11-12-2021

Effect of Flow Phonation Voice Exercises on Vocal and Aerodynamic Measures in Undergraduate Student Singers

Jorge A. Diaz
Florida International University, jdiaz451@fiu.edu

FLORIDA INTERNATIONAL UNIVERSITY

Miami, Florida

EFFECT OF FLOW PHONATION VOICE EXERCISES ON VOCAL AND AERODYNAMIC MEASURES IN UNDERGRADUATE STUDENT SINGERS

A thesis submitted in partial fulfillment of

the requirements for the degree of

MASTER OF SCIENCE

in

SPEECH-LANGUAGE PATHOLOGY

by

Jorge A. Diaz

2021

To: Dean Ora Strickland
College of Nursing and Health Sciences

This thesis, written by Jorge A. Diaz, and entitled Effect of Flow Phonation Voice Exercises on Vocal and Aerodynamic Measures in Undergraduate Student Singers, having been approved in respect to style and intellectual content, is referred to you for judgment.

We have read this thesis and recommend that it be approved.

_____
Angela Medina

_____
Helene Fisher

_____
Vindhya Khare

_____
Balaji Rangarathnam, Major Professor

Date of Defense: November 12, 2021

The thesis of Jorge A. Diaz is approved.

_____
Dean Ora Strickland
College of Nursing and Health Sciences

_____
Andrés G. Gil
Vice President for Research and Economic Development
and Dean of the University Graduate School

Florida International University, 2021

DEDICATION

This thesis is dedicated to my family and friends who have supported me throughout this program. Your presence and words of encouragement have meant the world to me throughout this journey! I especially know my grandparents, who aren't with us anymore, would be proud of all the progress I have achieved at this point, and what I will continue to make. Although the journey is not over, this degree and thesis is a major milestone not only in my education, but also in my life!

ACKNOWLEDGMENTS

The completion of this thesis could not have been possible without the participation and assistance of Dr. Balaji Rangarathnam, Dr. Vindhya Khare, Dr. Monica Hough, Dr. Angela Medina, and Dr. Helene Fisher. I want to thank Dr. Kathleen Wilson for imparting into me a passion for voice science as it relates to singing. I especially want to acknowledge Dr. Teri Muñoz for taking me under her guidance in the beginning on how to do research when I started in the graduate certificate program. Each of the mentioned individuals have contributed to my education and growth as a future Speech-Language Pathologist and researcher. I sincerely appreciate and gratefully acknowledge their support.

ABSTRACT OF THE THESIS

EFFECT OF FLOW PHONATION VOICE EXERCISES ON VOCAL AND AERODYNAMIC MEASURES IN UNDERGRADUATE STUDENT SINGERS

by

Jorge A. Diaz

Florida International University, 2021

Miami, Florida

Professor Balaji Rangarathnam, Major Professor

This study examined the effects of Flow Phonation Voice Exercises on vocal measures in undergraduate student singers. Whereas these exercises have provided positive outcomes in individuals with vocal hyperfunction, the use of these exercises in potentially enhancing the singing voice has not been explored. A total of 10 participants were randomly assigned into an experimental group (n = 6), that received 5 sessions of the Flow Phonation Voice Exercises across 5 weeks, and a control group (n = 4) which did not receive the treatment. Changes in auditory-perceptual, acoustic, subjective respiratory, quality-of-life and fatigue related measures compared across two groups. Results indicate statistically significant differences in Singing Voice Handicap Index and perceptual singing voice quality and a positive trend toward improvement in Vocal Fatigue Index in the experimental group alone. The results suggest positive outcomes of the use of these exercises. Small sample size and COVID-19 related methodological constraints should be considered while interpreting these results.

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

LIST OF FIGURES

FIGURE PAGE

Chapter I: Introduction

The purpose of this study is to investigate the effects of flow phonation exercises on vocal characteristics of students in undergraduate vocal music training programs. Flow phonation exercises enable "better" channeling of air stream achieved using a relaxed laryngeal position, which eventually facilitates clear vocal quality (Stone & Casteel, 1982). For singers, this is the ultimate goal in any vocal execution on and off stage. Professional voice users include elite singers and the styles of classical singing correspond to the operatic style and demands complex adjustments, including vocal quality with harmonic richness, accurate articulatory control and vocal projection (Zuim et al., 2021). This allows the voice to stand out from the orchestra even without electronic amplification, and requires intricate training (Zuim et al., 2021). Goals of voice therapy and vocal pedagogy share similar views with respect to addressing laryngeal anatomy and physiology, breath support, posture, phonation, vocal resonation, vocal projection, articulation, vocal registration, and tone quality, all of which can potentially alleviate the negative effects of phonotrauma. Therefore, therapy approaches designed to improve the disordered voice may be equally effective when used to enhance the normal voice, and by consequence, the singing voice (Stemple, 2005).

Existing research utilizing some of these treatment methods such as vocal function exercises (Guzman et al., 2013) and resonant voice treatment (Yiu et al., 2016) have provided positive outcomes for enhancing voice quality in singers. The physiological bases of the flow phonation exercises are suggestive of achieving a potential balance of laryngeal resistance and airflow (Rangarathnam et al., 2015). As such, these exercises have the potential to improve efficiency in balancing airflow and

voice production in singers which could further translate into positive changes in self-perception of voice. However, empirical data to support this are lacking. As such, this study investigates vocal outcomes in a cohort of students in undergraduate singing programs in comparison to a similar group of students that did not receive training with these exercises. This preliminary study is the first data-based study in this direction.

Chapter II: Review of the Literature

Phonotrauma and Singers

Phonotrauma in singers has been documented throughout the literature, particularly due to the complex vocal needs of singers. They are required to have higher phonatory agility, stamina, and strength, which helps them while performing intricate vocal passages to fulfill said voice demands for singing (Gunjawate et al., 2018). Vocal pedagogues have different approaches to help promote vocal wellness in their singing students. These practices include, but are not limited to vocal hygiene, semi-occluded vocal tract exercises (SOVTEs), anatomic and physiologic knowledge of the voice, as well as perceptual knowledge and experience (Gill & Herbst, 2016). These practices allow future trained singers to have an optimum vocal education with evidence-based pedagogical practices within the voice studio.

Vocal Hygiene/Voice Conservation

Vocal hygiene constitutes all or some of the following components: counseling or education regarding voice production, the identification and elimination of phonotraumatic behaviors, an emphasis on proper hydration, and strategies for healthy voice production (Pomaville et al., 2020). Current clinical practice guidelines suggest that vocal hygiene education can enhance the effects of other physiological voice therapy methods (Rodríguez-Parra et al., 2011).

Broaddus-Lawrence et al. (2000) reported positive outcomes in singers' perceived value of vocal hygiene education. Eleven adult participants were asked to rate the vocal hygiene education they received based off of four class parameters: anatomy and physiology, vocal abuses, vocal pathologies/voice disorders, and preventative vocal

hygiene measures. Each measure was rated on a 7-point scale based on three statements, all of which led to either a "strongly agreed" or "agreed" response towards all the statements that were asked of the participants. At the conclusion of the study, the participants indicated much satisfaction with their vocal hygiene education and stated it will benefit them throughout their careers.

