

# **What insights does existing literature provide on the benefits of Semi-Occluded Vocal Tract exercises for Contemporary Commercial Music singers?**

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# **What insights does existing literature provide on the benefits of Semi-Occluded Vocal Tract exercises for Contemporary Commercial Music singers?**

## **PORTFOLIO**

### **Introduction**

As a vocal coach who works with students aged 5-25, I find it essential to learn practical tools to help students develop healthy, flexible, and expressive voices. Due to the demands of my students, I am now shifting my practice from Western Classical to Contemporary Commercial Music (CCM) (LoVetri & Weekly, 2003). Individuals learning CCM face unique challenges, including high vocal demands, such as frequent register transitions, and maintaining vocal stamina across different genres and expressive vocal effects, including vocal fry and twang, which increase the risk of vocal fatigue and misuse (Saldias et al., 2020; Lloyd et al., 2020). Commonly found in CCM singing, the use of a high-intensity vocal mode, such as belting, involves increased subglottal pressure and vocal fold adduction to achieve powerful sounds (Sundberg et al., 1993). The elevated subglottal pressure and strong vocal fold adduction to produce powerful tones increase the risk of vocal fatigue and strain (Sundberg et al., 1993). These combined factors highlight the need for specialized vocal strategies to support vocal health in CCM singers. This paper seeks existing literature on the benefits of Semi-occluded vocal tract exercises (SOVTE) for CCM learners and applies this information to the vocal studio setting.

### **Programme of Study**

#### **Context**

SOVTE have shown measurable improvements in vocal ease through three mechanisms (Apfelbach & Guzmán, 2024): increase inertive reactance of vocal fold and

vocal tract (Story et al., 2000; Titze & Laukkanen, 2007), increase inertive reactance of air column (Titze, 2006) and increase flow resistance (Guzmán et al., 2016; Horáček et al., 2019). While both CCM and SOVTE are widely used in vocal training, there is limited research exploring how these two ideas intersect in educational settings. This paper investigates the existing literature to reveal how SOVTE benefits CCM singers.

### Aims

1. Support CCM learners in vocal health through gaining knowledge of SOVTE and its application to my practice.
2. Critically review existing literature on SOVTE and their vocal pedagogical implications.
3. Identify key pedagogical strategies emerging from the literature relating to SOVTE and CCM singers.

### Objectives

1. Collect and analyze peer-reviewed articles, books, and authoritative sources addressing SOVTE and CCM in vocal pedagogy.
2. Compare and contrast outcomes in the literature on the effectiveness of SOVTE in supporting student learning CCM.
3. Gain a deep understanding of how SOVTE benefits CCM singers.

### Expected Learning Outcomes

1. What is SOVTE?
2. What are the benefits of SOVTE?
3. What are the limitations of SOVTE?

4. How to apply SOVTE for CCM learners?

### Tasks and Timeline

Figure 1 shows a GANTT chart and timeline of tasks for completing this study.

### Activities

1. Collect and analyze peer-reviewed articles, books, and authoritative sources addressing SOVTE in vocal pedagogy.
2. Summarize the benefits of using SOVTE in voice training, finding specific literature related to CCM singers.
3. Summarize vocal challenges for CCM singers.
4. Synthesize findings into a coherent framework outlining how SOVTE benefits CCM singers.
5. Discuss limitations and gaps in the current body of research and propose directions for future study.

|                |               |
|----------------|---------------|
| Project Start: | Mon, 9-1-2025 |
|----------------|---------------|

|  |  |             |             |              |              |              |             |              |              |              |
|--|--|-------------|-------------|--------------|--------------|--------------|-------------|--------------|--------------|--------------|
|  |  | Sep 1, 2025 | Sep 8, 2025 | Sep 15, 2025 | Sep 22, 2025 | Sep 29, 2025 | Oct 6, 2025 | Oct 13, 2025 | Oct 20, 2025 | Oct 27, 2025 |
|--|--|-------------|-------------|--------------|--------------|--------------|-------------|--------------|--------------|--------------|

[illegible]

**What insights does existing literature provide on the benefits of Semi-Occluded Vocal Tract (SOVT) exercises for Contemporary Commercial Music (CCM) singers?**

|                |               |
|----------------|---------------|
| Project Start: | Mon, 9-1-2025 |
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|               |   |
|---------------|---|
| Display Week: | 1 |
|---------------|---|

|                                                                                                       |  |  |  |             |   |   |   |          |   |   |    |              |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
|-------------------------------------------------------------------------------------------------------|--|--|--|-------------|---|---|---|----------|---|---|----|--------------|----|----|----|----|----|----|----|--------------|----|----|----|----|----|----|----|--------------|----|----|----|---|---|---|---|-------------|---|---|---|---|----|----|-------------|----|----|----|----|----|----|--------------|----|----|----|----|----|----|--------------|----|----|----|----|----|---|--------------|---|---|--|--|--|--|
| Display Week:                                                                                         |  |  |  | 1           |   |   |   |          |   |   |    |              |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
|                                                                                                       |  |  |  | Nov 3, 2025 |   |   |   |          |   |   |    | Nov 10, 2025 |    |    |    |    |    |    |    | Nov 17, 2025 |    |    |    |    |    |    |    | Nov 24, 2025 |    |    |    |   |   |   |   | Dec 1, 2025 |   |   |   |   |    |    | Dec 8, 2025 |    |    |    |    |    |    | Dec 15, 2025 |    |    |    |    |    |    | Dec 22, 2025 |    |    |    |    |    |   | Dec 29, 2025 |   |   |  |  |  |  |
|                                                                                                       |  |  |  | 3           | 4 | 5 | 6 | 7        | 8 | 9 | 10 | 11           | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19           | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27           | 28 | 29 | 30 | 1 | 2 | 3 | 4 | 5           | 6 | 7 | 8 | 9 | 10 | 11 | 12          | 13 | 14 | 15 | 16 | 17 | 18 | 19           | 20 | 21 | 22 | 23 | 24 | 25 | 26           | 27 | 28 | 29 | 30 | 31 | 1 | 2            | 3 | 4 |  |  |  |  |
| TASK                                                                                                  |  |  |  | PROGRESS    |   |   |   | START    |   |   |    | END          |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
|                                                                                                       |  |  |  |             |   |   |   |          |   |   |    |              |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Researcher                                                                                            |  |  |  |             |   |   |   |          |   |   |    |              |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Projection Completion                                                                                 |  |  |  | 100%        |   |   |   | 9-1-25   |   |   |    | 12-30-25     |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Brainstorm on Research Question                                                                       |  |  |  | 100%        |   |   |   | 9-1-25   |   |   |    | 9-6-25       |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Collect and analyze peer-reviewed articles, books, grey literature addressing SOVTE in vocal pedagogy |  |  |  | 100%        |   |   |   | 9-6-25   |   |   |    | 10-26-25     |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Prepare Component 1 (C1) Context                                                                      |  |  |  | 100%        |   |   |   | 9-6-25   |   |   |    | 9-11-25      |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| C1 Aims, Objectives, Expected Learning Outcomes, Activities                                           |  |  |  | 100%        |   |   |   | 9-6-25   |   |   |    | 9-9-25       |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| C1 determine type of methodology and research                                                         |  |  |  | 100%        |   |   |   | 9-9-25   |   |   |    | 9-14-25      |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| C1 recognize limitations                                                                              |  |  |  | 100%        |   |   |   | 10-26-25 |   |   |    | 10-28-25     |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Summarize benefits in the use of SOVTE, finding specific literature related to CCM                    |  |  |  | 100%        |   |   |   | 10-26-25 |   |   |    | 10-31-25     |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Summarize vocal challenges for CCM singers                                                            |  |  |  | 100%        |   |   |   | 10-26-25 |   |   |    | 10-31-25     |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Synthesize findings into a coherent framework outlining how SOVTE benefits CCM singers                |  |  |  | 100%        |   |   |   | 10-31-25 |   |   |    | 11-2-25      |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Discuss limitations and gaps in current body of research and propose directions for future study      |  |  |  | 100%        |   |   |   | 11-2-25  |   |   |    | 11-4-25      |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Component 2 (C2) review of literature to write                                                        |  |  |  | 100%        |   |   |   | 11-4-25  |   |   |    | 11-14-25     |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Component 2 (C2) review of literature to write                                                        |  |  |  | 100%        |   |   |   | 11-10-25 |   |   |    | 11-20-25     |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| C2 Critifcal Reflection                                                                               |  |  |  | 100%        |   |   |   | 11-20-25 |   |   |    | 11-22-25     |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Prepare initial draft                                                                                 |  |  |  | 100%        |   |   |   | 11-29-25 |   |   |    | 12-8-25      |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |
| Final Draft: Revise based on draft comments                                                           |  |  |  | 100%        |   |   |   | 12-8-25  |   |   |    | 1-2-26       |    |    |    |    |    |    |    |              |    |    |    |    |    |    |    |              |    |    |    |   |   |   |   |             |   |   |   |   |    |    |             |    |    |    |    |    |    |              |    |    |    |    |    |    |              |    |    |    |    |    |   |              |   |   |  |  |  |  |

