

BMPF 7003: Working and Learning: An Introduction to Work-Based Higher Education

This is a two-part assignment

Part 1

Critically evaluate a range of theories and models that you have recently studied, explaining their relevance to your workplace practice and procedures and develop a strategy applying what you have learned to improve your practice.

This part of the assignment is 2700 words and is 60%

Semi-Occluded Vocal Tract: Can SOVT methods develop an effective training program for professional CCM Music Theatre singers, who use high-intensity phonation on a regular basis, to increase economic phonation?

Introduction

This study is to critically examine Semi-Occluded Vocal Tract Exercises (SOVTEs), the academic research that has been explored thus far in the pedagogical community, and a variety of traditional and innovative Semi-Occluded Vocal Tract (SOVT) methods/exercises. While there are emerging scientific underpinnings as to why SOVTEs can be a positive training method (Titze, 2013, p. 305, Andrade et al, 2014, p. 594), there is still considerable research needed. An even more limited research pool was attainable for SOVTE effects on Music Theatre singers (MTs). Through my analysis, my aims are:

- To understand why SOVTEs are recommended throughout the Music Theatre (MT) industry (Manternach, Maxfield, Manternach, 2020, p. 40; Zuim, Stewart, Titze, 2021, p. 1).
- To ascertain how using SOVTEs can improve vocal production, whilst preventing vocal injury for professional MTs, therefore assisting contemporary commercial music (CCM) MT voice coaches/teachers and students to meet the growing vocal demands required in the evolving MT industry (Green et al, 2014, p. 327; Freeman, Green, Sargent, 2015, p. 491; Meerschman et al, 2019, p. 662).
- To use SOVTE research to develop a SOVT-based training program for professional MTs.

Through my personal experiences with MT and Pop/Rock, I have practiced Lip-trills, Humming, Sirening, and Straw Phonation as part of my vocal warmups, technique building, or working on material. I continued to use SOVTEs throughout my teaching and coaching

with little academic knowledge. As an MT performer and vocal coach, examining SOVTE research and techniques will contribute to both areas of my personal and clients' ongoing training. My program will be developed using academic research to allow the voice to be at its most effective and durable for vocal production, preventing injury to meet the demands and trends of the industry, benefiting my teaching strategies.

Music Theatre Genre Definitions

With the vocal demands of the 21st century leading away from “classical” or “traditional” MT (Green et al, p. 324), there is an indubitable level of athletic ability and versatility required from a professional MT performing eight shows a week, most often with high vocal intensity (Melton, 2007). In a 2014 study, Green et al (2014, pp. 324 - 325) found four primary categories within musical theatre audition listings for a range of high-low paying jobs listed for a demographic of mixed-gendered young performers (aged 18-24) between six months: Pop/Rock (25%), Contemporary (30%), Traditional (40%) and Legit (5%). Freeman, Green, Sargent (2015, p. 492) discovered, from 24 Broadway shows in April 2014, that Belt dominated the Leading Female role listings by 85%: Belt (62%), Belt/Mix (23%), and non-Belt (15%). Vocal requirements may have shifted since the publication dates of these papers, and results may vary with research designed to discover trends for different voice types, casting types, and age demographics. We could also discover trends by extending the duration of studies. Further research is needed.

With 95% of musicals leaning towards genres requiring CCM and Belt voice qualities and 85% of Female roles requiring a Belt quality, it can be theorised that high-intensity vocals are becoming more prevalent in the MT industry. In my experience, students bring a large arsenal of Pop/Rock and Contemporary material to singing lessons, as the material they have to prepare for auditions can lean more towards this. Furthermore, these students tend to require more athletic ability, or durability, for professional MTs to sustain prolonged cord collision because of the extreme vocal qualities needed.

What Are SOVTEs?

