UNDERSTANDING VOCAL FATIGUE AND GRADE LEVEL DEMAND AS QUANTIFIED BY THE VOCAL FATIGUE INDEX (VFI)

By

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ABSTRACT

UNDERSTANDING VOCAL FATIGUE AND GRADE LEVEL DEMAND
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Previous research has concluded that teachers are at higher than normal risk for voice issues that can cause occupational limitations, but specific grade levels affected most by voice issues have not yet been identified. This research aims to identify by grade level, the teachers most at risk for vocal fatigue. A self-reported survey was distributed using the Qualtrics online survey software. Vocal fatigue was measured using the Vocal Fatigue Index and used to quantify the amount of potential risk involved in each teaching grade. Teachers' responses from several different school districts throughout the United States were separated into grade levels and analyzed.

The data collected in this study showed no effect of a teachers' specific teaching grade level on the amount of vocal fatigue that they experienced. However, several other factors seemed to have an effect: size and capacity of the classrooms in which the teachers taught; frequency of colds, sinus infections, and laryngitis; frequency of caffeine, smoking, and alcohol consumption; and as well as the presence of reflux and allergies. These research discoveries will have a great effect on the precautions taken by educators and school administrators to avoid vocal fatigue, and, thus, occupational risk from short- and long-term voice issues. There are many additional factors which may affect perceived vocal fatigue that must be explored.

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BACKGROUND

Over the last three decades, sizeable amounts of research have been done involving school teachers and the various voice problems that are associated with working in this occupation. In a survey of over 2500 teachers and non-teachers in the United States (Roy, et al. 2004), 57.7% of school teachers reported having experienced voice problems during their lifetimes. In comparison, only 28.8% of non-teachers had experienced voice problems during their lifetimes. According to the study, 11% of the school teacher population surveyed also reported having current voice issues (roughly 4.8% more than non-teachers reported). This research, along with other experiments conducted in recent years (e.g. Kostyk and Putnam Rochet 1998; Smith et al. 1997), suggests that school teachers are at a higher-than-average risk for experiencing short- and long-term damage to their voices.

Other research has shown that students learn less from teachers who frequently miss work due to voice problems as compared to students of vocally healthy teachers (Morton & Watson, 2001; Rogerson & Dodd, 2005). Given that public school teachers are a very important part of our society and that this population is at higher risk for experiencing voice problems, understanding conditions in which a teacher may experience voice issues may contribute to solutions as to how to keep them in the classroom, reduce the cost of lost workdays, and improve instruction. Additionally, understanding the factors associated with maintaining a healthy voice in the school setting may prove to be an important factor in increasing children's likelihood and ability to learn in the classroom.

Key Risk Factors

Previous research (Hunter and Titze, 2011; Gotass and Starr, 1993) has hypothesized that the increased prevalence of voice issues in teachers may be due to several key factors: a variety of occupational factors; environmental characteristics; and individual teacher characteristics. Oftentimes, these factors express themselves in teachers as "vocal fatigue."

Occupational and Environmental Factors

Research has suggested that there are several occupational requirements and environmental factors that may potentially increase voice problems experienced by teachers. One of the many requirements of teachers is high vocal demands (Hunter and Titze, 2011). These high vocal demands are hypothesized to be a major factor that may contribute to a higher prevalence of voice problems in teachers than in the non-teacher population. Gotaas and Starr (1993) found that teachers who spend more time taking part in vocally demanding extra-curricular activities (such as after-school programs, choral groups, and coaching sports) were more susceptible to voice problems. It was also found that teachers who spent increased time speaking in situations that they felt were "highly stressful" (e.g., teaching new students, public speaking) were more likely to experience voice problems. Teachers who tended to spend more time speaking in general throughout the day were also at higher risk for voice problems.

Limited vocal training and the lack of awareness of speaking hazards have been implicated as potential causes of voice problems in teachers (Duffy and Hazlett, 2004). Many teachers are unaware of the potential damage that teaching demands can have on the voice. Moreover,

they are often unaware of the resources available that help avoid vocal misuse and that aid teachers in the rehabilitation of voice after injury.

Further, Thibeault et al. (2004) found that there may be a relationship between the specific courses taught by individual teachers and their increased risk of developing voice problems. Teachers of performing arts (such as vocal music, chorus and drama) and chemistry were at significantly greater risk of developing voice issues that would limit their teaching ability. It is hypothesized (Roy et al. 2004) that the teachers of these courses are at greater risk because of the vocal load (overuse or misuse of the voice; Hunter and Titze, 2009) associated with daily teaching requirements and chemical exposure (in the case of chemistry teachers).

Some studies have shown that certain environmental characteristics may negatively impact teachers' voices. Poor classroom acoustics have been studied as a possible factor that may increase the likelihood that teachers experience voice problems. Nadalin, Astolfi, Bottalico, Riva, Garzaro, Raimondo, and Giordano (2011) found that a major cause of voice problems was an increased amount of time speaking in a classroom with poor acoustics (noticeable noise and reverberation within a given room). The research by Nadalin et al. (2011) also found that teachers of larger classrooms (larger physical classrooms with more students) reported higher amounts of vocal effort throughout the day and a higher occurrence of voice problems. Ahlander, Rydell, & Lofqvist (2011) found that teachers who experienced voice problems were more aware of poor classroom acoustics and thus changed their teaching techniques in order to compensate.

Another factor that has been shown to affect the prevalence of voice problems in teachers is the lack of voice amplification. Voice amplification systems have been used as a way to

rehabilitate voices of those whose voice issues create occupational limitations (Roy et al. 2002). Those teachers who have access to and use voice amplification may be able to reduce their daily vocal load and effort. This may result in fewer voice problems. As voice amplification is considered an aid in the remediation of voice issues, information regarding its use is important to the study of voice problems in teachers.

Individual Teacher Characteristics

Physiology

There are physiological characteristics that have been implicated as ones that may increase a teachers' likelihood of experiencing voice problems. For example, gender seems to play a role in the occurrence of voice problems. Females have been found to have a higher instance of voice problems than males (Hunter, Tanner and Smith, 2011). Traditionally, studies have pointed to differences in pitch (perceptual correlate of frequency) and vocal fold length and mass (Titze, 1989) as major reasons for the difference between the number of voice problems experienced by females compared to males. According to Titze et al. (1989) and Hunter et al. (2011), females' generally shorter vocal folds and higher speaking pitch increase the number of vocal fold collisions per second compared to males. Thus, the strain and increased effort exerted on contact areas of the vocal folds may be one potential explanation for the disproportionate number of females' voice problems to males'. As females' shorter vocal folds of smaller mass hit together at a higher frequency (rate per second) than males', they become more prone to injury during increased vocal loads or speaking tasks.

Ward, Thibeault, and Gray (2002) indicated that differences in measured amounts of hyaluronic acid (HA) may also cause a disproportionate number of voice problems between

males and females. “HA is a randomly coiled, negatively charged molecule that attracts water …. It is spread throughout the body, where it also functions as a shock absorber, viscosity regulator, and important signaling molecule. In particular, it is responsible for providing the vocal folds with some of the viscoelastic properties that are vital to voice production” (Ward et al. 2002, p. 307). It was found that men possess a higher concentration and distribution of HA throughout the body and also in the area of the larynx (which houses the vocal folds). Due to its shock absorbing and hydrating properties, increased amount of HA could account for the decreased instances of voice problems in males. With a system that vibrates at a lower pitch (fewer times per second) and better lubrication with the assistance of HA, males may be more able to handle the vocal load of daily teaching tasks. Additionally, Hunter et al. (2011) identified three additional gender differences (not discussed here) which could contribute to females increased risk of voice problems: endocrine differences, other non-laryngeal physiological differences (nervous system, respiratory system, digestive system, whole body hydration), and non-physiological and behavioral differences (anxiety and depression, daily vocal load) .

Vocal Hygiene

Vocal hygiene is the process of education and action by which hyperfunction (overuse) of the vocal folds is avoided by an individual (Froeschels, 1943). Several studies have examined factors that have an effect on maintaining good vocal hygiene and thus appropriate vocal function. Certain pharmaceuticals (e.g., antihistamines, antispasmodics, testosterone enhancemnet) have been found to affect vocal hygiene and the ability to produce clear voicing (Martin, 1988; Chen, Chiang, Chung, Hsiao, Hsiao, 2010) due to their dehydrating properties. Though recent studies (Chen et al., 2010; Roy et al., 2004; Miller, Verdolini, 1995) have

indicated that the use/consumption of cigarettes, caffeine and alcohol may have only small, relatively imperceptible effects on the voice, historically, these factors have been included as ones that have an effect on overall vocal hygiene.

The effects that smoking has on the voice and vocal hygiene are well documented (Lee et al. 1999, Gilbert et al. 1974) and can be a contributing individual factor among teachers that may increase the likelihood of voice issues including vocal fatigue in study participants. Seasonal allergies have also been documented to have a negative effect on the voice and can increase the amount of strain (and possibly fatigue) on the voice (Jackson-Menaldi, Dzul, Holland, 1999; Gotaas and Starr 1993).

Years of Experience

The number of years a teacher has been teaching may contribute to the likelihood that a teacher will experience voice problems. Roy et al. (2004) suggested that teachers with 16 or more years of experience were significantly more likely to experience voice problems. The number of years that a teacher has been teaching is generally correlated with their age (i.e. if an individual has been teaching for many years, they tend to be older than those who have been teachings for fewer years; Roy et al. 2004). For this reason, many researchers choose to gather information regarding only the number of years of teaching experience a teacher has.

Age

There are well-documented changes to the voice that occur as a result of aging known as presbylaryngis (Shindo and Hanson, 1990; Hagen, Lyons, and Nuss, 1996; Woo, Casper, Colton, and Brewer, 1992). However, general perceptual characteristics and descriptions of

presbylaryngis differ from those who suffer from vocal fatigue. Presbylaryngis is caused by factors related to age and the physical changes of the vocal folds associated with aging (Woo, Casper, Colton, and Brewer, 1992). As vocal folds age, they tend to "bow" and create increased amounts of airflow during speech resulting in a "breathy" voice quality (generally perceptual characteristics of vocal fatigue are not associated with breathiness but rather hoarseness (Kostyk and Putnam Rochet, 1998)). This bowing is visible upon laryngoscopic examination and is not associated with physiological characteristics of those who suffer from vocal fatigue (Gelfer, Andrews, and Schmidt, 1991; Stemple et al. 1995; Chang and Karnell, 2004; Hunter and Titze, 2009).

