Preserving Vocal Health in Student Teachers

By

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A Thesis
Submitted in Partial Fulfillment of
the Requirements for the Degree of

Master of Science in Communication Sciences and Disorders

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2015

Abstract

Teachers and student teachers are at risk for developing voice disorders due the intense vocal requirements necessary for teaching (Cultiva, Vogel & Burdorf, 2013; Roy et al., 2004; Van Lierde et al., 2009). Due to the negative impact voice disorders have on the lives and vocational capabilities of teachers, preventative measures should be taken to preserve vocal functioning from the early stages of student teaching (Schneider & Bigenzahn, 2004). Ten student teachers from a Midwestern university participated in this study. Seven were women and three were men. The mean age was 25 with a range of 21 – 26. Participants were all student teaching through the duration of the study period, had no history of a voice disorder, and were not former or current smokers. Participants were randomly assigned to one of two treatment groups. The study was a between group and within group comparison using a modified ABACA crossover design comparing the effectiveness of vocal hygiene and vocal functional exercises. Additionally, a visual analysis of perceptual measures was completed. Acoustic, perceptual and self-rated measures were collected prior to participants' student teaching, six weeks into student teaching, and 14 weeks into student teaching. Results revealed that while both vocal hygiene and vocal functional exercises resulted in some vocal improvements and prevented a decline in many measures, vocal functional exercises resulted in greater positive outcomes in acoustic, perceptual and self-rating measurements. The results indicated that vocal functional exercises should be introduced into the routines of student teachers early in their careers in order to produce the greatest positive outcomes and to best preserve healthy vocal functioning during the student teaching experience.

Introduction

Although student teachers are prepared with years of academic and practical training, little attention has been given to the instrument they will rely on for years to come: their voices. Teaching is a high risk occupation for voice disorders to develop with over half of teachers experiencing a voice disorder at some point in their careers (Cultiva, Vogel & Burdorf, 2013; Roy et al., 2004; Van Lierde et al., 2009). Teachers and student teachers alike face a variety of risk factors associated with the occurrence of voice disorders, including 1) speaking over background noise 2) poor acoustic environment within the classroom, and 3) extensive use of the voice (Cultiva et al., 2013; Schneider and Bigenzahn, 2004). The constant vocal use required to lead a classroom can result in consequences student teachers do not expect while in training to become professionals. If voice disorders can be prevented, teachers may be able to have longer careers with better vocal health. To determine what can be done to prevent voice disorders from developing, previous research regarding the prevention, treatment and risk factors related to voice disorders must be examined. The purpose of this literature review is to gain knowledge regarding what voice therapy techniques have been successful in treating and preventing voice disorders in teachers and student teachers.

Normal Voice Production

Phonation is the process in which vocal folds produce sound (Sapienza & Ruddy, 2013). In order for phonation to occur, the respiratory and phonatory systems must be engaged. The respiratory system provides the power behind the voice through the accumulation and release of subglottic pressure. Boyle's law, which states that there in an inverse relationship between pressure and volume of a cavity, can be applied to the respiratory system (Sapienza & Ruddy, 2013). During inspiration, the diaphragm contracts and lung volume is increased, thus decreasing

intrapulmonary pressure. When the diaphragm relaxes, exhalation occurs and air moves out of the lungs and through the trachea, on the top of which sits the larynx. Phonation occurs by principles of the myoelastic aerodynamic theory, which states that as the air pressure builds up in the subglottic space, the adducted vocal folds are forced apart. This airflow through the glottis creates negative pressure which causes the vocal folds to adduct once more. For the duration of sustained airflow, this process repeats and a mucosal wave, or vocal fold movement, occurs. The pitch produced is dependent upon properties of the vocal folds, specifically, the mass per unit length and degree of stiffness (Sapienza & Ruddy, 2013).

Common Voice Disorders Among Professional Voice Users

While voice is generally produced effortlessly, when abused or overused a variety of voice disorders can occur. These voice disorders can be 1) structural, meaning an anatomical change to the vocal fold has occurred or 2) functional, in which there is no known anatomical cause, but rather damage has occurred due to improper use or a physiological dysfunction (Sapienza &Ruddy, 2013). Vocal nodules are one of the most common structural voice disorders. Vocal nodules are primarily found in children and women, particularly if they have a profession with intense vocal requirements, such as teaching or singing. Vocal nodules occur bilaterally and are caused by continuous damaging behaviors such as speaking too loudly or too much, speaking over noise or frequent coughing or throat clearing. Vocal polyps, another structural voice disorder, generally occur unilaterally and are caused by a single instance of vocal abuse, such as yelling at a sporting event. Laryngitis is yet another voice disorder that may be caused by overuse or abuse of voice and is worsened with prolonged use or demanding vocal activities. When laryngitis is present, the vocal folds are inflamed and swollen. Forceful phonation or vocal fold abuse can result in a variety of other, albeit less common, structural voice disorders such as

contact ulcers, granulomas, vocal fold cysts, and vocal fold hemorrhage (Sapienza & Ruddy, 2013). When a structural disorder is present, the voice often sounds breathy, hoarse, rough, fatigues easily and the pitch range and vocal intensity range are decreased (Sapienza & Ruddy, 2013).

When the laryngeal structures are adequate for phonation, yet a disorder occurs a functional voice disorder may be present. Similar to structural disorders, professional voice users are susceptible to a variety of functional disorders, one of which is muscle tension dysphonia. Muscle tension dysphonia occurs in individuals who have high levels of stress, excessive voice use and/or excessive loudness (Altman, Atkinson, & Lazarus, 2005) and can result in abnormally high amounts of contraction and tension of the glottis and supraglottic structures. Similar to muscle tension dysphonia, functional aphonia is caused by stress, along with depression and anxiety. Ventricular dysphonia is another functional disorder that threatens professional voice users as it arises from using phonatory compensation strategies to overcome a preexisting dysfunction and involves having excessive tension in the laryngeal and pharyngeal areas. When a functional voice disorder is present, the voice often sounds strained, rough, aphonic, has an unnatural pitch, and the pitch range and vocal intensity range may be decreased (Sapienza & Ruddy, 2013). Individuals with vocally demanding jobs are at risk to develop a wide variety of structural and/or functional voice disorders.

Voice Disorders in Teachers

Roy et al. (2004) investigated the prevalence of voice disorders in teachers in comparison to other professions. In this study, a voice disorder was considered to be present if one’s voice negatively impacted communication due to abnormal qualities. After conducting

phone interviews with over 2500 people with a wide range of occupations, teachers were found to have the highest probability to experience frequent vocal irritation. Fifty-eight percent of teachers who participated in this study experienced a voice disorder compared to 29% of non-teachers. While the majority of those interviewed who experienced a voice disorder had an acute episode lasting for less than four weeks, (81.4%), a much lower percentage (18.6%) of those interviewed who experienced a voice disorder had a chronic disorder. Teachers who had experienced a voice disorder were more likely to have reoccurring episodes of vocal irritation than non-teachers (81% compared to 68%, respectively). The research of Roy et al. (2004) provided evidence that teachers are at a significantly higher risk of experiencing at least a single episode of vocal irritation when compared to non-teachers, and that vocal irritation has a higher rate of reoccurrence for teachers than non-teachers. This study also revealed that voice disorders have the potential to be an issue throughout the career of a teacher.

While Roy et al. (2004) identified teachers to be at a significantly higher risk for developing a voice disorder than the general population, Thibeault, Merrill, Roy, Gray and Smith (2004) sought to identify whether certain types of teachers were at greater risk than others. Phone interviews were conducted with 1243 primary and secondary teachers. In this study, a voice disorder was defined as a change in the voice that hindered communication. The questions asked to participating teachers regarded the frequency of specific vocal activities throughout an average school day, exposure to chemicals, number of years teaching, what grade and content the participant taught, the number of hours spent teaching and in which environment he or she taught. While all participants were teachers, some were, in fact, found to experience a voice disorder more frequently than others. An odds ratio is a measure of the likelihood an event will occur and significantly higher odds ratios of a voice disorder occurring were reported for

teachers of vocal music (Odds Ratio = 2.2), drama (Odds Ratio = 2.1), performing arts (Odds Ratio = 1.6), and chemistry (Odds Ratio = 2.0) when compared to odds ratios of other subjects.

Another factor influencing voice disorders in teachers is the grade level taught. Remacle, Morsomme and Finck (2013) compared the voices of teachers across grades in order to establish whether the age taught had an impact on voice use, referred to as vocal loading. A vocal load is the demands and stress put on one's voice. This study compared 32 elementary school teachers without voice disorders. Vocal health of the teachers was assessed using the Voice Handicap Index (VHI) (Jacobson et al., 1997) and a patient survey of the effect of voice disorders on daily life. Vocal load was measured by an Ambulatory Phonation Monitor (APM) voice dosimeter (KayPENTAX, Montvale, NJ) worn by each participant. The teachers wore the APM to measure their fundamental frequency, sound pressure level and phonation time for five days during occupational and non-occupational activities. Results revealed that teachers spoke at significantly higher intensities and significantly more when engaged in teaching when compared to non-occupational activities. Additionally, it was found that kindergarten teachers had significantly higher levels of vocal fold oscillatory cycles and significantly farther vocal fold distance travelled when compared to non-kindergarten elementary teachers, indicating that teaching kindergarteners and young students is more demanding on the voice than teaching older students. Increased vocal load and the effects of continually demanding use of voice is a likely contributor for weakened voices for professionals who have high communicative requirements and is a risk factor for voice disorders to develop (Remacle, et al., 2013; Sapienza & Ruddy, 2013; Schneider & Bigenzahn, 2004). This evidence suggested all teachers are at significantly higher risk of developing a voice disorder than other professions, particularly if young students are being taught.

Intervention Techniques

Intervention for voice disorders frequently involves vocal hygiene (VH), which revolves around patient education and is aimed at eliminating harmful vocal behavior. Vocal hygiene can vary from a laundry list of do's and don'ts for vocal health to a personalized plan of how to properly use the voice. In addition to vocal hygiene, common treatments for voice disorders include resonant voice therapy and vocal function exercises (VFE). As described by Sapienza and Ruddy (2013), resonant voice therapy can be used with adults and adolescents who have vocal hyperfunction or hypofunciton. Resonant voice exercises promote the production of a strong voice with little laryngeal stress, thus avoiding laryngeal injury. Exercises done in resonant voice therapy include prolongation of nasals, gliding on nasals, producing consonant-vowel (CV) syllables of alternating nasals and bilabials and producing sentences with nasal and non-nasal consonants. The authors also provided a description of VFE. VFE can be used with all ages and, similar to resonant vocal exercises, are used to treat hyperfunctional and hypofunctional voice disorders. VFE consist of vocal warm ups, pitch glides and prolonged phonation of vowels. Benefits of VFE include ease of vocal production, an increase in clarity of voice, and an increase in glottal efficiency (Roy et al., 2001, Sabol, Lee & Stemple, 1995; Sapienza & Ruddy, 2013).