Semi-Occluded Vocal Tract means that the vocal tract is partially closed in some form. A Semi-Occluded Vocal Tract Exercise (SOVTE) is the premise of economy-oriented voice training (Titze, 2006, p. 448) which is used as a vocal warm-up or technique exercise that occludes part of the vocal tract (please see Appendix 1 for Deciphering SOVTEs). These

exercises can vary in type of occlusion and can be at the front or back of the mouth or extended outside the vocal tract. For instance, exercises such as /ŋ/ occlude the back dorsal to velar or hand-over-mouth extends the vocal tract outside the lip. Vocal tools such as straws, vocal tubes, and mouth masks have become another commodity in the theatrical industry of recent years (see Appendix 2 for Voice Training Tools).

Identifying Potential SOVTE Benefits

Aerodynamic energy can be defined as a transfer of the glottal airflow to vocal fold tissue and drives airflow through the vocal tract. Acoustic energy is described as sound waves (vibrations) disrupting energy by traveling through matter (tissue and air). The output-cost ratio (OCR) for phonation is aerodynamic energy input (mean subglottal pressure x mean airflow) to acoustic energy output (Berry et al, 2001, pg. 29).

It is hypothesised that supraglottal pressure facilitates or mimics a mixed register (Titze, 2006, p. 449) which may be favourable to an MT singer for the durability of phonation and less vocal cord collision. SOVTEs can be quite effective for Belt “Probably the difference becomes more evident during high-intensity voice production (*fortissimo*)” (Cordeiro et al (2012, p. e30).

SOVTEs can improve the aerodynamic and acoustic energy, therefore the OCR benefits as additional supraglottal pressure influences intraglottal pressure and airflow through the vocal tract (Titze, 2006, pp. 449 - 450). This allows for tension reduction and promotes a more resonant voice quality (Andrade et al, 2014, p. 589). The steady back pressure of air can help stabilize vocal fold adduction, reinforce the full phasing of the folds, increase maximum flow declination (MFDR) and reduce stress collision for vocal fold tissue (Titze, 2013, p. 305). Furthermore, they may improve the vocal economy with the lengthening of the vocal tract, vocal fold oscillation cycle, breathing mechanisms, and also widen the pharynx with more formants clustering (third, fourth and fifth) (Andrade et al, 2014, p. 589). SOVTEs are also hypothesised to bring vocal awareness to the singer. The perceived effort may be an indicator of SOVTE prescription (Manternach, Maxfield, Manternach, 2020, pp. 45 - 46). This shows that a combination of benefits may occur simultaneously.

SOVT Theories, Methods, and Models

SOVTEs have been a popular method for voice rehabilitation and therapy (Titze, 2006, p.448; Cordeiro et al, 2012, p. e17; Andrade et al, 2013, p. 590) and classical singing (Gaskill, and Erickson, 2008, p. 634; Cordeiro et al, 2012, p. e18). Early mentions of Traditional SOVTEs dated between 1960 to 1999 emerged in voice pedagogy (please see Appendix 3 for a traditional overview of SOVTEs). While Resonant Voice Therapy and nasal consonants (Verdonlini, 2000), Flow Resistant Straws (Titze, 2002a, Titze et al, 2002), and Titze's SOVT Voice Training and Therapy rational (Titze, 2006, p. 448) were developed in the early 21st century. These may be a good foundation on which to base my training program.

Popular methods of SOVT research have had a wave of interest in the pedagogical community in the last fifteen years generating advancements in the field. I chose to examine Lip-trills, Tongue-trills, Humming, Hand-over-mouth, Tongue-trill combined with Hand-over Mouth, Straw, LaxVox, and Tube phonation. I used studies from Synthesiser/Simulations, Rehabilitation, Classical, and MT voice styles to support my study due to available research at this time.

