

MODULE 5

BMPF 7013: Independent Study Module

An investigation into the physiological characteristics of belt and the impact on voice pedagogy when working with female adolescent voice.

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COMPONENT 1

Introduction

As a singing teacher who works predominately in a Performing Arts College, the majority of my work centres around providing vocal tuition within the Contemporary Commercial Music (CCM) genre and, more specifically, the Musical Theatre (MT) genre. The majority of singers I work with are aged between 16 and 19, attending a full-time college programme. I have been teaching for 15 years and, whilst I strive for continuous professional development, my initial training, and the majority of my professional work, has its roots firmly in the field of classical voice performance and pedagogy. Whilst many aspects of classical voice pedagogy overlap with CCM and MT styles; respiration, phonation, resonance and articulation (Bonamico, 2025; Bruder & Larrouy, 2023), there are many reported differences in terms of vocal quality and teaching techniques (Fisher, 2022; Rooney, 2023). The main gap in my knowledge I am seeking to address through this study is how to effectively and safely teach belt technique to adolescent female voices. My previous research projects have focussed on adolescent female voice, and I am keen to remain within the scope of this specialist area. The majority of my students are within this community, and I find having a specialist focus helps narrow my lens and allows me to concentrate on a specific area of voice pedagogy that is beneficial to my current practise. When choosing this study, I discovered several useful papers and books discussing effective strategies for teaching CCM and MT (Tan, 2020; Bartlett and Naismith, 2020). There is also a plethora of useful studies on teaching adolescent and developing voices (Manternach, Maxfield and Manternach, 2021; Sweet, 2015), but I found a lack of peer reviewed articles discussing teaching approaches for belt technique for adolescent singers. This study aims to fill that gap and develop my understanding of the topic to benefit my current practise.

Programme of Study

Learning Outcomes:

- To develop a deeper understanding of the term belt and understand the associated physiological characteristics.
- To develop my understanding of implications for a voice pedagogue working with students in CCM/ MT and appropriate teaching strategies to include.
- To develop an understanding of how CCM/ MT styles impact adolescent voices and how the demands of the genre impact healthy and appropriate voice use.

Objectives:

- To develop my understanding of literature review styles by selecting strategies that are most appropriate for the material and constraints of the project.
- To develop time management skills in terms of balancing research and writing tasks by developing a GANTT chart for the project.
- To develop my critical analysis and understanding of bias when completing research through self-reflection.

Literature Review Methodologies

The aim of this project is to address a gap in my knowledge through additional research and investigation. This research is grounded in the pragmatic paradigm, using mixed methodology as required to answer the research question with an emphasis on practicality (Morgan, 2014). My focus for this project was understanding the physiological characteristics of belt and considering how this impacted teaching strategies when working with adolescent female voice. An initial look at peer reviewed literature revealed a lack of research into this specific topic. A scoping review would have therefore been appropriate as it enables a researcher to clarify key concepts, analyse knowledge gaps and map evidence, particularly when there is limited research into a specific topic (Anderson, Peckham & Goodwin, 2008; Munn et al, 2018). A scoping review is intended to be exhaustive, accessing all relevant research, collating and synthesising information from a large range of sources (Randolph, 2009). I decided, on reflection, that this review style would not be possible due to the limited time frame for the project and the use of an individual researcher. These limitations, along with the challenges created by a distance learning setting; without regular support from tutors and peers, finalised by decision to veer away from a scoping review. I therefore decided to adopt a rapid review model, this is an emerging methodology that streamlines the gathering and synthesising of information through a focus on inclusion and exclusion criteria (Khangura et al., 2012; Tricco et al., 2015).

I began by contextualising the project with an initial search of literature to assess the key themes. I then began a 'berry-picking method' (Zwakman et al. 2018, p3) using both the University of Wales Trinity Saint David (UWTSD) online library and online searchers through google scholar. I chose the key phrases 'belt in adolescent voice', 'teaching belt' and 'physiological characteristics of belt'. I chose these phrases based on my learning aims and

personal experiences. These searches led to a vast amount of information surrounding the topic, but minimal peer reviewed papers linking belt technique and adolescent voice. I refined the searches further, looking for specific studies where the research participants had been adolescent voices. I focused on looking at citations from key articles, forward and backward chaining to further delve into the available literature (Winter, 2022). This led to a key article by Barlow & Lovetri (2010) who used adolescent voices as research participants when undertaking a qualitative study investigating the closed quotient phase in varying singing styles including classical and belt. This deepened my interest in investigating the specific physiological characteristics of belting and how this impacts the adolescent voice and informed the development of my inclusion and exclusion criteria.

