



# The technical principles of Bel Canto in the 18<sup>th</sup> and 19<sup>th</sup> centuries: an experimental case study on dynamic range



Mariana Andrade Pimenta

(c013319)

Research Coach: Inês de Avena Braga

Master Circle Leader: Gerda van Zelm

Main subject teachers: Maria Acda Maas, Jill Feldman, Michael Chance,  
Peter Kooij

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“The true method of singing is in harmony with nature and the laws of health”  
(Translated by T. H. Baker)

G. B. Lamperti: *The Technics of Bel Canto*, p. 5

“The genius that creates, the feeling that examines, the taste that judges, and the reflection that corrects and perfects, each have with the delicacy of art, and the exercising of the human refined the gifts of Nature, near to perfection and made them capable of delighting the human intellect and heart”  
(Translated by Pietro Buzzi)

G. Mancini: *Practical reflexions on the figurative Art of Singing*, p. 116

## Abstract

### Introduction and objectives:

The author studied singing treatises from 18<sup>th</sup> and 19<sup>th</sup> centuries in order to apply, into her singing practice, the technical principles of the Italian singing technique: *Bel Canto*. The focus of the practical sessions of the author was on her dynamic range. The purpose was to increase flexibility in her dynamic range in the different registers of the voice.

### Method:

At the beginning of the research process, the author made an audio recording of G. F. Händel aria: “Se Pietà di me non senti”, from the opera *Giulio Cesare*. In this same phase of the research, she used the software *Voice Profiler 5.1* to record her Voice Range Profile (VRP) (singing technology that evaluates dynamics related to pitch), the same piece and the vowel /a/, throughout the vocal registers, exploring the complete dynamic range of her voice. After three months of practicing specific exercises designed to train the dynamic range, the same recordings were made and also a comparison with the first ones.

Results: The training had an impact on the author’s dynamic range. An increase of flexibility in realizing *Messa di Voce* was verified in the author’s middle vocal register. This impact does not happen in the highest vocal register, where technical differences are not detected by the VRP recording. The latest result is also applicable in the Händel aria.

Conclusion: This method has proved beneficial in the middle section of the author’s vocal range. The appliance of this method is a work in process, which the author believes that it should bring more beneficial results, especially in the high register of her voice; It offered the author a much bigger awareness of the breathing system which resulted in a better *Messa di Voce*. The knowledge gained from the sources from the 18<sup>th</sup> and 19<sup>th</sup> centuries, guided the practical study in this investigation. In future studies, the author wishes to further research Italian vocal technique and use this important knowledge of historical information by transferring it to her singing practice. The outcome of the present study is an interesting interdisciplinary fusion between Old Italian vocal pedagogy of *Bel canto* singing and advanced vocal technology.

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## 1. Introduction

This work relies on the Old Italian vocal pedagogy of *Bel Canto* and the application of its technical principles in an experimental study. It researches the origins of *Bel Canto*, and technical specificities. As an early music singer, I applied these technical principles in repertoire stemming from 18<sup>th</sup> century Italian opera. My main goal is to train flexibility of dynamic range throughout my vocal register.

A large number of contemporary singing experts affirm that the Italian School of singing uses a very effective technique for singing, maintaining vocal health and allowing for a long career; in his book *Bel Canto: Principles and Practices*: Cornelius Reid writes: “There is only one way of singing freely in the high, low and intermediary ranges of the voice smoothly and easily, and that is the *correct way*” (Reid, C. 1978, p. 24). By the correct way, Reid is referring to *Bel Canto* technique. Italian singing treatises and methods from the golden age of *Bel Canto* are very clear about how important it is to sing with a healthy technique, following the nature of the mechanisms and functions of the human body, such as breathing, vibration, resonance and articulation, which will result in vocal production, or phonation.

As a singer, I consider very important to study this subject deeply and apply it into my singing practice, in order to achieve a theoretical and practical knowledge of effective application of my singing technique. This knowledge can be a fundamental tool to accomplish an artistic goal that is only possible when possessing a good singing technique. Personally, I believe that the main goal of a musician is to make music as an artistic product, however to achieve the flexibility to express the artistic ideas, one must work technically. The technique is a way to achieve an end, or as G. Mancini says: “The amount of pleasure to be derived depends upon the execution”<sup>1</sup> (Mancini, G. 1777, p. 26).

Before starting this research, concurring with the general thinking among musicians, I believed that the *Bel Canto* singing technique had emerged in the 19<sup>th</sup> century; however, after reading earlier singing treatises, it is clear that long before 1800 the Italian singing technique had already developed the same basic principles and purposes. It is true that in the 19<sup>th</sup> century orchestras increased in size as a result of larger halls, which in turn brought the aim of gaining more projection to be a priority to a singer. One could ask if the singers explored more their singing technique skills to be able to sing the repertoire that was being composed, or if this new repertoire was only possible because singers already had a technique that explored all their vocal skills.

With the rise and success of the first *dramma per musica*, in works such as the *Intermedi* of *La Pellegrina* by Girolamo Bargagli in 1589, and *Daphne* in 1597, by Jacopo Peri, the focus of these works shift to the dramatic play between characters, and these characters acquire a soloist role, which explored the voice as an instrument in all its registers and capabilities. (Reid, C. 1978, p. 7). This concept and new practice gains popularity, to the extent that in the 18<sup>th</sup> century the focus is now the singers, the so-called *divas*. This is when the golden age of *Bel Canto* begins.

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<sup>1</sup> Translated by Pietro Buzzi

## 1.1 Bel Canto terminology

The term *Bel Canto* is not easy to define. Literally, it means ‘beautiful singing’, which by itself is vague and subjective. The first question that emerged at the beginning of this research was: what is the exact meaning of *Bel Canto*? The definitions found demonstrate that there is not an exact meaning of this terminology. According to the first edition of the *New Grove Dictionary of Opera*, from 1991, Owen Jander writes that *Bel Canto* is a “term with a variety of interpretations”; “Italian vocal singing of 18<sup>th</sup> and early 19<sup>th</sup> centuries” (Sadie, S. 1991, p. 380). The first time the term *Bel Canto* appears written, is in a volume of “Ariette da Camera”, by Nicola Vaccai, before 1840 (Warrack, J; West, E. 1991, p. 381). It does not appear in the singing treatises of the 18<sup>th</sup> century, such as Pier Francesco Tosi or Giambattista Mancini.

One of the most important characteristics of *Bel Canto*, which regularly appears in treatises, is grace: singing beautifully, giving the impression of easiness. Since *Le nuove musiche* (1601) by Caccini, and including other authors as Tosi, Mancini, Garcia, Lamperti and Marchesi, grace is a characteristic always present when describing how one should sing: effortless so it is graceful.

Rodolfo Celletti, in his book *A History of Bel Canto*<sup>2</sup> (1991), presents a more clear definition of what *Bel Canto* represents. Celletti affirms that *Bel Canto* singing emerged in the Baroque period, following the artistic idea of the time: “Baroque art set itself a definite role – that of creating through the imagination a world more beautiful, more sumptuous than the everyday world, and depicting it in images calculated to appeal not only to man’s intellect but to his senses as well” (Celletti, R. 1991, p. 1). Celletti characterizes the manner of communicating through art in the Baroque period as “poetics of wonder”, explaining that: “wonder is precisely the emotion which Baroque art tended to excite and experience. The world of fantasy was set off against the real world, and became identified for that very reason with a whole sheet of emotions which went and still goes by the name of “poetics of wonder” (ibid, p. 2). Giambattista Mancini confirms this ideology saying that music “is capable of making us forget the pains of life, thus relieving us [...] disclosing to us a better existence by giving us pleasure and recreation” (Mancini, G. 1777, p. 17).