According to Titze (2006, p.448), the effects of semi-occlusion at the lips are efficient when transitioning to a nonoccluded vocal tract acting as "muscle memory" for the singer. While Titze's research supported the lip trill, the study was performed through a computer simulation and therefore does not account for varied vocal tract sizes, voice types, human experience/error, or cross-examination of multiple SOVTEs or methods. The first live study on Lip-trills (Gaskill, and Erickson, 2008, p.634) had 25 participants (11 classically trained and 14 untrained). Electroglottography showed a reduction of the CQ during the lip trill. The untrained singers tended to have a larger CQ change which could have occurred because trained singers have experience with SOVTEs. The varied results between the two groups suggest that SOVT training could have long-term effects as the trained singers had a baseline closer to the concluding results. Further research is needed.

Similarly, tongue-trills maintain CQ results, although lower than a lip-trill, and change the oscillation cycle and vocal fold shape (Cordeiro et al, 2012, p. e21). Semi-occlusion occurs on the hard palate behind the alveolar ridge. Cordeiro et al (2012, p. e17) studied the effects of Lip and Tongue trills with the sustained vowel /ε/ using ten classically trained participants

using electroglottography on the same frequency. They discovered an oscillation of the CQ during the tongue and lip trill exercises, with the latter being higher correlating to the /ε/ and tongue trill, presenting that a lip trill may have more noticeable results due to differences in SPL.

Straw and tube phonation differ because the vocal tract is extended outside the lip. These tend to narrow the epilarynx causing vocal tract glottis impedance. This lessens tissue trauma and muscle effort with increased economic vocal intensity and production (Titze, 2006 p. 457, Guzman et al, 2013, 523.e19, Andrade et al, 2014, p. 589). Stirring and drinking straws, Finnish glass “resonance tubes” and LaxVox silicone tubes differ greatly as they can be of different diameters and lengths and used in the air or submerged under different amounts of water (Guzman et al, 2013, Andrade et al, 2016, pp.37-38).

Guzman et al (2013, pp. 523.e19-34) compared phonation with a stirring straw with a Finnish resonance tube in the air and found that the stirring straw offered greater subglottic pressure, CQ results, and acoustic energy. Notably, the supraglottal back pressure of a straw changes depending on straw diameter rather than the length. Smaller straws in the air had larger supraglottal pressure contrasting with wider tubes underwater overcoming the PTP and maintaining smaller changes in supraglottal pressure. They also found that the difference between diameter and water depth in straw phonation has varied results that can be advantageous to singer customisation (Andrade et al, 2016, p. 40). A study comparing straw phonation, lip trills, and tongue trills further support the customisation theory, with four classically trained participants concluding that “all the singers benefited from at least one SOVT, but no single SOVT benefited all four singers” (Dargin, Delaunay, Seal, 2015, pp. 377.e1).

Humming on /m/ and /n/ occludes at the back of the oropharynx and has a medium acoustic $F_1 - F_0$ difference (Andrade, et al, 2013, p. 594). It is one of the occlusions that resemble a more natural vocal production. Another example of this occlusion is the /ŋ/.

In the cross-examination of seven contrasting SOVTEs (Andrade et al, 2013, pp. 590-594) four SOVTEs were found to have a secondary source of vibration and showed no CQ difference. I used this evidence to classify the SOVTEs into Andrade’s two distinct

physiological groups, or a combination of the two for dual SOVTEs, for my training program. The first is the 'Steady' group which has a single source of vibration such as humming /m/ or /n/, straw phonation, and hand-over-mouth. The second is the 'Fluctuating' group which introduces vibration of a secondary source, for example at the lips and tongue, or a LaxVox tube (please see Appendix 1 for SOVTE group categorisation). He found that the Steady group had lower CQ and $F_1 - F_0$ results whereas the Fluctuating group have greater CQ and $F_1 - F_0$ results. In this study the Steady group had small-medium effects.

Last year, Manternach, Maxfield, Manternach (2021, pp. 40-50) conducted a 30 participant CCM MT study on four SOVTEs (humming/lip trill/drinking straw phonation/stirring straw phonation). This study looked at both acoustic and perceptual analysis with the aim to discover a correlation between the two. This could better equip SOVTE recommendations. They found that the results supported the cross-genre research Manternach, Maxfield, Manternach, 2021, p. 47). They also suggest that SOVTEs may need to change depending on the individual.

