

# The Scientifically Assisted Evolution of the Professional Voice in Adult Singers and Actors

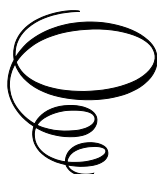


# The Scientifically Assisted Evolution of the Professional Voice in Adult Singers and Actors

By

Hugo Lycke

**Cambridge  
Scholars  
Publishing**



The Scientifically Assisted Evolution of the Professional Voice  
in Adult Singers and Actors

By Hugo Lycke

This book first published 2026

Cambridge Scholars Publishing

Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, UK

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

Copyright © 2026 by Hugo Lycke

All rights for this book reserved. No part of this book may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the copyright owner.

ISBN: 978-1-0364-5943-7

ISBN (Ebook): 978-1-0364-5944-4

# TABLE OF CONTENTS

Foreword .....	vi
Introduction .....	viii
Chapter 1 .....	1
Subject Classification in Voice Research	
Chapter 2 .....	5
The Influence of Singing Education on Voice Characteristics	
Chapter 3 .....	8
Contemporary Singing Education and Voice Classification	
Chapter 4 .....	12
Voice Classification in Voice Research	
Chapter 5 .....	28
Parameters of Voice Revealed by F <sup>0</sup> -SPL Profiles	
Chapter 6 .....	55
The Importance of Voice Classification and its Impact on Voice Diagnosis and Therapy	
Chapter 7 .....	63
Own Procedure of F <sup>0</sup> SPL- Measurement	
Chapter 8 .....	114
Discussion	
Chapter 9 .....	116
General Conclusions	
References .....	119

## FOREWORD

For many years I worked as a vocal coach/speech and voice therapist for European music conservatories and opera and musical theatre companies, participating as a special member of the jury at many castings, auditions, and rehearsals, testing voices, and providing therapeutic support for conservatory students and professional actors, dancers, and singers (commercial and classic).

This special, creative environment incited me to do my own research on the singing voice. In this exclusive and closed environment - the world of theatre -, not easily accessible for scientific research, I was able to freely experiment and to introduce, little by little, the development of my own methodology of **voice classification by phonetography**,

I could observe that almost every voice problem, which occurred during the short, but intensive rehearsals, and during the demanding performances on the stage afterwards, primarily had to do with voice classification. In my experience as a voice therapist, phonetographic analysis proved to be very helpful to all kinds of actors, singers, acting students, singing students, singing teachers, conductors, and directors of contemporary Opera and Musical Theatre.

Nowadays, this objective and non-invasive method of Voice Range Profiling (Phonetography), improved by modern technology, provides a clear image of all parameters of the speaking and singing voice, visible in real time on the PC screen. Moreover, longitudinal phonetograms offer the interesting possibility to document the evolution of a given voice, providing sound technical advice for voice education and voice therapy.

Since the publication of my first 4 books, published by Cambridge Scholars Publishing (2022 - 2025), scientific studies on voice confirm the generally growing appreciation of the usefulness of phonetography in voice testing, education, therapy, and research. However, studies on the lifelong evolution of the human voice remain rather scarce.

In this 5th manual, a new approach on the evolution of the professional voice in adult singers and actors, will be proposed, based on an objective

voice analysis by phonetography, and providing practical cues for voice education and voice therapy, with the emphasis on the most important period of their professional life on stage.

I hope that this new book will be useful to anyone interested in this fascinating object of study: the evolution of the professional voice in adult singers and actors.

Dr. Hugo LYCKE, PhD, MSc, MA.  
Doctor in Biomedical Sciences  
Vocal Coach, Speech and Voice Therapist

# INTRODUCTION

In my former publications I stressed the fact that professional voice users, e.g., singers and actors, using their voice as a primary tool, are especially prone to voice problems. Therefore, *it is important in voice and singing education to know the physiological limits of the voice and to carefully watch them.*

The influence of voice training on vocal capabilities is well known from clinical experience and the relationship between the singing teacher and the singing student is particularly interesting in this regard.

The singing student often chooses a singing teacher with a particular voice type, which he or she likes and wants to imitate, while the singing teacher in turn may be inclined to reinforce that attitude. Moreover, frequently changing from one singing teacher to another during one's singing education and one's professional singing career is common practice. This means that the singer is flooded with different advice over the years, including many comments on his "real" voice type. At the same time, during the singing education, the singer becomes aware of the changing features of his or her own voice, for the better or worse.

Chapter 1 of this manual gives an insight into the many difficulties encountered in trying to classify a voice. Chapter 2 confronts us with the considerable influence of singing education on voice characteristics. Chapter 3 indicates how, at present, music education and performance can be divided into two broad categories: Classical Music and Commercial Music, and how contemporary singing education deals with voice classification, with an analysis of the results of three questionnaires, clearly showing the need for an objective voice classification. The many contradictory scientific publications on voice classification are analysed in Chapter 4, while Chapter 5 is dedicated to the different parameters of voice, revealed by F<sup>0</sup>-SPL Profiles. Chapter 6 stresses the importance of voice classification and its impact on voice diagnosis and therapy. In Chapter 7 an analysis is given of my own methodology of voice analysis by phonetography, including the results for male and female voices of ages 25 to 49 years, followed by Chapters 8 and 9 (discussions and general conclusions).

