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**An Analysis of Vowel Modification in One Pop/Rock Belting Sample:
Observations, Strategies for Application, and a Pathway for Personal Development**

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Table of Contents

Introduction	3
Two instances of the /u/ vowel from “I Don’t Want to Miss a Thing” by Aerosmith	4
Acoustic impacts of vowel modification	4
Physiological considerations.....	6
Influences on emotional expression	7
Influences on song structure and interpretation.....	7
Critical reflection	8
Strategies for analysis and instruction	10
Conclusion	13
References	14
Appendix 1: Personal Development Plan	19

Question: How is vowel modification used during belting in contemporary commercial music (CCM), and how does its application influence vocal function, stylization, musicality, and emotional expression, within the greater context of the song?

Introduction

Belting is a widely-used aesthetic feature in contemporary commercial music (CCM), used as a means of demonstrating power, emotion, and genre-specific stylization (Echternach et al., 2014). Research has shown that vowel modifications are often used as a tactic for facilitating a belt sound (Herbst, Story, and Meyer, 2023), and studies are revealing helpful information about vocal acoustics and physiology that can empower singers to incorporate belting safely and effectively into their singing (Sundberg and Popeil, 2012; McGlashan, Thuesen, and Sadolin, 2017; Saldias et al., 2019).

Even with research developments in the area of contemporary commercial music, and in spite of the massive demand for its many sub-genres among performers and listeners (Bartlett and Naismith, 2020), a systematic method of vocal instruction for CCM singers, especially those who utilize the belt sound, still remains an area of opportunity (McCoy, 2013; Moniz, 2022). Due to the vocal demands of this high-power form of singing, vocalists put themselves at greater risk of injury when they undertake this form of vocal performance without training; and yet, aspiring singers continue to pursue it due to its popularity in the music marketplace (Sielska-Badurek et al., 2018). Conversely, exposure to vocal training and vocal health education is a factor in the way singers experience singing with ease (Zuim et al., 2021).

The aim of this paper is to learn about what has been discovered through research on pop vocal technique by studying vowel modifications used in belting, and to make preliminary contributions to pedagogic strategies for functional and stylistic training. This paper explores the concept of vowel modifications for belting using two lines from one pop/rock song, “I Don’t Want to Miss a Thing,” written by Diane Warren and recorded by Aerosmith (1998). In this exploration, I will study two specific articulation strategies, one wherein the vowel is observably modified and another wherein the vowel is less overtly modified, and investigate the implications of such articulation choices in light of vocal resonance, physiology, timbre, emotive expression, genre-specific stylization, and other elements of vocal production. Through this process, my goal is to develop a multi-dimensional understanding of vocal technique as it pertains to belting and vowel modifications, and to curate a set of suggested practices for vocal instructors who wish to employ a systematic analysis of vowel modification in pop music, along with strategies for applying such observations into vocal instruction. I also hope to extrapolate a personalized path

for my own professional development that builds upon my current knowledge of vocal pedagogy as well as my internal experience of singing pop music.

Two instances of the /u/ vowel from “I Don’t Want to Miss a Thing” (Aerosmith)

“I Don’t Want to Miss a Thing” was written by Diane Warren and recorded by rock band Aerosmith in 1998. It was released to great commercial success, landing the top spot on the Billboard 100 and remaining there for four weeks (Billboard, 2024). In the chorus, Aerosmith lead vocalist Steven Tyler modifies the vowel in the word “you,” substituting the /u/ with a diphthong which can be approximately phoneticized as /əʊ/ (Tyler, 1998). The modification becomes more apparent when compared to the intended rhyme in the following line, wherein Tyler pronounces the word “do” with a vowel that approximates /ʌ/, which is closer to the /u/ vowel with less of an active vowel modification (Tyler, 1998). It bears noting that these phonetic transcriptions are only approximations of the singer’s articulation. Exact representations of the singer’s articulation would require more comprehensive imaging techniques, such as the ones used in research conducted by McGlashan, Thuesen, and Sadolin, (2017). An approximate phonetic transcription of the phrase is included below (Fig. 1).