In another study, Achey et al. (2016) investigated classical singing students' use of vocal hygiene practices utilizing a cross-sectional survey. Results from 108 responses indicated a moderate degree of vocal handicap. However, the data suggests preventative vocal hygiene practices may currently be overstated and direct voice therapy treatment would increase successful outcomes in individuals with vocal pathologies/disorders (Achey et al., 2016).

Maria et al. (2020) reported the importance of vocal hygiene as "vitally important" for protecting vocal quality and promoting vocal longevity. This prospective cohort study contained 84 participants, all of which had some level of formal singing training. However, it was reported that the formal training in the sample did not relate to improved vocal hygiene behaviors. This study concluded with the acknowledgement of their group performing less at risk phonotraumatic behaviors as compared to equivalent ages in the general population, secondary to education and socioeconomic status (Maria et al., 2020).

Within the last ten years, vocal hygiene education programs have increased their potential in improving an individual's knowledge concerning their voice care. This allows the individual to improve their condition with a voice disorder, all while decreasing overall phonotraumatic behaviors that would otherwise exacerbate their vocal

condition (Pomaville et al., 2020). The reduction in an individual's phonotraumatic behaviors, and specifically for singers, a reduction in their singing voice handicap would entail improved longevity in their vocal careers (Reckers et al., 2020). However, vocal hygiene alone is not sufficient to prevent a voice disorder, thus, proper vocal technique is required to maximize vocal output (Lloyd et al., 2020).

Semi-Occluded Vocal Tract Exercises

The American Speech-Language-Hearing Association (ASHA) (2016) defines Semi-occluded vocal tract exercises in voice therapy as vocal exercises that involve narrowing at any supraglottic point along the vocal tract to maximize interaction between vocal fold vibration (sound production) and the vocal tract (the sound filter) and to produce resonant voice. As described in the literature, there are several variations of SOVTEs such as: straw phonation, tube phonation, lip trills, tongue trills, y-buzz, hand over mouth and voiced bilabial fricatives, among others (Kapsner-Smith et al., 2015). SOVTEs are theorized to heighten the interaction between the glottic source and the supraglottic geometry, allowing the vocal folds to work more effectively with the vocal tract. When the vocal tract is partially occluded, air pressures above and between the vocal folds increase and maintains the approximated vocal folds in a slightly separated position (Bane et al., 2018). This phenomenon is partially attributed to the buildup of positive intraoral pressure resulting from vocal tract semi-occlusion. Increased intraoral pressure acts on the superior surface of the vocal folds to maintain a slightly abducted position, forming a nearly rectangular-shaped glottis (Titze, 2014). With the vocal folds almost parallel, vocal economy is maximized during phonation (Berry et al., 2001). Thus,

the goal of an SOVTE is to achieve greater vocal output while minimizing vocal fold stress and physical effort (Croake et al., 2017).

Recent research in the use of SOVTEs for singers have yielded positive outcomes. One such SOVTE would be "LaxVox" which induces an immediate positive effect on vocal self-assessment of professional singers without voice complaints (Fadel et al., 2016). In this study, 23 participants were recruited and were asked to complete a demographic questionnaire and a variety of vocal samples, including singing. The results suggested improved self-assessment of voice after use of the LaxVox SOVTE in both speech and singing. Although self-assessment improved within the participants, all other measures such as acoustics and auditory-perceptual were similar pre- and post-SOVTEs (Fadel et al., 2016).

Another SOVTE used with singers is the Flexible Resonance Tube technique (FRT) which is a method used for vocal conditioning and provides better control of phonatory mechanisms (de Oliveira et al., 2020). With the improvement from pressed phonation to flow phonation, there is an expansion of the vocal tract and reduction of phonotraumatic behavior between the vocal folds.

Vocal Function Exercises

Vocal function exercises (VFEs) are a series of systematic voice manipulations designed to facilitate return to healthy voice function by strengthening and coordinating laryngeal musculature and improving efficiency of the relationship among airflow, vocal fold vibration, and supraglottic treatment of phonation (Angadi et al., 2019). The exercises in the program are produced with an engaged laryngeal muscle system (well-balanced laryngeal muscle function promoting an appropriate vocal efficiency and

economy), a front tone focus, and a lower loudness level (Stemple, 2010). In a 2013 study, Vocal Function Exercises were being examined in the singer population as a vocal warm-up (Guzman et al., 2013). The results from this study indicated an improvement in the following investigated vocal acoustical measures: alpha ratio, L_1-L_0 ratio, and singing power ratio (SPR). When compared to a control group, the results from the analysis showed significant changes after treatment in the alpha ratio and singing power ratio for the speaking voice, and the SPR for the singing voice in the VFE group. This improvement provides supporting evidence on the effectiveness of VFEs on vocal quality, especially in the singer population.

Resonant Voice Therapy

The goal of Resonant Voice Therapy (RVT) is to achieve the strongest and clearest possible voice with the least effort and to reduce impact stress between the vocal folds to minimize the likelihood of injury (Saltürk et al., 2019). The participant is instructed to produce a voice with a forward tone focus that involves vibratory sensations on the alveolar ridge and other facial bones in easy phonation. Generally, a vibrating sensation on the face indicates the effective use of air and resonance placement during voicing tasks. The premise for resonant voice therapy is the use of a myriad of oral sensations and easy phonation. These sensations build from basic speech gestures (phoneme level, syllable level, word level, etc.) all the way to conversational speech (Yiu et al., 2016). The overall goal in resonant voice therapy is to achieve the strongest, cleanest, and clearest possible voice with the least effort and impact between the vocal folds thereby improving vocal efficiency. This is meant to minimize the likelihood of phonotraumatic injury and maximize the likelihood of vocal health in all patients

(Stemple, 2010). The program incorporates humming as well as voiced and voiceless productions that are shaped into phrase and conversational productions (Verdolini, 2000).

Ouyoung et al. (2018) reported improvements of vocal production in hormone-related voice disorders in professional female singers as an effect of RVT. This randomized study had a total of 20 professional female singers. Ten premenstrual participants (women who are in the premenstrual phase of their menstrual cycle) were placed in one group and 10 postmenopausal participants were placed in another group. Results indicated positive outcomes on voice handicap index, self-reporting severity, phonation effort, voice quality severity, and vocal fold abnormality in addition to self-perceived singing voice quality, and speaking flexibility for both groups of participants.

Flow Phonation

Flow Phonation is a set of voice therapy exercises that promotes the "relaxation" of laryngeal musculature, rebalances laryngeal resistance and airflow, and improves vocal quality (Watts et al., 2015). These exercises are structured in a hierarchical manner which progressively become more complex, ending with the removal of the feedback. Within each level of the flow phonation protocol, the primary perceptual target is the airflow movement throughout the vocal tract. These exercises have provided positive outcomes in individuals with hyperfunctional voice disorders (McCullough et al., 2012) and individuals with phonotraumatic lesions (Watts et al., 2015).