Understanding the Vocal Risks and Vocal Fatigue

The occupational, environmental, individual and specific teacher characteristics outlined above have been found to affect teachers and the likelihood that they will experience voice problems and report vocal fatigue. These factors were considered in this research.

Research has examined the underlying causes of vocal fatigue as it relates to the structures used to produce speech and voice. These studies examined acoustical analyses, self-reported feedback on surveys and questionnaires, and stroboscopic analysis of both healthy and vocally fatigued individuals (Gelfer et al. 1991; Stemple et al. 1995; Chang and Karnell 2004; Hunter and Titze 2009). However, these studies were unable to determine the exact underlying process behind the cause and onset of vocal fatigue. Regardless of the reason for the increased occurrence of voice problems among teachers, vocal fatigue has been observed as a common description among most of the affected individuals and may be used as an indicator of potential

future voice problems. Due to the lack of a generally accepted definition of vocal fatigue, recruiting characteristics of vocally fatigued individuals varies widely in current research.

Vocal fatigue has been described in many different ways by researchers in this field. It has been defined as both a diagnosis and a symptom (Welham et al 2003). McCabe and Titze (2002) defined vocal fatigue as an increase in phonatory effort accompanied by a progressive decrease in phonatory capabilities. Some of the reported characteristics associated with vocal fatigue include hoarse vocal quality, loss of voice, pitch breaks, reduced pitch range, lack of vocal carrying power, reduced loudness, pain upon swallowing, unsteady voice, running out of breath, and/or discomfort in the head, neck, chest, ears or throat (Kostyk and Putnam Rochet, 1998). Similar to the effects of vocal fatigue after a full day of teaching, Hunter and Titze (2009) used vocal loading tasks (extended periods of voice use) to induce the effects of short-term vocal fatigue. They found that there were likely two mechanisms contributing to fatigue: a short-term fatigue, which recovered in a matter of hours, and a long-term fatigue, which took a few days to resolve. This research supported conclusions made by Gotaas and Starr (1993), who defined vocal fatigue as vocal issues that begin as a speaking day progresses and usually reverses with vocal rest. Oftentimes, teachers in full-time teaching positions have only the weekend and evenings in order to rest their voices. This, however, may not be enough time to fully overcome the effects of long-term vocal fatigue symptoms as many teachers participate in vocally demanding after school and weekend activities (Gotaas and Starr, 1993).

Therefore, because of its complexity, it is difficult to identify those teachers at-risk for experiencing vocal fatigue and who are thus at risk for experiencing voice problems. Further,

without a clear definition, it is also difficult to recruit a reliable group of participants with vocal fatigue for research purposes.

In order to address the lack of an operational definition of vocal fatigue, Dr. Chayadevie Nanjundeswaran created the Vocal Fatigue Index (VFI; see Appendix II, questions 1-19) as part of her doctoral dissertation at the University of Pittsburgh (Nanjundeswaran, 2015). This index aims to reliably identify those suffering from vocal fatigue. The Vocal Fatigue Index is a nineteen-question scale used to quantify the amount of vocal fatigue suffered by a given individual and discriminate between those with voice problems (dysphonia) and those without.

Research Questions

Using an online survey (which included the Vocal Fatigue Index and 41 other questions applicable to teachers), this research aimed to answer the following questions: (1) To what extent do teachers experience vocal fatigue, as quantified by the Vocal Fatigue Index? and (2) At which grade levels are teachers most at risk for vocal fatigue and, thus, long-term voice problems as quantified by the Vocal Fatigue Index?

First, it was anticipated that the Vocal Fatigue Index would adequately discriminate between vocally fatigued teachers and vocally healthy teachers. Second, it was hypothesized that teachers of lower grade levels (Kindergarten through 3rd grade) would be the most at risk for voice problems, including vocal fatigue, due to the requirements of the teaching styles and the increased amount of daily voice use. For example, much of the learning in lower elementary grade levels is teacher directed. In contrast with lower elementary grade levels, children in higher elementary, middle and high school grade levels are often expected to have more

independent learning opportunities. Thus, teachers of these higher grade levels demand less of their voices, simply because they use them less daily (with the exception of chemistry teachers as mentioned above).

METHODS AND RESEARCH PLAN

Human Subjects

Participants

Paper copies of the survey were distributed and completed in both Tennessee and Utah by colleagues in those areas. This distribution method was chosen after several attempts to acquire responses using online teacher forums, Facebook, and individual school district research organizations failed to provide substantial numbers of responses. These methods (forums, Facebook, and research organizations) did not yield large amounts of responses despite the high number of members belonging to these different forums, groups, and organizations.

Surveys/questionnaires were also sent to teachers throughout the United States via email. Over 50,000 teachers from kindergarten, elementary, and high schools were contacted using email addresses that were obtained from individual school websites. Within the email, a link to the survey was provided and teachers were encouraged to complete the survey as fully as possible.

Recruitment and Respondents

The Vocal Fatigue Index was originally tested using roughly 200 responses from participants who were already suffering from symptoms of vocal fatigue. For this reason, it was assumed that more than 200 responses were necessary to reliably test the sensitivity of the VFI to grade level differences. As of 2011 the total number of elementary, middle, and high school teachers in the US was just over three million (Digest of Education Statistics, 2011). Assuming a margin of error of between two and three percent and a confidence interval of 95 percent, the

ideal number of respondents needed for the survey was between approximately 1000 and 2300. Additionally, at least forty teacher responses from each grade was desired.

Toward the goal of 1000 responses, several different methods were employed to obtain the most responses possible. Initial telephone or email contact was made with school administrators (principals and superintendents) of various schools throughout Michigan, Utah, Tennessee, Alabama, Florida, Georgia, New Hampshire, South Carolina, and other states. Each administrator was asked if they were interested in the research being conducted and if they felt they had time to administer the survey to the teachers in their buildings, schools, and/or districts. If the administrators consented, the survey was distributed among the teachers in their respective school buildings, schools, and/or districts. These administrators' contact information was obtained using publicly available information on schools' websites. More teachers were contacted through various collaborators of Dr. Eric Hunter at educational institutions in Alabama, Michigan, Tennessee, and Utah (Drs. Chris Gaskill at the University of Monevallo at Alabama, Chaya Nanjundeswaren at East Tennessee State University, and Lynn Maxfield at the University of Utah). Most teachers were contacted via email with a letter containing information about the research being conducted and a link to the Qualtrics survey.

Next, teachers who had responded to the survey were asked to forward the provided link to the survey to other kindergarten through twelfth grade teachers in their respective areas who would be interested in and have time to take the survey. This allowed for more access to more teachers and potentially more responses to the survey. The specific number of responses to the survey received as a result of a teacher forwarded email is not known. However, at least twenty

responses were received in this way as the researcher received confirmation from participants that they were forwarded the survey from a work colleague.

Various listserv databases associated with teacher/education organizations were used to distribute this survey and obtain grade-level specific information. Listserv databases from ASHA.org, ASHA's Special Interest Group #3 (for those interested in voice and voice disorders) ED.gov, and various other locations were used to distribute the survey. Other similar resources were used to aid in obtaining the target number of participants for this study. Several teachers belonging to large Facebook groups were contacted and asked to respond to the survey. These groups included "Teachers A-Z," "Teachers Pay Teachers," and "Michigan Teachers." Several teachers participated through links provided within these groups.

Finally, and with the most success, in order to obtain sufficient responses for this survey, personal email addresses of teachers at various schools and universities throughout the United States were obtained from publically available school databases and websites. An email containing a link to the survey was then sent to these teachers via their publicly available email addresses. Roughly 50,000 emails were sent in this manner. The email containing the survey also invited teachers, once they had responded, to forward the survey to other teachers they thought might be interested. This again allowed for an extended reach to other teaching professionals we would not otherwise have contact with.

Demographic information regarding ethnicity and race was gathered to allow for comparison against census data of school teachers to check diversity of responses. Additionally, this information may allow for a better understanding of any relationships and correlations between the demographics and the survey responses.

ANALYSIS

In order to understand the analysis that was run on this cross-sectional study of vocal fatigue in teachers, the variables of interest must first be understood in terms of each research question that was asked. To reiterate, there were two main research questions. Responses to the VFI were analyzed in response to the first question: "*To what extent do teachers experience vocal fatigue, as quantified by the Vocal Fatigue Index?*"

The second research question, "*At which grade levels are teachers most at risk for vocal fatigue and, thus, long-term voice problems as quantified by the Vocal Fatigue Index?*", was addressed by using "R Project for Statistical Computing" software (R Core Team, 2014) and lme4 (Bates, Maechler & Bolker, 2012). These tools were used to run a linear mixed effects model (multilevel model) fit by maximum likelihood. The dependent variable in this question was the sum of the ordinal VFI responses. The fixed factors included: the primary teaching grade (five levels: kindergarten – 3rd grade, 4-5th grade, 6-8th grade 9-10th grade and 11-12th grade); years of experience (five levels: 0-5 years, 6-10 years, 11-15 years, 16-20 years, 21 or more years); classroom size in terms of capacity (four levels: small (5-10 students), medium (16-35 students), large (35+ students), very large (outdoors, gymnasium, cafeteria, auditorium, etc.); frequency of activities relating to poor vocal hygiene (five levels: never, almost never, sometimes, almost always, always); frequency of experienced colds, sinus infections, and laryngitis (possible responses: *1-2 times per year, 1-2 times per 6 months,1-2 times per month, 1-2 times per week, 1 time per day*); and gender (two levels: men, women). The random factors controlled for in this study comprised subject location (derived using coordinates provided by Qualtrics survey software). It will be tested if and where interactions are required using Chi-

square likelihood ratio tests. Groupings for each factor were made in the manner they were due to minimum grouping requirements needed to perform Chi-square tests. It was attempted to create groups in which there were at least five responses in each group.

The independent variable in the same question above was the teaching grade level of the subjects who respond to the survey. These teaching grade levels were grouped in the same way (five groups) as those mentioned above. The average amount of vocal fatigue was compared among grade levels using responses to the Vocal Fatigue Index and various relationships were examined. The questions involved in this area of analysis were the nineteen VFI questions (see Appendix II).

For the fixed factor of grade level, the survey question that was included in the analysis was the following:

- *What is your PRIMARY teaching grade?*

It was important for this research question that all nineteen questions related to the VFI were answered. As this section of the survey was be analyzed using a single summed vector method of analysis (Nanjundeswaran, 2015), if all of the questions of the VFI were not answered (254 participants), the given subject was not included for analysis.