# CHAPTER 1

## SUBJECT CLASSIFICATION IN VOICE RESEARCH

In voice research, emphasis is put on the accurate describing of the specific qualities of the subjects used in the proposed study. The more accurate this description of the subjects, the more other researchers can understand the results of the study and compare them with other attempts of the same kind. However, in voice research, the classification of the subjects remains a weak point. If we look at the actual bulk of literature on voice, we can distinguish some major policies. Every study provides reliable information on the exact *number of the subjects*, their *gender*, and their *age*. Some studies make a distinction between the so-called “*normal people*” and “*voice patients*”. Few studies make a distinction between again, the so-called “*normal people*” and “*singers*”. At this level the confusion becomes exorbitant. This confusion can readily be understood if we consider the following assessments:

- ***The scientific validity of much of the research that is being carried out on singers has been questioned.***
- ***There still exists no exact definition of the singing process.***
- ***Phonetographic studies have demonstrated the interrelationship between different human vocalizations.***
- ***It is difficult to control for the amount and type of vocal training.***
- ***By assigning beforehand different people to different categories there is always a possibility that the same person may belong to more than one category.***

These assessments have been thoroughly discussed in Book 1<sup>528</sup>

According to Harvey<sup>1</sup>, the “professional voice user” is, regardless of age, a designation describing countless variations of phonatory abilities and demands (e.g., teachers, attorneys, secretaries, singers, actors).

Singers who had many years of singing lessons and enjoying a brilliant professional career, can, at a particular moment, be regarded as voice patients who are developing or already have developed a (functional) voice disorder. Teachey et al.<sup>2</sup>, for instance, conducted a study on singers with less than 2 years formal vocal training, which the authors called “untrained singers”, and found that nearly 70% of their subjects characterized their voices as being “hoarse, rough, or raspy”. Twenty percent also described some associated breathiness. Sixty percent of these “untrained singers” presented with vocal fold lesions, almost all of which were vocal nodules. Sapir<sup>3</sup> too, found nearly one-half of the voice students having sought medical help for voice problems.

Wuyts et al.<sup>4</sup> draw our attention to the problem of interpreting conflicting effects in voice diagnosis and therapy. They acknowledge that in some cases, the pathology was still present after therapy, even though the voice function was better according to E.N.T. specialist and patient. In other cases, therapy ameliorated just one variable of the voice while the other variables got worse.<sup>4</sup>

In vocal pathology, mild adduction disorders are neither organic nor functional disorders; rather there is a *continuum* of organic alterations with different laryngeal vocal disturbances<sup>5-7</sup>, or, as expressed during the ‘Jahrestagung der Deutschen Gesellschaft für Sprach- und Stimmheilkunde,’ Bad Segeberg 1978:” All functional voice disorders are situated between both poles of hyper- and hypofunction”.<sup>8</sup>

Airainer and Klingholz<sup>9</sup> examined patients to whom the diagnosis “hypo- or hyperfunctional dysphonia” or “hyperfunctional dysphonia with a secondary organic lesion” applied. However, they felt that their subjects had to be *a priori* divided into four groups: male non-singers, male singers, female non-singers, and female singers. To be classified as singers, their subjects had to be singing in choirs for several years.

Overlapping of categories also happens when one tries to divide people into non-singers, amateur singers, singing students and professional singers. Schutte and Miller<sup>87</sup> too, admit that the line between professional and dilettante is indistinct.

But what to do with the bulk of the subjects in my own studies? Some of them are “classical” singers, who changed their techniques hoping to get a role in a musical. Others had years of dancing training but just took a few singing lessons before auditioning for a musical production; the same with

many actors. Meanwhile, some of them had developed a functional voice disorder. They had no idea about their voice classification or even had forced their voice to simulate a voice type which was not their true natural vocal type.

During many auditions I also encountered “pop” and “rock” singers, without any form of vocal training, but who also wanted to become a “musical star”. During the rehearsals it became clear that their “years of professional experience” as “singers” were not at all useful to meet the high demands of acting, singing, and dancing in a modern musical performance. A lot of them could easily be classified as “voice patients”.

The self-reported voice problems in a questionnaire administered by the author to professional singers of opera, musical theatre, and contemporary music, aged 18 to 69 years (Chapter 3), revealed high rates of vocal disability (69%) and diagnosed bad vocal conditions (44%). Besides, singers can present with hoarseness in their speaking voice or with problems specifically related to their singing voice.<sup>2,11-12</sup>

Singers also differ greatly not only in the technical aspects of their singing technique, but also in their repertoire. Nobody will deny the differences between, for instance, a highly trained Wagnerian opera singer, a Peking opera singer, a Spanish falsetto singer, an American crooner, a well-loaded Irish folksinger, a hoarse jazz singer, a yodelling singer from Tyrol, a heavy metal or rock singer, a double-voice Touvinian singer,<sup>13-15</sup> and an operetta-soubrette, and so on. Miller<sup>16</sup> even points to the recent category of performer known as “the *untrained professional*”. Moreover, as Titze et al.<sup>17</sup> reported, only 15% of the estimated professional singers in the United States are classical singers; the other singers fit into multiple categories. However, all those “singers” have in common that they use their singing voice in one way or another.