## **Methodology**

### Rationale for Narrative Review

A narrative review was selected to explore the benefits of SOVTE for CCM singers because it allows the researcher to include a wide variety of studies and an overall summary with interpretations and critiques (Greenhalgh et al., 2018). Although this type of review will not provide an exhaustive, comprehensive literature review, it allows the researcher to compile multiple perspectives to shape the analysis (Sukhera, 2022). This is important to the research question because a narrative review allows the existing literature on SOVTE to be examined across vocal pedagogy, vocal science, and CCM practice, enabling a more comprehensive synthesis of insights into the specific physiological, acoustic, and pedagogical benefits of SOVTE for CCM learners in my studio. Adding the snowballing method helps capture relevant studies by checking reference lists (backward) and citations (forward), thereby uncovering key studies (Badampudi et al., 2015). This approach is directly relevant to the research question, as snowballing supports the identification of influential and discipline-specific studies on SOVTE that may not be retrieved through database searches alone; thus, focusing on a more comprehensive understanding of the benefits reported for CCM singers in the existing literature.

An integrative review was initially chosen because it allows selected studies to be evaluated for relevance and contribution to the topic. However, this method relies on systematically extracting and comparing data across studies (Whittemore & Knafl, 2005). Upon reading the SOVTE studies, it was found that they were highly diverse,

with different participants, various interventions (straw, lip, humming), outcome measures, and study designs. Therefore, it is challenging to standardize extraction across these studies; thus, synthesis would be inconsistent and potentially misleading.

In addition, a systematic review was deemed unsuitable because it relies on standardized, directly comparable outcome measures (Higgins et al., 2023). SOVTE studies had different measurable outcomes, for example, aerodynamic measures (Titze, 2006) versus supraglottic adjustments (Guzman et al., 2017), which makes it challenging to have a unified form of synthesis of information (Liberati et al., 2009). Similarly, a meta-analysis requires large comparable datasets for statistical pooling (Borenstein et al., 2021). From my initial review of SOVTE studies, the research often has small, diverse samples, such as 35 patients with dysphonia (Meerschman et al., 2019) and 20 healthy singers (Mills et al., 2018); thus, limiting the feasibility of meta-analysis (Valentine et al., 2010).

Another consideration was the scoping review. However, since this method is commonly used to assess breadth rather than effectiveness (Munn et al., 2022; Campbell et al., 2023), it was not selected. The broader scope makes the approach less practical for a focused question, such as the one addressed in this paper (Tricco et al., 2016). For all the above reasons, a narrative review using the snowballing method was used, as it addresses the research question and aims of this project.

### Literature Search and Selection Strategy

The review used a search strategy across multiple academic databases, including Google Scholar, JSTOR, and the University of Wales Trinity St. David

(UWTSD) database. The objective was to locate peer-reviewed journal articles, empirical studies, and pedagogical literature that examine SOVTE in singers (including but not limited to CCM singers), vocalists, or voice-therapy patients. See Table 1 for search terms used.

Studies were included if they a) explicitly used SOVTE; b) evaluated vocal outcomes quantitatively or qualitatively; c) involved human participants; d) were published in English; and e) were published after 2000 for relevance. Titles and abstracts were reviewed to assess against the inclusion criteria. Peer-reviewed studies were prioritized for their methodological rigour, quality, accuracy and credibility (Kelly et al., 2014). To gain broader perspectives and fill knowledge gaps, I examined the grey literature of leading voice pedagogues to identify teaching strategies for CCM learners when engaging with SOVTE, gaining insights that may not appear in peer-reviewed literature. From my review, I found that strategies for vocal teachers are an area with minimal peer-reviewed literature, particularly for CCM learners. Grey literature may provide practical perspectives regarding teaching SOVTE, specifically with CCM singers. Practitioners' knowledge is a valuable component of evidence-based voice

| Table 1: Search Terminology in Review of Literature |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Search Terms</b>                                 | <p>Semi-Occluded Vocal Tract, SOVT<br/>Semi-occluded vocal tract exercise<br/>Semi-occluded vocal tract benefits</p> <p>Voice pedagogy<br/>Vocal health<br/>Vocal health strategies<br/>Vocal care</p> <p>Contemporary Commercial Music, CCM<br/>CCM challenges<br/>CCM vocal challenge</p> <p>Semi-occluded vocal tract AND Contemporary Commercial Music<br/>Semi-occluded vocal tract AND CCM</p> <p>"Semi-occluded vocal tract" AND ("benefits" OR "advantages")<br/>"Semi-occluded vocal tract" AND ("disadvantages" OR "harm")</p> <p>"CCM" AND "semi-occluded vocal tract"<br/>"Contemporary Commercial Music" AND "semi-occluded vocal tract"</p> <p>("CCM" AND "pedagogy") AND ("semi-occluded vocal tract" OR "straw phonation")<br/>AND "(music education" OR "voice study" OR "vocal pedagogy")</p> <p>"Contemporary Commercial Music" AND ("pedagogy" OR "strategies")</p> |
| <b>Academic Databases</b>                           | <p>Google Scholar<br/>Jstor<br/>Library of UWTSD</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Inclusion Criteria</b>                           | <p>Publications from 2000 to present.</p> <p>English-language publications.</p> <p>Studies focus on SOVT or CCM</p> <p>Research examining vocal pedagogy with relevance to SOVT and/or CCM.</p> <p>Peer-reviewed journal articles, scholarly articles and vocal pedagogy text.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Exclusion</b>                                    | <p>Sources mention SOVT and CCM in passing without meaningful engagement with the research question.</p> <p>Non-scholarly web articles, opinion blogs, or informal teaching materials.</p> <p>Publications that are older than 1999 unless relevant to my research question and no further updated existing literature on the same topic.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

pedagogy, contributing practical insight grounded in real-world experience (Bozeman & Ragan, 2022).

Inclusion criteria for grey literature were based on the CRAAP test (Blakeslee, 2004) and on ideas from Paez (2017), Ragan (2018), and Baethge et al. (2019). Paez's ideas, although for systematic reviews, provide a more clearly defined criterion for this research in assessing the validity of the grey literature. Criteria include direct relevance to SOVTE and/or CCM, as this ensures the information is not generalized classical voice pedagogy but specific to CCM. Formal credentials, including specialized training,

provide evidence of formal knowledge and demonstrate practical expertise relevant to CCM. Professional experience acknowledges the value of practicality in the literature (Ragan, 2018). Grey literature used in this paper includes work by speech pathologist and CCM vocal coach Tom Burke (2019) on practical application strategies for SOVTE. Table 1.1 shows consideration for this source using the CRAAP test. A similar evaluation was completed and concluded for the works of vocal pedagogue Nix (2016) and exercises from Rosenberg and Leborgne's (2024) *The Vocal Athlete*.

| Table 1.1: Evaluation of Grey Literature by Tom Burke (2019)<br>CRAAP Test (Blakeslee, 2004) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Currency</b>                                                                              | The timeline of SOVTE video by Tom Burke used is posted March 2019, which is still relevant to this 2025 research paper.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Relevance</b>                                                                             | Content of the video is regarding SOVTE and a step-by-step approach to using it, tailored for CCM learners. Thus, the content is relevant to the research question.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Authority</b>                                                                             | The source is from Tom Burke whose vocal coach practice is informed by Estill Voice Training, a physiologically based model that emphasises conscious control of vocal structures and has been examined in peer-reviewed research for its relevance to contemporary singing styles (Fantini et al., 2017). He is an Estill Voice Training Instructor. In addition, he is an accredited speech-language pathologist.                                                                                                                                                                                                                                                                      |
| <b>Accuracy</b>                                                                              | Information from the content is consistent to some information found in peer-reviewed literature such as, the depth of straw in the water.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Purpose</b>                                                                               | The purpose of the information is to teach singers how to use SOVTE and a step-by-step approach based on level of perceived difficulty based on teaching experience. The target audience is likely CCM singers since there is reference to Broadway auditions. Thus, the purpose of the content is in line with the intended focus of the research question and the researcher's learning outcomes.                                                                                                                                                                                                                                                                                      |
| <b>Conclusion</b>                                                                            | Evaluation of the CRAAP test shows this resource is credible and appropriate for this research paper. It is recognized in Keeps Framework (2012) this YouTube video is likely tier 2 with moderate credibility. However, the above CRAAP test shows the resource is credible and will be used for the purpose of this research paper with the understanding of its limitation. Although Burke's work is not peer reviewed, it is included because it offers CCM specific, practice-based insight into how SOVTEs are applied in real teaching contexts, helping to contextualise the benefits identified in the literature and informing the applied strategies presented in Appendix A. |

The inclusion criterion was also used in the snowballing process. As the list of sources grew, the list of relevant peer-reviewed papers increased. Key articles included widely recognized voice scientist Dr. Titze (2006), voice pathologist and researcher Dr. Guzman et al. (2013) and biomechanical and aerodynamic voice researcher Silverman

et al. (2023). From these key articles, additional references served as sources for the literature review.

