THE ESSENTIALS OF ACOUSTIC VOICE PEDAGOGY: AN UPDATE

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KEY CONCEPTS

Acoustic Landscape

- Harmonics from the vocal folds interact with resonances of the vocal tract to create formants in the radiated sound.
- As the sung pitch rises, its harmonics rise through vocal tract resonances, causing timbral transitions.

Acoustic Registration

- These timbral transitions fit the classic definition of registers:
  - they are range segments of a similar quality caused by the same mechanism
  - due to the relationship of the sung pitch and its harmonic set with the first vocal tract resonance
  - they both mimic laryngeal registers and interact with them, partially explaining register confusion

Innate Vocal Tendencies Triggered by the Acoustic Landscape

- The lowest vocal tract resonance likes to track harmonics rising through it (yelling, whispering, whooping)
- This is done by raising the larynx, narrowing the pharynx, and excessive mouth opening, and leads to:
  - reduction of timbral depth
  - a predominantly divergent resonator (possibly a “mouthy, spread” tone)
  - over vowel prominance—the tone color being featured by the 2nd vocal tract resonance
  - this is skillfully exploited in popular genres that seek to extend a speech-like timbre
  - must be moderated or countered for Western classical *chiaroscuro* timbre

Passive vowel modification/migration

- Change of pitch with no change of shape, which causes the vowel timbre to migrate
- Mostly used for sung pitches below and up to a vowel's first resonance or formant
- Requires allowing migrations of sensation and perception

Active vowel modification

- Change of shape, with or without change of pitch, which alters the vowel
- Mostly used for pitches above vowels' normal first resonance or formant locations
  - Appropriate reshaping to track a harmonic or to find a better formant/harmonic match
  - Usually for first resonance tracking $1f_o$ (treble voices singing above normal $^{f}F1$ locations)
  - Also for second resonance on $2f_o$, $3f_o$ or $4f_o$ (female middle voice; male operatic top; belting)
  - Sometimes raising first resonance to avoid whoop timbre (male upper voice on [i] and [u])
- Involves some degree of vowel opening
  - Without tube shortening for Western classical timbre
  - At first via mouth opening without lowering the tongue dorsum
  - Eventually involves lowering tongue dorsum
  - Accomplished by playing with the qualities and percentages of the over and under vowels
  - Usually involves an increase in the under vowel color and some neutralization
  - Ideally, appearance is "natural" and retains some vowel identity fairly high

REVIEW OF ACOUSTIC REGISTERS

Open timbre (*voce aperta*): when singing an octave or more below the first resonance), the voice is in open timbre, or *voce aperta*.

Yell: If the second harmonic one octave above the sung pitch matches the first resonance, and is tracked higher by raising the first resonance along with the rising pitch, one moves into yell timbre, especially on open vowels above D4.

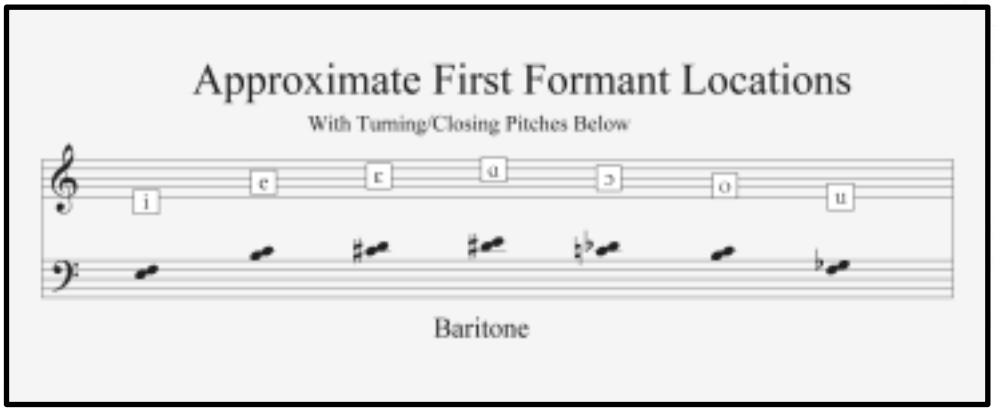
Closing or Turning Over: When the second harmonic is allowed to rise above the first resonance, the timbre and voice turns over or closes. This corresponds to a passively achieved vocal "cover." It *can* be actively done by lowering the first resonance below the second harmonic, creating a heavier, more dramatic timbral shift.