Nonetheless, the *loudness* factor seems to be all important to performers engaged in vocally demanding professions and hobbies. As mentioned before, physiological inefficient SPL control strategies are since long acknowledged as potentially injurious to vocal fold tissues<sup>18</sup>, but the fact that “a comparable acoustic product can be generated using different physiological strategies”<sup>19</sup> is widely ignored in the voice research paradigms.<sup>20</sup> Phyland et al.<sup>21</sup> too, point to the “wide variability among singers as one of the major confounders in the estimation of the incidence or prevalence of voice disorders among singers”. Variables such as the amount and nature of singing training and experience, the amount and

nature of singing demands and the performance environments and the singing style, are of influence on the occurrence of voice problems.

Finally, Peppard et al.<sup>22</sup> advise that, in studies of voice disorders, “voice production in the populations examined should be viewed on a *continuum* with normal singers at one end and non-singers with nodules at the other”. This also means that “further research should look at *larger samples* of normal populations of singers and non-singers and should consider *other sources of variation* to delineate more clearly normal production and deviations occurring with voice disorders”.<sup>22</sup>

I am convinced that a basic elementary source of variation is *voice category*. That’s why the author of this book spent a lifetime of testing all kinds of voices, trying *to classify them in an objective, scientifically based way*.

## CHAPTER 2

# THE INFLUENCE OF SINGING EDUCATION ON VOICE CHARACTERISTICS

Today's life is immersed in music: willing or not, in almost every situation, day or night, music is in the air. Especially young people have a leaning to listen to contemporary music, songs based on all kinds of regularly changing hit lists and promoted by the market and mass media. Successful voices of the moment - good or bad ones - are imitated by young people, often without concern of the quality of the sound produced by their idols or by themselves.

The influence of voice training on vocal capabilities is well known from clinical experience and the relationship between the singing teacher and the singing student is particularly interesting in this regard. The singing student often chooses a singing teacher with a particular voice type, which he or she likes and wants to imitate, while the singing teacher in turn may be inclined to reinforce that attitude. On the other hand, frequently changing from one singing teacher to another during one's singing education and one's professional singing career is common practice. This means that the aspiring professional singer is flooded with different advice over the years, including many comments on his "real" voice type. At the same time, during the singing education the singer becomes aware of the changing features of his or her voice, for better or worse.

Tarneaud<sup>23</sup> already explained, many years ago, that pitch and timbre not only depend on constitutional and physiological factors but also on *educational mimesis, acquired in various surroundings, family, school, and profession*. Each singer has not only one characteristic timbre, but a set of timbres, or a timbre transformation. *Voice quality depends highly on vocal techniques, thus on voice education. Many singers have developed a functional adaptation of their vocal organs, which is not always in correspondence with their anatomical and physiological abilities.*

Nowadays a lot of singing students are often in turmoil: by choosing a kind of education programme - be it classic or commercial - they enter a protected environment in which they are directed for many years in a particular

direction: choosing a repertoire, taking singing lessons which direct them to make restraint choices in connection with their assumed voice type. As the singing teacher is not sure about the exact voice classification at the beginning of the study, very often a cautious repertoire is chosen. Singing teachers then claim the voice of the young singer is supposed to ripen, to mature and so on. However, singing exercises try to expand the singing range in one or another direction and this also influences the singing teacher and the singing students in their perception of their vocal evolution. If the singing teacher is not sure about the right voice type of his/her pupil, there is a great chance that the voice of the young singer is forced in a direction which can damage his future career.

Lycke and Siupsinskiene<sup>24</sup> made a widely cited study on the *effects of training duration and institution on basic Voice Range Profile parameters*. VRP recordings were made of 162 females, taking individual singing lessons *during 5 consecutive years (1<sup>st</sup> - 5<sup>th</sup> level)* in Dutch, Belgian, English, and French public or private training facilities. Sixty-seven non-singing female students served as controls.

## Results

- Vocal capabilities of singing students measured by Voice Range Profile are significantly extended in both *frequency and intensity parameters* in comparison to non-singing students.
- Training years have a significant effect; conservatory singing students in more advanced singing classes demonstrated a *significantly greater frequency range, particularly at high frequencies*, than did first-year students.
- Musical theatre training has more positive effects on both *frequency and intensity related parameters* than does classical training.
- Private and musical theatre training have more positive effects on voice characteristics than do public or classical training.
- Private training has more positive effects on *voice dynamics* than does public training.
- When compared to non-singers, all singing student subgroups showed significant increases in all basic VRP parameters. However, *the register transition parameter was not influenced by training duration*. This important observation is analysed in a further study.
- We concluded that *VRP recording provides both qualitative and quantitative information about vocal capabilities and could serve as*

*a useful tool for voice teachers, offering a way to assess vocal training and training progress.*

## CHAPTER 3

# CONTEMPORARY SINGING EDUCATION AND VOICE CLASSIFICATION

At present, music education and performance can be divided into two broad categories: Classical Music and Commercial Music.

**Classical Music** represents various genres such as Opera, Lied, and Oratorio. Traditionally, in Classical Music voices are classified into three principal categories: for the female voice: *alto, mezzo, and soprano*, and for the male voice: *bass, baritone, and tenor*. There are, however, *many subtypes, according to different roles and based on the characteristics of the voice*, such as loudness, timbre, mobility, vibrato, temperament, expression, and personality. *In classical singing education great emphasis is put upon voice classification, but little is known how the relatively new music institutions and individual singing teachers deal with voice classification.*

**Commercial Music** represents genres including Pop, Rock, Jazz, Country, Rhythm, and Blues, Hip-Hop, Rap, Gospel, and Musical Theatre...