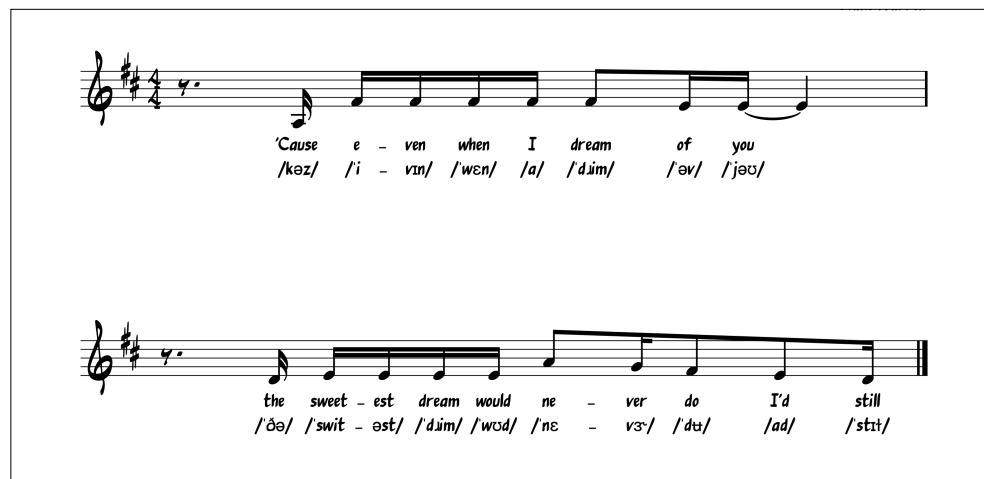


Fig. 1: An approximate phonetic transcription of the singer’s articulation in the last two lines of the chorus of “I Don’t Want to Miss a Thing” by Aerosmith.

Acoustic impacts of vowel modification

Figure 2 shows spectrogram images from the lead vocal track of “I Don’t Want to Miss a Thing.” In Figure 2a, the fuchsia rectangular marker indicates the sustained word “you,” while in Figure 2b, the fuchsia rectangular marker indicates the word “do.” In both images, the two horizontal markers indicate vowel resonances as identified using the VoceVista vowel synthesizer, with the bottom marker indicating the first resonance and the upper marker indicating the second

resonance. Note that for the purposes of this paper, the terms “first resonance” and “second resonance” are being used in place of the terms “first formant” and “second formant” in order to clearly differentiate them from spectral peaks (Howell, 2016). The right-hand panel contains the short-term spectrum which displays the harmonic peaks. The bottom panel displays the waveform as well as the time scale. The furthest left panel displays the piano, with the fundamental pitch highlighted in red.

Fig. 2: Spectrogram images

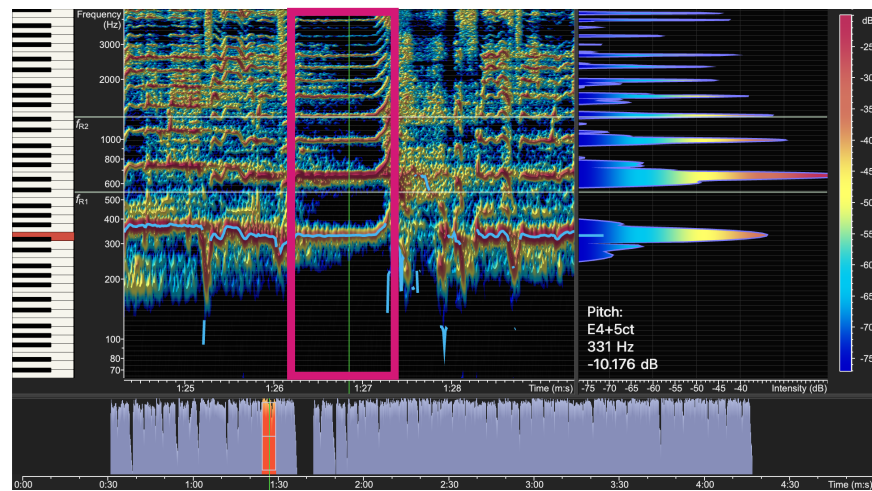


Fig. 2a: Spectrogram image from the main vocal track of “I Don’t Want to Miss a Thing”, with the fuchsia rectangular marker indicating the sustained word “you”

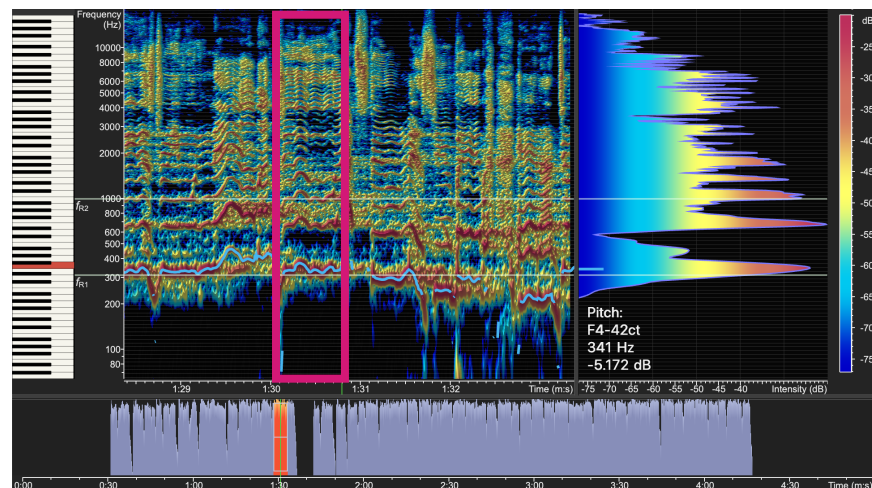


Fig. 2b: Spectrogram image from the main vocal track of “I Don’t Want to Miss a Thing”, with the fuchsia rectangular marker indicating the sustained word “do”