Close timbre (*voce chiusa*): When singing within an octave below the first resonance, one is in close timbre, or *voce chiusa*, the closer to the first formant the sung pitch, the closer the timbre.

Whoop timbre: If the lowest harmonic, or sung pitch, matches the first resonance, one is in whoop timbre.

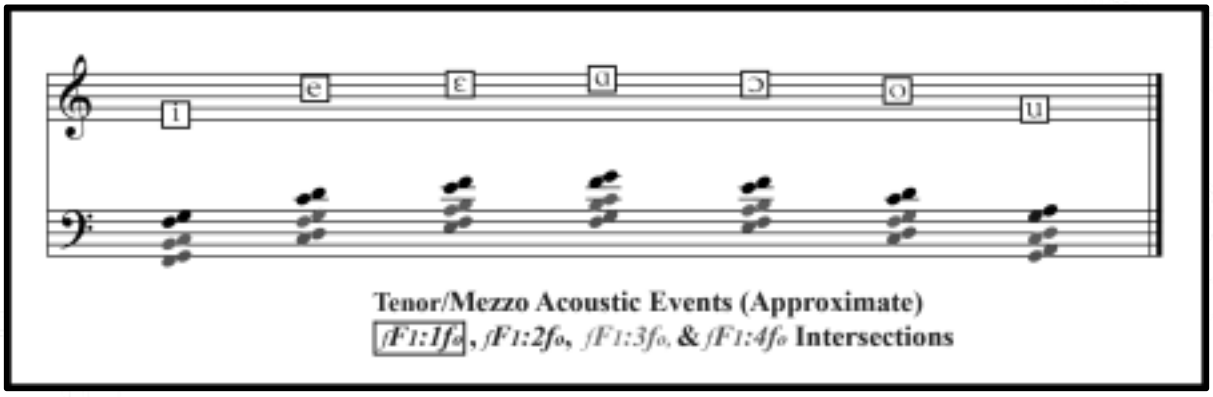
NECESSARY KNOWLEDGE: SINGER'S ACOUSTIC LANDSCAPE

- First formant locations—at least of cardinal vowels
- First few intervals of the harmonic series



Acoustic Registers

- Whoop timbre from the vowel boxes (first formants) and above ($1f_o = {}^fR1$)
- Close timbre between the black pitches and the vowel boxes ($1f_o < {}^fR1 < 2f_o$)
- Open timbre below the black pitches (2 harmonics below F_1 ($2f_o < {}^fR1$)
- Greater degrees of open timbre below the red and blue pitches (3, 4 harmonics below F_1)
- Madde demonstration



NEW INFORMATION

Absolute Spectral Tone Color (Ian Howell, NEC: Breakout Session Monday 9am)

- Humans perceive light frequencies as colors
- Humans perceive sound frequencies on a brightness scale and as vowel-like tone colors
- Low frequencies as dark and /u/-like below C5; and bright and /i/-like above D7; other colors in between
- Most sounds are comprised of many frequencies, hence a blend of many vowel color components

Necessary Roughness (Ian Howell, NEC: Breakout Session Monday 9am)

- Harmonics a minor third or closer together introduce a buzzy roughness to the timbre.
- Lower Harmonics are very consonant, resolve into the pitch, and impart a smoothness to the timbre.
- Higher Harmonics impart a rough quality—a buzz or sizzle that seems independent of the pitch.

