

CHAPTER 1

What Is Vocology and How Did It Arise?

Objectives of Vocology

The Clientele of Vocologists

Vocal Problems as a Public Health Concern

Postulates of Voice Habilitation

Postulate 1: The Existence of Equilibrium Positions

Postulate 2: Extreme Equilibrium Positions

Postulate 3: Finding the Best Combined Equilibrium Positions

Postulate 4: Oscillatory Movement Around the Equilibrium Positions

Postulate 5: The Carrier-Modulation Principle Governs a Hierarchy for
Training With Oscillatory Modulations

Postulate 6: The Hierarchy Is Influenced by Normal Development

Postulate 7: Perceptual-Motor Learning Principles Guide the Practice
Regimens for Voice Habilitation

Chapter Summary

WHAT IS VOCOLOGY AND HOW DID IT ARISE?

According to current knowledge, the first public reference to the word "vocology" dates to October 13, 1989 when George Gates presented a talk entitled "Coping with Dysphonia" at the Pacific Voice Conference in San Francisco. In his talk, he credited one of the authors of this book (Titze) as having recommended the adoption of the word "vocology" into our field. Titze and Gates had discussed the idea informally at a prior professional meeting. The first written recommendation to consider vocology as a field of specialty followed three months later (Titze, 1990). A rationale for a curriculum in vocology was presented soon thereafter (Titze, 1992). The first journal to carry vocology in its title was *Logopedics Phoniatics Vocology*, formerly the *Scandinavian Journal of Logopedics and Phoniatics*. The name change occurred with Vol. 22 in 1997. The following year, the second author of this book published a *Guide to Vocology* (Verdolini, 1998), which launched the conceptualization of the current text.

In its broadest sense, vocology is the study of vocalization. This can include every aspect of human and animal sound-making in airways within the body. As a professional discipline, we give vocology a narrower focus in this book: the science and practice of voice habilitation, which includes evaluation, diagnosis, and behavioral intervention. The emphasis in this definition is on habilitation rather than rehabilitation. Restating from *Principles of Voice Production* (Titze, 1994, 2000):

"Habilitation is the process of *enabling, equipping for, or capacitating*. Voice habilitation is therefore more than repairing a voice, or bringing it back to a normal state. It includes the process of building and strengthening the voice to meet specific needs."

For the majority of people, normal (unassisted) vocal development in any society is sufficient to meet both occupational and recreational needs. Although "sufficient" may be difficult to define in precise terms, one could claim that it involves a perceptual quality that lies within social norms, is expressive when necessary, and is able to produce intelligible speech at a distance of a few meters. Special voice needs may be associated

with occupation, recreation, or expression of specific personality traits and emotions. These normal and special needs become the target for vocologists in terms of prevention of disorders, evaluation, and intervention.

In developed countries, about one-fourth of the working population relies heavily on their vocal instrument to carry out professional activities (Titze et al., 1997). Thus, to understand vocology, one must understand what is meant by the term *professional vocalist*. We define a professional vocalist as any person who 1) relies on his or her voice as a primary tool of trade and 2) would probably seek alternate employment if the voice were to become seriously impaired. Often, one thinks of professional vocalists as singers and actors. However, these performing artists are but a small percentage of professional vocalists (Sataloff, 2005). Teachers, telephone workers, receptionists, counselors, dispatchers, trial lawyers, and broadcasters, to name a few, form a much larger and economically significant group from a public health point of view. For the vocologist who serves such clientele, the boundaries between providing vocal training and vocal rehabilitation are often unclear. Vocologists develop a set of tools that are not only those of traditional speech-language pathologists (rehabilitation), but also those of the teachers of singing, theatre and public speaking who traditionally habilitate rather than rehabilitate. Furthermore, working with children and others who may be at risk for voice problems requires special knowledge and skill sets.

Academically, formalizing vocology as a discipline reverses history somewhat. Less than a century ago, departments of speech pathology and audiology tended to grow out of departments of communication studies, which included rhetoric, oration, theatre arts, and broadcast journalism (Cohen, 1994). Thus, training of public speaking was once combined with the science of human sound production, transmission, and reception. When communication sciences and disorders began to expand, there appeared to be a need to separate normal processes of speech, hearing and language (and the related disorders) from the *art* of speaking. Now the need is reversed, at least partially. Advancing knowledge in voice science while at the same time supplementing such knowledge with selected traditions in the arts and humanities of voice production seems necessary.