Celletti supports the idea that *Bel Canto* singing arose to serve the “poetics of wonder” that characterized the Baroque era, saying that the Italian Opera is a “product of the taste and sensibility [...] of the age of Baroque” (Celletti, R. 1991, p. 1). The main adjectives that Celletti uses to describe *Bel Canto* singing, is hedonism (meaning “lyricism, [...] smoothness, tenderness and pathos (ibid, p. 4)”, and virtuosity. Celletti explains the origin of these adjectives: (a) Hedonism: in the second half of the 17<sup>th</sup> century, “[...] melodies tended to become more and more expansive, and vocalises tended to break away from progressions formulated with geometrical rigidity” (ibid, p. 5); (b) virtuosity: “Divisions, variations, and improvisations, which emerged in the first half of the sixteenth century not as vocal but as contrapuntal displays by the singers of the holy chapels, came within reach better endowed vocally and better trained” (ibid, p. 3). This development of hedonism and virtuosity is very much explored by G. F. Händel as it is shown in the examples below:

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<sup>2</sup> All the quotations from this book written by Rodolfo Celletti are translated by Frederick Fuller



3-7 CLEOPATRA. *Piangerò la sorte mia, sì crudele*



Figure 1 – Example of ‘Hedonism’ - Part A of the Da capo aria *Piangerò la sorte mia*, from the opera *Giulio Cesare*, by Händel (Editor: Frideric Chrysander, p. 130, bars 1-15)

As an example of Hedonism written by Händel, in Figure 1 we observe that the A part of the aria, that is sung very *legato* in a slow tempo, expresses the emotion of sadness of the character *Cleopatra*. In the same aria, as it is demonstrated in Figure 2, the B part, is sung in tempo *Allegro, coloratura*, Händel making use of the vocal virtuosity as an expression of the determination and revenge of the emotional state of *Cleopatra* at this point of the opera.



Figure 2 – Example of ‘Virtuosity’- Part B of the Da capo aria *Piangerò la sorte mia*, from the opera *Giulio Cesare*, by Händel (Editor: Frideric Chrysander, p. 131, bars 53-55)

The main voice type in Italian Baroque opera was the castrato. This voice type, produced by a modified body, was associated with the fantasy that the poetics of wonder provided. Monteverdi writes in a letter to Alessandro Striggio in 1616, that the roles for a common woman or man should be composed in a plainer and simpler singing style, while the castrato should sing roles from the divine and mythical, and their singing should be ornate and allegorical (scale runs, shakes and trills) (Celletti, R. 1991, pp. 6-7).



Contrary to what the present author previously considered, Celletti states that *Bel Canto* starts to wane with Bellini and Donizetti, because it is when opera involves realism in their arguments in place of “abstraction, stylization and ambivalence of timbre” (ibid, p. 10). Celletti defines the golden age of *Bel Canto* between A. Lotti and G. F. Händel (ibid, p. 66), between the years ca.1667 and ca.1759.

The term *Bel Canto* can be difficult to describe, as it can be seen through two following perspectives: (a) through an aesthetic point of view and (b) through the point of view of vocal technique. This separation is also described by Cornelius Reid: “When a tone is truly beautiful it signifies that the vocal mechanism is functioning correctly, and that a complete harmony exists between aesthetic principles and those laws of Nature by which the operation of the vocal mechanism is governed (Reid, C., 1978, p. 19).

In the present study the focus will be on the technical principles of *Bel Canto*, those being: breathing; *legato*; virtuosity (agility); blending of the registers, and flexibility in the dynamic range.

## 1.2. Specific goals

This study proposes to:

- Increase the knowledge of the old Italian school of singing, focusing on the vocal pedagogy of the 18th and 19th centuries;
- Acquire the capacity of transferring this knowledge into the singing practice;
- Train the flexibility of the dynamic range associated with pitch.

## 1.3. Research Question

This is an experimental study, being myself the object of study, with all the subjectivity issues that this entails. After practicing specific singing exercises, the goal was to be able to answer the following question:

**How did the vocal exercises from *Bel Canto* singing influence my singing technique, especially in the dynamic range associated with pitch?**

## 2. Literature Review

In this chapter, Italian singing methods of the 17<sup>th</sup>, 18<sup>th</sup> and 19<sup>th</sup> centuries will be shortly discussed. Works written by Giulio Caccini, Pier Francesco Tosi, Giambattista Mancini, Manuel Garcia, Giovanni Battista Lamperti, and Mathilde Marchesi, will be compared. Here, the present author attempts to find the ideals and practical elements of the singing technique that was taught and used at the time. Next to that, the most general subjects, those more commonly described, are presented as well. In the following subchapters, all translations of quotations are consistent to every writer<sup>3</sup>.

### 2.1 Nature

All the methods that were analysed for this research state that the role of nature in singing is fundamental: singers should follow the mechanisms of the human body which make the singing free, and not artificial. Giambattista Mancini, in his *Practical Reflections on the figurative Art of Singing*, mentions often how important it is to follow the laws of nature: “Art consists in one’s ability to know what nature intended one to be. When once the gifts of nature are known, cultivating them easily makes man perfect; [...] The teachers must be careful not to betray their pupils and the pupils to not pay more attention to the teacher than to Nature” (Mancini, G. 1777, p. 109). Mancini does not explore very deeply the anatomy, but “vocal organs” is an expression mentioned at various times in his singing treatise: “Nature in her generosity of giving away her gifts, never puts them [...] all in one person; so it seldom happens that we find one person gifted with all those harmonious conditions of vocal organs that form a perfect voice” (ibid, p. 57). Pier Francesco Tosi also mentions nature saying, for example, that the student should always “sing standing, that the voice may have all its organization free” (Tosi, F.P. 1723, p. 7). Giovanni Battista Lamperti opens his work – *The technics of Bel Canto* – with a chapter: “General Observations”, which only contains the following statement: “The true method of singing is in harmony with nature and the laws of health” (Lamperti, G.B., 1905, p. 5). He also continues by explaining the anatomy of the human body and its interaction with singing phonation, which also calls for the laws of nature. (ibid, pp. 5, 6 and 8).

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<sup>3</sup> Translator of Tosi: J. E. Galliard  
Translator of Mancini: Pietro Buzzi  
Translator of Lamperti: T.H. Baker  
Translator of Garcia: Albert Garcia

## 2. The Vocal Organs

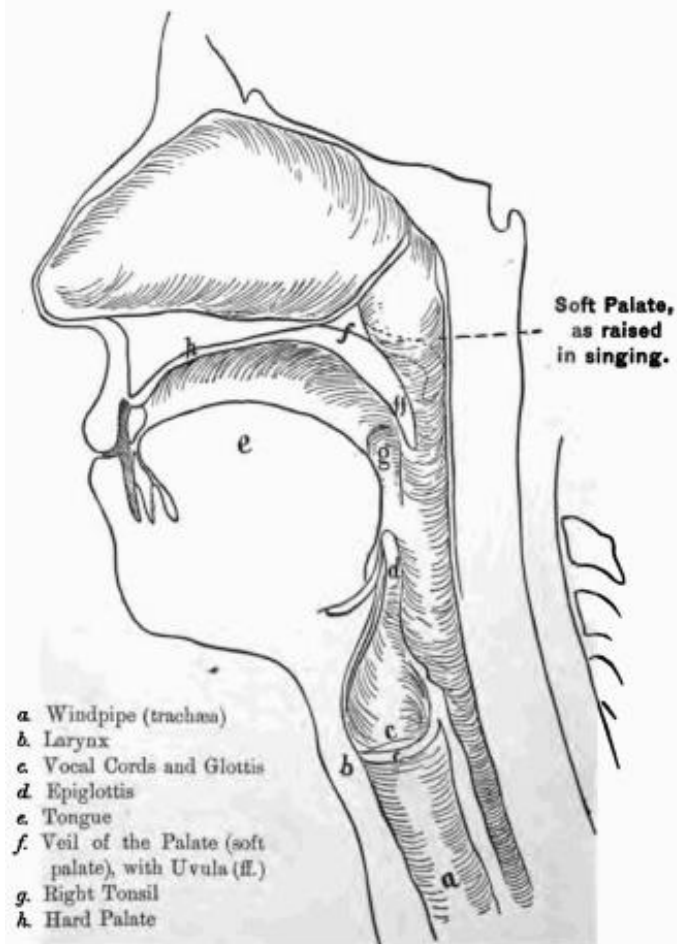


Figure 3 – Illustration of the “Vocal Organs”, by Lamperti, p. 8

Manuel Garcia, in his *A complete treatise on the Art of Singing*, gives a detailed explanation about the physiology of voice production, describing the (1) lungs, as “air supply”, (2) larynx as “vibratory organ”, (3) pharynx as “reflecting organ”, and (4) mouth as “articulating organs (i.e. lips, teeth, tongue and palate)” (Garcia, M. 1847, p. 3). Garcia was one of the first singers/singing teachers that explored the science of singing, being the one who made the first experience with a laryngoscopy.