It is important to note that while SOVTE may have copious amounts of benefits, they render different outcomes depending on the exercise combined with additional variables associated with the singer (Dargin and Seal, 2015, p. 155). These studies show promising results but contain small sample sizes, short durations, and a small demographic either in terms of voice type, singing style, or age. A number of studies use a simulation/synthesizer, therefore personal experience is omitted. Live participants should be considered for future studies as Titze (2006, p. 450-457) says, sensory changes in a singer may influence results as they feel the sounds in the facial tissues and experience heightened supraglottic pressure. SOVTEs are not successful for every singer and could have a damaging result if not performed correctly. Therefore, it is important to take this into consideration when recommending and teaching SOVTE. As Keltz and McHenry argued:

This study revealed that these strategies are not universally successful, and clinicians should recommend them only after assessing their effectiveness for their clients. Another consideration is the importance of teaching proper SOVT technique, so it is done correctly without added tension. Even blowing bubbles into a cup of water with phonation can be done poorly, in some cases yielding counterproductive results (Keltz and McHenry, 2020, p. 1).

I recognise that I need to moderate my personal bias towards exercises I have experience with and enjoy. Titze identified a 'most artificial to most natural' rationale of some SOVTEs through his research which could be a good way for me to determine part of an individual development plan (IDP) for a singer:

1. Highly resistant (small diameter) stirring straw
2. Less resistant (larger diameter) drinking straw
3. Bilabial or labiodental voice fricative
4. Lip or Tongue Trill
5. Nasal consonants
6. Vowel /u/ and /i/ (Titze, 2006, pp. 457-458)

If used correctly, SOVTE may help a singer develop a combination of benefits: combatting adduction and register changes, breathing issues, extending vocal range, a more resonant voice quality/timbre/character, pitching issues, the singer's perceived effort, reducing muscle effort/vocal fold collision, and/or preventing injury (please see Appendix 4 for Identifying SOVTE Benefits).

Advancing SOVT Methods: to blend from simulated to articulated vocal production

Meerchsman et al (2020, p. 661) stated there is a limitation to the single-phoneme task because articulation, speech, and singing are not applied. They investigated a water-resistant ventilation mask to mimic the standard SOVT occlusions benefits. This is the first study of its kind. They found that water-resistant ventilation masks had phonatory benefits when adding in articulation. They thus hypothesise that using this technique has a higher transfer to continuous singing (Meerchman et al, 2020, pp. 669 – 670). The addition of articulation, in particular, supports their theory but further studies are needed.

Another way to discover potential SOVTE benefits can be found by combining SOVTs. Hand-over-mouth creates a pocket of air outside the lips which extends the vocal tract. A combined version of hand-over-mouth combined with a tongue-trill is a popular combination exercise and is found to be more effective on lowering the CQ. Furthermore, the tongue-trill has a lower $F_1 - F_0$ relationship (Andande, et al, 2013, pp. 590-594).

Conclusion

I have to conclude that there are many gaps in SOVTE research because we are in the infant stage of our physiological understandings. At the beginning of this research project, I thought I may conclude by being closer to developing a training program to maximise economy-oriented voice training, however, a 'Pandora's box' surrounding SOVTE has emerged which I think is important to further research. I shall continue to develop my training program by experimenting with ideas of water-resistant ventilation masks, SOVTE combinations, and the Fluctuating group on long-term impact. The benefits of SOVTE on Music Theatre CCM voices and water-resistant ventilation masks used to link natural vocal production to artificial are of particular interest to me. I shall continue to re-enforce categorising SOVTE benefits to better inform which exercises to recommend to a singer.

From this study, I have established findings that impact my future practice:

- Steady and Fluctuating groups definitions.
- Straws can have additional levels of resistance with varying widths in water depth, or air.
- Initial results of Music Theatre singers confirm theories are consistent with CCM and Classical research.