As mentioned in Chapter 2, the conclusions expressed in the study of Lycke and Siupsinskiene<sup>24</sup> clearly demonstrate the many effects of individual singing lessons on the voice of singing students, strongly *depending on the type of singing education and institute.*

In their study on Commercial Music, Radionoff et al.<sup>25</sup> concluded that “along with nomenclature disparity, a tremendous lack of consistency exists among curriculums of commercial music degrees.” Many singing students are taking private singing lessons which are not curriculum bound. Contemporary commercial music singers often complain that their singing teachers do not understand the vocal styles and demands of a Contemporary Commercial Music singer.

**Classifying a voice means, in the first place, to determine the frequency and intensity voice range in which a subject can work without harming**

**or fatiguing his voice and to which repertoire he should be assigned.**<sup>23,26-28</sup>

*Correct classification of the singer's voice is indispensable to achieve optimum performance.* Coleman<sup>29</sup> already stated the consensus that singing and speaking outside a given physiological pitch or intensity range is a potential hazard. The biographies of famous and less famous singers frequently mention examples of the pernicious outcomes for their voice and for their career caused by incorrect voice classification.

With the intention *to explore how contemporary singing teachers deal with voice classification and which criteria they use*, a **first questionnaire** was sent to **200 private singing teachers** who recommended themselves for a total of 134 specialties and styles of singing! Many of them had a classical singing education, but each of them proclaimed to master a great variety of singing styles like Belting, Blues, Classic, Close Harmony, Country, Disco, Easy Listening, Evergreens, Funk, Fusion, Gypsy, Hard Rock, Jazz, Latin, Opera, Pop, Rhythm and Blues, Salsa, Soft Rock, and World Music... *The private singing teachers were asked if voice classification was important to them and why. They were also asked which criteria for voice classification they applied.*

A **second questionnaire** was distributed among singing teachers in 3 officially subsidized national music conservatories, submitted to the inspection by the Government: one Belgian *classical conservatory* specialized in Opera, Lied, and Oratorio, and one Dutch and one British conservatory specialized in *Musical Theatre*. The **22 singing teachers from the 3 conservatories** who cooperated in this study classified a total of **165 singing students**: 81 singing students (58 females and 23 males) at the Belgian classical conservatory, 63 singing students (55 females and 8 males) at the Dutch conservatory (Musical Theatre), and 21 singing students (9 females and 12 males) at the British conservatory (Musical Theatre). The singing students were aged between 18 and 28 years, mean age 21 years. The singing teachers were asked to classify their own singing students and to indicate on what criteria their voice classification was based.

A **third questionnaire** was distributed among the singing students of all levels of the above indicated three conservatories. A total of **165 singing students**, 122 female students and 43 male students, aged between 18 and 28 years, mean age 21 years, filled in the questionnaire about their voice classification. The students were asked if they knew their voice

classification, who had determined their voice classification and how, and if they thought their voice classification was correct.

During this investigation, spread over one year, 75.3% of the classical singing students and 88.3% of the Musical Theatre students were classified by their singing teacher. A total of **73 female first year students in the Masters' degree program in speech-language pathology** at a Belgian university (aged between 18 and 20 years, mean age 18 years) were used as a control group.

Descriptive statistics were performed by SPSS 16.00

The results of these 3 questionnaires are amply discussed in Book 1.

## General Conclusions

While many singing teachers in the internet enquiry (questionnaire 1) had a classical singing education themselves, they paid few or no attention to voice classification, which was formerly very important in classic voice education. Almost 40% of the internet singing teachers stated that voice classification was no important issue for their teaching.

While in classical and in Musical Theatre conservatories voices are still classified according to well-known traditional criteria, this is much less the case in private singing education: frequency range/tessitura (100.0% vs. 56.0%), quality/timbre (100.0% vs. 56.0%), register transition (57.1% vs. 9.0%), and volume (52.4% vs. 12.1%). Private singing teachers also prefer a more careful testing over time (13.6%) and specific methodologies (12.0%). It is also quite possible that private singing teachers do not feel the need to classify, nor do their singing students feel the need to be classified. *Obviously, there is no consensus about the criteria for voice classification.*

*Musical Theatre students were most frequently classified in the middle and lower voice categories. Quite the opposite was seen in the classical singing conservatory, where the highest categories dominated.* An explanation may be that middle voices are more preferred in Musical Theatre, while higher voices are most favoured in classical conservatories, each attracting in a way its own clientele of singing students. There is also the possibility that each type of conservatory tries to train its own preferred vocal types by specifically adapted singing techniques and gives less thought to a correct voice classification.

According to McKinney<sup>30</sup>, *misclassification can be a major cause of dysfunction in the young adult voice*. As “every aspiring young singer knows that the larger incomes are in the high notes, so regardless of statistical evidence that most of them are baritones and mezzos, they push for the higher voice classifications quite early.”<sup>30</sup> These observations are corroborated by a study on mechanical stress in phonation by Titze<sup>31</sup>, who found that the largest mechanical stresses in vocal fold vibration are the tensile stresses required for pitch increase.