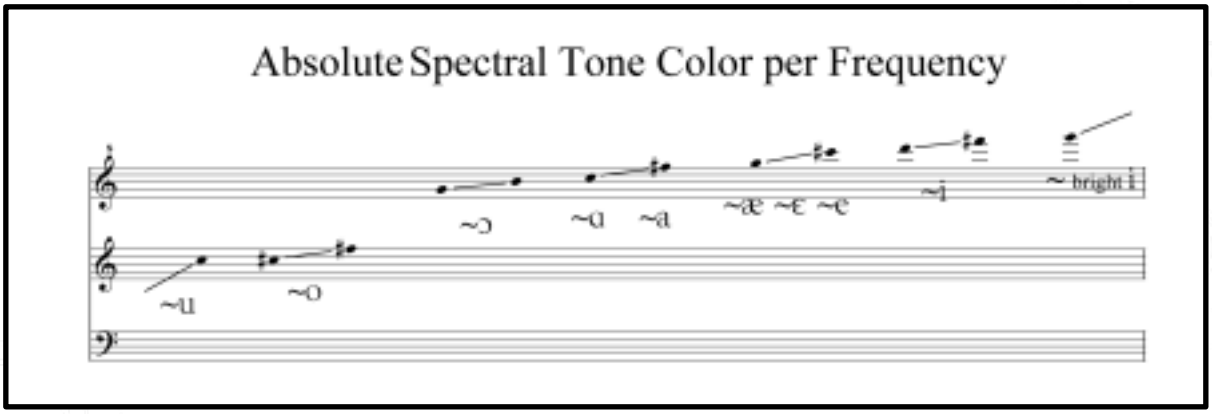
Vibrotactile Sensation (Chadley Ballantyne, Stetson: Poster Session Sunday 12-2pm)

- Vibrotactile perception is strongest near ca. 250-300 Hz, near "middle C" (C4).
- Vibrotactile sensation above the treble clef diminishes and disappears by 1000Hz, soprano high C (C6)

Vowel Perception: Over and Under Vowel (Bozeman, Lawrence; adapted from Howell)

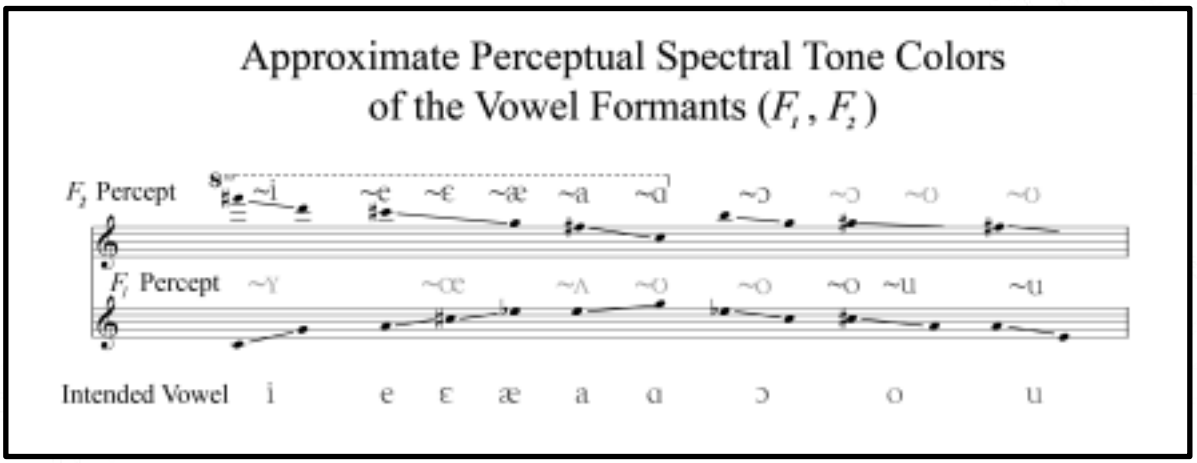
- Single vowels are actually comprised of *two* vowel colors
- Contributed by the harmonics being featured by the first two resonances of the vocal tract.