### Limitations

Several of the literature were highly technical in vocal physiology and acoustics. As a vocal teacher without extensive formal training in voice science, this may have influenced how the findings were understood and presented. The inherent nature of the narrative review approach relies on the researcher's judgment in selecting and synthesizing studies (Paré & Kitsiou, 2017), introducing a degree of subjectivity. There is a limitation: I may have misinterpreted the complex scientific information about the voice. However, the information I have concluded includes several studies supporting a similar point, along with comments from vocal pedagogues. Thus, supporting my conclusion is likely sound within my context.

Although the snowballing method expanded the number of relevant studies (Greenhalgh & Peacock, 2005), it depended on the initial key articles chosen. Thus, pertinent research may have been missed. Furthermore, the project was limited by a four-month completion timeline, which constrained the depth of the search and analysis. The range of grey literature explored was also limited. Non-English studies and publications before 2000 were mainly excluded to reduce the risk of translation errors and ensure relevance, potentially leaving out additional insights. Overall, while the review provides a considered overview of SOVTE for CCM singers, its findings are limited and not exhaustive. This point is acknowledged when drawing broader conclusions.

# PROJECT REPORT

## Introduction

As my teaching practice expands within CCM, the need for approaches that support adaptable vocal production has become increasingly apparent in my studio. Many of my CCM students encounter obstacles that differ from those found in classical training, particularly when navigating stylistic qualities such as rapid shifts between registers and genre-specific effects like twang and vocal fry. These elements, while central to CCM performance, can have considerable demands on the voice and heighten the likelihood of fatigue or misuse when not approached with sufficient technical grounding (Saldias et al., 2020; Lloyd et al., 2020).

SOVTE have gained attention for their ability to promote efficient phonation by enhancing inertive reactance in both the vocal folds and the vocal tract (Story et al., 2000), increasing the supportive pressure of the air column (Titze, 2006), and offering beneficial flow resistance (Guzmán et al., 2016; Horáček et al., 2019). Although SOVTEs are well-integrated into many contemporary teaching practices, the extent to which the current literature connects these exercises specifically to the vocal health of CCM singers remains under-examined.

For this paper, my analysis centers on approaches that can be meaningfully applied within a teaching studio. Although a wide range of scientific and quantitative research exists on vocal acoustics and physiology, interpreting such data extends beyond my training and the intent of this project. I aim to gain a clearer understanding of how SOVTE benefits CCM singers and to identify practical techniques to incorporate into my own vocal pedagogy.

## **Review**

### What is SOVTE

SOVTEs use phonation through a partially closed vocal tract (Titze, 2006). SOVTEs have been beneficial in voice therapy (Guzman et al., 2013; Abbott, 2008), Western Classical singing (McKinney, 1994; Miller, 1996), choral singing (Titze et al., 2015; Manternach et al., 2019) and CCM singing (Nix, 2016; Rosenberg & Leborgne, 2024). Given the widespread use of SOVTEs, it is important to examine what the existing literature says about SOVTE and its benefits for vocal health.

In summary, SOVTE increases resistance in the vocal tract above the vocal folds, reducing the air pressure required to initiate vocal fold vibration (Titze, 2006). Thus, resulting in greater ease of producing sound (Titze, 2006; Ford et al., 2024). Upon closer inspection, the semi-occluded configuration of the vocal tract creates back pressure (inertive reactance) in the supraglottic area, which aids in the vibration of the vocal folds (Titze, 2021). This back pressure gently pushes against the vocal folds, resulting in steadier (Ford et al., 2024) and more efficient vibrations (Titze, 2006; Patel et al., 2019). As a result, it decreases the effort needed for phonation (Apfelbach & Guzmán, 2024). Additionally, this back pressure reduces the impact force of the vocal folds during voicing, potentially protecting the tissues from damage caused by excessive strain (Silverman et al., 2023). In addition, SOVTEs improve impedance matching between the vocal folds and the vocal tract, thereby enhancing acoustic energy and vocal efficiency (Titze, 2006). Consequently, singers note less effort in phonation (Titze et al., 2007).

One of the key physiological advantages of SOVTE is a reduction in phonation threshold pressure (PTP), the minimal subglottal pressure required to initiate and sustain vocal vibration (Silverman et al., 2023). By increasing supraglottal pressure, SOVTE reduces glottal pressure, ultimately lowering PTP (Titze, 2006). A reduction in this threshold pressure indicates that phonation becomes easier (Story et al., 2000). Furthermore, studies indicate a positive relationship between the duration of exposure to SOVTE and sustained benefits for students (Kang et al., 2019).

Due to the lengthened vocal tract in SOVTE, there is acoustic backpressure, which improves source-filter interaction by enhancing the timing of supraglottal pressure release and glottal closure (Conroy et al., 2014). Supraglottal pressure plays a crucial role in sustaining vocal fold vibration with minimal exertion, thereby stabilizing vocal fold oscillation (Conroy et al., 2014). From a teaching perspective, this makes phonation easier because managing supraglottic pressure lowers the phonation threshold, making it less demanding to initiate phonation (Silverman et al., 2023). Thus, explaining why there is a perceived decrease in vocal effort for SOVTE (Kang et al., 2020), as reported by musical-theatre singers in a pilot study (Manternach et al., 2021) and by theatre actors and voice professionals (Di Natale et al., 2022). Apfelbach & Guzman also observed that blending of registers is improved, as straw phonation allows vocal adduction, where the vocal folds come together more easily, thus making transitions between registers smoother (Titze, 2006).

### *Benefits for CCM singers*

#### **1. Vocal efficiency**

Greater ease in singing, or vocal economy, is a desired trait for CCM singers (Saldías et al., 2025). Titze (2006) found that the semi-occluded position encourages a

high maximum flow declination rate (MFDR), a measure of how rapidly the vocal folds cut off airflow during each vibration cycle. A higher MFDR leads to rapid closure of the vocal folds, producing stronger higher harmonics (Titze, 2006). Thus, the vocal output is high, or perceived as louder (Herbst et al., 2015), with less effort from the vocal folds (Titze, 2006). This quality could be beneficial for CCM singers who rely on high-intensity sounds such as belting (Magid, 2023).

An issue found among CCM learners is a tendency to press the glottal level when attempting to belt to achieve power and projection (Bourne & Garnier, 2012). Singers may compensate by increasing extrinsic muscle tension and subglottal pressure, thereby increasing vocal effort (Titze, 2006). The inertive reactance from SOVTEs stabilizes the vocal folds during high-intensity phonation (Titze, 2006), which may allow a belting singer to sing with less effort. In addition, SOVTE can help singers access higher notes (Titze, 2009) of belting without pressing as it promotes efficient source-tract interaction during phonation at higher pitches (Titze, 2021).

Studies of water-resistance therapy (WRT), a type of SOVTE, in CCM singers demonstrate that SOVTE reduce subglottic pressure while maintaining sound pressure level (Saldías et al., 2020). This allows singers to produce more powerful sounds with less respiratory effort (Saldías et al., 2020). Additionally, SOVTE appears to decrease inspiratory airflow while maintaining similar vocal output (Saldías et al., 2020). This provides evidence of more efficient synchronization between airflow and phonation (Saldías et al., 2020). Research also shows that SOVTE reduces the effort required for phonation by minimizing tension in the extrinsic laryngeal muscles (Savareh et al., 2023). These physiological effects support more efficient and sustainable voice

production, which may be beneficial for CCM singers performing high-power styles, helping them maintain projection without overusing the voice.