My primary inclusion criteria was based on publication year. I was keen to focus my research on recent papers and studies, recognising that there have been vast advances in voice science due to technological advances (Velarde, 2013) and I was keen to ensure all information gathered was in line with current understanding. When specifying this date, I decided on post 2010, I chose this in line with the personal timeline of my education: I completed my Bachelor of Arts (BA) degree in 2010 so was keen to gather information from after my initial training to assist in completing my leaning objective of expanding my current knowledge. When considering the focus of my research, I was keen to ensure it would have an impact on my personal practise and align with the institutional aims of the performing arts college where I am employed. I therefore chose to focus on adolescent voice; this meant I was including papers that focussed on participants from this community. I found that in order to synthesise information effectively I was required to also include papers relating to belting across varying communities, but excluded those referring to dysphonic voices. My justification for this was that it was outside the scope of my role. I also excluded studies that used digital kymography and vibration simulators such as Ji-sung et al. (2021) as I am keen to focus on participant studies, putting the community at the heart of the methodology in line with my personal and institutional aims.

This research is being conducted in an area that is highly personal to my current practise, information gathered will be of direct benefit to me, making me an insider researcher. This provides some positive influence: studies conducted by insider researchers tend to be diligent and focussed, as the researcher is driven by a personal desire to acquire relevant knowledge (McClintock et al., 2003). However, it also provides some challenges: there is a risk of bias in terms of inclusion and exclusion criteria and a lack of accurate dissection of

key topics (Ross, 2017). Confirmation bias may be present – the ‘tendency to search for information that supports [the researchers] beliefs and ignore or distort data contradicting them’ (Peters, 2022, p1351). Confirmation bias is believed to be ‘an unconscious and automatic tendency to search for data that corroborates the researchers’ preconceived beliefs and is therefore difficult, if not impossible, to eradicate’ (Palminteri et al., 2017, p14). It is therefore important that I recognise the impact of acting as an insider researcher with bias and find ways to minimise and critically reflect on its potential impact.

Critical Reflection

I have chosen to use a reflective model to structure my critical reflection, this enables a scaffolded approach, reduces wandering thought and promotes deeper self-awareness (Thomson, 2024). I selected the Gibbs model; as shown in figure 1, as this is a model I have worked with previously and feel confident in its structure. The Gibbs reflective cycle prioritises analysis of feeling and emotional response, enabling the writer to make sense of the experience and create an action plan to inform future practise (Essuman, 2025).

Figure 1: Gibbs Reflective Cycle (Gibbs, 1988)



Description

When beginning this process, I considered which specific gaps in my knowledge were currently impacting my practise. Careful consideration went into selecting the area of focus and the decision to focus on MT vocal technique, and specifically belting, was based on my current professional role working within a Performing Arts College. I considered my previous training and how my classical techniques are sometimes not suited to the repertoire I am now being asked to teach. I wanted to address this lack of cohesion between personal training and current practise to analyse what knowledge could be gained. For previous modules I have narrowed my lens to adolescent female voices, and I made the decision to continue that through this module as through doing so I am building an area of specialism that is relevant to my professional work and valued within my local community of voice pedagogues. I began with a broad literature review, looking for key themes and areas of focus. I utilised the University library, online search engines and books that had been suggested by tutors and peers. I found there was a wealth of research connected to adolescent voice and physiological characteristics of belt which I used inclusion and exclusion criteria to process efficiently. I did note in my initial literature review that there was a lack of peer reviewed papers into belting for adolescent voice, so synthesis of information was required, to bring information together from several papers. I created a GANTT chart (see appendix 1) to work towards developing my learning objective of time management and aimed to complete tasks withing the allocated time frame. Some personal challenges created pressure points throughout the process, but support from tutors enabled me to remain on track and complete the written element of this paper promptly. I wrote component two and found I was initially over the word limit, after refining and editing this was within the accepted range. The final stage of the process was completing this reflection and considering my experience through Gibbs' cycle of reflection.

Feelings

My initial feelings were of overwhelm at the enormity of the task ahead. When selecting my research focus by considering gaps in my knowledge, I had feelings of self-doubt and inadequacy, this is in line with research by Yong and Roberts (2024) who put forward the notion that reflecting on areas of improvement and self-growth can lead to fear of inadequacy by focussing on knowledge you lack. I used peer support to overcome these initial feelings and found excitement and enjoyment within the literature review process. I felt engaged and focussed when synthesising research across the fields of adolescent voice change and physiological characteristics of belt, though at times this was frustrating and

challenging. I found the scientific data, particularly in terms of contact quotient and vocal tract length, difficult to work through at times. As a person with a creative brain, studying mainly arts-based subjects throughout my education this was something that presented a challenge. I found it useful to keep notes of particular acronyms and units of measure to refer to throughout, being proactive in this way made me feel like I was progressing effectively and minimised the impact of self-doubt at this stage. Personal challenges during this process made me feel anxious as I was aware I was navigating away from my GANNT chart, reframing this into new deadlines and areas of focus enabled me to remain positive and diligent in my studies. The acquisition of new information is something that I find motivating and, whilst not engaging in a participant study on this occasion, I found I was bringing new ideas into my practical practise which made me feel exhilarated and proud of my achievements.