Overall, the training received by singers in an undergraduate program typically involves either exercises passed down through tradition and/or the use of incorporating vocal pedagogy practices (Lennon & Reed, 2012). Additionally, a robust body of research has documented instances of phonotrauma in future elite vocal performers, such

as students in singing programs (Timmermans et al., 2005). Although the education for a singer has been evolving to a more scientific vocal pedagogy practice, the inclusion of Evidence Based Practice (EBP) voice exercises, such as those used in voice therapy to optimize vocal and aerodynamic outcomes is lacking. Currently, there is existing research utilizing some treatment methods from voice therapy such as vocal function exercises (Guzman et al., 2013) and resonant voice treatment (Yiu et al., 2016). These voice therapy treatments have provided positive outcomes for enhancing voice quality in singers. Flow phonation voice exercises have the potential in improving the efficiency in balancing airflow and voice production in singers, which could hypothetically further translate into positive changes in self-perception of voice. However, empirical data to support this is lacking. Determining if flow phonation voice exercises improve vocal outcome measures in undergraduate student singers would provide the first data-based outcomes study that could potentially further voice science within vocal pedagogy.

Specific Aim and Hypothesis

Specific Aim: To determine the specific effects of the flow phonation exercises on auditory perceptual, acoustic, subjective respiratory, fatigue and quality-of-life measures in undergraduate classical singers.

Hypothesis: Participants evaluated and treated with flow phonation exercises will improve auditory-perceptual measures, acoustic, subjective respiratory measures, as well as singing voice handicap and vocal fatigue compared to baseline.

Chapter III: Methodology

Research Design

This study adopted an experimental research design, specifically, a controlled experimental design. As such, results obtained from experimental samples were compared against control sample results.

Participants

A total of 10 participants were recruited for this research study. Effort to recruit participants of all genders were attempted, however, only self-identified cis females of Latina/Hispanic, African American, and White ethnicities and various socio-economic statuses, meeting the inclusionary criteria were enrolled in the study. Participants were randomized into two groups: an experimental group (Group 1, n = 6) receiving 5 sessions of flow phonation intervention and a control group (Group 2, n = 4) that did not receive any direct intervention.

The inclusion criteria included: a. Singers at the beginning stages of their vocal training; b. over 18 years of age; c. enrolled in a professional singing program. The exclusion criteria included: a. individuals with advanced voice knowledge/training; b. history of organic/functional voice disorders; c. individuals with neurological or other organic laryngeal conditions. All participants provided written informed consent and all study procedures were completed after IRB approvals.

Treatment Exercises

Participants in Group 1 received 5 sessions of flow phonation exercises spread across 5 weeks. Each treatment session lasted about 30 minutes. Participants in Group 2 did not receive any direct training and only received tips for vocal hygiene and

conservation. The flow phonation therapy method that was administered to participants in Group 1 utilized three exercises: gargling, cup bubble blowing, and stretch and flow (Appendix 4). Each exercise used a built-in form of biofeedback (water or tissue) and the same basic progression of activities: (1) airflow task without voicing to establish positive airflow, (2) adding voicing to the task, (3) moving up and down the pitch range during the voicing task, (4) moving to a speaking/voicing task, and (5) removing biofeedback. During each vocalization attempt, the clinician provided feedback to participants regarding the clarity of voice. Participants were also trained to listen and feel their own productions and make self-corrections as necessary. In general, participants were expected to produce voice in a comfortable range with an undisrupted flow of air as evidenced by the strength and "smoothness" of the bubbles or tissue blowing.

The gargling exercise required the participant to place a small amount of water in the mouth, recline the head, and gargle without voice 10 times for 5–6 seconds with breaks in between. Participants were instructed to relax the throat and gargle with enough airflow to make the bubbles pop up out of the mouth. After this was accomplished, the next step was to gargle the same way but with voice in a comfortable range—again ensuring bubbles pop up out of the mouth. The third step was to gargle with the voice moving up and down pitch scales freely and relaxed. This was done 10 times, as well. The fourth step began with participants gargling with the voice and then required them to roll their head forward while gargling, closing the mouth as their head rolls forward allowing the sound to come out of the nostrils into a hum. Participants then swallowed the water, took an easy breath, and repeated "mmmma ma ma ma," "mmmmay, may, may, may," and continued with other vowels. When voicing sounded sufficiently relaxed

and had a nasal-like quality without laryngeal tension, it was carried over into words, such as mamma, mary, many, maybe, marble.

The cup bubble blowing exercise required participants to take a clear, plastic cup of water filled about 2/3 of the way up, placed their mouths over the cup and tipped it up until the top lip was in the water. The participants drew in a breath and blew bubbles without using voice, again to establish positive airflow. Bubbles were supposed to be actively popping up from the cup. This was done 10 times and then voicing was added for 10 trials. When voicing was added, bubbles were expected to remain just as active as they were without the voice. In the third step, participants blew bubbles with voice moving freely and relaxed up and down in pitch. In the fourth step, participants began by blowing bubbles with the voice. As the cup pulled away, pursed lips were maintained, and the sound continued into a relaxed /u/. After a breath, /u/ was repeated. This step was repeated 10 times.

The final exercise was “stretch and flow.” For this exercise participants took a piece of tissue paper, separated the layers, and folded one layer in half. The tissue was held between the index and middle fingers near the top of the tissue, and the tissue was held in front of the face hanging down where the mouth is centered around the junction of the bottom and middle third. In the first part, participants blew air into the tissue such that the tissue moved back parallel to the floor for 4–5 seconds. This was done 10 times with breaks in between. The airflow should have felt easy and effortless. Then, participants began as in step 1, blowing air into the tissue. When the tissue was parallel to the floor, participants added in their voice. This was done 10 times with sufficient breaks. In step 3, participants began blowing air into the tissue and voicing simultaneously, ensuring it was

parallel to the floor, and then said “one” with the same easy voice. The tissue came down. This was repeated for numbers two, three, etc, up to ten. The fourth step was done the same way, but with “H” and “WH” initiated phrases rather than words (i.e., “How are you?” “What time is it?”).

From sessions 2-5, participants performed singing during the last 10 minutes of each session. Participants were encouraged to listen to their voice and focus on the way they felt with respect to their vocal effort. Participants were encouraged to use relaxation strategies they acquired during the exercises and utilize them during the singing part of the session. The research clinician listened to their voice and provided feedback about easy onset, relaxation and coordinated airflow for voice production. All treatment sessions were delivered virtually in order to comply with social distancing guidelines for the COVID-19 pandemic. Participants were also instructed to practice these exercises at least three times per day for about 10 minutes per session.

Data Collection

Participants completed a demographic history documenting their years of experience, vocal hygiene knowledge and use, estimated amounts of voice use, medications and vocal inventory.

Assessment

Participants were assessed on the following measures at two time points: before and after 5 weeks of intervention.

Table 1

Measurements Table

Auditory-Perceptual Evaluation	Singing Voice: Auditory-Perceptual Rating Instrument for Operatic Singing Voice.
Acoustic Evaluation	Jitter, Shimmer, and NHR utilizing PRAAT.
Subjective Respiratory Assessment	Maximum Sustained Phonation (MPD) and S/Z Ratio.
Quality of Life and Self-Perceived Handicap	Singing Voice Handicap Index (sVHI).
Perception of Vocal Fatigue	Vocal Fatigue Index (VFI).

