

Defining Musical Theatre Belt and Identifying Functional Acoustic Resonance Strategies For Optimum Timbral Production and Sustainability

Part I: Critical Evaluation

Part II: Develop A Strategy

Part III: Critical Reflection

Part IV: Appendix and PDP

WORD COUNT: 4,089

Introduction

It is widely acknowledged that vocal demands placed upon musical theatre (MT) performers are steadily increasing in respect to both timber and fitness, with performers now required to be proficient across multiple contemporary commercial music (CCM) vocal styles whilst maintaining an eight-show per week schedule (LeBorgne & Rosenberg, 2021). With the focus on story-telling and emotional expression, and with the rise in popularity of the 'rock' musical (Edwin, 2005; Popeil, 2007), the modern MT vocal archetype, which could now be classified under the CCM banner, is more speech-based and intelligible than its Western classical counterpart, and consists of timbres commonly referred to as belt and mix qualities, particularly for female singers (Roll, 2015; Read, 2021).

As expectations upon a professional MT performer's voice evolve toward current musical tastes (Edwin, 2005), and with the prevalence of vocal 'burn-out' (Binney, 2022), the pursuit of more sustainable and efficient production of these contemporary sounds has been an important topic of voice pedagogues over the latter part of the twentieth century (Bartlett & Naismith, 2020; LeBorgne & Rosenberg, 2021). Today, much research exists surrounding the understanding and control of the physiological mechanisms of CCM and MT voice qualities, such as presented by leading investigators Colton & Estill (1979), Sundberg et al. (1993), Björkner (2008), Bourne & Garnier (2012) and Kochis-Jennings et al. (2014). Numerous systemised pedagogical approaches to manipulation of "laryngeal register" (Bozeman, 2022, p. 182), or the muscular configurations required for CCM qualities such as belt, have developed from this research including Estill's *Estill Voice Training (EVT)* (1988), Popeil's *Voiceworks Method* (2007) and LoVetri's *Somatic Voicework* (2013). However, approaching the teaching CCM qualities from a predominantly physiological viewpoint has limitations, including how to maintain timbral homogeneity over a broader vocal range, which is increasingly essential for contemporary MT singing and creation of the belt quality (Roll, 2015).

With the rise of commercially available spectrographic equipment (Sound & Science: Digital Histories, 2018), the relatively newer field of vocal tract (VT) acoustic research has opened a different avenue of understanding of timbral or “acoustic register” creation (Bozeman, 2013, p. 13). Spectral analysis of different voice qualities has provided a deeper insight into the intrinsic, critical role of the natural acoustic resonances of the VT not only in timbral identity, but their effects on vowel perception (Fant, 1970; Bozeman, 2022), an integral element for modern MT singing (Holley, 2017). The dimensions of the VT can be consciously modified, with different shapes yielding different acoustic results (Fant, 1970). The intentional manipulation of VT acoustics toward a certain sound, that is, the use of a resonance strategy (RS), reveals new possibilities for more efficient MT vocal technique: wider control over timbral choices, effective broadening of vocal range, and clearer lyric intelligibility (Bozeman, 2021; LeBorgne and Rosenberg, 2021).

As a voice teacher focussed primarily on MT training for pre-professional (tertiary) and professional performers, this author’s particular interest is in developing understandable and functional vocal acoustic pedagogy as a new approach to facilitating more intentional and efficient production of MT voice qualities, particularly for belting. As this is a relatively young avenue of research, accessible and discrete pedagogical techniques illustrating how to use MT-specific RS are yet difficult to source.

This paper will describe different RS researchers have observed in the singing of pre-professional and professional MT performers to create belt qualities specifically, and delve into the mechanics of these techniques. With a focus on formant tuning, also known as formant tracking (Miller & Schutte, 1990; Miller, 2000), this paper aims to propose one functional strategy for singers to better understand and action this technique, in aid of developing more refined, efficient, wider-ranging and most importantly, sustainable MT belt timbres.

An Overview of Vocal Acoustics

Vocal acoustics comprise largely of two factors: the vibrator (vocal folds - VF) which produces a fundamental frequency (H_1) with an accompanying series of harmonic frequencies spaced at positive integer multiples of the fundamental (heard all together as a sung pitch), and a resonator (vocal tract filter) which can strengthen or weaken the harmonics of a frequency passing through it dependant on its shape (Fant, 1970). The ratio of emphasised to non-emphasised harmonics contributes to a sound’s timbre, or colour (Bozeman, 2013).

