Using Digital Technology in a Voice Lesson

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Traditional practices from the past are deep rooted and slow to change. Today's technology being then unknown made development of the singing voice entirely dependent upon the ear, the good taste in style, and the musicality of the teacher.

The vocal needs today require bigger voices due to present day size of concert halls and opera houses. They are larger in every way over performing areas of the past. Filling these spaces, a singer must have an energized instrument which necessitates finding new avenues that point the way to increased vocal energy without harming the voice, i.e.balanced resonance. Computer analysis programs which are relatively inexpensive and readily portable fit well into voice studios. Energies such as harmonics (formants), vowel consonant relationship and vibrato can easily be checked on a computer screen.

How to use such analytical programs requires a more in-depth knowledge of physiology and acoustics than in past pedagogical approaches. Former years demanded good ears, musicianship, etc.; however, todays larger halls place different demands on present day singers and those of tomorrow . It is important to note that microphones do not lend voices energy, they merely magnify what the voice contains. The dynamics are added in with a volume control.

Financial demands today are such that time plays an important role. With the speed of the computer analysis comes a quick location of the problem, hence a quicker development of the singer; the screen provides a strong bio - feedback which does much to confirm the teaching.

The Instrumentation

All of the instrumentation for this study is affordable. Its total value does not exceed $8,000.00. The computer program was Dr. Speech made by Tiger Electronics.

The Singers

There were 5 singers involved in this study ranging from 20 to 60 years of age. All had sung either in choirs or professionally.

Through the use of graphs, the tensions shown are indicated by a lack of vibrato - straight tone - and pitch variances in the repetition of the utterance. Alterations in the dB levels of the formants in the two examples, one on C4 and the

other on F4 prove a change in the tongue posture in the vocal tract. This alteration would effect not only the defining of the vowel in a text but would seriously effect the vocal energy. With this information so readily before one, immediate attention could be focused on the tongue problem and accompanying instabilities (breath, posture). Additional laryngeal tensions are indicated in a vibrato analysis when there are gaps in the wave when none is intended. Quite often these breaks, which are minuscule, go unheard despite the keenest of ears. Here technology brings a focus to an important vocal function in improving a teacher's appreciation of an important energy: vibrato.

The Breath

In the singing world, many different approaches to breath application exist. Thomas Hixon (1973, p.85) states, "it is possible to move air in and out of the lungs using a number of relative displacements of the thoracic cage and diaphragm." Hixon fails to mention postural alignment, whereas Richard Miller (1993, p.20) claims that, "the axial body (head, neck, and torso) must be well aligned, there should be no elevation or lowering of the chin, a relatively high sternal position is essential to such alignment." Combining these facts, one resolves that the options for *relative displacements* would be much reduced as movement would be limited to the lower abdominal area alone.

The Resonator or the Vocal Tract

The excitement found in singing voices is a result of postural alignment, breath management (application), laryngeal onset (closure of the vocal folds), and vocal tract configuration. Removing vocal tract tensions allows for a complete freedom of integrated action between the many parts, giving the audience the *thrill* they came to hear.

A major part of the vocal tract is the tongue to which many of the attributes and misdemeanors of speech can be attributed.

Formants

As a result of the various tongue postures two things occur: the vocal tract is divided into two chambers, a front and a back chamber, and vowels result from the filtering effects of the shape as sound passes through it from the larynx. This positioning of the tongue results also in the formation of formants: a vocal tract resonance shown as intensity in the frequency curve.

The most important of these are F1, F2, and F3. (I exclude here F0 which is the basic pitch. It is F3 which is vitally important as it is quite strong in the singing voice and has been given the name "the singer's formant." Other instruments possess no F3 or are relatively weak in it, allowing the singers formant to dominate and carry the voice over large orchestras filling today's modern 3,500 plus seat halls.

This formants location on the energy scale differs with each voice category; however, a rule of thumb is 2700 Hz - 3400 Hz for baritones and tenors (they have the higher category) and 3400 - 3900 Hz for mezzos and sopranos (again the lower number is for mezzos and the higher for sopranos).

Formant location is dependent upon three major factors, " the place of the major constriction within the vocal tract, the degree of constriction at that point and the area and length of lip constriction" (Minifie, 1973, p.248). Other factors such as age and sex play an equally important role in determining vocal formants.