There are opportunities to make advancements in the SOVTE field:

- SOVTEs are hypothesised to facilitate a mixed register.
- Water-resistant ventilation may be a way to bridge the gap between artificial and natural phonation while benefiting from the effects of SOVT still.
- There is potential to mix SOVTEs as a training method, but beneficial combinations need to be studied.
- Evidence suggests that a tailored program should be recommended to the singer; the SOVTE could accordingly require alteration during a training program.
- Evidence suggests that SOVTEs may have long-term effects.

Further research is needed for the carryover to the "vocal norm" looking at natural phonation methods combined with SOVT, and what effect SOVTEs have in a long-term study with live subjects. This could discover trends in SOVTE benefits that may assist in training customisation. The singer's perceptual results may also be useful to consider. More detailed

demographics of age, the 6 voice types, and abilities are needed. Studies would benefit from cross-examining a larger quantity of exercises, looking at SOVTE combinations, and looking at how to perform exercises correctly to create an inclusive program. More research is also needed on the SOVTE effects on professional MTs.

Part 2

A Reflective Review Comprising of Two Parts:

Reflect on your recent learning experience, and the value of learning you acquired.

Assess your current competencies and identify future development needs in the context of the work situation.

Devise a detailed personal development plan which incorporates development objectives, activities to be undertaken, methods, resources review periods and timescales.

This part of the assignment is 1800 words and is 40%

Using a combination of Gibbs's reflective practice theory (Briggs, Brigden, Hellenburg, 2014, p. 5), and Bolton reflective practice (2006), I have identified my current competences and future development.

Prior to my SOVTE study, I felt quite nervous and overwhelmed by the many possible research avenues I could have taken. Deciding what question I was going to ask was daunting. I think this is because I had a lot of self-doubt which gave me a feeling of imposter syndrome. During the study however, my overall knowledge of SOVTE benefits improved greatly but new discoveries led to more areas of research. Throughout this journey, I feel I have gained more confidence in my abilities and I developed a more systematic approach to research which evolved during this study meaning I had to adapt my research through my reflection in action (Schon, 1992).

Furthermore, upon reflection, I realise the SOVT research I was undertaking was still too wide. In the future I need to narrow down key areas of research to coordinate a well-researched vocal training program (please see personal development plan). During the experience I did alter my processes, but I don't think this was as effective as it could have been because my time management was affected negatively by my personal life. This was also because I spent too much of my early research phase looking at the wrong type of resources for my paper.

The value of this study has contributed to the changes in my views on SOVTE. This has led to a more experimental view of SOVTE which has been implemented in my teaching practice

henceforth. I think I need to have more conversations with my students to find out which SOVTE they feel works best for them. I have started using a larger range of SOVTEs in my teaching practice and delivering a more thorough explanation of how to perform each SOVTE. I have been able to identify key areas of my personal development which I expect to change throughout my master's studies (please see personal development plan). I feel more confident teaching and recommending SOVTEs as a result of this.

My research has also given me a clearer view on what I may specialise my studies in and how I can use different modules to my advantage to achieve my goals. I have become particularly interested in water-resistant ventilation masks which have given me ideas for other topics such as Breath, Registers, Voice Types, and Vocal Qualities. I think these areas will better inform my training program and while I'm sure areas of study will evolve over time, I think it is a very good starting point. I have also thought about how I can continue my education post-graduation and how I could contribute to the research in the academic field.

The freedom in study time and amount of research felt overwhelming at times because of my own self-discipline. I have struggled with the online nature of the course and how independent I must be. As a part of my action in reflection, I found using Thursday evenings and attending live classes helped me engage better with the course and self-discipline. Ongoing research in Anatomy, Physiology, and Evolution helped my understanding of terminology and helped me overcome my feeling of imposter syndrome. Other modes of study I utilised in my learning process were podcasts, YouTube videos, university live and recorded classes, and blog posts by organisations I work for such as The Sing Space. I found these to be very useful for my engagement in content, however, the time spent on these could have been better spent researching SOVT pedagogy to further support my paper. These areas can still be a part of my development plan but will be secondary to my main study at the time.