It was anticipated that there would be several factors that would have an influence on the results of the Vocal Fatigue Index. The first of these fixed factors was vocal hygiene. The questions on the survey that were used to analyze the effect of vocal hygiene are listed below.

- *Do you commonly experience symptoms of reflux or heartburn?*
- *Do you commonly experience symptoms of respiratory allergies?*

- *How often would you say that you experience the following: colds, sinus infections, and laryngitis?*
- *In the last year, how often would you say that you smoked?*
- *How many caffeinated beverages do you consume per day?*
- *How many alcoholic beverages do you consume per week?*

The next fixed factor that was examined for its possible effect on individuals' responses to the Vocal Fatigue Index were those related to general characteristics of teachers' classrooms. The survey question that was included in this analysis was:

- *What does your PRIMARY classroom look like? Choose the closest description of your PRIMARY classroom.*

A teacher's age and the number of years teaching were implicated as potential factors that may have an effect on vocal fatigue experienced by teachers (Roy et al. 2004). It was found that teachers who had been teaching for sixteen years or more had experienced more voice problems than those who had been teaching for fewer than sixteen years. It was anticipated that the majority of teachers who had been teaching for more than sixteen years were older than those who had fewer years of experience. For that reason these fixed factors were combined into the following survey question:

For how many years have you been teaching?

Responses to questions regarding teachers' use of voice amplification systems was analyzed to determine the effect such use may have on responses to the Vocal Fatigue Index. The survey question that was included in this section of the analysis was:

- *How often do you use the vocal amplification system?*

Finally, the fixed factor of gender was included in the statistical model to determine its effect on the teachers' responses to the VFI. The following survey question was used for this section of the analysis:

- *Are you male or female?*

After statistical consulting, R and lme4 (Bates, Maechler & Bolker, 2012) were used to run a linear mixed effects model (multilevel model) fit by maximum likelihood. The fixed effects included in the linear mixed effects model were: primary teaching grade; primary classroom size; gender; a summed score of the frequency of experienced colds, sinus infections, and laryngitis; a summed vocal hygiene score (frequency of smoking, allergies, alcohol consumption, caffeine intake, and reflux); age; knowledge of amplification availability (*Do you have access to an amplification system at your school?; responses: yes, no, I don't know*); hours per day spent in non-occupation voice use (*0,1,2,3…8+ hours*); and frequency of extracurricular out of school activities (*1 time per year, 1 time per 6 months, 1 or 2 times per month, 1 or 2 times per week, 1 time per day*). Interactions were not included in this model because with them the models' output would be too complex to interpret. As a random factor we included the location of the subject (zip code) so that the scope of inference could include teachers across the United States. These statistical analyses were run only on those surveyed who had responded to all 19 VFI questions and those that had indicated their primary teaching grade.

MATERIALS

A 60-question survey was constructed through Qualtrics survey software. Questions were formed from the topic areas discussed in the previous section. A copy of the current letter to administrators and teachers, as well as a copy of the current survey distributed, can be found in Appendix I and II respectively. The length of the survey was controlled so as to promote the highest possible percentage of participation, with the goal of 9-10 minutes to complete. Using Qualtrics survey software, it was found that teachers took an average of 12.5 minutes to complete this survey.

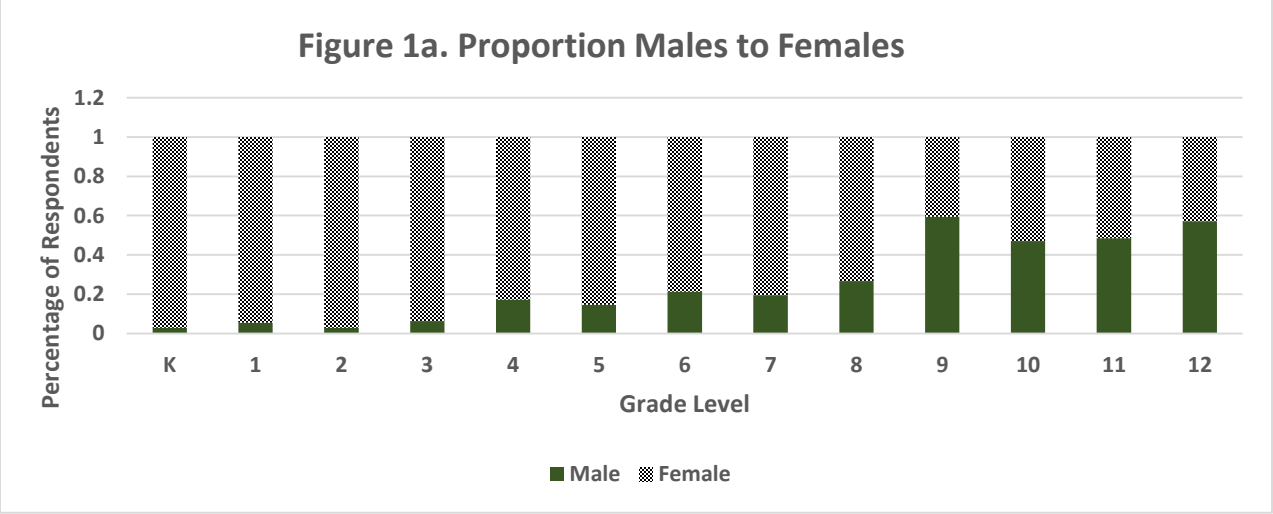
Invitations to participate in the survey were sent via email and also distributed in schools using a paper copy of the survey. This current version of the survey was determined exempt by the MSU IRB (copy of the IRB documents can be found in Appendix III). Some descriptive statistics data was collected using the same Qualtrics survey software and then analyzed primarily offline. Information regarding gender, age, and school district, as well as subject and grade level taught by each teacher was gathered to determine the generalizability of the information received.

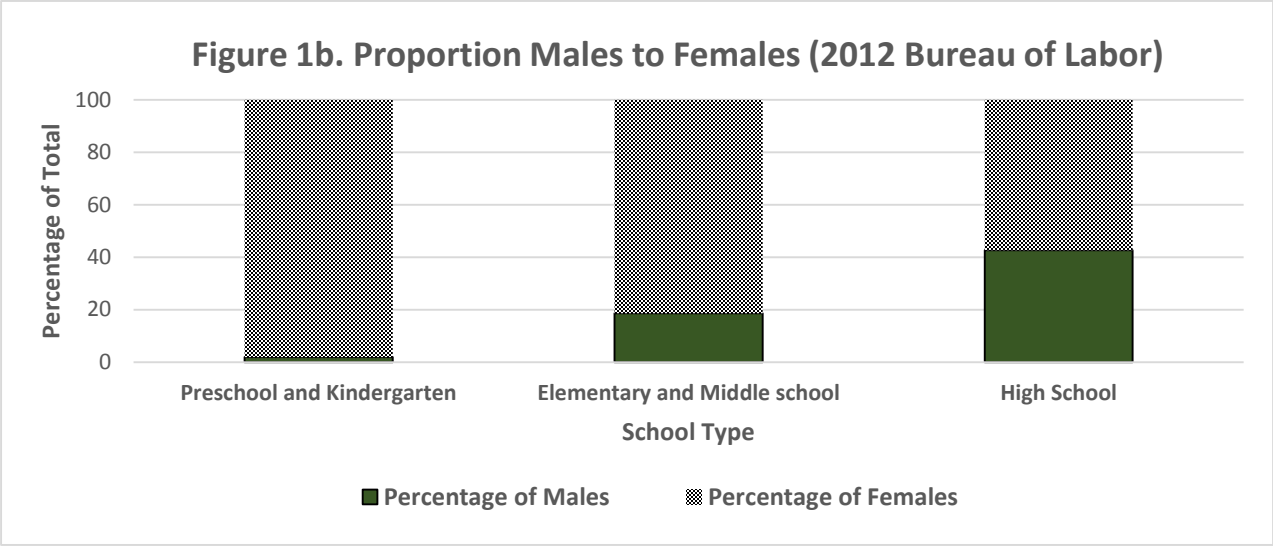
Preliminary data analysis was reported within the Qualtrics survey software. Measures of the mean, variance, standard deviation, minimum, and maximum were provided by the software used for creating the survey. Once an adequate number of surveys had been completed and returned, a statistical consult was performed in order to gain a better understanding of the statistics that could be carried out with data received from the survey.

RESULTS

Of the more than 1000 teachers that began the survey given to them, 748 teachers responded to enough of the survey that they were able to be included in analysis (answered nineteen VFI questions and provided their primary teaching grade). Respondents were not required to provide their gender. However, it was found that of those who did provide gender information, there were 141 males and 572 females (19.8% male teachers). The average age of teachers who responded to this survey was 42 years. These teachers reported an average of 11-15 years of teaching experience.

The proportion of male to female teachers was examined in relation to grade level. It was found that the distribution of males and females per grade who responded to the survey (Figure 1a.) was very similar to that of the 2012 Bureau of Labor Statistics data (Bureau of Labor Statistics, U.S. Department of Labor; Figure 1b.).