As Garcia, Mathilde Marchesi (who was one of Garcia’s pupils) also describes in her *Vocal Method*, Op. 31 (1910) some mechanisms of the body that should function well while singing, giving special emphasis to the “Respiration” (breathing).

### 2.2 Grace

This characteristic is important not only in singing, but in the whole attitude of the performer. A singer who did not possess this quality was considered to have bad taste. Singing without effort, singing passages that are of difficult realization easily are needed to sing with grace: “That graces or passages be easy in appearance, thereby to give universal delight” (Tosi, P.F. 1723, p. 82).

Giulio Caccini, in 1601 says that his goal by writing *Le nuove musiche*, is that the grace that he listens internally can come through in his writings (Caccini, 1601, p. 5).

Regarding the attitude of a singer, Tosi says that one should take care to sing with a “graceful posture and an agreeable appearance” (Tosi, P.F. 1723, p. 7). The last chapter of his singing treatise: “Of passages or Graces”, states in what manner one should sing these graces, the appropriate ornamentations which a singer must study and practice, and its applicability into the music. Tosi defines graces as: “[...] being the principal ornaments in singing and the most favourite delight of the judicious, it is proper that the singer is very attentive to learn this art” (ibid, p. 81). He affirms that a singer will be graceful by mastering five points: (1) *appoggiatura*, (2) shake, (3) put forth the voice, (4) gliding and (5) dragging (ibid, p. 81). He says that a passage with grace should seem invented and not studied, and that the singer should play with all the embellishments, *Messa di voce*, and more expressive resources.

For Mancini, grace was also a very important element. It is important to give a good impression to the audience with an elegant posture and never force the voice to have more sonorous volume. He writes: “Let it be known that to force a voice will always be one of the greatest errors a singer can commit” (Mancini, G. 1777, p. 107). As Tosi, Mancini enumerates embellishments to sing with grace: *portamento di voce*, *appoggiatura*, *messa di voce*, *trillo* and *mordente* (ibid, p. 117). He also considers a good pronunciation a characteristic of grace (ibid, p. 172).

With Lamperti grace is achieved with artistic taste, with dynamics, correct tempo, and phrasing. However, Lamperti considers important that each singer thinks individually about music and creates his own artistic taste (Lamperti, G. 1905, p. 31). His perspective is not exactly the same as Mancini and Tosi, nonetheless the importance of singing (seemingly) without effort is equal.

Marchesi shares the same view of Lamperti: “A singer who has learned how to breathe well and who has equalized the voice, neatly blended the registers, and developed the activity of the larynx and the elasticity of the glottis and resonant tube in a rational manner, so that all possible shades of tone, power, and expression can be produced by the vocal organs, would most assuredly be able to sing well, and without fatigue or effort (that is, without exaggeration or shouting), the long and declaimed modern phrases” (Marchesi, M. 1899, p. 10).

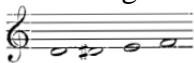
## 2.3 Registers equalization

Register equalization consists in blending all the vocal registers: chest and head register. This skill offers homogeneity to the singing voice throughout all its *tessitura*. This ability is described by many authors as a very important element for a singer.

Tosi writes that the chest or head voice “should always come forth neat and clear, without passing through the nose or being choked in the throat [...]” (Tosi, F.P. 1723, p. 5).

Mancini expresses the importance of this matter various times in his treatise. He states that “the great art of singing consists in acquiring the ability to render imperceptible to the ear, the passing from the one register to another. In other words, to unite the two, so as to have perfect quality of voice throughout the whole range, each tone being on a level with your best and purest tone” (Mancini, G. 1777, p. 59).

Garcia writes that after the chest voice is well established, the singer should start to blend immediately with the other register. The author explains how this can be

obtained: between these notes  and it should be practiced slowly, and passing without interruption from one register to another (Garcia, M. 1847, p. 8).

Lamperti, in the chapter “Vocal Development, and Blending of the Registers”, writes specific exercises:

The image displays two musical exercises from Lamperti's method. Exercise 1, labeled '(a) Moderato', is on page 3. It consists of a vocal line with 'la' notes and a piano accompaniment. The tempo is marked 'Moderato'. Exercise 2, labeled 'Lento ed espressivo', is on page 14. It also features a vocal line with 'la' notes and a piano accompaniment. The tempo is marked 'Lento ed espressivo'. A note 'N.B.' (Nota Bene) is present above the vocal line in Exercise 2. To the right of Exercise 2, the text 'Continue on successive degrees.' is written.

Figure 4 and 5 – Lamperti’s exercises for blending the registers (pp. 3 and 14)

Lamperti instructs the student to sing these exercises slowly and very legato.

Marchese advises that to blend “the *Chest* and *Medium* registers, the pupil must slightly close the last two notes of the former in ascending, and open them in descending. Every effort expended upon the highest notes of a register increases the difficulty of developing the power of the lower tones in the next register, and therefore of blending the two registers, until eventually it becomes impossible” (Marchese, M. 1899, p. 7).

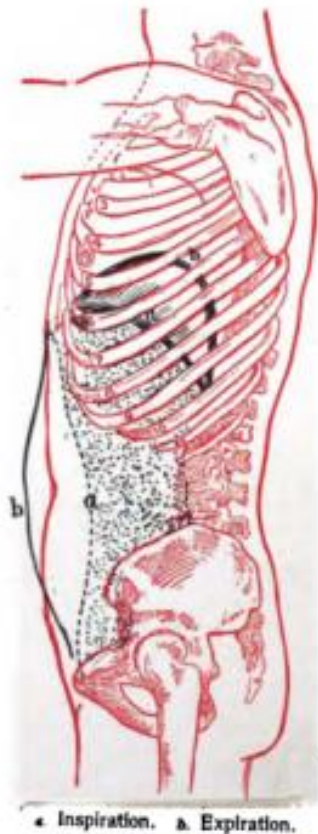
## 2.4 Breathing

This subject is addressed in more detail by 19<sup>th</sup> century authors mentioned here. Breathing is considered the motor, the mechanism that starts the whole process of phonation.

What Mancini writes is that it is important to have a good breath control, especially to know how to save the air, especially at the attacking and leaving a tone, and to realize a *Messa di Voce* (Mancini, G. 1777, pp. 112-113). Lamperti shows in his method a more mechanical explanation about breathing. First, an image illustrates its function:



## 1. Diagram of the Action of the Diaphragm



Lamperti explains that the inhalation must be done only through the mouth, and the last should be open with space to fit a finger (on the horizontal) between the upper and the lower teeth. The inhalation should be taken deeply, and quietly. Lamperti then explains the involvement of the diaphragm, describing its movement during inhalation and exhalation (Lamperti, G. 1905, p. 7). He also warns us that if the breathing is uncomfortable for the singer, he/she still did not acquire a good skill of breathing. Lamperti mentions the support, which comes from the pressure caused by the air during exhalation. He concludes with the following statement: “Breath-control is the foundation of all vocal study” (ibid, p. 9).

Figure 6 - Illustration of the breathing from Lamperti's singing method (p. 6)

Garcia debates the matter of breathing also as a primary force for singing, writing that, to be a successful singer, breath control has to be very well-mastered. Before breathing, it is important to be in a correct posture: “[...] the head is erect, the shoulders thrown back without stiffness, and the chest expanded. The diaphragm must be lowered without any jerk, and the chest regularly and slowly raised” (Garcia, M. 1847, p. 6). In a more detailed way than Lamperti, Garcia describes the mechanism of breathing, agreeing that the inhalation should be quiet. Next, Garcia defines an exercise to increase the volume capacity of the air of the lungs (ibid, p. 6).

