weight, and the measuring tape was used to determine the subject's height.

The measurement data were recorded in a spreadsheet using the system developed by Dr. Lindsay Carter for use in somatotyping. The spreadsheet calculated the ratio of endomorphy, mesomorphy and ectomorphy of each subject. Endomorphy was calculated using the following formula: (-0.7182 + (0.1451 × subscapular measurement) - (0.00068 × supraspinale measurement) + (0.0000014 × medial calf measurement). Mesomorphy was calculated using the formula (0.858 × breadth of humerus) + (0.601 × breadth of femur) + (0.188 × measurement of biceps) + (0.161 × measurement of flexed calf) - (0.131 × weight in kilograms) + 4.5. Ectomorphy was calculated using the formula (0.732 × height/weight ratio) - 28.58. These three formulas gave each subject a somatotype rating on each of the three scales; endomorphy, mesomorphy and ectomorphy (see Appendix B). Prominence towards a specific body type was determined by the ratio of these three numbers. For ectomorphs the number rating needed to be at least three points higher than the mesomorphic and endomorphic ratings. For mesomorphs a rating of three points higher in mesomorphy was needed. For endomorphs, only one half-point over the other two somatotypes was needed for prominence to occur.[27] Each subject was placed into one of the three anthropometric categories, according to the final results.

Video Recording

Each participant video recorded the first four measures of the Italian art song *Caro mio ben*. Each singer breathed at identical places in the phrase, which were the initial breath, and a breath after each of the next three measures. The key of E-flat major and a pre-established tempo of a quarter note equals 72 in common time were the same for each singer. Only the author and the individual participant were in the room. The subjects were given the initial pitch of E-flat and sang *a cappella.* They were given several opportunities to rehearse before the recording process began.

Breathing Tendencies Assessment

To assess breathing tendencies, the participants stood 3.0 meters in front of a video camera. They stood with their left side toward the camera and wore white tank tops and slacks.

---

[27] Jeannette Hoit and Thomas Hixon, "Body Type and Speech Breathing," *Journal of Speech and Hearing Research,* no. 29 (1986): 314.

They were in front of a contrasting backdrop so that the movement of the breath would be more visible. Strips of colored tape were positioned on the subject at the level of the chest, the base of the rib cage and the umbilicus to make breath movement more visible. A Panasonic VHSC model PV-L550D video camera was set on a tripod 3.0 meters from the participant. The videotape was uploaded to a computer and converted from analog video to digital video files using the computer program Adaptec Video Capture 1.1. Each participant's video was saved as a file on a computer. The video file was viewed on a 17-inch monitor and the movement at the chest, base of rib cage, and umbilicus was measured by placing a millimeter scale on the monitor and measuring the width of the image of the trunk at the measurement points in millimeters. The maximum expansion at the end of each inhalation and the minimum position at the end of each exhalation, or sung breath, were measured, frame by frame, with a millimeter ruler. The differences between the two measurements were recorded at each of the measurement points. These differences represented the extent of movement during the singing on each breath (see Appendix C). The measurements reflected relative change as opposed to the actual magnitude of the change. The participants used four breaths each in singing the test song segment. The measurements were recorded in an Excel spreadsheet and several calculations were made. The mean of each set of measurements for each somatotype grouping was then determined and plotted on a graph. These data were statistically analyzed using analysis of variance (ANOVA) techniques. The ANOVA used was a 3x3x3 design using the three somatotypes, three breathing styles and three kinds of measurement as the levels of the factors. The tendencies were then correlated to determine any relation with one of the three stated breathing techniques, e.g., *appoggio*, pancostal or costal.

During pilot testing of the measuring system, it was noticed that the subjects took breaths that were not only lateral but vertical in movement. The entire thoracic region moved vertically as each breath was taken; therefore a fourth measurement, called vertical chest movement, was added, and incorporated into the data.

Lung Function Assessment

In order to ensure that each subject had normal lung function at the time of the measuring, each took a test by use of a spirometer. Spirometry is defined as a "versatile test of pulmonary physiology."[28] There are several different types of spirometric testing. For this study, emphasis was placed on vital capacity. When the spirometer was used, the subject formed an airtight lock around the mouthpiece of the spirometer with her lips and blew as hard and as long as possible into the spirometer. The spirometer recorded the amount of air and rate of air breathed in and out over a specified time. For purposes of this study, the test required forced inhalation, and exhalation after a deep breath. The spirometer then graphed the expired air and measured the volume of the air and the rate of the airflow. The FEV (forced expiratory volume), FVC (forced vital capacity) and the FEV/FVC were measured to analyze lung function. The FEV measured the volume of air expelled in the first second of maximal forced expiration.[29] The FVC measured the maximum amount of air that can be forcefully expired from a position of full inspiration.[30] The FEV/FVC measured the ratio of the forced expiratory volume in the first second to the forced vital capacity of the lungs. The normal value for this ratio is .70. The subjects repeated the spirometer test three times and the average of those three times was used in calculating breath lung function (see Appendix D).

---

[28] Thomas Gross, "Internal Medicine", *The Virtual Hospital*, 01 June 2002, <http://www.vh.org/adult/provider/internalmedicine/Spirometry/SpirometryHome.html>.
[29] Andrew Coker, ed., "Pulmonary Function Test," *The Health Network*, 03 December 2000, <http://www.healthnetwork.com.au/search- display.php?cat=tests&name =PULMONARY %20FUNCTION%20TEST>.
[30] Ibid.