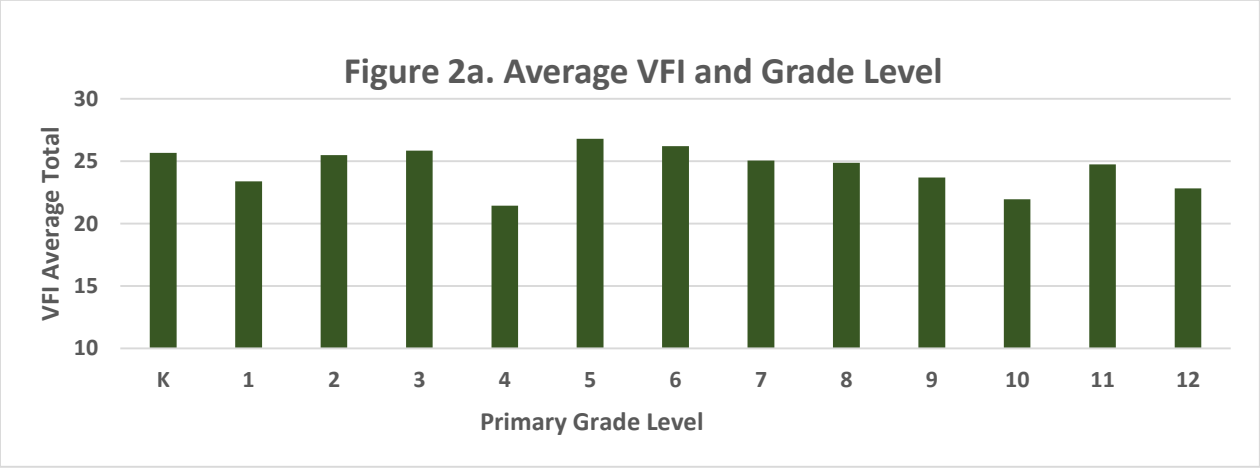


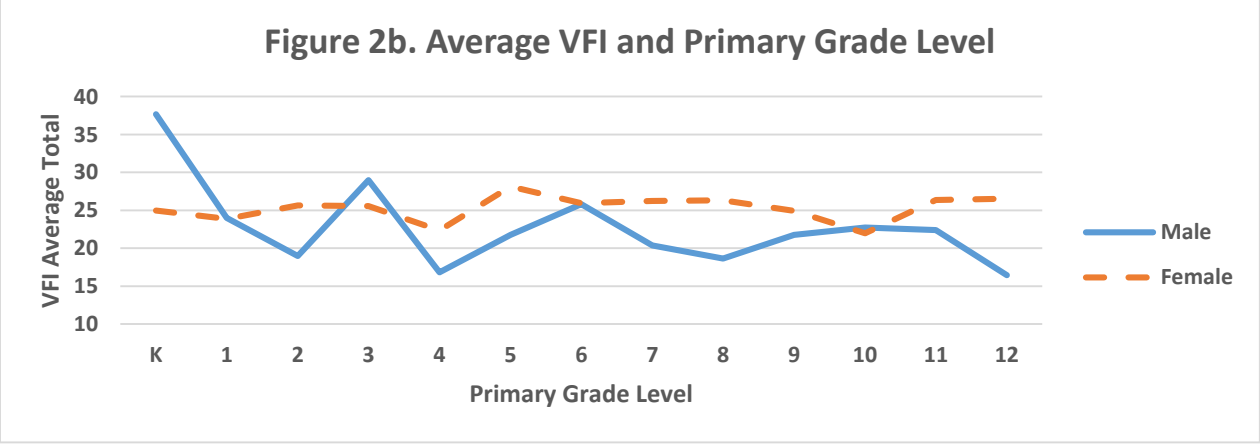


Primary Teaching Grade

In response to the question originally addressed in this research, "*At which grade levels are teachers most at risk for vocal fatigue and, thus, long-term voice problems as quantified by the Vocal Fatigue Index*" VFI total scores were averaged for teachers of specific grade levels. After receiving 748 survey responses to this question, the results indicated that there was no reliable effect of teaching grade on vocal fatigue. A Chi-squared Test showed that primary grade did not have an effect on reported VFI levels (X-squared = 9.55, df=8, p=0.29) thus the variables are assumed to be independent. This and all other factors (including VFI average totals) were grouped in a way that provided appropriate counts for Chi-squared tests to be run reliably (at least 5 counts in each grouping). In this way, only a small number of independence measures were run with fewer than the desired counts. The groups with small counts tended to be those measures on the extreme ends of reported values where few responses fell (age-group 55-80; colds, sinus infections, laryngitis- group 7 with the highest summed total of experienced illness). The different groupings (if required) for each factor examined can be seen in tables 1-11.

When VFI totals were averaged combining male and female responses and plotted on a line graph by primary grade, visible differences between certain grades and the average VFI scores were evident (see Figure 2a). For example, teachers of grades 4 and 10 showed the lowest average amounts of vocal fatigue while those of grades 5, 6 and kindergarten reported the highest. When males and females are considered separately, different patterns among primary grade levels emerge (see Figure 2b.) For example, male teachers of kindergarten and 3rd grade reported the highest amount of vocal fatigue. Male teachers of 4th and 12th grades experienced the lowest totals of vocal fatigue. Female teachers remained fairly consistent across grade levels with vocal fatigue peaking among 5th grade teachers.





Though no reliable effect of primary teaching grade on the measured amount of vocal fatigue in teachers was found, the VFI may still be considered a reliable and useful tool for identifying those who are experiencing symptoms of vocal fatigue. Table 1 below details the descriptive statistics related to female and male teachers of each grade level (only one 2nd grade male teacher responded, hence NA is reported for Std. Dev.).

Table 1. Descriptive statistics for grad level and gender.

		Females			**Males**		
Primary Grade	**Number of Responses**	**Mean VFI (N)**	**Median**	**Std. Dev.**	**Mean VFI (N)**	**Median**	**Std. Dev.**
K	83	24.97 (78)	25.5	12.36	37.67 (5)	38	3.51
1	45	24 (37)	33	21	24 (8)	33	21
2	45	25.60 (44)	26	12.23	19 (1)	19	NA
3	53	25.57 (49)	25	12.64	29 (4)	30	11.74
4	44	21.91 (36)	21	11.21	16.2 (8)	11	14.88
5	55	28.51 (46)	29	15.55	18.28 (9)	23	8.80
6	59	25.76 (48)	29	12.39	28.22 (11)	28	13.24
7	58	26.26 (42)	25	13.52	20.36 (16)	12	14.37
8	81	24.97 (62)	27	12.78	18.64 (19)	19	11.46
9	65	24.94 (39)	25	9.66	21.76 (26)	22.5	10.50
10	58	21.97 (34)	20	10.46	22.72 (24)	21.5	14.61
11	54	26.38 (34)	28.5	13.31	22.39 (20)	18	15.37
12	48	26.53 (28)	28	13.13	16.44 (20)	16.5	7.99

After examining the effect of several factors on reported average totals of experienced vocal fatigue using a linear mixed model fit by maximum likelihood, there were several factors that emerged as having a reliable effect. A Bonferroni Correction was applied to these results. The new alpha or p-value for results of this study was .008 (derived from .05/6 (the number of factors included in the final linear mixed model)). The results of this linear mixed model are outlined in Table 2. The effect of these factors on the measured outcome of the Vocal Fatigue Index is being examined in this model. Using teacher location or school zip code as a random factor, it was found that only 3.4% of total variance was attributable to the subjects' location. This calculation was derived from the variance of the location or zip codes of respondents over the total variance of the sample.

Table 2. Results of linear mixed (multilevel) model with VFI as dependent variable. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Estimate	**Std.**	**Error**	**df**	**t**	**value**	Pr(>|t|)
(Intercept)	16.47168	3.24884	518.10000	5.07	5.55E-07	***
primarygrade	-0.11451	0.13752	610.00000	-0.833	0.405355	
primaryroom2	4.60670	1.68051	606.80000	2.741	0.006301	**
primaryroom3	7.64871	2.00203	610.00000	3.82	0.000147	***
primaryroom4	10.09864	3.22199	609.50000	3.134	0.001805	**
genderM	-4.01671	1.28942	606.60000	-3.115	0.001925	**
colds_sinus_lary	2.59199	0.38352	608.90000	6.758	3.27E-11	***
hygiene	0.51514	0.14541	562.90000	3.543	0.000429	***
age	-0.09232	0.03976	608.60000	-2.322	0.020576	*
ampl2	-2.04719	1.03094	485.40000	-1.986	0.047623	*
ampl3	-0.47084	2.67278	606.60000	-0.176	0.860227	
hoursperday_nonoccup	-0.42191	0.2486	606.40000	-1.697	0.090187	.
extracurr_outofschool2	2.70377	1.45621	594.50000	1.857	0.063846	.
extracurr_outofschool3	0.71285	1.33255	603.30000	0.535	0.592880	
extracurr_outofschool4	2.64559	1.35259	603.90000	1.956	0.050932	.
extracurr_outofschool5	-0.51372	2.11735	607.80000	-0.243	0.808377	

The factors implicated in this model as being predictors of vocal fatigue ratings in teachers have been reviewed in depth below.

It was anticipated that several factors would influence the reported average results of teachers on the Vocal Fatigue Index. Not all factors had an effect on teachers' vocal fatigue. The

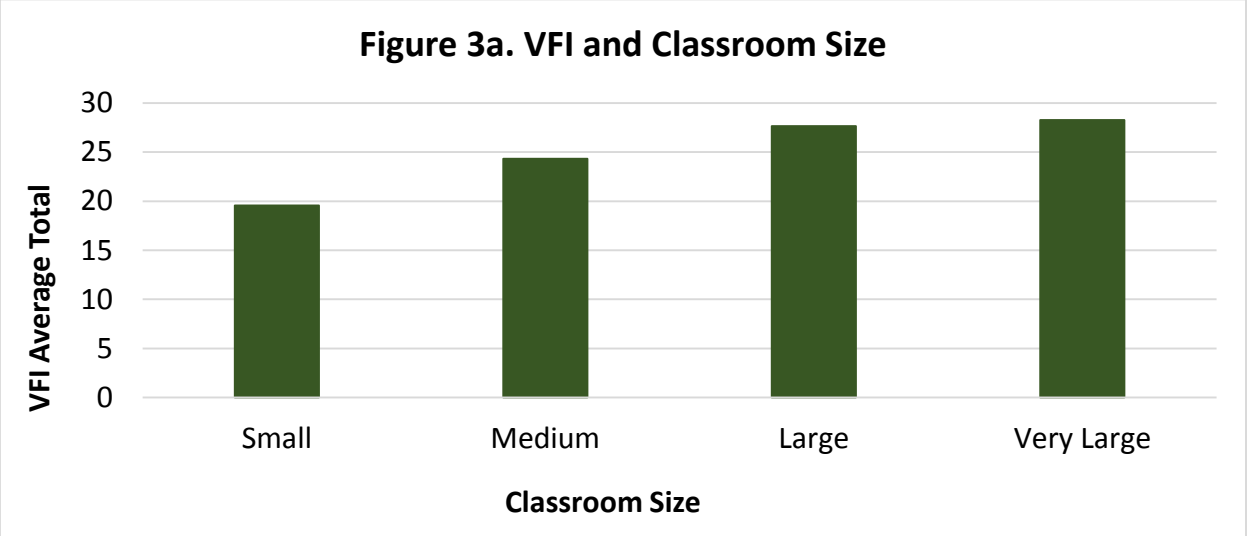
factors that were analyzed for their effect on vocal fatigue reports were the following: 1) primary classroom size; 2) gender; 3) frequency of colds, sinus infections and laryngitis; 4) a summed score of the frequency of reflux, allergies, smoking, and caffeine and alcohol consumption (referred to in this study as "Vocal Hygiene"; 5) years of teaching experience; 6) amplification use; 7) extracurricular out of school activities; 8) and hours per day of non-occupational voice use. Each factor explanation contains a table of descriptive statistics including means, medians and standard deviations.

