THE TONGUE
as a Gateway to Voice, Resonance, Style, and Intelligibility

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PLURAL PUBLISHING INC.

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Website: https://www.pluralpublishing.com

Typeset in 10.5/13 Minion Pro by Flanagan's Publishing Services, Inc.
Printed in the United States of America by Integrated Books International

Library of Congress Cataloging-in-Publication Data:
Names: Nair, Angelika, author.
Title: The tongue as a gateway to voice, resonance, style, and intelligibility / Angelika Nair.
Description: San Diego, CA : Plural Publishing, Inc., [2021] | Includes bibliographical references and index.
Identifiers: LCCN 2021002984 (print) | LCCN 2021002985 (ebook) | ISBN 9781635503630 (paperback) | ISBN 1635503639 (paperback) | ISBN 9781635503647 (ebook)
Subjects: MESH: Voice—physiology | Tongue—physiology | Speech—physiology
Classification: LCC QP306 (print) | LCC QP306 (ebook) | NLM WV 501 | DDC 612.7/8—dc23
LC record available at https://lccn.loc.gov/2021002984
LC ebook record available at https://lccn.loc.gov/2021002985

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Foreword

The human voice has been receiving increased attention from researchers, scholars, clinicians, and vocal pedagogues all over the world. Abstract rhetorical and metaphorical discourse has been replaced with detailed scientific information offered by colleagues from different academic backgrounds.

It is a pleasure to introduce to the voice audience this book by Angelika Nair, a thoughtful, intriguing, and fascinating text on the human voice. This book makes a unique contribution to the field in two major respects. First, Dr. Nair translates the complex nature of voice science into simple terms, practically applicable to anyone who wants to enhance his or her training, performance, teaching, or voice awareness. Second, she explores the voice as a whole, giving attention not only to phonation and the voice box itself, but also to whole vocal product as the result of a sophisticated transformation of the basic sound through the vocal tract. Tongue and mandible are not treated as components of the vocal tract but as important elements of interconnectedness with the entire voice box, which makes complete sense. The world of voice is predominantly based on vowels, the so-called "vowel centric world"; however, consonants have resonance, and this may interfere with the quality of the vocal output. Beautiful ultrasound images are offered to give insights on the inner process of singing and also to help improve speaking. Moreover, Dr. Nair shares with the reader her experience using biofeedback in the voice studio. Consonants and tongue are never going to be overlooked again.

This book has updated scientific information, but beyond that, it is a practical resource with exercises, step-by-step instructions, and graphics/illustrations that make it engaging and easy to follow, with immediate applications. Special attention has to be given to the illustrations, all made by the author. They are simple, precise, and attractive—a tough combination when showing anatomical landmarks and specific movements' details. The integration of drawings and ultrasound imaging is unique; I am sure that these figures are going to be used in classes, congresses, and courses all over the world. The whole text plus the exercises enable the reader to visualize the hidden nature of voice production, thus helping with the execution. For example, how to manipulate the tongue for maximum consonant resonance is clearly presented.

A final word should be said on the intense presence of Prof. Garyth Nair between the lines of this book. Those who had the privilege of meeting him surely remember quite well his intelligence, high expectations, and intense criticism of the obscurantism of some approaches to vocal pedagogy. The arrival of Dr. Angelika Nair in his life produced a strong combination of their talents, with immediate scientific and pedagogic results that were presented in conferences across the United States and abroad. She has not only maintained but also upgraded this legacy by challenging and motivating herself to write this book. I deeply recognize and appreciate her efforts, even if I can barely grasp the mix of

emotions that must have been involved in this process.

I wish all colleagues a good reading of this book, with confidence that not only the knowledge it contains but also the passion for the human voice will be perceived throughout its chapters.

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Preface

Life can be full of surprises. And I certainly had a lot of them in mine, including publishing this book. Writing a book is always a long endeavor, particularly if it is the first one. In this case it is both the first book I have written and a continuation of my mission to show that there is no dichotomy between voice science and voice pedagogy.

