On the Voice

Duane Cottrell, editor

Categorizing and Notating Timbres for Vocal Ensembles

by Fahad Siadat

Exploring Timbre

The voice is an exceptionally versatile instrument capable of expressing innumerable sounds and styles of singing. Often, however, we confine our ensembles to what we think is an "appropriate" timbre decided through our understanding of the performance practice for the style and genre of any given piece. This is tricky for contemporary music which does not necessarily have a set performance practice and style can vary from piece to piece, relying on the conductor to make a decision based on personal preference and the abilities and limitations of their ensemble. Contemporary composers are increasingly interested in using sound and style as an expressive device even utilizing different timbres within a single composition and are relying on conductors to build flexible and diverse ensembles that can engage effectively with their creative intentions. Exploring vocal timbre provides an opportunity for conductors and singers to engage with a greater breadth of repertoire, it also expands their expressive palette and makes available to ensembles of all experience levels a new depth of musicality. By familiarizing themselves with the acoustics of different timbres, conductors (and by extension the singers with whom they work) open the door to a world of compositions that are gaining popularity in the wider vocal ensemble community.

Categorizing Timbre Based On the Spectral Envelope

Merriam-Webster defines timbre as "the quality given to a sound by its overtones: such as…the quality of tone distinctive of a particular singing voice or musical instrument."[1] While all sounds produce overtones, it is the relative strength of the various overtones that gives each sound its unique quality, which is why a flute doesn't sound like a clarinet, even though the harmonics they produce are the same. One way of visualizing this difference in timbre is by using a spectrograph[2] which shows the balance of harmonics in any given sound. The particular "shape" of a sound is referred to as the Spectral Envelope. With this definition in mind, there are four over-arching spectral shapes I propose we use as a starting point when discussing tone and color in a vocal ensemble setting. Roughly described, these four timbres show a gradation from "dark" to "extremely bright" based on how strong the fundamental (actual pitch being sung) is and which harmonics in the sound are emphasized and which are de-emphasized, or attenuated. The four timbres are:

- Fundamental dominant with attenuated upper harmonics (Fundamental Dominant)

- Wide spectrum of emphasized harmonics (Wide Spectrum)

• Emphasized "middle" harmonics with attenuated upper and lower harmonics (Narrow Band)

• Individual upper harmonics dominant with attenuated fundamental (Overtone Dominant)

Those familiar with the term *Bel Canto* may notice that I have not included it among the vocal timbres outlined in this paper. For those unfamiliar with the term, *Bel Canto* can generally be thought of as the "operatic" style of singing. In addition to emphasizing lower harmonics, *Bel Canto* singing boosts the harmonics around the 3,000hz frequency band, referred to as the "Singer's Formant." This frequency is boosted through a narrowing of a tube above the vocal folds (the epilarynx) and creates an acoustic boost to the voice that allows singers, in combination with vibrato, to be heard without amplification over an orchestra. The four timbres I have described are generally based on the spectral envelope of harmonics below the singer's formant range. Because of *Bel Canto*'s pedagogical prevalence in Western classical training, and because it is possible to narrow the epilarynx and create this boost in the singer's formant with the timbral categories I propose, I have not included *Bel Canto* in the list of overarching timbral categories in this paper.

Two primary factors that affect the spectral envelope for the voice are the shape of the vocal tract—specifically the size and shape of the mouth and throat—and the amount of vocal fold mass touching during phonation. While there are a number of formants in the voice, the first and second formants, generally considered to be created in the space between the tongue and the vocal folds (formant 1) and in the space in the mouth between the back of the tongue and the teeth (formant 2), have the largest effect on the spectral envelope, and hence the overall sound.

Perhaps the most readily available means for understanding the results of changing the vocal tract is through our perception of vowels. Each vowel is formed through a different placement of the tongue, lips, larynx, and every other adjustable aspect of the vocal tract. These adjustments change the spectral envelope of the sound, emphasizing specific frequency bands and boosting or attenuating certain harmonics in a sung pitch.[3] Below are the various spectral envelopes for the five Latin vowels sung on the same pitch (Image 1 on page 55).[4]

Fundamental Dominant with Attenuated Upper Harmonics Timbre (Fundamental Dominant)

The Fundamental dominant with attenuated upper harmonics sound, which I will call the Fundamental Dominant sound, is a timbre