However, studies indicate the high variability in the benefits of SOVTE. Stroboscopic analysis by Dargin et al. (2016) in 4 singers performing different SOVTEs showed results that varied within each subject. There was no single exercise that benefited all four subjects. Not all singers responded the same way to the exercises, making it challenging to see a measurable benefit. Furthermore, Manternach et al. (2021) studied musical theatre singers and concluded that not one single exercise was superior. These studies show that SOVTE is idiosyncratic; thus, as a teacher without access to stroboscopic information, it may take time and exploration to determine which exercises will benefit individual students. In addition, Lulich and Patel (2021) studied healthy young adults performing SOVTE and found no significant effects on vocal efficiency, suggesting that for already healthy voices, SOVTE might not improve efficiency. Thus, if an individual already has optimal vocal function, SOVTE may not provide additional benefits. This is relevant information for a vocal teacher to consider, since not all students may benefit from SOVTE.

## **2. *Vocal stability***

Existing literature indicates that SOVTE offers acoustic and effort advantages for singers. Acoustically, straw phonation has been shown to improve vocal stability (Ford et al., 2024) and to be perceived as increasing phonation comfort and sound quality (Fantini et al., 2017; Portillo et al., 2018). An increase in acoustic energy with less singer effort was noted (Titze et al., 2007), along with a decrease in phonation threshold pressure (Titze, 2009). Titze (2006) explained that SOVTEs increase interaction

between the vocal folds and the vocal tract by increasing supraglottal and intraglottal pressure. This results in a better impedance match, more efficient voice production, and reduced strain on the vocal folds (Titze, 2006). Research has shown that SOVTEs can effectively reduce electrical activity in the extrinsic laryngeal muscles (Savareh et al., 2023). Furthermore, these exercises lead to noticeable acoustic changes, including a decrease in the first formant frequency (F1) and a smaller difference between the F1 and the fundamental frequency (F0) (Savareh et al., 2023). These changes suggest a favourable shift towards a more relaxed and acoustically efficient vocal setup (Savareh et al., 2023).

However, this conclusion may be more aligned with Western Classical vocal pedagogy rather than CCM. A decrease in F1 alone is expected to darken the sound (Savareh et al., 2023), not brighten it. The decrease in F1 would be beneficial for the Western Classical pedagogy of darker vowel sounds (Lynn et al., 2021). The effect of SOVTE's impact on F1 is contrary to what CCM tends to demand, the bright, high-energy acoustic output characteristic of loud (Schutte & Miller, 1993). In the technique of belting, singers intentionally use resonance to amplify higher harmonics, resulting in a more brilliant sound quality (Bestebreurje & Schutte, 2000; Titze & Worley, 2009). Therefore, although research indicates that SOVTE can enhance efficiency in classical singing, its direct relevance to CCM warrants further exploration to confirm its effectiveness for styles such as belting.

From the perspective of CCM singers, voice pedagogue Nix (2016) recommended using SOVTEs as a vocal cool-down after practice sessions, given the athletically oriented style of CCM singing. Rosenberg and Leborgne (2024) also

support SOVTEs in *The Vocal Athlete: Application and Technique for the Hybrid Singer*, designed for CCM singers. Thus, there are CCM vocal pedagogues who support the use of SOVTE exercises, which supports my application of SOVTE despite the limitations found in the literature (Appendix A).

Common vocal challenges in singers include jitter (wavering of pitch) (Butte et al., 2009), shimmer (inconsistent loudness) (Mezzedimi et al., 2020) and glottal-to-noise ratio (inconsistent resonance) (Godino-Llorente et al., 2010). Research on CCM singers using SOVTE has shown improvements in acoustic measures, reducing jitter and shimmer (Fantini et al., 2017; Kaneko et al., 2020). Moreover, the exercises improved the glottal-to-noise ratio (Asadollahpour et al., 2025). The recent findings indicate noticeable improvements in vocal fold stability (Fantini et al., 2017). Likewise, engaging in straw phonation exercises has proven beneficial in improving timbral clarity (Saldías et al., 2020). A scoping review by Riquelme-Muñoz et al. (2025) evaluated various vocal exercises, including SOVTEs, and highlighted the positive impact on acoustic stability observed in trained singers. Also, SOVTEs can influence oropharyngeal shape and improve resonance, enabling singers to adjust their tone quality, pitch, and dynamic range more easily (Andrade et al., 2014; de Oliveira et al., 2022). These outcomes point to the idea that SOVTEs foster dependable tone production and enhanced flexibility, which is crucial for CCM singers who often switch between vocal registers, belt, and explore different stylistic nuances.

Despite these positive trends, studies suggest the quality of SOVTE outcomes remains limited. Recent studies indicate that SOVTE does not demonstrate a significant advantage over traditional vocal control methods (Pozzali et al., 2024). As

well, it has been suggested that larger study populations are necessary to validate these findings (Pozzali et al., 2024). Although there is theoretical evidence that changes in oropharyngeal shape and resonance patterns resulting from SOVTEs may enhance energy transfer efficiency, the extent to which these modifications lead to lasting improvements in vocal stability for CCM singers remains to be determined (Ford et al., 2024). Even though the literature suggests that SOVTEs have a measurable impact on key acoustic stability measures and perceptual vocal quality in singers, evidence is still emerging for the CCM context and functional relevance for CCM learners.

### ***3. Vocal health / preventive effects***

While SOVTEs are often praised for supporting vocal health and preventing voice disorders among singers (Lulich & Patel, 2021; Narasimhan et al., 2025), a deeper dive into empirical research reveals some limitations to these claims. Evidence suggests that SOVTEs can improve vocal fold vibration (Holm et al., 2025), reduce vocal fold collision stress (Smith & Titze, 2017), and maintain healthy mucosal wave and glottal function (Meerschman et al., 2019), thereby contributing to injury prevention (Guzman et al., 2017). Furthermore, studies involving both clinical and healthy singers indicate that regular practice of SOVTEs can enhance vocal fold efficiency and may help prevent dysphonia by reinforcing stable vibratory patterns and decreasing muscular tension during phonation (Meerschman et al., 2023).

These findings collectively support the use of SOVTE as a preventive measure, helping CCM singers preserve vocal health and reduce the risk of strain or injury over time. However, literature review notes that the overall quality of evidence supporting

SOVTEs is low, and they do not consistently outperform other therapeutic interventions in generating significant improvements in jitter, shimmer, or perceptual voice measures (Pozzali et al., 2024). While some studies report positive self-perceived benefits and improvements in voice quality following SOVTE warm-ups, these subjective improvements are not always backed by objective acoustic measures (Di Natale, 2022).

From a physiological standpoint, SOVTEs are known to alter vocal-tract impedance and promote more effective interaction between the source and filter (Apfelbach & Guzmán, 2024). However, there is still limited direct measurement of their protective effects on vocal fold collision stress and long-term mucosal health (Riquelme-Muñoz et al., 2025). Additionally, it is still uncertain how short-term advantages translate into meaningful injury prevention, particularly in CCM singing. Several randomized trials have also shown that the benefits of SOVTE programs are frequently comparable to those of other established voice therapies, indicating that SOVTEs may not be a unique solution for enhancing vocal health (da Silva Antonetti et al., 2023).

For all these reasons, the literature supports the idea that SOVTE can be a valuable component of vocal health. However, further robust evidence of its standalone preventive efficacy in maintaining long-term vocal health in CCM is still emerging.

#### *Duration of the benefits of SOVTE*

Several studies have reported immediate improvements in aerodynamic and acoustic measures after SOVTE (Kapsner-Smith et al., 2015; Mills et al., 2018; Meerschman et al., 2019; Heller-Stark et al., 2024). However, these improvements do not appear to persist for long periods. Kang et al. (2019) noted some effects were present for only 20 minutes after the exercises, while Narasimhan et al. (2024) reported

effects lasting up to 30 minutes. This indicates that although SOVTE may have short-term carryover effects, the benefits tend to decrease within a relatively brief time frame. For example, Kang et al. (2019) showed that 10 minutes of straw phonation resulted in an immediate drop in phonation threshold pressure, with the effect persisting for 5 minutes. Participants in this study were new to SOVTE, which limits the ability to conclude whether repeated practice might produce longer-lasting adaptations. Research shows that motor learning may occur with more frequent practice (Kantak & Winstein, 2012), and the benefits may be sustained (Kang et al., 2019). Titze et al. (2021) found that training SOVTE may carry over into vocalization via motor memory; however, further studies are needed to understand the duration of the benefits.