CHAPTER THREE

DATA RESULTS

Somatotyping Results

Body type was determined by a method of measuring the leanness or fatness of a person. Ten anthropometric measurements were taken. After the measurements were taken, the data were recorded into an Excel spreadsheet. The data were calculated and each subject was given a three number rating. The rating showed the amount of endomorphy, mesomorphy, and ectomorphy of each subject.

To show prominence of one component of body type, certain criteria were followed. For ectomorphy and mesomorphy the rating of one somatotype needed to be three points higher than the other two somatotypes. Because it is difficult to find individuals with high endomorphy accompanied by low mesomorphy, the criterion for endomorphic prominence was one half-point higher for endomorphy than for the other two somatotype groups. The somatotype ratings were based on a similar study done in 1986 entitled *Body Type and Speech Breathing* by Hoit and Hixon. The ratings of the twelve subjects can be seen in the following table.

Table 1: Somatotyping Results

Subject	Endo	Meso	Ecto	Final
EN1	6	5	0.1	6-5-0.1
EN2	7	5	0.1	7-5-0.1
EN3	5	3	0.1	5-3-0.1
EN4	6	5	0.1	6-5-0.1
Mesos				
ME1	3	6	1	3-6-1.0
ME2	2	5	2	2-5-2.0
ME3	3	6	0.1	3-6-0.1
ME4	3	6	0.1	3-6-0.1
Ectos				
EC1	1	1	4	1-1-4.0
EC2	1	1	4	1-1-4.0
EC3	1	1	4	1-1-4.0
EC4	1	1	4	1-1-4.0

Lung Function Assessment Results

A spirometer was used to determine each subject's lung function. From these data, the ratio of the FEV/FVC was determined. In addition, the spirometer also indicated the rate of speed at which the breath was blown or the peak flow.

The measurements of lung function revealed the following results for FVC. The ectomorphs exhibited a mean FVC of 3.46 liters, with a standard deviation of 0.26 liters, the mesomorphs exhibited a mean FVC of 3.51 liters with a standard deviation of 0.30 liters, and the endomorphs exhibited a mean FVC of 3.71 liters with a standard deviation of 0.40 liters. As shown in Figure 9, there was very little difference among and within the somatotype groups. The analysis of variance (ANOVA) confirmed this observation, as no significant differences were found among the somatotype groups [$F(2, 9) = 0.692$, $p = .525$, $\eta^2 = .133$].

The measurements of lung function revealed the following results for FEV. The ectomorphs exhibited a mean FEV of 2.88 liters with a standard deviation of 0.14 liters. The mesomorphs exhibited a mean FEV of 3.00 liters with a standard deviation of 0.30 liters, and the endomorphs exhibited a mean FEV of 3.14 liters, with a standard deviation of 0.25 liters. As shown in Figure 9, there was very little difference among and within the somatotype groups. The ANOVA confirmed this observation, as no significant differences were found among the somatotype groups [$F(2, 9) = 1.193$, $p=.347$, $\eta^2= .210$].

Using the measurements of lung function, the following results for FEV/FVC-% could be determined. The ectomorphs exhibited a mean FEV/FVC-% of .84 with a standard deviation of .10. The mesomorphs exhibited a mean FEV/FVC-% of .86 with a standard deviation of .09, and the endomorphs exhibited a mean FEV/ FVC-% of .85 with a standard deviation of .04. As shown in Figure 10 there was very little difference among and within the somatotype groups. The ANOVA confirmed this observation, as no significant differences were found among the somatotype groups. [$F(2, 9) =0.057$, $p= .944$, $\eta^2=.013$].

The spirometer revealed the following results for peak flow. The ectomorphs exhibited a mean peak flow of 5.80 liters per second with a standard deviation of 0.70 liters per second. The mesomorphs exhibited a mean peak flow of 5.49 liters per second with a standard deviation of 0.69 liters per second, and the endomorphs exhibited a mean peak flow of 6.48 liters per second, with a standard deviation of 0.48 liters per second. As shown in Figure 11 there was very little difference among and within the somatotype groups. The ANOVA confirmed this observation, as no significant differences were found among the somatotype groups [$F(2, 9) =2.547$, $p=.131$, $\eta^2=.364$]. In conclusion, the data revealed that the lung capacity of all subjects varied little across the somatotypes, and that there was no significant difference between any of the readings determining lung capacity based on body type.