Marchesi describes three types of breathing: (1) diaphragmatic or abdominal, (2) clavicular, and (3) lateral or intercostal (Marchesi, M. 1899, p. 3). The first is considered the correct and healthy one. The author, as Lamperti and Garcia, describes the physiology of the body while breathing (ibid, p. 3).

### 2.5 *Messa di Voce*

*Messa di Voce* can be described as a homogenous and gradual *crescendo* and *decrescendo* in one note. It is an expressive resource of extreme beauty if well applied and realized, and is one of the tools to sing with grace.

Tosi considers that the “modern singers” of his time could not realize a *Messa di Voce* with good taste. The author recommends that this resource be used “sparingly” and in open vowels (Tosi, 1723, p. 8).

Mancini believes that the “modern singers” were not able to sing well a *Messa di Voce*, because they did not know how to make the *diminuendo*. The author advises the singers not to attack de *Messa di Voce* violently, and to be very soft and sparing with the air. Mancini also characterizes the opening of the mouth while singing a *Messa di Voce*: “At the beginning of the tone, the mouth should be but slightly open, thus helping to draw the voice in its sweeter and softer quality. Then gradually reinforce the tone, by opening the mouth as wide as the rules of art prescribed” (Mancini, G. 1777, p. 121).

Lamperti writes that a student should not start practicing *Messa di Voce* when he/she is at an initial phase of the learning process of singing. After the student is more advanced, his instructions to practice it are: (1) strictly in tempo, (2) vowel /a/ (3) start very softly and swell the sound slowly until a forte (Lamperti, G.B. 1905, pp. 20-21):

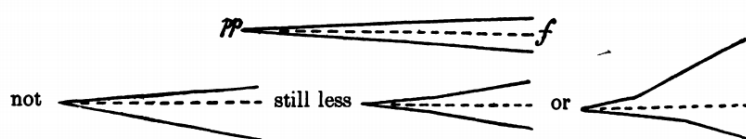


Figure 7 - *Messa di Voce (crescendo)* (p. 21)

For the second part of the *Messa di Voce*, the *decrescendo*, Lamperti writes that the diaphragm must be working with elasticity, so the air is streamed out softly. The *decrescendo* should be gradual and even, decreasing in breath pressure:



Figure 8 - *Messa di Voce (decrescendo)* (p. 21)

Marchesi also advise that “The *Messa di Voce* should not be practised until the voice has acquired a certain degree of suppleness and flexibility, and should never be attempted by beginners.” (Marchesi, M. 1899, p. 49). The following exercises are suggested to train *Messa di Voce*:



Figure 9 - Marchesi's exercise to train *Messa di Voce* (p. 49)



After reading all this material, the present author concludes that the Italian School of singing, *Bel Canto*, evolved progressively. In three centuries there are not significant differences in what regards vocal technique (not aesthetic changes). The treatises, from Tosi to Marchesi emphasize the importance of daily practice; even very successful singers should not stop practicing. It is interesting that the first singing treatises of the 18<sup>th</sup> century here analysed are written by two *castrati*. This demonstrates how the *Bel Canto* technique emerged and evolved, probably boosted by the fact that *castrati* had very powerful voices and were the operatic stars. Only after their appearance and after their experience was shared in treatises and through teaching, others, not only *castrati* (Garcia – tenor; Lamperti – Bariton; Marchesi – Mezzosoprano), appeared with their singing methods a century later, containing a few aesthetic changes and more scientific details, however, the basic technical principles maintained.

### 3. The Physiology of the Vocal Instrument

After the literature review of singing treatises from the 17<sup>th</sup>, 18<sup>th</sup>, and 19<sup>th</sup> centuries, this chapter explains, in general, the physiology of the singing voice, as a necessary contextualization. This knowledge allowed the present author to practice the exercises selected with more awareness and understanding about the process that the body goes through during practice sessions.

The human voice in a musical context is a particular instrument, as it is constituted by elements that are not directly observable, or palpable (Miller, R. 1996, p. 3). Singers cannot observe how all the elements of the voice articulate between each other, therefore, singers must find helpful strategies to manipulate all parts of the voice. The next illustration presents the systems that are activated to achieve the phenomenon of phonation: respiratory system, vibratory system, and articulatory system.

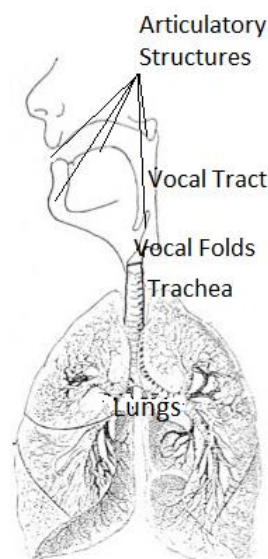


Figure 10 - representation of the singing systems (adapted from Lindblom & Sundberg, 2007: p. 678)

All systems have their individual function in singing, but they are interdependent to function. If the respiratory system does not have air, the latter cannot go through the glottis and produce vibration in the vocal folds, which means that it will not be possible to create resonance in the vocal tract, any articulation, or phonation.

The respiratory system is constituted by inspiratory muscles – diaphragm, external intercostal muscles – and expiratory muscles – abdominal muscles (rectus, internal and external oblique, and transverse). From the contraction of these muscles, the singer creates different subglottic pressures to achieve the pitch and the intensity of the sound desired.

The vibratory system is constituted by the larynx. This fibromuscular organ is formed by a musculoskeletal system of great complexity. The skeletal part is formed by a group of cartilages and is suspended in the neck through the hyoid bone. These structures are easily movable through the articulation between intrinsic muscles and membranes. Besides these structures, the vocal folds are very sophisticated and have the function of vibration. The air passing through the vocal folds produce the primary sound which is filtrated by the vocal tract. (Sá, M. 1997, p. 39).

However, the larynx also participates in the articulatory system. Being suspended in the neck by hyoid extrinsic muscles, it can make the vocal tract (acoustic tube with its own resonance, formant frequencies) shorter or longer. If the larynx does a movement downwards, the vocal tract will be longer, which acoustically results in a diminution of the five formants that constitute the resonance of the vocal tract (F1, F2, F3, F4 and F5). Formant is a complex sound produced by the vibration of the vocal folds, which is constituted by frequencies, which are the integral multiples of the lowest frequency, F0 (Miller, R. 1996, p. 50). Alterations in the position of the tongue modify F2, while the opening of the mandible increases F1. These strategies are fundamental for singers that need to sing high F0, to avoid the instability created in the vibration of the vocal folds between  $F1 > F0$ .

Figure 11 represents F1, F2 and F3 of different vowels. It demonstrates that when the singer reproduces frequencies higher than 750 Hz, (near F#5) he/she needs to apply acoustic strategies to increase F1, so that its value is never less than F0.

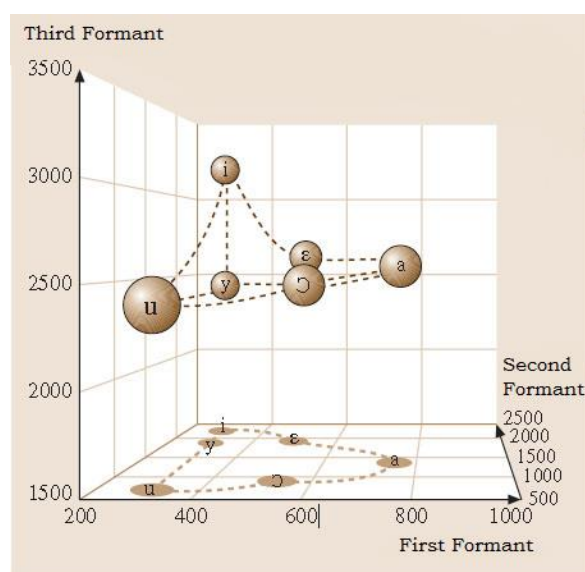


Figure 11 - Graphic representation of the first three formants of the vocal tract (Lindblom & Sundberg 2007, p. 686)

Other articulatory elements are the tongue and lips. A movement of the tongue in the front part towards the hard palate diminishes F1 and increases F2, and the movement of the back of the tongue towards the soft palate increases F1 and diminishes F2. Moving the lips forward will have the same effect as the movement of the larynx downwards: the increasing of the size of this acoustic tube, the vocal tract.