In retrospect, I could have spent more time focused on my essay rather than finding more ways to fit studies into my schedule for better preparation. I also could have spent more time delving into uncovered and new SOVT Methods. I found that my study was still successful as I still achieved some of my aims and discovered new SOVT methods and theories to add to my teaching strategy. Because of this reflection I will develop a research plan to identify articles, books, and other resources within the sub-topics of SOVT. Researching sections of SOVT and other pedagogical topics will allow me to develop detailed understanding in that particular area. I will also continue my research of SOVTE benefits, vocal tools, and innovative methods (masks and combining SOVTEs).

Personal Development Plan

When designing a personal development plan, I must take into consideration my recent mental health due to work overload and returning back to London after the pandemic. I need to be realistic with how much work I can undertake so that quality is maintained through my academic research and writing. I have a busy schedule working 6 days a week so one night a week focused on course modules will help streamline a steady learning process.

As I am thinking about timelines to manage my workload, my development plan will be further defined by goal term length:

- Short – Between now and December 2022
- Medium – Between January and December 2023
- Long – Between January and September 2024, and post-course finish date

Why am I doing this course:

- As I'm in the early stage of my teaching career, I want to develop my pedagogical, methodical, and theoretical knowledge to become a better teacher and build trusted teaching strategies. In my practice, there is not enough research on CCM MT singers therefore SOVTE knowledge can be used to develop further research.
- I want to develop an evidence-based training program on SOVTEs as I can identify a gap in the market.
- I want to discover areas that I will specialise in and study beyond this course.

What is the direct benefit to me?

- I believe I have a duty to my students to keep an up-to-date outlook on vocal pedagogy and to help them maintain a long career in Music Theatre.
- Developing a tailored SOVTE program will give me a focus to work towards.
- Outlining areas which I study will help me think about my career in the long term and I can mould my short term goals to help achieve my long term goals.

Developmental area	
1. Further SOVTE research	Action – Short Term • Answer the question of what the benefits of each SOVTE are using the appendix 1 to develop an SOVTE benefits document. • What other vocal tools are available? Use appendix 2 to create a SOVT tool document and conduct further research. • Create a document summarising all the useful research that I have learned in this study into a worksheet, including my references, traditional SOVT methods and research I haven't used but have logged already. It must include SOVT physiology, methods and benefits and what exercises can be applied to my teaching strategy that I can reference in the future. Start Date: 4th May 2022 during Module 2 Deadline: 5th August 2022
2. Project and schedule time management	Action – Short, Medium and Long Term • To create a timeline plan for each project I work on Start Date: Ongoing Deadline: Ongoing
3. Gain a clearer understanding of pedagogical research	Action – Short, Medium and Long Term • Develop resource sheet for further study including; vocal anatomy, evolution, and physiology, breathing mechanisms, voice registers and changes between them, vocal qualities, vocal effort (perceptual and acoustic), vocal fold adduction, voice-body connection, steaming and SOVT, range extension, the resonant voice, water-resistant mask ventilation SOVTE, what happens to strap and anchor muscles when performing

	SOVTEs, vocal warm up methods, straw phonation in and out of water, vocal injury statistics for CCM MTs and SOVT as a device for therapy. • Develop glossary to assist with culminating all the new terminology. Start Date: 4th May 2022 Deadline: To be kept updated until end of course 16th September 2024 and potentially beyond
4. Maintain fun ways to engage with Vocal Pedagogy	Action – Short term • Conversations with colleagues at vocal coach community The Sing Space of which I work with • Conversations with fellow students on my course • Listen to podcasts • Search YouTube for method demonstrations • Catch up on master's classes on the student system • Write a blog post on my research findings Start Date: 4th May 2022 Deadline: Ongoing Action – Medium term • Create an educational SOVTE PowerPoint Start Date: 19th September 2022 Deadline: 5th January 2023 Action – Long term • Lead workshops on SOVTE findings Start Date: 5th January 2023