There is evidence that direct methods of treatment, such as resonant voice therapy and VFE, are effective in eliciting positive changes in voice (Chen, Hsiao, Hsiao, Chung & Chiang, 2007; Roy et al., 2003; Roy et al., 2001). Chen et al. (2007) studied the effect of resonant voice therapy on 24 teachers who suffered from reoccurring hyperfunctional voice symptoms. After eight weekly 90 minute sessions of resonant voice therapy, the impact on improving participants' voices in regards to auditory perceptual, acoustic, aerodynamic and functional measures was

very successful. Post treatment, participants exhibited better vocal quality, improved vocal fold function, phonation that required less effort and an overall positive effect on functional communication occurred (Chen et al., 2007). Roy et al. (2003) compared several different types of therapies, including resonant therapy, in order to determine what techniques were effective in treating voice disorders. Sixty-four teachers who had a history of voice disorders participated in this study. Participants were divided into three separate treatment groups: vocal amplification, resonant therapy and respiratory muscle training. The VHI and a voice severity self-rating was given before intervention, and once again after the six week intervention period. The groups in which voice amplification and resonant therapy was utilized improved in both measures. The respiratory muscle training group did not experience a significant improvement on either measure. While all groups decreased from pre therapy to post therapy, only the voice amplification and resonant therapy groups saw significant decreases. These results indicated that successful techniques in reducing voice disorders include voice amplification and resonant therapy and should be considered as treatment options for teachers who are experiencing a voice disorder.

Roy et al. (2001) compared the effectiveness of VFE, VH and no treatment. The VHI was administered to 58 teachers with a history of voice disorders pretreatment, and once again post the 6 week treatment period. Self perceived vocal improvement was also measured through a questionnaire for participants in the VFE and VH group. A traditional VH regime which focused on eliminating vocally abusive behaviors was utilized as treatment for the VH group and resulted in no significant change in VHI scores. The control group also yielded no significant change in VHI scores. The VFE treatment group, however, experienced a significant improvement in their VHI scores from pretreatment to post treatment and had significantly better overall vocal

improvements based on the questionnaire given. Similar to Chen et al.(2007) and Roy et al. (2003), a direct treatment with exercises yielded strong improvements in the voices of teachers (Roy et al., 2001), indicating that teachers need to take an active approach to preserve their voices.

While Roy et al. (2001) saw no significant effects from VH, Leppänen, Ilomäki and Laukkanen (2010) found evidence to the contrary. These authors compared VH education, vocal training and vocal massage and the effects each had on the voices of 90 primary school teachers and got compelling results. All participants in this study attended a single, three hour lecture on VH that discussed factors that contribute to the development of voice disorders and techniques on how to use one's voice economically. In addition to this education, 30 participants had voice training in which vocal exercises were taught and practiced throughout the nine week study period. A different set of 30 participants met with vocal massage therapists to reduce tension in laryngeal muscles over nine weeks. All participants answered a questionnaire before their intervention, six months after, and one year after that inquired about throat irritation, fatigued voice, strained or hoarse voice and if voice problems after a work day impacted the participant's social life. Although all three methods of intervention revealed long term positive outcomes, no statistically significant differences were found, suggesting the educational component of VH was enough to effect behavior and decrease symptoms of voice disorders and vocal fatigue comparable to the effectiveness of direct treatments of vocal massage and voice exercises on the same measures. The contradictory findings between Roy et al. (2001) and Leppänen et al.(2010) raised questions regarding what type of VH is needed to be effective and suggested that VH should not be discounted as a potentially effective therapy approach for this population.

Although much work has been done investigating voice disorders and treatment in professional teachers, there is less known about voice disorders in student teachers.

Prevalence of Voice Disorders in Student Teachers

Student teachers may be susceptible to falling into vocally abusive behaviors as they navigate managing a classroom. Simberg, Sala and Rönnemaa (2004) sought to confirm the hypothesis that students who were going into teaching were at a higher risk for experiencing a voice disorder than their non-teacher student peers. After asking nearly 400 students to answer a questionnaire about whether they had experienced any voice symptoms and the frequency of occurrences, Simberg et al. (2004) discovered that teacher students were significantly more likely to experience voice disorder symptoms than their non-teacher counterparts. The symptoms assessed were throat clearing, coughing, hoarse voice, strained or tired voice, voice breaks, throat pain, loss of voice, and difficulty being heard. While 78% of non-teacher students reported no symptoms, only 58% of teacher students reported no symptoms. The difference in reported symptoms was found to be significant for coughing, throat clearing, vocal fatigue, vocal strain and difficulty being heard (Simberg et al., 2004). Results of Simberg et al.'s 2004 study revealed that students who are in a teaching program have more stress put on their voices and have a higher prevalence of symptoms related to voice disorders when compared to peers who are not enrolled in a teaching program.

Van Lierde et al. (2009) also studied the vocal health of 143 student teachers over their college careers and student teaching practicums. Van Lierde et al. (2009) used both objective and subjective measures to assess student teacher voices over a three year study period using the Dysphonia Severity Index (DSI), VHI and a Grade, Roughness, Breathiness, Asthenia, Strain

(GRBAS) scale (Hirano, 1981). Like Simberg et al. (2004), results of this study illuminated the high prevalence of unhealthy vocal symptoms student teachers experience. Ninety-one percent of students in the study self-reported having experienced pain either before or after speaking, the most common of which was a sore throat, which was reported by 61% of participants. In addition to symptoms of vocal damage, misuse, and overuse, a quarter of the students exhibited vocal risk factors in their speaking and teaching, such as vocal loading, which is the stress on laryngeal structures due to heavy vocal demands. Based on VHI scores, 33% of the students who participated in the study were found to have had experienced voice problems at some point throughout their student teaching, and many more exhibited symptoms related to the development of voice problems. However, only 24% of participants were familiar with potential risks that are associated with overuse or misuse of one's voice (Van Lierde et al., 2009), providing evidence that more training and education in this population is needed. The awareness of risk factors, VHI scores and scores on the GRBAS scale did not significantly improve from student teachers in their first year of teaching to later years of student teaching, and many participants who were third year student teachers reported experiencing a hoarse voice, irritation to their larynges and a decrease in vocal quality. However, DSI scores significantly improved from first to third year of student teaching. Van Lierde et al. (2009) suggested improved VH was a potential cause of improved DSI scores, but this was not formally investigated. From the previously discussed articles, evidence that student teachers are at a substantial risk of vocal misuse and damage has been established and early intervention is warranted (Simberg et al., 2004; Van Lierde et al., 2009). Due to the intense vocal demands, it is important to know how to avoid voice disorders from developing in student teachers.

Nanjundeswaran Chan, Wong, Yiu, and Verdolini-Abbott (2012) explored the effectiveness of VH and vocal training on preventing voice disorders from developing in student teachers. There were three groups used in this study, a control group, a group with a personalized VH program, and a group that had a personalized VH program in addition to a resonant voice therapy program. The resonant voice therapy required participants to do vocal exercises twice a week for five minutes, although they were allowed to do more if desired. Throughout the eight week study period, all 31 participants checked in twice a week in order to chart self-perceptions of their voices. The VHI was given before students began teaching, four weeks into the study and at the end of the study. The results of the study shed light on the need for prevention versus treatment of voice disorders in student teachers. While Nanjundeswaran et al. (2012) intended to conduct a strictly a preventative study, due to high VHI scores (over 18) in some participants, intervention for several subjects was considered treatment. For participants who initially had low VHI scores (18 or lower), indicating a healthy voice, it was found that the tailored VH program was sufficient in preventing worsening VHI scores throughout the study and that the addition of resonant vocal therapy did not consistently improve VHI scores. However, for participants who initially had high VHI scores, indicating a damaged voice, resonant voice therapy in addition to the tailored VH regime was needed in order to see improvements in VHI scores. Nanjundeswaran et al. (2012) reported that student teachers may be at a particular risk for developing symptoms of voice disorders such as strained and fatigued voices or pain in their throats. This study found that a minimally personalized VH program focusing on hydration and proper use of voice may be enough to avoid the development of vocal symptoms in student teachers, but that VH plus resonant voice therapy exercises are needed for student teachers with damaged voices to see improvements.

While Nanjundeswaren et al. (2012) focused on preventative measures, Schneider and Bigenzahn (2004) investigated ten student teachers who all presented with insufficient glottal closure, reduced maximum sound pressure level and vocal hypofunction. All participants were given ten weeks of vocal treatment and education of VH in an attempt to improve their glottal closure, maximum sound pressure and vocal hypofunction. Vocal hypofunction was classified as being unable to reach 90 dB SPL. It was found that after education and application of VH practices and weekly 45 minute sessions focusing on exercises that improved the efficiency of vocal productions, all areas assessed saw improvements. In addition to the weekly therapy sessions, participants were asked to perform therapeutic exercises regularly on their own. Similar to results from Nanjundeswaran et al. (2012), Schneider and Bigenzahn's (2004) research also indicated that student teachers who have vocal problems are able to recover functionality of speech mechanisms from exercises and VH.

If treatment of voice disorders in teachers shifts from a reactive to proactive model, the negative impact on quality of life and vocational functioning experienced by teachers with voice disorders could potentially be avoided. Student teachers should have the knowledge of how to protect the voice before the first lesson is taught. In a study conducted by Van Lierde et al. (2009), it was found that 76% of student teachers were unaware of how to take proper care of their voices, and this lack of knowledge did not significantly improve throughout 3 years of student teaching experiences. In order to protect the voices and careers of teachers, there must be an educational component to their training to enhance their abilities to care for their voices. Schneider and Bigenzahn (2004) advocated the importance of education early in one's career to prevent voice disorders among professions who rely heavily on voice usage. However, before student teachers can be educated on how to most effectively care for their voices, evidence to

support these techniques and their effectiveness must be established. The purpose of this study was to determine if a combination of 10 minutes of VFE prior to teaching in addition to basic VH would have an effect on the acoustic and perceptual properties of the voice in student teachers compared to the exclusive use of VH.

Methods

Subjects

Ten student teachers participated in this study. The mean age of participants was 25 (range 21 – 26 years). Seven participants were female and three participants were male. All participants were undergraduate students within the Teacher Education Department at a small, Midwestern university. In order to qualify for participation, the potential participants were screened for eligibility (Appendix A). Participants must have been scheduled for full time student teaching fall semester of 2014, have no history of or current voice disorder, and have no history of smoking and were not currently smoking. Participants were assigned student teaching placements in a variety of grades by the Teacher Education Department (Table 1). Once deemed eligible, participants completed the consenting process (Appendix B) and were randomly assigned to a treatment group.

Table 1. Summary of Subject Settings

Subject	ST_01	ST_02	ST_03	ST_04	ST_05	ST_06	ST_07	ST_08	ST_09	ST_10
Setting	High school	High school/ middle school	Elementary	Elementary	High school/ Middle school	Elementary/ Middle school	Elementary	Elementary	Preschool/ elementary	Elementary

There was a range of past experience among participants regarding choral participation and vocal training which is summarized in Table 2. Three participants had a history of receiving

vocal training by a professional and six participants had a history of being in choir. Over the course of the study period, four participants dropped out (ST_03, ST_08, ST_09 and ST_10) due to scheduling conflicts and inconsistent adherence to treatment protocols. This study was approved by Institutional Review Board.