From this short explanation, one deduces that vocal production is associated with physiologic and acoustic phenomena that occur simultaneously. One should address each element in an isolated form, however with the goal of learning how these elements articulate together in the most efficient way for vocal production.

This chapter of contextualization about the voice physiology is followed by the next section: “Methodology”, where the research process of the present study will be described.

## 4. Methodology

The practical section of this investigation is based in an experimental study – case study, in which the present author applied the experiment to herself. The practical method of this research unfolded is as follows:

- Audio recording of the aria: “Se Pietà di me non senti” (*Giulio Cesare*) by G. F. Händel.
- Vocal Range Profile (VRP) recording of the same aria and the vowel /a/ with singing technology that evaluates range dynamics associated with the pitch.
- Practice of specific *Bel Canto* exercises to increase the dynamic range through all the voice register.
- Repetition of the same recordings as in steps 1 and 2, three months later.
- Comparison between the initial and final recordings and analysis of the results.
- Conclusion.

### 4.1 Se pietà di me non senti

This aria (Appendix) comes from the opera *Giulio Cesare*, written by Händel, and is sung by the role of Cleopatra. The reasons this author chose this specific aria were the following:

- a. It was written during the golden age of *Bel Canto* in the 18<sup>th</sup> century.
- b. It is indicated for the voice type of the present author, i.e. soprano.
- c. This aria is a technical challenge and could improve with the application of this study.
- d. From the personal point of view of the author, the dynamics of this piece can be varied, according to the text and mood of the character (tempo: Largo); The author intends to sing in the dynamic *piano*, in a medium-high register, as an expressive resource, which in the author’s specific case is particularly difficult to maintain flexibility of dynamic range.

Example (the dynamic suggestions were added by the author):



Figure 12 - excerpt of the aria "Se Pietà di me non senti", Händel (Editor: Frideric Chrysander, p. 108, bars 12-15)

- e. It is a piece which requires a very good *legato*, in a slow tempo, which will help the air stream to flow, a skill that is necessary to be flexible with the dynamic range.

## 4.2 Voice Range Profile Recording (VRP)

Voice Range Profile (VRP) evaluates the Sound Pressure Level (SPL) in decibels (dB), the density of the tone in seconds (s) and the frequency in Hertz (Hz), showing the acoustic formation of a produced tone, and the dynamic range associated with pitch. The recording analyses the harmonic composition of a complex tone: points of concentration and general distribution of the overtones with relation to its fundamental.

The software used for this recording was *Voice Profiler 5.1*. This software allows singers to have a visual feedback of his/her vocal production. In this case it offered the opportunity to have very specific, measurable results before and after the application of the practical method to train dynamic flexibility. Mr. Peter Pabon, teacher in the sonology department at the Royal Conservatoire of The Hague who guided the recording presented in this research, wrote: "The VRP is [...] a very useful tool to compare voices with themselves over time in an objective way."

In this recording, the author was connected to software with the goal of identifying the pitch and the dynamic that is being sung, as mentioned above. The author recorded her Vocal Range Profile (VRP), through the software *Voice Profile 5.1*, the vowel /a/ starting at her lower register (chest voice), medium register, and highest register (head voice) in *crescendo* until a *fortissimo* and *decrescendo* until a *pianissimo*. Afterwards, the author recorded with the same technology the aria "Se pietà di me non senti", by Händel.

The result of this recording offers the author a precise feedback about her flexibility in terms of dynamic range. Furthermore, using this technology at the beginning and at the end of the experiment allows us to compare very specifically if there were changes in the technique of the author. This will be a tool which will give a visual feedback, making the results measurable, which would be difficult only from an audio recording.

## 4.3 Vocal Practice sessions: exercises and plan

After reading all these sources, a plan was designed to apply some of the instructions of the treatises and methods into singing practice sessions, combined with the exercises that were already usually practiced by the author. In this method the Händel aria mentioned in chapter 4.1 is the one in focus as it is also the aria recorded. Nonetheless, the technical goals of the exercises of this study were applied into the rest of the repertoire that was being practiced by the author. The following table is a

summary of the plan. These exercises are focused in the dynamics.

*Table 1 – Practical exercise plan for flexibility on the dynamics range*

Exercise	Description		Goals
<b>1. Posture</b>	Head erect and aligned with the neck, shoulders thrown back and down without stiffness, open chest.		A relaxed position of the body, however with energy. By having the head aligned with the neck, the shape of the vocal tract is not affected. Having the chest open so that the lungs are free to expand in the most effective way.
<b>2. Breathing</b>	With the posture described above, take a quiet inhalation through the mouth, and exhale with fricative consonants: /v/; /f/; /z/; /s/.	Repetition of the same exercise, but replacing the consonants with vowels. Note: There should not be felt any kind of discomfort during this practice.	To breathe freely. This will be always the origin of a good phonation. Using the fricative consonants as these activate the air stream automatically. Adaptation of the same feeling when using vowels.
<b>3. <i>Messa di Voce</i></b>	Sing exercises similar as in the example shown in <b>Figure 13</b> , in different vowels. Start slowly and very softly, and make a <i>crescendo</i> increasing the stream of the air. Without stopping the movement of the air, start a <i>decrescendo</i> , in a way that the diaphragm is flexible. Note: never execute this exercise by forcing the sound, causing subglottic pressure.		To gain practice of breath control. Gain flexibility in the dynamic range. Realize a <i>crescendo</i> and a <i>decrescendo</i> , through continuous movement of the air, and consequently resonate the sound in the cavities of the vocal tract.
<b>4. <i>Händel Aria: Se Pietà di me non sento</i></b>	Studying the aria, this author, should attempt to apply the results of the exercises described above. Singing separate phrases and fragments, not the complete aria every time that it is practiced. Start only by (a) examining the posture, (b) inhaling effectively (c) without stopping the air flux, exhaling by starting to sing the aria (d) realize desired dynamics, as explained in the <i>Messa di Voce</i> exercise: not creating subglottic pressure. The same can be applied to any other musical piece that is being studied by the author.		To transfer the knowledge given by then practice of the exercises above into the repertoire that the author wishes to perform.



Figure 13 - *Messa di Voce* exercise *The technics of Bel Canto*, by Lamperti (p. 21)

## 5. Results

In this chapter, the results of this training are exposed. The results are based on the VRP recordings.

Before presenting the results of the VRP recording, the following terms will be defined, as an aid to a better understanding and interpretation of the graphs:

- Fundamental Frequency (F0), as it is describes in chapter 3 Formant is a complex sound produced by the vibration of the vocal folds, which is constituted by frequencies, which are the integral multiples of the lowest frequency, F0 (Miller, R. 1996, p. 50).
- Voice Registers: Empirically, as a traditional and a helpful way of describing and identifying sensations that singers feel while exploring the total range of their voices, different names have been given to three different areas of the vocal registers. These are: “chest” register, “mixed” register and “head” register. Observing the physiology of the larynx, these three different types of register are distinguished by different mechanisms happening in the larynx that manipulates the behaviour of the vocal folds. In the results of the following graphs the terms “chest voice”/ “Modal voice” and “head voice”/“*Falsetto*” are used.

Evaluating specifically the dynamic range, it was verified that the realization of *Messa di Voce*, in modal/chest voice was easier after practicing the designed exercises, with an increased flexibility. The same result applies at the *falsetto*/head voice at the midrange of the author’s voice. There was no difference registered in higher limits of the vocal register.

In the aria there are no significant differences present in the graphs, although in the audio recording differences are perceptible. Since these differences are very small in acoustic terms, these are not exposed in the graphs.

The following section is the report given by Peter Pabon in his own words, where a comparison of the first VRP recording (6-10-2014) and the second (27-01-2015) are made, by evaluating the different vocal registers, being these (a) speaking voice (b) modal/chest (c) *falsetto*/head, and to conclude (d) the Händel aria “Se pietà di me non senti”. Peter Pabon also expresses a personal evaluation, where he describes what should be expected in the future, especially some changes in the high register of the present author.