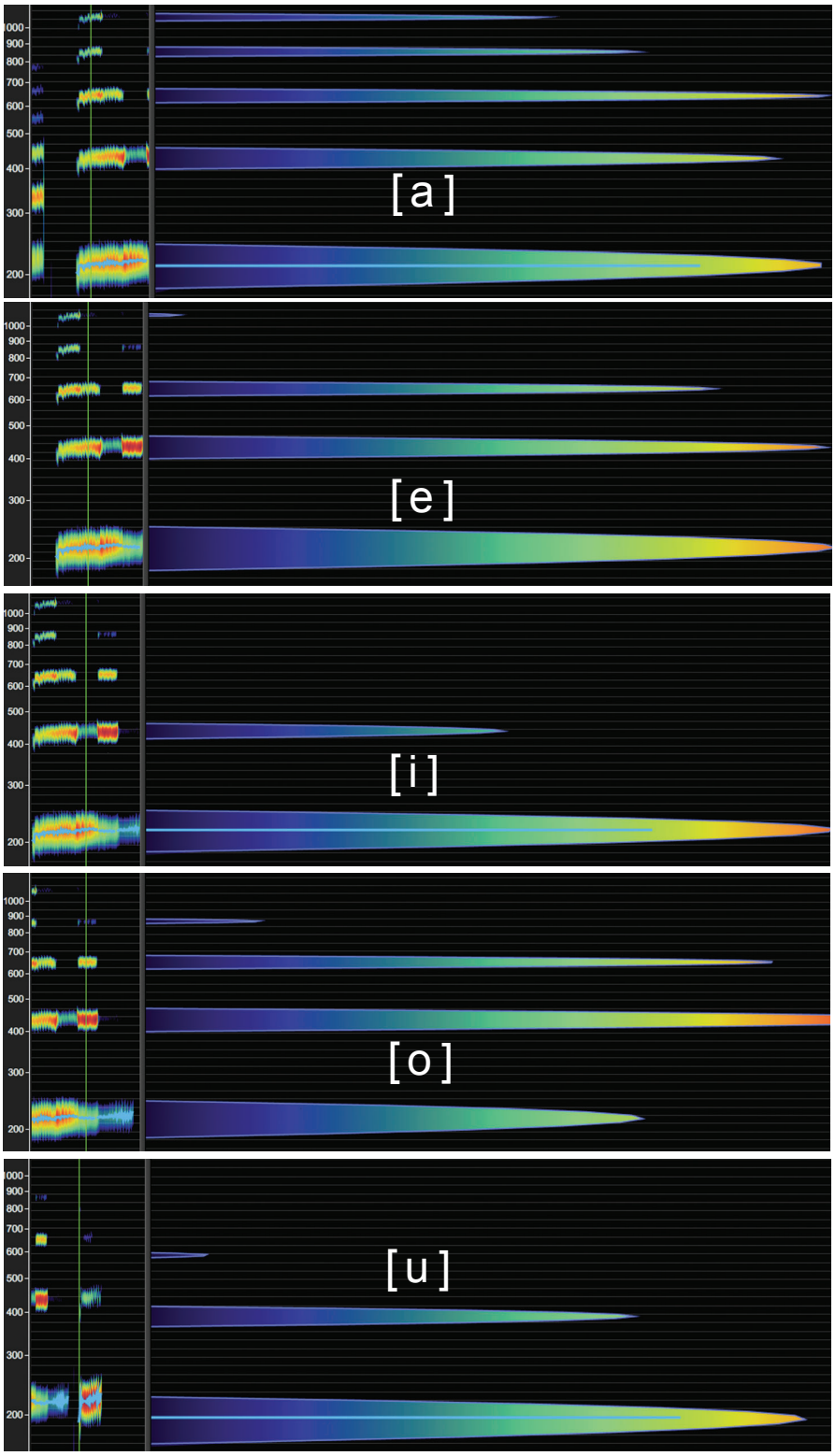


Image 1. The five Latinate vowels sung on an A3 (220 hz). Note the change in spectral envelope for each vowel. All spectrograph images in Image 1 show a frequency range of 200hz - 1,000hz

that most closely emulates a "pure" tone, a sound strongly emphasizing the fundamental pitch, with the upper harmonics significantly less present.[5] Much like blowing over a partially filled bottle, the resonant frequencies emphasized in a sung pitch will lower as the open space expands. In the voice, this occurs by widening and lengthening the vocal tract. Typically, singers achieve this by creating a more vertical, rather than horizontal space in the mouth, regardless of what vowel is being sung, and maintaining a low laryngeal position (Image 2 on page 56).

This sound effectively emphasizes the fundamental pitch, which is the lowest frequency present, allowing a group of singers to easily create a timbrally homophonic sound.[6] For many in the choral world, the Fundamental Dominant timbre is considered the default and desired "choral tone" and is similar to the sound often used in Western renaissance music because it helps maintain the clarity of individual lines in polyphonic music, even in a highly reverberant space. Reducing the amount of vibrating vocal fold mass also helps de-emphasize upper harmonics. When the folds stretch and tilt on their edges, similar to what happens when singing in *falsetto*, less of the vocal folds vibrate, exciting less air. Because the vocal folds tend to stretch and thin as one sings higher, Fundamental Dominant singing is easiest to achieve in the upper-middle part of a singer's tessitura. The Fundamental Dominant timbre lends itself particularly well to dynamics in the *mezzoforte* to *pianissimo* range.[7] The change in

muscular tension also allows the larynx to maintain a relatively low position and helps other muscles in the throat to relax, creating more space and further de-emphasizing upper harmonics. This essentially creates an [u] space in the throat regardless of what vowel the oral cavity shapes.

Wide Spectrum of Emphasized Harmonics (Wide Spectrum)

In stark contrast to the Fundamental Dominant sound, which creates a timbral homophony of voices by de-emphasizing upper harmonics and focusing on the fundamental pitch, Wide Spectrum singing emphasizes a singer's individual sound by expressing a wide range of harmonics, as well as the fundamental, similar to the style of singing used in Sacred Harp music. Another example of the Wide Spectrum sound is Musical Theater Belting, traditionally defined as using the 'chest voice' (a term often used to describe a feeling of resonance in the chest when more mass of the vocal folds is touching) in the middle to upper middle part of the range. Note, for instance, this example of Musical Theater Belting by Broadway singer Idina Menzel as she sings the climactic high note in *Let It Go,* from the Disney musical *Frozen.* Here you can see the broad set of harmonics in all parts of the overtone series (Image 3).

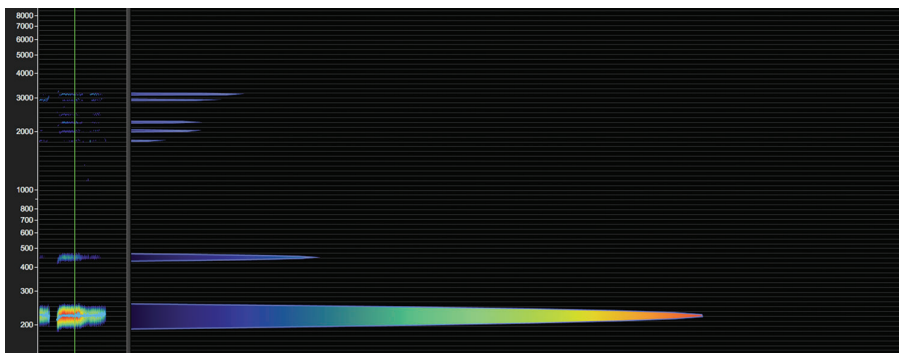


Image 2. [u] Vowel sung on an A3 with the fundamental pitch dominant and upper harmonics attenuated. Spectrograph image shows a frequency of 200hz - 10,000hz

