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OREN LATHROP BROWN PROFESSIONAL DEVELOPMENT PROGRAM

**FEATURED COURSE: ON-DEMAND ONLY**

**Comparative Voice Pedagogy**
A Comprehensive Review

Review the past informative seasons of NYSTA’s favorite On-Demand PDP course.
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For more information, contact NYSTA’s Professional Development Program Director Felix Graham at pdpdirector@nyst.org.

**PAST PRESENTERS**

2014: Richard Leech, Elizabeth Kling, Amy L. Cooper, John West, David McCall, Lisa Rochelle;
2013: Jeanne Goffi-Fynn, Matthew Hoch, Lori McCann, Jan Prokop, Melissa Cross, Margaret Lattimore;
2012: Stephen Oosting, Taina Kataja, Jeffrey Gall, Justin Stoney, Margaret Cusack, Mary Saunders-Barton;
2011: Margaret Baroody, Gwendolyn Bradley, Scott McCoy, Sally Morgan, Michael Paul, Michael Rider, Patrick Wickham;
A common complaint I hear among colleagues in- and outside of academia is that a particular knowledge base lies out of reach. In our attempts to develop more consistent language for discussing vocalism, insider terminology still distances us from one another. The most perilous areas for most of us continue to be resonance and acoustics. The concepts, the words, the numbers, and (how to agree on) what to do with the numbers continue to confound us. I am called to facilitate learning, help give meaning and application value to academic concepts, and help others find their unique voices in this large, yet intimate, field. This article shares one interpretation on these terms in the hopes that some find meaning and the possibility of application of the shared information. It is with this in mind that I offer this article, inspired by the writings of the late Paul Kiesgen¹ who was, in my view, a great seeker of knowledge and clarity in the area of voice pedagogy.

INTRODUCTORY ACOUSTIC SNACKS: Celery, Carrots, (and Ranch)

Let us dive directly into acoustic terminology since it continues to be a source of frustration for many teachers of singing and their students. My pedagogy students are always amazed by the math involved in acoustics, and I enjoy unveiling the code for them. Of course, not all of them are keen to accept this into their music-view (worldview) immediately, but we can only hope that their passion for learning and growing will bring them back to this material with enthusiasm at some point in their careers. Rather than attempt to ingest these terms and concepts in holiday-meal style, I recommend a simple veggie or fruit tray approach. Here are a few of my favorite acoustic snacks.

**Sung Pitch**

This is expressed scientifically in Hertz, a frequency measurement. The higher the pitch, the higher the frequency. Vibrato adds an excursion (higher and lower frequency) that adds and subtracts from the central pitch by 4.5 to 7 Hz,² on average. One wondrous thing about pitch and tuning is that our ears hear someone at middle A (A₄=440Hz) on the treble clef as being in tune even at a frequency of say, 435 Hz or 450 Hz, thanks to the presence of vibrato. The perceived absence of vibrato is what causes some sounds to be interpreted by listeners as out of tune. Since pitch is an audiated construct, keep in mind that the most strongly resonated harmonic might not be the sung note. This is shown in *Figure 1* (page 84) and the concept fleshed out a bit in the definitions that follow...

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**Fundamental Frequency**

The sung pitch is a composite perception of the fundamental frequency (the pitch that we produce and hear) and a series of overtones. The vibrations of the vocal folds produce the fundamental frequency, and the overtones are enhanced or suppressed by the vocal tract to produce a unique sound that distinguishes one singer from another. You’ll see fundamental frequency referred to as F0 in some voice pedagogy books and articles predating this one; newer books and articles from 2015 forward likely use newly updated symbolic notation. In the recently updated notation, we label the fundamental with $f_o$. We then clearly distinguish lower case $f$ from upper case $F$ which is the symbol for formant. Subscript letter o stands for oscillation of vibration. As stated by Titze et al.,

“...[the] symbol $f_o$ as the fundamental frequency of oscillation of the vocal folds has been used in thousands of publications, both with upper case and lower case letters and both with subscript and no subscript. If capitalized, the symbol is not clearly dissociated from formant frequencies $F_1, F_2,..., F_n$. “

A zero is not an adequate substitution because it is meaningless in this context.

**Overtones**

A simple YouTube search can locate any number of clear examples of singers manipulating the overtone series. In solo classical singing, we work with the overtones to strengthen and beautify the sung tone rather than the overtones individually. In pedagogy books and articles, you will see overtones referred to more specifically as harmonics as it is the harmonic overtones, not the non-harmonic tones, with which we work. Of course, some vocal genres utilize non-harmonic tones to great effect. Acoustic descriptions addressing the use of non-harmonic tones in singing would be of benefit to the pedagogic community.