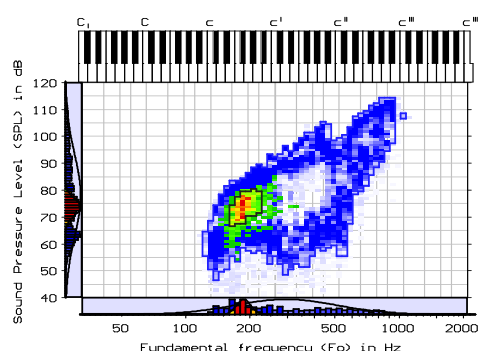
## “Report VRP re-recording Mariana Andrade, January 27, 2015.

By: Peter Pabon

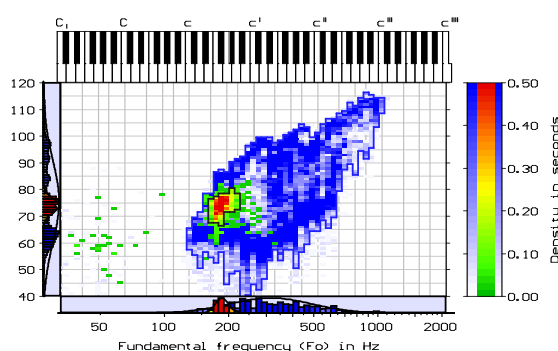
This report describes the differences or changes in voice range and dynamics following a Belcanto singing training period by Mariana Andrade. Check the first report to get an impression of the Voice state before the training period. For this recording the same protocol is used: the two voice registers modal/chest and head/falsetto are recorded separately, the speech range and again the same aria is performed.

### Results

Recording 6-10-2014



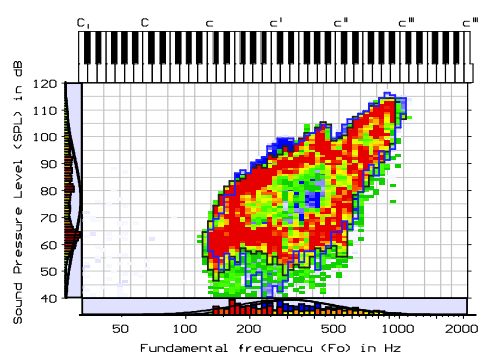
Recording 27-1-2015



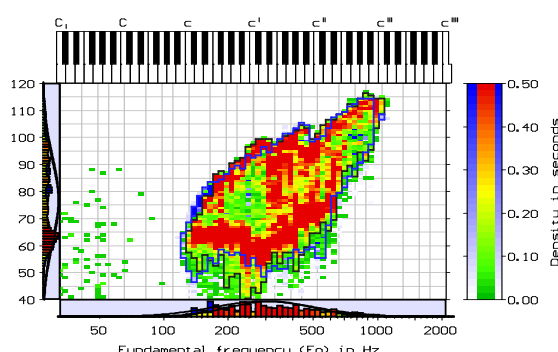
*Speech range on top of total range, phonation density.*

The average speaking fundamental frequency (speech F0) and the average speaking sound level (speech SPL) were not significantly different.

6-10-2014 on top of 27-1-2015



27-1-2015 on top of 6-10-2014



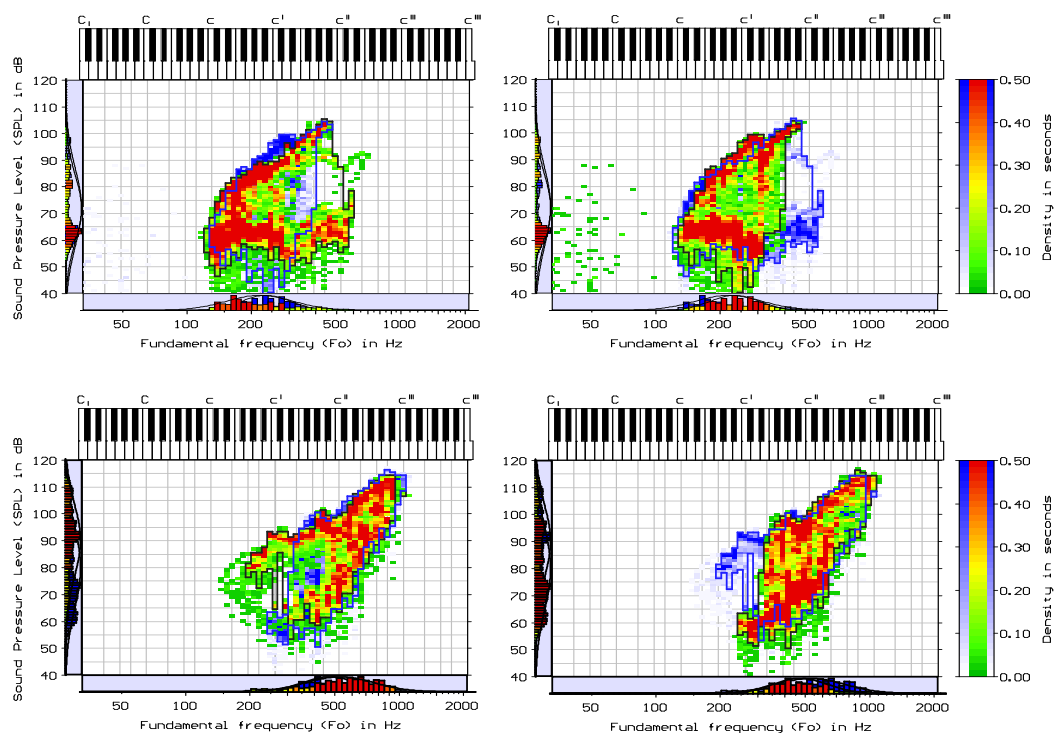
*Comparison of total areas.*



## Separate register recordings

6-10-2014 on top of 27-1-2015

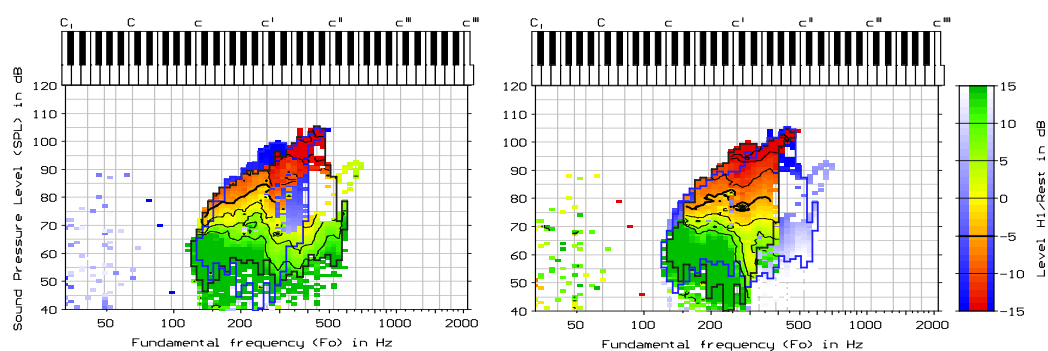
27-1-2015 on top of 6-10-2014

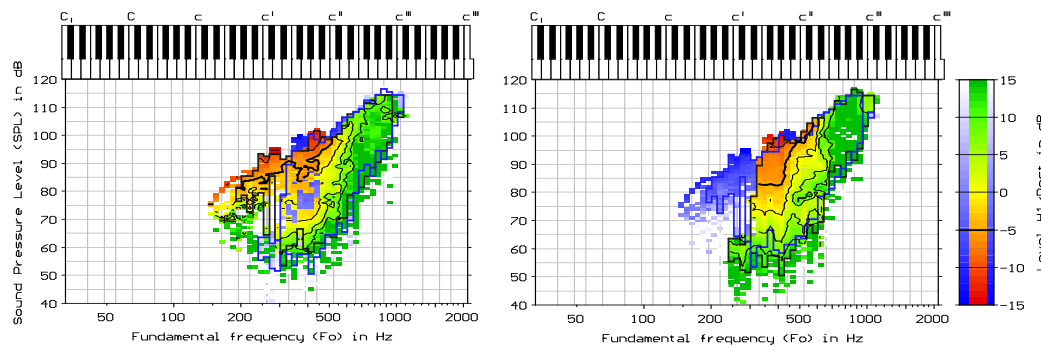


*Phonation density, Modal/chest register (top row), Head (bottom row).*

6-10-2014 on top of 27-1-2015

27-1-2015 on top of 6-10-2014





*Relative power of the fundamental, Chest register (top row), Head (bottom row).*

### **Interpretation of the results for the separate registers**

This is the only part that shows a change, not that much in the absolute quality of the voice, but more in the certainty while using either register or mixed voice.