Evaluation

The best part of this process was developing a clear understanding of physiological characteristics of belt. I found the research into vocal tract alteration, larynx position, vocal fold contact phases and resonance implications enlightening and informative for my current practise. This enabled me to reflect on the imagery centred, sensation-based approach of my own training and I found this beneficial. Researching the impact of the language voice pedagogues use was a valued experience within this process and enabled me to focus on my current practise and teaching methods which I found worthwhile. I found the most challenging part of this process to be linked to self-motivation. Completing a distance learning module has its challenges, not physically being with peers and tutors can create a feeling of disconnect. This is also articulated by Rajan et al. (2023) and Uyun and Fitriani (2025) who both suggest that distance learning minimises interaction with peers and can lead to feelings of isolation, demotivation and anxiety. I overcame this by utilising technology such as video calls and group messaging to remain positive. but self-motivation is an area I would be keen to improve for the next module, perhaps arranging more frequent sessions with peers. Another challenge was in the sole reliance on desk top based research, a lack of real-world participants made the project feel hypothetical, but I appreciate that using participants is beyond the scope of this module.

Analysis

To analyse the process, I will begin by considering why certain aspects of the literature review were successful. I feel my research area was of personal interest to me which ensured I remained positive and engaged. This is in line with the notion that researchers carrying out studies of personal interest, from an insider researcher perspective tend to be diligent and committed (McClintock et al., 2003). I feel my rapid review was effective as I used effective inclusion and exclusion criteria due to experience gained through similar work on previous modules. I noted that a challenge was understanding the scientific data and results from some papers addressing vocal apparatus, I have analysed this to be due to a lack of experience in working with scientific data, specific acronyms and complex result diagrams. If I consider the writing process I feel although successful and timely, it could have been more efficient if I had recorded research findings, participant information and methodological limitations in one place to avoid constantly cross referencing.

Conclusion

In conclusion, this research enabled me to meet the learning objective I set of developing my understanding of belting physiology and how this impacts the adolescent voice. This occurred most successfully in my understanding of vocal tract dimensional change and vocal fold contact quotient. I also felt success was achieved in improving academic reading and synthesising diverse sources. I recognise gaps that still exist in my knowledge, primarily in complex acoustic concepts, this is something I wish to address in future research. I also feel a lack of knowledge is apparent in understanding how adolescent changes impact male voices and I am keen to research within this area to blend my current understanding with those of male and, as an expansion, trans and non-binary voices. This was outside the scope of this paper, but something I am keen to investigate. I would approach my time line differently if I were to complete a similar project again. I created a GANNT chart which was quite rigid, personal challenges lead to me getting behind schedule and this rigid format did not allow for changes and adaptations without stress and anxiety. I would seek to find a time management strategy that allowed for greater flexibility with desired goals and alternatives to enable for a more fluid timeline to minimise anxiety and feelings of failure when the initial plan is not met. The information I have gathered during this project has met my learning aims and I feel it has informed by practise. This has been meaningful work for me as a voice pedagogue and significant in my development.

Action Plan

If I were to complete another study in this area of research I would consider expanding and deepening the breadth of my literature sources through additional search engines such as PubMed and Scopus to encourage a multi-disciplinary perspective. This was I would consider refining and targeting my search terms further to identify harder to find studies. I would ensure I utilised search features that link to inclusion and exclusion criteria (such as searching by publication date) much sooner in the process to avoid unnecessary manual filtering. When looking at a systematic review by Yiu, Lo and Barrett (2017) I gained experience of using a comparison table summarising methodology, sample characteristics and key findings. This represents a time efficient way of making quick reference to research findings and something I will adopt for future projects to make more efficient progress, enabling me to use thematic analysis techniques to see patterns, contradictions and gaps. I would also keep a research journal to encourage and increase reflexivity throughout the research process and track how interpretations change.

COMPONENT 2: WRITTEN ASSIGNMENT

Introduction

This study will begin by briefly outlining the stylistic requirements of Musical Theatre singing and the challenge classically trained pedagogues can face working within the MT style.