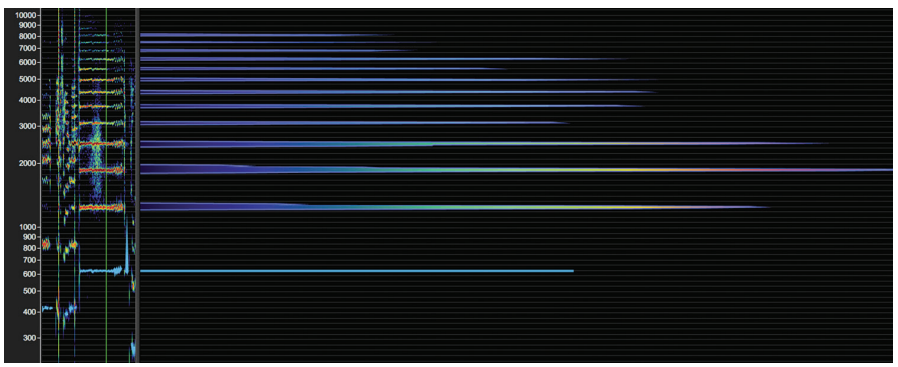


Image 3. An Eb5, around 600hz, belted at full volume. The Spectrograph image shows a range of 200hz - 10,000hz.

This image reinforces Scott McCoy's observation that "spectral analysis reveals strong harmonic overtones as high as 10,000hz, very different from the classical ideal, in which the harmonics above 4,000hz are sharply attenuated."[8] Notice, in particular, how strong the upper harmonics are, even compared to the fundamental. In this case, the 2nd through 4th harmonics are quite a bit stronger than the fundamental, and significant harmonic presence continues all the way up to nearly 10,000hz, a result of the intense sub-glottal pressure during Musical Theater Belting.[9] The degree to which the upper harmonics are attenuated reveals the difference between what is referred to in musical theater parlance as a *Belt* vs. *Legit* singing. The *Legit* quality attenuates the highest harmonics, making it closer in timbre to *Bel Canto* singing. The effect can be achieved with some additional increase in vocal fold mass (shortening/thickening of the vocal folds) in combination with shortening parts of the vocal tract, emphasizing upper harmonics as well as the fundamental, and can be tiring for the performer.[10] There are a number of ways to shorten the vocal tract and achieve the particular acoustic effect of the harmonic richness in the Wide Spectrum sound, but the most readily accessible is through vowel modification. Pedagogically, this means asking singers to emphasize a horizontal, rather than vertical, mouth shape, adjusting words that use normally "open" and "back" vowels, like [ɑ], to have a brighter quality closer to [æ], which

is still open but "front." The line where the voice can attain this level of strong high frequency harmonics without becoming quickly fatigued, and while remaining pleasant to hear, is the sweet spot between the effort and ease of any Wide Spectrum singing.

Emphasized Middle Harmonics with Attenuated Upper and Lower Harmonics (Narrow Band)

This vocal timbre can be described as a bright, perhaps "biting" timbre, similar in quality to the Wide Spectrum sound, but with more focus on a smaller range of harmonics. The vocal timbre found in the Bulgarian vocal ensemble tradition is an excellent example of a sound that creates this particular spectral envelope. While authentic Bulgarian singing takes years to master properly, it can be used as an aural guide for a timbre that more generally emphasizes middle harmonics and attenuates higher and lower ones. A brief examination of this particular singing tradition can also lend clues as to how singers might achieve a similarly Narrow Band timbre.

Nathalie Bernardoni theorizes that "the development of resonance tuning in this singing style may be related to the relatively low importance of vowel height in some dialects of Bulgarian."[11] This lower vowel height suggests that the narrow vocal tract of some Bulgarian dialects may be a key aspect of producing a Narrow Band timbre since any narrowing of the vocal tract, adjusting the position of the tongue root, or partially lowering the soft palate, will narrow the band of emphasized frequencies, boosting a smaller set of harmonics than the more robust harmonic presence of the Wide Spectrum sound. While it may be tempting to categorize this brighter sound as "nasal" in quality, actual nasal resonance is not necessary to produce this timbre.[12]

While the descriptors of the Narrow Band sound often overlap with those used to categorize the Wide Spectrum sound (bright, piercing, etc.), there are some important differences. From a vocal ensemble perspective, one of the most important distinctions is that it is easier to create timbral homophony with the Narrow Band timbre than it is with the Wide Spectrum sound, creating a unified sound among singers.[13] Comparing the spectrographs of the Narrow Band and Wide Spectrum sound can offer some clarity on the acoustic distinctions between these two timbres. Below are images of Jasna Duran, a Bulgarian singer, and Idina Menzel, a Broadway singer, both singing a strong pitch around 400 hz (Images 4 and 5).

Note how, in the top image, the fundamental pitch is not emphasized. Rather, it is the 2nd through 4th harmonics that are the most prominent. Also note that, unlike the spectrograph of the Wide Spectrum timbre shown in the bottom image,

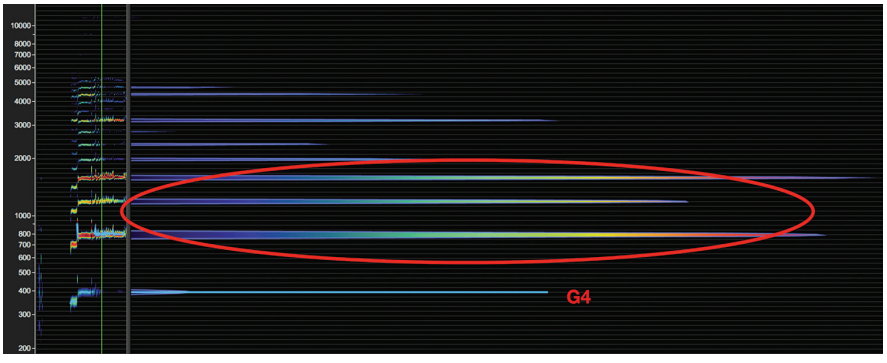


Image 4. Jasna Duran, a Bulgarian Singer, singing a G4. Note the emphasis on the 2nd, 3rd, and 4th harmonics. The range of the spectrograph is showing 200hz - 10,000hz.