Vocology parallels audiology, which broadly is defined as the science of hearing. In professional terms, audiology can be described as the science and practice of aural habilitation and rehabilitation. A percentage of the working population relies on their aural skills in the workplace, but it is not clear if the same levels of extraordinary hearing skills

are needed to function in various occupations. How many workers need aural habilitation as opposed to rehabilitation? The answer is not immediate and perhaps deserves some research. More importantly, vocology parallels audiology because in both cases there is a primary organ in the human body that becomes the focal point for care. In vocology it is the larynx, and in audiology it is the ear. Both of these organs are dependent on the nervous system to transduce and organize signals for the purpose of meaningful communication. The medical profession has given specialty labels to the treatment of these two organs, namely laryngology and otology.

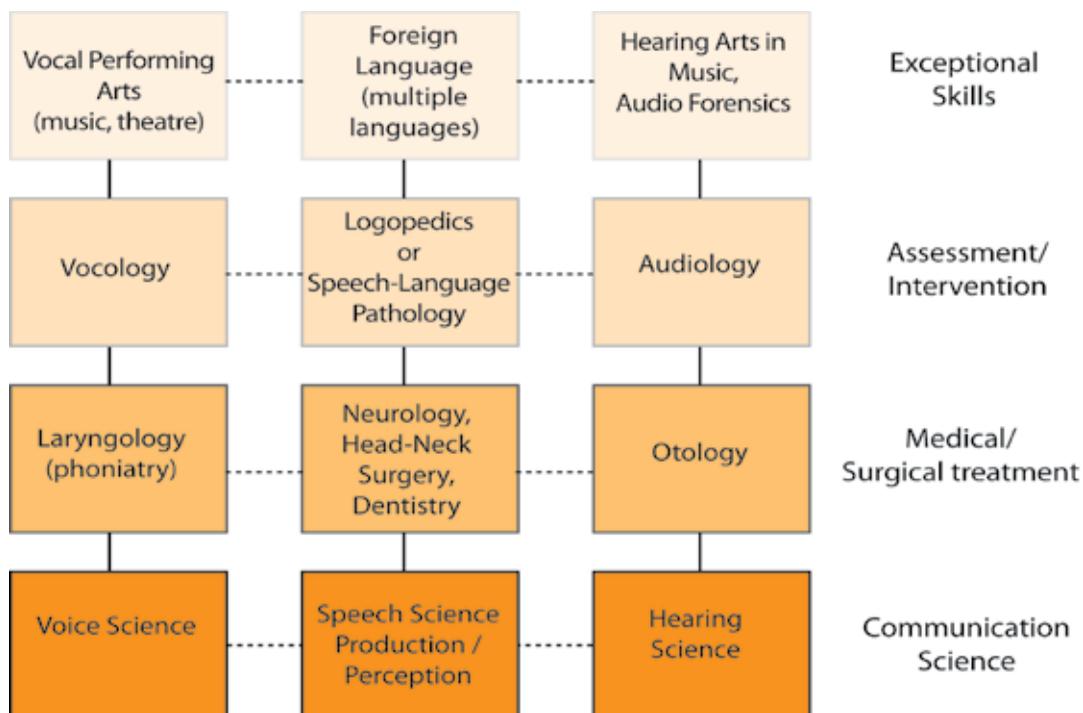


Figure 1.1 Professional disciplines and their relation to voice (after Titze, 1994, 2000)

Vocology is gradually being recognized as the third leg in a “trilogy” of the communication sciences (Figure 1.1). In this figure, the interplay between various disciplines in oral-aural communication is outlined. Note that vocology can be grouped with laryngology (or phoniatriy, a European medical specialty that has grown out of laryngology), voice science, and the vocal performing arts. Audiology is grouped with otology, hearing science, and the hearing arts (mostly in the form of accurate tone perception, forensics,

etc.). Speech science is divided into speech production and speech perception, the natural bridges to voice science or hearing science when speech sounds are produced. Logopedics, the science and practice of speech and language habilitation, forms a natural trilogy with vocology and audiology. Its ally for exceptional skill acquisition becomes foreign language. Speech-language pathology, the American equivalent of logopedics, is a less inclusive term because the name itself suggests no habilitative (training) component. However, speech pathologists do practice behavioral intervention.