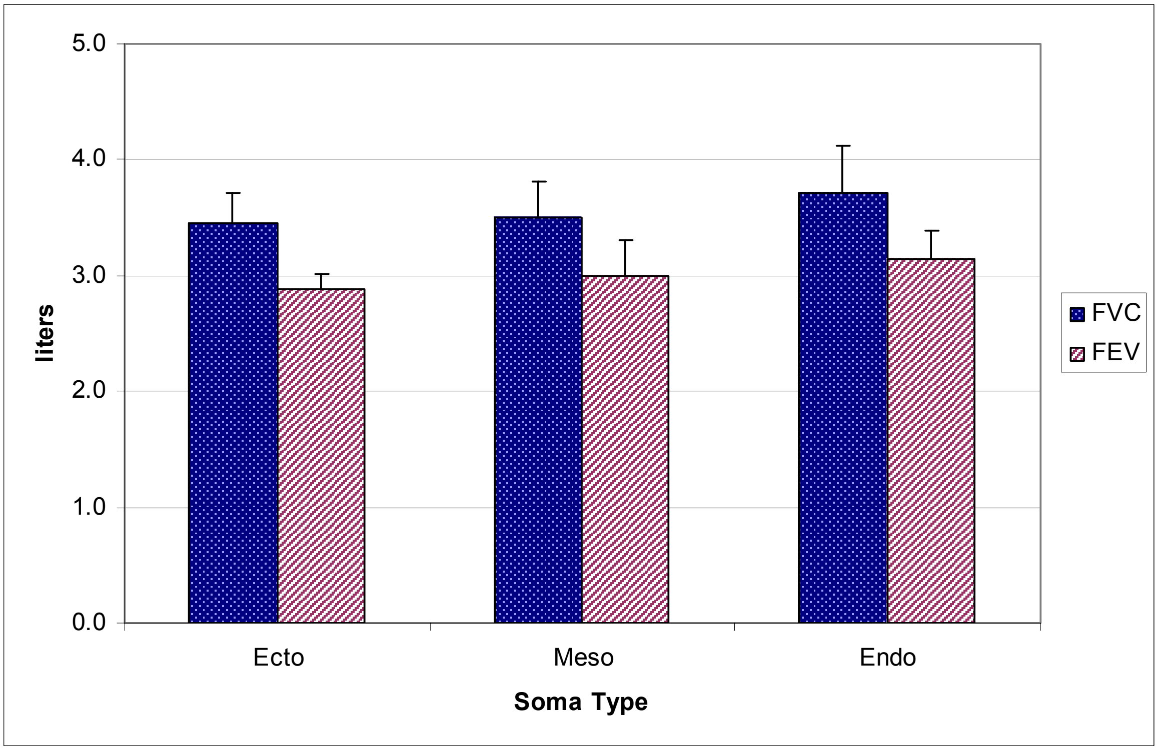

Figure 9: Lung Capacity Measurements

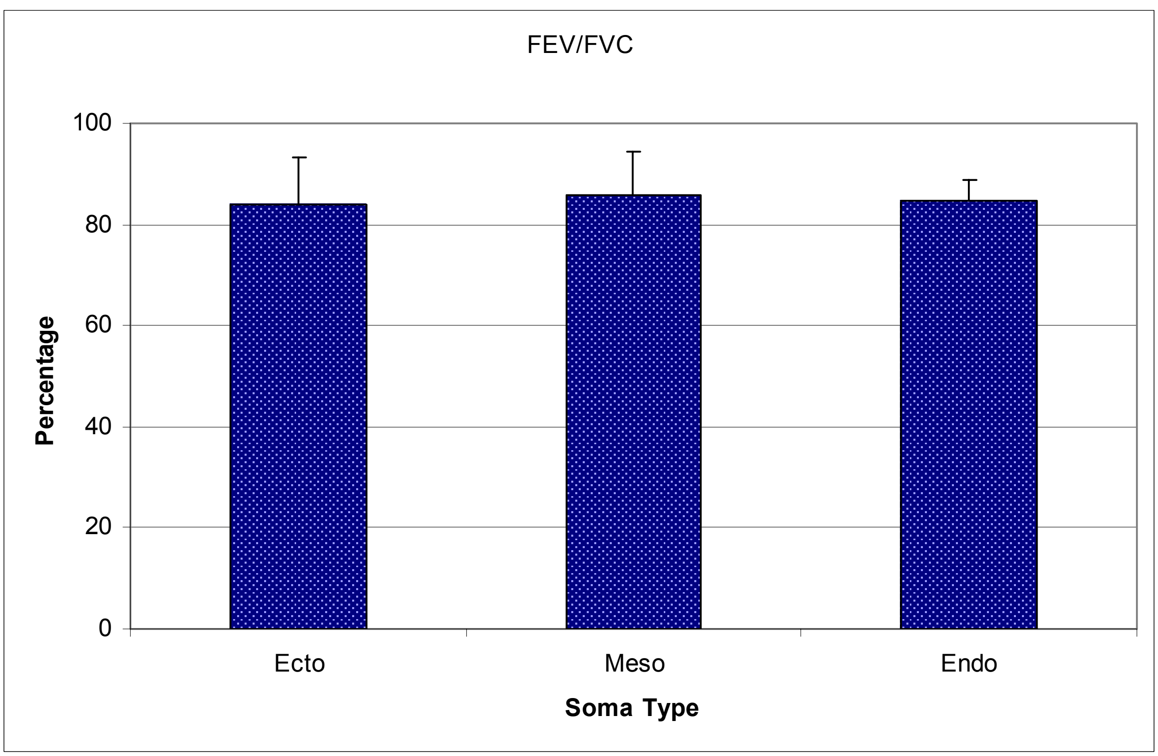

Figure 10: Measurements of FEV/FVC Ratio

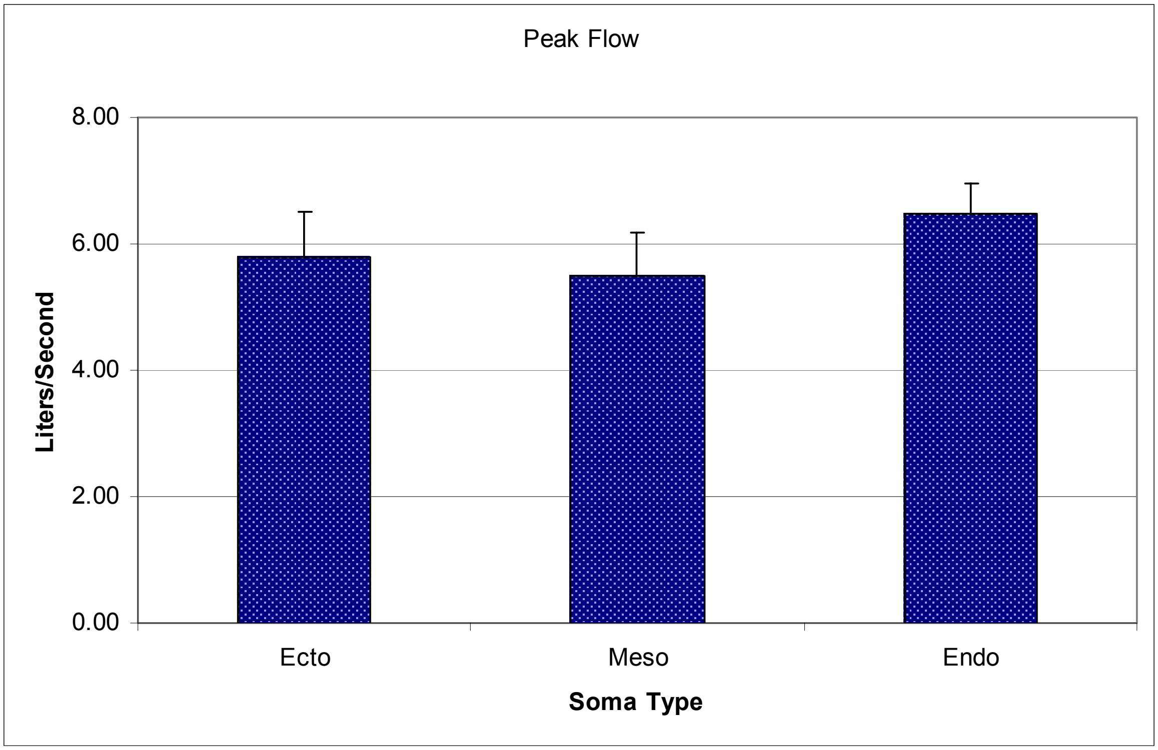

Figure 11: Measurements of Peak Flow

Breathing Results

To determine the movement patterns of the torso by each subject, a side view of the torso was videotaped. As described earlier, each subject took breaths at identical places in the song. The extent of lateral movement during exhalation was measured at the lateral chest, base of rib cage, and umbilicus. In addition, the extent of vertical movement was measured at the shoulder. All three somatotype groups exhibited movement at all four measurement locations. The movements were measured by use of a millimeter scale.

The differences between the somatotypes were compared using a repeated measure ANOVA. The data revealed that there were significant differences among the somatotypes in terms of the area of movement and place of breath. [$F(2, 9) = 6.206$, $p = .020$, $\eta^2 = .580$] (see