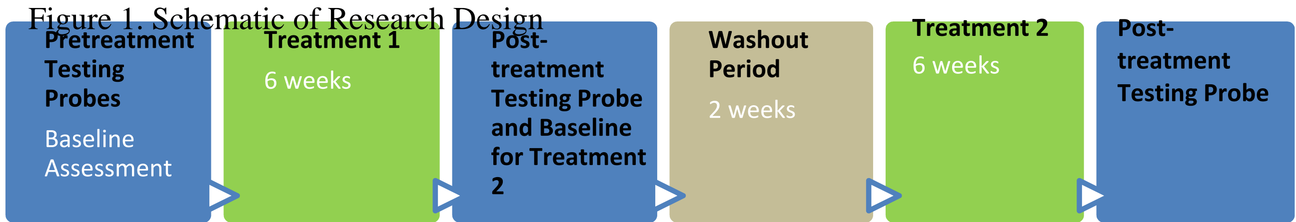
Table 2. Summary of Choir Participation and Voice Training

Subject	ST_01	ST_02	ST_03	ST_04	ST_05	ST_06	ST_07	ST_08	ST_09	ST_10
History of being in choir	+1year	_	+ 2 years	+ 5 years	_	+ 3 years	_	+ 20 years	+ 6 years	_
History of vocal training	_	_	_	+ 3 years	_	_	_	+ 5 years	+ 3 years	_

Design and Procedures

This study was a between group comparison using a modified ABACA counter-balanced crossover design (Figure 1).

Figure 1. Schematic of Research Design



Two treatment conditions were presented: Treatment 1 (VH condition): training in VH only and, Treatment 2 (VFE condition): training in VH and VFE. One group received treatment in a VH: VFE sequence, the other group received treatment in VFE: VH sequence. Between treatments, there was a washout period of two weeks. During the washout period, participants were instructed to refrain from participating in any extra vocal exercises or hydration wouldn't do if they weren't in the study. The washout period was used to remove any lasting effects of Treatment 1.

Participants attended a one-on-one training with the primary researcher prior to beginning their student teaching. All participants completed the VHI, were assessed with the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) (Kempster, Gerratt, Abbott, Barkmeier-Kraemer, & Hillman, 2009) by two speech-language pathologists who had experience treating voice disorders, and provided voice samples to be analyzed using Computerized Speech Lab (CSL) software (KayPENTAX) using the vocal profile range, CSL main program with a sustained tone and speech, and using the Multi-Dimensional Voice Program (MDVP). Three trials were completed for all CSL data. A headset was used with a consistent 5 millimeter mouth-to-microphone distance. After voice measures were collected, participants were given instructions on either VH or VH and VFE depending upon their random group assignment. Members in the VH condition were instructed to drink no less than four cups (32 ounces) of water throughout the days during which they were student teaching for a six week period of time. Members in the VFE condition were instructed to drink no less than four cups of water in addition to engaging in VFE for ten minutes prior to student teaching each day of the study period (Table 3). Vocal exercises were taught during the one-on-one training meeting and instructions were provided for participants to reference throughout the course of participating in the study (Appendix C and D).

Table 3. Vocal exercises used by subjects

Vocal Function Exercises
• Glide on nasal phonemes from the lowest pitch comfortable to the highest pitch comfortable and back down to the lowest pitch • Sustain a hypernasal /i/ for as long as possible on a comfortable tone • Chant alternating voiced and unvoiced CV syllables on a comfortable pitch varying in speed and intensity • Recite voiced and unvoiced sentences

At the end of the six week treatment period, participants returned for an individual follow up assessment using the same VHI, CAPE-V and CSL assessments as used at baseline. Participants were then trained on the alternate treatment condition. Participants were asked to refrain from engaging in either treatment for two weeks in order to washout any effects from the original treatment. After the two week washout period was complete, participants were asked to follow the new treatment protocol for an additional six weeks. After the second treatment trial period was completed participants met with the primary investigator at which time a final collection of data was completed using the same VHI, CAPE-V and CSL measures once more. All measures were taken at the university's Speech Science and Voice Lab.

Statistical Analysis

An a priori one-way ANOVA was performed in order to examine between group differences at baseline, the 6 week probe 1 and the 14 week probe 2. A post hoc one-way ANOVA was performed in order to examine the within group differences between baseline and probe 1, probe 1 and probe 2 and baseline and probe 2 for both the vocal hygiene group and vocal functional exercise group. A visual analysis was performed to examine the within group perceptual change for overall vocal quality, strain, breathiness and roughness for both the vocal hygiene group and the vocal functional exercise group.

Variables measured using CSL software included: minimum, maximum and range of sound pressure levels, frequency range, amount of jitter, shimmer, perturbation, peak to peak amplitude variation, noise to harmonic ratio, and voice turbulence (Table 4). The CAPE-V was also used to assess the perceptual qualities of the voice including overall severity, roughness, breathiness, and strain as measured by experienced speech-language pathologists. The VHI

assessed the impressions of overall, physical, functional and emotional impact of voice as measured by participants.

Table 4. CSL Variables

Measure	Definition
Minimum Sound Pressure Level (SPL min)	Least amount of voice intensity achieved
Maximum Sound Pressure Level (SPL max)	Highest amount of voice intensity achieved
Range of Sound Pressure Levels (SPL range)	Absolute difference between the maximum sound pressure level and minimum sound pressure level
Range of Frequencies	Absolute difference between the highest frequency and the lowest frequency achieved
Jitter	Cycle-to-cycle variation in fundamental frequency
Shimmer	Cycle-to-cycle variation in intensity
Perturbation (RAP)	Disturbance in the quality of vocal phonation
Peak to Peak Amplitude Variation (vAM)	Cycle-to-cycle changes in amplitude
Noise to Harmonic Ratio (NHR)	Index of hoarseness
Voice Turbulence (VTI)	Index of breathiness

Results

See Appendix E for a complete table of ANOVA statistics (F, degree of freedeom (df) and p-value) for acoustic, perceptual and self-rated perceptual measures for between group and within group measures.

Between Group Differences at Baseline

A priori analysis consisted of a between group comparison by time.

Acoustic

At baseline, groups had no significant differences on the study measures except for frequency range (F = 0.00, df = 25, p = 0.004), for which the VH group had a significantly smaller frequency range than the VFE group (Figure 2).

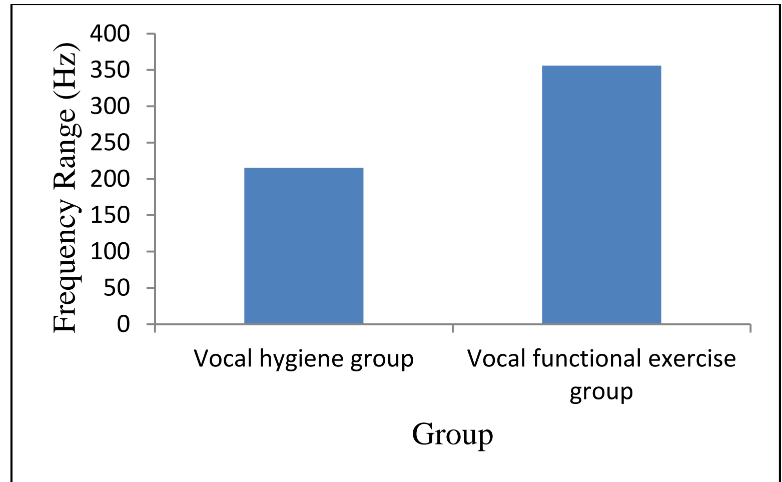


Figure 2. Comparison of Frequency Range at Baseline

Perceptual

There were no statistically significant differences between groups across all perceptual features (Table 6).

Self –perceptual rating

There were no statistically significant differences between groups at across all self-rated features (Table 7).

Between Group Differences: 6 week probe session

Acoustic

At the six week probe session (Probe 1), significant differences were found for frequency range (F = 17.179, df = 24, p= 0.044) (Figure 3) with the VH group having a smaller range of

frequencies than the VFE group. Shimmer also had a significant difference (Figure 4) with the VH group having lower levels of shimmer than the VFE group (F =7.18, df =24, p = 0.048)

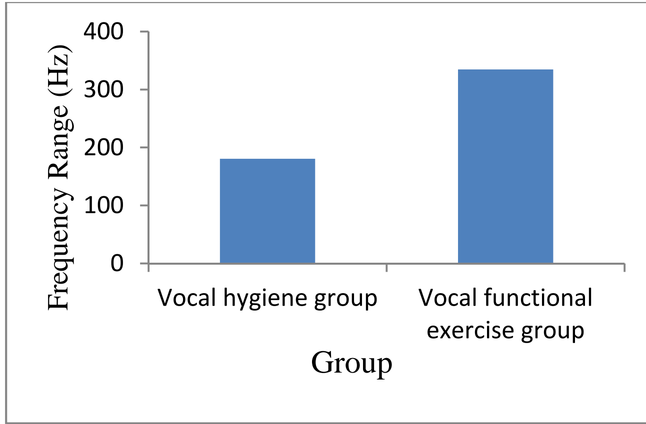


Figure 3. Comparison of Frequency Range at Probe 1

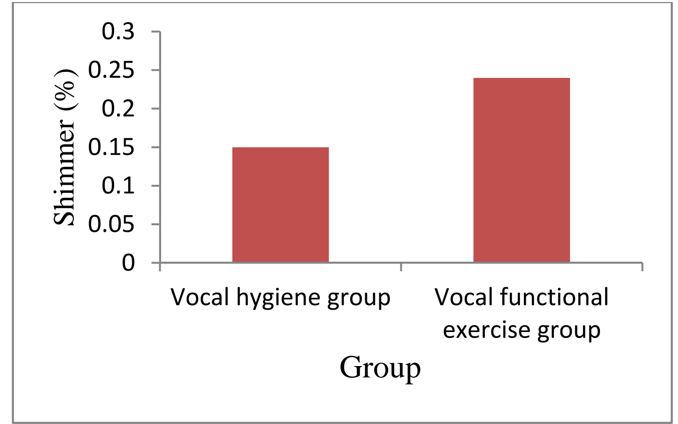


Figure 4. Comparison of Shimmer at Probe 1

(Table 5).

Perceptual

There were no statistically significant differences between groups across all perceptual features. However, Probe 1 approached statistical significance for strain (F = 4.56, df =7, p = 0.089) with the VFE group having a lower score than the VH group, indicating less strain was present (Table 6).

Self –perceptual rating

There were no statistically significant differences between groups across all self-rated features, nor were any trends towards statistical significance observed (Table 7).