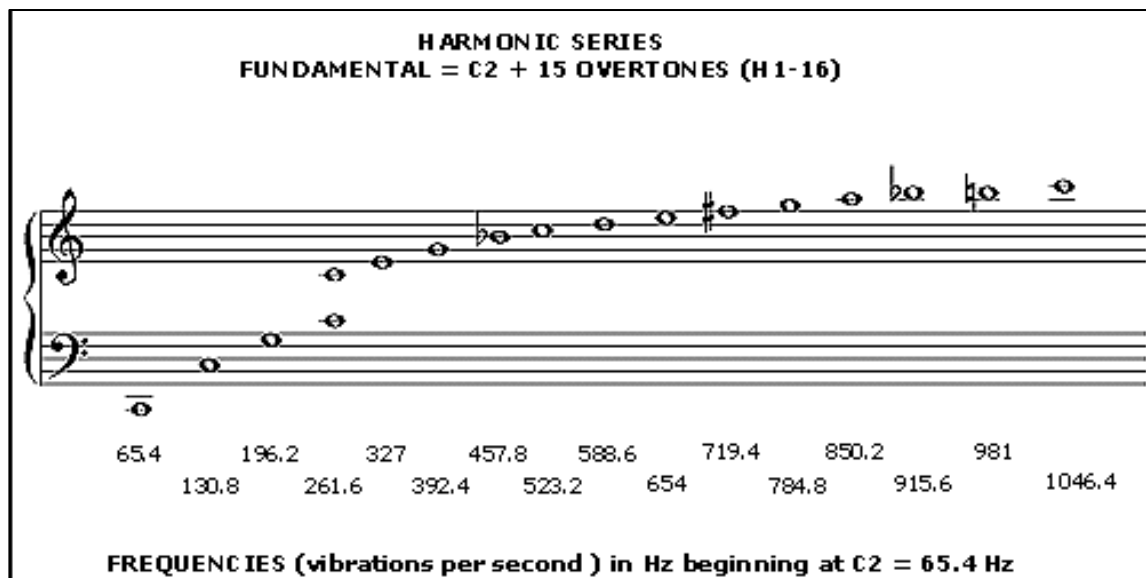


Fig 1: Harmonic series of C² (65.4Hz). (Khoomei.com, 2023)

The natural resonances of the VT are called formants (F), and it is especially the first two - F₁ and F₂, created in the pharynx and mouth - which provide the greatest perceptual contributors to a vowel (Fant, 1970). As the VT is muscular and moveable, these formants can be consciously altered and shaped via larynx, soft palate, jaw, tongue and lips (Bozeman, 2013). Please see **Appendix A** for a diagram illustrating physiological configurations for English vowels. A table of accepted averages for F₁, and F₂ for American-English vowels can be found in **Appendix B**.

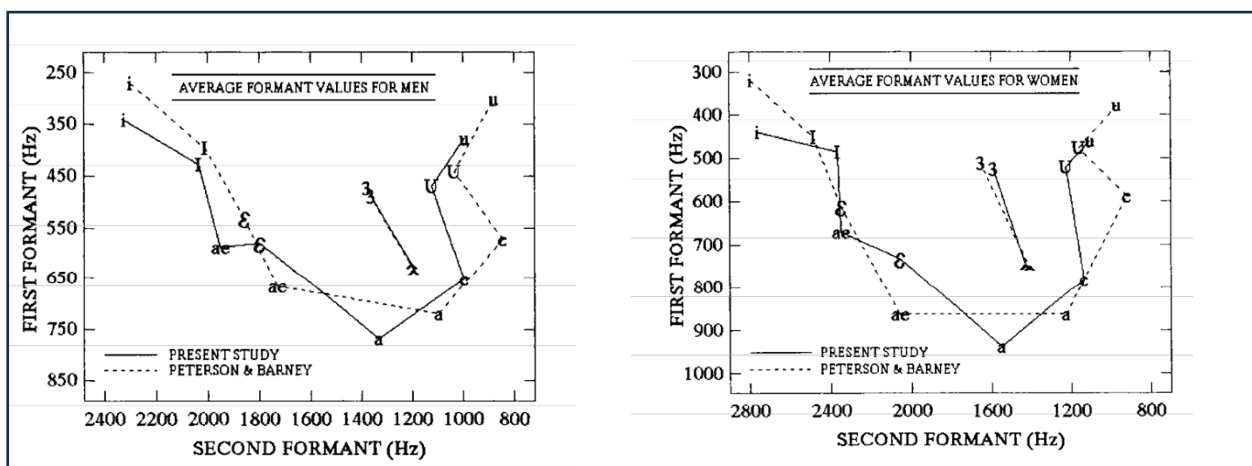


Fig 2 & 3: Diagram of average male and female vowel formant frequencies for American-English speakers, as documented by Hillenbrand et al. (1995) as compared to an earlier study by Peterson & Barney (1952) ("ae" = /æ/, "a" = /a/, "c" = /ɔ/, "u" = /ʊ/).

When the VT is shaped to cause a formant to align with a sung fundamental pitch's harmonic (formant tracking – FT), the resulting sound gains clarity, power, and more efficiently achieves desirable speech-like vowel shapes, such as required for contemporary

MT styles (Bozeman, 2013, Bourne & Garnier, 2012). The systematic implementation of FT is known as a resonance strategy (Carlsson & Sundberg, 1992; Bestebreurtje and Schutte, 2000; LoVetri, 2013). MT performers are shown to employ different RS to create the commonly desired qualities of belt, mix and legit, seemingly leaning toward speech RS for belt timbres and toward classical RS for legit timbres (Bourne, Garnier & Samson, 2016). Mix qualities likely fall somewhere between the two, though contributing RS have yet to be defined or researched (Read, 2021). For belt qualities, FT is shown to ameliorate VF function and reduce muscular over-pressing, boost timbral efficacy, and widen the range boundaries of speech-like sounds (Besterbreurtje & Schutte, 2000; Bourne, Garnier & Samson, 2016).