Figure 12). The eta squared effect size of .58 indicates a large effect size.[31] This indicates differences in movement related to the somatotype. The four places of breath movement presented in Figure 12 show the pattern of breathing for each of the three somatotype groups, endomorphs, mesomorphs and ectomorphs.

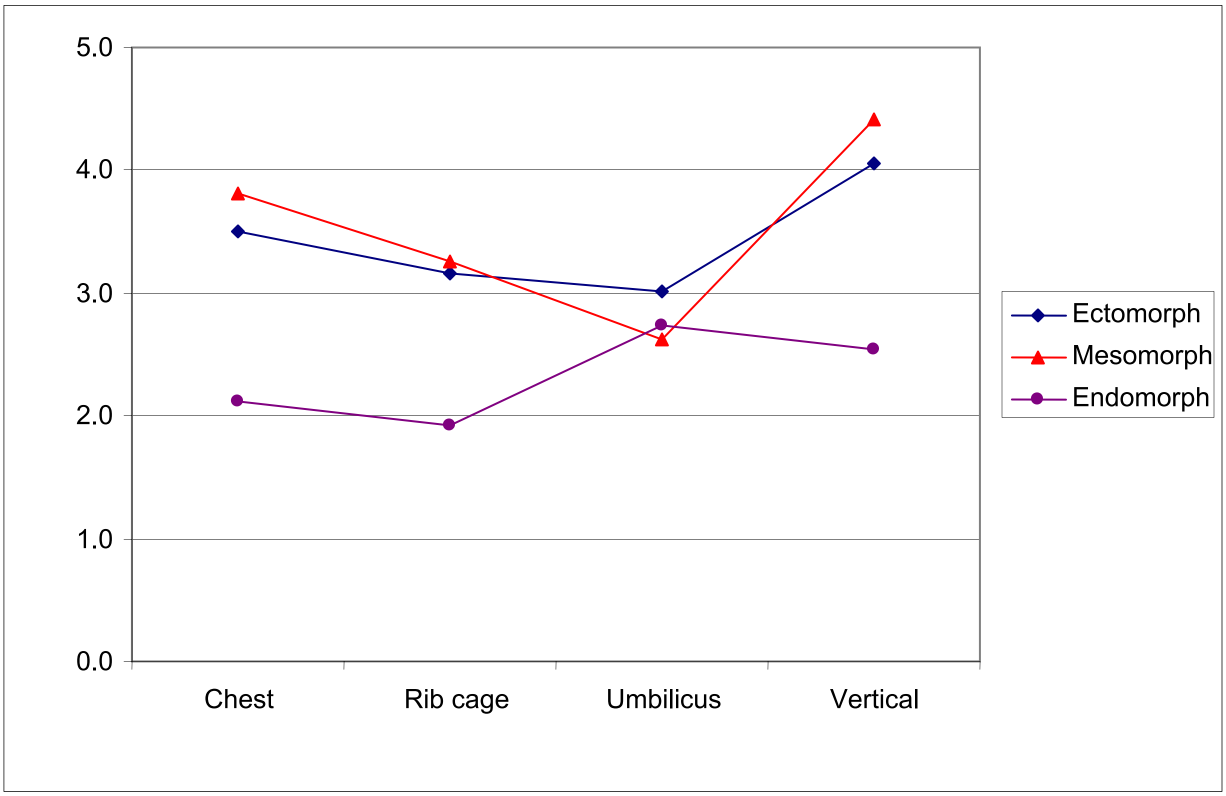

Figure 12: Extent of Movement During the Breath Cycle (movement in mm)

Because the breath movement data had different degrees of variability across the four places, e.g. lateral chest, rib cage, umbilicus and vertical chest, a correction factor needed to be used for the degrees of freedom. An analysis of the similarity of variation among the measured levels of the variables indicated a need to lower the degrees of freedom in order to achieve appropriate ANOVA results. A Greenhouse-Geiser correction factor was used to complete the

[31] Cohen, J. *Statistical power analysis for the behavioral sciences.* Hillsdale, NJ: Lawrence Erlbaum, 1988.