Between Group Differences: 14 week probe session

Acoustic

At the 14 week probe session (Probe 2), significant differences between groups were found for SPL max (F =1.667, df =16, p= 0.00) and SPL range (Figure 5) (F = 0.00, df =16, p= 0.001) which both revealed better SPL flexibility for the VFE group. RAP (F = 0.75, df =16, p= 0.03) also reached statistical significance with the VH group showing less perturbation than the VFE group (Figure 6).

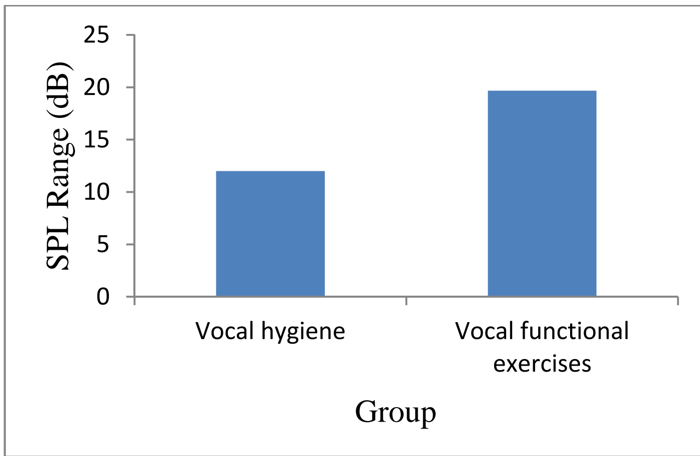


Figure 5. Comparison of SPL at Probe 2

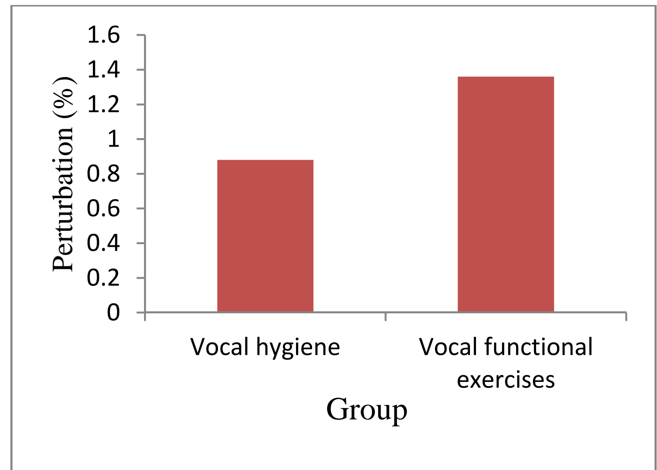


Figure 6. Comparison of RAP at Probe 2

Perceptual

There were no statistically significant differences between groups across perceptual features at Probe 2. However, overall vocal quality approached significance (F =

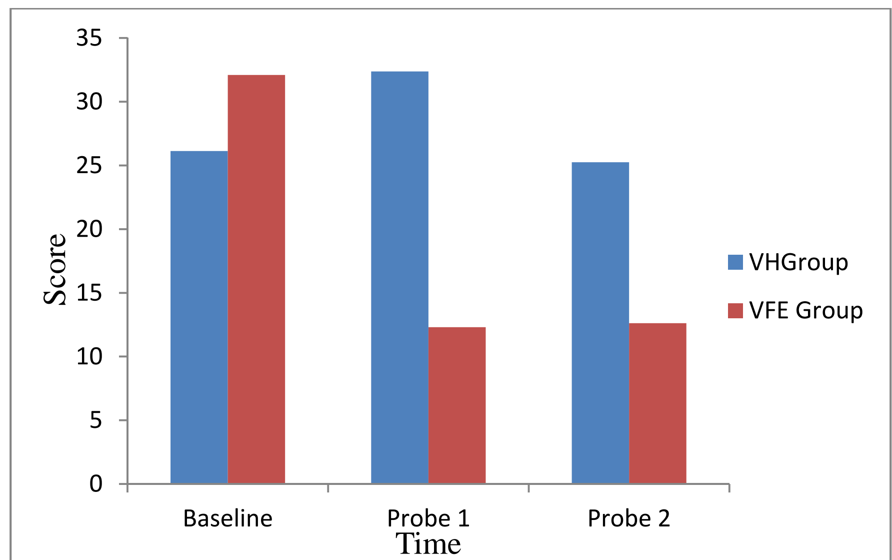


Figure 7. Comparison of Overall CAPE-V Scores by Probe

0.39, df = 4, p= 0.078) (Figure 7) with the VFE group having lower scores, indicating a better vocal quality, than the VH group.

Self-perceptual rating

There were no statistically significant differences between groups across all self-rated features, nor were any trends towards statistical significance observed (Figure 8).

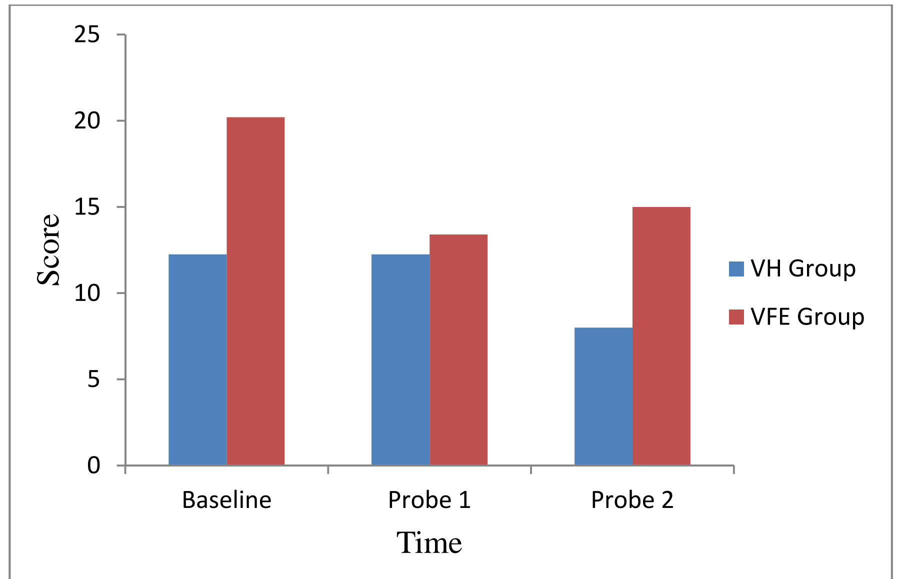


Figure 8. Comparison of Overall VHI Scores by Probe

Within Group Differences

A post hoc within group ANOVA was performed.

Within Group Differences: Baseline to 6 week probe: VH group

Acoustic Measures

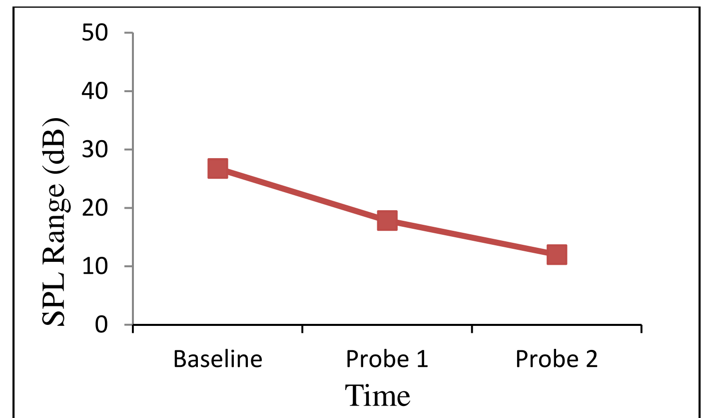


Figure 9. VH Group SPL Range by Time

The VH group demonstrated a significant decrease in SPL range, ($F= 21.11$, $df =24$, $p =0.031$) (Figure 9) and frequency range ($F = 8.11$, $df = 24$, $p =0.043$) (Figure 10), which indicated poorer vocal functioning. The VH group also had significant decreases in the amount of jitter ($F = 3.42$, $df = 25$, $p =0.01$), RAP ($F = 2.08$, $df = 25$, $p = 0.006$), and shimmer ($F = 0.02$, $df = 25$, $p = 0.00$), which indicates an increase in stable vocal quality (Table 5).

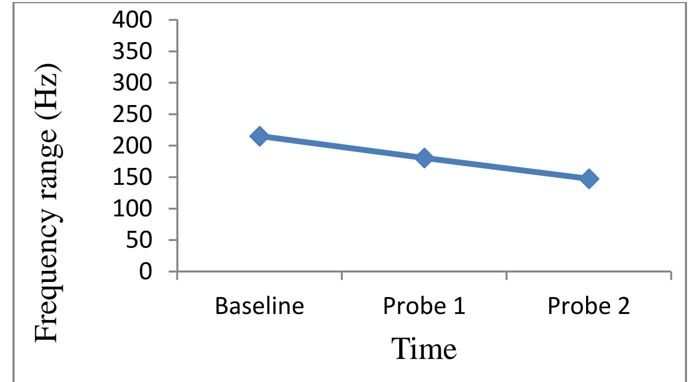


Figure 10. VH Group Frequency Range over Time

Perceptual

CAPE-V scores increased between baseline and the six week probe, indicating poorer vocal quality, across overall quality and strain. Scores decreased in roughness and breathiness, indicating improvement between baseline and the six week probe. However, no changes were statistically significant (Table 6).

Self-perceptual rating

VHI scores increased for overall and physical measures, indicating improvement, and decreased for functional and emotional measures, indicating poorer self-perception. No changes were statistically significant (Table 7).

6 week session to 14 week session: VH group

After the 2 week washout period, the VH group then engaged in both VH and VFE.

Acoustic

A significant increase in SPL min (F = 1.06, df =15, p =0.012) occurred, as did a significant decrease in the SPL range (F = 0.69, df = 15, p = 0.007) which both indicate a decline in functioning (Table 5).

Perceptual

A decrease in scores occurred for all CAPE-V measures, indicating improvement. No changes were statistically significant (Table 6).

Self –Perceptual Rating

A decrease occurred across all variables indicating improvement. No changes were statistically significant (Table7).

Baseline to 14 week session: VH

Acoustic

Significant changes were observed from baseline to week 14 in SPL min (F= 15.2, df = 19, p =0.048), SPL max (F= 1.19, df = 19, p =0.021), SPL range (F = 9.81, df = 19, p =0.013)(Figure 9) and frequency range (F = 8.49, df = 19, p =0.022) (Figure 10) which all indicated a decline in vocal functioning. A significant decrease occurred for shimmer (F = 0.196, df = 19, p =0.001) (Figure 11) indicating improved vocal stability (Table 5).

