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Critical Evaluation

Examining updated knowledge of whistle register production, how is a singer's whistle register tone/timbre manipulated via vocal fold vibration, formant awareness/production, and shaping of the lips? Using this information, develop a strategy for application, especially towards a goal of intelligible full word phrases produced entirely in whistle register.

Introduction

Scholarly debate continues in regards to proving the existence of all perceptually categorized voice registers; to honor its scope, this paper assumes the recognition of whistle or flute register as its own register. While remaining a largely uncommon practice, Contemporary Commercial Music (CCM) sees employment of this register by a few artists for its breathy and extensively high note production, globalized by Mariah Carey. Single whistle notes are most commonly vocalized, and the connection of lengthier phraseology much less so. Rarest is the usage of full intonation and meaning expressed through extensive textual phrases. I aim to explore how various anatomical and physiological features of the vocal process affect and color the timbre of the whistle register and allow text recognizability in order to produce connected words and stanzas full in whistle register.

What Makes It a Register?

Harry Hollien categorized voice registers by the production of consecutive pitches in the upwards direction that are marked by the same timbre, or acoustic quality of tone, and relative similarity in sound levels between the pitches (Herbst, 2020). Christian Herbst claimed that this expounded on Manuel Garcia's definition of vocal fold vibration by adding resonance via vocal tract (Herbst, 2020). Hollien also claimed that perceptual, acoustic, physiologic, and aerodynamic levels defined a register (Herbst, 2020). While there are multiple operative names, the following are the hereafter mentioned registers: vocal fry (M0), chest voice (M1), falsetto/head (M2), and whistle (M3) (Herbst, 2020).

The whistle register can be perceptually identified as having a different sonoral quality even when producing some of the same higher pitches as the M2 register, starting at C5; whistle tones are produced using a combination of different physiological process in the larynx than in M2; there is a “fluty resonant” timbre produced in M3 versus the “full head” quality in M2; harmonics produced in M3 are observably lower than in M2 phonation; airflow rates are also lower in M3; EGG signal analysis of M3 displays a reduction in vibrational amplitude, reduction in vocal fold contact area, and a longer open glottal phase than in M2; and laryngoscope observation displays an open glottis and vibration along the totality of the vocal folds during the entire time of high whistle tone production (Holmes-Bendixen, 2013). As I explore the various conditions for whistle tones to be produced, I subscribe to the following claim by Herbst (2020): “There is no reason to assume that the register above the chest [and thus, the whistle register as well] is functionally any different in females and males. Both females and males have comparable laryngeal configuration through activity in the same intrinsic laryngeal muscles.”

Corcia and Fussi (2015) identified four different mechanisms for notes produced above the M2 register. The sub-registers/ classifications are marked by the production mechanism: “Female Laryngeal Whistle” (FLW), with its partial closure of the glottis and observable vocal fold vibrations, and “Stop-Closure Whistle” (SCW), named for its fully closed glottis and absent mucosal wave and absent vocal fold vibrations (Corcia and Fussi, 2015). While FLW does not depend on the fold mass to determine vocal range, SCW responds to increasing pitch and maintaining tone more consistently in association with increased thickness of mass of the fold (Corcia and Fussi, 2015). I will not be extensively exploring the “Ingressive Whistle" (IW) due to its nature of production depending on the inward breath. As yet to be recorded, IW is not used in any classical or contemporary vocal genre in which I am aware. It is to be noted, however, that CCM voice coaches, such as Justin Stoney (2016), equip the IW as a pitch and proprioceptive tool with which to match an outward whistle. Edgerton proposed an M4 register classifying any extreme frequencies phonated with both ingressive and egressive mechanisms (Herbst, 2020). This supports Corcia and Fussi’s (2015) final concept of the “Hiss Register.” Hiss can range as high as the 10th octave (Corcia and Fussi, 2015).