OBJECTIVES OF VOCOLOGY

One of the primary objectives of a vocologist is to find the *ideal voice* for an individual's need, given a specific anatomy, personality, occupation, or activity. Because vocal habits are developed to some extent by mimicking the vocalizations of others during childhood, there is no guarantee that a physiologically ideal voice is spontaneously acquired by everyone. Although the vocal patterns of parents, siblings, and extended family members may be a good model to follow because of genetic similarities, these family members may themselves have acquired vocal behaviors that are not ideal for their physiological make-up. For example, extremely low or high pitch, aggressive voice onset, or atypical speech rate (too fast or too slow) may have been acquired from parents, siblings, friends, or colleagues at work, which may then be passed on to their next of kin. Thus, some retraining may be appropriate.

Another objective of a vocologist is to teach clients how to *feel good* by making vocal sounds. It has been claimed that sound-making has a certain healing effect (discussed in Chapter 6). Some individuals who practice meditation and self-healing often are led to vocalization as a primary medium of emotional release or spiritual expression. Such is the case for Tibetan and Mongolian monks who chant when they are meditating, thereby possibly enhancing their spiritual, emotional, and physical health. It has also been claimed that those who frequently vocalize emotions such as anger, fear, and happiness are prone to maintain enhanced functioning of their immune system (Mingji, 1992). It is possible that keeping one's emotions penned up by remaining quiet, when there is a need to emote, tends to suppress neuronal transmissions and weaken the body in its ability to fight disease (Jindrak & Jindrak, 1988). Thus, regular sound making, like physical exercise, may contribute to pleasure and general well-being.

A third objective of vocology is to allow speakers and singers to achieve *maximum*

control over their voice in order to be maximally expressive. Primary control variables in sound production are fundamental frequency (related to pitch), intensity (related to loudness), and frequency spectrum (related to voice quality or timbre). These variables are not always under voluntary control. For example, males going through puberty find that their pitch can change abruptly as a new voice develops (the mature male voice). For many women, certain days in the menstrual cycle may cause periods of reduced vocal control (Ryan and Kenny, 2009). A lack of control of pitch or voice quality is witnessed in churches, court rooms, and emergency situations, when speech is produced under heightened emotions.

A fourth objective of vocology is to *maximize the longevity* of vocal production. Some vocal careers, by design, are shorter than others. In the entertainment world, changing styles may at some point overshadow vocal ability, but some artists retain a vocal freshness for many decades. Teachers, lawyers, and counselors intend to perform at peak levels for an entire lifespan. Yet many suffer from vocal fatigue, which can lead to pathology. Some habilitative training in longevity can assist such individuals in eliminating vocal degeneration. This topic will be discussed in detail in Chapter 6.

A final objective of vocology is to provide reliable and cost-effective *tools of assessment* of voice disorders. In modern managed health care, the trend has been to aggressively reduce the cost of treatment; therefore, it is important to have assessment tools that are accurate and economic. We predict that self-diagnosis procedures will become more available to those who need or want thorough evaluations. As patients have become computer literate and feel more comfortable with man-machine interaction, there will be more techniques for self-assessment. One of these tools, described in Chapter 5, is a computerized Oral Pressure Range Profile that an individual can produce without much assistance.

THE CLIENTELE OF VCOLOGISTS

In recent years, voice has assumed an increasingly important role in job functioning. According to United States Bureau of Labor Statistics (Titze, Lemke, & Montequin, 1997; The U.S. Department of Labor, 2008), about one-fourth of the working population in the United States (30 million persons) depend on their voice for some critical aspect of their job. This suggests that loss or serious impairment of voice constitutes an occupational limitation similar to limb loss in the industrial age.