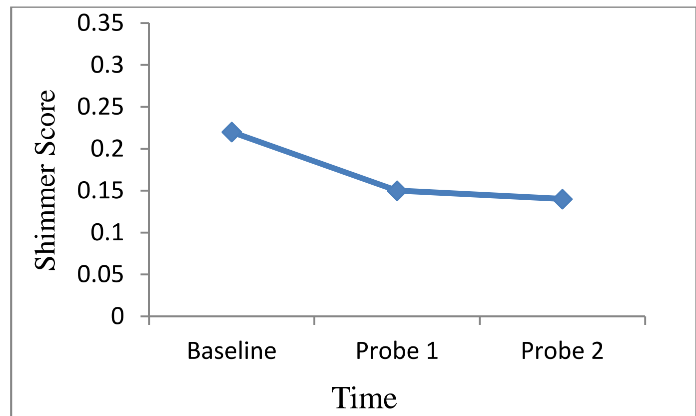


Figure 11. VH Group Shimmer over Time

Perceptual

No significant changes occurred from baseline to week 14 in perceptual measures, however, all measures experienced a decrease from baseline to week 14 indicating an improvement in vocal quality (Figure 12).

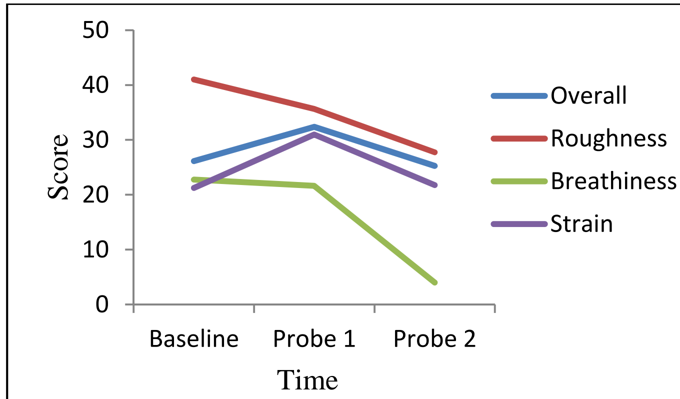


Figure 12. VH Group Perceptual Changes over Time

Self –perceptual rating

No significant changes occurred, however, the overall measure decreased over time indicating an improvement in self-perceptions (Table 7).

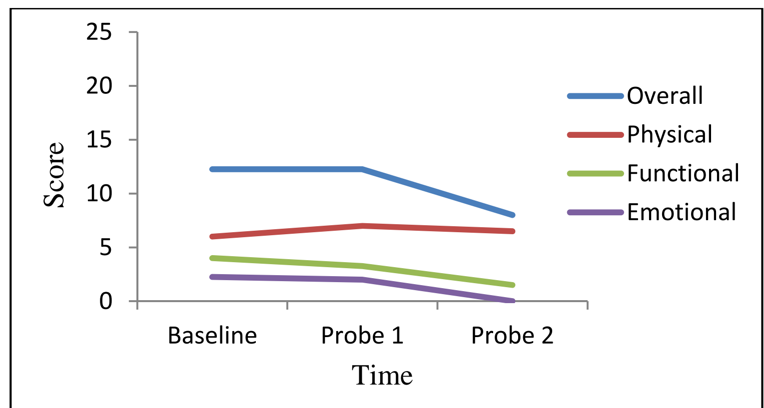


Figure 13. VH Group Self-Perceptual Ratings over Time

Within Group Differences: Baseline to 6 weeks: VFE

Acoustic

No significant changes occurred (Table 5).

Perceptual

All CAPE-V measures decreased, indicating improvement. No changes were of statistical significance. A trend towards statistical significance was evident for overall vocal quality (F = 3.65, df = 8, p =0.064) (Figure 14).

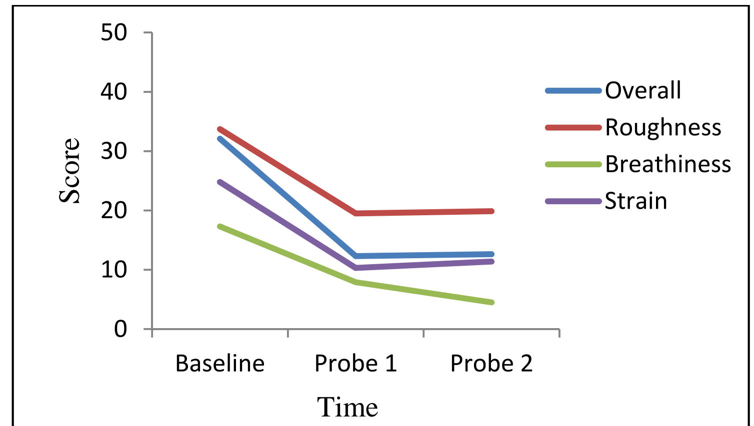


Figure 14. VFE Group Perceptual Changes over Time

Self -perceptual rating

A decrease occurred across all variables occurred indicating improvement (Figure 15). Changes were not statistically significant (Table 7).

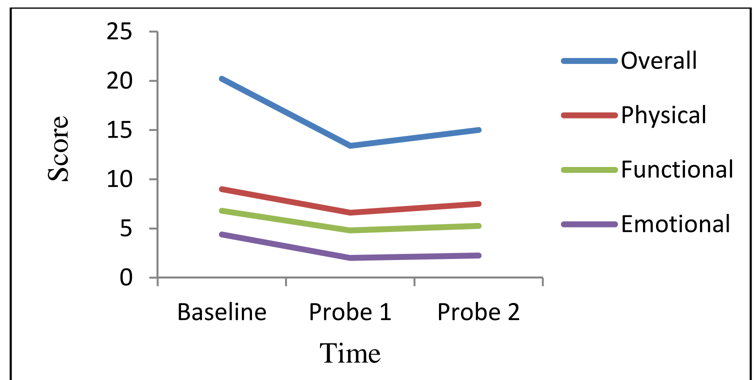


Figure 15. VFE Group Self-Perceptual Ratings over Time

6 week session to 14 week session: VFE

After a 2 week washout period, the VFE group engaged exclusively in VH.

Acoustic

SPL max experienced a statistically significant increase (F= 2.36, df = 25, p =0.013) (Table 5).

Perceptual

Overall quality, roughness and strain all marginally increased in perceptual value, indicating a poorer vocal quality (Figure 14), but were not statistically significant (Table 6).

Self –perceptual rating

While all self-perceptual rating scores increased, indicating a worsening of self perceptions (Figure 15), changes were not statistically significant (Table 7).

Baseline to 14 weeks: VFE

Acoustic

There was a significant increase in SPL max (F = 0.69, df = 25, p = 0.001) achieved from baseline to the 14 week probe (Table 5).

Perceptual

While no changes were significant, there was a trend towards significance for overall perceptual quality (F = 4.88, df = 7, p = 0.091), which decreased indicating improvement (Figure 14).

Self –perceptual rating

No significant changes occurred, however, all measures decreased over time, indicating improved self-perceptions (Figure 15).

Within Subject Perceptual Visual Analysis

A post hoc visual analysis of perceptual features was performed.

Overall

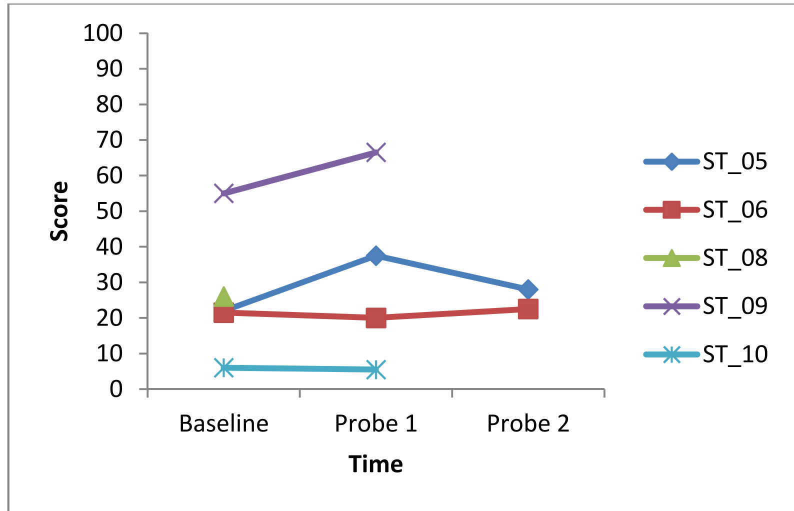


Figure 16. VH Group Overall Perceptual Score by Time

No consistent pattern occurred for the overall vocal quality for the VH group. During the first six weeks of student teaching, some participants experienced a worsening of vocal quality (ST_05, ST_09), while others experienced a minimal improvement (ST_06, ST_10). One subject (ST_08) withdrew from the study after the initial baseline probe. Of the remaining participants at Probe 2, one participant (ST_05) experienced an improvement in overall vocal quality, while the other participant (ST_06) had a minimal worsening of vocal quality (Figure 16).

All participants in the VFE group experienced an improvement in overall vocal quality at the time of the Probe 1. After VFE were removed from the treatment regime, exclusive VH was unsuccessful in improving the voices of 75% of participants. One participant (ST_01) continued to experience an improvement in overall vocal quality when solely engaged in VH (Figure 17).

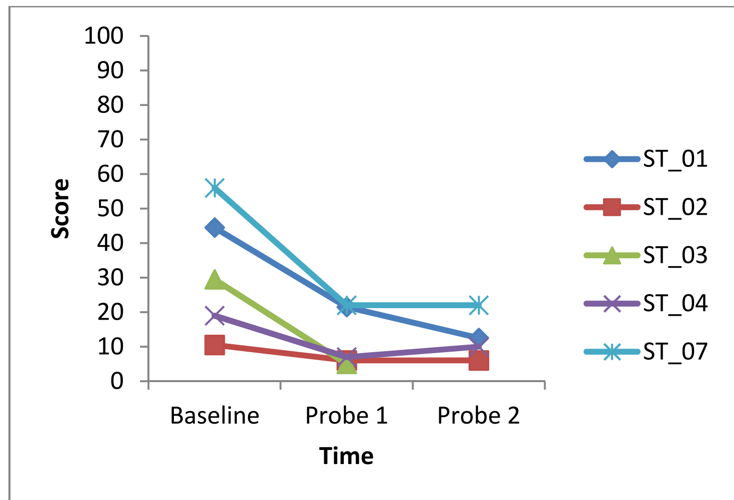


Figure 17. VFE Group Overall Perceptual Score by Time

Breathiness

After engaging in VH, no participants in the VH group experienced changes in breathiness that went beyond minimal improvements or decline. After VFE were introduced, one participant (ST_05) experienced an improvement in breathiness (Figure 18).