It all started with Garyth Nair's first book *Voice Tradition and Technology: A State-of-the-Art Studio* (Singular Publishing, 1999) in which he merged new knowledge into musical training by integrating computer-assisted, real-time analysis through spectrography. This was, as Sataloff wrote, "a milestone in the interdisciplinary evolution of vocal art and science."[1] A couple years later, his second book *The Craft of Singing* (Plural Publishing, 2007) came out in which he applied the current knowledge about voice function to the art of singing.

Now, this book continues in the same spirit, merging new knowledge—particularly about the tongue shapes and movements in resonant vocal production—into vocal training by integrating ultrasound as biofeedback.

How did I get from being a professional singer and experienced voice pedagogue to doing voice research? The journey started with both my curiosity to always know the how *and* why, the instinctual sense that there is more to singing (and teaching voice) than what I had learned in my studies. Listening to and watching the best of the best in the classical singing world, I observed a lot that I was not able to copy, let alone understand the physiology. So, I went on a personal mission and started researching, reading every book there is, attending workshops, and the like. But it was not until I looked for literature outside the German-speaking countries that a whole new world opened up to me: voice research. It was a steep learning curve working through the literature primarily written for, and by, scientists and clinicians. Trust me, I wished I would have already had the training to become a vocologist at the National Center for Voice and Speech (Salt Lake City, Utah) back then. But that did not yet exist. Anyway, eventually, I found Garyth Nair's first book and instantly felt as if he was writing from my own heart. Little did I know that this bibliographic love at first sight would literally become the love of my life.

Fast-forward, I not only found the love of my life, but also a man with whom I could share intellectually and professionally. So, I became Garyth's research partner, and together we continued his legacy of finding new insight into voice science and making it applicable to everyday teaching methods and voice use. In this spirit, we started to conduct groundbreaking research together, investigating the physiology of the low mandible maneuver (LMM; drop of the posterior mandible) and its ramification

[1]Garyth Nair, *Voice Tradition and Technology: A State-of-the-Art Studio* (San Diego, CA: Singular Publishing, 1999), ix.

for resonance production, as well as the rehabituation of tongue shapes required for all phonemes in high-ranking singers. In preparation for this research, we knew that we needed to use various imagery techniques. The collaboration with the Austrian Medical University of Graz was one major and generous puzzle piece. Our goal to have equipment that can be broken down for transportation to remote locations—singers' homes, studios, dressing rooms, and so forth—led us to ultrasound, and ultimately to Dr. Maureen Stone of the University of Maryland, who originally developed the technique of the acquisition of midsagittal (the midline slice) tongue profiles.

Dr. Stone generously invited us to come to her lab to introduce us to the ultrasound, and to explore its use for our purposes. I will never forget how ecstatic, fascinated, and astounded we were seeing our tongue in action during singing. It felt like Christmas, Easter, and every other feast and birthday wrapped in one. We just could not believe what we saw, experimented for hours, and recorded a protocol for further study. Before long, it became clear that this would be a major part in our research. So, for our LMM study we used magnetic resonance imaging, ultrasound, and spectrographic techniques and collected enough data to analyze for years. We even purchased our own portable ultrasound machine, knowing that we would continue using it for research and teaching. In June of 2013, with preliminary results, we presented as well as won first prize with our poster at the Voice Foundation's annual symposium in Philadelphia, Pennsylvania. Tragically, in August of the same year, Garyth passed away and was not able to see all that has become of our work.

Determined to continue, I analyzed and published our original LMM study and continued to study both the vast amount of data as well as the work with the ultrasound as biofeedback in the voice studio. Even so, the scope of its potential application was and still is not exhausted. Exploring my own tongue movements and the effect on the voice and working with my students—who have been an incredible help—I started to develop techniques and found indications to help master a more conscious and precise maneuvering/manipulation of the tongue.

I could not believe what I learned for my own singing and, by extension, as a pedagogue. I wished I would have had this tool and knowledge in my own study, cutting down a lot of explanations and—knowing now what is really happening—imaginary and even misguiding instructions. It is interesting that many voice users (including singers, actors, teachers, coaches, therapists, etc.) and scientists agree that the tongue is a crucial part in singing as well as speaking. Yet, there is no literature that solely addresses that organ and its acoustic influence in the context of a technique; in other words, what all does the tongue actually effect/influence? how can I manipulate/execute it for my purpose and why?