Defining Belt: Physiology, Timbre and Resonance

Belt is the term often used to describe the more speech-like, non-classical timbres desired on contemporary MT stages (Bourne, Garnier & Samson, 2016; Read, 2021). Since the establishment of the 'rock musical' with *Hair* in 1968 (Wollman, 2006), the evolution of the MT voice has been seen to mirror popular musical genres (Edwin, 2005; LeBorgne & Rosenberg, 2021), and thus for employability and career longevity, it is paramount that MT singers command a reliable belt which is flexible, versatile and sustainable (Roll, 2015; LoBorgne & Rosenberg, 2021).

Belt timbres are nuanced and wide-ranging (Kayes, 2006), with little consensus of a single aesthetic beyond being rooted in 'chest' voice production, using mode 1 (M1) laryngeal and acoustic register, as does speech (Bourne, Garnier & Samson, 2016). This contrasts with Western classical voice production which is commonly referred to as using 'head' voice or mode 2 (M2) laryngeal and acoustic register (Bozeman, 2022). See **Appendix C** for a description of M1 and M2 acoustic and laryngeal registers and uses.

Physiologically, compared to Western classical singing, belt has been shown to employ shorter and thicker thyroarytenoid (TA) configuration, a longer closed glottal phase with a greater depth and length of vocal fold (VF) contact, higher subglottal pressure, and a generally higher larynx position which rises as pitches ascends above spoken frequencies (Sundberg, Gramming & LoVetri, 1993; Bjorkner et al., 2006; Bourne & Garnier, 2012). For the female voice, Bourne and Garnier translate belt as "the extension of laryngeal mechanism M1 over the overlap range of M1 and M2" (Bourne & Garner, 2012, pp. 1587). For males, a lack of research and literature leads to uncertainty as to whether there is as defined a laryngeal mode change between belt and legit techniques, as males largely sing in

laryngeal M1 regardless of genre due to sung voice range and natural formant location (Bourne, Garnier & Samson, 2016; Read, 2021).

Across both biological sexes, belt articulation has been seen to require a higher tongue position that is more forward, a more narrowed pharynx, and more open mouth position (Schutte and Miller, 1993; Bestebreurtje and Schutte, 2000; Bourne, Garnier & Samson, 2016). This configuration has been likened to the shape of a “megaphone” (Titze & Worley, 2009, p. 1530). However, one study by LoVetri et al. (1999) suggests that belt qualities could also be produced with a static or even a comparatively lower larynx, wider pharynx, and in their highly-trained subjects, with overall lower muscular tension. They note that different vocalists could achieve belt timbres in several ways and could consciously make physiological changes affecting their sound if perceptually their initial output was not what they had desired (LoVetri et al., 1999). These findings were reflected in Bourne, Garnier and Samson (2016), who observed that their male subjects produced legit and differing belt timbres with “significantly different glottal and vocal tract adjustments” (Bourne, Garnier & Samson, 2016, pp. 22). These findings speak to the subjective perceptual classification and scope of interpretation of belt quality from physiological and perceptual perspectives. They also highlight a singer’s potentially innate ability to reorganise (consciously or unconsciously) laryngeal musculature and VT resonances based on aural and sensation feedback. These bases therefore could provide a pedagogical approach for creating specific belt RS, particularly if accompanied by real-time spectrographic analysis.

From a timbral perspective, belt is still often described in terms of what Western classical voice is not. It is often attributed labels such as “bright” (Schutte & Miller, 1993, pp. 145), “brassy”, “loud”, “twangy” (Estill, 1988, pp. 37-38), buzzy or with “auditory roughness” (Bozeman, 2022, p. 182), and more intelligible and “speech-like” (Roll, 2015) than its classical counterpart. Spectrographic information shows how energy is organised to contribute to these perceptual attributes (Howard & Murphy, 2008; Titze & Verdolini Abbott, 2012), and may provide insight into the characterisation of other MT voice qualities such as mix quality and its subsets.

From an acoustic viewpoint, there is general acknowledgement that for both biological sexes MT belt quality displays consistently higher frequencies for F_1 especially, but also for F_2 (which is consistent with the megaphone VT shape of narrowed pharynx, anterior tongue position, a more open mouth, and higher VF closed quotient), and that the most important aim for belting is the boosting of higher harmonics (as in speech) as compared to classical singing (Bestebreurtje and Schutte, 2000; Bozeman, 2013; Bourne, Garnier & Samson, 2016).