Frameworks Have Evolved Over Time to Explain Vocal Fold Vibration

Justin Stoney, voice coach and founder of New York Vocal Coaching, stated that the whistle register has a different mechanism of production from all other registers, missing the mucosal wave component entirely. “The vocalis muscle helps to lock down the bodies, leaving a space in the back,” through which it was thought vocalists “whistled” their breath for the

namesake tonality (Stoney, 2016). Many practitioners continue to believe this to be true, as updated research can be inaccessible to the pedagogical community-at-large. Misinformation could lead to misteaching, and thus, harm or unsuccessful vocal techniques. Such theories have a longstanding history in the whistle voice literature, such as with Steven Walker's (1986) review theorizing the very same concept as above owing to a taut "stretching" of the vocal folds. It is worth noting that I have decidedly included Walker's research in this paper, while being aged multiple decades, because there are very few relevant studies on these matters and also because of his fluid explanations of the elusive concepts of formants and register classifications. Two additional well-established but inaccurate theories are as follows: "damping," whereby compressing the arytenoids was postulated to manipulate the vibrating vocal folds' length, and thus, producing the extremes of high frequencies; and the compelling "vortex-induced" theory that posited enduring vocal fold vibration but likened it to standard "lip whistling," in which a nearly-closed glottis would produce an "oscillating jet" that modulated the pitches to higher frequencies by way of the vocal tract's second resonance (Garnier *et al.*, 2012).

Turbulence as the cause for phonation at high fundamental frequencies was also disproven in favor of evidence showing oscillations in the vocal folds that allowed for adjustments of airflow (Echternach *et al.*, 2013). By operating a digital imaging device with a "frame rate above 10,000 fps," the most recent discovery solidly demonstrated six total patterns of vocal fold vibrations: first, vibratory motions throughout the length of the vocal folds with full closure in their closed phase; second, vibratory motions throughout the vocal folds with incomplete closure due to a gap for the total vocal fold length; third, pervasive vocal fold vibration with incomplete closure due to a gap at the posterior end of the glottis; fourth, pervasive vocal fold vibration with a gap at the anterior end of the glottis; fifth, pervasive vocal fold vibration with gaps at both ends of the glottis; and lastly, partial vocal fold vibration in the sixth pattern (Kato *et al*., 2023).

Formants: Vocal Tract Resonance Informs Articulatory Clarity

A crucial aspect of singing is text intelligibility. The vocal tract produces resonances that are linked to hydraulic pressure differences, thereby effectuating vocal fold vibrations and, hence, can be used to amplify phonation (Barrientos and Cataldo, 2024). Observable "peaks of acoustic energy" in the sound spectrum from these resonances that concentrate at a frequency are called formants (Walker, 1986). A singer can increase pitch loudness by tuning the first formant, F1, in relation to the sung pitch, or the fundamental frequency, F0 (Barrientos and Cataldo, 2024). The second and higher formants are particularly responsible for higher

recognizability of text (Sundberg and Romedahl, 2009). Vowels are formed by combinations of two or more formants, adjusted by the singer utilizing various degrees of shaping the mouth and dropping the jaw accordingly (Walker, 1986). This is consistent with findings of buccal widening, jaw opening, upper surface of tongue elevating, and persistent pharynx widening that all occurs as F0 approaches F1 (Echternach *et al.,* 2010).

Whistle tones often have a breathy timbre and are audibly softer in presentation. Owing to the exponentiality of F0 becoming significantly higher than F1 in the higher registers, intelligibility of vowels decreases as pitch rises (Walker, 1986). Phonation amplification, and thus formant tuning of the F1 to the F0, is required to increase text recognition in the whistle register (Corcia and Fussi, 2015). It was observed in the SCW that elevating the soft palate, widening the oral cavity, and relaxing the tongue and suprahyoid contributed to tuning the F1 to the F0 (Corcia and Fussi, 2015). Though still uncommon and fairly new, there are some cases of CCM performer use of whistle tones set to intelligible words, the pioneer of which seems to be Mariah Carey. I have yet to uncover any performers using the “Hiss Register” to carry textual phonations, suggesting possible incapability of the vocal tract to support such and owing, perhaps, to the M4’s absence of vocal fold vibrations mentioned above. Antonio Di Corcia and Franco Fussi (2015) opined that the “Hiss” is produced by SCW mechanisms after observation of increased subglottal pressure that causes increased “stiffness of the mucosa” and a much higher elevated F0, which would thereby limit intelligibility of text.