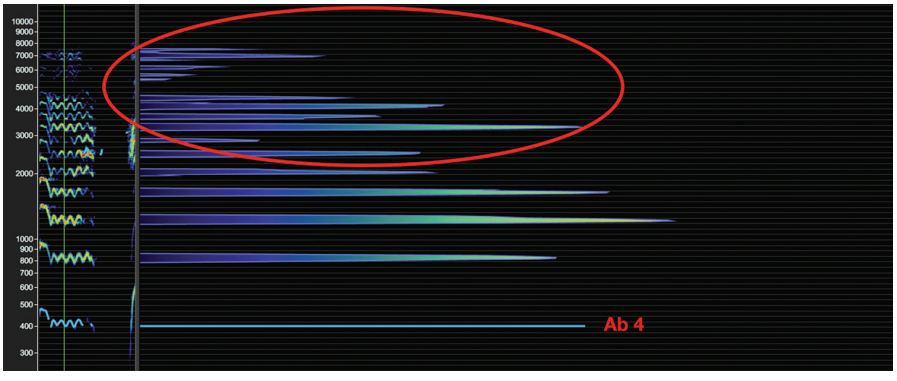


Image 5: Isolated vocals from Idina Menzel, a Broadway performer singing Let it Go, sustaining an Ab 4. The range of the spectrograph is showing 200hz - 10,000hz.

the harmonics above 4,000hz are sharply attenuated in the Narrow Band timbre, putting the main focus on the 2nd, 3rd, and 4th harmonics. I believe this narrow harmonic focus is what allows Bulgarian choirs to maintain timbral homophony (choral blend). Like the Fundamental Dominant sound, timbral homophony among voices singing the same melodic line is partly achieved by having all singers emphasize the same harmonics. In a vocal ensemble setting, this is typically achieved by asking singers to match the same shading of vowel, since each vowel boosts its own set of frequencies (as illustrated in Image 3). If that emphasis boosts only a small range of harmonics, like in the Narrow Band sound or the Fundamental Dominant sound, then it will be easier to achieve a greater degree of timbral homophony. Because the Wide Spectrum boosts harmonics over an extensive range of frequencies, it will more readily create timbral heterophony (the effect of many individuals singing at once).[14]

Individual Upper Harmonics Dominant with Attenuated Fundamental (Overtone Dominant)

Much like Narrow Band singing, the Overtone Dominant timbre boosts a small band of frequencies while suppressing the fundamental pitch. By contrast with the Narrow Band sound, Overtone Dominant singing narrows the boosted band of frequencies to the point where only one harmonic at a time is emphasized.[15] When executed by a well-practiced performer holding a drone, this technique may be used to create whistle-like melodies that follow the pattern of the overtone series. In a vocal ensemble, the technique can be used as a generally brighter timbral effect or to acoustically recreate an electronic "filter sweep" by moving between high and low harmonics through various vowel shapes. This extreme narrowing of the vocal tract can be achieved initially through use of a retroflex American 'R' [ɹ] shape, with the back and sides of the tongue very high.

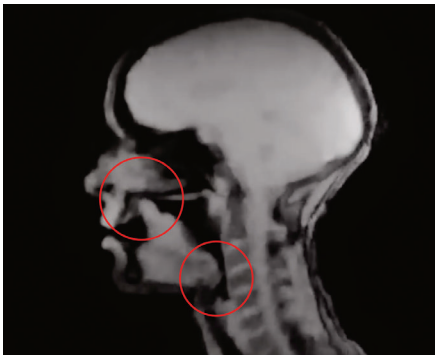
Reinforced harmonics can also benefit from a touch of nasality in the sound. The specific overtone emphasized can then be adjusted through very small changes in lip and mouth shape (Image 6).[16]

Visual Representation of Timbral Categories

Because of the relatively consistent spectral envelope of each timbre, I will propose a standard set of symbols derived from the spectral envelopes of the four timbres discussed previously that can be used by conductors interested in a quick pedagogical reference to indicate which timbres they are interested in hearing from their ensemble, or for those who may find it helpful to understand these symbols as they encounter them in contemporary literature.[17] Again, the four timbres are:

- Fundamental dominant with attenuated upper harmonics (Fundamental Dominant sound)

- Wide spectrum of emphasized harmonics (Wide Spectrum)



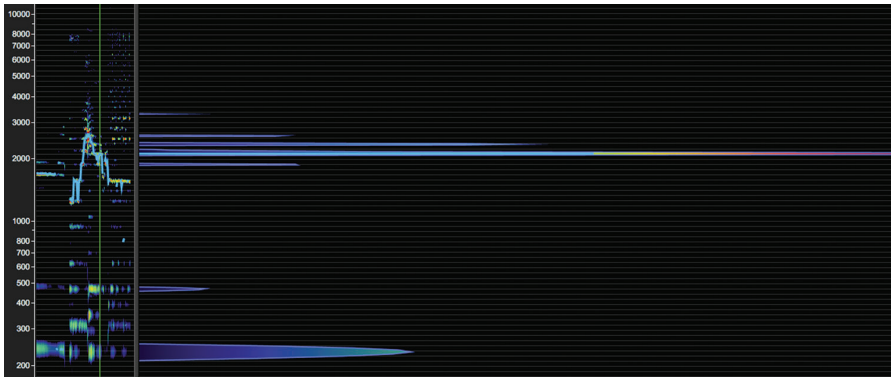


Image 6. An MRI image of Anna-Maria Hefele overtone singing and the corresponding spectral envelope. Note the narrowing of the vocal tract with the high placement of the tongue and in the throat in the upper image. The spectrograph image ranges from 200hz - 10,000hz, with the harmonic boost occurring around 2,000hz.