When seeking more extensive benefits, Bane et al. (2019) found that SOVTE benefits decreased slightly after one month of daily exercise over six weeks. There was an increase in ease of phonation at the one-month mark; however, post one month, the ease of phonation decreased slightly but remained above the initial level prior to beginning the exercises. In a more recent study, Holm et al. (2025) concluded that daily SOVTE lasted longer than one day and less than seven days, as measured by participants' ease of phonation after stopping the exercises. Table 2 summarizes additional studies on the duration of SOVTE benefits. Based on the research, daily SOVTE over four weeks will result in benefits lasting up to seven days, even after the exercises stop. After seven days, the ease of phonation returned to the initial rating without SOVTEs.

| Table 2: Summary of Studies Reflecting on SOVTE lingering effect                                           |                                                                                                |                                                                             |                                                                                                                                                                                                                           |
|------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Study                                                                                                      | Population                                                                                     | Duration                                                                    | Conclusion                                                                                                                                                                                                                |
| Effects of Sustained Semi-Occluded Vocal Tract Exercises in Non-Disordered Populations (Holm et al., 2025) | Non voice disorder participants, 4 weeks daily SOVT straw phonation of different straw lengths | Measured at week 0, week 2, week 4 and week 5.                              | Phonation threshold pressure (PTP) decreased during week 4 of daily SOVTE exercises. Exercises stopped after this point. Week 5 measurement showed PTP returned to week 0. Benefits of SOVTE is between 1 day and 7 days. |
| Effects of a 6-Week Straw Phonation in Water Exercise for the Aging Voice (Wu & Chan, 2020)                | Aging voice population, 6 weeks in water straw phonation                                       | 6 week measurement. No indication of follow-up after 6 weeks.               | Conclusion of positive effects from SOVTE for 6 weeks.                                                                                                                                                                    |
| Comparative Study of Two Semi-Occluded Vocal Tract Exercise Protocols (Heller-Stark et al., 2024)          | Voice disorder population, 4 week and 8 weeks                                                  | Measurements at week 4 and week 8. No indication of follow-up post 8 weeks. | Improvement in Voice Handicap Index (VHI) score which indicates self assessment on vocal discomfort in daily life. Thus, an improvement in VHI is beneficial for vocal health.                                            |

As informed by the literature, studies show that one minute of SOVTE yielded no measurable benefits (Costa et al., 2011), while five minutes yielded some benefits (Kang et al., 2019), and ten minutes showed lasting benefits lasting up to 20 minutes (Kang et al., 2019). Thus, the recommended practice guideline I will use in my studio is 5-10 minutes daily. Daily SOVTE over a minimum of four weeks will be encouraged in my teaching to help students with the ease of phonation for singing CCM. After the initial four weeks, I will conduct biweekly visits to SOVTE during lessons to continue the benefits for my students. Implementing a bi-weekly rotation in my lesson plans will enable me to incorporate a diverse range of vocal content while also providing opportunities for review. This approach is consistent with the findings of Carter and Grahn (2016), who advocate for interleaving, switching between different activities, and

random practice (Steinhauer & Eichhorn, 2023) as methods that enhance long-term retention in music learning.

The research suggests that for CCM learners, SOVTEs can lead to rapid gains in vocal efficiency and ease of phonation (Fantini et al., 2017; Portillo et al., 2018). However, these benefits tend to be temporary, with some studies showing lasting benefits of only one week (Holm et al., 2025). Thus, existing literature suggests that SOVTEs are practical tools for immediate performance support in CCM singing (Fantini et al., 2017; Portillo et al., 2018), but the potential for long-term benefits remains an area requiring further investigation. Despite the lack of evidence for effects over time, SOVTE may still serve a functional role in my teaching as part of a broader vocal training approach.

### SOVTE Types

SOVTE encompass a range of vocal tasks that vary in the degree to which they restrict airflow and in the amount of resistance and impedance that occur (Dargin & Searl, 2015). The literature identifies SOVTE as varying in resistance from high to low depending on the degree of narrowing and the length of the vocal tract (Story, Laukkanen & Titze, 2000; Dargin & Searl, 2015). When resistance increases, the vocal tract lengthens; when resistance decreases, the vocal tract shortens (Story, Laukkanen & Titze, 2000; Dargin & Searl, 2015). While not CCM-specific, Andrade et al. (2014) explore seven types of implementations (Table 3) that can assist my analysis of different SOVTE types. Further investigation of the literature allowed distinction into two categories, as summarized in Table 4.

| <b>Table 3: Summary of SOVTE types (Andrade et al., 2014)</b> |                                                                                                                 |
|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>SOVTE</b>                                                  | <b>Explanation</b>                                                                                              |
| Straw                                                         | Singing through a narrow straw in open air                                                                      |
| Hand over mouth (HOM)                                         | Sing into a hand placed over the mouth. Hand creates partial occlusion.                                         |
| Humming                                                       | Singing on closed sound of /m/ or /n/ with sustained pitch with lips closed. Nasal cavity is partial occlusion. |
| Tongue-trill                                                  | Sing “roll r” with tongue while phonating. Tongue is partial occlusion.                                         |
| Tongue trill + HOM                                            | Tongue trill with hand over mouth. Tongue and hand is partial occlusion.                                        |
| Lip-trill                                                     | Sing “brr” vibration of the lips while phonating. The lips are the occlusion.                                   |
| LaxVox                                                        | Commercial silicone tube for phonation exercises.                                                               |

For singers in CCM, practicing exercises that focus on a single source can enhance their belting technique (Andrade et al., 2014). This approach helps increase supraglottal pressure (Smereka et al., 2024) and facilitates the interplay between the vocal folds and the vocal tract, improving its efficiency (Titze, 2006). In my studio, this is valuable because many students regularly perform belting passages, and these exercises may support more efficient vocal production (Titze, 2006). Another attractive point from the literature relevant to my studio is that CCM singers may experience less fatigue because phonation is more efficient, with fewer collisions in the folds (Titze, 2006). My students often comment on a tired voice after practice; single-source SOVTE may be a suitable cool-down exercise. Dual-source exercises can help loosen tension (Dhruw et al., 2020) and improve airflow (Croake et al., 2017), making them useful for

riffs and light passages which are areas that many of my CCM students find challenging.

| Table 4: SOVTE Categories |                                                                                                                                                                                                                                                     |                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Category                  | Description                                                                                                                                                                                                                                         | SOVTE Types<br>(Andrade et al., 2014)                                                                             | Physiological/Acoustic Features                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Single-Source             | <ul style="list-style-type: none"> <li>• Small difference between formants and fundamental frequency (Andrade et al., 2014)</li> <li>• Stable supraglottal pressure supports impedance matching (Smereka et al., 2024)</li> </ul>                   | <ul style="list-style-type: none"> <li>• Hand over mouth</li> <li>• Humming</li> <li>• Straw phonation</li> </ul> | <ul style="list-style-type: none"> <li>• Lower contact quotient range resulting in more uniform glottal contact (Andrade et al., 2014; Dargin &amp; Searl, 2015)</li> <li>• This targets efficiency vocal fold closure since vocal folds moving with a more steady rhythm (Andrade et al., 2014; Dhruw et al., 2020)</li> <li>• may reduce vocal phonation effort since more efficient phonation (Ford et al., 2024)</li> <li>• benefits to CCM singers include support for sustained and powerful phonation (Ford et al., 2024)</li> </ul> |
| Dual-Source               | <ul style="list-style-type: none"> <li>• Large difference F1-F0 thus greater acoustic variability (Dhruw et al., 2020; Brockmann-Bauser et al., 2020)</li> <li>• Fluctuating supraglottal pressure and oscillation (Guzman et al., 2018)</li> </ul> | <ul style="list-style-type: none"> <li>• Lip trill</li> <li>• Tongue trill</li> <li>• LaxVox</li> </ul>           | <ul style="list-style-type: none"> <li>• higher contact quotient range (Andrade et al., 2014; Dargin &amp; Searl, 2015)</li> <li>• lip trill alters pitch variability and may reduce stress on vocal tract (Chua-Lawas &amp; Rotor, 2023) since secondary oscillation massages the vocal tract (Dhruw et al., 2020)</li> <li>• helps to develop flexibility and smoother glides (Dhruw et al., 2020)</li> </ul>                                                                                                                             |

Although a range of SOVTE exist, my studio will initially focus on straw phonation, humming, and lip trills. This offers a mixture of both single-source (humming, straw phonation) and dual-source (lip trill) types. Straw phonation helps stabilize backpressure and works on efficient vocal fold vibration (Titze, 2006; Meerschman et al., 2023). Humming has the benefits of tactile and auditory feedback to enhances students' awareness of airflow (Ogawa et al., 2014). Higher contact quotient lip trills offer slightly longer vocal fold contact (Brockmann-Bauser et al., 2020) for greater ease in phonation. Appendix A includes a tailored lesson plan for each of these three types of SOVTE tailored for my studio based on findings from the literature.