ANOVA. The analysis revealed significant differences among the somatotypes in where the breath movement occurred [$F(1.5, 13.6) = 5.047$, $p = .030$, $\eta^2 = .359$]. The η^2 indicates a large effect for this statistic, meaning that the somatotype was a major factor in the breathing patterns.

As can be seen in the chart, the results of the breath measurements showed a similarity between the ectomorphs and mesomorphs in terms of movement and place of breath. The pattern of movement was very similar between the two somatotype groups as well. The pattern for the ectomorphs and mesomorphs was larger chest breaths, slightly less movement in the rib cage and almost no movement in the umbilicus, combined with marked vertical chest movement. The mesomorphs had a little more movement than the ectomorphs, especially in the umbilicus area and in the vertical chest area. They were almost identical in their movement in the rib cage area.

The endomorphs, however, did not follow the same pattern as the other two somatotype groups. They had much less movement overall than that of the ectomorphs and mesomorphs. For the endomorphs, there was little movement in the lateral chest and even less in the rib cage than the other two groups. However, they had greater movement in the umbilicus area, although less in the vertical chest movement, which was the largest in the other two somatotype groups. Within all three somatotype groups a prominence of vertical chest breath movement occurred.

CHAPTER FOUR

DISCUSSION

The purpose of the present investigation was to determine whether or not beginning level, young female voice students of different body types differed in their breathing tendencies while singing, and whether these tendencies correlated to the stated breathing techniques.

To determine this, each subject participated in a series of three groups of measurements. First, each subject's lung function was measured by use of a spirometer to rule out lung or breathing problems. Second, each subject was anthropometrically measured and placed into one of three body type categories. Finally each subject's breath movements were videotaped and measured at four places, lateral chest, umbilicus, rib cage and vertical chest to determine where the most breath movement occurred.

Somatotyping

Each subject was placed into one of the three body type categories. For this research project, only extreme endomorphs, mesomorphs and ectomorphs were used. The criterion for prominence of body type was based on information taken from the article *Body Type and Speech Breathing* by Jeannette Hoit and Thomas Hixon. As stated in their article:

Prominence for the mesomorphic and ectomorphic components was defined as a rating of at least 3 points higher on either of them as primary component than on the other two components rated. Prominence for the endomorphic component was defined as a rating of at least ½ point higher on endomorphy as a primary component than the other two components rated. A more lenient criterion was required because of the difficulty in finding individuals with a high endomorphy rating accompanied by a relatively low mesomorphy rating. [32]

Spirometer

A spirometer measured each subject's lung capacity. Specifically, the FEV, FVC, FEV/FVC and the peak flow of each subject was measured. There were no significant differences that occurred for lung function among the three somatotype groups. These results indicated that the lung function of all subjects could be considered equivalent.

In order to compare the subjects' lung function with other young females within their age range, a prediction nomogram was used. The nomogram, taken from the American Review of Respiratory Disease, determined whether the spirometric values of the subjects were within normal range based on their height and age. All of the subjects in the current study were within range according to the nomogram.[33]

Breath Movements

[32] Jeannette Hoit and Thomas Hixon, "Body Type and Speech Breathing," *Journal of Speech and Hearing Research*, no. 29 (1986): 314.
[33] J.F. Morris, W. Koski and L. Johnson, "Spirometric standard for healthy non-smoking adult," *American Review of Respiratory Disease,* no. 103 (1971): 57.

Endomorphs

The endomorphs exhibited breath movements that were lower in the thoracic region than the other two somatotype groups. The breath movements were most prominent in the umbilicus area. The hypothesis for this project stated that singers with more body fat had a tendency to breathe lower than those who were lean or muscular. The results of the research demonstrate that people with more fat do tend to breathe lower in the thoracic region than those who are more lean or muscular. This result correlated with one of the stated breathing techniques, the *appoggio* technique; however, the data also showed that along with marked breath movements in the umbilicus area there was a large amount of vertical chest movement as well. The *appoggio* technique does not condone vertical chest movement. On the contrary, it maintains that the chest should find a comfortably elevated position and remain stabilized throughout the breath cycle.

Mesomorphs

The mesomorphs displayed large amounts of rib cage and vertical chest movement while exhibiting little movement in the umbilicus area. The hypothesis stated that singers who were muscular tended to breathe primarily in the rib cage area which correlates with the *costal* technique. The results of the study, however, showed the greatest movement in the vertical chest and the second greatest movement in the rib cage area. Therefore, although rib cage movement is high among mesomorphs, vertical chest movement is greater. As in the case of the endomorphs, the mesomorphs demonstrated high vertical chest movement. High vertical chest movement is not condoned in the costal technique; instead a stabilized chest is used while breathing for singing.