Auditory-Perceptual Assessment

Participants provided singing voice samples for auditory-perceptual analyses. The rating scale developed by Oates et al. (2006) (Appendix 1) was utilized to assess singing voice samples. These samples were rated on a visual analog scale and the parameters of rating included pitch accuracy, resonance balance, ring, vibrato, breath management, evenness throughout the range, strain along and an overall vocal performance score. Ten percent of the data corpus was re-rated blindly by 2 singers with a minimum of 5 years of experience in classical singing for singing voice samples to determine inter-judge reliability. Inter-judge reliability was measured using intra-class correlation coefficients.

All singing samples were collected via the Zoom videoconferencing platform. Participants were instructed to be in a quiet environment and to phonate their voice samples into either their computer microphone or microphone from an available headset. As the participants were producing the requested voice samples, the Praat software (Styler, 2013) was used to record voice samples for future analysis. The initial evaluation sessions lasted on average 30 minutes. Participants were also given sheet music to practice ahead of time for preparation of voice samplings.

Acoustic Voice Measurement

Acoustic measurements were also performed for speaking and singing voice samples. Sustained vowel, sentence production and reading samples were analyzed using the Praat program. This program incorporates measures of the voice such as: jitter, shimmer, and NHR. Participants were instructed to produce a sustained production of the vowel /a/, read the first paragraph of the rainbow passage and read the six sentences of Consensus auditory perceptual evaluation of voice (Kempster et al., 2009) at comfortable pitch and loudness. Participants were instructed to sing an English language classical song with their best singing voice at comfortable pitch and loudness levels without accompaniment. Participants were provided 5 minutes of vocal warm up of their choice before providing singing voice samples.

Subjective Respiratory Measurement

- Maximum Phonation Duration (MPD): The participant was instructed to take a comfortable breath, then to produce a sustained open vowel (/a/) at a comfortable pitch and loudness for as long as they could. Duration was measured using a stopwatch.

- S/Z Ratio: The S/Z ratio is obtained by timing the longest duration a participant can sustain the individual phonemes (/s/) and (/z/). Participants were instructed to take a comfortable breath, then to produce (/s/) and (/z/), respectively, for as long as they could. Ratio of duration of /s/ to /z/ was considered for analyses. Durations were measured using a stopwatch.

Participant's Perception of their Singing Voice

Participants completed the Singing Voice Handicap Index (sVHI) (Cohen et al., 2007) before and after 5 weeks of intervention. The sVHI (Appendix 2) is a patient-based self-assessment tool consisting of 36 items that measure participants' self-perception of singing voice problems. The 36 items measure physical, emotional, social and economic impacts of singing voice problems.

Participant's Perception of Vocal Fatigue

Participants completed the Vocal Fatigue Index (VFI) (Nanjundeswaran et al., 2015) before and after 5 weeks of intervention. The VFI (Appendix 3) consists of 19 items that measure participants' self-perception of fatigue in their voices.

Data Analysis

To address the specific aim, the Wilcoxon signed-rank test was administered for the following comparisons:

a. Comparison of ratings of overall singing voice quality before and after treatment for each participant group.
b. Comparison of acoustic measures (jitter, shimmer, and NHR) before and after treatment for each participant group.

c. Comparison of subjective aerodynamic measures (MPD and S/Z Ratio) before and after treatment for each participant group.
d. Comparison of sVHI before and after treatment for each group.
e. Comparison of VFI before and after treatment for each group.

Chapter IV: Results

Descriptive Statistics

Means and standard deviations of each outcome measure is presented in Table 2.

Insert Table 2 about here

Wilcoxon Signed-Rank Test

Wilcoxon ranked sign test was administered to compare outcomes across the two time points (baseline and post intervention) for each of the participant group. Results are presented in tables 3 and 4.

Insert Table 3 and 4 about here

As can be seen in Tables 3 and 4, the statistical outcomes of this study found possible significant changes from pre-treatment to post-treatment in three outcome measures in the experimental group. These measures included the overall singing quality as measured by the Auditory-Perceptual Rating Instrument for Operatic Singing Voice ($p < 0.05$), overall severity on the Singing Voice Handicap Index ($p < 0.05$), and trends toward positive outcomes ($p = 0.068$) on the Vocal Fatigue Index. None of the outcome measures were statistically significant in the control group that did not receive the flow phonation intervention.

Chapter V: Discussion

This study aimed to investigate the effects of a voice therapy approach – flow phonation method – typically used with patients with hyperfunctional voice disorders on vocal outcomes of healthy singers in training. Phonotrauma and laryngeal changes are well documented in future vocal performers, however research utilizing voice therapy methods for this population is rare. Extant research investigating some of these treatment approaches such as the Lax Vox SOVTE (Fadel et al., 2016) and the Vocal Function Exercises (Guzman et al., 2013) has provided positive evidence.

It was hypothesized that the flow phonation exercises could potentially improve vocal, airflow and self-perceived voice related quality-of-life outcomes in student singers. While our target enrollments have not been met to achieve optimal statistical power, the hypotheses were at least partially supported. In particular, positive intervention related changes were observed in self-perceived voice handicap, vocal effort and perception of singing which were not observed in the control group.

Singers are typically classified as elite vocal performers as even supposedly trivial vocal changes can be detrimental to performance and consequently have a negative impact on livelihood, and quality-of-life (D'haeseleer et al., 2017). Student singers receive intensive training on several aspects including coordination of breath support, projection, and resonance among others. Future elite vocal performers, such as student singers, show poor vocal quality at times and negative changes in laryngeal mucosa (Teachey et al., 1991). Because of these considerations, optimal vocal coaching is critical to alleviate the negative effects of phonotrauma and for general vocal wellness.

Flow phonation exercises utilize biofeedback and have demonstrated to enhance airflow characteristics by normalizing laryngeal resistance and airflow in individuals with vocal hyperfunction (Rangarathnam et al., 2015). Given that singers exhibit similar hyperfunctional phonotraumatic behaviors, the exercises could logically enhance airflow characteristics in this population. Our data appears to be consistent with this hypothesis.

Firstly, participants in the experimental group demonstrated statistically significant changes in auditory-perceptual measures of singing. That is, participants exhibited noticeable changes in how they "sound" perceptually. One of the primary goals of singing pedagogy is to improve a singer's technique by how they sound (Hoch & Sandage, 2018). Based on the ratings on Auditory-Perceptual Rating Instrument for Operatic Singing Voice, participants appear to have improved on one or more of the components the instrument measures – vibrato, ring, pitch accuracy, breath management, evenness, resonance and strain. Although analyses of these individual parameters were not made, the exercises do appear to enhance overall singing quality.

Secondly, participants improved on self-perceived singing related quality-of-life. In other words, participants reportedly "felt" better after 5 weeks of training with flow phonation exercises. Singers represent a distinct treatment seeking population in voice clinics because of factors related to how their voice related quality-of-life is affected. Many singers experience performance anxiety and are more sensitive to smaller changes in their voices (Ryan & Andrews, 2009). Consequently, singers report more disability, more emotional impact, and are more likely to seek medical attention than non-singers (Phyland et al., 1999). Therefore, changes in self-reported voice related quality-of-life measures are significant in interpreting treatment effects. As such, it appears that the data

in the present study are suggestive of positive outcomes of flow phonation exercises in this small group of singing students from a singing quality-of-life perspective.