• Emphasized "middle" harmonics with attenuated upper and lower harmonics (Narrow Band)

• Individual upper harmonics dominant with attenuated fundamental (Overtone Dominant)

In graphic form, these spectral envelopes can be outlined as an oval, diamond, square, and wedge, shapes that can be used to quickly delineate the various timbres (Image 7).

It's important to note that these timbres are sound possibilities based on acoustic phenomena and not an imitation or appropriation of existing vocal traditions. While I have mentioned singing traditions as examples of these acoustic phenomena, such traditions involve more nuance than creating a particular timbre and take years of dedicated study to master; there is a big difference between creating a bright and focused sound and singing "like a Bulgarian choir." What these timbral categories offer, however, is a spring board for singers and conductors to interpret a score that asks for many timbres with minimal explation.

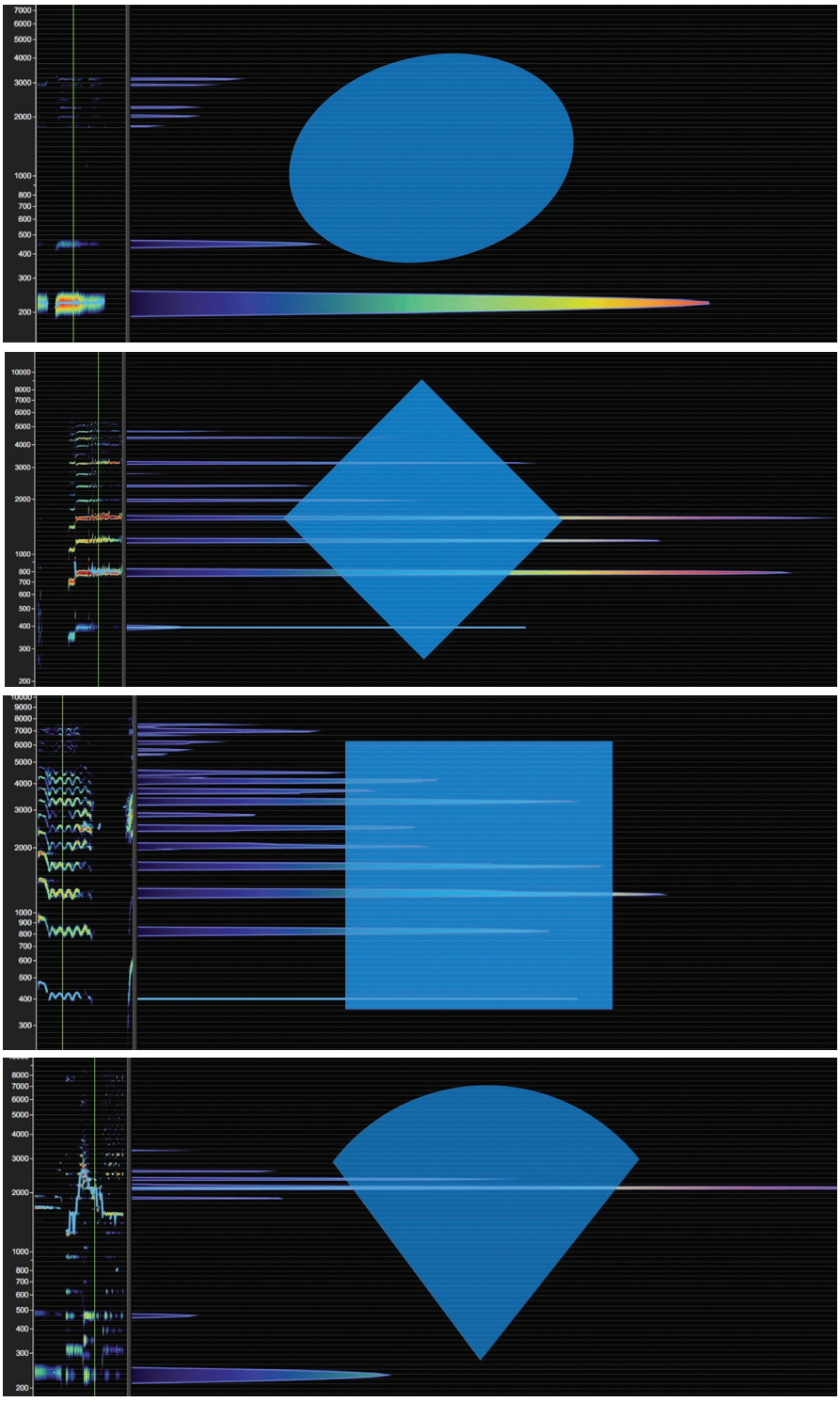


Image 7. Spectral envelopes (listed from top to bottom) for Fundamental Dominant sound, Narrow Band sound, Wide Spectrum sound, and Overtone Dominant sound, with shapes outlining their respective harmonic strengths overlaid. Note that the first image is the same as the standard notehead shape in traditional Western notation. Spectrographs show a range of 200hz-10,000hz.

Examples of How to Use Timbral Categories to Interpret Existing Repertoire

One example of a popular piece that asks for a variety of timbres is *Pseudo-Yoik* by Jaakko Mäntyjärvi. *Pseudo-Yoik* plays off a stereotype that may be considered culturally offensive, but is such an important part of the contemporary vocal ensemble repertoire and has served as an introduction to using timbre as an

expressive device for many vocal ensemble singers.[18] Figure 1 shows the opening tenor line of the piece in its original notation.