Bestebreurtje and Schutte (2000) found that the /u/ vowel needs significant modification in order to facilitate a belt sound, raising the first and second resonance to track the higher harmonics. Fig. 2a shows the initial /ə/ modification on the /u/ vowel of the word “you,” demonstrating that the first resonance at approximately 550 Hz is indeed tracking the second harmonic peak at approximately 662 Hz, which characterizes a yell timbre (Bozeman, 2013; McGlashan, Thuesen, and Sadolin, 2017). The spectral composition, featured in the right-hand panel, shows a boosted second harmonic peak at -13 dB, compared to the fundamental at -33 dB, giving the sound its brassy quality (Titze, Maxfield, and Walker, 2017). The dominance of the second and third harmonics relative to the fundamental indicates a higher level of glottic closure (Sundberg and Thalén, 2015), creating the perception of loudness and brightness that characterizes the belt sound (Bestebreurtje and Schutte, 2000).

By contrast, Fig. 2b shows the approximate /ʌ/ vowel on the word “do” with the first resonance at approximately 310 Hz tracking much closer to the fundamental at approximately 341 and 322 Hz, resulting in what can be described as whoop timbre (Bozeman, 2013). The short-term spectrum shows a dominant fundamental at -17 dB, with the second and third harmonics boosted to a lesser degree at -26 dB and -25 dB respectively, characterizing a sound that is closer to speech (Bestebreurtje and Schutte, 2000) or a style of singing described by Sundberg and Thalén as neutral (2015). It bears repeating that the phonetic transcription of the /ʌ/ vowel is only an approximation based on the writer’s auditory perception, and may vary slightly from one listener to another.

Physiological considerations

Vowel modification is recognized as a tool for enabling singers to manage vocally demanding repertoire such as in the pop/rock genre while conditioning the voice for efficiency and endurance (Roll, 2016; Moniz, 2022). Roll (2016) observed that, when training professional Broadway musical theatre performers to perform a high belt sound, vocal instructors tended to favor vowel narrowing as a strategy for encouraging a more head voice dominant coordination, resulting in less reported fatigue in the higher belt range. However, the same study observed that a more varied approach was taken by the vocal instructors when training for the lower belt (Roll, 2016). In the word “you,” the singer modifies the approximate /u/ vowel into an approximate /əʊ/ diphthong. Upon visual observation of the singer’s articulation through a recording of a live performance (Aerosmith, 2014, 0:53-0:59), it can be seen that this vowel substitution creates a more megaphone-shaped vocal tract on “you,” thereby creating more optimal conditions for a belt sound (Bozeman, 2013; McCoy, 2019). Articulating the intended /u/

vowel would have resulted in more lip rounding, which would have resulted in more of a whoop timbre (McCoy, 2019). It can also be observed that the singer's jaw is lowered on the word "you," resulting in what appears to be a low mandible maneuver as studied by Nair, Nair, and Reishofer (2016), facilitating an elongated pharynx and increased resonance. This lowered mandible could be a useful counterbalance to the increased constriction produced in belting, especially in Edge mode as studied by McGlashan, Thuesen, and Sadolin (2017). A more robust system of observation is required to measure the singer's articulatory movements with precision, but a visual observation of the live performance can be a helpful starting point for making inferences about the physiological influences of this vowel modification.

Influences on emotional expression

Besides facilitating the belt aesthetic, the vowel modification on the word "you" is also an effective choice for creating emotional expression because the resulting acoustic intensity and timbre produced by the /ə/ vowel effectively support the emotional content of the lyrics (Spreadborough and Anton-Mendez, 2019). Nevertheless, it would be worth studying in detail what emotions are being perceived by listeners in this particular melodic and lyrical line. Hakanpää, Waaramaa, and Laukkanen (2019) found that listeners tend to accurately recognize joy and anger at high pitch, but neither of these emotions accurately reflect the lyrical content. On the other hand, Waaramaa et al. (2008) found that the /a/ vowel best conveys tenderness. With the /ə/ vowel being partway between the /u/ and the /a/ vowel (International Phonetic Association, 2018), it can be argued that this vowel modification may be contributing to the expression of tenderness in this line, which would be congruent with the lyrics, "And even when I dream you, the sweetest dream would never do" (Warren, 1998).

Influences on song structure and interpretation

As the word "you" is taken on a pitch glide up to approximately a B4 and the vowel narrows from /ə/ to an approximate /ʊ/ vowel, the second harmonic travels upwards and the first resonance shifts downwards closer to the ascending fundamental, effectively shifting from a yell timbre towards a loft timbre (McCoy, 2019). One can observe that this translates to a shift from a more pressurized sound to one that has less glottic closure (Sundberg and Thalén, 2015) until the singer employs an emotional affect at the end of the word, characterized by a distortion in the sound of the voice. This upward inflection in pitch is one that humans learn in early childhood as a means of attracting attention (Weeks, 2015), and is an effective strategy for emphasizing the phrase, possibly as a means of giving voice to the longing conveyed in the lyrics. It is worth noting that unlike the word "you," which is sustained for two beats, the word "do" transitions more quickly into the next word with no rest in between, signaling that it is more of a