Of course, with the complexity of vocal production, it is never just one point that fixes everything. That said, the tongue is a major puzzle piece and should be, like breath support, posture, and so on, on the same checklist of fundamentals in voice production. By providing a visual demonstration of what is happening biomechanically and kinetically, students begin to feel the effect on the larynx as well as sensitize themselves to the possible physiological changes through muscle control and balance. This can help address, among other issues, the breathiness of a voice (vocal folds do not close because of tension in the tongue) and singing through the upper passaggio (transition into the top registers) with ease and without loss of timbre and intelligibility (often a result of tongue

tension, tongue position—particularly for consonants and/or lack of pharyngeal resonance modification).

With the use of real-time video feedback and images derived from ultrasound, I observed a rapid acceleration in the students' understanding of complex vocal strategies that ultimately helps them to efficiently manifest a healthy vocal production in their own practice. No matter where I presented, gave workshops, or taught, it was the work with the ultrasound, and subsequently the attention on the tongue, that had the biggest effect. Statements like, "I cannot believe how important precise tongue positions are" or "I had no idea how much the tongue influences my voice" were not uncommon. This reality, plus the rapidly growing demand to have a book to refer to, and my excitement to help many vocal users by making this knowledge accessible, finally led me to write this book. It is by no means complete. The discoveries of new insight in the workings of the tongue, coupled with the acoustic influence and possible manipulations are ongoing. Even though I wanted the book to be as up-do-date as possible, I finally had to stop rewriting chapters every time I found something new. The primary audience for this book may be singers and actors, regardless of the level. Although based on scientific knowledge, it should not discourage those without a background in voice science. If anything, it should encourage them to get in touch with and maybe even become intrigued by it. For this reason, I tried not to omit technical terms, but I also did not make them a priority. Also, I purposely kept ancillary details to a minimum and simplified as much as possible. My focus in this book is the tongue and jaw. There are already multiple books and papers that cover vocal anatomy, physiology, and acoustics in great detail. Some of those "bibles" are referenced and should suffice—for those interested in more details and literature—to get off to a good start.

The book may also be useful to vocal therapists and professionals in related disciplines, giving a new perspective and ideas on vocal productions and analysis in everyday practice through the use of ultrasound. This may also be true for voice scientists. The spectrographic analysis on tongue shapes and various presented theories on consonants may be interesting for further research in the lab.

My research focus and goal is to make gained scientific knowledge and technological development more readily available and practically applicable to anyone who wants to learn how to sing or speak in a healthy manner and use the entire potential of their voice to express themselves. Since the "spectrographic big bang" in the evolution of voice pedagogy, many more books have been written by other authors who embrace the rapidly changing field of voice science and apply it in their pedagogical practice. Spectrography has since become a similar eye-body biofeedback that is now in extensive use in many voice studios worldwide.

I have been privileged and blessed by God to carry on Garyth's legacy together with him and now I am continuing and living it. So, it is my hope for the near future that ultrasound will follow the same path and find its way into the studios. Indeed, I am already working on development of an affordable USB transducer. Until then, I hope that this effort to codify new insights on tongue shapes and maneuvers will benefit all voice users and kindle new scientific studies, new appreciation for the complexity of voice production, new perspectives and ideas for voice pedagogy and therapy, and maybe even new excitement for voice research.

Note to the Reader

Many of the figure captions have two indicators for the color, e.g. gray/red. The first indicator refers to the black and white figure that appears in the printed book. The second refers to the full-color versions of the figures that can be found on the companion website.

For users of the eBook, the second color in the caption refers to the figures that appear within the book. There is no companion website access available for eBook users.

1 It Is a Vowel-Centric World

Few of us ever stop to think about our ability to speak language—we speak every day, and each of us has been communicating in this way since we were between 12 and 18 months old. Our speech occurs automatically—we think a thought, and the words pour out without any conscious effort on our part. This automatic, background-processing nature of speech will take on huge significance later in this book when we begin to discuss high-level, classical singing in minute detail.