Teaching is among the most common occupations in many countries. In the U.S. approximately 8 million individuals (5.8% of the employed population) call themselves teachers, teaching assistants, or teacher aides. Due to the high vocal demands of the job, teachers are at a high risk for developing a voice disorder. Estimates of voice disorders range from 11-38% (Smith et al., 1998b; Roy et al., 2004; de Jong et al., 2006; Simberg, Sala, & Rönnekaa, 2004) making voice problems more frequent among teachers than other occupations that involve more than 2% of the population (Fritzell, 1996; Titze, Lemke, & Montequin, 1997; Verdolini & Ramig, 2001; Roy et al., 2004). It has been reported that the prevalence of having at least one occurrence of dysphonia during the life span was as high as 57.7% for teachers, as compared to 28.8% for non-teachers (Roy et al., 2004). Teachers of vocal music, performing arts, drama, physical education, and interestingly chemistry, are reported to be disproportionately affected by voice problems (Smith, Kirchner, Taylor, Hoffman, & Lemke, 1998a; Thibeault et al., 2004).

The fact that women outnumber men in the teaching world, and that women are more prone to vocal pathology, means that voice problems in teachers may be considered a women's health issue. In the U.S., female teachers are affected at a ratio of about 2.7:1 compared to males (Russell et al., 1998; Smith et al., 1998b; Thibeault et al., 2004), and gender distributions are generally similar for teachers in other countries (de Jong et al., 2006; Kooijman et al., 2006). It is likely that the higher rates of voice problems in female teachers is due to their higher fundamental frequency of phonation. School teachers typically engage in six to seven hours a day of monologue and dialogue. They do this five to six days a week, probably exceeding safe limits of tissue vibration dose (Titze et al., 2007; Hunter et al., 2007), and more importantly, getting insufficient time for recovery.

As for most individuals with professionally linked voice problems, teachers are at least superficially "high-functioning," and appear to carry no visible sign of a disorder. The consequences of voice problems in teachers, however, are non-trivial and may include physical injury to the laryngeal tissue (Simberg, Sala, Laine, & Rönnekaa, 2001; Sliwiska-Kowalska et al., 2006), a limitation in job satisfaction, job performance, job attendance (Mattiske et al., 1998; Thibeault et al., 2004; Yiu, 2002), and a limitation in social, psychological, emotional, physical, and communicative functioning (Yiu, 2002). In fact, although voice problems in teachers are typically not life-threatening, some repercussions from them have been found to be similar to those occurring with life-threatening conditions (Smith et al., 1996; Yiu, 2002).

Besides teachers, typical voice clients in speech and hearing clinics are salespeople, counselors, caretakers of children, actors, singers, lawyers, ministers, public speakers, auctioneers, aerobics instructors, coaches, stock traders, and a variety of others who fatigue or injure their vocal mechanisms. In data obtained from 1,484 clients seen in eight major phoniatics departments in Sweden (Fritzell, 1995), significant representations were found among people employed in social work, law and clerical work. Mothers, who engage in significant amounts of vocal interaction with children, especially over room-length distances and sometimes under stress, were also mentioned.

With regards to children, voice disorders in children have been linked to developmental and behavioral problems, and may negatively impact the development of communication skills. As a result, participation in the classroom, as well as social interactions and psychosocial functioning, may be impaired (Ramig & Verdolini, 1998). Furthermore, persistent voice problems have been shown to increase feelings of sadness, anger, nervousness and embarrassment in children, which frequently also heightens children's self-consciousness (Connor et al., 2008).

Much of this interaction impairment applies also to adults with movement disorders, such as Parkinson's disease, which affects vocal communication. Often the inability to speak loudly and clearly is socially more restrictive than the inability to walk or lift.

VOCAL PROBLEMS AS A PUBLIC HEALTH CONCERN

Given that vocal problems can result in social isolation, diminished capacity to perform a job, and difficulty in communicating over telephones and other voice channels, vocal problems constitute a significant public health concern. Often vocal problems begin with vocal fatigue. Those who have experienced problems with prolonged use of the voice often say that they have a raw throat after several hours of talking. Others are not personally aware of vocal problems, but listeners notice a change in vocal quality after prolonged use. To some degree, vocal fatigue is similar to muscle fatigue after exercising. Common belief is that professional voice users are vocal athletes, suggesting that many of the principles associated with strength and endurance conditioning in athletics also apply to vocal performance.