transition note within its section of the song as opposed to being at the boundary of it (Bruderer, McKinney, and Kohlrausch, 2009). It is melodically positioned as a passing note towards the ending of the chorus, which lands on the tonic and serves as a motive around which the rest of the section is structured (Stefani, 1987). The rhythm of the two lines suggests that the word “you” lands on a power position within its line, while the word “do” serves as more of a bridge into the next power position in the chorus (Pattison, 1995), which is the closing line: “I’d still miss you, babe, and I don’t want to miss a thing” (Warren, 1998). Therefore, one can argue that it is musically advantageous for the word “do” to be de-emphasized in congruence with the melodic shape as it travels from the mediant, a perceptually less stable scale degree, to the tonic, a perceptually more stable scale degree (Maimon, Lamy, and Eitan, 2021). The relatively less intense acoustic profile of the word “do” then supports what one might presume to be the listener’s expectation within the context of the song’s melodic structure (Meyer, 1961).

The vowel in the word “you,” which has been turned into the diphthong /əʊ/, contrasts with the approximate /ʌ/ vowel in the word “do,” which remains a single vowel throughout the word, thus distorting what would have otherwise been a perfect rhyme (Pattison, 1995). The rhyming structure would have been preserved had the singer chosen to match the /u/ or /ʌ/ vowel in the words “you” and “do” in order to preserve the perfect rhyme, but it begs the question of whether or not such a precise rendition would have provided the sense of rebelliousness that is expected in the pop/rock style, a genre that is rooted in themes of subversion and rebellion (Homan, 2020). There are precedents of the use of imperfect rhyme in the rock genre, as Heetderks (2022) observes in a study of the Beatles and their use of contrasting rhyme strategies, but further studies on this subject could be a useful contribution to pop/rock scholarship.

Critical reflection

The knowledge gleaned through this research has immensely enriched my teaching practice, enhancing my ability to make nuanced and precise tool choices that offer more efficient solutions to singers’ vocal challenges, especially as it pertains to belting. I reflected on this process using Kolb’s model of experiential learning (2015), outlining the concrete experience, making a reflective observation on the experience, formulating an abstract conceptualization of how new knowledge may be applied to the situation, and then actively experimenting with the new concept. Below is one example that demonstrates how this research has been integrated into my instructional approach.

Concrete Experience: A male student, James, is a classically trained tenor who wishes to improve his ability to belt for pop/rock repertoire. James expressed interest in singing a cover of

“Eat Me” by pop/rock singer Demi Lovato (2022). The song required him to sing most of the chorus on an E4 with a belt aesthetic. James struggled to find a sustainable coordination for the vocal task, either defaulting to a light head voice dominant mix or a highly pressurized chest voice dominant belt. The belt sound was a closer approximation to his desired aesthetic, but he reported an excessive amount of constriction and strain in producing the sound.

Reflective Observation: It is already my practice to use vowel modification to facilitate a more head voice dominant coordination in the high belt. However, in order to find the correct vowel modifications, I would have relied on knowledge accrued over years of mentorships and experience, combined with trial-and-error and intuition. In this instance, I felt that I could apply my improved knowledge of vocal acoustics and physiology to efficiently find more precise vowel modifications combined with other articulatory strategies that are effective at achieving the timbre and coordination that the singer needed.

Abstract conceptualization: Based on what I have learned about the acoustic results of vowel modification, I surmised that the singer may be able to achieve the desired belt sound with less vocal fatigue even while maintaining a chest voice dominant coordination by utilizing a slightly more rounded lip shape throughout the phrase, along with a lowered jaw. In theory, the chest voice dominant coordination would help to maintain the intensity of sound required for belt (Herbst, Story, and Meyer, 2023). The rounded lip shape would assist with lengthening the vocal tract, thereby lowering the vowel formants and preventing the voice from shifting too far into yell timbre (Bozeman, 2013; McCoy, 2019). Lastly, the lowered jaw would help elongate the pharynx and offer additional resonance, reducing the need to use excessive subglottic pressure (Nair, Nair, and Reishofer, 2016).

Active experimentation: I advised James to make the modifications outlined above. I also led him through an exercise of singing the lyrics with a highly constricted vocal tract using a “bratty baby” affect and then a very open vocal tract using a “sighing” affect. This helped him establish the sensations of constriction versus openness in the vocal tract, which enabled him to appropriately reduce the amount of compression he was using during the phrase.

Upon making the vowel modifications and the adjustments to his compression levels, James was able to perform the belt sound on the E4 pitch and reported greater ease, less fatigue, and improved dynamic control. We were able to facilitate these improvements with minimal trial-and-error, which was beneficial for preserving his vocal stamina for further vocal work.

Strategies for analysis and instruction

In order to develop a comprehensive system of vocal instruction for CCM singers, it would benefit vocal instructors to undertake the practice of systematically analyzing CCM repertoire and reflecting on how their observations can be translated into instruction for vocal function and stylization, such as in Kolb's model of experiential learning (2015): consider what they observed, reflect on these observations, consider how they might apply new knowledge, and then actively experiment with the newly established concepts.