Singing Styles, Vocal Resonance, and Acting

This book is aimed to benefit all singers and actors alike, even though it is primarily geared to the high-level classical singer. Most singing styles, such as folk, pop, Broadway, and jazz (contemporary commercial music [**CCM**]), are **speech based**. This means that the phonemes of the language being sung are produced in almost the same manner as when the singer is speaking. In addition, the singer's voice is amplified, an often forgotten and, in its impact, underestimated component. Diction and intelligibility are still critical to the speech-based singer; achieving greater clarity is usually a matter of making sure that all the necessary phonemes are present and sung with sufficient force to be heard.

However, classical singers do not operate in a speech-based world. The rich resonance that surrounds the language sounds of such singers differs significantly from their speech norms. This style also requires power sufficient enough to fill large venues without the aid of electrical amplification and to sing over the accompaniment of a full orchestra. This rich resonance creation is a learned behavior that takes *years* to develop properly. It must pervade all phonemes in the singer's output. This often presents a problem, because classical singers tend to concentrate far more on their vowel production than on that of their consonants; a subject that will be addressed in greater detail as we proceed.

You may ask, how does all of that correlate to acting? As mentioned earlier, in the speech-based singing style, sufficient force and presence seem to be enough in order to be heard. But the important puzzle piece for both **speech-based singing** and acting is *how* efficiently one is producing the force and presence. If you keep pushing and screaming from your throat (**larynx**) to get more power in your voice, you will not have much voice left after the premiere of the play. Frequently, such voice problems have already begun within the last few weeks before the premiere, when the intensity and

frequency of rehearsals (and subsequently the voice abuse) increase, leaving actors little time to recuperate.

Although some of these circumstance in acting are similar to those in classical singing, it is interesting that so few actors seem to pay attention to how to use their voice properly in order to achieve good intelligibility and variety in their recitation. Many theaters lack good acoustics and/or are not supported by amplification. If speech-singing is not sufficient to carry a voice within those circumstances, why would a regular speech application do so? Just because one can speak does not mean that it is enough for the stage. That would be like saying that someone can play in the NFL simply because they can run and catch a football.

You may argue that this may not be as important in film and TV, where your voice is recorded through microphones and heavily processed by the sound engineer. I am aware of the trend toward a very natural way of speaking—aka "mumbling"—in those industries. But a BBC adaptation of *Jamaica Inn,* for instance, evoked hundreds of complaints from viewers who could not understand what the actors were saying, because they were so "natural" (in many cases, their thick accents were impenetrable). But do not take my word for it; Google the problem, and other films such as *Public Enemies*, *Shooter*, the *Pirates of The Caribbean* series, *Four Christmases*, *Miami Vice*, *The Wolfman*, *Be Kind Rewind*, *Fear and Loathing In Las Vegas*, and many Sylvester Stallone movies are quickly cited as examples.

Speech on stage has to be escalated over the speech norms we acquired since we are born, therefore requiring actors to be present more than the average 100%. When a singer starts to arrive at their first truly wonderful sung sounds, they are often reluctant to accept them as their own and describe them as "fake" because it feels "foreign." The same is true for actors. The proof is easily shown with the **SAS ("say it as a singer")** exercise—the phrase was coined by Garyth Nair (1999, 2007)—in which the student is asked to *speak* the sounds of the phrase he or she is attempting to sing utilizing a *full, rich singing technique.*

To visualize our exercise, we use the **spectrogram** (Figure 1–1), a computer-generated analysis of sound that is extremely useful in both research and vocal study (Koenig, Dunn, & Lacy, 1946). The time is indicated from left to right, the **frequency** is indicated from bottom to top (the further up on the screen, the higher the frequency of the sound component), and the **loudness** is represented by the brightness of color of the graphic element. Of course, there is much more one can read in it, which we will do throughout the book, but for now that should suffice.