Thirdly, scores on the vocal fatigue index showed trends toward improvements even though statistical significance was not observed. Although vocal fatigue has been defined by various authors differently, common consensus describes vocal fatigue as reduced endurance and control of voice with prolonged use often accompanied by physical discomfort (Hunter et al., 2020). Elite vocal performers experience higher instances of vocal fatigue as do students with poor vocal technique (Siqueira et al., 2021). Prolonged vocal fatigue could potentially lead to other phonotraumatic behaviors further exacerbating voice problems (Ilomäki et al., 2017). The data in the present study appears to demonstrate possible reduction in vocal fatigue after flow phonation treatment. While more research is still needed to ascertain the benefits of flow phonation voice exercises and their relationship with vocal and aerodynamic measures in singers, the present study indicates a possible improvement secondary to positive results/improvements in their singing related voice handicap, perceptual singing quality and a positive trend with reduced vocal fatigue after treatment.

However, there are other measures that did not reach statistical significance. None of the acoustic measures were observed to change in the post-treatment assessment. This could partly be due to methodological constraints and data collection methods. While in-person data collection was completely impossible due to the ongoing COVID-19 pandemic, measures were obtained through the videoconferencing platform, Zoom. Several factors including the use of headphones, noise cancelation and microphones among others could not be controlled, all of which could have negatively affected the

authenticity of acoustic measurements. Similarly, objective airflow measures were not obtained in the study. Originally, we proposed to utilize the phonatory aerodynamic system to obtain objective indices of airflow for voicing. This was modified to subjective measures such as maximum phonation duration and s/z ratio to comply with guidelines outlined by the Centers for Disease Control (CDC) to contain the effects of the pandemic. Whereas these measures could offer potential insights into aerodynamics, they can be influenced by other factors, especially the laryngeal status of the individual. As such, meaningful comparisons of acoustic and respiratory measurements were not made in the study (Roy et al., 2009).

Regardless of these limitations, the data does offer several clinical insights. As mentioned earlier, participants "sounded" and "felt" better after training with flow phonation exercises – two important features that are also important for elite professional voice users. Elite performers are sensitive to perceptual changes and the impact of voice changes on their quality-of-life (Aquino & Teles, 2013). Changes in these two measures are potentially significant in understanding the effects of flow phonation exercises.

As for the reasons for these possible improvements, the flow phonation exercises utilize a built-in form of biofeedback. For example, the cup bubble blowing, and the gargling exercises utilize the strength of bubbles as a form of feedback, and the stretch and flow exercise utilizes the strength of tissue flutter as a form of feedback. Feedback is an important part of motor learning and facilitates muscle plasticity and formation of newer motor memories (Sigrist et al., 2013). As such, these exercises facilitate the participant to reflect on their performance and make changes to their performance during instances of inaccuracies. Physiologically, all of the exercises provide opportunities for

continuous release of airflow. This continuous release of airflow and forward focus of laryngeal tension – an aspect constantly emphasized during the delivery of the exercises – potentially help reduce laryngeal tension. In addition, an intentional effort to transfer treatment gains achieved during the practice of these exercises to singing was made throughout the length of treatment such as, but not limited to: sense of resonance, sympathetic vibrations, use of airflow, forwardness of voice placement, and so forth.

Limitations

Overall, this study indicates that the use of flow phonation voice exercises have the potential to improve voice instruction within the voice studio. There are, however, many limitations to this study. Target enrollments were not met due to multiple factors, mostly related to the COVID-19 pandemic. As such, statistical power of the data is limited. It is possible with an increased sample size, statistical significance could potentially be obtained since a sample size of 6 participants in the experimental group is too small to make meaningful interpretations. Other limitations include software updates and differences between Zoom versions, connectivity issues, background noise, use (or lack-thereof) and quality of headphones, device used by participants. Additionally, vocal warm-up methods used by participants were not homogenous.

Conclusions

The results of this study increase our understanding of incorporating voice therapy protocols into the voice studios of vocal pedagogues and singers. At this point in time, focusing singing education with other EBP voice therapy protocols will achieve maximum benefit for future singers. Should future researchers look to replicate this study, by increasing the sample size in the study it is possible that more meaningful

statistical comparisons are possible due to an increase in statistical power. Such efforts will provide future vocal pedagogues and singers with greater understanding and appreciation of which voice therapy protocols to incorporate into the voice studio, practice, and performance (Nail-Chiwetalu & Ratner, 2007).

References

Achey, M. A., He, M. Z., & Akst, L. M. (2016). Vocal hygiene habits and vocal handicap among conservatory students of classical singing. *Journal of Voice*, *30*(2), 192-197.

American Speech-Language-Hearing Association. (2016, June 29). *Voice Disorders*. https://www.asha.org/PRPSpecificTopic.aspx?folderid=8589942600&section=Treatment

Angadi, V., Croake, D., & Stemple, J. (2019). Effects of vocal function exercises: A systematic review. *Journal of Voice*, *33*(1), 124-e13.

Aquino, F. S. D., & Teles, L. C. D. S. (2013). Vocal self-perception of professional singers. *Revista CEFAC*, *15*, 986-993.

Bane, M., Brown, M., Angadi, V., Croake, D. J., Andreatta, R. D., & Stemple, J. C. (2018). Vocal function exercises for normal voice: With and without semi-occlusion. *International Journal of Speech-Language Pathology, 21*(2), 175-181. doi:10.1080/17549507.2017.1416176

Berry, D. A., Verdolini, K., Montequin, D. W., Hess, M. M., Chan, R. W., & Titze, I. R. (2001). A Quantitative Output-Cost Ratio in Voice Production. *Journal of Speech, Language, and Hearing Research*, *44*(1), 29–37. https://doi.org/10.1044/1092-4388(2001/003)

Broaddus-Lawrence, P. L., Treole, K., Mccabe, R. B., Allen, R. L., & Toppin, L. (2000). The effects of preventive vocal hygiene education on the vocal hygiene habits and perceptual vocal characteristics of training singers. *Journal of Voice*, *14*(1), 58–71. https://doi.org/10.1016/s0892-1997(00)80095-8

Cohen, S. M., Jacobson, B. H., Garrett, C. G., Noordzij, J. P., Stewart, M. G., Attia, A., ... & Cleveland, T. F. (2007). Creation and validation of the singing voice handicap index. *Annals of Otology, Rhinology & Laryngology*, *116*(6), 402-406.

Croake, D. J., Andreatta, R. D., & Stemple, J. C. (2017). Immediate Effects of the Vocal Function Exercises Semi-Occluded Mouth Posture on Glottal Airflow Parameters: A Preliminary Study. *Journal of Voice*, *31*(2). https://doi.org/10.1016/j.jvoice.2016.08.009

de Oliveira, K. G. S. C., de Lira, Z. S., da Silva, H. J., Lucena, J. A., & Gomes, A. D. O. C. (2020). Oropharyngeal Geometry and the Singing Voice: Immediate Effect of Two Semi-Occluded Vocal Tract Exercises. *Journal of Voice*.