Below are a few strategies that may be helpful for voice teachers who wish to develop a better system for analyzing vowel modifications in CCM singing, as well as making use of vowel modification strategies in their teaching practice:

Using the spectrogram as a tool in the voice studio

It is helpful for vocal instructors to gain a working knowledge of spectrogram applications such as VoceVista as a means of generating a visual representation of the sonic information being analyzed in the vocal performance. As observed by Miller (2009), the ability to see the acoustic profile of each syllable is helpful for gaining a more multi-dimensional understanding of what one is perceiving through the singer's articulation and resonance choices. The visual nature of spectrum analysis can be a helpful way of discerning the more subtle differences between vowels that are within close proximity of each other along with their resulting acoustic profiles, helping students to map different vowel shapes as they are able to connect their own sensory perception with visual information (Gabriel, 2023).

Using the phonetic alphabet for notation of CCM recordings

It is also valuable to have some proficiency in phonetic transcription using standardized systems such as the International Phonetic Alphabet. The practice of phoneticizing sung lyrics is helpful for challenging one's ability to discern the finer details of singers' articulation choices (Gabriel, 2019). Phoneticized lyrics can also provide a detailed visual guide for singers who are seeking to improve their stylization through intentional articulation.

Developing a working knowledge of vocal acoustics

A basic knowledge of vowel resonances can be helpful for making logical vowel modification choices depending on the vocal task, lyric, and its corresponding melody (Bozeman, 2013). It is also helpful to know the pattern of intervals that comprises the harmonic series – for example, where the second and third harmonics fall relative to any given fundamental pitch – in order to

make more informed vowel modification or substitution choices that boost certain partials and achieve certain timbres (McCoy, 2019).

Curating CCM listening samples

A curated playlist of recordings and clips can be a useful tool for voice teachers who wish to develop their own perception of vowel modifications. Below are some suggested tracks for such a playlist, taken from a variety of different CCM sub-genres, artists, and decades (Fig. 3):

Song Title (Artist/Album)	Lyric (Time stamp)
“And I Am Telling You I’m Not Going” (Jennifer Hudson, <i>Dreamgirls</i>)	“You’re gonna love me” (4:41-4:17)
“Whatcha Want” (Lawrence)	“Tell me what you need” (0:21-0:17)
“Don’t Stop Believing” (Journey)	“Hold on to that feeling” (3:28-3:20)
“My Days” (Joy Brooks, <i>The Notebook</i>)	“My days” (3:33-3:23)
“How Great Thou Art” (Carrie Underwood)	“Then sings my soul” (4:01-3:56)

Fig. 3: A suggested list of tracks containing vowel modifications for observation and analysis

Systemized listening and analysis

In order to develop one’s skills in listening and analysis of vowel modifications in CCM singing, and then to develop proficiency in applying this analysis to teaching strategies, it is beneficial to use a system that can be repeated in preparation for practical application (Kimura and Nakano, 2019). This system will eventually create a practice of listening that is more focused, and that lends itself to practical application.

Below is a list of questions that can provide structure for reflection. Although not exhaustive, this list offers some guidance for analysis and can be a helpful starting point for vocal instructors who wish to develop a more deliberate practice of listening to pop repertoire:

- What is the phonetic transcription of the lyric as rendered by the singer?
- How does the phonetic transcription differ from the typical pronunciation of the lyrics?
- What are the sound characteristics of the line in question?
- What are the emotional characteristics of the line in question?

- What potential vowel modifications may be needed when stylizing the song in the context of a voice lesson?
- How might these vowel modifications affect vocal production for the singer?

A suggested listening log format is provided below (Fig. 4):

Song Title (Artist/Genre)	
Lyric	<i>Insert the lyric/phrase/verse/section being analyzed in this column</i>
Key signature/ Melodic transcription	<i>Insert the key signature of the song and, if desired, transcribe the melody of the section being analyzed</i>
Phonetic transcription	<i>Insert the phonetic transcription of the lyrics being analyzed</i>
Sound characteristics	<i>Describe the sound characteristics of the section being analyzed, using any sensory characteristics that come to mind</i>
Emotional characteristics	<i>Describe any emotional characteristics of the section being analyzed, using any emotional language that comes to mind</i>
Potential vowel modifications	<i>Outline any vowel modifications that may need to be made in the process of stylizing or applying aesthetic treatment to the song</i>
Potential effects of vowel modifications	<i>Think of how these vowel modifications may influence vocal function, resonance, timbre, etc. Also consider how these vowel changes may affect rhyme, song structure, and prosody.</i>

Fig. 4: A suggested listening log that can be used by voice teachers in their practice of analyzing CCM singing samples

Note that this listening log can also be used when evaluating a student's vocal performance with the goal of assisting the singer with improving vocal function and stylization.

Simplicity of use is important in order to ensure minimal effort for vocal instructors as they integrate reflection into their daily teaching practice, because it increases the likelihood that voice teachers will be able to sustain the habit (Clear, 2018). With repetition, the practice of systematically analyzing pop repertoire and technique application will become less energy-consuming and will feel more automatic (Speelman and Kirsner, 2005).