In previous voice pedagogy articles and books, the fundamental frequency may have been labeled as H1 (or F0, with the second harmonic—first overtone above the fundamental—labeled as H2. The harmonics are tied numerically to the fundamental. Therefore, if $F_0=220$ Hz, then $H_1=220$ Hz, and $H_2=440$ Hz ($2 \times H_1$). We can look at individual harmonic strength with programs like Voce Vista. However, the symbolic notation has changed, so whereas $H_2$ equaled 440 Hz before, the newly updated symbols notate this value as $2f_o$.

Figure 1 (page 84) shows the features above using a fundamental frequency of about 220Hz on a Voce Vista screen capture. The fundamental frequency, formerly labeled as H1,
is labeled on both sides of the image as $f_o$. Notice that the fundamental is not the most strongly resonated harmonic. In this case, $3f_o$ is the strongest harmonic. Three harmonics in the Singer’s Formant region are stronger than the fundamental which is not surprising, given the sung pitch, even though the sample is of a female voice.

In review, the most important basic things to remember about overtones are as follows. First, overtones can be harmonic or non-harmonic. In classical genres, we tend to focus on harmonic sound and reducing non-harmonic sounds that we may perceive as roughness. Additionally, harmonic overtones, previously notated as H, are tied numerically to the fundamental frequency which corresponds to the sung pitch.

Pitch is a perceptual term, reflective of the measurable fundamental frequency and harmonic overtones. We can calculate the harmonic series of a “pitch” by multiplying the fundamental frequency by whole-number integers. Further, researchers and Speech Language Pathologists tend to deal with the sound spectrum on this evenly-spaced linear scale, whereas musicians tend to navigate the sound spectrum utilizing a logarithmic scale—the keyboard. As teachers, we must be careful about using the term “overtone,” and ensure that we do not conflate terms or assign individual meanings to well-established scientific terms. My recommendation for classical singers and teachers is to use the word harmonic, instead of overtone.

On the left-hand side of Figure 1, we see sound produced over time, with the last captured sound of the sample furthest from the left (closest to center). The right-hand side of the image is a time slice of the tone where we can see the strength of individual harmonics in the select sound spectrum (in this case 0-5,000 Hz). The Singer’s Formant is explained further on in this article.

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Figure 1

Click this link for an excellent audio-visual explanation of the logarithmic scale https://www.khanacademy.org/math/algebra2/exponential-and-logarithmic-functions/logarithmic-scale/v/logarithmic-scale.
HEAVIER ACOUSTIC HORS D’ŒUVRES: Crabcakes, Dumplings, and Beef Carpaccio

Sound Spectrum

This is one of those terms that, in my view, is made unnecessarily complicated. Spectral envelope is another term that sounds impressive but may not be valuable to most voice teachers and singers. I mention this here because many pedagogy textbooks now include this concept. Simply stated, all of the possible frequencies within a certain range being studied (in Voce Vista and other programs) or recorded (using equipment and software) comprise the sound spectrum. Classical singing has been concerned heretofore with frequencies at or below 5,000 Hz, though newer studies are looking at frequencies above this range. What we potentially gain from analyzing a sound spectrum is information concerning individual harmonic intensity, the Singer’s Formant, registration, vowel clarity, vibrato rates and extents, and timbral depth. Visualizations of the sound spectrum do not replace expert ears but may be particularly useful when teaching across styles and genders, when one is less confident in his or her analyses.

Formant

A saucy definition of this acoustic term might be something along the lines of “… that concept having to do with resonance that does not really make a lot of sense, especially on first approach, and is prone to tautologic explanation.” To further frustrate the learning process, one minute you might think you understand the definition of a formant from a scientific perspective and/or a practical perspective, and then another presentation comes along and washes away your sandcastle of understanding. Again, I recommend a frequent, repeat, snack-like consumption of the concept. Most simply stated, formants are perceived energy peaks. One compact definition offered by Barrichelo et al. suggests that the Singer’s Formant, unique to specific musical genres, is a resonance effect “…associated with vocal adjustments and influenced by technical voice training…” which helps the voice produce a ringing sound that carries over orchestras in larger acoustic spaces. In other words, voice training helps singers—with specific acoustic goals—adjust the resonator to enhance vocal energy.