	Deadline: Ongoing
5. Conduct a trial study of a 12-week SOVT training program	Action – Medium term I think it would be interesting to conduct a study on the long-term effects of SOVTEs during a 12-week trial. This may be best focused on the water-resistance ventilation mask or a range of different sized straws. This may be an ambitious idea and could be an idea to explore for my final module. It would ideally have a medium sample size and difference in demographics. Start Date: 20th January 2023 – potentially for Module 4 Deadline: 6th June 2023
6. Develop an SOVTE training program for professional CCM MT singers	Action – Long Term I think this may be something I'm interested in focusing a lot of my research on. I think there are a breath of topics to uncover, and it would be something that hasn't been done before. This may be something I look at something I look at for my final module or perhaps a further study after this course. It would contain a large sample size and study the effects over long periods such as 6 months or a year. It's a very early idea and I'm open to it developing. Start Date: 16th January 2024 Deadline: 16th September 2024

After my course I also aim to conduct studies in SOVTE myself to gain further understanding. I think there is a lot of protentional to develop beyond a 12-week program. I also had an idea to create a podcast to have continuing discussions with other pedagogues centred around innovative methods such as the water-resistant ventilation mask. This is because I want to use academic research to transfer to other media platforms. Two interviews on the same afternoon each month could be a possibility when I have more time.

I think overall my research has been very useful and my reflective practice has outlined a plan of action and a way to improve my learning processes. I'm looking forward to researching further and feeling quite excited – which is always a bonus!

Word Count: 4599

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Appendices

Appendix 1: Deciphering SOVTEs

SOVTE	Description	Group – CQ/ F_0 Characteristic	Acoustic $F_1 - F_0$ Difference	Titze Rational
Bilabial Voiced Fricatives	/v/ or /z/ sound	Fluctuating	Large	3
Cups	Placing a cup over the mouth to extend occlusion outside the vocal tract	Steady	Small	7
Gargle	TBC	Fluctuating	TBC	TBC
Hand-Over-Mouth	Hands covering the mouth creating an occlusion out of the mouth	Steady	Small	7
Hand-Over-Mouth with a Tongue-Trill	A combination of Hand-Over-Mouth and the Tongue-Trill	Steady & Fluctuating	Medium	Both 4 & 7
Humming	Phonating on /m/ or /n/	Steady	Medium	5
LaxVox	Soft silicone tube – length 25mm and diameter 4mm	Fluctuating	Large	
Lip Trills	Occlusion at the lips	Fluctuating	Medium	4
Puffa Fish	Mimicry of straw phonation without the	Steady	Small	1 and 2

	straw adding puffy cheeks for back pressure			
Raspberries (linguolabial)	An occlusion at the lip with the tongue between the lips	Fluctuating	Medium	4
Sirening	Phonating on /ng/	Steady	Medium	5
“Standing Wave” exercise	Vowel sung then cover the mouth	Steady		6
Straw Phonation	Using Straw or Tubes	Steady	Small	1 and 2
Tongue Trills	An occlusion inside the	Fluctuating	Large	4
Vowels - /o/ and /u/	Traditional	Steady	Smallest	6
Y-buzz	/j/ sound	Fluctuating	Medium	3

Titze’s Resistance Rational: Most artificial to most natural:

1. Highly resistant (small diameter) stirring straw
2. Less resistant (larger diameter) drinking straw
3. Bilabial or labiodental voice fricative
4. Lip or Tongue Trill
5. Nasal consonants
6. Vowel /u/ and /i/ (Titze, 2006, pp. 457-458)

Andrade’s Steady and Fluctuating groups:

The first is the ‘Steady’ group which has a single source of vibration such as humming /m/ or /n/, straw phonation and hand-over-mouth. The second is the ‘Fluctuating’ group which introduces a second source of vibration for example at the lips, tongue, or additionally LaxVox (Andrade, 2013, pp. 590-594).