Ectomorphs

The ectomorphs followed a similar pattern of movement as the mesomorphs; however, they displayed the highest degree of movement in the lateral and vertical chest than either of the other two body type groups. The hypothesis stated that singers who are thin and lean tended to breathe higher in the thoracic region which correlates with the pancostal technique. Although the lateral chest movement was significant, there was a higher degree of vertical chest movement among the ectomorphs. The pancostal technique does not condone vertical chest movement.

Limitations and Further Research

This study included a total of twelve participants, four in each body type category. The small sample size of the study created limitations in the research. Further investigation that would include a larger sample size with the same criteria would be helpful in determining whether the results of this study represent the typical breathing patterns of inexperienced female singers. Further research could be done on male singers while singing, to determine whether their tendencies were similar to female breathing tendencies in terms of breathing and body type. For example, in Hoit and Hixon's article *Body Type and Speech Breathing* twelve men were measured to show where movement of the breath occurred. Although the measurements were focused on speech breathing, their study showed marked similarities with the present investigation. For example, subjects considered endomorphs demonstrated substantial abdomen movements while subjects considered ectomorphs demonstrated large rib cage movements. The subjects who were considered mesomorphs, however, demonstrated a mixture of characteristics.[34]

Endomorphs demonstrated abdomen movements in the Hoit and Hixon study, just as they showed movement in the abdomen area, specifically the umbilicus, in the present study. The ectomorphs in their study breathed more in the rib cage than chest area, that is, they breathed higher than the endomorphs, just as in the present study. The mesomorphs in Hoit and Hixon's study had a combination of breath movement characteristics as did the mesomorphs in the present study.

Further research could be done to compare men and women in terms of breath movement while singing. Also comparisons could be made between breathing for singing and breathing for speech.

[34] Ibid, 314.

CONCLUSION

The data showed marked correlations between body type and breathing tendencies that corresponded with the stated hypothesis. For example, endomorphs showed movement in the umbilicus area (*appoggio*), mesomorphs showed movement in the rib cage area (costal), and ectomorphs showed movement in the lateral chest area (pancostal). Although these findings matched the stated hypothesis, a major problem exists in accepting the results completely. Because there was a large prominence of vertical chest movement in all three somatotype groups, it is difficult to relate the subject's breath tendencies to the stated breathing techniques discussed, the *appoggio*, the costal and the pancostal. None of the breathing techniques mentioned condones vertical chest movement. In fact, they require the opposite, that is, a stabilized chest while breathing for singing. Although the singers all displayed elements of the various stated techniques, they also displayed aspects of breathing that did not correlate with those techniques. Some had a combination of several places of movement, and all three body types showed considerable vertical chest movement, which is forbidden in any solid breathing for singing technique.

The prominence of vertical chest movement is significant because it shows that young singers regardless of body type tend to use vertical chest movement when inhaling for singing. This tendency among all of the body types points to a lack of understanding of proper breath function, and would suggest that understanding and facilitating a healthy breathing technique for singing is a learned experience, and requires training. This does not mean, however, that the results of the study are useless. They reveal that endomorphs tend to breathe lower, mesomorphs tend to breathe in the rib cage area and ectomorphs in the lateral chest area.

These findings demonstrate that 1) singers with different body types do tend to breathe differently, and 2) that beginning level singers of every body type show a prominence of large vertical chest breaths. Knowing which body types have which breathing tendencies will be helpful for the teacher of singing in determining where to look for each student's breath movement, and in guiding the student accordingly.

Appendix A
Singer's Questionnaire

(Adapted from Benninger, Jacobson & Jacobson, 1994; Sataloff, 1998)

1. Have you had training for your singing voice? Y N

   If yes, please, specify when and the approximate time in months or years.

2. Have you ever had training for your speaking voice? Y N

3. Have you ever had acting lessons? Y N

4. Have you ever had speech therapy? Y N

5. Do you smoke?

   ______ Never

   ______ Quit. Please note the approximate year and month___________

   ______ Smoked about______ packs per day for ____ years.

   ______ Currently smoke_____ packs per day. I have smoked for_____ years.

6. Please list any medications that you currently take (prescribed or non prescribed)

7. Do you currently have any of the following respiratory conditions?

   _____ asthma

   _____ bronchitis

   _____ chronic obstructive pulmonary disease

   _____ common cold

   _____ cystic fibrosis

   _____ emphysema

   _____ pleurisy

   _____ pneumonia

   _____ Other (please specify)

   _____ I am currently aware of none of the above respiratory conditions

Appendix B
Somatotype Calculations

Table 2: Somatotype Calculations

SOMATOTYPE CALCULATIONS						
THIS PROGRAM CALCULATES THE HEATH-CARTER ANTHROPOMETRIC SOMATOTYPE						
THIS SOMATOTYPE RATING USES THE HEIGHT-CORRECTED ENDOMORPHY						
ENTER DATA FOR THE SUBJECT AND 10 ANTHROPOMETRIC VARIABLES:						
SUBJECT NAME OR NUMBER:TEMPLATE - A.D. complete						
STATURE (cm)	158.6					
BODY MASS (kg)	104.5		Height/weight^1/3:	33.68		
Skinfolds (mm):						
TRICEPS	23.0		Sum 3 skinfolds:	63.0		
SUBSCAPULAR	24.0		Sum 3 (ht-corrected):	67.6		
SUPRASPINALE	16.0		Sum 3 squared:	4569.7		
MEDIAL CALF	20.0		Sum 3 cubed:	308914.0		
Girths (cm):						
BICEPS-flexed & tensed	40.2		Corrected Biceps G:	37.9		
CALF -maximum	43.0		Corrected Calf G:	41		
Breadths (cm):						
HUMERUS-biepicondylar	6.40					
FEMUR-biepicondylar	10.30					
Somatotype rating (decimal)			**Somatotype rating (half-unit)**			
ENDOMORPHY:	6.4		Write the rounded rating here:6-9-0.1			
MESOMORPHY:	9.1					
ECTOMORPHY:	-3.9					
IF HWR<40.75&>38.25, then Ectomorphy = 0.463*HWR-17.63						
If HWR=<38.25, then Ectomorphy = 0.1(or recorded as 1/2)						
X,Y coordinates:						
X-coordinate:	-10.3					
Y-coordinate:	15.8					