Conclusion

Contemporary commercial music is a widely-consumed and performed genre of music, currently outpacing the Western classical genre in demand and market saturation (Bartlett and Naismith, 2020). Belting as an aesthetic feature is a hallmark characteristic of many CCM sub-genres, often used for expressing emotion, conveying power, and imbuing genre-specific style (Echternach et al., 2014). Vowel modifications have been examined and found to be a useful tool in the practice of belting, not only for facilitating sustainable vocal function but also for creating desired timbral qualities (Herbst, Story, and Meyer, 2023). However, an established system of instruction for CCM singers remains an area of opportunity in vocal pedagogy (McCoy, 2013; Moniz, 2022). While it is outside the scope of this paper to create an entire pedagogic framework for vocal instructors who specialize in CCM vocal performance, the aim of this study was to examine one specific sample of pop/rock belting, featuring two contrasting vowel articulation strategies, in order to make a contribution to the field of CCM vocal pedagogy specifically focusing on the use of vowel modification, as well as to deepen my own understanding of the many elements at work in facilitating the belt sound in vocal performance.

Spectrographic analysis through VoceVista demonstrated that the /u/ vowel in the word “you” benefited from a modification into the /əʊ/ diphthong as it created a megaphone shaped vocal tract (McCoy, 2019), which effectively raised the first resonance towards the second harmonic, facilitating the yell timbre that characterizes the belt sound (Bozeman, 2013; McGlashan, Thuesen, and Sadolin, 2017). It also appeared to engage a lower mandible maneuver, which has been found to be conducive to maintaining a relatively lower laryngeal height, a more elongated pharynx, and increased resonance (Nair, Nair, and Reishofer, 2016). This vowel modification is partway towards the /a/ vowel, which has been found to convey tenderness (Waaramaa et al., 2008), an emotion that is congruent with the lyrical content of the line. In the context of the song, the vowel modification does interfere with the rhyme structure, but there are arguments to be made for this interruption in the rhyming structure as being congruent with the prosodic qualities of the lyrics (Pattison, 1995) as well as the structure of the melody relative to the tonic (Maimon, Lamy, and Eitan, 2021), not to mention the sense of rebelliousness that permeates and serves as a foundation for rock as a genre (Homan, 2020).

This examination facilitated a deepened understanding of existing data pertaining to the way that vowel modification impacts vocal production in CCM singing. It also gave rise to a set of suggested strategies for vocal instructors who wish to develop a framework for analysis and instruction in the CCM style. This set of suggested strategies includes a systematic approach to

listening to pop music, especially to the vowel modifications being applied. It also encourages a working knowledge of spectrogram technology such as VoceVista, understanding of vowel formants, as well as familiarity with the pattern of intervals that comprise the harmonic series. In creating this set of suggested strategies, I was able to devise a professional development plan (Appendix 1) for further pursuing my own process of examining vowel modifications in the greater CCM genre, reflecting on these examinations, and applying them in my teaching practice.

References:

Aerosmith (2014) *I Don't Want to Miss a Thing (Live from the Office Depot Center, Sunrise, FL, April 3, 2004)*, 17 June 2014. Available at: <https://youtu.be/9o4kvBI5A98?si=HoySN-wmiLhXFuNp>. (Accessed: 03 October 2024).

Bartlett, I. and Naismith, M.L. (2020) 'An Investigation of Contemporary Commercial Music Voice Pedagogy: A Class of its Own?', *Journal of singing*, 76(3), pp. 273–282.

Bestebreurtje, M.E. and Schutte, H.K. (2000) 'Resonance strategies for the belting style: Results of a single female subject study', *Journal of voice*, 14(2), pp. 194–204. Available at: [https://doi.org/10.1016/S0892-1997\(00\)80027-2](https://doi.org/10.1016/S0892-1997(00)80027-2).

Billboard (2024) *Billboard Hot 100*. Available at: <https://www.billboard.com/charts/hot-100/1998-09-05/> (Accessed: 24 September 2024)

Bozeman, K. (2013) *Practical Vocal Acoustics: Pedagogic Applications for Teachers and Singers*. Lanham: Rowman & Littlefield.

Bozeman, K. (2017) 'The Pedagogic Use of Absolute Spectral Tone Color Theory', *Journal of singing*, 74(2), pp. 179–183.

Bruderer, M.J., McKinney, M.F. and Kohlrausch, A. (2009) 'The perception of structural boundaries in melody lines of Western popular music', *Musicae scientiae*, 13(2), pp. 273–313. Available at: <https://doi.org/10.1177/102986490901300204>.

Clear, J. (2018) *Atomic Habits: An Easy & Proven Way to Build Good Habits & Break Bad Ones*. New York City: Avery.

Collister, L.B. and Huron, D. (2008) 'Comparison of Word Intelligibility in Spoken and Sung Phrases', *Empirical musicology review*, 3(3), pp. 109–125. Available at: <https://doi.org/10.18061/1811/34102>

Echternach, M. et al. (2014) 'Vocal Tract Shapes in Different Singing Functions Used in Musical Theater Singing—A Pilot Study', *Journal of voice*, 28(5), p. 653.e1-653.e7. Available at: <https://doi.org/10.1016/j.jvoice.2014.01.011>.