Appendix 2: Voice Training Tools

Singing Straw (2022) The Singing Straw. Available at: <https://singingstraw.com/> (Accessed: 17th April 2022)

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at: <https://www.doctorvox.co.uk/product/doctorvox-voice-mask-with-dc-valve/> (Accessed:
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Appendix 3: Traditional SOVTE List

Covering the mouth with one hand (Aderhold, 1963), Straw (Sovijärvi, 1965), Y-Buzz and nasal consonants, Lip-trills (Linklater, 1976), “Standing Wave” exercise (Coffin, 1987), Humming, Bilabial Voiced Fricative (Laukkaenen 1992b, Laukkaenen et al, 1996), Nasal Consonants, Lip-trills, Tongue-trills and Raspberries (Nix 1999).

Appendix 4: Identifying SOVTE Benefits

Potential benefits of SOVTEs for the vocal folds:

- Supraglottal pressure can mediate the usually greater subglottal pressure lowering the intraoral pressure with the upper portion of the vocal folds spread apart equivalent to supraglottal pressure. The folds adopt a rectangular glottis shape. High sound pressure level (SPL) phonation with low vocal loading increases vocal fold vibration “massage effect”, contributing to lessened cord collision/stress/trauma on vocal organs. (Titze, 2006, p. 449, Titze, 2018, p. 313). Closed Quotient measurements identify the percentage of glottal cycle in which airflow is prevented by the subglottal pressure below vocal fold (Miller and Schutte, 2000)
- The increasing in vocal fold adduction efficiency changes effort, motion, and action of vocal fold phasing. Oscillation cycle is reinforced by marginally separated vocal folds and a reduction of vibrational amplitude. This occurs when the movements of the cricothyroid ligament and thyroarytenoid muscle coordinate the vocal folds with less cord collision. Results include being able to sing at a higher pitch (Titze, 2018, p. 313).
- Phonation Threshold Pressure (PTP) decreases and increases the change of the glottal flow waveform with the rectangular glottis and separated vocal folds (Titze, 2018, p. 313).
- First formant frequency F_1 is lowered (creating a vocal range from approximately 200-1500Hz) when occlusion happens near the mouth, or a tube is added. Register

changes/passaggio inaccuracy may benefit and it supports a mixed register (Titze, 2018, p. 313).

- The $F_1 - F_0$ relationship becomes more acoustically compliant (Titze, 2006, p. 449).

Potential benefits of SOVTEs for the vocal tract:

- Vocal tract vertical length is changed causing an impedance (flow) match regarding glottis impedance. This causes an increase of acoustic compliance in the vocal tract which contributes to lessening tissue trauma and muscle effort with increased economic vocal intensity and production (Titze, 2006 p. 457, Guzman et al, 2013, 523.e19, Andrade et al, 2014, p. 589).
- Epilarynx tube narrowing causes an increase of inertance (stored acoustic energy) in the vocal tract creating more resonance and a clear, bright, sonorous voice (Titze, 2006, p. 449, Guzman et al. 2012 p. e17, Titze, 2013, p. 306, Andrade et al, 2014, p. 589).
- Vocal tract Acoustic inertance lowers the PTP (Titze, 2018, p. 313).

Additional benefits of SOVTEs:

- Breathing mechanisms by increasing maximum flow declination (MFDR) (Andrade et al, 2014, p. 589). The aerodynamic and acoustic impedance through the vocal tract is better controlled.
- Widening of the pharynx in relation to the Epilarynx assists in clustering of third, fourth, and fifth formants increasing the resonant voice quality (Titze, 2006 p. 449).
- Singer's awareness of their voice