Based on the benefits of WRT, additional straw phonation in water will be added to the lesson plan. Studies indicate straw phonation in water provides additional vocal

fold protection through increased backpressure compared with straw phonation in air (Meerschman et al., 2023). Meerschman et al. (2023) and Guzman et al. (2017) have shown that SOVTE in water reduce collision stress and mucosal wave amplitude. It is acknowledged that the studies were for dysphonic or aging populations (Meerschman et al., 2019; Tsai et al., 2023). In terms of application to CCM learners, WRT was seen to help lower subglottic pressure while still achieving intense vocal output (Saldias et al., 2020). Additional study for classical soprano singers found SOVTE reduced PTP (Enflo et al., 2013). Lowering PTP serves as a recovery role in effective cool-down practice, which can reduce the likelihood of phonotrauma after intense performances (Guzman et al., 2017; Horáček et al., 2019). It is acknowledged there is limited research applicable to CCM singers; only Saldías et al. (2020) was found in this review for WRT. Thus, the impact of using straw phonation in water needs to be monitored in my studio.

#### Effects of Straw diameter, length and materials

The attributes of the straw, such as its thickness, length, and material, are crucial in influencing the amount of supraglottal pressure produced during SOVTE (Titze, 2018). This increase in supraglottal pressure contributes to several advantages, including a lower PTP and enhanced vocal efficiency (Andrade et al., 2014). However this paper acknowledges the literature reveals variability in how SOVTE affect singers, and these findings hold important implications for CCM training where vocal demands differ greatly across styles and skill levels (Ragan, 2020).

Straw diameter is often suggested as the key determinant of resistance (Maxfield et al., 2015; Smith & Titze, 2017). The narrower the diameter (3-4mm), the greater the supraglottal pressure for the majority of adult female and male singers (Maxfield et al.,

2015). However, Tagney et al. (2021) noted that a 9mm diameter straw can facilitate easier phonation. As seen, findings across different studies are inconsistent, with many based on small samples (Manternach et al., 2021) or laboratory models (Regner & Jiang, 2011). These may not capture the complexities of live vocal fold behaviour in singers. This variability, in addition to differences of individual uniqueness, suggests that straw diameter alone should not be used as the sole determinant of SOVTE benefits, but rather as a starting point for individual adjustments (Smith & Titze, 2017). In my studio with some young CCM learners who typically have smaller glottal structures and less consistent breath management (Patel et al., 2013), a straw with a larger diameter might not create the necessary resistance to ensure stable vocal fold oscillation (Maxfield et al., 2015). For these students, a narrower straw may be beneficial in limiting excessive airflow and help promote more stable vocal phonation (Maxfield et al., 2015). Thus, a 3-4mm straw will be my starting point to explore with my students, with careful monitoring to ensure students achieve the intended vocal outcomes.

The length of the straw is another factor in literature that affects vocal performance. There is a range of reported lengths, from 7.5cm to 30cm, with noted benefits of increased supraglottal pressure, as well as longer straws measuring 50cm to 75cm which unfortunately exhibited inconsistent airflow (Holm et al., 2025; Tagney et al., 2021). The studies reveal there is not just one best length for straws, but rather a range that works effectively. For my teaching practice, standard drinking straws of approximately 20cm offer a reasonable compromise within the researched range, providing adequate back pressure without introducing aerodynamic instability or logical complications in the studio.

Although the straw material can influence the impact on supraglottal pressure, it is perhaps the least studied variable in SOVTE. Singers have reported distinct tactile feedback with more rigid materials, such as metal or silicone, for monitoring breath flow and phonatory balance (Mendes et al., 2019). For beginner CCM singers, softer plastic straws are recommended as they can help create smoother airflow transitions and minimize distractions (Andrade et al., 2014; Silverman et al., 2023). The limited research available highlights the importance of choosing materials (Mendes et al., 2019) based on physiological factors and the teaching context. The teacher can then make adjustments based on the student's feedback.

The existing literature highlights various limitations worth noting. Short-term measurements appear to be the primary focus of many studies, and none were found to provide long-term data. This raises concerns about the sustainability of the effects observed with SOVTE (Oliveira et al., 2024). Secondly, the outcome measures used in these studies are inconsistent, with perhaps greater emphasis on subjective perceptions than objective assessments (Apfelbach & Guzman, 2024). Thirdly, there is considerable variability among participants. Some demonstrate significant progress from SOVTE (Dargin et al., 2016) while others show minimal change (Lulich & Patel, 2021). This emphasizes the importance of ongoing monitoring and adaptation within the teaching context (Apfelbach & Guzman, 2024).

In the context of CCM pedagogy, the literature suggests there is no universal approach to straw selection. Starting with a narrow, medium-length 20cm plastic straw is likely practical for most learners in my studio. However, as the literature shows, it is important to make individualized adjustments to factors including diameter, length, and

material based on observations and acoustic feedback to achieve the intended benefits of SOVTE.

#### Pedagogical Application to my studio

Since my studio is transitioning from a more classical-oriented focus to CCM, I intend to implement a gradual SOVT based pedagogical plan for the beginner CCM singers. Appendix A summarizes pedagogical application procedures as informed by the research. As seen in the research, straw phonation with a narrow straw for as little as 5-10 seconds (Dargin & Searl, 2015) on a comfortable vowel during warm-up helps promote more stable and efficient vocal fold vibration and airflow immediately after exercise (Dargin et al., 2016). This improves impedance matching between the glottis and the vocal tract for an easier onset (Titze, 2006). It reduces collision forces (Titze, 2006), which is especially critical for singers in my studio who are still building coordination in singing CCM. For CCM beginners, SOVTE warmup may decrease the risk of fatigue and strain (Meerschman et al., 2023) during initial singing.

The transition from straw phonation in the first sound to a simple melodic phrase (Appendix A) allows students to build the balanced sensations of airflow and resonance created by the straw (Guzman et al., 2015). This can help students internalize what it means for efficient coordination, since SOVTE raises supraglottal pressure and promotes favourable source-filter interaction for efficient voice (Titze, 2006).

Straw phonation while submerged in water offers the advantage of less strain on the vocal folds (Meerschman et al., 2023). A laryngoscopic investigation revealed decreased vibratory amplitude and reduced mucosal wave activity (Meerschman et al., 2023). This reduction in amplitude could help minimize phonotrauma by lowering the

exertion required of the vocal folds (Meerschman et al., 2024). In addition, WRT allows beginners to feel airflow and back-pressure without requiring strong vocal adduction and to produce sound without pushing the voice (Ford et al., 2024). Students are likely to have a positive experience, as self-perceived loudness is perceived as a benefit after SOVTE (Ford et al., 2024). However, as seen in the above studies, the benefits last only in the short term (Kang et al., 2019). Integrating SOVTE into the voice studio for CCM singers has the potential to offer long-term vocal health benefits. Improved objective acoustic parameters and subjective voice comfort suggest that SOVTE can be a tool for healthy voices (Meerschman, 2019).

### Limitations and Rigour Considerations

A significant limitation is that studies relate specifically to CCM singers. Most research on SOVTE has been conducted with Western Classical participants (Enflo et al., 2013) or clinical patients (Kapsner-Smith et al., 2025). In addition, study results often show high variability. A pilot study with musical theatre singers from Manternach et al. (2021) found no particular exercises emerged as most effective, and the results are largely idiosyncratic. Research with Western Classical also showed high variability across laryngeal adjustments during SOVTE, with no single SOVTE benefiting all participants (Dargin et al., 2016). Such variability challenges generalizability, and conclusions from other vocal studies may not fully apply to CCM singers, whose vocal demands differ.

This research paper acknowledges certain limitations, particularly the absence of long-term studies specifically focused on CCM and the lack of large-scale research. There is a risk that evidence from the existing literature may overrepresent remedial

benefits rather than performance-oriented outcomes for CCM learners. Recognizing these limitations, this paper positions its conclusions as provisional and emphasizes the need for future CCM-specific research.