Primary Classroom Size

The first fixed factor that was examined for its possible effect on teachers' responses to the Vocal Fatigue Index were those related to general characteristics of teachers' classrooms. Teachers were asked questions regarding classroom size as it compared to the normal classroom size of their school building. Possible responses to this question included: *My classroom is… much smaller, smaller, about the same, larger, much larger… than my schools average sized classroom.* A reliable effect ($p < .0083$) of primary classroom size on vocal fatigue was shown when responses to this question were analyzed. Significance was found when VFI total of teachers teaching in larger capacity classrooms were compared to VFI totals of teachers in the smallest capacity classrooms. The plot in Figure 3a shows that, generally, the larger the classroom size compared to the average classroom size in the building, the higher the average teacher reported vocal fatigue. As with many of the other effects that will be discussed in this section, this effect of classroom size (both in comparison to the normal classroom size and in terms of capacity) is seen more readily in females than in males (Figure 3b).

A Chi-squared Test showed that the hypothesis of independence between total VFI and primary room size was not supported (X-squared = 27.2, df=8, p<0.0083). This can be visualized in Figure 3a. as a relationship is seen when, as teachers' reported class sizes increase, their reported total VFI increases as well.

A similar visual trend was seen when teachers were asked about the size of their primary classroom in terms of capacity, though this trend was not significant. This trend is more perceptible when the responses are further separated into specific gender scores on the VFI in classrooms of increasing sizes (Figure 3b.). In this figure, with the exception of males in the largest capacity classrooms, the larger the classroom capacity, the higher the amount of reported vocal fatigue. Again with these responses, it was found that those teachers who taught in larger capacity classrooms reported higher average total vocal fatigue than those of smaller capacity classrooms.



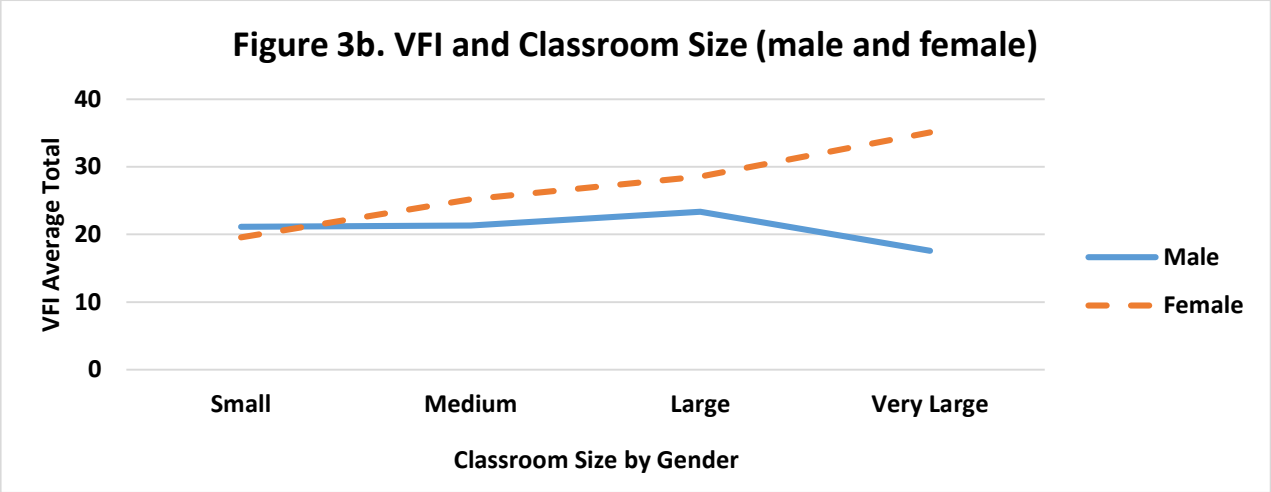


Table 3. Effect of Classroom Size

		Means (VFI)		Medians (VFI)		Standard Dev. (VFI)	
Primary Room Size (capacity)	**Number of Responses**	**Female (N)**	**Male (N)**	**Female**	**Male**	**Female**	**Male**
Small	71	18.16 (62)	18.62 (9)	16.5	19.5	10.4	16.4
Medium	493	24.8 (396)	20.95 (97)	25	19	12.45	13.03
Large	126	28.44 (98)	23.5 (28)	30	20	13.08	13.25
Very Large	18	35.09 (11)	17.57 (7)	33	22	12.89	9.81

Gender

The second fixed factor that was analyzed for its effect on teachers' reported vocal fatigue was that of gender. Several studies have indicated that gender may play a role in the increased amount of vocal fatigue experienced by females than males (Titze, 1989; Ward, Thibeault, and Gray, 2002; Roy et al., 2004; Hunter, Tanner and Smith, 2011). According to the results of this study, gender affected VFI total ($X2\ (1)=16.8$, $p<0.001$). A Chi-squared test for

independence revealed the hypothesis of independence between reported VFI scores and participants' gender was not supported (X-squared = 17.16, df=4, p<0.0083). The VFI total estimate for males was 4 units lower than the estimate for females. Female teachers averaged a score of 25.39 on the VFI where males averaged a score of 21.52 (Figure 4a.). Though both scores are considered "high" and relatively vocally fatigued, these results are consistent with those previously mentioned.

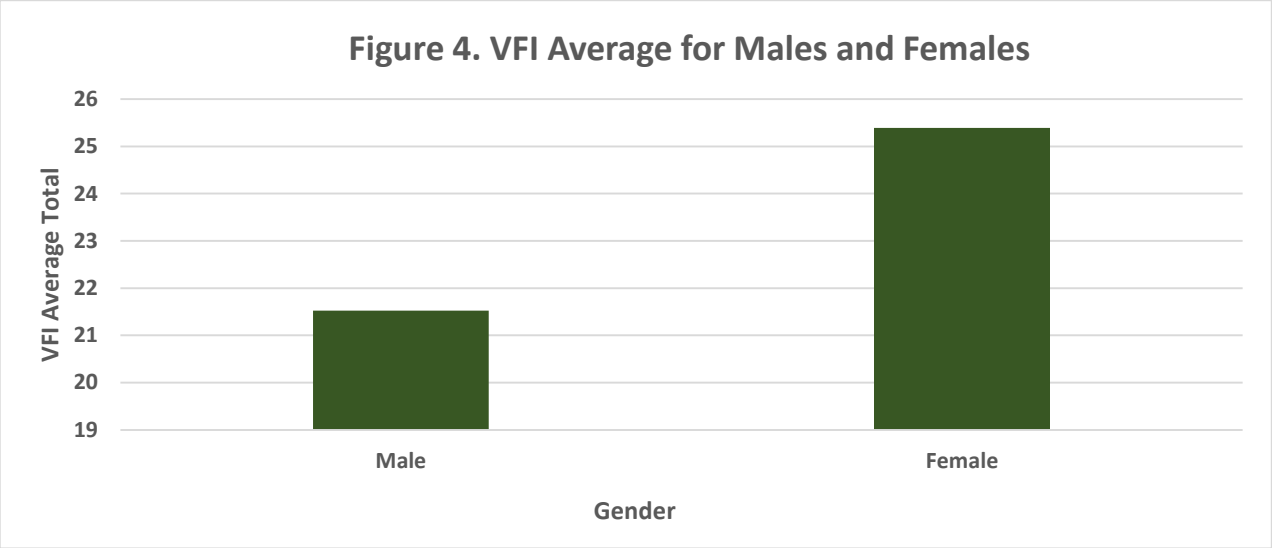


Table 4. Effect of Gender

	Means (VFI)		Medians (VFI)		Standard Dev. (VFI)	
Gender	**Female (N)**	**Male (N)**	**Female**	**Male**	**Female**	**Male**
Female	24.97 (572)	NA	25	NA	12.74	NA
Male	NA	21.06 (141)	NA	19	NA	13.07

Colds, Sinus Infections, Laryngitis

Next a summed score of the frequency of experienced colds, sinus infections and laryngitis was examined for its potential effect on the amount of vocal fatigue experienced by teachers.

Three questions on the survey with responses similar to those of the This total score was difficult to garner due to the way the output data was produced and the difficult manner required to respond to this question. Together, these difficulties led to several “dropouts” or missing data with this question specifically. It was also found that many teachers simply don’t experience frequent sinus infections or laryngitis. Despite difficulties in data collection for this question, responses were determined to have a reliable effect on vocal fatigue. Generally, those teachers who reported a higher summed colds, sinus, laryngitis score (corresponding to more frequent episodes of colds, sinus infections, and laryngitis) also reported increased VFI scores. The experience of colds, sinus infections and laryngitis affected teachers VFI totals ($X2(1)=44$, $p<0.0001$), increasing it by 2.6 units. As the frequency of colds, sinus infections, and laryngitis increased, teachers reported VFI totals increased. The hypothesis of independence between total reported VFI scores and the summed score of frequency of colds, sinus infections and laryngitis was not supported (X-squared = 69.19, df=8, $p<0.001$).

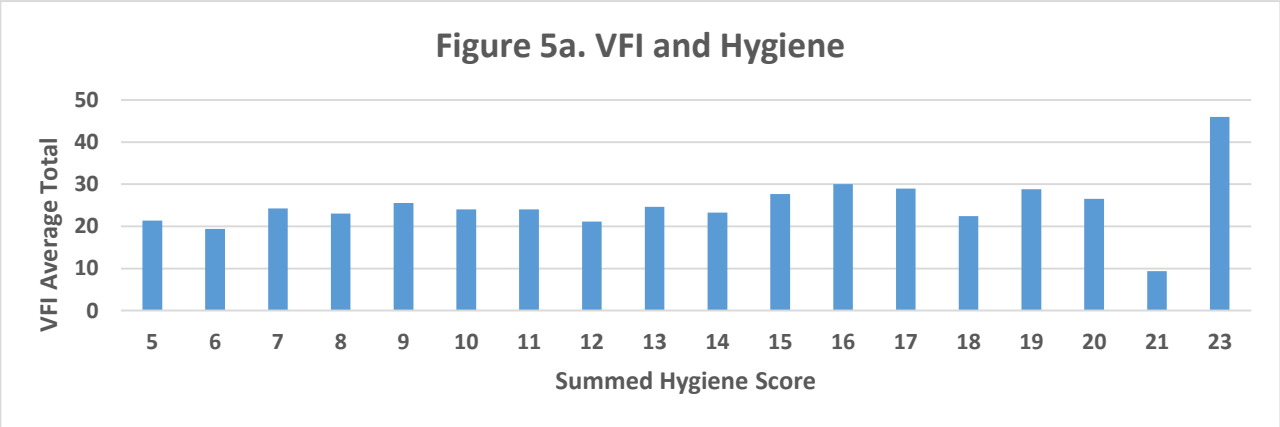
Table 5. Effect of colds, sinus and related.