The graph in Figure 1–1 shows the Italian phrase, *Sospiri di foco, che l'aure in fiammate* performed three times: (a) spoken in a regular speech setting; (b) spoken with singer's resonance (utilizing the resonance of a classical technique); and (c) sung in classical style. The difference between the speech (first, left) and sung (third, right) is obvious. Interesting for us right now is the difference between the spoken (first, left) and the SAS (second, middle) phrases. In the latter, the singer speaks the phrase through the same vocal tract configuration used for singing. As a result, the vowels are showing much more harmonics (frequency) and loudness (brighter color) compared to the first one. It gets even more interesting when we look at the consonants (the core of this book, which we talk about in more detail later). Let us compare the first two vertical lines that indicate the consonants "s" and "sp" of *sospiri*. They show (a) more

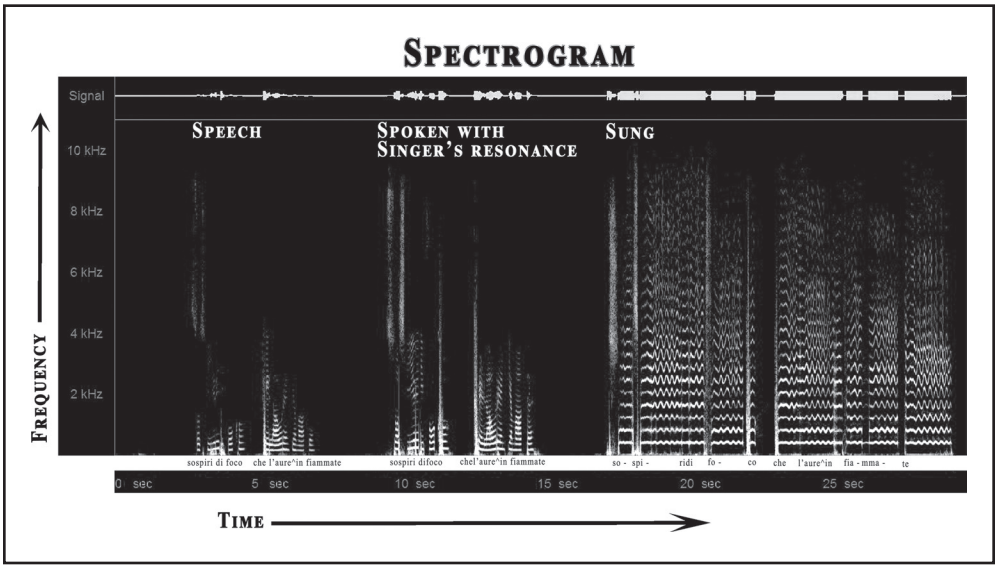

Figure 1–1. The phrase *Sospiri di foco, che l'aure in fiammate* performed as speech (*left*), speech utilizing the resonance of a classical technique (*middle*), and classical singing (*right*).

higher and lower frequencies, (b) more prominent and less scattered formants, and (c) increased intensity/loudness (brighter color). Thus, applying the singing technique in your speech leads to

- more resonance in all phonemes, vowels, and consonants;
- increased intelligibility because of purer phoneme-to-phoneme shifts; and
- an acoustical outcome that carries through any space, no matter the circumstances, while offering a variety of colors and dynamics for recitation.

The job of both singers and actors is to be a medium to convey a message through one of the greatest of all musical instruments: the human voice. We can only accomplish this with an effective delivery; for that, we have to train on how to use the body and learn the skills of voice/vocal use and body movement in the most efficient and healthy way possible. This enables us to not only build the stamina for the entire performance (not just one aria/monologue) but also to sustain and carry through the circumambient demands such as stage/hall acoustics, accompaniment (orchestra, background noise, etc.), and much more.

This may sound like a lot of work, but the benefits of artistic excellence are for both artists and listeners. The audience's experience may run the whole gamut, from simply entertaining to total emotional transformation. Similarly, performers enjoy the personal fulfillment of performing great music/play, the physical and emotional excitement of making great sound (e.g., **endorphins**), the appreciation and validation from the audience, and so forth. As one of the great baritones, Thomas Hampson, once so beautifully said, "We don't present our voices to the audience, we resonate our souls."

Any discussion of singing or acting technique must deal with language in great

specificity. In a very real sense, a high-level singer has to become a **phonetician**—one who deals with **phonetics,** the study of phonemes. Great singing, both in terms of tone and diction, depends on the singer's development of every needed phoneme to its fullest potential within his/her vocal technique.

> A **phoneme** is the basic building block of language; a singular, identifiable, and unique sound.