Appendix C
Mean and Standard Deviation of Breath Movement Measurements During Singing

Table 3: Mean and Standard Deviation of Breath Movement Measurements During Singing

		Chest	Ribcage	Umbilicus	Vertical
Ecto	Mean	3.50	3.17	3.02	4.06
	s.d.	1.49	1.21	1.18	1.29
Meso	Mean	3.81	3.25	2.63	4.42
	s.d.	1.20	0.84	0.67	1.50
Endo	Mean	2.13	1.92	2.73	2.54
	s.d.	0.70	0.50	1.27	0.90

Appendix D
Spirometer Results

Table 4: Spirometric Results: Mean Values for FVC, FEV, FEV/FVC and Peak Flow, with standard deviations in parentheses.

Group	FVC	FEV	FEV/FVC	Peak Flow
Ecto	3.46(.26)	2.88(.14)	.84 (.10)	5.80(.70)
Meso	3.51(.30)	3.00(.30)	.86 (.09)	5.49(.69)
Endo	3.71(.40)	3.14(.24)	.85 (.04)	6.48(.48)

Appendix E

Florida State
UNIVERSITY

Office of the Vice President
for Research
Tallahassee, Florida 32306-2763
(850) 644-8633 • FAX (850) 644-4392

REAPPROVAL MEMORANDUM

from the Human Subjects Committee

Date: **August 20, 2003**

From: **David Quadagno, Chairperson** DQ/HH

To: **Jennifer Cowgill**
119-B Maple Wood Court
Albany, GA 31701

Dept: **Psychology**

Re: **Reapproval of Use of Human subjects in Research**
Project entitled: Breathing for Singers: a Comparative Analysis of Body Types and Breathing Tendencies

---

Your request to continue the research project listed above involving human subjects has been approved by the Human Subjects Committee. If your project has not been completed by August 12, 2004, please request renewed approval.

You are reminded that a change in protocol in this project must be approved by resubmission of the project to the Committee for approval. Also, the principal investigator must report to the Chair promptly, and in writing, any unanticipated problems involving risks to subjects or others.

By copy of this memorandum, the Chairman of your department and/or your major professor are reminded of their responsibility for being informed concerning research projects involving human subjects in their department. They are advised to review the protocols of such investigations as often as necessary to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

:hh
cc: L. Gerber
human/renewal.hs
APPLICATION NO. 03.413-R

Appendix F

INFORMED CONSENT FORM

I freely and voluntarily and without element of force or coercion, consent to be a participant in this research project entitled "Breathing for singers: A comparative analysis of body types and breathing tendencies".

Jennifer Cowgill, doctoral student at Florida State University, is conducting this research. I understand the purpose of this research project is to better understand breathing functions in conjunction with body types. I understand that I will complete a questionnaire that includes a series of questions that relate to my voice, my vocal health, and my breathing tendencies. All of my answers to the questions will be kept confidential and identified by a subject code number. My name will not appear on any of the results. No individual responses will be reported. Only group findings will be reported. I understand that my results will be kept confidential during the course of study to the extent allowed by law.

I understand that the researcher will videotape me singing the first four measures of "Caro mio ben". The researcher will keep these tapes in a locked filing cabinet. I understand that only the researcher will have access to these tapes and that they will be destroyed by August 2008.

I also understand that my body type will be measured with a skin caliper. This consists of gently gripping four areas of the body: the triceps, below the shoulder blade, the waist area and the back of the calf. My bone density will also be measured with a steel caliper, which will be placed above and below my upper arm and calf. My height and weight will be measured with a physician's scale. I will then be asked to blow into a spirometer, which will measure my breath capacity. I understand that this experiment may be beneficial to my singing because it may help me to determine what breathing style to use in my future singing. I also understand that I will receive three points of extra credit for Applied Voice Lessons or Vocal Ensemble. I understand my participation is totally voluntary and I may stop participation at any time. I may withdraw my consent any time that I decide to stop participation. The recordings of my voice and all data will be kept confidential to the extent allowed by law.

I understand that I may contact Jennifer Cowgill at 229-430-6854 or 850-576-6378 or Professor Larry Gerber at 850-644-1245 at any time with questions about this research. I understand that I may also contact the Human Subjects Committee at Florida State University at 850-644-7900.

Subject   Date

FLORIDA STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD
Approved: 8/13/03
HS No. 04.413-R
Void After 8-12-04

FLORIDA STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD
Approved: 7/11/02
HS No. 02.334
Void After 7-10-03

Appendix G

SDSU
San Diego State University

Department of Exercise and Nutritional Sciences
College of Professional Studies and Fine Arts
San Diego State University
5500 Campanile Drive
San Diego CA 92182-7251

15 September 2004

Jennifer Cowgill
Florida State University Doctoral Student

Re: Permission for use of illustrations.

Dear Jennifer:

You are hereby granted permission to use eight illustrations from Anthropometry Illustrated, W.D. Ross, R.V. Carr and J.E.L. Carter (1999), Copyright: Rosscraft/ Turnpike Electronic Publications. Each illustration should have the following acknowledgement in the legend: "Photo from Anthropometry Illustrated with permission from Rosscraft." If you put all photos on one page with a single legend, then you only need the above sentence once with the plural "Photos".