Klingholz<sup>32</sup> stated that female voices very often are classified as a voice type which is too high. In a study on “vocal attrition” (vocal pathology and reduced vocal functions associated with behavioural, biogenic, and psychological factors), 62 of the 74 of the university female voice students (84%) said to be sopranos, 11 (15.0%) were mezzos and only one student declared to be a contralto. Only 10 (13%) of these singing students proved to be free of symptoms, 19 (25%) had few and 45 (61%) had multiple symptoms.<sup>32</sup>

Miller<sup>33</sup> testified: “*young singers press for louder and louder and higher and higher sounds, no matter what their bodies can do comfortably and efficiently*”, and Sataloff<sup>34</sup> stated: “*singers are habitually unhappy with the limitations of their voices. In many situations, voice teachers are to blame. Both singer and teacher must resist the impulse to show off the voice in works that are either too difficult for the singer’s level of training or simply not suited to the singer’s voice*”.

The results of my study confirm these statements.

## CHAPTER 4

### VOICE CLASSIFICATION IN VOICE RESEARCH

One must consider that voice classification has known many variations according to the period and the musical styles. In the 13th century, for instance, neither the high nor the low region of the human voice were exploited. In France, at the end of the 16th to the end of the 18th century, voices were divided in soprano, mezzo, contralto, tenor, baritone, first bass, and second bass, each voice utterly within the limit of one octave and a quarter.

Writings<sup>3,36,39-41</sup> – even from a psychoanalytical viewpoint<sup>41-42</sup> – describe the *many different roles in religious and profane performances attributed to specific voice types in different cultural settings.*

*During many centuries professional singing was usually restraint to church music and opera and so was the singing education. Singing students were mostly educated in a very private environment.* Before conservatoires showed up, singing students lived for many years in the closed family setting of the singing teacher. They not only got their daily singing lessons but were also involved in the daily life of the singing teacher and his family.

*On the opera scene, female and male voices are divided in six principal types: bass, baritone, tenor, contralto, mezzo, soprano. There are, however, many subdivisions (voice types), according to different roles, and based on the structure of the voice, i.e., the loudness, timbre, mobility, vibrato, temper, expression, personality, and so on.* For instance: Soprano leggiero, Soprano Lirico, Soprano lirico spinto, Soprano drammatico, Soubrette, Jugendlich-dramatische Sopran, Dramatic coloratura soprano, Mezzo, Dramatic Alt, Spielalt, Tenore Lirico, Tenore lirico spinto, Tenore drammatico, Tenore buffo, Jugendliche Helden Tenor, Lyric baritone, Dramatic baritone, Character baritone, Heldenbariton, Bass-baritone, Basso noble, Basso buffo, Character bass...

There also exist *intermediate voices*, like the light lyric soprano (“dugazon”), the baritone-Martin and so on for corresponding roles.

*Secondary classifications* are made according to:

- the *maximal voice intensity*, distinguishing e.g. the lyric opera tenor, the tenor of the comic opera (“demi-caractère”) and the operetta tenor, or the tenor lirico spinto and so on.
- *the used vocal techniques* e.g.: “coloratura”, specialty in quick vocalises, mostly with the light soprano, but also with the dramatic soprano, the “basse chantante” and so on.
- *the age of the artist*: young lyric sopranos are often used as “soubrettes” in specific Mozart operas, in operettas, while young dramatic sopranos are called “jugendlich dramatisch”. At the end of her career, a mezzo becomes “desclausas”.
- *the vocal possibilities*: in cases of reduced possibilities some adjectives are added: “second”, “third”, or, worse, “coryphe”, “comprimaria” or “comprimario”.
- *the artistic possibilities to play a certain role*: a second tenor for instance, could be brilliant as “tenor buffo” (which asks for a penetrating timbre) or a “trial”.
- in the concert hall a concise classification is used: sopranos, altos, tenors, and basses, on the understanding that the sopranos are most of the time light or lyric sopranos, the altos are mezzos, the tenors are very light, and the basses are baritones. In the lyric theatre they often would be attributed to second roles or less. Concert performances frequently appeal to male falsetto voices.<sup>43-45</sup>

*Specific songs suitable to specific voice types were scrupulously elaborated by opera composers. In some cases, composers even adapted (and still adapt) the musical score to the vocal possibilities and limitations of the singer. This could explain why some singing teachers of commercial music don't bother about voice classification: songs are adapted or even rewritten to suit the assumed possibilities of the chosen singer or singing student.*

One thus could easily argue so many singers, so many voices. Voice categories are artificial creations, bound to the historical development of the schools and the singing theatre, to the evolution of the aesthetic taste and to the particularities of the writing of some composers (Verdi for instance).

*Voice specialists, however, stressed the importance of a correct voice classification before voice education starts.*<sup>23,27,46-51</sup>

*Incorrect voice classification can enhance functional and organic voice disorders.*<sup>23,30,40,46,52,54</sup>

The biographies of famous and less famous singers very frequently mention examples of the pernicious outcomes for their voice and for their career caused by incorrect voice classification.<sup>56-58</sup>

The Recommendation by the Union of European Phoniaticians (UEP) for Standardizing Voice Area Measurement/Phonetography (1982) provided a lot of technical instructions regarding the registration of the "laryngeal possibilities with respect to fundamental frequency and sound intensity". Typical applications are :

- the assessment of the normal voice.
- testing singing voice potentialities.
- diagnostic aid in cases of vocal disturbances.
- the assessment of the results of therapeutic treatment.