## **Conclusion**

The review of literature revealed that SOVTE can serve as a practical learning tool for CCM singers to develop more efficient (Titze, 2006; Guzman et al., 2017; Saldias et al., 2020), stable (Portillo et al., 2018; Silvermann et al., 2023; Ford et al., 2024) and healthy (Brockmann-Bauser et al., 2020; Smith & Titze, 2017; Meerschman et al., 2023) singing. Benefits of straw phonation include balancing airflow (Titze, 2009; Ogawa et al., 2014) and resonance (Titze et al., 2007), reducing collisions between the vocal folds (Titze, 2006; Meerschman et al., 2023), and promoting sustainable phonation (Guzman et al., 2013; Fantini et al., 2017; Portillo et al., 2018). The gradual transition from straw exercises to melodic phrases allows students to internalize vocal coordination, thereby facilitating the transition to repertoire singing (Meerschman et al., 2019). Research has shown that individual responses vary and that exercise parameters may need to be adjusted; however, the literature indicates that SOVTE provides a practical, evidence-based approach to supporting immediate and long-term vocal development in the CCM context.

## **Critical Reflection**

This section reflects on my learning and teaching process using Driscoll's (2007) reflective model. I chose this model because its' structured, three-stage approach, "What?" "So What?" and "Now What?" provide a clear framework for systematically examining my experiences, evaluating the insights gained, and planning practical

applications (Driscoll, 2007). Using Driscoll's model allows me to critically reflect on how I engaged with SOVTE literature, made decisions in my teaching practice, and developed strategies for student-centred vocal training, while keeping the reflection organized and actionable.

### What?

I started this module without much knowledge of SOVTE. I have seen other vocalists online use SOVTE and have heard of this concept among colleagues; however, I have yet actually to use it in my own vocal learning. I was curious about what literature reveals the benefits of SOVTE to be and how I can apply this to CCM singers. This module was a research investigation into SOVTE, examining its benefits for my vocal teaching practice. Since SOVTE was unfamiliar to me, I initially planned to organize the information I read into themes using Thomas and Harden's (2008) thematic synthesis approach. However, Thomas and Harden's approach focused on line-by-line coding, then on descriptive themes, and then on analytical themes (Thomas & Harden, 2008). This was too time-consuming, and the details of studies I was reading often included qualitative data that was beyond the scope of my understanding as a vocal teacher. Thus, I transitioned to a narrative review framework that focused on understanding and summarizing patterns in the literature without detailed qualitative analysis (Popay et al., 2006). This guided me to note recurring benefits of SOVTE and was effective in answering the research question.

Reflecting on my four expected learning outcomes: a) I am now more knowledgeable about SOVTE; b) its physiological and acoustic benefits; and c) the limitations of the exercises. Lastly, d) Appendix A is a summary of teaching strategies

on how to apply SOVTE for CCM learning based on the literature review. Gaining a deep understanding of SOVTE informed me of the appropriate straw length, size, and practice duration for my CCM students. The highlighted benefits of improved vocal efficiency (Titze, 2006), enhanced resonance (Titze et al., 2007) and reduced effort for phonation (Meerschman et al., 2023) are attractive benefits I see applicable to my CCM students for vocal health. However, I do recognize the limitations reported in the literature, including varying individual responses, and I carefully take this into account in my lesson plans and will monitor the impact for each of my students. Overall, this paper met the outlined learning expectations, with continued learning evident in my students' results.

### So What?

Grouping the literature into themes of vocal benefits was helpful for me to organize the information and resulted in Appendix A for practical application in the studio. Although I found Driscoll's model helpful for reflection, I was attracted to Schön's (1987) "reflection-in-action" and "reflection-on-action" processes. Reflection-on-action occurs after the event, whereas reflection-in-action is conscious reflection in the moment to achieve a better outcome (Schön, 1987).

As I wrote about the benefits of SOVT, I found myself imagining specific students in my studio who would benefit from the exercises. Engaging in reflection-on-action after the readings prompted me to summarize the exercises in Appendix A, which I can apply in the voice studio. This process also led me to adopt reflection-in-action while teaching. When I found a student was experiencing consistent, unnecessary tension in the belt and difficulty recognizing it, we took a few minutes to conduct SOVTE in water.

Visual feedback on changes in bubble sizes was helpful for the student to identify inconsistencies in airflow (Lã et al., 2017; Burke, 2019).

Reading about the different types of SOVTE was initially overwhelming due to the wide range of SOVTE reported in the literature, as summarized in Table 3. Based on Cognitive Load Theory (CLT) (Skulmowski & Xu, 2022), I recognized that my working memory capacity is limited, and that too much information at once will result in inefficient learning. To enhance clarity and manageability, the model recommends condensing information by focusing on a smaller set of elements (Skulmowski & Xu, 2022). In my voice studio, I have chosen to prioritize techniques including straw phonation, humming, and lip trills. Straw phonation aids in efficient vocal fold vibration by maintaining stable backpressure (Titze, 2006; Meerschman et al., 2023). Through tactile and auditory feedback, humming enhances students' awareness of airflow (Ogawa et al., 2014). Lip trills offer similar benefits, helping with subglottal pressure control, dynamic flexibility, and stable vocal-tract configuration (Brockmann-Bauser et al., 2020). Looking back on the process through reflection-on-action, I recognize the CLT approach allowed me to process the SOVTE meaningfully, resulting in a set of practical applications for my studio (Appendix A). Through reflection-on-action, I now recognize that I used the Adaptive Cognitive Fit (ACF) framework (Sameul et al., 2022) by pre-filtering studies for relevance based on publication date (sorting by most relevant in the search system) and using the summary abstracts to choose which ones to read thoroughly. These approaches allowed me to synthesize a large amount of information into a smaller, practical quantity to apply in my studio (Samuel et al., 2022). Realistically, I cannot use that many different exercises with my students at once; thus, I

needed to start somewhere, and CLT and ACF allowed me to condense and focus on a practical number of exercises I could use as tools to assist CCM singers with healthy vocal development (Appendix A).

### Now What?

In reflection of this research process, I recognize the importance of continued flexibility in my approach. Recognizing when an approach, such as thematic analysis, is not feasible given time constraints and the volume of available information is important. This is a takeaway point for my future research approach. I have gained an overview of SOVTE, and the research yielded a starting point of practical exercises to use with my students (Appendix A). In my future research, it may be helpful to approach my research question with a more curious pedagogical perspective. I want to emphasize future research on approaches focusing on practical application with my students. In hindsight, it may have been beneficial for me to refine my research question further to explore one specific type of SOVTE, such as straw phonation alone. This will allow me to dive more deeply into the types of exercises within straw phonation that can be used in the studio. Perhaps a more comprehensive list of applicable exercises may result in the use with students. There is room to explore the impact of specific exercises on the more specific challenges of CCM singers, including which exercises can help with range transitions and which are beneficial when students have a raspy voice after singing. Alternatively, I may have approached the research through the lens of a pedagogue, beginning with a common problem I see in my CCM learners, such as how to reduce a breathy tone through the use of SOVTE. These approaches may yield more practical solutions for SOVTE in my voice studio.

From this paper, building on physiological and acoustic evidence (Meerschman et al., 2019; Ford et al., 2024; Holm et al., 2025), I will implement a set of exercises using straw phonation, lip trill, and humming, as warm-up or cool-down tools (Appendix A). I plan to expand Appendix A and design a flexible student-centred plan rather than a one-size-fits-all plan. The research comparing different SOVTEs points out that they affect vocal fold vibration patterns differently depending on whether the exercise uses a single or dual source of vibration (Andrade et al., 2014). This means that some students may find lip trill more beneficial while others find straw phonation more effective. My plan moving forward is to experiment, observe, and adjust as needed. During lessons, I will focus on reflection-in-action. Afterward, I will engage in reflection-on-action to evaluate the results, including my comfort level with teaching the exercises and students' feedback. I expect there to be additional questions that will arise once I actively teach the SOVTE. I plan to track results in a studio journal, noting which exercises were used, the student's vocal context, perceived effects and additional future research areas. Over time, this will allow me to refine which SOVTEs work best for different singing voices in my studio.

I remain aware of the limitations of the information in this literature review. While literature provided insights into the benefits of SOVTE research, long-term effects remain under-investigated (Holm et al., 2025). Therefore, I will treat my application as exploratory and include ongoing reflection and evaluation. The above plan allows me to move from literature-based conceptual understanding to a reflexive student-centered pilot implementation, combining empirical evidence, personal teaching context, and continuous reflection to refine vocal pedagogy for CCM singers in my studio.