Be sure to label the photos with the correct anthropometric names as in Anthropometry Illustrated. That is: Skinfolds – triceps, subscapular, supraspinale, medial calf; Breadths, biepicondylar humerus breadth, biepicondylar femur breadth; Girths: arm girth (flexed and tensed), calf girth.

Best wishes and good luck with your dissertation.

Sincerely yours,

J.E.L. Carter

J.E. Lindsay Carter, Ph.D.
Co-author, Anthropometry Illustrated.
(For Rosscraft)

cc: Dr. W.D. Ross, Rosscraft.

Bibliography

Alderson, Richard. *Complete Handbook of Voice Training*. New York: Parker Publishing Company, 1979.

Arnold, Denis. *The New Oxford Companion to Music.* (New York: Oxford University Press, 1983. S.v. "Vocalise," 1938.

Arraj, James and Tyra, "Tracking the Elusive Human, Volume 1," *Inner Explorations*, http://www.innerexplorations.com/catpsy/3.htm.

Brown, Oren. *Discover Your Voice: how to develop healthy voice habits*. San Diego: Singular Publishing Group. 1996.

Bunch, Meribeth. *Dynamics of the Singing Voice*. New York: Springer-Verlag, 1982.

Carter, J.E.L. *The Heath-Carter Somatotype Method.* San Diego: San Diego State University Press, 1980.

Coffin, Burton. *Historical Vocal Pedagogy Classics.* New York: Scarecrow Press, Inc., 1989

Cohen, J. *Statistical power analysis for the behavioral sciences.* NJ: Lawrence Erlbaum, 1988.

Coker, Andrew, ed., "Pulmonary Function Test," *The Health Network*, http://www. healthnetwork.com/au/search-display.php?cat=tests&name= PULMONARY% 20FUNCTION%20TEST.

Dixhorn, J. Van. "Functional breathing is 'whole body breathing'," *Biological Psychology* 46 (1997): 89-90.

Dixhorn, J. Van. "Hyperventilation and dysfunctional breathing," *Biological Psychology* 46 (1997): 90-91.

Dixhorn, J. Van. "Body Awareness: the proper application of relaxation and breathing Technique." *Gedrag* 12 (1984): 31-45.

Emmons, Shirlee. "Breathing for Singers…Why it is so difficult to learn (or teach?)." *Focus on Vocal Techniques*. www.voiceperformance.com/technq2.htm. 1999.

Garcia, Manual. *A Complete Treatise on the Art of Singing: Part One.* New York: Da Capo Press, 1975.

Gross, Thomas. “Internal Medicine.” *The Virtual Hospital*. 01 June 2002, http://www.vh.org/adult/provider/internalmedicine/Spirometry/SpirometryHome.html>.

Hayward, Vivian and Lisa Stolarczyk. *Applied Body Composition Assessment.* Illinois: Human Kinetics, 1996.

Hoit, Jeannette D. and Thomas J. Hixon. “Body Type and Speech Breathing.” *Journal of Speech and Hearing Research* 29 (1986): 313-324.

Jones, John Desmond. *Comparative Physiology of Respiration.* London: Edward Arnold, 1972.

Lamperti, Francesco. *A Treatise on the Art of Singing.* New York: G. Schirmer, 1890.

Lehmann, Lilli. *How to Sing, 10th ed.* New York: The MacMillan Company, 1890.

Mikkelsen, Carol. “Muscular readiness for the act of singing.” DM treatise, Florida State University, 1994.

Miller, Richard. *On the Art of Singing*. New York: Oxford University Press, 1996.

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

Miller, Richard. *Training Soprano Voices*. New York: Oxford University Press, 2000.

Miller, Richard. *Training Tenor Voices*. New York: Schirmer Books, 1993.

Morris, J.F., W. Koski, and L. Johnson, “Spirometric Standard for Healthy Non-Smoking Adult.”*American Review of Respiratory Disease,* no. 103 (1971): 57.

Proctor, Donald F. *Breathing, Speech and Song*. New York: Springer-Verlag, 1980.

Sataloff, Robert Thayer. *Professional Voice: Science and Art of Clinical Care*. San Diego: Singular Publishing Group, 1997.

Sundberg, Johan. *The Science of the Singing Voice.* Illinois: Northern Illinois University Press, 1987.

Thomasson, Monica and Johan Sundberg. “Consistency of Phonatory Breathing.” *Journal Of Voice* 13:4 (1999): 529.

Van Cura, John. “Breathing for the Singing Voice.” DM treatise, Florida State University, 1975.

Vennard, William. *Singing: The Mechanism and the Techni*c. New York: C. Fischer, 1968.

Wood, Annetta Lois. “Breathing for Voice Production.” Ph.D. diss., Columbia University, 1954.

BIOGRAPHICAL SKETCH

Jennifer Griffith Cowgill was born in 1970 in Williamsport, PA. She received her Bachelor of Music degree from the Oberlin Conservatory of Music where she studied vocal performance with Richard Miller. After Oberlin she attended the Peabody Conservatory at Johns Hopkins where she obtained her Master of Music degree in vocal performance. At Peabody she studied voice with Ruth Drucker. She taught voice for three years at Darton College in Albany, Georgia and is currently an Assistant Professor of Voice at the University of Alabama in Tuscaloosa. Her Doctor of Music Degree was granted in December, 2004 from the Florida State University where she studied voice with Yvonne Ciannella.