Resonances and formants have been used interchangeably to describe an attribute of the vocal tract, but some experts advocate for distinguishing between vocal tract resonances, which we work to enhance, and formants, which we seek to measure and visualize.

7 If one looks at the harmonic energy output of a sung pitch, the spectral envelope is the outline of the peaks of energy inferred by the intensity of the individual harmonics. I recommend Clifton Ware’s chapter on resonance in Basics of Vocal Pedagogy for an in depth discussion of the properties of sound and vocal tract resonance. Clifton Ware, Basics of Vocal Pedagogy (Boston: McGraw Hill, 1998).


Regardless, be aware that the pedagogic community is not in agreement regarding the definitions of vocal tract formants or resonances. A review of the literature suggests that the terms “Singer’s Formant” and “vowel formant” are still widely accepted and broadly used.

**Singer’s Formant**

Back when I was learning about formants, resonance, and self-amplification, I thought that what I was learning to do was make my voice “ring” so that I would have Singer’s Formant (located somewhere in the vicinity of 3000 Hz in the sound spectrum). “Ring” can correspond with high energy in harmonics in the Singer’s Formant range but also may be created by tuning to other resonances of the vocal tract. The Singer’s Formant is more critical for lower voices in classical repertoire, particularly male voices, because more harmonics will line up within the Singer’s Formant range. Additionally, male voices can utilize a clustering phenomenon of Singer’s Formant energy. Whether or not female voices can and do make use of the Singer’s Formant Cluster (SFC) has not been thoroughly studied or justified in the literature.

**ACOUSTIC BOG: Peat, Heather, and Huckleberries**

So what! Why is this information relevant? Why allow ourselves to get stuck in a bog, wading about the weeds? Most simply stated, the availability of this information deems it so. We may not always like our students’ reliance on YouTube, Wikipedia, and search engines for technical advice, style advice, easily accessible translations, questionable IPA resources, and the like, but since information is readily available, we can choose to help curate resources that can help our singers progress. Science-based books, instruments, software, and online resources become more affordable, accessible, and incorporated every year. We see this in many academic pedagogy books currently used in the United States. Therefore, it behooves us to challenge ourselves to snack on this information and learn to apply it, perhaps in small doses.

In this age of do-it-yourself, I see that our students are also figuring out how to do things with their phones and tablets that still confound me. Most of them instantly recognize a waveform envelope (see Figure 1) and know what that means. Many of them are learning how to edit sound and video quite adeptly with free or nearly-free apps. These students find the visual information provided by programs like VoceVista and simulations like Madde to be helpful in understanding how they create and enhance sound. We can pick an app or software

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She maintains an active performance career particularly as a concert artist and recitalist and has performed in concert with the London Sinfonietta, the New World Symphony, the Los Angeles Symphony, and on stage with New Orleans Òpera, Chautauqua Opera, Opera Theatre of Saint Louis, among other organizations. Her performance repertoire is quite diverse, encompassing oratorio works by Bach, operatic repertoire from Purcell to Adano, and concert works by Verdi, Mahler, Ravel, and contemporary composers.

James is passionate about culturally-situated art and exploring Las Vegas, the US Southwest, Mexico, and the Central and South Americas in performance venues and repertoire. Her concentration on bridging the gap between the hard sciences and singing began in 2008 when she completed a vocology certificate program at the National Center for Voice and Speech under Dr. Ingo Titze. Her
program to learn as a professional development project, and help our students better apply these tools to their creative works.

These programs, and numerous others out there in the marketplace, provide information that is more objective, these interactions of harmonics and formants, and perhaps less emotional. It can remove us from “what is wrong with this student’s middle voice” or “why can’t I help this student fix her middle voice” and gives us the tools to solve for “what is the interaction between harmonics and resonance energy on this vowel in my student’s middle voice.” “What energy can I borrow from a neighbor vowel posture to improve resonance?” “What articulatory position will help this student produce a balanced sound?” “Is there something going on in the resonator that is negatively affecting phonation?”

I hope this article and the definitions within reinforce the knowledge you already have and add to your knowledge base and confidence. The key to bringing them into that knowledge base is to use them, perhaps first in very basic, simple ways or limited applications—the snack approach. Many teachers and singers find enhanced and improved vocalism by exploring these topics in conference presentations, workshops, online courses, and more. With time and attention, these words assimilate and set the foundation for further, nuanced understandings of voice acoustics and additional tools for our teacher toolbelts.