Schutte and Miller (1993) and Miller (2008) define belt quality as F_1 raising (via larynx elevation) to track H_2 for open vowels, with a far stronger second harmonic to first harmonic amplitude ratio. Titze mirrors these findings expressing that to constitute belting, the sound must include a strong H_2 (Titze, 2016). Contrasting this definition, Lebowitz & Baken (2011) found belt timbres could be achieved with a weaker H_2 to H_1 ratio, noting that the F_1/H_2 resonance strategy could therefore not be a reliable marker to characterise belting on its own, but in fact just one strategy to achieve this quality. Another study by Dargin (2017) observed Ethel Merman's resonance strategy as tracking F_2 with H_3 , supporting the notion that there exist multiple RS that create belt timbres. Flynn, Trudeau & Johnson (2018) further support this finding, noting that whilst sampled MT singers consistently relied on spectral peaks located nearest H_2 and H_3 (never H_1), the ratio between the energy levels H_2 - H_3 was variable between subjects, and found that RS between female singers varied when singing above C^5 . This could demonstrate that especially for female singers, different belt RS may be chosen specifically due to comfort or experience in a particular strategy, or to suit dramatic or musical intent. There is not yet documented imagery (MRI or otherwise) showing exactly how the shape of the VT changes to achieve these different resonance strategies in situ, and teachers often rely on concepts of "placement" and "forward" sensation to achieve them (Bozeman, 2021, p. 107; Johnson, 2023), rather than physiological movement instruction. This approach may lead to confusion if a singer is unable to match the concept or feeling to output sound, and thus could be viewed as a haphazard route to achieving a stable and reproduceable RS.

Methods Of Altering VT Acoustics

There is agreement that VF vibration and VT resonance interact and intrinsically affect one another (Bozeman, 2022). In simple terms, when the acoustic pressure/flow ratio above the glottis facilitates the most efficient VF vibration it is termed inertive supraglottal reactance (IR), which is favourable for any resonance strategy and promotes stability during changes in pitch or vowel (Titze & Worley, 2009; Titze, 2021). Titze and Verdolini Abbott (2012) state that the aim for optimal and stable voice production is to create as many regions of IR in the VT as possible, generating interactions that reinforce desired harmonics. They continue to describe three primary methods by which to alter the vocal tract's inertive areas: (1) change VT shape (2) adjust the VT length, and (3) create epilaryngeal narrowing (Titze & Verdolini Abbott, 2012). These alterations offer the basis by which formants can be moved, with Bozeman (2013) describing this intentional shaping of the vocal tract to adjust formants from habituated speech postures as "vowel modification" (Bozeman, 2013, p. 13). Finding the optimum 'recipe' of the above adjustments is key for achieving a reliable belt resonance

strategy, with each method offering a starting point for exploring the effects of manipulating formants, ideally developing timbral palette and sustainably extending the belt range.

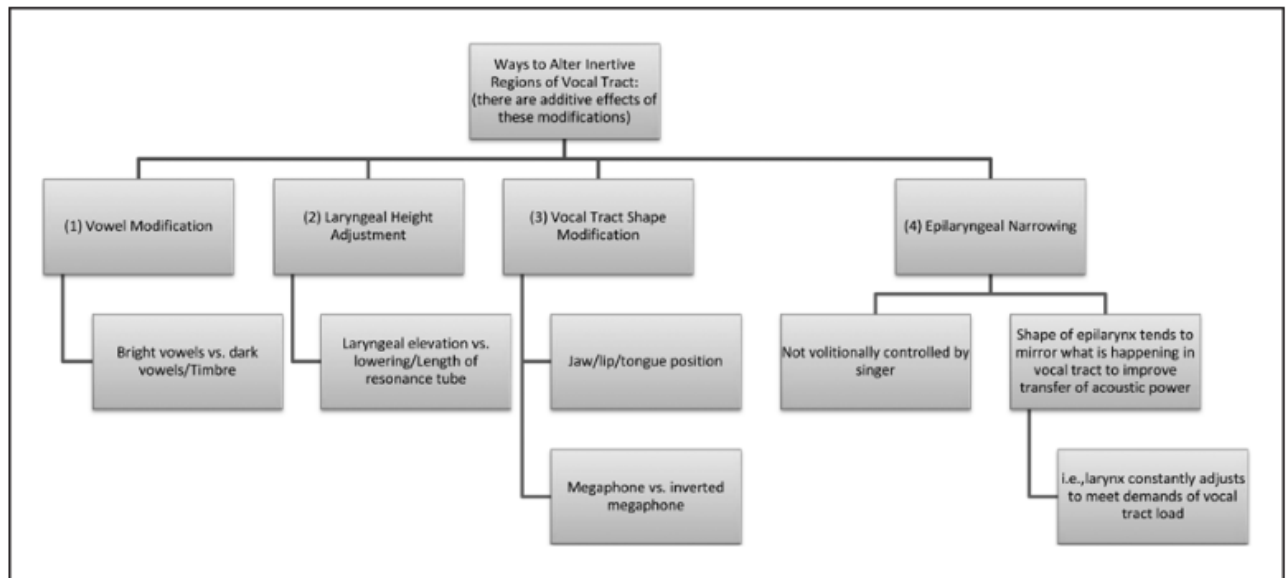


Fig. 4: Methods by which to modify inertive regions of the VT (LeBorgne & Rosenberg, 2021, pp. 307)

Is There Practical Acoustic Pedagogy for CCM and MT Styles?

Due to most vocal acoustic research to date focussing on the pursuit of Western classical sound, there is more extensive documentation of resonance strategies and acoustic pedagogy dedicated to this style of voice production (for example Miller, 1987; Miller & Schutte, 1990, 1994, Bozeman; 2013), than for CCM and MT styles. Acoustic researchers of belt quality such as Besterbreurtje & Schutte (2000), Bourne, Garnier & Samson (2016), and Chadley Ballantyne (2021) have pinpointed resonance strategies observed in MT voices, however they've not gone on to specify pedagogy around how to achieve them.