To illustrate, say the word "say" out loud but in slow motion so you can hear the individual sounds of the word (phonemes) one after the other. Notice that the long vowel is actually sounded with two phonemes: /e/ and /i/ (which are written in **International Phonetic Alphabet,** more on that later) so that the word would be written with the phonemes /s e i/. If we change the word to "see," even though the word is written with three letters, it only sounds as two phonemes: /s/ and /i/. When thinking of phonemes, it is critical to note that we are discussing individual sounds, not spelling. We can illustrate this by using the word itself: *phoneme.* The two written letters that begin the word, "ph," actually stand for a single phoneme, /f/. The entire word contains the phonemes /f o n i m/—five phonemes that took seven written letters to notate. As we go along, you will quickly learn this alphabet, and when you do, you will be on your way to being a better singer because you will be thinking in the language of sounds, not writing alphabets.

All languages are composed of two basic classes of phoneme:

- **Vowels**
- Consonants

As we see as we progress in this book, these two principal classes can be broken down into many subclasses (see Chapters 5, 6, and 7).

All singers speak during their everyday lives. In fact, we talk most of the time (when we are not singing). Thus, most of our interaction with language is through our speech, so speech seems to be a good place to begin our phonetic journey.

To illustrate some basic concepts, we are going to work with the same text used earlier from a famous song by the Baroque composer, Francesco Cavalli, *Sospiri di foco*. We use the first phrase of the song:

Sospiri di foco, che l'aure in fiammate

First, we must break down the component parts of the language (the phonemes), and we can see that this passage is composed of 29 separate phonemes (Figure 1–2). When we separate them by vowels versus consonants, we find that the passage is composed of a total of 15 vowels and 14 consonants distributed as shown in Figure 1–2.

When we speak the text of this passage, each of its 29 phonemes consumes a precise amount of time within the total 3.41 seconds (sec) that it takes to utter the entire passage. (We measure the execution time of each of the phonemes in milliseconds [msec, or thousandths of a second].) After

consonants	s	s	p	r	d	f	c	ch	l	r	n	f	m	t
vowels	o	i	i	i	o	o	e	a	u	e	i	i	a	a	e

Figure 1–2. Cavalli, *Sospiri di foco*—consonant/vowel breakdown.

carefully measuring the length of each phoneme (using a spectrograph), we find that the execution time of the vowels totals 2.137 sec, and the total of the consonants equals 1.274 sec.

As you look at this distribution of vowels versus consonants in the graph in Figure 1–3, are you surprised at how close to equal their execution times are? Most people tend to think of languages in terms of vowels—another reason for our vowel-centricity.

This total phonemic execution time looks considerably different when we perform the same analysis on that text when sung according to Cavalli's musical notation (Figure 1–4). Now the total time for the sung phrase climbs to 8.28 sec, with the vowels consuming a whopping 6.72 sec (81%) of the total.

However, the total consonant execution time climbs only slightly as one can see in Figure 1–5.

When the data that produced the simple illustration in Figure 1–4 are recast to show execution times phoneme-to-phoneme, they produce the graph shown in Figure 1–6.

We now arrive at a critical point in this book.

This fact leads to a realization of why our singing culture is so vowel obsessed: because of composer's notation, the vowels are the phonemes that we sustain. They take up the lion's share of our time spent singing. Because of this time concentration, we have the luxury of concentrating on their production.

However, in singing, consonants fly by at roughly the same speed as they do in our speech. We do not have the same luxury of dwelling on their production because they are executed too fast. Because of this, the following occur:

- Singers *subconsciously* turn to *their automatic speech habits* for the neuromuscular instructions for their consonant production.
- While the resonance of our sung vowels is *exponentially greater* than those we produce in everyday speech, when we turn to our speech habits for consonant instructions, our consonants

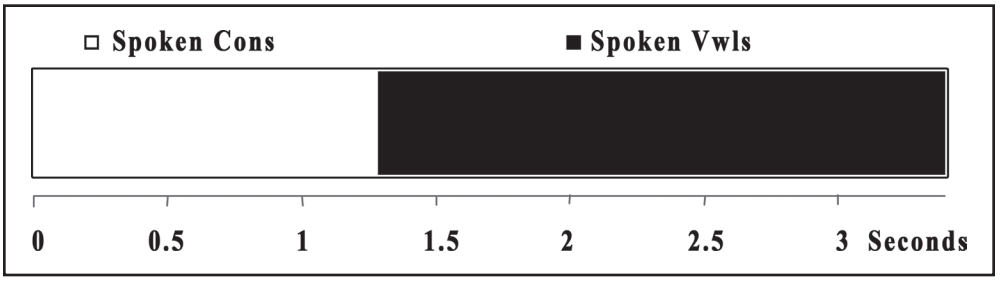

Figure 1–3. The execution time totals for vowels and consonants in the Cavalli phrase.