ABSOLUTE SPECTRAL TONE COLOR
(IAN HOWELL)



OVER AND UNDER VOWEL PERCEPTS

(ADAPTED BY BOZEMAN)



PERCEPTUAL MIGRATIONS

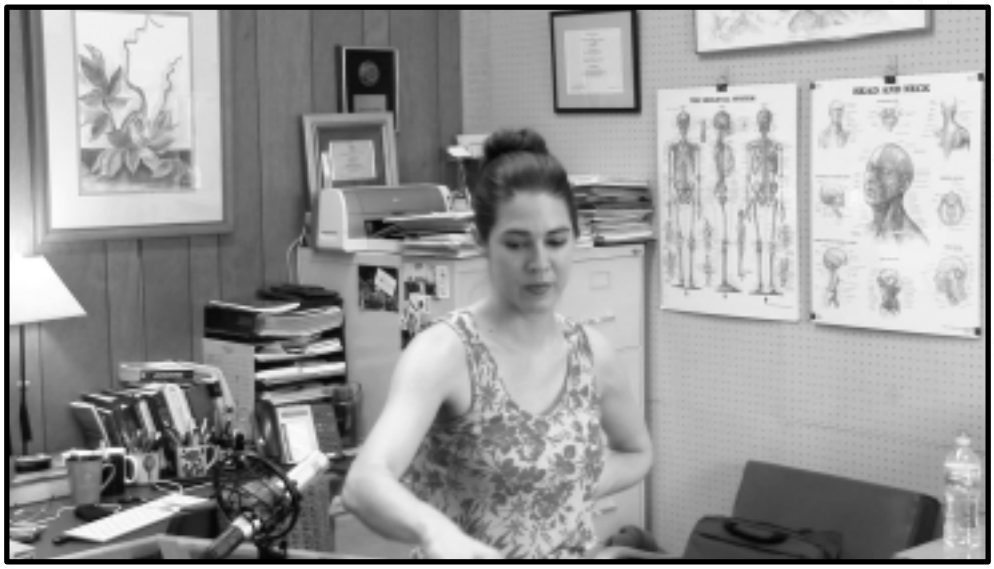
Nothing stays exactly the same across range.

- **Acoustic sensations migrate through various levels of acoustic registration:**
  - Across Various levels of Open
  - From Open to Close
  - From Close to Whoop
- **Vowels migrate** due to:
  - Gradually shifting tone colors of the rising harmonic set
  - Changing intensities of harmonics as they move through resonance peaks
  - Resultant change in relative percentage of over and under vowel contributions
- **Acoustic sensations migrate** (pallesthesia)
  - Eventual reduction of pallesthetic sensation approaching 1000Hz
- **Affect migrates** and motivates pitch change
  - Different affects motivate different range effects
- **Relative smoothness/roughness migrates**
  - Depending upon the frequency of the sung pitch (higher smoother; lower rougher)
  - Depending upon the strength of high, closely clustered harmonics

TENOR PASSIVE MIGRATION ON THE VOWEL [ɑ]

BARITONE PASSIVE MIGRATION ON THE VOWEL [ɑ]

SOPRANO ACTIVE MODIFICATION OF THE VOWEL [i]



CONTINUITY

- And yet we desire a sense of continuity
  - Continuousness of the sound flow
  - Smoothness of emission
  - Continuousness of the vibrancy
  - Consistency of *chiaroscuro* timbral balance
  - Smoothness of dynamic shaping and changes
  - Smoothness of laryngeal registration transitions
  - Evenness of range
- And all accomplished with an ease and efficiency of production
  - Sufficient but minimal pressure for effect
  - Sufficient but minimal glottal resistance
  - Sufficient but efficient airflow
  - Sufficient but minimal articulation change for vowel definition and intelligibility

ADDITIONAL STRATEGIES (OLD AND NEW)

Pharyngeal voice or *voce di strega* (Herbert-Caesari; Ken Querns; Randy Buescher)

- a "peculiar" overly bright timbre in a mode 2 laryngeal adjustment
- achieves high spectral content (brilliance) by means of efficient vocal fold closure with low subglottal breath pressures due to thinned, mode 2 vocal fold shape.
- an effective bridge between the strong closure but thick folds of mode 1 and the thin folds but weak closure of mode 2.
- assists ease of production with clarity across the major laryngeal register shift
- It reverses the universal percept that bright is front and dark is back

Retroflex R for second formant dominance (Chadley Ballantyne: poster on Sunday**)**

- R lowers $^{f}F3$ to cluster with $^{f}F2$, strengthening and raising awareness of the $^{f}F2$ percept
- facilitates a shift in dominance from $^{f}F1$ to $^{f}F2$ for male upper voice and treble middle voice