There are differences, however, that may make prolonged use of the vocal folds in phonation even more problematic than frequent running or weight lifting. Excessive vibration of tissues is of major concern. There is no evidence that human body tissues are

well designed for long exposure to vibration. In fact, aside from incidental noises made in passing air or snoring, humans do not engage in other activities that involve vibrating and colliding body tissue at a rate of 20 to 1,000 times per second. Phonation and sound reception (hearing) are the exception. Thus we may ask, are there special stress and fatigue factors associated with rapid acceleration and deceleration of tissue that add to the problem of tiring muscles? Does the development of hoarseness involve nonmuscular tissue that may be undergoing traumatic changes, as often evidenced by inflammation of mucosal and submucosal tissue?

According to our personal observations in voice clinics and vocal studios, the body language of vocal fatigue consists of frequent licking of the lips, swallowing, throat clearing, sipping water, attempts to alleviate tension in the face, neck, and shoulders by re-adjusting posture, and more frequent or unplanned breathtaking. Aurally, one perceives hoarseness and loss of intensity on the extremes of the pitch range. High and low notes are weakened, while the middle of the range is maintained a bit longer. The loss of high pitches is expected if the parallelism with athletics holds up, but the loss of low pitches and soft voice is less expected. Surely a fatigued weight lifter can lift the lightest weight and a fatigued runner can usually walk without much trouble. Apparently, phonating softly involves more than simply reducing muscular effort.

Again, based on personal observation, specific signs of vocal fatigue in singers include a lack of ability to sustain long phrases, a loss of tone “focus,” and irregularity in vibrato. The inability to sustain long phrases is probably a direct result of respiratory fatigue, the tiring of abdominal and intercostal muscles that are responsible for maintaining constant subglottal pressures (Titze, 1994, 2000).

Collectively, it can be hypothesized that physiologic limitations for vocal endurance may be related to the following phenomena: (1) fatigue of laryngeal muscles that normally provide tension in the vocal folds and stability of the laryngeal configuration; (2) fatigue of respiratory muscles; (3) straining of nonmuscular support and connecting tissue (ligaments, joints, membranes); (4) mechanical fatigue of vibrating tissue as a result of excessive frictional energy dissipation coupled with loss of blood circulation and fluid balance, and; (5) poor vocal economy (still only vaguely defined as too little vocal output for too much effort at input).

Smith et al. (1996) used a quality of life questionnaire, which elicited demographic information from occupational voice users seen in a clinic, as well as information about

voice symptoms, to study the impact of voice problems on various aspects of daily functioning. All questions focused on moderate to severe impairments due to voice. The findings indicated that the majority of patients felt that voice problems had negatively affected past and current work abilities (53% and 49%, respectively). Moreover, 76% of respondents felt that voice problems would negatively affect work in the future, and approximately the same percentage felt that voice problems negatively influenced their social interactions. The majority of patients described moderate to severe depression due to vocal impairment (65%) as well as moderate to severe negative professional self-esteem (61%). Respondents felt that not only voice quality, but also speech intelligibility, was compromised by their voice disorder.

A separate questionnaire study by Jacobson et al. (1997) used another tool, the Voice Handicap Index (VHI), to address similar issues. In that study, 63 patients with voice problems were questioned about self-perceived impairments due to voice, using the VHI. On average, patients who perceived their voice problems as “mild” indicated relatively mild functional deficits in intelligibility, social activity, job function, emotional status, and mild-moderate physical problems associated with voice production. Not surprisingly, patients who perceived their voice problems as “severe” indicated considerably worse problems in the same domains.