Differing definitions of the term Belting will be highlighted, noting its key conceptual components. Discussion will then be made into the physiological characteristics of belting, including registration, vocal tract changes, laryngeal height, vocal fold contact quotient and changes in subglottal pressure. Consideration will then be made into teaching belt in adolescent female voice, analysing how the physiological characteristics discussed have impact on the developing vocal apparatus. Conclusions will be drawn about how voice pedagogues are able to use knowledge of physiological characteristic of belt to inform their MT singing teaching by utilising evidence-based considerations.

Musical Theatre Singing

Musical Theatre has a broad and diverse history, with styles and vocal demands changing throughout the decades (Hall, 2014). The Musical Theatre singer is now expected to perform from a diverse and ever-expanding range of musical styles from classical to Pop/Rock and Rap (Taylor, 2016; Hurwitz, 2024). Performing Arts courses and voice pedagogues are being asked to provide training within this broad genre. Many voice pedagogues working within the field of Musical Theatre have their training rooted in classical techniques (Glindemann, 2021; Cox, 2024) so how are these voice pedagogues able to safely and effectively guide developing performers in this board spectrum of styles? It is articulated by some researchers (Hall, 2014; Day-O'Connell, 2014) that classical singing technique is the foundation of all styles: efficient breath work, resonance, pitch awareness and musicality are deemed to underpin all musical styles. Teaching from a classical framework and incorporating traditional techniques has been perceived as a valued corner stone of musical theatre voice pedagogy (Chandler, 2014). This is countered by LeBorgne and Rosenberg (2014) who put forward the notion that there is a need for a distinct approach to CCM vocal pedagogy to best serve the needs of the singers.

If we look at traditional classical singing training, such as Bel Canto technique which focuses on using imagery to create vocal efficiency and desired tone (Junjie & Meesorn, 2024), we see this pedagogical framework filtering through the training of many classical singers and pedagogues to this day (Chen, 2019). Ce (2023) discusses the historical shift in voice pedagogy from this imagery centred, sensation-based approach to a more science-based model informed by technological advances and deeper understanding of how vocal apparatus works. This gradual shift in approach is argued to correlate with the need for different approaches to voice pedagogy in line with physiological understanding of genre specific requirements (LeBorgne & Rosenberg, 2014). The requirements for vocal technique required in MT singing are often reported to focus on the registration requirements and, in particular, the inclusion of belting (Sanderson, 2024; Bourne & Welch, 2016; Roll, 2024)

Belting

Whilst there is no definitive origin of the word 'belting', the term is thought to have emerged in the early 20th Century (LoVetri, 2024). Belt sound originated with singers such as Ethel Merman and Patti Lupone (Bourne & Kenny, 2016), but is now commonplace in contemporary repertoire (Wilson, 2023). Well known research into the vocal quality was conducted in the 1970s by Jo Estill, who describes the term belt with words such as 'bright', 'loud', 'forward', 'speech like' and 'yell' (Estill, 1980). By the start of the 21st Century researchers were countering this, suggesting that belt does not need to be loud and does not always require a 'yell' quality, rather it is the inclusion of nasality and a lack of vibrato that are the key perceptual components (Edwin, 2002, Popeil, 2007). At this time, other researchers were highlighting that within belt, nasality is optional and adding vibrato can be of benefit to the overall colour of the sound and belt is varied in sound rather than one homogenous quality (Deer, 2008; LeBorgne, 2010). Recent developments in technology have led to a greater understanding of vocal mechanics and how specific components of the vocal apparatus impact the way in which the voice operates and how belt is produced (Ce, 2023). This has led to an understanding that belt is typified by a high laryngeal position, high and forward tongue position, high subglottal pressures and strong glottal adduction (Sundberg and Thalen, 2015; Burdick, 2005). High speed Imagery, Electroglottography (EGG) and Electromyography (EMG) all enable detailed investigation of physiological characteristics of belt in terms of vocal fold vibration pattern, closed quotients, cartilage tilting differences in thyroid and cricoid cartilages, resonance characteristics and laryngeal height; no longer relying on sensation-based imagery to inform effective pedagogy (Sundberg,

Thalén & Popeil, 2010). It is noted that voice pedagogues should possess comprehensive knowledge of the physiological characteristics of voice mechanism specific to the style in which they are teaching in order to teach effectively (Ballantyne, Horne & Manternach, 2024).