Author Ken Bozeman, though largely focussed on the production of classical timbres, concedes that the scope for applying acoustic resonance physics to attain desired CCM timbres is limitless though yet to be defined. LeBorgne and Rosenberg agree that "vocal tract shaping to influence perception of registers and timbre may be the single most important element for musical theatre singers to master" (LeBorgne & Rosenberg, 2021, pp. 343), but concede that there is still much to be learned about the potentials of physiology and vocal acoustics.

Conclusion

Whilst there seems to be advancement toward a consensus on the specific definition of what belt voice entails, semantic discrepancies continue to present obstacles for both researcher and pedagogue. Further, making sense of spectral information and the resonance properties of the VT is multifaceted and complicated, presenting a further barrier to the development of accessible RS techniques for CCM and MT teachers and students. The pedagogical implications are vast however, and like all voice science exploration particularly over the past 150 years, it is continued research in this area that will continue to provide a rationale for new methodologies that support acoustic pedagogy for CCM and MT techniques.

PART II:

A Thousand Versions of a Vowel: Choosing A Resonance Strategy for MT Belt

As the notion of belt seems to encompass many timbres, to keep a singer's predisposed ideas and experience of creating these sounds to a minimum, this author tends to refer to different RS as one of a thousand "versions of a vowel" rather than using the term belt. To keep to the purpose of training MT performers who need as broad an understanding as possible of producing these contemporary timbres, the following strategy is presented to delineate one abovementioned method by which a singer can access and utilise a speech-like, intelligible, and wide-ranging belt sound: tuning F_1 to the second harmonic (H_2) (Schutte & Miller, 1993; Bestebreurtje and Schutte, 2000).

Bozeman (2021) lists the ideal attributes of a sustainable and healthy belt as including:

- Speech-like, palatal F_2 dominance as opposed to a much lower and settled F_1 dominance (classical timbre)
- As effective/free VF vibration as possible with minimal squeeze sensation at the glottis level
- Minimal feeling of sub-glottal pressure accumulation
- Increased sensation of muscular ease through the neck in comparison to a raw yell
- Unimpeded expressiveness and naturalness of speech-like prosody

In order to choose a RS that fulfills the above aims, the singer must firstly be able to identify differences in sensation and sound when acoustic registration changes over naturally in the VT (when a formant can no longer find an harmonic to resonate with without modifying the vowel shape) (Bozeman, 2013).

To illustrate the F_1/H_2 strategy, the use of a vowel with the lowest F_1 values - [i] or [u] – can provide a starting point of a settled, low larynx position and least laryngeal lift, facilitating the least tension and effort at the VF level as possible (Miller, 1986; Bozeman, 2013; 2021). Experience of this sensation is key for building awareness of excessive laryngeal elevation and VF over-activation due to excessive back pressure if a singer attempts to track F_1 higher without making necessary articulatory adjustments - turning into an unstable “yell” sound (Bozeman, 2013, pp. 21). Coming from a relaxed and low larynx position can provide avenues for more flexible F_1 movement and depth of sound, more natural to human prosody (Goudbeek, Goldman & Scherer, 2009) and therefore necessary for more believable and authentic expression whilst acting when singing.

A exercise by which to illustrate F_1/H_2 strategy could be to have a singer voice an [u] vowel to a scale that crosses the natural F_1 turning (note there is slight variation of location depending on voice-type and physiology – see **Appendix D**) which will cause the commonly-termed vocal ‘flip’ (Bozeman, 2020). So as not to excessively push down the tongue in this shape, putting a [k] sound in front of the vowel (as in the letter “Q”) may help keep the back of the tongue higher and more relaxed as it would be in speech for this vowel. This also accesses the “Y-Buzz” (Lessac, 1997; Johnson, 2023) thickening VF function through resonance without increase of backpressure and effort.

For a female, an ascending portamento scale between Bb^3 to Bb^4 , for males E^3 or F^3 to the octave above, would suffice (depending on voice type).

1. Sing the scale to “Q” (“kyu”)- being sure to keep the vowel shape stable without opening, to feel and hear where M1 (which as in speech follows F_1/H_2 resonance) wants to change to M2 (closer to F_1/H_1). Singer will hear and feel resonance when fundamental’s harmonics are near or match F_1 or F_2 (Bozeman, 2013; Ballantyne, 2021).
2. Sing the same scale, with the same static vowel shape, staying in M1, and notice how without vowel modification movements, pressure mounts on the VF, resulting in a feeling of more muscle activation or pressing sensation due to the increase of backpressure occurring when VF cannot resonate well with any harmonic in the current VT configuration (IR is misaligned, VF must work harder to stay in contact) (Titze and Verdolini Abbott, 2012). From here we need to find ways to alter IR of the VT to facilitate most efficient VF vibration whilst boosting acoustic resonance output (Johnson, 2023).
3. Sing the scale using F_1/H_2 resonance, this time using different methods to comfortably and efficiently lift F_1 via shortening and shaping the VT, through the most efficient means possible of lifting larynx: fronting the tongue, open the mouth to modify the vowel toward the next in the series with a higher F_1 (in this case [o]), lift

the chin to different degrees, all to feel and hear where resonance is most obviously felt and heard (Bozeman, 2013).