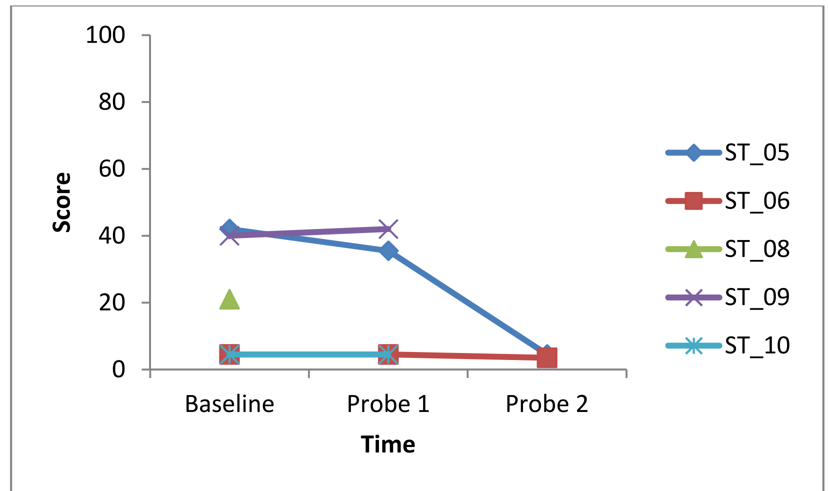


Figure 18. VH Breathiness Score by Time

Of the VFE group, three of the five participants (ST_01, ST_03, ST_07) experienced an improvement in the breathy quality of their voices, and this trend of improvement persisted into the exclusive VH treatment period for one participant (ST_07). All other participants had almost no breathy quality at Probe 1, therefore there was minimal room for improvement to be made during the exclusive VH treatment period (Figure 19).

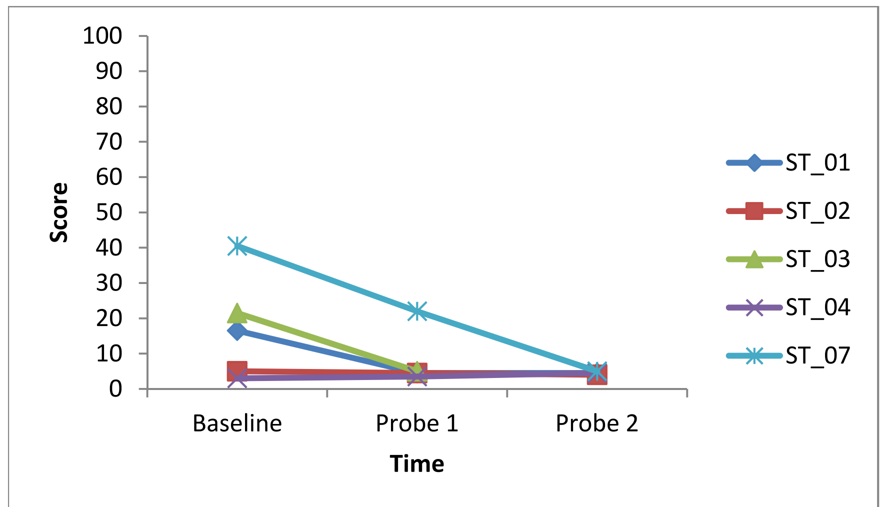
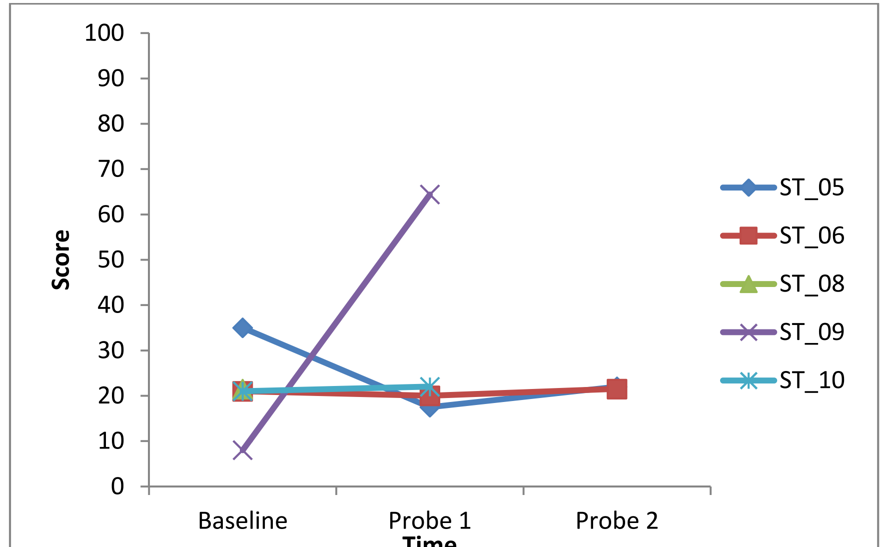


Figure 19. VFE Breathiness Score by Time

Strain

The VH group had no consistent pattern of vocal change. Notably, when engaged in VH one participant (ST_09) had a large worsening in strain. The addition of VFE had little to no effect on the strain for the remaining participants at Probe 2 (Figure 20).



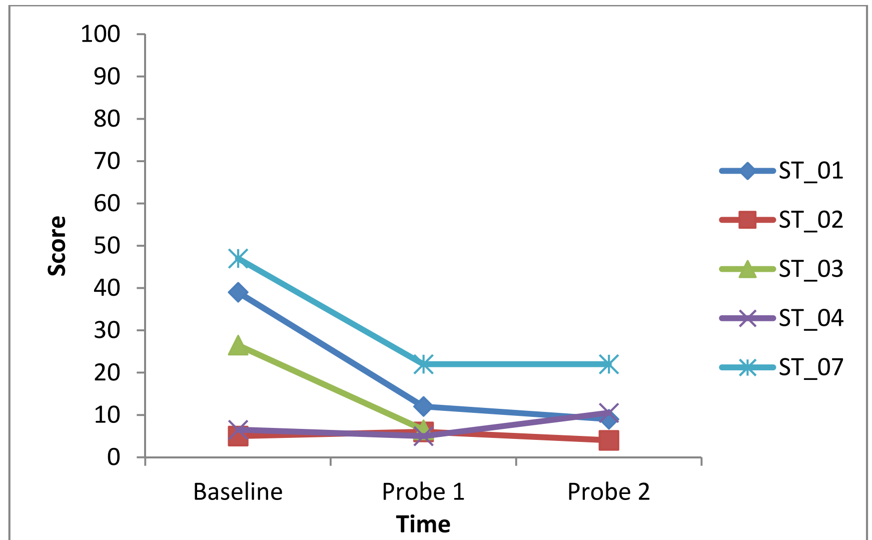


Figure 21. VFE Strain Score by Time

Of the VFE group, three of the five participants experienced an improvement in strain (ST_01, ST_03, ST_07), while the other two participants had minimal vocal strain at baseline (ST_02, ST_04). After the VFE were removed from treatment, three of the now four participants maintained levels of strain, while one participant (ST_04) experienced minimal worsening of strain (Figure 21).

Roughness

There was no consistent pattern of change in vocal roughness for the VH group. One participant experienced a notable increase in roughness (ST_09), while another participant experienced a notable decrease in roughness (ST_05). The addition of VFE did not result in notable change of vocal roughness for any participant of the VH group at Probe 2 (Figure 22).

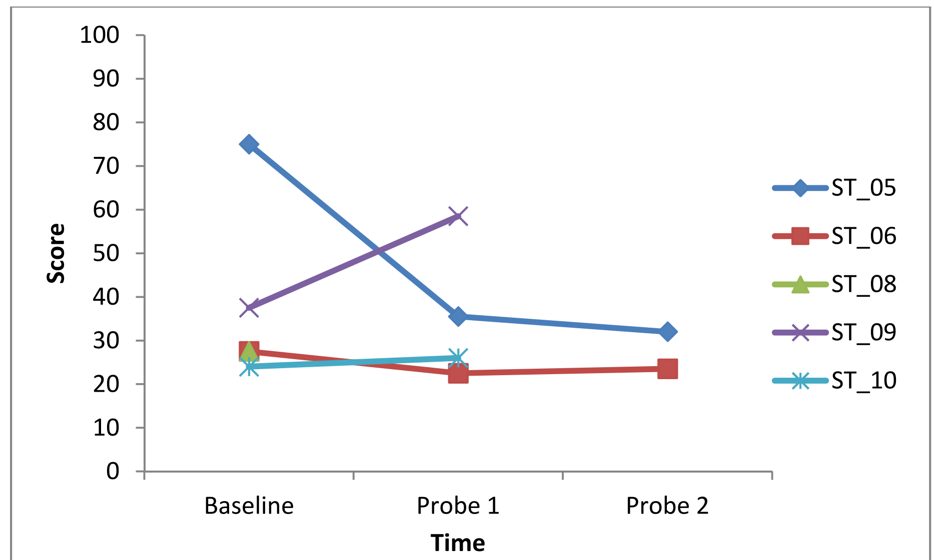


Figure 22. VH Roughness Score by Time

Of the VFE group, four of the five participants experienced a decrease in vocal roughness, albeit of varying amounts (ST_01, ST_03, ST_04, ST_07). After VFE were discontinued, participants experienced a variety of changes. Two participants had experienced a small decrease in roughness

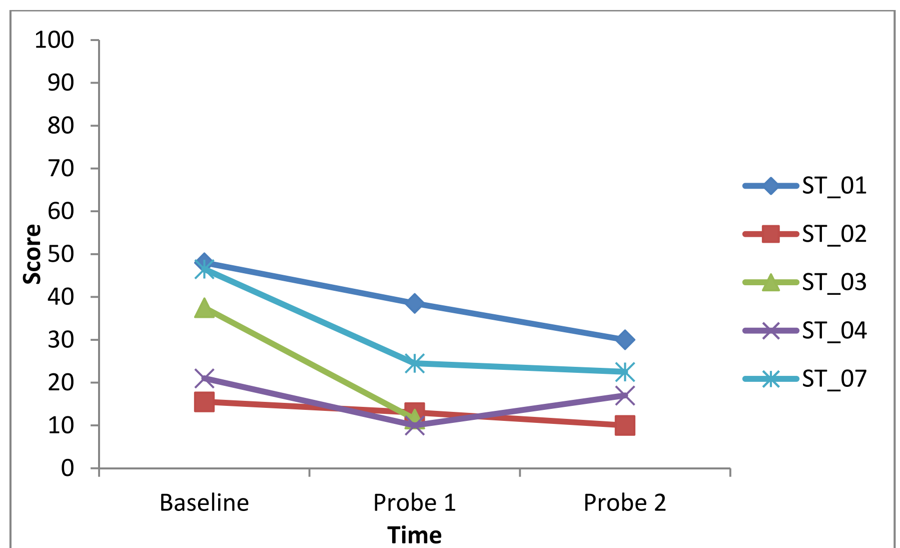


Figure 23. VFE Group Roughness Score by Time

(ST_01, ST_02), one participant experienced an increase in roughness (ST_04) and one participant experienced essentially no change (ST_07) (Figure 23).

When performing a visual analysis of perceptual features of the voice, as determined by the CAPE-V, the VH group had no consistent vocal changes across measures. While multiple participants experienced worsening of perceptual qualities, one participant (ST_09) experienced a marked worsening of overall vocal quality, strain and vocal roughness when engaged in VH. The addition of VFE did not have a large effect on vocal functioning with the exception of an improvement in breathiness for one subject (ST_ 05). The VFE group largely experienced an improvement in vocal quality across measures, or maintained pre-existing levels of a perceptually healthy voice. After the removal of VFE from their daily treatment, the VFE group maintained vocal functioning, but rarely experienced further improvement.