Today, science can locate and determine the energies of formants. In the past, the Italian Masters talked of chiaro oscuro (light and dark) and balanced the vowels accordingly. Little did they realize how modern they were as they adjusted their students voices energy.

Front vowels are associated with fairly wide F2 - F1 separation, back vowels with fairly narrow F2 - F1 separation. Therefore, F1 - F2 correlates with advancement or retraction of the tongue. High vowels are associated with a low F1, low vowels with a high F1. Therefore, F1 frequency correlates with tongue height (or jaw opening). The effect of lip rounding is to lower all formant frequencies. In English, only the back vowels and the r - colored vowels are rounded. (Kent, 1993)

Changing Registers

Where registers change is constantly being debated in singing. Some approach it by listening, others by the fact that sound is produced through muscle manipulation; therefore, different muscle constrictions must produce different vocal ranges or registers. One of the early researchers in this area was William Vennard.

Finding the primo passaggio is mostly done through observation and listening. As the point is reached students usually lift their head and a marked quality change in timbre is heard. In analysis technology, alteration in the vibrato pattern and timbre at the point of change (primo passaggio) occur leaving no doubt about the vocal events taking place.

It is important in singing to maintain a matching timbre throughout the voice. One such approach in doing so is advocated by a famous American pedagogue who writes, "gradual opening of the mouth alters relationships among harmonic partials of the spectrum but the same tongue, lips, and zygomatic area (area of the cheekbone) muscles are retained while defining the vowel." (Miller, 1993, pps. 39&49) Other approaches exist, to sing higher, but, I wont mention them here as they mostly advocate changing the vocal tract to another vowel conformation.

Vibrato

Here the musical tastes vary widely. Some pedagogues advocate no vibrato, while others work ceaselessly creating an even and non obvious vibrato, contending it lends warmth and vibrancy to the singing. However, if we stick to fact, science, then Sundberg's (1993) statement serves to support vibrato well, "vibrato tones are produced with a lesser degree of glottal adduction than non vibrato tones." From this statement, one can gather there would be less wear and tear on the instrument with than without vibrato. Sundberg goes on to state that, "it is certainly a basic condition for creating an esthetically and artistically satisfactory result that difficult tasks are solved without apparent difficulty."

Past masters of the art of singing were most particular with their students' vibrato, ensuring it was not too wide nor too fast nor irregular. Browsing through

Giovanni Battista Lamperti's comments as recorded by his student William Brown, one reads,

> It is not difficult to sing from one note to another, if there is a common quality of vibration in the two tones, though the resonance changes. Resonance always changes. Vibration never. (1891 - 93, p.98)
>
> The energy in regular vibrato is constructive. The violence in irregular (vibrato) energy is destructive. (Lamperti, 1891, p.49)

A computer analysis program points out that, despite the most heroic attempts to suppress vibrato, appearances of it are visible in a vibrato analysis. Viewing a sonogram analysis (an FFT which depicts all of the harmonics), it is quite obvious that suppressed vibrato sharply reduces the energy in all of the harmonics, resulting is a smaller vocal sound. Adding a breath pressure measurement to the vibrato analysis, gives evidence in support of Sundberg's theory that an over adduction does take place in non-vibrato singing and that results in an extremely high sub-glottal breath pressure.

Summary

It is the hope of the researcher to make others aware of some of the smaller factors in sung sound which are the real contributors to vocal beauty and power, all of which attract us to the singing voice. Through these attributes the singer can be assured of their appeal as a vocalist and look forward to a relatively lengthy career - heavy drinking and drug usage are naturally not recommended ; however, it cannot be denied that vocal energy and interpretation are inextricably joined and without one or the other, magical musical moments are lost.

Although using digital technology makes arduous learning demands on the pedagogue, it is time well spent. New pedagogical approaches and a greater insight into the student's vocal dilemma come through new knowledge and result in new approaches. Connections between the physical and the acoustical are less remote. For this reason, technological instrumentation is a boon to anyone who can coordinate its usage into their concept of a 21 Century voice studio.

Note: The editor regrets that the full paper by Professor Bell could not be reproduced here because of technical limitations. Readers who may be interested in a fuller account of Professor Bell's research may contact him at the University of Calgary.

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