Chest voice: In the last recordings (27-1-2015) the choice to go for pure chest register was more clear and also it was easier to do a *messa di voce* (swell tones at the same pitch) in pure chest, as there seemed to be more confidence that using this pure chest technique would not interfere with her mixing skills in midrange. At 6-10-2014, there was at c1 at 85 dB SPL a very sudden change (orange-to-red) in the relative power of the fundamental to values below -10 dB. At 27-1-2015, the relative power of the fundamental reaches this (red) state already at an 'a' (220 Hz). So pure chest voice was applied earlier, while also the maximum SPL in the 'b-e1' (100 dB SPL) range comes 5 dB above the maxima in 6-10-2014 (95 dB SPL).

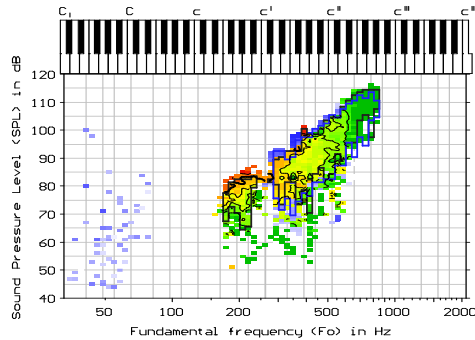
Head voice: With the last recordings (27-1-2015) it is again easier to do a *Messa di Voce* (swell tones at the same pitch), but now in mixed voice, while originating from a higher pitched head voice. Also it is much easier to sing the very soft tones in this quality, especially in midrange. This is clear from the much higher phonation density values at 27-1-2015 (VRP at the right hand side) as evident from the red band that runs from c1/55 dB SPL to e2/75 dB SPL. The relative power of the fundamental shows in the last recording from 27-1-2015 a much more fluent gradient in the same pitch range (c1-e2). There is some loss in steadiness or certainty with the very soft and highest tones in the range f2-c3. Although the same dynamic range is being covered in the VRP (areas did not change) the phonation density around f2-g2 during the first recording at 6-10-2014 is considerably higher then during the last recording at 27-1-2015.

Personal remark PP: Mariana seems to be uncertain on her control in the highest part of her range, while tones up to c3 are available to her. The VRP contour shows from c2 to c3 no dips, but just above d2 there is a steep change in harmonic balance where the relative strength of the fundamental turns from -5 (red) to +10 dB (green). Above d2 there will be less ease, as an extra driving power is needed at this high end of the range. The extra effort needed does not have to imply that the voice is thus "pushed", "not free" or "strenuous". Accepting the extra effort that is needed for this high part to be a natural demand of specifically her voice doing these high tones could be a help in gaining confidence at the high end. I expect that Mariana can be more smooth at her entry to this high end.

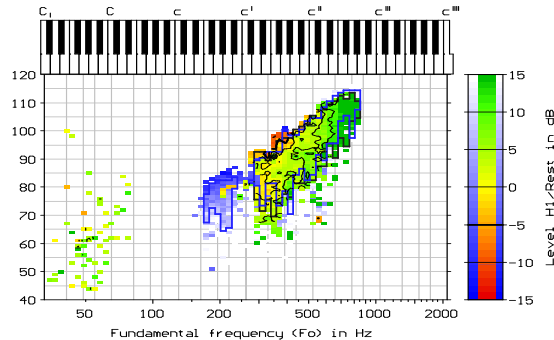
## Aria

The same aria that was sung for the first time (I) at 6-10-2014, and again three times (attempts II, III and IV) this last date 27-1-2015. There were three attempts as Mariana was not satisfied with her performance(s). The VRP results show no clear differences. There were noticeable perceptual differences when listening again to the first recording (I), but these differences are too subtle and so depending on the variable acoustical context, to be backed up by any of the rather “blunt” acoustical measures that simply lack the means to accommodate to the context.

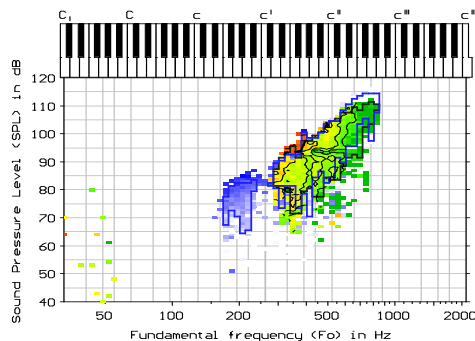
I on top of attempt II



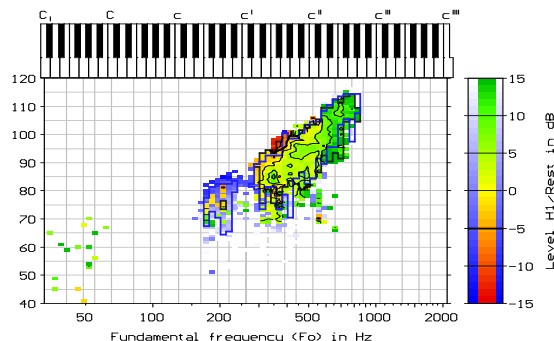
Attempt I on I



attempt III on I



attempt IV on I



*Relative power of the fundamental, I (6-10-2014) and attempts II, II, IV (27-1-2015).*

PP, 2-2-2015.”

## 6. Reflection

This chapter intends to be a reflection about the process of increasing the dynamic range and flexibility that the author undertook and also the experience gained on to how this led to the conclusions presented in the next section.

After beginning the practice the of these exercises the author recognized the importance of exploring the training of breathing, as this mechanism is responsible for the air stream, which depending on its pressure will determine the intensity or volume of the sound produced. The first tries on producing *Messa di Voce*, only thinking about the continuum movement of the air seemed not efficient enough to achieve effective results. Therefore, the author sought other practical tools that would improve this technique.

The introduction of fricative consonants, especially /v/, forced the air to move continuously and regularly, by the activation of the abdominal and lower back muscles, which offered the author the exact feeling needed for the so-called “breath support”, which is nothing more than exhalation. The fact that articulating the consonant /v/ where the lips are almost together and being the mouth almost closed, increased the air pressure that would be otherwise diminished if there was a larger mouth opening. This condition offered the author an amplified feeling of exhalation, with special attention on the work of the muscles that were involved in this process.



Figure 14 - Example of the half full water bottle exercise

Another tool later introduced in the work of exhalation was the use of a half full water bottle and a straw. By blowing into the straw placed in the interior of the bottle, the air stream on the water originated bubbles. The goal was that the amount and intensity of bubbles would be constant, regular, as a way of controlling the air movement. This tool offered, besides the practical sensation of a controlled exhalation, a visual feedback to the author. In figure 14 it is possible to observe an example of this exercise. The repetition of this first part of the session offered a much bigger awareness of the lower back musculature that was not efficiently active before starting this method regularly.

In the following exercise, vowels were introduced in the training. First in one note of the lower register, for example F1 (respectively to the notes nomination in the graphs presented on the previous chapter, Results), the author, primarily only using the consonant /v/ made a gradual *crescendo* and, without breathing, a gradual *decrescendo*, creating a *Messa di Voce*. Right after, the same exercise was repeated, however with a vowel, where the author searched for the same sensation of freedom, as not “forced” or “pushed” sound, offered by the consonant. The exact same process was repeated throughout an ascended chromatic scale, until the sensation of discomfort was felt. Usually this exercise resulted as efficient until G2/G#2. After this region of the author’s vocal register the same results were harder to achieve.