D'haeseleer, E., Claeys, S., Meerschman, I., Bettens, K., Degeest, S., Dijckmans, C., ... & Van Lierde, K. (2017). Vocal characteristics and laryngoscopic findings in future musical theater performers. *Journal of Voice*, *31*(4), 462-469.

Fadel, C. B. X., Dassie-Leite, A. P., Santos, R. S., Santos Junior, C. G. D., Dias, C. A. S., & Sartori, D. J. (2016, January). Immediate effects of the semi-occluded vocal tract exercise with LaxVox® tube in singers. In *Codas* (Vol. 28, No. 5, pp. 618-624).

Gill, B. P., & Herbst, C. T. (2016). Voice pedagogy—what do we need?. *Logopedics Phoniatrics Vocology*, *41*(4), 168-173.

Gunjawate, D. R., Ravi, R., & Bellur, R. (2018). Acoustic analysis of voice in singers: A systematic review. *Journal of Speech, Language, and Hearing Research*, *61*(1), 40-51.

Guzman, M., Angulo, M., Muñoz, D., & Mayerhoff, R. (2013). Effect on long-term average spectrum of pop singers' vocal warm-up with vocal function exercises. *International journal of speech-language pathology*, *15*(2), 127-135.

Hoch, M., & Sandage, M. J. (2018). Exercise science principles and the vocal warm-up: implications for singing voice pedagogy. *Journal of Voice*, *32*(1), 79-84.

Hunter, E. J., Cantor-Cutiva, L. C., van Leer, E., Van Mersbergen, M., Nanjundeswaran, C. D., Bottalico, P., ... & Whitling, S. (2020). Toward a consensus description of vocal effort, vocal load, vocal loading, and vocal fatigue. *Journal of Speech, Language, and Hearing Research*, *63*(2), 509-532.

Ilomäki, I., Kankare, E., Tyrmi, J., Kleemola, L., & Geneid, A. (2017). Vocal fatigue symptoms and laryngeal status in relation to vocal activity limitation and participation restriction. *Journal of Voice*, *31*(2), 248-e7.

Kapsner-Smith, M. R., Hunter, E. J., Kirkham, K., Cox, K., & Titze, I. R. (2015). A Randomized Controlled Trial of Two Semi-Occluded Vocal Tract Voice Therapy Protocols. *Journal of Speech, Language, and Hearing Research*, *58*(3), 535–549. https://doi.org/10.1044/2015_jslhr-s-13-0231

Kempster, G. B., Gerratt, B. R., Abbott, K. V., Barkmeier-Kraemer, J., & Hillman, R. E. (2009). Consensus auditory-perceptual evaluation of voice: development of a standardized clinical protocol.

Lennon, M., & Reed, G. (2012). Instrumental and vocal teacher education: competences, roles and curricula. *Music Education Research*, *14*(3), 285-308.

Lloyd, A. T., Gerhard, J., Baker, P., Lundy, D. S., Diaz, J., Bretl, M. M., ... & Rosow, D. E. (2020). Prevalence of vocal fold pathologies among first-year singing students across genres. *The Laryngoscope*, *130*(8), 1996-2002.

Maria, C. S., Sung, C.-K., Baird, B. J., & Erickson-Direnzo, E. (2020). Vocal Hygiene in Collegiate Singers—Does Formal Training Relate to Practices? *Journal of Voice*. https://doi.org/10.1016/j.jvoice.2020.03.014

McCullough, G. H., Zraick, R. I., Balou, S., Pickett, H. C., Rangarathnam, B., & Tulunay-Ugur, O. E. (2012). Treatment of laryngeal hyperfunction with flow phonation: A pilot study. *Journal of Laryngology and Voice*, *2*(2), 64.

Nanjundeswaran, C., Jacobson, B. H., Gartner-Schmidt, J., & Abbott, K. V. (2015). Vocal Fatigue Index (VFI): development and validation. *Journal of Voice*, *29*(4), 433-440.

Nail-Chiwetalu, B., & Ratner, N. B. (2007). An assessment of the information-seeking abilities and needs of practicing speech-language pathologists. *Journal of the Medical Library Association*, *95*(2), 182.

Oates, J. M., Bain, B., Davis, P., Chapman, J., & Kenny, D. (2006). Development of an auditory-perceptual rating instrument for the operatic singing voice. *Journal of Voice*, *20*(1), 71-81.

Ouyoung, L., Villegas, B. C., Liu, C., Talmor, G., & Sinha, U. K. (2018). Effects of Resonance Voice Therapy on Hormone-Related Vocal Disorders in Professional Singers: A Pilot Study. *Clinical Medicine Insights: Ear, Nose and Throat*, *11*, 1179550618786934.

Phyland, D. J., Oates, J., & Greenwood, K. M. (1999). Self-reported voice problems among three groups of professional singers. *Journal of Voice*, *13*(4), 602-611.

Pomaville, F., Tekerlek, K., & Radford, A. (2020). The Effectiveness of Vocal Hygiene Education for Decreasing At-Risk Vocal Behaviors in Vocal Performers. *Journal of Voice*, *34*(5), 709–719. https://doi.org/10.1016/j.jvoice.2019.03.004

Rangarathnam, B., McCullough, G. H., Pickett, H., Zraick, R. I., Tulunay-Ugur, O., & McCullough, K. C. (2015). Telepractice versus in-person delivery of voice therapy for primary muscle tension dysphonia. *American Journal of Speech-Language Pathology*, *24*(3), 386-399.

Reckers, H., Donahue, E., & LeBorgne, W. (2020). Comparison of reported vocal habits of first-year undergraduate and graduate vocal performance majors. *Journal of Voice*.

Rodríguez-Parra, M. J., Adrián, J. A., & Casado, J. C. (2011). Comparing voice-therapy and vocal-hygiene treatments in dysphonia using a limited multidimensional evaluation protocol. *Journal of Communication Disorders*, *44*(6), 615–630. https://doi.org/10.1016/j.jcomdis.2011.07.003

Roy, N., Nissen, S. L., Dromey, C., & Sapir, S. (2009). Articulatory changes in muscle tension dysphonia: evidence of vowel space expansion following manual circumlaryngeal therapy. *Journal of communication disorders*, *42*(2), 124-135.

Ryan, C., & Andrews, N. (2009). An investigation into the choral singer's experience of music performance anxiety. *Journal of Research in Music Education*, *57*(2), 108-126.

Saltürk, Z., Özdemir, E., Sari, H., Keten, S., Kumral, T. L., Berkiten, G., ... & Uyar, Y. (2019). Assessment of resonant voice therapy in the treatment of vocal fold nodules. *Journal of Voice*, *33*(5), 810-e1.

Sigrist, R., Rauter, G., Riener, R., & Wolf, P. (2013). Augmented visual, auditory, haptic, and multimodal feedback in motor learning: a review. *Psychonomic bulletin & review*, *20*(1), 21-53.

Siqueira, L. T. D., Dos Santos, A. P., da Silva Vitor, J., Moreira, P. A. M., Silva, R. L. F., Fernandes, G., & Ribeiro, V. V. (2021). Vocal Self-Perception of Singers During COVID-19 Pandemic. *Journal of voice*.