Physiological characteristics of belt

Several papers reference registration requirements when discussing belting (Sanderson, 2024; Bourne & Welch, 2016; Roll, 2024). The term 'registers' is used to categorise distinct laryngeal mechanisms which create specific frequency ranges (Herbst, 2020). This categorisation remains debated (Pabon and Ternstrom, 2020), but contemporary sources are generally in agreement that there are four distinct registers: M0 (also termed 'vocal fry' or 'pulse'), M1 ('chest' or 'modal'), M2 ('falsetto', 'head' or 'loft') and M3 ('whistle' or flute) (Herbst and Elemans, 2025). The main registers for Musical Theatre singing are M1 and M2 (Bourne et al., 2010). M1, also termed chest or modal, is the main register used in speech. Activation of the Thyroarytenoid (TA) muscle whilst relaxing the Cricothyroid (CT) muscle creates a 'thickening, shortening and medial bulging of the [Vocal Folds] VFs' (Herbst and Elemans, 2025, p4). The thickening of the VFs leads to a higher level of tension in the VF body compared to the VF cover, creating a mucosal wave in the VF cover due to the vibratory independence between the two VF portions (Kumar et al., 2020; Zhang 2023). In contrast, M2 is typified by a smaller activation of the TA muscle and stronger contraction of the CT muscle, lengthening the VFs and stiffening the VF body and VF cover (Herbst et al. 2011, Zhang 2023). Belting is most associated with the TA dominant, thicker VF mechanism of M1 (Bourne and Garnier, 2012).

A 2016 study by Bourne and Kenny (2016) aimed to understand the pedagogical perspectives of registration and the characteristics of belt amongst expert singing teachers. The study used semi-structured interviews to assess how pedagogues understand registration and teach the belt vocal quality. The research revealed a diverse range of understanding, with gaps in knowledge, most notably in the varying use of language. This was concluded to mainly focus around the use of terms linked to vocal registration such as 'chest voice'. The paper highlighted that simply assuming belting was M1 register failed to understand the impact of other physiological characteristics of belting. This notion is also highlighted by Roll (2016), who suggests that the belief that belting is produced solely by a TA dominant mechanism is outdated and the suggestion that belting is singing in M1 beyond

its typical range has led to the idea that belting is unhealthy and unsustainable. Research suggests that belting is M1 dominant, but utilises CT function, particularly as pitch ascends (Roll, 2016).

Several papers indicate that one of the key physiological characteristics of belt is an altering of the vocal tract through lifting the larynx. (Moriarty, 2014; Bozeman, 2014; Ballantyne, Horne & Manternach, 2024). There is solid evidence that raising the larynx, shortens the vocal tract as the vertical dimension of the pharyngeal cavity is effectively reduced (Smith and Zhu, 2018; Fleischer et al., 2022). A 2022 study by Fleischer et al. used 3D-MRI data, audio recordings, and electroglottography (EGG) to analyse vocal tract function across different voice qualities, including opera (classical) and belt. Results supported the previous work of Titze and Abbot (2012), which noted a shortening of the vocal tract and a megaphone shape of the vocal tract in belting; a wide and open oral opening (mouth), narrow pharynx, elevated larynx, slightly raised soft palate and slightly lowered or pulled back tongue (Sundberg, 2015; Story, 2001; Titze, 2000). A 2025 study by Rudish et al. used Magnetic Resonance Imagery (MRI) to investigate the shape of the vocal tract whilst belting for professional Musical Theatre performers. This paper referenced understanding from previous studies that the Vocal Tract produced a megaphone shape in belting (Bozeman, 2014; Titze and Abbot, 2012), but concluded that, within their research participants, a more forward tongue configuration and space in the oropharynx resulted in a 'tube-like' vocal tract when belting, countering the previously held assumption of a megaphone shape. The paper noted limitations of a small sample size and the use of a two-dimensional sagittal plane MRI, which was unable to capture lateral aspects of vocal tract shaping. The researchers discussed the high variability and complexity in vocal tract shapes produced in belting styles and highlighted the need for voice pedagogues to establish evidence-based practice in the voice studio, understanding the impact of the vocal tract function (Rudish et al, 2025).

Solid research across many decades is in agreement that there is a lengthening of the vocal tract in adolescent female voice (Wisenall, 1930; Weiss, 1950; Huff-Gackle, 1985; Abitbol et al., 1999). A 2010 study by Xue et al. used Acoustic Reflection Technology (ART) to investigate the effect of vocal tract dimension development on adolescent voices. The research concluded that there was statistical significance in the changes to not only vocal tract length, but volume during pubertal changes. They noted that this change was rapid and varied across participants (Xue et al., 2010). This concurs with research conducted in 2009 by Vorperian et al. who noted that vocal tract morphology in adolescent singers does not

stabilise until after adolescence and this impacts resonance strategies. The changing dimensions of the vocal tract enable many of the physiological characteristics of belting in late adolescents: allowing greater resonant capacity, sophisticated vowel tuning and greater harmonic reinforcement, with greater muscular control enabling an ability to manipulate precise auditory shaping required for belting (Cheng and NG, 2010). This level of control is not seen in younger adolescent singers who, with reduced muscular control due to sudden changes in larynx dimension and vocal tract capacity, may have instability in phonation (Abitbol et al., 1999). Thus, the need for voice pedagogues working within this community to use evidence-based research to inform and adapt teaching techniques as adolescence progresses is vital when incorporating belting.