Some vocal injury may be classified as *repetitive strain injury* (RSI). The most obvious site for injury due to repetitive motion is at the arytenoid cartilages. The vocal folds adduct (move together) and abduct (move apart) as much as 10,000 – 20,000 times a day when someone speaks as long as a teacher (Titze, et al., 2007). This is about the same number of repetitive up-and-down movements of a finger in a heavy daily dose of keyboard use. Repetitive motion outside of the larynx, in the hands and arms, can lead to additional voice problems. As described by Guidotti (1992), repetitive strain injuries are a group of conditions that are most commonly encountered in persons using repetitive movements of the neck and upper limbs. The relevance for voice is that although the condition usually initiates in upper limbs engaged in repetitive action such as keyboard use, over time some symptoms tend to appear in the larynx. This is especially significant in light of the fact that computer keyboard users who experience debilitating repetitive strain in the limbs frequently convert to voice recognition software to operate their computers. The physical predisposition to RSI, together with heavy and unusual speech demands, may provoke vocal symptoms.

NEED OF A NATIONAL CAMPAIGN

A campaign needs to be launched for voice preservation. Restaurants, convention halls, cocktail lounges, bars, bowling alleys, pool halls, dance halls, airplanes, trains, subways, playgrounds, and sports arenas are places where conversations are often held at high loudness levels. Background music is often played at foreground intensities.

To get involved in the campaign, one can ask to be seated, or otherwise located, away from loudspeakers or other major sound sources. With some courage, one can ask the attendant or proprietor to turn down background music, but the opposite request may follow from other customers. Persistence pays off, however.

In convention halls, exhibitors can amplify their own voices, but that may be to the further detriment of those who try to speak unamplified. The use of sound absorbing and isolating material is one good answer. In most schools around the country, significant efforts are underway to make classrooms more acoustically friendly to teachers and students.

Cocktail lounges and bars are places where many voices are potentially at risk. Often there is a high density of people in a small room and a lack of consideration for acoustic treatment of sound reflecting surfaces. Bar gatherings and cocktail parties can be avoided, of course, and enlightened vocologists routinely do so, but for some people these venues are places of business - avoidance may not be the answer. Again, making the proprietor aware of the problem is a good start toward creating some partitioning in sound environments. As vocologists, we should be as persistent as possible in making these requests.

According to recent reports by the United States Bureau of Labor Statistics (2008), repetitive strain injury (RSI) has been among the fastest growing occupational illnesses in the United States. Reported cases increased from about 20,000 to 700,000 annually in the U.S. between 1980 and 1996. More work days are lost due to RSI than any other occupational injury (an average of 15-20 days yearly, in comparison to an average of 3-10 days yearly due to falls, transportation incidents, fires and explosions, overexertion, assaults and violent acts, or exposure to harmful substances).

POSTULATES OF VOICE HABILITATION

Most vocologists practice behavioral medicine, with the term *medicine* encompassing all forms of treatment. In physical medicine, the primary target of intervention is disease reduction through biological processes. The physician's primary tools are *pharmacology* and *surgery*, assisted by a body with healthy cells. The behavioral vocologist's primary tool is *skill acquisition*, assisted by a *mind* that has a healthy level of compliance and will. The scope of behavioral medicine can then be broken down into the *what*, *how*, and *if* of a treatment (Verdolini-Marston et al, 1995). *What* establishes the goal of the habilitation, *how* establishes the procedures for approaching the goal, and *if* regards the adherence of the client with the clinician's suggestions. As will be discussed in Chapter 8, the *if* is often overlooked in the treatment process. It is clear that if the client does not comply, the entire therapy enterprise is useless. Thus, it behooves every vocologist to be enough of a psychologist to assess the motivation of the client and the veracity of statements made about practice and understanding of the concepts.

For the *what* and *how*, every successful approach to problem solving benefits from a conceptual framework. For voice habilitation, our framework is a few postulates that will permeate throughout the subsequent chapters. All the postulates are first listed on the following page. Some brief introductory comments about each postulate will then be made in the remainder of this chapter.

With our postulates, we split the *what* of voice habilitation into two parts: (a) maximizing vocal skill with minimal effort and minimal injury, and (b) optimizing the system to accomplish the goal, i.e. using equilibrium states around which coordinated movements can occur. The *how* of training will be described in terms of basic skill acquisition in Chapter 7, and with carrier-modulation exercises in Chapters 9-12.