Fine, P. and Ginsborg, J. (2014) 'Making myself understood: perceived factors affecting the intelligibility of sung text', *Frontiers in psychology*, 5. Available at: <https://doi.org/10.3389/fpsyg.2014.00809>.

Gabriel, R. (2023) 'Noises and Colors: Two Untraditional Methods of Teaching ESL/ EFL Pronunciation', *Journal of language teaching and research*, 14(4), pp. 882–892. Available at: <https://doi.org/10.17507/jltr.1404.04>.

Hakanpää, T., Waaramaa, T. and Laukkanen, A.-M. (2019) 'Emotion Recognition From Singing Voices Using Contemporary Commercial Music and Classical Styles', *Journal of voice*, 33(4), pp. 501–509. Available at: <https://doi.org/10.1016/j.jvoice.2018.01.012>.

Heetderks, D. (2022) 'Norms of Textual Scansion and Rhyme in Beatles AABA Forms', *Music theory spectrum*, 44(1), pp. 41–62. Available at: <https://doi.org/10.1093/mts/mtab018>.

Herbst, C.T., Story, B.H. and Meyer, D. (2023) 'Acoustical Theory of Vowel Modification Strategies in Belting', *Journal of voice [Preprint]*. Available at: <https://doi.org/10.1016/j.jvoice.2023.01.004>.

Homan, S. (2020) 'Rock, Popular Culture, and Power: Politics and Policy', *The Bloomsbury handbook of rock music research*, pp. 413-430. New York: Bloomsbury Academic. Available at: <https://doi.org/10.5040/9781501330483>. (Accessed: 23 September 2024).

Howell, I. (2016). *Parsing the Spectral Envelope: Toward a General Theory of Vocal Tone Color*. DMA Thesis. The New England Conservatory of Music. Available at: https://www.academia.edu/29162454/Parsing_the_Spectral_Envelope_Toward_a_General_Theory_of_Vocal_Tone_Color

International Phonetic Association (2018) *IPA Chart*. Available at: https://www.internationalphoneticassociation.org/IPAcharts/inter_chart_2018/IPA_2018.html (Accessed: 01 October 2024)

Kolb, D.A. (2015) *Experiential Learning : Experience As the Source of Learning and Development*. Second edition. Upper Saddle River, New Jersey: Pearson Education.

Kimura, T. and Nakano, W. (2019) 'Repetition of a cognitive task promotes motor learning', *Human movement science*, 66, pp. 109–116. Available at: <https://doi.org/10.1016/j.humov.2019.04.005>.

LoVetri, J. (2008) 'Contemporary Commercial Music', *Journal of voice*, 22(3), pp. 260–262. Available at: <https://doi.org/10.1016/j.jvoice.2006.11.002>.

Lovato, D. (2022) 'EAT ME (feat. Royal & the Serpent)', *HOLY FVCK*. Available at: Apple Music. (Accessed: 09 October 2024).

Maimon, N.B., Lamy, D. and Eitan, Z. (2021) 'Space oddity: musical syntax is mapped onto visual space', *Scientific reports*, 11(1), pp. 22343–22343. Available at: <https://doi.org/10.1038/s41598-021-01393-1>.

McCoy, S. (2019) *Your Voice: An Inside View 3, Voice Science & Pedagogy*. Gahanna, OH: Inside View Press.

McCoy, S. (2013) 'Why I don't teach belting', *Journal of singing*, 70(2), pp. 181–182.

McGlashan, J., Thuesen, M.A. and Sadolin, C. (2017) 'Overdrive and Edge as Refiners of "Belting"?: An Empirical Study Qualifying and Categorizing "Belting" Based on Audio Perception, Laryngostroboscopic Imaging, Acoustics, LTAS, and EGG', *Journal of voice*, 31(3), p. 385.e11-385.e22. Available at: <https://doi.org/10.1016/j.jvoice.2016.09.006>.

Meyer, L.B. (1961) *Emotion and meaning in music*. Pbk. ed. Chicago: University of Chicago Press.

Miller, D. (2009) 'Voice Pedagogy: On Master Classes and the Olympic Games', *Journal of singing*, 65(4), pp. 441–444.

Moniz, J.J. (2022) 'Regulating Vocal Load in High Impact Production', *Journal of singing*, 78(5), pp. 601–607. Available at: <https://doi.org/10.53830/OMOO7954>.

Nair, A., Nair, G. and Reishofer, G. (2016) 'The Low Mandible Maneuver and Its Resonential Implications for Elite Singers', *Journal of voice*, 30(1), p. 128.e13-128.e32. Available at: <https://doi.org/10.1016/j.jvoice.2015.03.010>.

Pattison, P. (1995) *Writing Better Lyrics: The essential guide to powerful songwriting – from generating ideas to developing verse and beyond*. Cincinnati: Writer's Digest Books.