If we consider the vocal fold Contact Quotient (CQ) in belting; the period where the vocal folds remain in contact during the vocal fold vibration (Ikavalko & Laukkanen, 2025). There are several research papers with varying results. Herbst et al. (2011) has noted that successful belting requires a CQ of 0.5 (50%), where the vocal folds remain in contact for half of the vocal fold vibration. This is countered in a research paper by Sundberg et al. (2012) who noted a CQ for belting of only 30%. Overall, all accessed research recognises CQ for belting to be higher than that of classical singing (Bourne et al., 2016). A study by Frič et al. (2024) used Electrolaryngography (ELG) analysis to investigate the six vocal qualities referenced in Estill Voice Training (EVT) which included 'Opera' (rooted in classical technique) and 'Belt'. This study noted a longer contact phase for belt consistently across all participants, but individual variation was present and not all participants demonstrated equally high levels of CQ when Belting. An interesting study by Barlow & Lovetri (2010) into the CQ of belting in adolescent females found that there was only a mean increase in CQ of 4.1% when investigating classical and belt singing, with belt CQ being 30.7% compared to 26.6% in classical. This was considerably lower than the researcher had expected and not in line with previous studies investigating adult belt voice CQ (Evans and Howard, 1993; Howard, 1995). An important reminder for voice pedagogues, working with adolescent female voice, that their developing vocal apparatus may not make the same physiological changes between styles as fully developed professional voices used as research participants.

Björkner (2008) articulates that the higher CQ for MT singing demonstrates a greater reliance on strong glottal closure and increased subglottal pressures (P_{sub}). Additional recognition of a link between a higher CQ and an increased P_{sub} highlights that the increase

enables initiation of vibration and an ability to sustain oscillation of the vocal folds (Titze, 2000; Sundberg, 2015). A study by Sundberg, Thalén and Popeil (2012) investigated Psub in a single subject study, using Flow Glottograms to measure Psub across various singing styles including classical and belt. The researcher concluded that Psub was highest in belt and lowest in classical, this was discussed as being in line with previous research recognising that belt is mostly produced in modal register where the vocal folds are assumed to be thick and require high pressures for phonation (Hein, 2010). A Pedagogical viewpoint is highlighted by Titze (2000) who suggests that the increased Psub and increased CQ in belting can lead to a strained and constricted tone which may represent unsustainable vocal effort. Zhang (2019) makes reference to this unsustainable vocal effort in terms of the muscular ability to adapt to differing Psub in voices which are dysphonic, with a lack of control over efficient adduction and glottal closure. Links could be made here to similar inability to control vocal mechanisms in developing adolescent voices, an important consideration for voice pedagogues working within this community.

Practical pedagogical considerations when teaching belt in adolescent voice

Adolescent female voice is characterised by the physical changes brought about by the changing hormones in puberty (Thurman, 2012; Sweet, 2015; Lebourgne, 2016). Numerous research papers detail the sudden period of laryngeal growth which are linked to surges in hormones. This growth in the Larynx reduces muscular control over the posterior cartilage and vocal folds leading to a decrease in efficient adduction and an onset of a characteristic breathy tone, inconsistent pitching and difficulty navigating the passagio (Abitbol and Abitbol, 2014; Gackle, 2000; Mercado and Draut, 2023). A 2022 study by Baker, articulated that the major audible descriptor of adolescent female voice is breathy phonation. The study used inverse filtering techniques to assess vocal characteristics and concluded that varying subglottal pressure, vocal fold adduction and a low CQ were responsible for breathy phonation. It was concluded that this was due to a lack of control of phonatory mechanisms due to adolescent changes. As voice pedagogues, a knowledge of this challenge is important in teaching belt which requires a longer CQ and consistent Subglottal Pressure.