4. Track this F_1 up the range: for females, once a Bb^4 can be comfortably achieved using the above articulatory modifications, extend the range using smaller increments (perhaps sirens of 5ths) to D^5 and above, emphasising the actions noted above to create and sustain the timbre.
5. Refining the technique whilst singing MT repertoire: use the same articulatory modifications to sustain this belt timbre for higher pitches as necessary.

PART III. CRITICAL REFLECTION

My experience of reflection in the realm of my pedagogy has always been to do with seeking new information and expanding my understanding in as many fields as possible to assimilate into my practice, rather than focussing deeply on the process by which I find and synthesise this new information into my work.

As I deeply view my teaching practice as a work-in-progress, when I see need for expansion and innovation, I have found a new model or theory to learn and integrate, one that's already been proven. I'll then modify and expand upon it in situ (reflection-in-action) and build from this experience, without necessarily dedicating much time reflecting on how it went afterwards (reflection-on-action) (Schön, 1992). Gibbs (1988) however suggests that in fact utilising this method only could be considered putting "the cart before the horse" (Gibbs, 1992, pp. 8), and that opportunities for concept development born from experience and increased competence in an area can benefit the learner-practitioner just as much if not more. Put another way, using practice to create and test a theory rather than the other way around (Gibbs, 1992). In choosing to expand upon the topic of acoustic resonance pedagogy specific to CCM genres, this is exactly what I set out to achieve: to independently build understanding in order to develop functional and accessible methodology that doesn't necessarily exist yet in mainstream pedagogy, or as Schön states "...derive techniques for diagnosing and solving the problems of practice" (Schön, 1992, p. 26); I intend to continue this research as the implications for my future pedagogy and clients is significant.

Though I found that the topic seemed to get increasingly complex as I continued my research, I had clear goals:

- deepen understanding about the acoustic definitions of belt,
- be able to evaluate key spectrographic analysis
- integrate knowledge of FT methods in pursuit of the F_1/H_2 strategy

To keep the focus tight, I kept returning to Gibbs' enquiring statement, "after this experience I will be able to..." (Gibbs, 1992, p. 30) when tackling each section of my paper. Having this direction and clear objectives was fortifying as I often struggled to find and make sense of relevant research, which in turn led to frequent experiences of overwhelm that I was potentially reaching beyond my means. As I'm not a physicist, learning the symbols, mathematics, and language of acoustic scientific papers took far longer than anticipated. I'm glad to have persisted as it was greatly rewarding when light-bulb moments became more quickly reached.

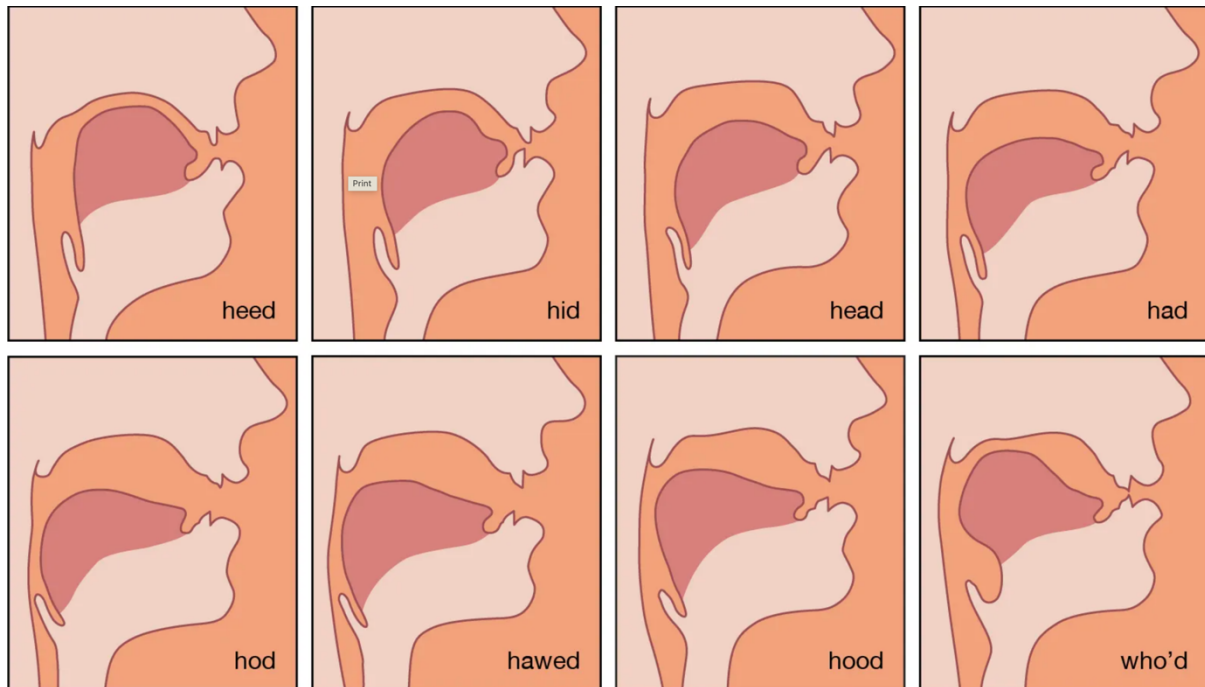
Each frustration led me to ask what the next "logical step" (Gibbs, 1992, pp. 50) could be. For instance, I often felt I was not finding the most relevant research – or enough of it, thus my next logical step was to concisely identify what I was gleaning from given material, and what I had yet to find. Breakthroughs occurred when reading bibliographies of the papers I'd found, as each offered a new starting point, development of a concept, or fresh inspiration. This method of finding further research proved very useful and will become a valuable part of my research practice in future, also helping me clarify the direction in which I was heading (Gibbs, 1992) with my functional strategy.