Speaking empirically, what the author experienced after having more control of the breathing system was that in the first part of the *Messa di Voce*, in the *crescendo*, instead of aiming to project the sound forward into the room, the focus in increasing air pressure aiming to resonate the sound (created by the cavities of the Vocal Tract) made the sound richer in its acoustic formation, which transformed a tone, instead of only

louder, into a “big-tone”, as Reid explains: “In any discussion of tonal volume a very real distinction should always be made between a ‘big’ tone, or one that is well resonated, and a ‘loud’ tone, which is nothing but noise. ‘Loud’ singing is both inartistic and injurious to the voice and is to be avoided at all costs. A ‘big’ tone is the very essence of musical quality and indicates that the tone is being well resonated.” (Reid, C. 1978, pp. 30-31).

As well as to make the second part of this expressive resource, which is the *decrescendo* of the *Messa di Voce*, the practical difference realized by the author was: in place of taking out energy to the movement of the air, while the sound is diminishing, the opposite happens, the air stream is as active or even more active on the velocity of the air movement. The author learned that she should not associate the fact that she is singing with less volume with being less energetic in the movement of the air.

Transferring this practice into the repertoire, implicates different conditions, different contextualization. In order to integrate this training in the repertoire, the study of a piece was made in musical fragments, where this could be practiced replacing the text with the consonant /v/, afterwards with one vowel, and gradually introducing the text and finally singing the fragments in the context of the whole phrase or the whole piece.

As it is observed in the Chapter Results, this practice had more impact in the author’s medium vocal register. On the contrary, in the high register there are no differences registered, and probably more time would be needed. Figure 15 is a graph that illustrates the learning process of the technique of singing or playing an instrument in three phases. The author situates herself in the second phase, the associative part of the process:

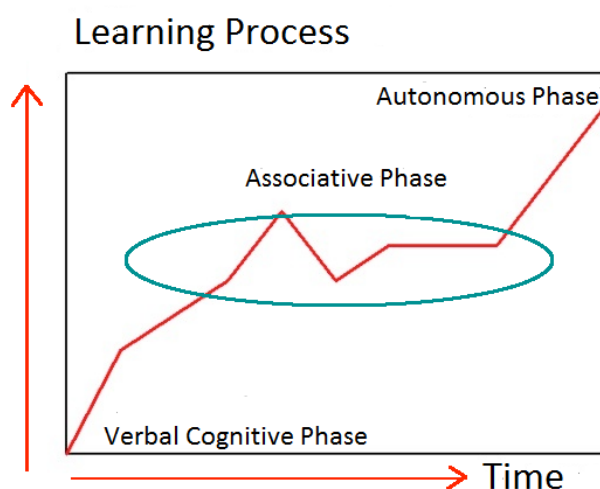


Figure 15 - Learning process of the technique of singing or playing an instrument – Image from the material of subject “Music Psychology”, integrated in the Music Course at the University of Aveiro, in Portugal, oriented by the vocal science expert, singing teacher and singer Dr<sup>a</sup> Filipa Lã

This author believes that this learning process, the exploration of dynamic range, needs persistency and time to improve to reach the autonomous phase. Quoting Reid once more: “To force progress is to attempt to overcome difficulties the vocal organs are not yet conditioned to handle” (Reid, C. 1978, p. 28). With the same idea of learning singing as a long process that requires hard training, being specific about gaining flexibility on dynamic range, Richard Miller, an important vocal pedagogue of the 20<sup>th</sup> and 21<sup>st</sup> century, writes in his book *Training Soprano Voices*: “It is destructive for most young sopranos during early training to attempt the full range of dynamic subtlety that

an accomplished artist has learn to deliver. Much of the coaching of student and “preprofessional” singers is less than successful because of rigid adherence to the principle that every voice must meet the demands for dynamic finesse [...]”, Miller continues explaining that “It is unrealistic to require the young soprano to sing at *pianissimo* or *fortissimo* levels in all regions of her voice while she is still I the process of developing basic technique.” (Miller, R. 2000, p. 152)

Some conditions of this experimental study can be critiqued by the author as limitations of this research: while the VRP recordings offer a visual and very specific feedback, it is true that, as any other athlete, the training can be different each day. Of course within a certain range however, the level of efficiency can vary, depending on the different circumstances that one must learn to cope with, such as: tiredness, mental disposition, concentration level, amount of sleep, emotional state, diet quality etc. Unfortunately, the author believes that anxiety felt during the recording (wishing for the best results possible), influenced her performance, as she felt it was not the best time she practiced the exercises. Nevertheless, this recording of the VRP, among other tools involved in singing technology can be a very helpful tool to analyse very specifically one’s vocal behaviour.

After reading vocal pedagogic sources from 18th and 19th centuries, it is clear how dedicated to daily practice good singers were, and efficient in their very methodical manner of training, executing at their best level very virtuoso musical fragments, such as exemplified in Figure 16, an example of an early *coloratura* that was performed by the soprano Lucrezia Agujari in the presence of Mozart, Parma, Italy (1770) (Reid, C. 1978, p. 12).



Figure 16 - Early Coloratura (Reid, C. 1978, p. 12)

Their dedication to practice aiming for perfection, offered a purpose, inspiration and a good connection to execute these exercises for this research.

## 6.1. Conclusions

Already present as a priority in the author’s mind as a singer, the need of singing following the laws of nature, in a healthy manner, is even stronger after reading early sources from 18th and 19th centuries, such as Mancini, Garcia, Lamperti, Marchesi, who always put nature as a number one guide and priority in singing.

Reading these sources increased the knowledge about *Bel Canto* pedagogy in Italy, and how the singers practiced at the time. The fact that the technical principles



are similar to what this author has been oriented by her teachers, was a motivation to make this experimental study, which had a positive impact and increased the dynamic flexibility in her medium vocal register, and offered more awareness of breathing aspects, especially the activation of the musculature involved in this process.

The practical section of this investigation based in a study-case, with only one study object, make these results very personal; however, the fact that it had an impact in the singing technique of the author can be an indicator of an efficient method, specific for training the dynamic range. Therefore, it could be interesting to repeat the VRP recording in some months and analyse the results given at that time. The author would be also curious to know how the exercises from this training could influence the singing practice of others singers with similar technical goals.

As a final thought, this experimental study and investigation formed an interesting interdisciplinary connection between early Italian vocal pedagogy from the golden age of the *Bel Canto* era, with advanced voice science and singing technology. The author wishes to proceed with her singing practice following the *Bel Canto* technique, which is still (in the case of this author) a vast universe full of new information to explore.



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## Appendix

Aria recorded with VRP system: “Se pietà di me non senti”, from the opera *Giulio Cesare*, composed by G. F. Händel, II act, Scene IX.

Editor: Frediric Chrysander, pp. 108-111

2-26 CLEOPATRA. *Se pietà di me non senti, giusto ciel*

*Largo.*

CLEOPATRA.

Se pie - tà di me non sen - ti,

giu - sto ciel, io mo - rirò, giu - sto ciel,

io mo - rirò, io mo - rirò,

16

giu - sto ciel, giu - sto ciel, io mo - rirò;

19

se pietà di me non sen-ti, giu - sto ciel, io mo - ri -

22

- rò, giusto ciel, io mo - ri - rò, giusto ciel, io mo - ri-rò; se pie -

25

tà di me non sen - ti, giu - sto ciel, giusto ciel, io mo - ri-rò, giu - sto ciel, giu - sto

28

ciel, io mo - ri-rò.

81  
giu - sto ciel, io mo - ri - rò.

84  
Tu dà pa-ce a miei tor-men-ti, o quest' al - ma spi - re-

87  
rò, o quest' al - ma spi - re-rò,

40  
o quest' al - ma spi - re-rò; tu dà pa-ce a miei tor -

43  
men-ti, o quest' al - ma spi - re - rò, o quest' al - ma spi - re-

*f* *pp* *Fine.*

46 *Adagio.*

rò, o quest' al-ma, o quest' al - ma spi - re-rò.

49

*Dal Segno.*

SCENA IX

2-27 TOLOMEO. *Belle dee di questo core*

TOLOMEO.

3

5

Bel - le de - - e, bel - le de - e di