Stemple, J. C. (2005, May). A holistic approach to voice therapy. In *Seminars in Speech and Language* (Vol. 26, No. 02, pp. 131-137). Copyright© 2005 by Thieme Medical Publishers, Inc., 333 Seventh Avenue, New York, NY 10001, USA.

Stemple, J. C. (2010). Survey of voice management. *Clinical voice pathology: Theory and management*, 245-249.

Stone, R. E., & Casteel, R. (1982). Restoration of voice in nonorganically based dysphonia. *Phonatory voice disorders in children*, 132-165.

Styler, W. (2013). Using Praat for linguistic research. *University of Colorado at Boulder Phonetics Lab*.

Teachey, J. C., Kahane, J. C., & Beckford, N. S. (1991). Vocal mechanics in untrained professional singers. *Journal of Voice*, *5*(1), 51-56.

Timmermans, B., Vanderwegen, J., & De Bodt, M. S. (2005). Outcome of vocal hygiene in singers. *Current opinion in otolaryngology & head and neck surgery*, *13*(3), 138-142.

Titze, I. R. (2014). Bi-stable vocal fold adduction: A mechanism of modal-falsetto register shifts and mixed registration. *The Journal of the Acoustical Society of America*, *135*(4), 2091–2101. https://doi.org/10.1121/1.4868355

Verdolini, K. (2000). Resonant voice therapy. In J. C. Stemple (Ed.), *Voice therapy: Clinical studies* (pp. 46–61). San Diego, CA: Singular.

Watts, C. R., Diviney, S. S., Hamilton, A., Toles, L., Childs, L., & Mau, T. (2015). The effect of stretch-and-flow voice therapy on measures of vocal function and handicap. *Journal of Voice*, *29*(2), 191-199.

Yiu, E. M., Lo, M. C., & Barrett, E. A. (2016). A systematic review of resonant voice therapy. *International Journal of Speech-Language Pathology, 19*(1), 17-29. doi:10.1080/17549507.2016.1226953

Zuim, A. F., Lloyd, A. T., Gerhard, J., Rosow, D., & Lundy, D. (2019). Associations of education and training with perceived singing voice function among professional singers. *Journal of Voice*.

TABLES

Table 2: Means and Standard Deviations of Undergraduate Student Singers

Measure	**Group 1**		**Group 2**	
	Pre [Mean (SD)]	**Post [Mean (SD)]**	**Pre [Mean (SD)]**	**Post [Mean (SD)]**
NHR	.0525 (.0603)	.0523 (.0604)	.0385 (.0383)	.085 (.089)
Jitter	.0038 (.0028)	.0044 (.0018)	.0038 (.0028)	.005 (.0018)
Shimmer	.0601 (.0259)	.0643 (.0384)	.053 (.0100)	.089 (.046)
MPD	15.20 (3.7059)	14.60 (3.2728)	14.75 (3.775)	15 (3.56)
sVHI	27.30 (19.7768)	20.30 (23.4713)	24.25 (29.511)	25 (35.09)
VFI	24.80 (15.0466)	20.70 (16.2279)	19 (13.7)	23.75 (24.96)
S/Z Ratio	0.94 (0.57)	0.97 (0.18)	1.13 (0.43)	0.76 (0.19)
OATES	71.2 (13.7016)	87.1 (12.7406)	69.25 (22.186)	83.5 (18.95)

Table 3: Wilcoxon Signed-Rank Test Results (Experimental Group)

	NHR (Post) – NHR (Pre)	Jitter (Post) – Jitter (Pre)	Shimmer (Post) – Shimmer (Pre)	MPD (Post) – MPD (Pre)	sVHI (Post) – sVHI (Pre)	VFI (Post) – VFI (Pre)	OATES (Post) – OATES (Pre)	szpost – szpre
Z	-.734	-.734	-1.153	-.677	-2.207	-1.826	-2.032	-.314
Asymp. Sig. (2-tailed)	.463	.463	.249	.498	.027	.068	.042	.753

Table 4: Wilcoxon Signed-Rank Test Results (Control Group)

	NHR (Post) - NHR (Pre)	Jitter (Post) - Jitter (Pre)	Shimmer (Post) - Shimmer (Pre)	MPD (Post) - MPD (Pre)	sVHI (Post) - sVHI (Pre)	VFI (Post) - VFI (Pre)	OATES (Post) - OATES (Pre)	szpost - szpre
Z	-.730	-1.604	-1.826	.000	.000	-.447	-1.826	-1.826
Asymp. Sig. (2-tailed)	.465	.109	.068	1.000	1.000	.655	.068	.068

APPENDIX 1

Please place a stroke on the line to indicate voice quality on each of the following:

OVERALL VOCAL PERFORMANCE (an overall rating of the aesthetic and technical quality of singing voice)

Poor _____ Excellent

APPROPRIATE VIBRATO (regular and smooth undulation of frequency of the tone)

Poor _____ Excellent

RESONANCE BALANCE (*chiaroscuro*) (appropriate balance of dark and light colours in the voice)

Poor _____ Excellent

RING (brilliance of tone)

Poor _____ Excellent

PITCH ACCURACY (singing in tune)

Poor _____ Excellent

BREATH MANAGEMENT (efficient breath management)

Poor _____ Excellent

EVENNESS THROUGHOUT THE RANGE (ability to sing freely throughout the pitch and dynamic range without inappropriate change in voice quality)

Poor _____ Excellent

STRAIN (voice quality that gives impression of excessive vocal effort)

Severe Strain _____ Free from Strain

APPENDIX 2

These are statements that many people have used to describe their singing and the effects of their singing on their lives. Circle the response that indicates how frequently you have had the same experience in the last month.

1) It takes a lot of effort to sing.	never	almost never	sometimes	almost always	always
2) My voice cracks and breaks.	never	almost never	sometimes	almost always	always
3) I am frustrated by my singing.	never	almost never	sometimes	almost always	always
4) People ask "What is wrong with your voice?" when I sing.	never	almost never	sometimes	almost always	always
5) My ability to sing varies day to day.	never	almost never	sometimes	almost always	always
6) My voice "gives out" on me while I am singing.	never	almost never	sometimes	almost always	always
7) My singing voice upsets me.	never	almost never	sometimes	almost always	always
8) My singing problems make me not want to sing/perform.	never	almost never	sometimes	almost always	always
9) I am embarrassed by my singing.	never	almost never	sometimes	almost always	always
10) I am unable to use my "high voice."	never	almost never	sometimes	almost always	always
11) I get nervous before I sing because of my singing problems.	never	almost never	sometimes	almost always	always
12) My speaking voice is not normal.	never	almost never	sometimes	almost always	always
13) My throat is dry when I sing.	never	almost never	sometimes	almost always	always
14) I've had to eliminate certain songs from my singing/performances.	never	almost never	sometimes	almost always	always
15) I have no confidence in my singing voice.	never	almost never	sometimes	almost always	always
16) My singing voice is never normal.	never	almost never	sometimes	almost always	always
17) I have trouble making my voice do what I want it to.	never	almost never	sometimes	almost always	always
18) I have to "push it" to produce my voice when singing.	never	almost never	sometimes	almost always	always
19) I have trouble controlling the breathiness in my voice.	never	almost never	sometimes	almost always	always
20) I have trouble controlling the raspiness in my voice.	never	almost never	sometimes	almost always	always
21) I have trouble singing loudly.	never	almost never	sometimes	almost always	always
22) I have difficulty staying on pitch when I sing.	never	almost never	sometimes	almost always	always
23) I feel anxious about my singing.	never	almost never	sometimes	almost always	always
24) My singing sounds forced.	never	almost never	sometimes	almost always	always
25) My speaking voice is hoarse after I sing.	never	almost never	sometimes	almost always	always
26) My voice quality is inconsistent.	never	almost never	sometimes	almost always	always
27) My singing voice makes it difficult for the audience to hear me.	never	almost never	sometimes	almost always	always
28) My singing makes me feel handicapped.	never	almost never	sometimes	almost always	always
29) My singing voice tires easily.	never	almost never	sometimes	almost always	always
30) I feel pain, tickling, or choking when I sing.	never	almost never	sometimes	almost always	always
31) I am unsure of what will come out when I sing.	never	almost never	sometimes	almost always	always
32) I feel something is missing in my life because of my inability to sing.	never	almost never	sometimes	almost always	always
33) I am worried my singing problems will cause me to lose money.	never	almost never	sometimes	almost always	always
34) I feel left out of the music scene because of my voice.	never	almost never	sometimes	almost always	always
35) My singing makes me feel incompetent.	never	almost never	sometimes	almost always	always
36) I have to cancel performances, singing engagements, rehearsals, or practices because of my singing.	never	almost never	sometimes	almost always	always