Mäntyjärvi's performance instruction of "almost painfully nasal" is, of course, tongue-in-cheek, and we can only hope he does not want the singers to do anything painful to either themselves or the audience. Let us imagine that the composer desires what is commonly thought of as "nasal" timbre, but which might in fact be a narrowing of the vocal tract to emphasize a particular band of frequencies that produce a bright and biting timbre in stark contrast to the Fundamental Dominant sound.[19] In this instance I have employed the Narrow Band sound using the diamond shaped symbol in order to indicate an appropriately bright timbre (Figure 2).

Later in the piece, Mäntyjärvi asks for a somewhat different timbre (Figure 3).

The performance instruction of "like a demented jaw harp" seems, again, intended to be humorous, but may leave the performer with a question of how this sound should be interpreted differently than the previous instruction. The term "demented" implies an extremity of sound, which I interpret as a more extreme narrowing of the vocal tract, creating something even brighter and more focused than the instruction in the previous example. Because a jaw harp is an instrument that uses the vocal tract as a resonator to emphasize specific harmonics from a single droning pitch, it is not unlike the use of Overtone Dominant singing. In addition, the [n] consonant that starts each phoneme in this section is an inherently nasal sound, which can help reinforce individual harmonics. For this passage I've used the wedge-shaped Overtone Dominant notation and allowed the various consonant and vowel shapes to create subtle "filter sweep" effects from note to note as the vowels change (Figure 4).

Another piece that uses a variety of vocal timbres is *Hee-oo-hm-ha* by Toby Twining (b. 1957). Twining is a New York-based compos-

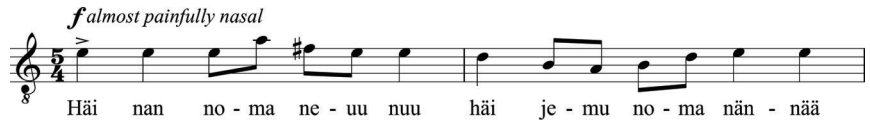


Figure 1. Jaakko Mäntyjärvi, *Pseudo-Yoik,* mm. 1–2.
Original Notation

Courtesy of Walton Music.

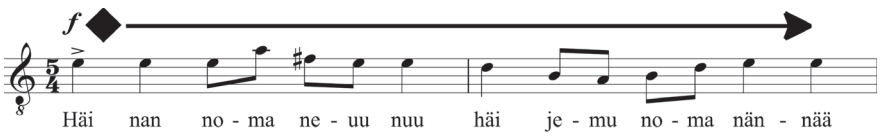


Figure 2. Jaakko Mäntyjärvi, *Pseudo-Yoik,* mm. 1–2.
Addition of timbre symbol

Courtesy of Walton Music.

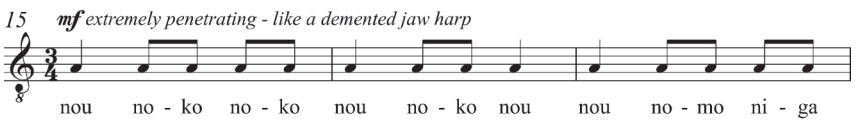


Figure 3. Jaakko Mäntyjärvi, *Pseudo-Yoik,* mm. 15–17.
Original notation and a re-notation

Courtesy of Walton Music.

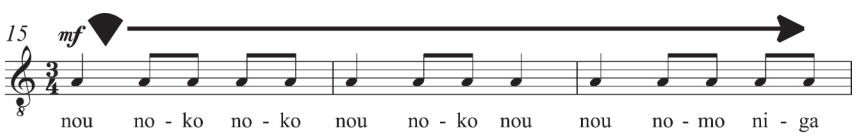


Figure 4. Jaakko Mäntyjärvi, *Pseudo-Yoik,* mm. 15–17.
Addition of timbral symbol and a re-notation

Courtesy of Walton Music.

er known for his exploration of vocal timbres for vocal ensembles. In this example, Twining asks the vocalist to start with an [i] vowel, which is made brighter by shifting to an Overtone Dominant sound, and moves through to an [u], thus changing to sound to a less bright, but still Overtone Dominant, timbre (Figure 5).

In this case, the tongue and lips adjust to morph from an [i] to an [u] vowel, while harmonics are made audible by an overall narrowing of the vocal tract.

These symbols have also been adapted into noteheads to delineate among desired timbres without affecting the traditional notation of pitch and rhythm. A variety of timbres can then be easily combined in a single passage without interrupting the visual flow of the score. My own composition, *Hymn to Aethon,* is an example of a piece that layers these various timbres to create certain musical effects (Figure 6).[20]

Using these noteheads to indicate which sound to use allows the precise notation of four different timbres within a few bars, presented without the distraction of many descriptive words for each desired timbre. In this segment, the lower voices sing an ostinato with a focused and bright timbre, while the upper voices sing a melody using the Fundamental Dominant sound, thus creating a timbral contrast between the rhythmic accompaniment and the lyrical line. All voices crescendo into a sudden Wide Spectrum sound and resolve with the altos singing a subtle "filter sweep," created through the use of changing harmonics, that transitions into the next section.

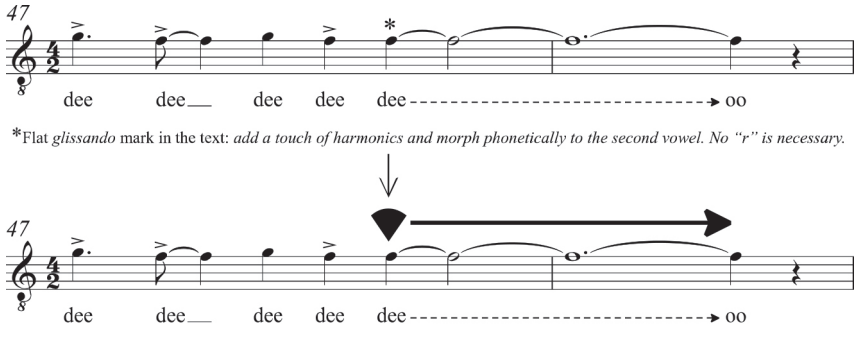


Figure 5. Toby Twining, *Hee-oo-hm-ha,* mm. 47–49.
Original and re-notation to include timbral symbols

Courtesy of See-A-Dot Music Publishing.