Timbre is Perceptible as Varied Even at the Highest Frequencies

Tonal character/color of the voice is affected by numerous elements and can be used to communicate contextual feeling. Electroglottograph signals show that strength of the fundamental frequency, the relationship between harmonics, and clustering of higher formants have an effect on timbre (Bjorkner, 2008). Another method of analysis is through the framework of nonlinear phenomena, a theory involving varying “subharmonics, biphonation, and aperiodic, irregular behavior (deterministic chaos)” that lead to the production of vocal sonorities that have been traditionally thought to be largely “accidental” but now shown via narrow-band spectrograms as an artistic quality that can be learned to be controlled to create an “intended affect, emotion, or meaning” (Neubauer, Edgerton and Herzel, 2004). The female glottal whistle described in this study seems to correlate best with FLW in accordance with the “vortex-induced fold vibrations and “subglottal airstream” descriptions, and the whistle’s timbre has a vocal fry quality (Neubauer, Edgerton and Herzel, 2004). Steven Walker (1986) surmised that formants have a part to play in the perception of register differences in relation to timbre. There are two

formant ranges that can inform timbre: The lower range approximates 800 Hz and can produce warm or dark qualities, while the formant range of about 2800 Hz to 3200 Hz may be recognized as brilliant (Walker, 1986). In practice, while it has been traditionally understood that formants are solely responsible for timbre changes, adjustments at the source of vocal production and in resonance contribute to light and dark timbres, which involve altering the height of the larynx and hypopharynx area and volume (Aaen *et al.*, 2021). During the open phase of the glottis' vibrations, "noteworthy harmonics," or overtones, in the trachea are reduced (Herbst, 2020). The duration of the closure in the glottal cycle seems to determine the strength of the overtones; hence, stronger harmonics are correlated with relatively longer closed glottal phases (Herbst, 2020). Christian Herbst (2020) concluded that a more brilliant timbre was then associated with strong overtones produced by a short open phase, which is directly linked with a long closed phase of the glottal cycle. Antonio Di Corcia and Franco Fussi (2015) intuited that because the glottis is not entirely closed yet vibration is absent in IW, whistle tones are generally produced in various areas throughout the glottis, incurring timbre alterations accordingly. Another finding is that during the glottal cycle's closed phase, partial anterior closure creates a breathier timbre (Herbst, 2020). Corcia and Fussi (2015) also believed that "for traditional and aesthetical reasons," the nearly two-and-half octaves above A4 should be performed using chest and falsetto registers. They imply that the timbre of the whistle register is not consistent enough with the primary conventional registers, at least in operatic singing. Their artistic note is of a fervent wording: FLW "is the only behavior in M3 one singer should adopt in the opera singing because of its intensity characteristic and timbre quality," further stating that a male opera singer is not permitted to perform any of the whistle mechanisms but releasing such pedagogical control to CCM genres (Corcia and Fussi, 2015). While SCW does not seem to be applied commonly enough to be reviewed in this research, Corcia and Fussi (2015) strongly discouraged its use even in cases of producing the lightest of the sonorities, implying that perhaps SCW, due to its mixed ingressive and egressive mechanisms, produces often a less refined, harsher sound inconsistent with the stylistic timbres of classical vocalizations. Another explanation for the devaluation of the whistle register in opera may be its airy/breathy phonation, which has been shown to increase in severity as singers practiced preset M3 exercises and decreasing when practices were discontinued (Holmes-Bendixen, 2013). As a stark contrast, this sought-after breathy quality in CCM is not related to airflow rates, as mentioned above, but pursued by way of enacting glottal resistance (Walker, 1986).

Shaping the Lips Modifies Whistle Tone Vowels

Nearly closing the lips, “exaggerating” a smile position, and raising the upper jawbones can allow for phonation congruent to whistle tone production (Holmes-Bendixen, 2013). The /u/ vowel modification, formed with a “pencil-sized” mouth opening and rounded lips, is another suggestion, as well as humming rather than egressive phonation (Holmes-Bendixen, 2013).