Research suggests that the inclusion of SOVT (Semi Occluded Vocal Tract) exercises may provide a solution to this challenge, encouraging efficient voice production (Hijleh and Pinto, 2021). SOVT exercises which have a single source of vibration such as humming and hand-

over-mouth (HOM) exercises are used to facilitate efficient vocal fold adduction (Andrade et al., 2014; Iwahashi et al., 2017). A study carried out by Zenari et al. (2023) used acoustic measurements and spectrographic data to investigate the impact of single source humming exercises on Phonation Threshold Pressure (PTP). The researchers concluded that the repetition of 5 humming exercises used in the study had a statistically significant impact on the PTP and subglottal pressure. This provides a basis for inclusion of SOVT exercises in adolescent voices working towards belting techniques as the reduction of PTP may enable a more stable Subglottal Pressure. Kayes (2019) notes the value of using SOVT exercises in teaching belt, highlighting that the inclusion of such exercises creates back pressure and facilitates proprioceptive awareness. Manternach (2024) highlights the importance of including SOVT exercises with adolescent voices developing belt technique as a vocal 'reset'; reducing supraglottic constriction and passively expanding the airway, retuning the larynx back to a neutral position after elevation during belt techniques. This is countered by Titze (2000) who articulates that the elevated position of the larynx which produces the desired bright and forward MT sound is not produced by the inclusion of SOVT exercises which produces a darker timbre by lengthening the vocal tract.

Double source SOVTE such as Water-Resistant Tube Phonation Exercises (WRTPE) involve bubbling air into water through a tube (Guzman et al., 2016). This has long been seen in the field of Voice Rehabilitation as it creates fluctuations in the vocal fold contact. This fluctuation comes from the quasi-periodic waveform: 'a waveform that does not repeat itself in the shorter term but does so in the longer term' (Cordeiro et al., 2015, p231), created by the variation in glottal air flow (Cordeiro et al., 2015; Story, Laukkanen and Titze, 2000). The varying back pressure and vocal fold contact creates a reported 'massage-like' effect, reducing tension on laryngeal muscles and reducing vocal effort (Guzman et al., 2016). In young adolescent voices, before a growth in vocal tract length and volume, the shorter vocal tract can lead to higher natural impedance, faster response to straw phonation benefits and greater sensitivity to pressure changes (Vorperian et al., 2009; Xue et al., 2010). A practical pedagogical consideration may therefore be considering adjusting SOVT parameters (e.g. straw length, diameter, depth of submersion) based on the individual impact. This is in line with research from Keltz and McHenry (2002) who highlight that double source SOVT exercises can be done ineffectively if parameters are not appropriate for the participant.

Another practical consideration when teaching belt in adolescent voice is in appropriate repertoire selection. A research paper by Gend et al. (2017) used qualitative data analysis to

assess appropriate repertoire in adolescent voices, it concluded that selecting repertoire that provided variation in range and registration was essential and that categorising voices too early in the singers training was detrimental to their overall vocal journey. This is also noted by Sweet (2019) who highlights that as selecting appropriate repertoire as the adolescent voice develops is essential for vocal health. Both of these studies were focusing on choral singing so have limited impact on this study and represent a gap in peer reviewed research within the area of adolescent musical theatre vocal training. An understanding of the challenges the adolescent singer may be facing should be fundamental to repertoire selection (Bonamico, 2024). A repertoire list has been suggested by the National Association of Teachers of Singing (NATS, 2025) with guidance on MT repertoire selection for adolescent voices. The discussion focusses on beginning with simple speech quality songs, basic in structure with a small pitch range that falls within the spoken frequency of their individual voice. The paper puts forward a suggested development of repertoire with incrementally more challenging range, sustain and registration requirements in line with developing vocal apparatus (Sale, 2022; NATS, 2025).

Voice pedagogues have reported concerns about the risks of belt singing and how to safely deliver training in this vocal quality, particularly in developing adolescent voices (Bourne and Kenny, 2016). The risk of vocal injury when attempting belt techniques without sufficient training and guidance can be high, especially when working with developing vocal apparatus (Cleveland and Stack, 2019). Vocal health experts and Speech and Language Therapists are in agreement that belt quality should aim to be effortless despite the high vocal energy (Gend et al., 2017). Research by Middendorf (2015) articulates that the combination of elevated pressure and tight glottal adduction increases the risk of phonatory fatigue and injury. This is also expanded by Rotsides et al. (2021) who discusses that laryngeal pathologies are prevalent in the field of MT singing due to a higher risk of vocal fold lesions due to increased vocal effort. This is further discussed by Zhang (2021) who highlights that increased vocal effort and vocal fold contact pressure can be reduced with a lowering of subglottal pressure. SOVT exercises and vocal tract shaping can help reduce contact pressure on the folds, reducing the risk of injury in high intensity singing styles such as belt (Zhang, 2021). Research by Stachler (2018) discusses the role of a voice pedagogue in facilitating referrals to a 'Voice Team' (Laryngologist, ENT, Speech-Language Pathologist) and identifies factors which should be considered for further assessment. These are noted as hoarseness, prolonged vocal fatigue, voice breaks, loss of resonant quality and pain while singing or speaking. This is also discussed by Ragan (2017) who highlights the professional responsibility of voice teachers to recognise potential issues and refer in a timely manner.