# APPENDICES

## Appendix A - Pedagogical Application to Lesson Plans

Introducing all SOVTE types at once risks overwhelming students and limiting focused practice. Based on an understanding of the Cognitive Load Theory (CLT) (Skulmowski & Xu, 2022), I have chosen to concentrate on three types of SOVTE (straw phonation, humming, and lip trills). Drawing on existing research from this literature review (Dargin & Searl, 2015; Andrade et al., 2014), the following illustrates practical routines tailored for CCM singers aged 5-25 in my studio, with the intended focus on students transitioning from classical training to CCM. Below are the exercises I plan to apply based on my understanding of the literature review.

### Application of Straw Phonation in the Air to My Lesson Plan

- **Warm-up:** As informed by the literature, using a narrow straw (3-4mm), begin with 5-10 seconds of straw phonation in the air on a comfortable vowel. Repeat this process 4-5 times. Students may choose different pitches. Straw phonation helps establish efficient vocal vibrations (Ford et al., 2024) and reduces extrinsic muscle tension (Savareh et al., 2023). This is an important aspect of my studio to help students begin lessons with a relaxed approach to singing, since many are working with CCM challenges that are new to them as they transition from the classical realm.
- **Flow into Singing:** For intermediate students, straw phonation can be extended to a small scale or simple melodic phrase. The purpose of singing the simple phrase is to integrate balanced sensations into more musical passages, helping students apply SOVTE benefits in context (Savareh et al., 2023). This is an important step for students

to recognize that SOVTE are not isolated exercises, but the benefits should be integrated into repertoire singing.

- **Cool-down:** After the lesson, a 5-minute straw phonation helps reset the system (Kang et al., 2019). As seen in some literature, aerodynamic benefits linger after the SOVTE. Thus, students often retain a sense of ease when they switch back to free singing (Kang et al., 2020).

#### Application of Water-Resistant Straw Phonation to My Lesson Plan

- **Warm-up:** As informed by the literature, use a straw of approximately 20cm in length (commercial straws), submerged in approximately 5cm of water with a narrow plastic straw (3-4mm). Blow steady bubbles at a comfortable pitch and observe their size. The goal is to maintain a similar bubble size visually when moving from voiceless sounds (sh, f) to voiced sounds (v, z) (Tom Burke, 2019). The size of the bubbles represents airflow. The objective is to maintain the same airflow across both voiced and voiceless sounds to reduce unnecessary tension (Tom Burke, 2019). Tom Burke (2019) identifies too much airflow (with water splashing out of the cup) as an undesirable bubble size. Increased supraglottal pressure from the water reduces the stress on the vocal folds and allows for stabilized vibration (Meerschman et al., 2023). For my younger CCM singers, this exercise will be beneficial for establishing a calm start to a voice lesson and reducing vocal strain (Meerschman et al., 2019), a common issue I observe in my students.

- **Technique Development for Voice Stability:** Using a similar setup to the warmup, for 2-3 minutes, phonate a five-note scale pattern. Encourage students to maintain a steady bubble size while singing at different pitches; this visual feedback

helps them internalize a more stable, balanced breath (Maxfield et al., 2015; Guzman et al., 2017). This increases the contact quotient, thus resulting in more efficient and less stressful vocal fold vibration (Guzman et al., 2017). As a side note, many of my students have a breathy vocal quality; stronger glottal closure from SOVTE will help reduce this breathiness (Graham et al., 2016). Furthermore, Thorpe (2022) emphasizes that visual feedback can support voice training by helping students understand complex ideas more intuitively. In addition, a water-resistant straw has been shown to improve self-perceived vocal comfort and reduce phonatory effort (Meerschman et al., 2018), which is beneficial for my students.

- **Dynamic control and Breathe Management Practice:** To explore dynamic control and breath management, students can alternate bubble strength between soft and strong for 1 minute. For an additional challenge, given a dynamic level, aim to glide from low to high pitch while maintaining a similar bubble size. The visual cue of bubbles provides real-time feedback on breath support, which helps students regulate airflow efficiently (Meerschman et al., 2023). This exercise can be applied to challenging CCM passages, allowing singers to practice dynamic control and expressive intensity while maintaining balanced phonation. Water-resistance phonation exercise can improve vocal comfort and reduce vocal fold collision (Meerschman et al., 2019).

- **Additional one-step further application:** After completing straw phonation in water, the next step, as proposed by speech pathologist and CCM vocal coach Tom Burke (2018), is to gradually raise the straw above the water's surface and produce a "zz" sound (similar to a kazoo). The aim is to create visible ripples in the water while sliding from low to high pitch through the straw. Burke emphasizes that when ascending

in pitch, the airflow should remain steady. Reduction in airflow at higher pitches may cause the singer to work too hard, counteracting the goal of ease in SOVTE. Once this water-to-air transition is stable, the straw is then removed. The “zz” sliding pattern is repeated in the air while the focus is on maintaining consistent airflow. A visual check that can be used is to hold a small piece of paper at the end of the straw to confirm that the airflow remains constant as the pitch rises. As a final step, the singer practices the same sliding pattern without a straw. The objective is to internalize the stable airflow and efficient vocal-tract configuration cultivated during straw work, transferring that same sensation when no props are used.

These exercises are consistent with findings in a laryngoscopic study (Meerschman et al., 2023), which found that both straw phonation in water and in air produced immediate beneficial laryngeal changes. Straw-in-water reduced vibrational amplitude and likely lowered vocal-fold impact stress, resulting in a reduction in the risk of phonotrauma (Meerschman et al., 2023).

#### Application of Lip Trill to My Lesson Plan

- **Warm-Up:** Choosing a comfortable pitch, begin with 3 minutes (Brockman-Bauser et al, 2020) of lip trill. Phonation can become easier with reduced straining because lip trills help stabilize vocal fold vibration and lower phonation threshold pressure (Brockmann-Bauser et al., 2020).
- **Technique Development:** Using arpeggio patterns, sing for 2-3 minutes, maintaining steady lip vibration. The tactile and auditory feedback from lip trills helps students monitor airflow and resonance (Van Stan et al., 2021). Literature

reveals that lip trills improve laryngeal efficiency by reducing vocal fold collisions and increasing the glottal contact quotient (Gaskill et al., 2008).

- **Integration into Repertoire:** Apply lip trills to passages of repertoire that are more difficult for the learner. Lip trill supports stable phonation (Titze, 1996; Brockman-Bauser et al., 2020), smoother register transitions, and reduced tension during stylistic or belting passages (Dhruw et al., 2020).
- **Dynamic Control:** Within a passage, explore the variation of the airflow and volume during lip trills. In addition, students can add pitch glides as they increase airflow and volume in lip trills. Lip trill exercises can help improve breath management (Dove et al., 2025), subglottal pressure control (Meerschman et al., 2019), and dynamic expression while minimizing vocal fold strain (Brockmann-Bauser et al., 2020).
- **Cool-Down:** End with 1-3 minutes of lip trills on comfortable pitches. Research shows lip trills promote vocal ease when returning to free singing (Ford et al., 2024).

#### Application of Humming to My Lesson Plan

• **Warm-Up:** Start with 30 seconds of gentle humming on a comfortable pitch. Lower phonation threshold pressure results due to humming stabilizing the vocal fold vibrations (Titze, 2006) as the vocal folds adduct more gradually (Iwahashi et al., 2017). Tactile and auditory resonant feedback helps students perceive the airflow (Chen et al., 2014).

- **Technique Development and Laryngeal Efficiency:** For 2-3 minutes, sing scales with sustained humming. Focus on consistent tone and notice the gentle facial vibrations. Humming increases the glottal contact quotient and reduces collision forces on the vocal folds, thereby improving efficiency without increasing strain (Ogawa et al., 2014). Help students note the vibrations of the lips, teeth, and nasal cavities during humming. This multimodal feedback can enhance students' awareness of airflow (Chen et al., 2014).
- **Integration into Repertoire and Stylistic Control:** Apply humming to passages of repertoire, exploring challenging parts that include register transitions or stylistic embellishments such as riffs. Through maintaining a stable sound source, SOVTEs can help to support smoother shifts between chest and head registers (Maxfield et al., 2015). For a similar reason, humming can help aid in stylistic phrasing and belt passages (Savareh et al., 2023).

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