	Means (VFI)		Medians (VFI)		Standard Dev. (VFI)	
Summed Frequency of Colds, Sinus and Laryngitis	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
0	20.92	18.11	19.5	18	11.99	11.59
1	24.03	19.48	24	17	11.96	12.34
2	27.19	39	30.5	39	13.85	11.87
3	30.34	28.44	31.5	28	12.98	12.89
4	37.55	20.75	38	16	12.87	14.00
5	33	30.5	30.5	30.5	11.86	10.6
6	30.85	45	30	45	8.571	4.24
7	46	NA	46	NA	16.97	NA

Vocal Hygiene

Included in this factor were questions about the frequency with which teachers reported symptoms of reflux or heartburn, and allergies. Also included in the analysis of the effect of the factor of hygiene was the frequency of smoking, caffeine and alcohol intake. This factor did not have a reliable effect on the amount of vocal fatigue experienced by respondents on the survey. A Spearman's rank correlation test indicated that the reported factors of teachers' experience of colds, sinus infections and laryngitis and their total vocal hygiene scores were only weakly correlated ($rho=0.08$, $p<0.05$). This means that there is only little evidence that questions regarding vocal hygiene and teachers' experience of colds, sinus infections and laryngitis are related. It can be said that as teachers experienced higher vocal hygiene totals,

summed scores of colds, sinus infections, and laryngitis in teachers also tended to increase. Teachers who reported an increased vocal hygiene score (more frequent experience or consumption of the factors mentioned above) did not necessarily report higher amounts of vocal fatigue (Figure 5a.). When these measures are separated by gender, abrupt peaks and valleys are evident (Figure 5b.). This is most likely due to the scarce number of participants who responded with very elevated vocal hygiene scores. Vocal hygiene affected VFI totals ($X^2(1)=47.8$, $p<0.0001$), increasing it by .5 units. As the total vocal hygiene increased, the total VFI increased. A Chi-squared test for independence revealed that when VFI scores were categorized into groups (0-14, 15-24, 25-34, 35-44, 45-65) there was some evidence that it was not independent from hygiene ($X\text{-squared} = 20.2$, $df=8$, $p<0.01$).



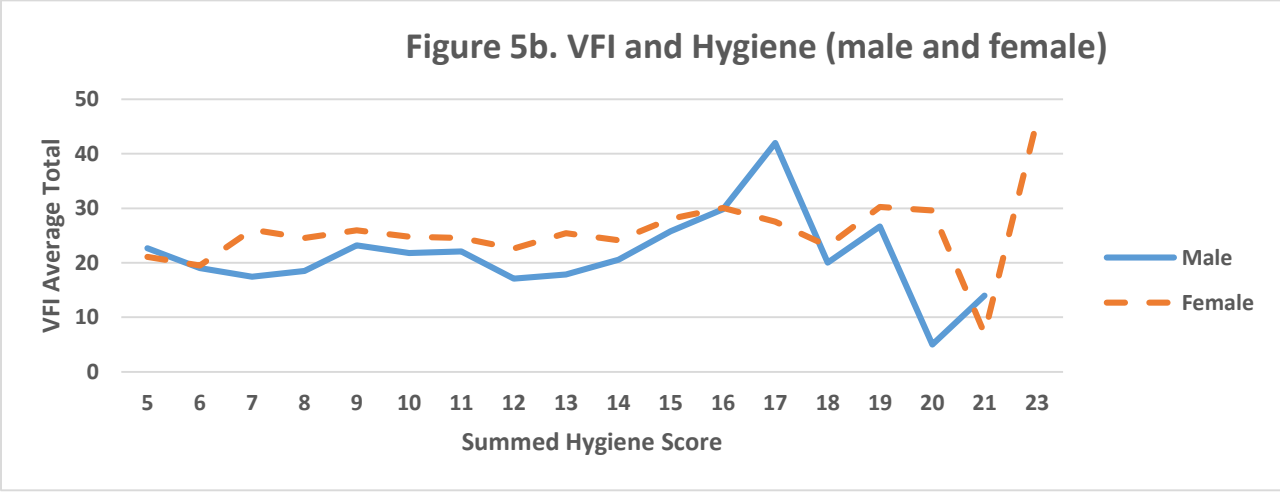


Table 6. Vocal fatigue and vocal hygiene questions.

		Means (VFI)		Medians (VFI)		Standard Dev. (VFI)	
Summed Vocal Hygiene	**Number of Responses**	**Female (N)**	**Male (N)**	**Female**	**Male**	**Female**	**Male**
0-10	146	23.45 (116)	18.67 (30)	24	19	13.02	11.36
10-15	357	24.63 (281)	19.21 (74)	24	17	12.85	11.95
15-25	212	27.70 (174)	26.46 (37)	28.5	23.5	11.93	15.23

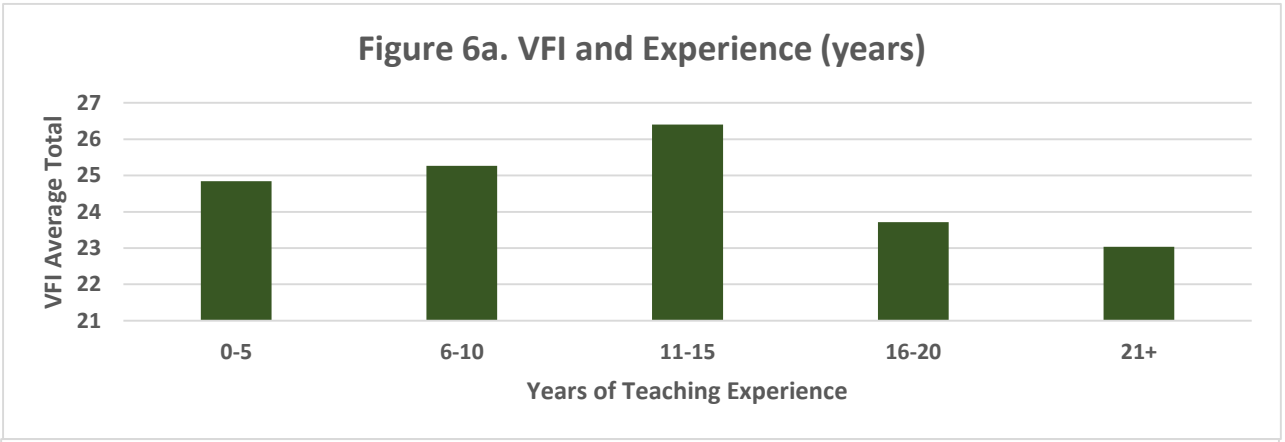
Experience and Age

As previously mentioned, teachers' age and increased number of years that a teacher has been teaching was implicated as a potential factor that may have an effect on vocal fatigue (Roy et al. 2004). It was found that those who had been teaching for sixteen years or more had experienced more voice problems than those who had been teaching for fewer than sixteen years. It was anticipated that the majority of teachers who had been teaching for more than sixteen years were older than those who had fewer years of experience. Additionally, a Spearman's rank correlation test indicated that the reported factors of teachers' experience and age were highly correlated ($rho=0.75$, $p<0.05$). For this reason, this study examined only the effect of years of experience on vocal fatigue instead of including teachers' age in the analysis.

A significant effect of years of teaching experience on the amount of vocal fatigue reported by teachers was reported. A Chi-squared test indicated there was moderate evidence that total reported VFI scores were not independent from the number of years of teaching experience for

respondents of the survey (X-squared = 27.87, df=16, p<0.001). It was teachers with between 11-15 years of experience who indicated the highest levels of vocal fatigue at an average total of nearly 26.5 (Figure 6a.).

Responses to this question showed no reliable effect on the severity of vocal fatigue experienced by teachers. In fact, contrary to previous research, teachers who reported more teaching experience (16+) recorded a lower average total amount of vocal fatigue than did those with less teaching experience (<16). Though not statistically significant, future research may be able to find generational explanations for this difference. Again, a notable difference is seen when gender is examined separately in this factor (Figure 6b).



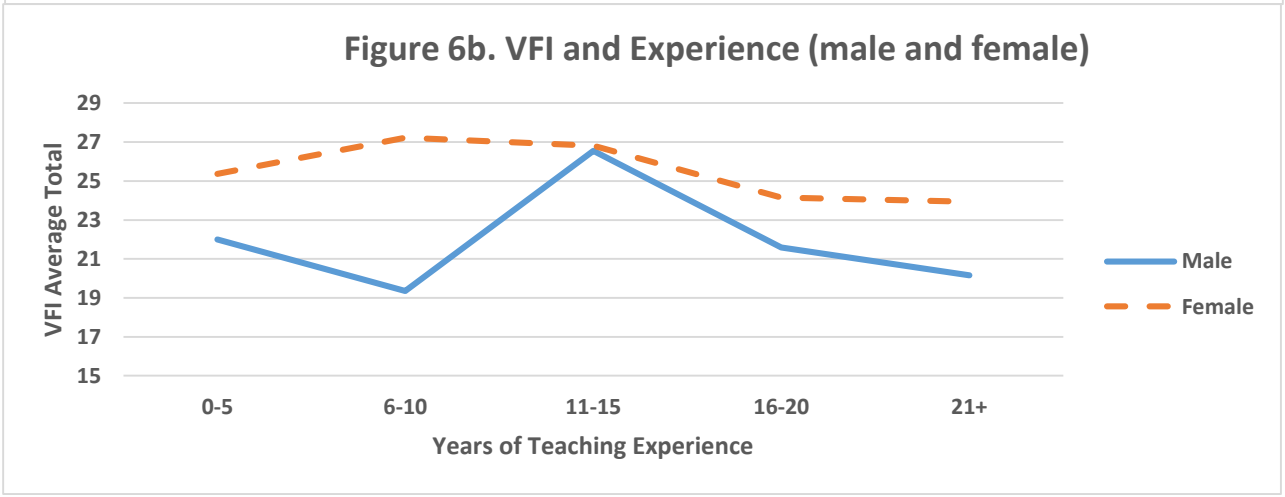


Table 7. Vocal fatigue and reported years of experience.