Roll, C. (2016) 'The Evolution of the Female Broadway Belt Voice: Implications for Teachers and Singers', *Journal of voice*, 30(5), p. 639.e1-639.e9. Available at: <https://doi.org/10.1016/j.jvoice.2015.07.008>.

Saldias, M. et al. (2019) 'A Computerized Tomography Study of Vocal Tract Setting in Hyperfunctional Dysphonia and in Belting', *Journal of voice*, 33(4), pp. 412–419. Available at: <https://doi.org/10.1016/j.jvoice.2018.02.001>.

Sielska-Badurek, E.M. et al. (2018) 'Contemporary Commercial Music Singing Students—Voice Quality and Vocal Function at the Beginning of Singing Training', *Journal of voice*, 32(6), pp. 668–672. Available at: <https://doi.org/10.1016/j.jvoice.2017.08.027>.

Speelman, C.P. and Kirsner, K. (2005) *Beyond the learning curve : the construction of mind*. 1st ed. Oxford ; Oxford University Press.

Spreadborough, K.L. and Anton-Mendez, I. (2019) 'It's not what you sing, it's how you sing it: How the emotional valence of vocal timbre influences listeners' emotional perception of words', *Psychology of music*, 47(3), pp. 407–419. Available at: <https://doi.org/10.1177/0305735617753996>.

Stefani, G. (1987) 'Melody: A Popular Perspective', *Popular music*, 6(1), pp. 21–35. Available at: <https://doi.org/10.1017/S0261143000006589>.

Sundberg, J. and Thalén, M. (2015) 'Respiratory and Acoustical Differences Between Belt and Neutral Style of Singing', *Journal of voice*, 29(4), pp. 418–425. Available at: <https://doi.org/10.1016/j.jvoice.2014.09.018>.

Sundberg, J., Thalén, M. and Popeil, L. (2012) 'Substyles of Belting: Phonatory and Resonatory Characteristics', *Journal of voice*, 26(1), pp. 44–50. Available at: <https://doi.org/10.1016/j.jvoice.2010.10.007>.

Sygyt Software (2024) *Private coaching for VoceVista video*. Available at: <https://www.sygyt.com/en/order/coaching/>. (Accessed: 04 October 2024)

Titze, I.R., Maxfield, L.M. and Walker, M.C. (2017) 'A Formant Range Profile for Singers', *Journal of voice*, 31(3), p. 382.e9-382.e13. Available at: <https://doi.org/10.1016/j.jvoice.2016.08.014>.

Tyler, S. (1998) 'I Don't Want to Miss a Thing', *Armageddon: The Album*. Available at: Apple Music. (Accessed: 24 September 2024)

Waaramaa, T. et al. (2008) 'Monopitched Expression of Emotions in Different Vowels', *Folia phoniatrica et logopaedica*, 60(5), pp. 249–255. Available at: <https://doi.org/10.1159/000151762>.

Warren, D. (1998) *I Don't Want to Miss a Thing*. New York: Columbia Records.

Weeks, K. (2015) 'Vowels—Sonic Gems of Emotion for Social Communication: Practical Singing Strategies for Non-musician Teachers with Developmentally Diverse Young Children', *Early childhood education journal*, 43(6), pp. 515–522. Available at: <https://doi.org/10.1007/s10643-014-0681-2>.

Zarate, J.M. (2013) 'The neural control of singing', *Frontiers in human neuroscience*, 7, pp. 237–237. Available at: <https://doi.org/10.3389/fnhum.2013.00237>.

Zuim, A.F. et al. (2021) 'Associations of Education and Training with Perceived Singing Voice Function Among Professional Singers', *Journal of voice*, 35(3), p. 500.e17-500.e24. Available at: <https://doi.org/10.1016/j.jvoice.2019.10.003>.

Appendix 1: Personal development plan

Below are some areas of opportunities that I plan to address as a means of furthering my understanding of the many dimensions of vowel modifications in CCM vocal performance, as well as increasing my proficiency in translating this knowledge into teaching strategies:

Continued practice in VoceVista

Isolate vocal tracks from CCM repertoire and upload to VoceVista for analysis. If possible, watch vocal acoustics content through the Voice Study Centre dashboard, invest in private training with VoceVista coaches (Sygyt Software, 2024), or seek further mentorship from known voice researchers and pedagogues who have expertise in the field of vocal acoustics and vocal pedagogy.

Learn the intervallic pattern of the harmonic series

Commit to memory harmonic series interval pattern (McCoy, 2019; Bozeman, 2013), and practice transcribing harmonics relative to different fundamental pitches.

Practice reflective journaling between sessions

Inspired by Kolb's model of experiential learning (2015), continually reflect on the process of vowel modification during vocal instruction and stylization for CCM repertoire, with the following potential areas of focus:

- The intended aesthetic versus the student's current default sound
- The intended experience of vocal function versus the student's current pattern of vocal production
- The target word/vowel and the pitch/location within the student's range
- The vowel modification used during practice
- The impact of the vowel modification on aesthetic and/or vocal function
- The vocal instructor's impression of the resulting change
- The student's impression of the resulting change
- Strategies for future application with the vocal task and the same student or other students with similar voice types and performance goals