As I collected materials from classical to CCM acoustic papers, articles and books, I started organising references with Mendeley. The initial excitement of learning the program and creating a library specific to my task was quickly diminished. The program does not work well with Mac and crashed often. The time wasted persisting with it would have been better used in either installing and learning a new program or keeping my own folder of reference material for a manually-written bibliography (as I had for my Formative assignment). I eventually chose the latter option for this paper.

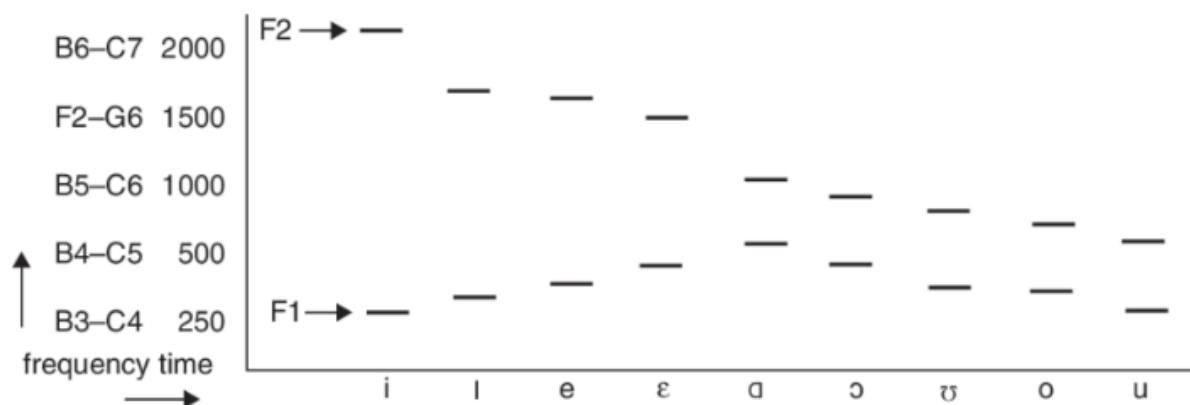
Though I found this Module lengthy and quite challenging, I have learnt that patience and a lot of persistence are key. Broadening my understanding of RS and physiological adjustments that can contribute to their achievement has led to my now being able to identify (fairly accurately) the F₁/H₂ strategy on stage and with my students in the studio. I am confident that continuing to research this topic may have significant implications for my approach with MT professionals and students, and potentially lead me to undertake formalised and presentable research in this area (see Appendix E for Personal Development Plan).

PART IV: APPENDIX**Appendix A:****Illustration of pharyngeal (F_1) and mouth (F_2) configurations for English vowels**

A larger space creates a lower formant frequency (Ladefoged, 2024, "Articulatory Phonetics")

**Appendix B:****Average frequencies overview for assorted American-English vowels**

Bozeman (2013), pp. 13



Appendix C:**Physiological, acoustic and stylistic characteristics of ‘Head’ (M1) and ‘Chest’ (M2) registers.**

Collated from papers by Hirano (1974), Gauffin and Sundberg (1980), Estill (1988), Ladefoged and Maddieson (1986), Schutte and Miller (1993), Ekholm et al. (1998), Bestebreurtje and Schutte, (2000), and Bozeman (2013, 2022).

Acoustic Register	Intrinsic Laryngeal Configuration/Function	Acoustic Output	Perceived Timbre	Genre/Style
Chest / Mode 1 / Modal	- Short, thicker/bulkier Thyroarytenoid (TA) configuration - Greater depth and length of VF contact - Longer closed glottal phase (>50%) - Higher larynx position - As pitch rises above spoken frequencies, or “belt” quality (Estill, 1988, pp. 37), laryngeal position rises and constricts pharyngeal diameter	- Complex pressure waveform - Stronger and greater number of higher harmonics - Dominance of Formant 1 (F_1) located near Harmonic 2 (H_2)	- “Auditory Roughness” - “Buzz” (Bozeman, 2013, pp. 6) - Non-Classical - “Open”, closer to “average speech”, “bright” (Schutte & Miller, 1993, pp. 145)	- Most frequently used in world’s spoken languages due to optimal combination of airflow and glottal tension which produces maximum vibration - CCM voice styles including MT, particularly where word-dominance is necessary/desired
Head / Mode 2	- Elongated and thinner VF - Less VF cover flexibility, with vibration of the edge of the cricothyroid ligament results in a shallower depth of contact - Shorter closed glottal phase (<40%) - Lower larynx position and maximised pharyngeal space - Flow-based phonation	- ‘Clean’ source signal with harmonic spectral content free of (or with little) reinforced buzz/noise (aperiodic content) - Lower F_1, with resonance closer to Fundamental. F_1 tends toward H_1 in ‘legit’ MT voice	- “Flutier” timbre (Bozeman, 2013, pp. 6-7) - Desired ‘Roundness’, ‘richness’, ‘covered’ timbres (Ekholm et al., 1998)	- Western Classical tradition - Desired timbral unity requires balance of suggested twelve criteria including ‘chiaroscuro’, vibrato, intensity, sostenuto, dynamic range