Studies on voice usually provide exact information on the *number of subjects*, their *gender* and *age*. All other descriptions of subjects' qualities are missing or less accurate. I scrutinized my bibliography to find out which characteristics were mentioned. Less than 5% of the studies give subject information on:

- the average/mean age,
- height,
- weight,
- home,
- health condition,
- cold or sinus problems at the time of participation,
- use of medication,
- smoking habits,
- pure tone hearing screening,
- speech or hearing problems,
- phoniatic examination,
- judgment by a speech pathologist

Information on certain aspects of *health condition*, *screening* and *examination procedures* are merely intended as eliminating criteria in composing a study group.

Regarding the *training of the subjects*, we could distinguish copious information on:

- vocal training
- singing training
- years of training
- profession
- professional status
- years of professional experience areas of professional experience.

To try to classify these items, I made *a compilation of 364 different descriptions* in the Appendix of Book 1.<sup>528</sup>

Although a lot of authors make great efforts to give a description of their subjects' development of vocal proficiency, the distinction between *vocal training* and *singing training* is seldom clear. Most used are the rather neutral terms of “*untrained subjects*”, “*non-singers*”, “*untrained singers*” and “*trained singers*”. Exceptionally, a definition is given of the subjects' status, e.g.: *trained singers*: “individuals who, actively and formally for professional reasons, study vocal music and train their voice according to the common principles and practices currently suggested by professional vocal teachers<sup>59</sup> In a study by Teachey et al.<sup>60</sup> on vocal mechanics in “untrained professional singers”, singers with less than 2 years formal training were classified as “untrained”. Miller<sup>61</sup> even mentions a category of performer known as “*the untrained professional*”.

The *years of training* and/or *professional experience* are seldom mentioned. Information on the *profession* of the subjects, their *professional status* and their *areas of professional experience* is very limited.

Despite this lack of uniformity in describing the subjects' vocal and/or singing training, a lot of authors do insist on the observed differences between “**trained**” and “**untrained**” subjects:

- because the laryngeal capacity is altered by voice training, the standard voice profiles obtained from trained children are not representative for the profiles of untrained children's voices.<sup>62</sup>
- individuals with vocal training are more accurate in their prephonatory adjustments than are individuals with no vocal training.<sup>63</sup>
- for the singer, laryngeal controls must be much more precise than for the speaker.<sup>64</sup>
- singers take just as long to initiate a tone as non-singers, but they are more accurate in their targeting of a given frequency once phonation is initiated.<sup>65</sup>

- the ability to sing on key might be considered the feature that distinguishes singers from non-singers.<sup>66</sup>
- singers and non-singers vary the position of their larynx over quite a distance as they sustain frequencies throughout their full vocal range.<sup>67-68</sup> Generally, a shortening of the vocal tract is observed in non-singers as they position their larynx upward with vocal pitch, while the vocal tract lengthening is observed in singers as they lower their larynx below the rest position, hence lengthening their vocal tract for singing throughout their vocal range.<sup>69</sup>
- whereas untrained persons appear to make little distinction in their production behaviour between speaking and singing, trained singers organize their production in a different manner for singing than for speaking.<sup>70-71</sup>
- voice quality differences occur as the voice source signal passes through the supraglottic vocal tract.<sup>72</sup>
- during singing tasks, the trained singers' respiratory movements were very well-organized with respect to abdominal-thoracic coordination, and to respiratory-vocal coordination. They showed little variation in pattern during repetitive tasks. Untrained subjects' respiratory patterns during singing were characterized by markedly poorer coordination and by greater variability of movement pattern within a given task.<sup>73</sup>
- breathing strategy plays an important role in voice production during singing.<sup>74,75</sup>
- trained singers sing with a less pressed phonation than do untrained singers.<sup>76</sup>
- the most outstanding single difference between this group of choral singing females and the voice of a professional singer was the almost total absence of the vocal vibrato.<sup>77</sup>
- vocal training does appear to develop differences in the utilization of the sound producing mechanism for singing that are not present in the average or untrained voice.<sup>78</sup>
- a trained singer can be considered as an athlete who needs exercises for strength, endurance, timing, and agility.<sup>79-83</sup>
- separate normative data are needed for evaluation of the vocal athlete, i.e., the classically trained singer,<sup>41</sup> whereas untrained persons appear to make little or no differential use of their speech mechanism for singing and speaking, trained singers in fact do. Herein then, lies the point of perceptual dominance of the trained singer. However, we are still unable to precisely describe the physiological manipulation

of the singer, nor have we explored the problem of inter-singer variability.<sup>78,84</sup>