		Means (VFI)		Medians (VFI)		Standard Dev. (VFI)	
Years of Experience	**Number of Responses**	**Female (N)**	**Male (N)**	**Female**	**Male**	**Female**	**Male**
0-5	171	24.39 (143)	20.95 (28)	23.5	18.5	10.83	13.48
6-10	119	27.11 (93)	17.09 (26)	29.5	20	14.03	12.45
11-15	120	26.82 (100)	27.10 (20)	27.5	27	14.36	10.20
16-20	106	23.39 (82)	21.30 (24)	23	19	12.42	13.77
21+	196	23.78 (153)	20.3 (43)	24	17	12.37	13.58

Age (though highly correlated with experience; rho=0.75, $p<0.05$) was run to measure its effect on VFI total ($X2\ (1)=166.3$, $p<0.0001$). Age did however, have an effect on VFI total and thus was included in the linear mixed (multilevel) model. A Chi-squared test, however, indicated that there was no dependence of teachers reported VFI scores and age. This was seen when age of teachers increased a single unit, VFI total scores tended to decrease by 0.09 (Tables 1&8). This relationship is not what would be expected given previous research. Explanations for this trend may include the total amount of hours worked by teachers in older age groups. As teachers age, they may begin to work less as they are approaching retirement. Thus, they use their voices less and are able to avoid symptoms of vocal fatigue. The trend may also be explained by adaptation effects. As teachers age and grow accustomed to their teaching style and teaching environments, they become more able to handle the vocal load of teaching and are able to avoid effects of vocal fatigue.

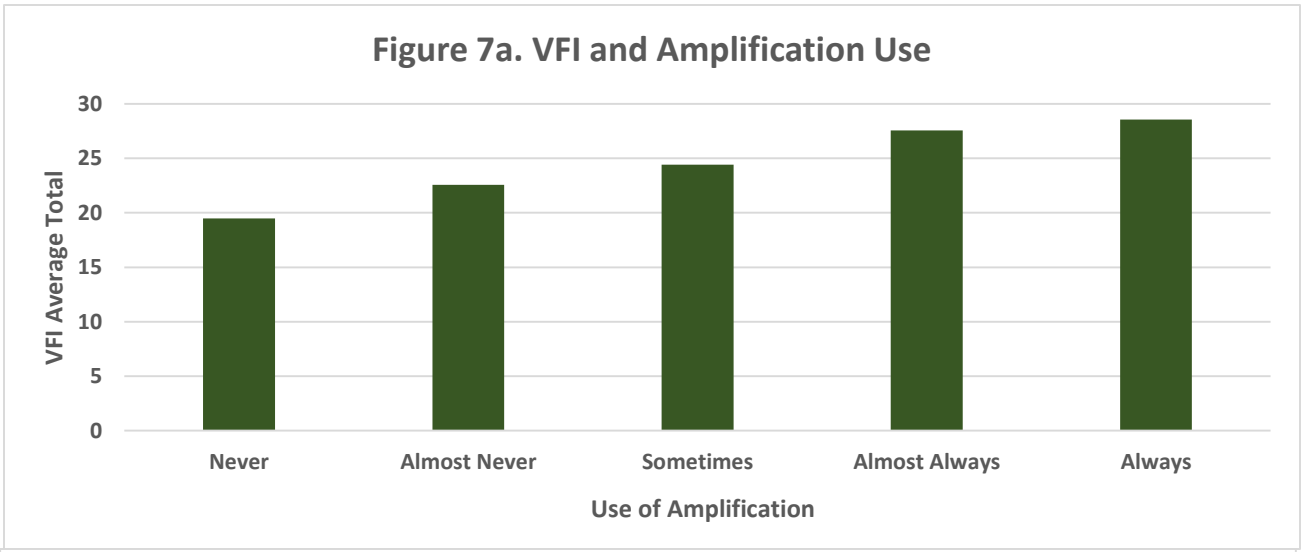
Table 8. Vocal fatigue and reported age (grouped).

		Means (VFI)		Medians (VFI)		Standard Dev. (VFI)	
Grouped Ages	**Number of Responses**	**Female (N)**	**Male (N)**	**Female**	**Male**	**Female**	**Male**
20-35	198	26.03 (167)	22.53 (31)	26	21.5	12.11	12.67
35-45	145	26.34 (107)	18.73 (38)	27	18	14.02	10.98
45-55	190	24.90 (190)	22.18 (36)	26	21	12.81	13.70
55-80	148	22.83 (148)	20.6 (34)	23	17	11.90	14.01

Amplification

Responses to questions regarding teachers' use of voice amplification systems were analyzed to determine the effect such use may have on responses to the Vocal Fatigue Index. It was determined that voice amplification use did have an effect on teachers reported VFI totals. The graph in Figure 7a. shows a steady increase in vocal fatigue as the frequency of teachers reported voice amplification increased. As voice amplification use frequency increases, teachers' reported amounts of vocal fatigue increase as well. As in previous data regarding gender differences for these factors affecting teachers vocal fatigue, Figure 7b. displays a notable upward trend in vocal fatigue in both males and females (more so in females) as the frequency of voice amplification increases. This trend may be due to the increased use of voice amplification among those teachers who have already damaged their voices. More than 50 teachers provided written feedback both within the survey and in electronic correspondence with the researcher indicating use of voice amplification after a period of voice misuse or long-term damage to the voice. Thus it may be possible that teachers are using voice amplification a

method to rehabilitate their voices rather than to protect their vocal structures from damage. Amplification affected teachers reported VFI total outcomes ($X^2(2)=4$, $p=0.137$). The difference between teachers that indicated that they did have access to an amplification system and those that did not was significant at $p<0.05$ (Table 1). Those teachers that did not have access to amplification systems were generally associated with a VFI score that was 2 units lower than that of teachers that did have access to amplification (Table 9).



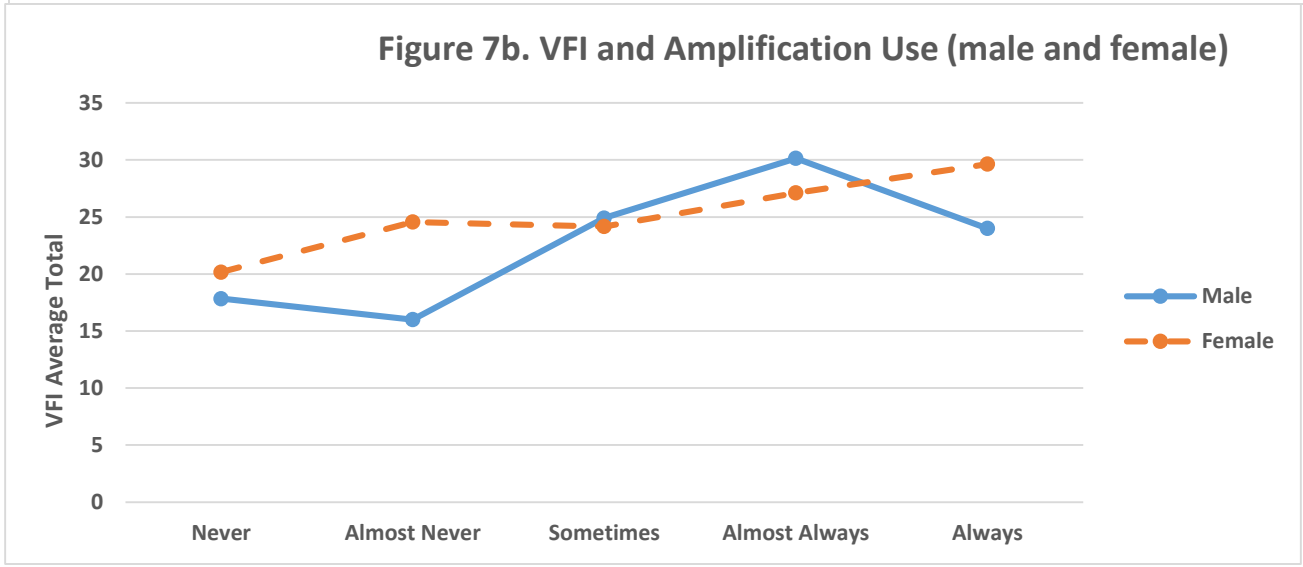
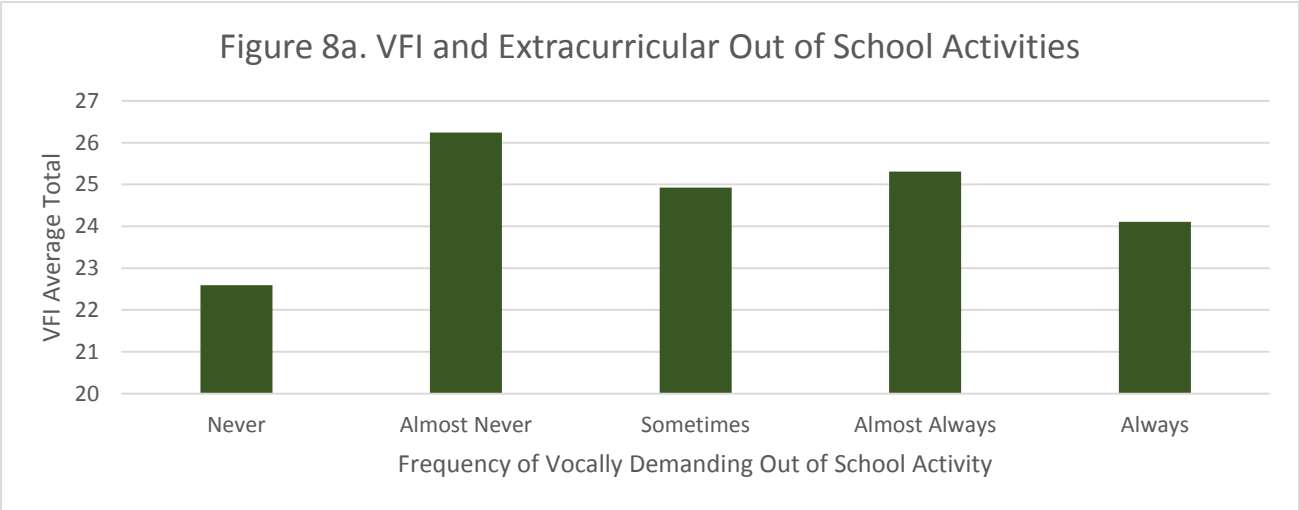


Table 9. Vocal fatigue and voice amplification access

		Means (VFI)		Medians (VFI)		Standard Dev. (VFI)	
Access to Amplification	**Number of Responses**	**Female (N)**	**Male (N)**	**Female**	**Male**	**Female**	**Male**
Yes	294	25.76 (228)	20.92 (66)	27	19	13.36	13.73
No	394	24.47 (325)	21.1 (69)	24	19	12.43	12.91
I don't know	25	24.05 (19)	21.83 (6)	25	19	9.89	10.38

Extracurricular Outside of School Activities

Teachers were asked about vocally demanding activities such as coaching, cheering, singing in choirs or clubs, or advising that they might take part in outside of school and on weekends. Responses of "Almost Never" and "Almost Always" had a reliable effect when compared with those who responded "Never" to this question. The reported frequency of extracurricular out of school activities affected VFI total ($X2 (4)=14.9$, $p<0.005$). As the frequency of teachers' participation in extracurricular out of school activities increased, VFI totals tended to increase as well. However, the other responses for this question did not show the same effect.