I gleaned from the little data available that M3 vowel modification is largely tailored to creating nonsyllabic utterances or an ornamentation in M3 within a larger word that audibly begins and ends in M2. Hence, much of the excluded exercises from the systematic review echoed the suggestions of minimized buccal opening. I find that very few singers, all of whom are CCM performers, attempt full textual phrases at such high frequencies. As there is a lack of further research on this particular mechanism of whistle register phonation, I tested all exercises that I encountered while conducting this review, including those of CCM vocal coaches Matthew Ramsey (2018) and Justin Stoney (2016). My experience practicing whistle tones is consistent with the above in terms of successful vowel modification. My perceptual analysis and anecdotal practice found that clear enunciation depended upon dropping the jaw, the mouth in a smile position, quick dental consonant production with the tongue, frequent use of sibilant-containing words, and lightly employing a glottal /h/ before any vowel to intensify the breathy timbre. These elements increase listener intelligibility of words in their totality, as I assessed such perception via self-recording and requesting feedback from an audience member.

Strategy

Conclusion

Research on this subject seems to be scarce and in correlation to the proportion of the whistle register’s frequency of use in all vocal genres. While it is understandable for more functional, in-use, or commonly occurring mechanisms to be the subject of vast study, none of the original research experiments utilized more than the average of four to six participants for any particular differentiating task, which only casts reasonable doubt via small sample bias (Lin, 2018). Extrapolating and universalizing the valuable insights discovered from a more diverse participant pool- by way of vocal knowledge, high-frequency proficiency levels, and genre- would lend to less possibility of sparse data bias as well (Greenland, Mansournia and Altman, 2016). Not only is sufficient research on any voice subject helpful to instructors guiding their students to success in a particular discipline, but it can also elucidate any potential harms and

uncover preventative measures against vocal damage. Additionally, scientific endeavors progress forward regardless of the necessitated uses due to researchers' curiosity and hope for interdisciplinary potential in the future. I urge the pedagogical community to desire and conduct further investigation into the whistle register, safe exercises to extend the range above falsetto, potential physiological damage and prevention, and research into manipulating timbre and intelligibility to create more opportunities for such a unique vocal phenomenon to be safely explored and nurtured in the future of musical expression.

Critical Reflection

I used Tony Ghaye's (2010) model for evaluating my process initially, but as it is largely centered on finding positivity and success in the situation, I had to first overcome many mental hurdles to later find sparks of encouraging areas for improvement. Encountering many difficulties in the initial stages of the research, I experienced much disappointment and frustration. The significant gaps and lack in research on the whistle register have made the process slow and arduous. However, this does speak to the point that more research would be favorable and perhaps even alludes to the mysterious nature of the whistle register being a possible reason for its underuse. I overcame much of this with the encouraging support and existing journal article knowledge of my advisor, Claire Thomas, and I imagine such generous support would be necessary going forward into less-charted territory with conducting the necessary research to finalize understanding on the physiology of whistle tones.

I also experienced major losses during this period of study. First, I grieved the loss of my significant other's father, who passed due to small-cell lung cancer in December. I became ill for three consecutive weeks due to an unidentified virus, making it difficult to focus and connect to my work or my voice in order to at least practice what I was studying. I, later, endured further emotional, verbal, and psychological abuse from my partner, whose own grief inflamed many of the problematic situations between us. Seeking change, I established therapy, at which point months of mental health work on myself showed that I needed to exit the relationship, which was also competing for time and attention with necessary schoolwork. Following the breakup, more abuse ensued, and I entered a constant state of panic that my former partner would become reckless and return to substance addiction. This proved to be an accurate prediction. My beloved canine, who served informally as my emotional support animal, passed away suddenly one month ago. I had spent a decade with her and my other dog, but there were no symptoms of disease or dysfunction; the death rattled my understanding of life and what is important to me. About two weeks ago, I was a victim in a driveby shooting of a restaurant, and

this has resurfaced dormant and informed novel bodily symptoms of post-traumatic stress disorder, including searing, electric pain throughout my nerves that only ends while sleeping. On top of these things, worry about completion of this paper has been clouding the necessary cognitive ability to truly finish the work.