Zhang (2021) also notes the importance of working from an evidence-based framework when awaiting referral, considering how you can reduce rehearsal load, simplify registration requirements and increase SOVT exercises to reduce vocal load, reduce subglottal pressure and pressed phonation.

Conclusion

In conclusion, Musical Theatre singing provides challenges for voice pedagogues who often have their training rooted in Classical techniques (Glindemann, 2021; Cox, 2024). The genre specific requirements and desired belt tone require a distinct approach which is underpinned with an evidence-based understanding of the physiological characteristics of belt (LeBorgne and Rosenbery, 2014; Roll, 2024). Whilst no definitive definition of 'belting' exists, research is generally in agreement that the sound is typified by a high laryngeal position, high subglottal pressure, long contact quotient and strong glottal adduction. (Sundberg and Thalen, 2015; Burdick, 2005). Advances in technology have enabled greater depth of research and analysis into vocal apparatus when phonating in belt. Understanding now goes beyond the basic categorisation of 'chest voice' and head voice' and categorises laryngeal mechanisms into four distinct registers: M0-M3 (Herbst and Elemans, 2025). Research suggests that defining belt as purely within an M1 register, with a strong Thyroarytenoid mechanism is outdated and fails to understand specific physiological changes that go beyond registration mechanisms (Roll, 2016). If we consider the altering of the vocal tract, research highlights a shortening of the vocal tract through an elevation in laryngeal position is expected in belting (Smith and Zhu, 2018; Fleischer et al., 2022). Established research suggests a megaphone shape of the vocal tract in belting; a wide and open oral opening (mouth), narrow pharynx, elevated larynx, slightly raised soft palate and slightly lowered or pulled back tongue (Sundberg. 2015; Story, 2001; Titze, 2000). This is countered by Rudish et al. (2025) who puts forward the notion of a 'tube-like' vocal tract. To discuss vocal fold Contact Quotient (CQ), research suggests a general trend to a longer CQ in belting (Fric, et al. 2024; Bourne et al. 2016). The increased subglottal pressure in a higher CQ can present a pedagogical challenge in terms of vocal health; the muscular ability to adapt to differing subglottal pressure may be insufficient in adolescent voices which lack muscular control and efficient glottal adduction (Zhang, 2019; Hein, 2010). This lack of muscular control is prevalent in adolescent female voice due to the rapidly changing hormones leading to periods of sudden growth in the larynx (Thurman, 2012; Sweet, 2015; Lebourgne, 2016). Reported issues are decrease in efficient adduction, inability to manage subglottal pressure and reduced CQ (Baker, 2022). To provide effective vocal training of belt quality in line with

stylistic requirements of MT repertoire, pedagogues must use evidence-based techniques to address the challenges adolescent female voices may face. Research suggests the inclusion of SOVT exercises to reduce PTP, return the larynx to a neutral position after elevation and stabilise subglottal pressure, promote efficient adduction (Hijleh and Pinto, 2021; Manternach, 2024). This could be achieved through single and double source SOVT exercises such as humming, HOM and WRTPE, adjusting parameters such as tube length, submersion depth or duration to suit the individual student (Xue et al., 2010). Assessment would need to be made based on reported benefits by the singer and audio analysis and reflection by the voice teacher. Research reveals a lack of evidence-based guidance for voice pedagogues in assessing the impact of SOVT exercises through audio analysis and more research is needed to provide a practical framework (Dargin, 2016). Appropriate repertoire selection is required when teaching belt to adolescent voice, considering scaffolding skills based on physiological complexities as the developing voice is able to achieve the desired sound. This requires monitoring of ability to maintain strong glottal closure with a long CQ, extend range without strain and additional tension in laryngeal muscles and meet desired registration requirements. Guidance is given by the National Association of Teachers of Singing (NATS, 2025), but aside from this, little practical guidance is seen in research leaving it up to individual teachers to develop progression plans. Vocal health is a key concern when teaching belt to adolescent voice. Voice pedagogues have a responsibility to report any issues of excessive vocal fatigue, prolonged hoarseness or pain while speaking or singing to a specialist voice team, ensuring vocal health is at the forefront of vocal development and training in adolescent voice (Stachler (2018; Ragan, 2017). Evidence-based understanding of the physiological requirements of belt enables a voice pedagogue to safely and effectively deliver training within this complex and wide-ranging genre.

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APPENDIX 1: GANNT CHART