APPENDIX 3

These are some symptoms usually associated with voice problems. Circle the response that indicates how frequently you experience the same symptoms (0—never, 1—almost never, 2—sometimes, 3—almost always, and 4—always).

Part 1					
1. I don't feel like talking after a period of voice use	0	1	2	3	4
2. My voice feels tired when I talk more	0	1	2	3	4
3. I experience increased sense of effort with talking	0	1	2	3	4
4. My voice gets hoarse with voice use	0	1	2	3	4
5. It feels like work to use my voice	0	1	2	3	4
6. I tend to generally limit my talking after a period of voice use	0	1	2	3	4
7. I avoid social situations when I know I have to talk more	0	1	2	3	4
8. I feel I cannot talk to my family after a work day	0	1	2	3	4
9. It is effortful to produce my voice after a period of voice use	0	1	2	3	4
10. I find it difficult to project my voice with voice use	0	1	2	3	4
11. My voice feels weak after a period of voice use	0	1	2	3	4
Part 2					
12. I experience pain in the neck at the end of the day with voice use	0	1	2	3	4
13. I experience throat pain at the end of the day with voice use	0	1	2	3	4
14. My voice feels sore when I talk more	0	1	2	3	4
15. My throat aches with voice use	0	1	2	3	4
16. I experience discomfort in my neck with voice use	0	1	2	3	4
Part 3					
17. My voice feels better after I have rested	0	1	2	3	4
18. The effort to produce my voice decreases with rest	0	1	2	3	4
19. The hoarseness of my voice gets better with rest	0	1	2	3	4

APPENDIX 4 – TREATMENT EXERCISES

Cup Bubble Blowing Exercise

1. Fill a clear plastic cup with water to about 1 inch from the rim.
2. Blow bubbles on the side of the cup. No sound, just air as you blow these bubbles without stopping.
3. Once you feel the need for air, take a breath. Don't try to squeeze all the air from your lungs as you do these exercises. Just easily and steadily blow bubbles.
4. Do 5 cup bubbles in a row. It should feel easy, with no tight or strained feeling in your neck.
5. Next, add your voice while you do the cup bubble. In other words, while blowing bubbles use your voice – as if humming but while keeping the bubbles going. Success means you're maintaining a breathy, steady voice. Do 2 sets of 5 correctly before moving to the next step.
6. Next, while blowing bubbles in the cup, go from low to high in your range, up and down a scale. Do this 5 times with clear sound. Again, don't strain. Easy, breathy voice.
7. Then, do cup bubbles with sound and pull the cup away from your mouth as you are voicing. The bubbles, of course, stop, and you should be left with a gentle, air-filled "oooo" that sounds clear and easy. Do this 5 times with clear sound.
8. Finally, take an easy breath (don't overdo it) and blow out an easy "oooo" (without the cup), mimicking the sound you made after removing the cup. You should sound breathy but clear.
9. Go into Gargling Exercise from here.

Gargling Exercise

Do each of these exercises with small sips of water (approximately 1 teaspoon)

1. Gargle without your voice for about 5-6 seconds. [10 times]
2. Gargle with your voice for about 5-6 seconds. This should sound like a motor boat. [10 times]
3. Gargle with your voice and go up and down in pitch while gargling. [10 times]
4. Gargle with your voice until you get the motor boat sound (as in #2) and then bring your head forward slowly and say "mmmm" [10 times]

    - When you bring your head forward close your lips gently to keep water from coming out
    - All airflow is directed through your nose for the "mmmm" sound
    - Wrinkle your nose and make sure you feel it

5. Once you have a clear “mmmm”, swallow the water, take an easy breath and say:

    - Mmmm ma ma ma ma
    - Mmmm may may may may
    - Mmmm muh muh muh muh
    - Mmmm me me me me
    - Mmmm my my my my
    - Mmmm moo moo moo moo
    - Mmmm moh moh moh moh

6. Carry this over into “m” words:

    - Mamma
    - Mary
    - Many
    - Maybe
    - Marvin
    - Marble

10. Go into Stretch-and-Flow therapeutic technique from here

Stretch-and-Flow Exercise

1. Take a piece of tissue, separate the layers, and fold it in half. Place the tissue between your index and middle fingers (near the top of the tissue so that most of it hangs down below) and hold it up about 6 inches from your mouth. This will help you to monitor whether or not you’re letting the air out when you’re speaking. Your mouth should be centered with the tissue just below your fingers.
2. Blow back the tissue without using your voice. The tissue blown back should stay parallel to the floor while you maintain airflow. Do this 5 times, take a break & do 5 more times.

    Should feel easy Let the air out like a sigh--it is passive

    Should not feel tired

    If you start to feel light headed, slow down—you’re doing too many too fast

    Move on to the next step when you have completed 10 correctly

3. Now, start by blowing the tissue once again. Once you have the air going and the tissue back, gently add in your voice “oooo”. The tissue should stay up. If it doesn’t, you’re cutting off your airflow. Voice will be very breathy. Do this 5 times, take a break & do 5 more times.

The tissue stays blown back while you're saying "oooo"
The tissue drops when you're out of air

Don't try to make this last forever, when you're out of air, take another breath and start again.

Move on to the next step when you have completed 10 correctly

4. Now, blow back the tissue with a nice, breathy "oooo." Once the sound is coming out of your mouth and the tissue is blowing steadily, say the number "one." The tissue will fall, but the voice should be light and breathy. Do the same for numbers 2 through 10.

   For example: "oooo--one", "oooo-two", etc.

   - The "oooo" should sound clear and smooth and so should the word [5 times, take a breath & do 5 more times]
   - When done, practice some light, breathy voicing with sentences that begin with "h" or "wh." For example, how are you, what's your name, what time is it. Voice should remain breathy and easy.