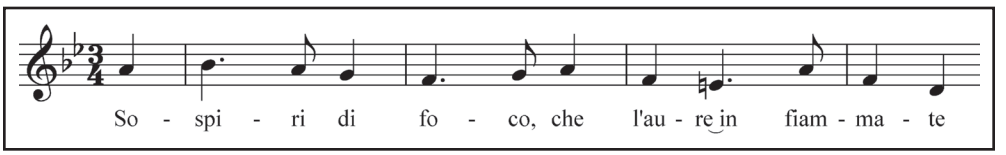

Figure 1–4. Cavalli, *Sospiri di foco*, opening phrase.

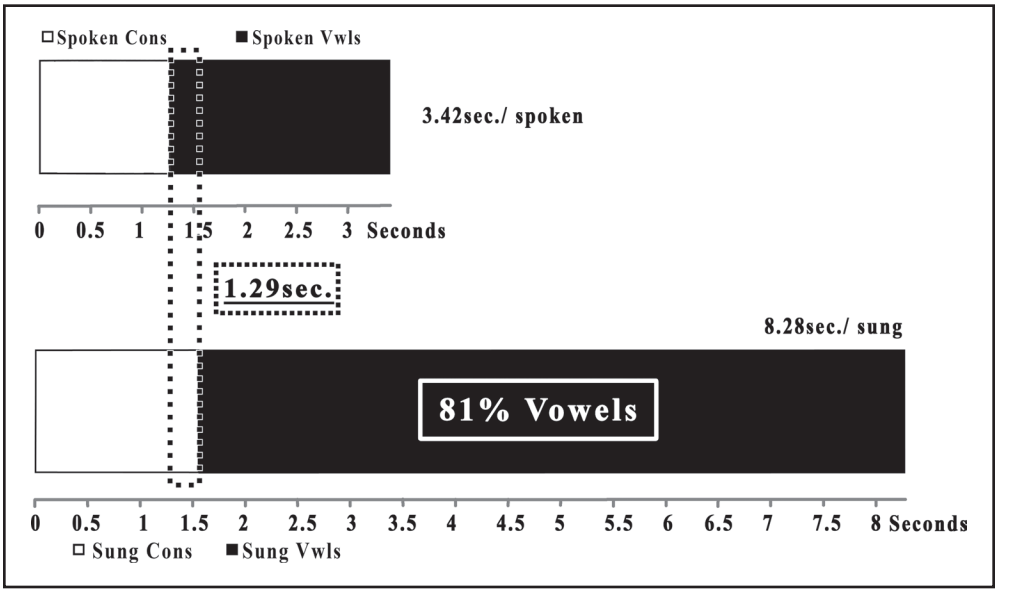

Figure 1–5. Vowel/consonant execution times—speech versus singing.