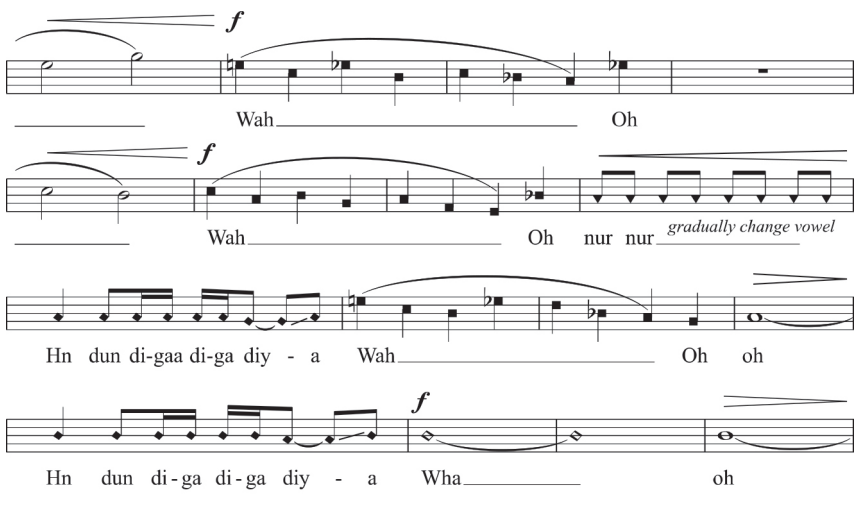


Figure 6. Fahad Siadat, *Hymn to Aethon, the bird-headed, the many taloned.*

Courtesy of See-A-Dot Music Publishing.

Limitations of Using the Spectral Envelope to Identify Vocal Timbre

While looking at spectral envelopes can provide a level of visual understanding of these timbres, there are certain limitations to what a spectrograph can capture and how that image relates to the aural experience of timbre. A spectral envelope of a sustained tone doesn't take into account articulation, the attack-decay envelope, or other environmental factors that effect the perception of timbre. In addition, vowels emphasize particular frequency bands that are consistent across ranges and pitch spectra,

which means that the spectrograph will not always display a spectral envelope in the expected shape of a given sound. The [o] vowel, for example, boosts frequencies around 440hz. Pitches sung with that vowel and at that frequency will clearly reflect the Fundamental Dominant sound in a spectrograph. Pitches sung on [o] below that frequency will still show a frequency boost in 440hz range, affecting the visual representation of the spectral envelope. If one were to sing an [æ] vowel at 440hz, the spectral envelope would show a boost in upper harmonics, requiring adjustments to the vocal tract to maintain the Fundamental Dominant Sound. This is why vowel choice and vowel modification are an integral part of creating the various timbres discussed.

In addition, the typical vocal tract can lengthen only so far, which results in the boosting of lower frequencies, and is generally unable to boost frequencies below ~220hz. When a fundamental lower than 220hz is produced by the vocal folds, we are actually hearing the *implied* fundamental, as it is generated by the upper harmonics. The spectral shape of any pitch below 220hz will inevitably show a weak fundamental (Image 8).

Recall that the Fundamental Dominant sound is created by emphasizing the fundamental and attenuating upper harmonics. The above image might imply that the sung pitch is closer to the Narrow Band sound, with attenuated upper and lower harmonics, rather than the Fundamental Dominant Sound. For frequencies below 220hz, however, the Fundamental Dominant Sound is created by emphasizing the lowest boosted harmonics, typically the 2nd through 4th harmonics in the series, while continuing to attenuate higher frequency bands.

Finally, it is important to note that there are many possible vocal timbres beyond the four listed above, including hybrid timbres. Use of certain vowel shapes and consonants will help move the sound towards one spectral envelope or another. For instance, a bright [æ] vowel will naturally narrow the vocal tract and boost higher harmonics, which can aid in creating the Narrow Band sound, even when the Overtone Dominant notehead is employed. Similarly, the presence of a retroflex [ɹ] shape in the mouth, like in the word "near," will push the sound towards the Overtone Dominant sound.

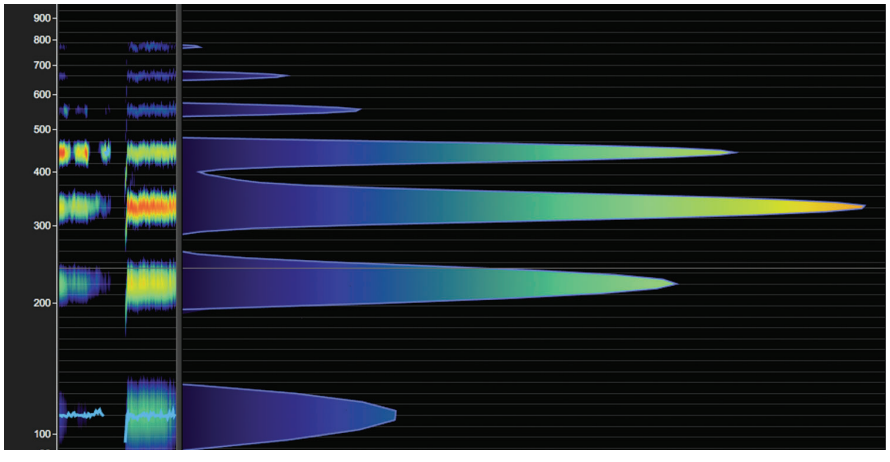


Image 8. A2 (110 hz) sung by a male voice on an [u] vowel. Note the relative strength of the fundamental pitch to the 2nd, 3rd, and 4th harmonic. Spectrograph shows a range of 80hz-1,000hz.