Appendix D: Approximate Locations of F_1 by Voice Type

Bozeman, 2013, pp. 125

Approximate First Formant Locations
With Turning/Closing Pitches Below

The figure displays five musical staves, each representing a different voice type. Each staff contains a sequence of seven vowels (i, e, ε, a, ɔ, o, u) in the treble clef. Below each vowel, a note in the bass clef indicates the approximate first formant (F1) location. The notes are as follows:

Vowel	Soprano	Mezzo Soprano	Tenor	Baritone	Bass
i	B2	B3	B3	B2	B2
e	B2	B3	B3	B2	B2
ε	B2	B3	B3	B2	B2
a	B2	B3	B3	B2	B2
ɔ	B2	B3	B3	B2	B2
o	B2	B3	B3	B2	B2
u	B2	B3	B3	B2	B2

Soprano

Mezzo Soprano

Tenor

Baritone

Bass

Appendix E: Personal Development Plan

1. Develop Pedagogical and Practitioner Skills

- a.
- | | |
|------------------|--|
| Activity | Expand teaching studio presentation |
| Objective | Improve learning environment. Create optimum voice studio set-up with access to visual, audible, and sensory information. |
| Action | Redesign room to include: large mirror, laryngeal anatomy posters, formant chart, microphone and stand, spectrographic software, anatomy models, availability of 2-3mm diameter straws for SOVT work, whiteboard |
| Timescale | Ongoing, completion by Dec 2024 |
- b.
- | | |
|------------------|---|
| Activity | Develop ACT-based approaches to teaching via online course |
| Objective | To deepen understanding and modify approach to management of performance anxiety and confidence in students |
| Action | Complete Dr David Juncos' "ACT for enhancing performance" course through VSC (Nov 2021) |
| Timescale | September 2024 |
- c.
- | | |
|------------------|---|
| Activity | Develop acting/interpretation approaches for MT repertoire |
| Objective | Expand knowledge and approaches to better facilitate access to acting/interpretation of text for MT repertoire for students of all levels, to complement music composition skills |
| Action | Complete "Meisner In Music" online VSC course (Feb 2024)
Complete "Emotion Performance Pedagogy" online VSC course (April 2022)
Complete "Making Holistic Connections Between Voice, Body & Emotions" online VSC course (March 2024)
Private lessons with acting mentor Mark Dickinson |
| Timescale | Complete by end 2024 |
- d.
- | | |
|------------------|--|
| Activity | Expand upon vocal tract acoustic pedagogy knowledge |
| Objective | Become proficient in vocal acoustic resonance pedagogy through further study of classical and CCM resonance strategies |
| Action | - Complete New England Conservatory Online Acoustic Vocal Pedagogy Course next it is running – sign up to mailing list and contact Chad Ballantyne for info
- Review previously-attended Ken Bozeman Advanced Acoustic online lectures (2021) |
| Timescale | NEC online dates TBC |
- e.
- | | |
|------------------|--|
| Activity | Expand upon CCM voice pedagogy approaches and techniques |
| Objective | Broaden skillset to include contemporary techniques of jazz, blues and RnB |
| Action | Continue private mentoring sessions with master teacher Tim Smith, including theory and auditing classes |
| Timescale | Ongoing |

f.	Activity	Purchase Voce Vista Software
	Objective	Incorporate spectral analysis for visual-learning in private studio
	Action	Contact Niels Miller to access student discount for software, test and modify microphone equipment for optimum efficacy
	Timescale	Before December 2024

2. Networking and Professional Relationships

a.	Activity	Expand tertiary teaching profile
	Objective	Build relationships and opportunities with new deans and HOD for tertiary and diploma level MT courses
	Action	Re-connect with Tyran Parke (head of VCA MT) and Rick Chew (Dean of Performing Arts Academy, Federation Uni), and Gerald Marco (Co-Convenor of BMus Popular Music, Monash University). Reach out to Matt Frank (Director of Music, Showfit Melbourne). Establish new career goals of teaching voice and musicianship, and musically directing at pre-professional level
	Timescale	August 2024
b.	Activity	Build profile in professional voice teacher community
	Objective	To become a leading teacher in CCM styles (specialising in MT) in the Melbourne and Australian voice community
	Action	Apply for ANATS membership Attend annual ANATS conference and sign up for networking events Submit to present at VCE "Music Theatre Futures" Conference 2025 Research International conferences to further understanding of submission requirements and presentation styles, and to survey what is being talked about in CCM pedagogy this year
	Timescale	Ongoing

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