Table 5. Acoustic measures: mean ± standard deviation

	VH Group			**VFE Group**		
	Baseline	**6 week**	**14 week**	**Baseline**	**6 week**	**14 week**
SPL min	83.67 ±12.84	90.42 ± 3.67	95.17 ± 1.47	88.4 ± 14.87	92.4 ± 4.44	95.25 ± 3.74
SPL max	110.42 ±3.42	108.234±2.34	107.12±2.64	108.6 ± 4.95	109.67±5.86	114.92±3.85
SPL range	26.75 ±13.02	17.83 ± 3.47	12 ± 4	23.13±13.88	17.27±3.28	19.67±3.96
Frequency range	215.36±46.74	180.61±44.26	147.55±31.63	355.92±139.4	334.55±232.76	327.32±250.09
Jitter	117.4±73.06	65.42±34.05	84.43±51.5	113.97±82.24	97.58±69.44	135.72±75.98
Shimmer	0.22 ± 0.05	0.15 ± 0.04	0.14 ± 0.03	0.21 ± 0.12	0.24 ± 0.15	0.2 ± 0.1

RAP	1.26 ± 0.61	0.77 ± 0.41	0.88 ± 0.32	1.18 ± 0.5	1.09 ± 0.53	1.36 ± 0.43
vAM	13.6 ± 5.54	11.64 ± 5.7	11.09 ± 2.68	12.96 ± 6.98	12.93 ± 4.59	12.96 ± 8.07
NHR	0.11 ± .0.3	0.11 ± .0.3	0.12 ± 0.04	0.11 ± 0.03	0.11 ± 0.04	0.11 ± 0.03
VTI	0.02 ± 0.01	0.03 ± 0.01	0.03 ± 0.01	0.02 ± 0.01	0.03 ± 0.01	0.02 ± 0.01

Table 6. Perceptual CAPE-V Measures: mean ± standard deviation

	VH			**VFE**		
	Baseline	**6 week**	**14 week**	**Baseline**	**6 week**	**14 week**
Overall	26.13±20.13	32.38 ±26.24	25.25 ±3.89	32.1 ±18.68	12.3 ±8.66	12.63 ± 6.8
Roughness	41 ±23.38	35.63 ±16.21	27.75 ±6.01	33.7 ±14.79	19.5 ±12.07	19.88 ±9.47
Breathiness	22.75±21.09	21.63±19.95	4 ± 0.71	17.3 ±15.1	7.9 ±7.9	4.5 ± 0.41
Strain	21.25±11.03	30.98±22.40	21.75 ±0.35	24.8 ± 18.87	10.3 ± 7.09	11.38 ±7.61

Table 7. Self-Perceptual VHI Ratings: mean ± standard deviation

	VH			**VFE**		
	Baseline	**6 week**	**14 week**	**Baseline**	**6 week**	**14 week**
Overall	12.25 ±9.5	12.25 ±14.97	8 ± 5.66	20.2 ±5.58	13.4 ± 6.31	15 ±4.97
Physical	6 ± 3.56	7 ± 8.29	6.5 ± 3.54	9 ± 2	6.6 ±3.78	7.5 ±2.38
Functional	4 ±2.7	3.25 ± 3.3	1.5 ± 2.12	6.8 ± 3.56	4.8 ± 1.79	5.25 ± 2.22
Emotional	2.25 ± 3.3	2 ± 4	0 ± 0	4.4 ± 3.78	2 ± 1.58	2.25 ±2.63

Discussion

Teachers and student teachers are at risk for developing voice disorders throughout their careers (Cultiva, Vogel & Burdorf, 2013; Roy et al., 2004; Van Lierde et al., 2009). Due to the negative impact voice disorders have on the lives and vocational capabilities of teachers, preventative measures should be taken to preserve vocal functioning from the early stages of student teaching (Schneider & Bigenzahn, 2004). This study sought to determine what was effective in promoting and maintaining functional vocal health among student teachers by comparing an exclusive VH regime to a VFE plus VH treatment regime.

When examining results between groups no consistent trend emerged. However, overall, the VFE group performed better at the 6 week probe and continued to perform better at the 14 week probe than the VH group, as evidenced by acoustic and perceptual measures. This indicates that the effect of participating in VFE early on in the student teaching experience was enough to strengthen the voice in order to maintain a positive impact after the exercises were discontinued.

After participating in an exclusive VH regime, there was no consistent improvement or decline in vocal functioning. While select acoustic measures revealed a significant change after the VH treatment period, the overall trend of acoustic measures was largely unremarkable. However, examining the effect of exclusive VH on measures of vocal flexibility, namely SPL range and frequency range indicated that VH did not serve to preserve vocal functioning, as a statistically significant decline in SPL range ($p = 0.031$) and frequency range ($p = 0.043$) occurred for the VH group. This decline in SPL range and frequency range could be indicative of vocal fold edema, a symptom of vocal fold irritation (Sapienza & Ruddy, 2013). Conversely, the VFE group experienced an increase, albeit a statistically insignificant increase, in SPL range and only a small decrease in frequency range occurred. Although these measures did not reach statistical significance, visual analysis showed better vocal preservation for the VFE group.

Measures of jitter, shimmer and RAP all significantly improved after completion of VH for the VH group and indicates that VH was successful in improving the steadiness of voice.

After engaging in VH, perceptual measures worsened for both groups. While neither group experienced a worsening that was statistically significant, the VH group had more severe worsening than the VFE group. In regards to self-rated perceptual measures, after the exclusive VH treatment period no changes in ratings were of statistical significance and neither group experienced a notable impact on the self-perceived functioning of their own voices.

Overall, engaging in VH was shown to have minimal positive impacts on the voice. Interestingly, participants in the VFE group had better perceptual and acoustic qualities of voice in regards to SPL range and frequency range than participants in the VH group. This provides evidence that VFE were effective in promoting healthy vocal functioning even when they were no longer being used. It cannot be concluded that VH had no benefit as a standalone treatment, as the VH group experienced a significant improvement in the measures of jitter, shimmer and perturbation.

After partaking in VFE, no significant improvements in acoustic measurements of the voice occurred. However, perceptual measures and self-perceived ratings revealed better vocal quality across all categories for both groups. While no changes for perceptual measures were significant for the VFE group, upon visual analysis a marked improvement was revealed for overall improvement. The improvements indicate that after engaging in VFE, participants were perceived by others and by themselves as having a better voice. This finding has exciting clinical implications because clients may be more apt to participate in a treatment regime and adhere to home practice if they can perceive a positive effect on the voice.

Throughout the treatment period, both groups experienced an overall decrease in acoustic functioning, but the decline was greater for the VH group. The VH group significantly worsened from baseline to the 14 week probe in regards to minimum SPL, maximum SPL, SPL range, and frequency range. Despite the overall trend of decline in acoustic function for both groups, some statistically significant improvements were made, such as the VH group's shimmer and the VFE group's maximum SPL. While both groups experienced an overall acoustic decline throughout their student teaching experiences, the fact that the VH group experienced a larger decline indicates that VFE are an important component to introduce early on in student teachers' careers because it has lasting effects on voice and can lessen the severity of vocal decline.

Overall, from baseline to the end of the study period, both groups experienced improvements in perceptual and self-rated measures. While no changes were of statistical significance, the VFE group had greater perceptual improvements overall. This is additional evidence to support the emerging trend that VFE are more effective the earlier they are implemented.

From the results, the conclusion can be made that while both VH and VFE resulted in some vocal improvements and prevented a decline in many measures, VFE resulted in greater positive outcomes in acoustic, perceptual and self-rating measurements. The results of this study are consistent with past results exploring the efficacy of using direct treatments, and similar to research conducted by Chen et al. (2007) and Roy et al. (2001 and 2003). Direct treatment, such as VFE, yielded greater improvements in voices of teaching professionals when compared to an indirect, education based treatment, such as VH. The current study provided evidence that, specifically, VFE is effective in improving voice measures, which is consistent with findings of past studies (Roy et al., 2001, Sabol, Lee & Stemple, 1995; Sapienza & Ruddy, 2013).

A limitation of this study was the rate of attrition and the resulting imbalance between groups. Participant attrition was as follows: VH group – Baseline: 5; Probe 1: 4; Probe 2: 2; VFE group – Baseline: 5; Probe 1: 5; Probe 2: 4. Attrition was due to scheduling conflicts and inconsistency in following the treatment protocols. While all participants who completed the study reported high levels of adherence to the treatment protocols, the exercises were completed independent of a researcher during the treatment periods, and thus uncertainty exists regarding the actual level of adherence versus reported level of adherence to protocols.

Another limitation to this study was the small sample size and the resulting lack of power when running statistical analyses. Additionally, the treatment time may not have been sufficient. Perhaps more than six weeks engaged in treatment is needed to see the full effects on vocal functioning. Additionally, it should be considered that acoustic measures may be more sensitive to changes in voice, and could be an explanation as to why there are particularly few statistically significant measures in perceptual and self-perceptual ratings.

Another aspect that must be considered when interpreting results is the possibility that after completing treatment with VFE, participants were more aware of healthy vocal practices and implemented a modified and healthier way of speaking into their daily lives. That possibility could be a contributing factor as to why the VFE group had overall better results than the VH group. In order to overcome this, an order effect and carryover of learned vocal exercises should be carefully examined in future studies.

While the current study adds to the body of evidence that professional voice users benefit from direct voice treatment to preserve vocal functioning (Chen et al., 2007, Roy et al., 2001, and Roy et al.,2003) many questions remain. Future research in the area of voice disorder

prevention in student teachers should focus on determining on the effect of VFE and VH on voices of student teachers who have disordered voices to see whether either treatment is sufficient to reverse vocal fold dysfunction. Additionally, it would be beneficial to explore vocal qualities after all vocal treatment was ceased in order to determine if healthy vocal habits are able to be generalized into everyday life after the treatment period has ended and to examine whether the positive impacts VFE has on the voice persist over time once all treatment has ceased. Additionally, another consideration for future research is to explore what treatments are effective in producing consistent, positive, and statistically significant changes in regards to acoustic properties of voice in order to determine the most effective treatment.

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Appendix A

Subject Screening Form

Subject Name: ________________________ **Subject Code: __________**

DOB: _______________ **Male Female**

Email address: ________________________ **Phone number: ______________**

Contact preference: Email Phone

Have you participated in choirs or singing groups? NO YES

If yes, for approximately how many years?

______ years

If yes, do you plan on participating in a choir or singing group in Fall 2014? NO YES

Have you received professional voice training? NO YES

If yes, for approximately how many years?

______ years

If yes, do you plan on receiving professional voice training in Fall 2014? **NO** **YES**

Do you have a history of smoking? **NO** **YES**

Do you currently smoke? **NO** **YES**

Have you ever been diagnosed with a voice disorder? **NO** **YES**

Have you ever received therapy due to voice issues? **NO** **YES**

By signing, you are acknowledging that you understand the above questions and have provided accurate information to the extent of your knowledge.