This is all to say that trauma and emotional changes can affect the voice, causing a felt sense of vocal musculature tightening, or constriction, and making it very difficult to sing without pain or strain. Anteropostior glottis and false fold tension, pharyngeal constriction, vocal tract shortening can occur due to emoting pain or anger while singing (Lemon-McMahon & Hughes, 2018). I found it nearly impossible to practice whistle tones, which seem to require much mental lightness and relaxation, and, thus, even more troublesome to record my findings and create future actions-steps; this is a matter for further research, as it is only a phenomenon I experienced and did not find in the research. A suggestion from the above study is to manage stress in order to relax vocal muscles and lower the larynx to its natural position (Lemon-McMahon & Hughes, 2018). I have continued my mental health therapy and asked for additional support and services than originally allotted to me. I also did learn from these experiences in that I asked for assistance for the first time in my academic endeavors. I requested extensions and additional advice. Further sources of aid for my confidence in pursuing this particular area of study are listed below in Appendix Item B. I intend to pursue professional development in various ways to support my journey both with knowledge and the grounding nature of positive emotions that will allow me to release much of the self-doubt and anxiety surrounding research and vocal practice. This can only improve my own work.

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Appendix Item A

<u>Exercises to extend range into Whistle (M3) Register</u>

Hum a "siren" ascending and descending

At the top of perceived range, hum while internally smiling, carefully ascending

Now, slightly open lips but continue humming in this pattern

Translate this to open resonance, no hum

Arpeggios on /u/ vowel, with partially closed smile

Yawn exercise but with slightly glottal /h/ to produce breathy tonality

Following sections from "The influence of whistle register phonation exercises in conditioning the second passaggio of the female singing voice" (Holmes-Bendixen, 2013):

Berton Coffin- ""Whistle while pronouncing vowels behind the hand" (p. 35), is a quick descending arpeggio (8-5-3-1) where the first tone of the arpeggio is produced using whistle register. In this exercise, the singer should place the palm or back of their hand over the mouth. The whistle tone should begin with a small puff of air through the nose, and vowel is sung with a small opening of the mouth. According to Coffin, producing the whistle register phonation behind the hand allows a double stream of vibrating air to pass through both the nose and the mouth. When the hand is removed for head voice phonation, the soft palate rises."

Coffin- ""Floating High Notes" (p. 79). This exercise (Figure 1.3) is sung mostly in head voice, with only the highest pitch produced in whistle register. The notes produced in whistle register are forward vowels with small mouth openings, sung at softer dynamic levels than the rest of the exercise. The singer is encouraged to aspirate a small /h/ at the onset of phonation in whistle register."

Richard Miller- "He suggests that the best way for a student to approach this register is in an almost child-like manner, executing rapid patterns imitative of hilarious laughter or the imitation of a rapid siren sound (low to high), aiming at no specific pitch. His vocalises encourage an effortless feeling of release, and are based on fast-moving arpeggios, scale passages and short agility exercises."

APPENDIX Item B

Professional Development Plan

Overall Goal	**Steps that will be taken to achieve goal**	**Resources of aid**	**Target date of achievement**

Knowledge and certification as vocal teacher	Begin vocal teacher training	New York Vocal Coaching with Justin Stoney	● Submit application of interest and payment by June 10 ● Classes from July 10- October 23
Knowledge of vocal pedagogy	● Read an established book ● Become familiar with various schools of thought ● Watch more recordings on Canvas	● <u>The Estill Voice Method: Theory and Translation</u> ● Ask Voice Study Centre team for more recommendations ● Dedicate 2 hours three times weekly to watching Canvas videos	● Finish book by September ● Establish habit for 30 days and reassess in August
Establish with a vocal coach as student	Contact a teacher	● Voice Study Centre ● Justin Stoney ● Local coach from high school years	● Establish a voice teacher/coach by early July
Practice singing	● Practice daily Western classical ● Practice Indian classical (Carnatic) ● Expand repertoire	● Dedicate 1.5 hours daily to practice ● Allot 30 minutes daily to breaching new repertoire	● Establish habit for 30 days and reassess in August
Become updated on current research for trauma and voice	Read more journal articles	● UWTSD library online ● Start with “A somatic approach to vocal psychotherapy for bereaved adults with attachment trauma”	● Read first article by mid-June