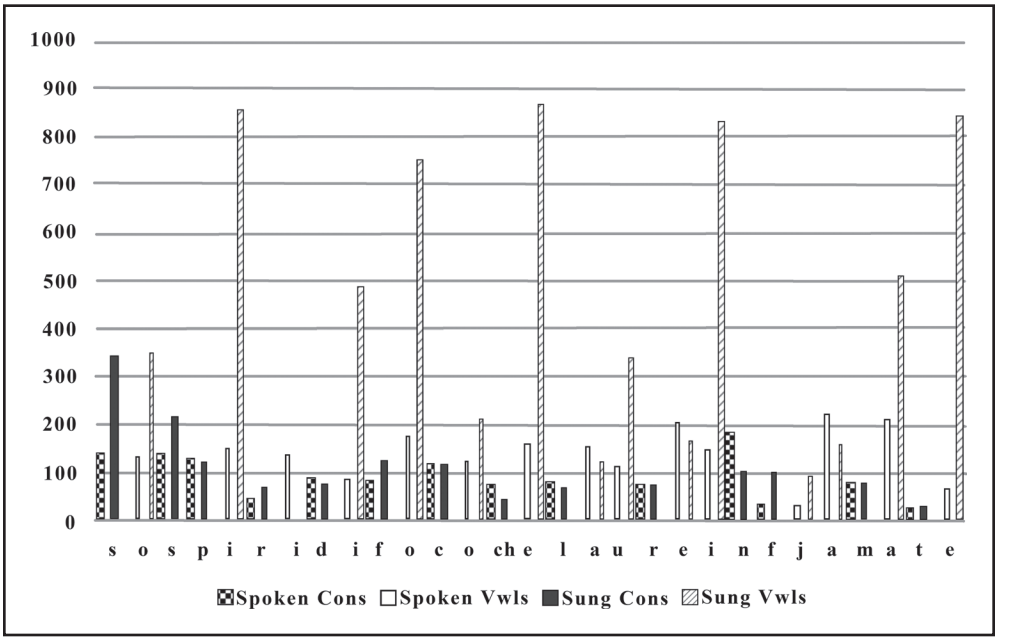

Figure 1–6. The execution times for each phoneme in the Cavalli text.

will be resonated as ***far*** less resonant phonemes.

- During each speech-based consonant, the resonance spaces in the vocal tract collapse toward speech norms. There is simply no neurophysical means for the brain to be able to recover the full resonant space for the following vowel.

This leads us directly to the prime tenet of this book.

Great singers learn to produce CONSONANTS with a resonance that RIVALS their VOWELS.

Once the singer has habituated appropriately resonant consonants, he/she is able to

- maintain the pharyngeal/oral space that produces the finest classical singing resonance ***consistently*** throughout the sung line, and
- once the consonants achieve this greater resonance, the diction of the singer instantly improves because these differently produced consonants will resound in the largest halls.

Now, we can also answer the question: Why don't my songs/monologues sound as good as my warm-ups?

Walk past any practice room when a singer-in-training is warming up on vowel vocalises (a melody sung only on vowels), and you may exclaim, "What a wonderful voice!" A few minutes later, when the same singer moves on to sing a song, you pass the room again, and it is as if another singer were there. The quality of the warm-up cannot be realized in the chaos of his/her attempts to toggle between singing vowels and spoken consonants. That is just another way of saying that all of the speech-based consonants are destroying the singer's ability to produce the very same vowels he or she was just singing during warm-up.

Now the reader knows why this book has been written. Any decent voice pedagogue can teach a student to sing vowels that he or she will be proud of. However, if that teacher never guides the student to concentrate on their consonant resonance (CR) with equal fervor, that singer may likely never realize the full potential of his other voice. The same is true for actors. In an age before microphones and cameras, the ability to project one's voice was an essential part of the classical theatrical repertoire. Any actor who mumbled would quickly have been booed off the stage. Nowadays, even on the cinema screen and in television, the consequences of that rigorous theatrical training are reflected in the precision of speech.

Throughout the history of singing, there have been teachers who have instinctively realized this technical need, going on to teach it to their students. By the same token, throughout history there have been singers who instinctively realized that their consonants deserved the same resonance as the vowels, and then went on to habituate a kind of resonance parity in their singing line. Whether it is the teacher, student, or a combination of both who works to impart equal resonance to both vowels and consonants, a great singer/actor is more than likely the result.

In this book, the secrets of CR will be revealed. This is no new discovery—singers who know this "secret" have sung among us for as long as *bel canto* has existed. Laurence Olivier, Sean Connery, Morgan Freeman, Meryl Streep, Judi Dench, Ingrid Bergman, and Helen Mirren are just a few examples of actors whose formal training stressed perfect diction in order to be taken seriously.

All we need to do is look and listen (YouTube has become a goldmine for this kind of study), and we can see that great singers and actors are demonstrating these techniques right out in the open. This book attempts to guide you in your discovery of these "secrets" so you can join their ranks.

So, now, let us explore the *Secret Life of Consonants.*

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