- as for the "singer's formant", it appeared from our preliminary acoustic records (real-time spectral analysis) that the trained singers produced this formant more consistently than the untrained singers during the singing of the arpeggios.<sup>78</sup>
- one of the goals in the training of the professional singing voice is the development of a frequency region of energy at about 2.8 K Hz. The presence of a significant amount of energy in this frequency region of the vocal spectrum tends to enhance the voice quality by producing an effect described by some as the vocal "ring". The vocal ring phenomenon is also referred to as the Singer's Formant.<sup>85</sup>
- since the singer strives to reduce or eliminate vocal roughness through training techniques, it might be hypothesized that there is less perturbation in vowels sustained by singers than in vowels sustained by subjects without vocal training.<sup>86</sup>
- in addition to respiratory differences, differences in laryngeal dynamics between trained and untrained subjects have been noted. Trained singers have been observed to utilize various modes of phonation not observed in untrained subjects, such as the use of "damped" folds, increased ability to control airflow, and isometric contraction.<sup>87</sup>
- skilled singers become adept at reproducing specific combinations of pitch, vowel, and intensity with what they consider a proper placement and desired colour.<sup>88</sup>
- in our work we have studied the development of the vibrato in students undergoing training, and find that, as this development progresses, vibrato is introduced to a greater extent, the movement is intensified, and the frequency raised. Most student's readings fell between 5 and 6 per second.<sup>89</sup>
- with years of training and performance, the mature vocal performer experiences fewer vocal changes with aging than does his or her age peer who is not a performer.<sup>90</sup>
- perceptual analysis indicated that singers could be correctly identified with greater frequency than by chance alone from their singing, but not their speaking utterances.<sup>91</sup> overall, the trained vocalists have the capability to produce greater  $F^\circ$  ranges and greater maximum, minimum, and comfortable intensity levels within the total  $F^\circ$  range than do untrained vocalists, regardless of gender<sup>92</sup>
- singers tend to produce greater SPL than non-singers, although this usually occurred only at a few intensity conditions.<sup>93</sup>

Other researchers, however, reported that:

- studies have demonstrated that trained subjects are less susceptible to vocal damage, although, once again, few statistically significant changes have been reported. In general, few conclusive findings have come from the laboratory.<sup>94</sup>
- there was no significant difference between artistic level singers and student singers or between either of the “singer” groups and the control groups.<sup>95</sup>
- the results of this study suggest a comparable constitution of the voice source in trained and untrained subjects, while the extended phonatory capabilities in trained subjects are probably based on an improved voluntary control over the voicing.<sup>99-100</sup>
- the vocal apparatus basically does not differ between the untrained and trained male and female subjects, which might be explained by the relatively low level of training in the “trained” group.<sup>97</sup>
- it is not necessary to understand the mechanics of respiration (or the mechanics of singing in general) to have a successful singing career.<sup>98</sup>
- as with any other measure of speech and voice, there was a good deal of variability in the way in which the professional singers positioned their larynx during the production of the various tasks.<sup>99-100</sup>
- the habitual pitch level of professional singers is like that of untrained speakers.<sup>100</sup>
- singers with or without symptoms of vocal pathology do not show differences in vocal range.<sup>101</sup>
- with a few exceptions, the typical speaking behaviour of trained singers is not differentiated from that of untrained speakers.<sup>60,100-102</sup>
- the mean differences between the mean phonational range of a group of professional singers of all ages and the mean phonational range of an untrained group were not statistically significant.<sup>100</sup>
- in this study, however, singers and non-singers exhibited very similar phonational ranges.<sup>138</sup> interestingly, there is little or no significant difference in maximum vocal intensity between a trained and untrained singer.<sup>93</sup>
- male singers do not produce any higher SPL values at maximum vocal loudness than male non-singers.<sup>104-105</sup>; the same is true for the lower part of female singers’ pitch range.<sup>105</sup>
- interestingly, the spectrum of the voice source is about the same in ordinary speakers as it is in singers and trained speakers.<sup>34</sup>
- it appears that the greatest evidence for a singer's formant can be found in the vocal performance of artistic level singers. The presence

of energy in the frequency region of interest also can be found in the vocal productions of some of the student singers, and, in some cases, even for non-singer musicians.<sup>99</sup>

- these findings suggest that certain attribute variables such as musical training may influence performance on speech and voice production tasks. In establishing normative data for voice performance tests, it may be desirable for speech and voice scientists to consider such variables more carefully. Additional research is needed, however, to specify the degree to which musical training transfers to non-musical speech/voice tasks.<sup>106</sup>
- the upper modal and lower falsetto register boundaries exhibit little variability between singers and non-singers.<sup>126</sup>
- it is very confusing to singers and actors to think that they have two voices when they really have two vocal folds that will speak or sing or yell or laugh.<sup>33</sup>
- when different singers are asked to sing the same vowel, marked differences in vowel quality are frequently noticeable.<sup>107</sup>
- the outstanding difference between the better and the bad singers is the lack of vibrato frequency spread which characterizes the poor voices. Regarding harmonic distribution, there is no pattern which may be selected as indicative of a good singer.<sup>107</sup>
- except for the fact that the singer who produced his voice badly gives a lower intensity than the others, there is no consistently outstanding characteristic.<sup>107</sup>
- respiratory behaviour of professional country singers during singing resembled that of speaking.<sup>127</sup>
- no significant differences were found between the trained and the untrained groups in their ability to discriminate and/or control breath pressure.<sup>59</sup>
- professional operatic singing does not request a uniform breathing strategy for all singers.<sup>75</sup>
- the results of these investigations have shown a wide variability in the respiratory strategies employed by different singers.<sup>109</sup>
- in reading a paragraph at normal loudness and reading the same paragraph at twice normal loudness, the respiratory kinematics obtained by female classical singers are, for the most part, like those obtained from untrained women, untrained men, trained male classical singers, and trained male and female classical actors.<sup>110</sup>
- we also showed how an artist could have a certain measure of success with limited vocal equipment. While this statement was not intended to depreciate the vital importance of voice, it did indicate the equally

great importance of artistry. While many phases of artistry are a matter of temperament and can, therefore, hardly be measured in scientific terms, certain other phases involve mechanical skill.<sup>107</sup>