Conclusion

The diverse possibilities of human sound are complex, exciting, and not easy to place in confined boxes. This categorization of vocal sounds is only a first step towards understanding and utilizing timbres for vocal ensembles. My hope is that by categorizing certain sounds coupled with this visual notational tool will encourage the use of timbral exploration in vocal ensemble composition, and will empower conductors and ensemble singers alike to expand their range of expressive singing. CJ

Appendix

For those interested in replicating the images provided in this paper, I have included in this appendix the technical settings I used while creating the spectrographic images. The images come from the Voce Vista software using a vertically oriented spectrum on a logarithmic scale. The visual and audio settings I chose for the images taken from the software—all of which can affect the shape of the spectrograph output—include:

• Display Dynamic Range (contrast): 40db

• Dynamic Range Top (brightness): -12db

• Master Volume for all audio playback: 33%

• Input volume: 73%

• Input Device: Built-in microphone on a MacBook Air, 2011 edition

I chose the above settings to emphasize the relative strength of key harmonics in the "short-term" view, which shows harmonic strength through the length of a peak for any given moment, rather than the "long-term" view, which shows harmonic strength over a period of time through the intensity of color in the image. The relatively low brightness and contrast settings reduce smaller harmonic presence to almost nothing, highlighting only the most prominent harmonics.

Full disclosure

A few of the musical examples are taken from the See-A-Dot Music Publishing catalog, a company which I own and direct. All such examples are indicated.

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NOTES

[1] *Merriam-Webster,* s.v. "Timbre," accessed January 13th, 2020, https://www.merriam-webster.com/dictionary/timbre.

[2] All spectrograph images in this article are made using VoceVista, a powerful software for studying sound available at www.sygyt.com

[3] For an excellent demonstration of how pitch and vowels are interconnected, please visit VoiceScienceWorks: https://www.

voicescienceworks.org/acoustic-registration.html

[4] Please see the Appendix on information regarding software and technical specifications of spectrograph images.

[5] A "pure" tone is a sine wave, a sound without upper harmonics. While harmonics are always present in singing, they can be suppressed to varying degrees depending on the vocal technique being employed.

[6] Timbral homophony is often called "blend."

[7] Quieter singing has less sub-glottal pressure, necessitating less adduction in the vocal folds, and therefore fewer upper harmonics.

[8] Scott McCoy, *Your Voice* (Delaware, OH: Inside View Press, 2012), 155.

[9] Lisa Popeil, "The Multiplicity of Belting." *Journal of Singing*, Sept./Oct. 2007.

[10] For a detailed discussion of the various perspectives on Musical Theater Belting, as well as an outline of the physiology involved, please read Lisa Popeil, "The Multiplicity of Belting." *Journal of Singing*, Sept./Oct. 2007.

[11] Nathalie Bernardoni, Iohn Robert Smith, and Joe Wolf. "Resonance strategies used in Bulgarian women's singing style: A pilot study." Research gate, February 2007, pg 7.

[12] It's worth noting that nasality is not an authentic part of the Bulgarian singing tradition and is considered undesirable. An easy test for nasality can be performed by pinching the nose while sustaining a vowel and seeing if the sound changes or stops. Jamie LynnWebster, "The mysterious voice! American women singing Bulgarian songs." *The Anthropology of East Europe Review*, Volume 22, Number 1, Spring 2004, 167.

[13] This combination of a unique, expressive tone color that does not lose the common vocal ensemble value of timbral homophony is, I believe, a key factor to Bulgarian vocal ensemble singing's popularity in the United States.

[14] By contrast, *Bel Canto* singing emphasizes a slightly wider band of harmonics than narrow band singing and does not attenuate the fundamental pitch. Such increased harmonic richness, coupled with the use of vibrato, are, I believe, two of the largest contributing factors to why opera singers maintain timbral heterophony when singing in an ensemble.

[15] The techniques I describe for achieving this timbre are based in the Western version of the Overtone Dominant sound, which is achieved primarily through narrowing the vocal tract. Perhaps the most remarkable version of the Overtone Dominant sound, and the primary influencer of the Western version, is the Tuvan style of singing called Sygyt which suppresses the fundamental even more fully through a great deal of sub-glottal pressure. For examples of this style of singing, I recommend the recordings of the Alash Ensemble.

[16] I recommend singing the word "courier" on a comfortable pitch in the middle to low portion of your individual range, moving as slowly as possible through each change in the word and making particularly effort to hold the 'R' shape throughout.

[17] As a music publisher, I have adapted these symbols into noteheads to indicate vocal timbre as part of our engraving rules and encourage other composers interested in using timbral variety as part of their composition to do the same.

[18] As the composer writes in the program notes for the piece: "This *Pseudo-Yoik* has nothing to do with the genuine traditional Lappish or Sámi *yoik*, and should thus be considered to have the same degree of authenticity as local colour in bel canto opera. If a connection must be sought, I would prefer to describe this piece as an impression of a stereotype—the stereotype that most Finns associate with Lapland and its people."

[19] This is, in fact, how ensembles interpret the performance instruction for this and the following example, as is evident in such performances and recordings by the Pretoria Camerata. https://www.youtube.com/watch?v=sivQRiBKo5M

[20] The noteheads used in figure 5 are the default shape notes found in the Sibelius notation software. At certain font sizes, the different between certain noteheads, like the diamond and wedge, may be difficult to distinguish. Composers using this timbral notation are advised to maintain a comfortable font size for notes, and might consider manually adjusting the shape of the noteheads to create more clarity.