______________________________ ______________

Signature of Subject **Date**

______________________________ ______________

Signature of Investigator **Date**

Appendix B

CONSENT FORM

Participant ______________________________

Principal Investigator **Froemming Gina B.S.** PI's Phone Number **(715) 425-3801**

Last First Credentials

Title of Project: **Effects of Resonant Voice Therapy Exercises on Maintaining Vocal Health in Student Teachers**

You are invited to take part in a research project conducted by Gina Froemming, B.S., Graduate Student in the Department of Communicative Disorders at UWRF.

Please ask for an explanation of any words you do not understand.

1. **Purpose**

   The purpose of this study is to determine the effect of resonant vocal exercises when paired with vocal hygiene on the vocal health of student teachers.

2. **Participation**
   You will be asked to partake in a vocal hygiene regime of drinking no less than four cups of water every school day of your Fall 2014 student teaching placement for six weeks. You may also be asked to do 10 minutes of resonant voice therapy exercises before going to teach every day for a six week period. At the beginning and end of the study period, you will be asked to complete a brief survey about your voice and be asked to read a passage and several sentences that will be recorded for perceptual and acoustic assessment.There is no compensation associated with participating in this study.

3. **Benefit**
   Participation in this study may help you avoid damaging your vocal folds due to high use of your voice. It may increase your knowledge of techniques to avoid damage to your voice and it may increase your vocal health both immediately and in the future.

4. **Confidentiality**
   The records of this study will be kept private. In any publications or presentations, we will not include any information that will make it possible to identify you as a subject. Your record for the study may, however, be reviewed by departments at the University with appropriate regulatory oversight. You cannot be individually identified for your participation in this study.

If you sign this form:

- Your signature and this form will not expire as long as you wish to participate.
- You may revoke your authorization.
- You are making a decision whether or not to participate. Your signature indicates that you have read the information provided above and have decided to participate.
- Your decision to participate will not affect your grade in any course nor will it affect your relationship with the Department of Communicative Disorders or the UWRF.

7. **Who do I call if I have Questions or Problems?**
   If you have concerns regarding how you were treated in this study, please contact Molly VanWagner, Interim Director of Grants and Research: 104 North Hall (715) 425-3195 or Gina Froemming B.S., Graduate Student: B31 Wyman Education Building (715) 425-3801.

This project has been approved by the University of Wisconsin Institutional Research Board for the Protection of Human Subjects: protocol # W2014 - T007.

I have read this consent form and have been given the chance to ask questions. I will also be given a signed copy of this consent form for my records. I give my permission to participate in the research described above, titled: Effects of Resonant Voice Therapy Exercises on Maintaining Vocal Health in Student Teachers.

____ ________________

Participant's Signature Date

Thank you for your important contribution to research studies aimed to improve medical care.

You will be given a copy of this form to keep for your records.

If you have concerns regarding how you were treated in this study, please contact Gina Froemming, B.S., Graduate Student: B31 Wyman Education Building (715) 425-3801.

Appendix C

Participant Instructions: Vocal Hygiene

Drink 4 cups or more of water throughout every day that you are student teaching for a 6 week period of time.

Appendix D

Participant Instructions: Vocal Hygiene plus Vocal Exercises

Please drink 4 cups or more of water throughout every day that you are student teaching.

Spend 10 minutes prior to teaching each day doing the following exercises:

-glide on m, n and -ing from the lowest pitch comfortable to the highest pitch comfortable and back down to the lowest pitch (do three times in a row)

-hold out eeeee for as long as possible on a comfortable tone (do three times in a row)

-chant me-me-pe-pe-me-me, may-may-pay-pay-may-may, ma-ma-pa-pa-ma-ma, mo-mo-po-po-mo-mo, moo-moo-poo-poo, moo-moo, on a comfortable pitch varying in speed and softness (do three times in a row)

Say the following sentences:

The boy and his dog jogged all around the lane.

We met near the bench in downtown.

The man liked to drive the new Volvo very fast around his neighborhood.

We bought the zoo next to our mansion so that we were able to gaze at the lions whenever we wished.

Nine girls and boys voiced alternating vies on the debate topic during the night class.

I think my friend in Hong Kong should take a trip to Saint Paul.

How should she choose which cat to purchase?

Pieces of paper fell through the ceiling.

Sheep and cows are commonly seen at the State Fair.

Can fish swim slowly when traveling up the stream?

Appendix E

Between Group Acoustic ANOVA

	Baseline			**6 weeks**			**14 weeks**		
	F	**df**	**p- value**	**F**	**df**	**p-value**	**F**	**df**	**p-value**
SPL minimum	0.00	25	0.391	1.54	24	0.293	2.67	16	0.959
SPL maximum	2.1	25	0.291	9.1	24	0.494	1.67	16	0.00
SPL range	0.04	25	0.496	0.33	24	0.733	0.00	16	0.001
Frequency range	5.07	25	0.004	17.18	24	0.044	12.13	16	0.103
Jitter	0.84	25	0.911	3.03	24	0.146	2.29	16	0.158
RAP	0.3	25	0.735	0.19	24	0.097	0.75	16	0.03

	F	df	p-value		F	df	p-value		F	df	p-value
Shimmer	11.05	25	0.688		7.18	24	0.048		3.8	16	0.159
vAM	1.38	25	0.798		0.17	24	0.536		2.24	16	0.614
NHR	0.32	25	0.852		0.01	24	0.947		1.41	16	0.546
VTI	0.56	25	0.697		0.36	24	0.984		2.51	16	0.562

Between Group Perceptual ANOVA											
	Baseline				**6 weeks**				**14 weeks**		
	F	**df**	**p-value**		**F**	**df**	**p-value**		**F**	**df**	**p-value**
Overall	0.01	7	0.662		4.2	7	0.148		0.39	4	0.078
Breathiness	2.64	7	0.664		18.36	7	0.20		1.33	4	0.31
Strain	2.48	7	0.75		4.56	7	0.089		2.24	4	0.143
Roughness	0.56	7	0.315		0.14	7	0.136		0.46	4	0.458

Between Group Self-Perceptual Rating ANOVA											
	Baseline				**6 weeks**				**14 weeks**		
	F	**df**	**p-value**		**F**	**df**	**p-value**		**F**	**df**	**p-value**
Overall	0.07	7	0.229		2.26	7	0.879		0.00	4	0.191
Physical	0.78	7	0.151		1.83	7	0.925		0.63	4	0.693
Functional	1.1	7	0.237		5.41	7	0.395		0.02	4	0.12
Emotional	0.03	7	0.401		3.41	7	1.00		2.8	4	0.318

VH Group Acoustic ANOVA

	Baseline – 6 weeks			6 weeks – 14 weeks			Baseline – 14 weeks		
	F	df	p- value	F	df	p-value	F	df	p-value
SPL minimum	18.95	24	0.114	1.06	15	0.012	15.2	19	0.048
SPL maximum	4.48	24	0.131	1.94	15	0.527	1.19	19	0.021
SPL range	21.11	24	0.031	0.69	15	0.007	9.81	19	0.013
Frequency range	8.11	24	0.043	2.48	15	0.13	8.49	19	0.022
Jitter	3.42	25	0.01	1.43	16	0.359	0.35	19	0.201
RAP	2.08	25	0.006	0.68	16	0.546	2.67	19	0.072
Shimmer	0.021	25	0	0.34	16	0.688	0.2	19	0.001
vAM	0.18	25	0.3	1.93	16	0.827	1.23	19	0.228
NHR	0.37	25	0.738	0.54	16	0.645	2.21	19	0.421
VTI	0.83	25	0.199	1.48	16	0.875	0.32	19	0.43

VH Group Perceptual ANOVA

	Baseline – 6 weeks			6 weeks – 14 weeks			Baseline – 14 weeks		
	F	df	p-value	F	df	p-value	F	df	p-value
Overall	0.05	7	0.976	2.89	4	0.737	1.71	5	0.697
Breathiness	1.21	7	0.658	69.78	4	0.304	4.11	5	0.361
Strain	4.05	7	0.785	3.78	4	0.611	9.93	5	0.323
Roughness	0.34	7	0.892	1.04	4	0.561	1.44	5	0.586

VH Group Self-Perceptual Rating ANOVA

	Baseline – 6 weeks			6 weeks – 14 weeks			Baseline – 14 weeks		
	F	df	p-value	F	df	p-value	F	df	p-value
Overall	0.02	7	0.622	1.26	4	0.73	3.72	5	0.422
Physical	0.02	7	0.713	1.05	4	0.941	1.12	5	0.678
Functional	0.67	7	0.398	3.33	4	0.544	2.59	5	0.269
Emotional	0.36	7	0.803	4	4	0.541	4.64	5	0.294

VFE Group Acoustic ANOVA												
	Baseline – 6 weeks				**6 weeks – 14 weeks**				**Baseline – 14 weeks**		
	F	**df**	**p-value**		**F**	**df**	**p-value**		**F**	**df**	**p-value**
SPL min	7.62	28	0.327		0.77	25	0.088		7.6	25	0.133
SPL max	0.56	28	0.595		2.36	25	0.013		0.69	25	0.001
SPL range	21.36	28	0.122		0.56	25	0.097		14.91	25	0.411
Frequency range	4.69	28	0.763		0.1	25	0.939		5.86	25	0.709
Jitter	1.25	28	0.726		0.47	25	0.27		0.17	25	0.487
RAP	0	28	0.749		0.14	25	0.224		0.25	25	0.346
Shimmer	1.05	28	0.313		3.3	25	0.278		1.19	25	0.901
vAM	3.32	28	0.98		1.71	25	0.949		0	25	0.972
NHR	0.36	28	0.658		0.46	25	0.64		0.07	25	0.94
VTI	0.01	28	0.313		0.56	25	0.258		0.47	25	0.882

VFE Group Perceptual ANOVA											
	Baseline – 6 weeks				**6 weeks – 14 weeks**				**Baseline – 14 weeks**		
	F	**df**	**p-value**		**F**	**df**	**p-value**		**F**	**df**	**p-value**
Overall	3.65	8	0.064		1.98	7	0.953		4.88	7	0.091
Breathiness	1.41	8	0.252		4.97	7	0.425		5.72	7	0.139
Strain	6.1	8	0.146		0.00	7	0.833		4.74	7	0.227
Roughness	0.65	8	0.135		0.93	7	0.96		3.4	7	0.143

VFE Self-Perceptual ANOVA											
	Baseline – 6 weeks				**6 weeks – 14 weeks**				**Baseline – 14 weeks**		
	F	**df**	**p-value**		**F**	**df**	**p-value**		**F**	**df**	**p-value**
Overall	0.09	8	0.191		0.51	7	0.692		0.44	7	0.321
Physical	3.94	8	0.245		2.2	7	0.693		0.04	7	0.337
Functional	4.9	8	0.295		0.08	7	0.745		2.48	7	0.475
Emotional	1.65	8	0.227		0.75	7	0.864		0.313	7	0.369