- the results revealed great variability among singers with respect to the use of the jaw opening. For example, one singer produced the vowel /u/ with a jaw opening of about 25 mm, whereas most other singers had an opening of about 5 mm. These differences may reflect different singing techniques, possibly in response to different vocal tract lengths or morphology.<sup>112</sup>
- our own study focused on singing according to the Western operatic style. In this style, the singers are required to produce loud singing, as sound amplification systems are mostly not used. It seems particularly important for these singers to produce loud singing without excessively high subglottal pressures, as that may strain the vocal fold mechanism. In many other styles of singing, such as musical theatre, belting, and country-and-western singing, sound amplifying systems are normally used. This may imply that singers in these styles use different strategies. This needs to be studied in future research.<sup>72,87,112-114</sup>
- the results suggest that these country singers used basically the same type of phonation when they sang and when they spoke.<sup>128</sup>
- one discrete factor that may be particularly relevant to loudness production is training. Superior speakers have been found to exhibit greater variability. Indeed, not only training in speech, but also training in vocal or instrumental music may affect vocal variability.<sup>116</sup>
- the large ranges in fundamental frequency, jitter, shimmer, and signal-to-noise ratio are perhaps explained by the different ages and sizes of the subjects. However, recall that statistical analyses of these data determined no significant age, or sex effects for any of the acoustic measures.<sup>117</sup>
- as might be expected, both the male and female singers exhibited less jitter during their singing utterances in comparison to the nonsingers, although these differences were nonsignificant. No clear trend emerged for the sung utterances for shimmer. For noise-to-harmonic ratio, the male singing group showed a significantly larger noise-to-harmonic ratio in comparison to the male nonsingers.<sup>91</sup>
- the most outstanding single difference between this group of choral singing females and the voice of a professional singer was the almost total absence of the vocal vibrato.<sup>77,118</sup>

- the most consistent differences were the presence or absence of the singer's vibrato and formant in the singers versus the non-singers, respectively.<sup>91</sup>
- there appears to be no direct relationship between vocal training and its influence on the speech parameters measured for these professional singers.<sup>91</sup>
- except for more frequently observed complete closure and lateral phase differences of vocal cord excursions in trained subjects, no further differences were established between untrained and trained subjects.<sup>94</sup>
- the prospective assignment of subjects to the voice performance classes (i.e., stage singers, students of singers, amateur singers, and phoniatric patients) on the results of the F<sup>0</sup>-SPL-measurement alone remains somewhat problematic.<sup>129</sup>
- it often seems that voice profiles only are not enough to differentiate between trained and untrained voices; in case of voice disorders, mostly with hyperfunctional voice disorders, it is not easy to distinguish between physiological voice and disorders of the voice, or to correctly describe success or failure of therapy.<sup>130</sup>
- even the boundaries in pathological voices proved to be very large, as demonstrated in acoustical, aerodynamic and phonetographic studies.<sup>4</sup>
- the differences between non-singers and singers do not concern those aspects of voice function that are reflected in a phonetogram.<sup>119</sup>
- in the case of male singers, no clear difference in maximum SPL can be observed between singers and non-singers. The same is true for the lower part of female singers' pitch range.<sup>105</sup>
- the excellent singer is not physiological endowed and/or "gifted" but rather has benefited from technical voice training.<sup>120</sup>
- even among the normal groups examined herein, there were individuals who exhibited extensive variation, a factor that warrant consideration when large subject groups are sampled or when sampling is done across voice disorders and diseases.<sup>99</sup>
- teachers of singing and control subjects acknowledged a similar rate of current voice problems.<sup>121</sup>

According to Sihvo and Sala <sup>117</sup> "great intra- and interindividual as well as intra- and inter-investigator variations are typical in all measurements of psychophysiological phenomena in humans". The search for objectivity in voice diagnostics too is hampered by the huge interindividual and intraindividual variability of the human voice.<sup>99,122-123</sup>

One can, without any doubt, conclude that *subject classification* remains a weak point in voice research. The review of a great variety of studies show that the same difficulties arise when trying to classify not only the *subject*, but also the *vocal instrument* and the *voice*. An extensive list of the most used descriptions of the subjects' *voice condition* can be found in the Appendix, cited above. Here again, the most common descriptions are general ones: '*healthy voices*' or '*normal voices*', and '*patients*' or '*pathological voices*'.

While acknowledging classification to be one of the major objectives of scientific endeavour, it was established in the preceding chapters, that *subject classification* and *voice classification* remain hotly debated items in voice research. Especially regarding *voice classification*, voice scientists exhibit an ambiguous attitude: on the one hand, a subject's voice category is uncritically accepted without any manner of control, and on the other hand, voice classification is regarded as an indispensable tool for assuring a person's vocal health. *Voice classification*, then, is said to be very complicated, requiring a whole battery of complex tests and instruments.

Years ago, I hypothesized, however, that F<sup>0</sup>-SPL measurement can provide a simple, but invaluable tool for voice classification. To that end, the different acoustical parameters of voice, traditionally explored in voice research will be reviewed in the next chapter.

Information on certain aspects of *health condition*, *screening* and *examination procedures* are merely intended as eliminating criteria in composing a study group.

Regarding the *training of the subjects*, we could distinguish copious information on:

- vocal training
- singing training
- years of training
- professional status
- years of professional experience areas of professional experience.

**Classifying a voice means, in the first place, to determine the voice range in which a subject can work without the risk of fatiguing his larynx and to which repertoire he should be assigned by the singing teacher.**