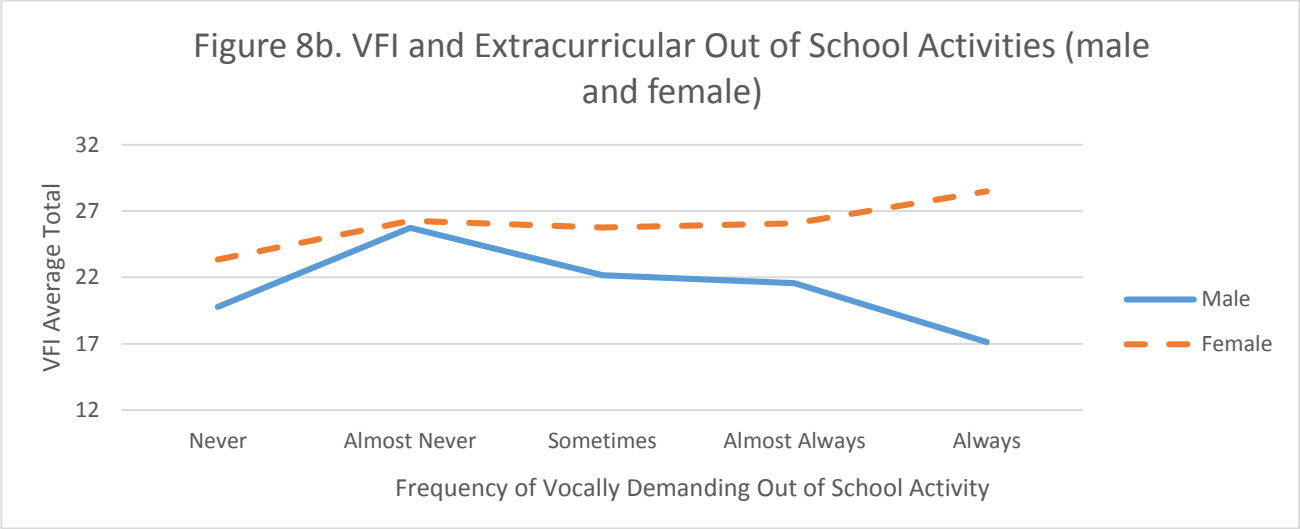


Table 10. Vocal Fatigue and Frequency of Extracurricular out of School Activities involving voice use.

		Means (VFI)		Medians (VFI)		Standard Dev. (VFI)	
Frequency	**Number of Responses**	**Female (N)**	**Male (N)**	**Female**	**Male**	**Female**	**Male**
Never	209	23.11 (172)	19.12 (37)	24	15	11.90	14.61
Almost Never	127	25.4 (99)	25.58 (28)	24	21.5	12.41	13.31
Sometimes	175	25.34 (144)	21 (31)	28	19	12.17	11.64
Almost Always	155	25.91 (127)	22.08 (28)	26	20.5	13.85	12.09
Always	45	28.14 (28)	17.11 (17)	30	12	15.33	12.37

Hours per Day of Non-Occupational Voice Use

An effect of the number of hours teachers spend per day engaging in non-occupational voice use was examined. As the linear mixed model used indicated this factor as one that would improve the models overall reliability it was included. However, there was no effect of the number of hours per day a teacher spent in non-occupational voice use on VFI total outcomes ($p=0.18$).

Table 11. Hours per day spent in non-occupational voice use.

		Means (VFI)		Medians (VFI)		Standard Dev. (VFI)	
Hours/Day	**Number of Responses**	**Female (N)**	**Male (N)**	**Female**	**Male**	**Female**	**Male**
1	77	24.3 (60)	24.29 (17)	22.5	22	13.99	14.39
2	156	26.63 (123)	21.42 (33)	27	22	11.61	12.51
3	175	24.68 (136)	22.09 (39)	25	18	12.53	13.98
4	119	23.73 (95	20.15 (19)	25	19	12.88	13.04
5	72	25.35 (58)	21 (10)	25	24	12.94	12.12
6	50	26.15 (36)	21.1 (11)	26.5	18.5	11.88	12.45
7	24	24.68 (19)	16 (5)	25	16	13.72	13.28
8	50	23.58 (43)	11.67 (7)	24	11	14.63	10.32

DISCUSSION

Several factors were found to have a measurable effect on the amount of focal fatigue reported by teachers. Though the grade taught by teachers in this study did not have an effect on the amount of vocal fatigue quantified by the VFI, several other factors did. Possible explanations for these effects are reviewed below.

Primary Classroom Size

Teachers who participated in this study reported an increased VFI score when speaking in a larger than normal classroom (compared to the building average) and in classrooms with large capacities. This is consistent with previous research and may provide a link between vocal fatigue and vocal effort measures. As previous research (Nadalin et al., 2011) has found that teachers of larger sized classrooms experience higher amounts of vocal effort and higher likelihood of voice problems, this research may help to educate teachers on the potential vocal hazards of speaking for extended periods of time in a large classroom (especially one with poor acoustic properties). The decrease in vocal fatigue experienced by males in larger classrooms may be due in part to the small number of responses from males teaching in large classrooms (Figure 2a. and table 3). The lack of equivalent numbers of male participants to female participants may be responsible for variability observed in results for this factor.

Gender

Hunter and Titze (2011) speculate that higher vocal fatigue reports in women may be caused by the larger proportion of female teachers in schools to male teachers. In Figure 1a. an

increase in the ratio of male to female teachers as grade level increases can be observed. However, generally female teachers outnumber males in all grade levels. Hunter and Titze proposed that male teachers in schools do not have to increase their vocal intensity as much as females in order to be heard or get the attention of a noisy classroom. This they contend may be due to the already increased differences between a relatively low pitched male teachers' voice as compared to the high pitch "babble" of children speaking in class. This difference in pitch may make a male teachers' voice more audible and distinguishable from other voices and background noise in a classroom. As female teachers generally speak in a pitch more closely resembling that of the children's voices in the class they teach, especially those that teach in younger grade level classrooms, they may need to increase their vocal intensity in order to be heard in a noisy classroom environment. This phenomenon may be a factor that can contribute to overall vocal fatigue experienced by teachers, especially females. It may also explain the generally elevated amounts of vocal fatigue experienced by teachers of 6th grade and younger as compared to those teachers of 7th grade and older. The research by Hunter and Titze (2011) also argues that gender differences in the experience of vocal fatigue and other voice problems may be due to the anatomical differences between males and females (discussed above in the introduction to this research, pg. 4).

Vocal Hygiene and Colds, Sinus infections, and Laryngitis

Though teachers were not asked questions about their pharmaceutical consumption in this research, it may have affected the responses gathered for questions comprising the vocal hygiene score and those of the colds, sinus infections, and laryngitis summed score as well. As

individuals (not just teachers) become ill with allergies, reflux, colds, sinus infections, and laryngitis, generally they take medications to make them well or decrease the symptoms of these ailments. Those who experience these symptoms and illnesses more frequently may ingest greater amounts of medications and thus may be more prone to the dehydrating effects of these pharmaceuticals (Martin, 1988; Chen, Chiang, Chung, Hsiao, Hsiao, 2010). As any population becomes more dehydrated, they may become more prone to voice problems and vocal fatigue (perhaps especially those with vocally demanding professions).

Contrary to studies conducted in recent years (Chen et al., 2010; Roy et al., 2004; Miller, Verdolini, 1995) results from this study show that the use/consumption of cigarettes, caffeine and alcohol may have a measurable effect on the amount of vocal fatigue an individual will experience. These substances are considered dehydrating agents and may have an effect on the structures of voice production leaving them dry and prone to damage.

Experience and Age

As expected, age did have an effect on teachers' experienced amount of vocal fatigue. However, the effect was not what previous research had indicated it might be. Rather than the expected increase of reported vocal fatigue in more experienced and older teachers, the teachers surveyed in this study instead reported a decrease in the amount of vocal fatigue they experienced (Figure 5a.) as they age.

One reason for the results visualized in Figure 6b. is that as teachers' age and gain more experience, many of them may be decreasing the number of hours they are working and moving into more part-time or coverage rolls within schools. These more experienced teachers

may also be learning habits to avoid vocal fatigue and thus other voice problems. Teaching styles and pedagogy may change as well after 15 years of experience. Teachers with more experience may learn to explain subjects with fewer words (less speaking throughout the day) thus preserving their voices and avoiding vocal fatigue. These teachers may also lean more heavily toward small group instruction rather than large, entire class lectures.

Another reason older, more experienced teachers (both male and female) may experience less vocal fatigue is that in general, their children are becoming adults and are requiring less "parenting" and are perhaps spending less time at home. The average age that women are beginning to have children in the United States has risen over the last 30 years and is currently in the mid-twenties. Assuming that children are out of the home more as they get older, mothers and fathers may be speaking less in general as they age simply because they are parenting less and instructing less outside of school. The increased amount of reported vocal fatigue in teachers in the first fifteen years of teaching experience may also be due to the stress of raising children. Less sleep and constant work schedules may have an effect on these teachers' reported vocal fatigue.

Amplification

It was found in this research that teachers who knew they had access to voice amplification systems had significantly higher reports of vocal fatigue. This research also indicates that as the frequency of voice amplification use increased, teachers' reported amount of vocal fatigue also increased. Possible explanations for these results may include that rather than using voice amplification for the purpose of avoiding damage to the voice, teachers are instead using voice amplification in order to rehabilitate their voices after injury or to compensate for a voice that may not be functioning properly (loss of voice, reduced

projection/intensity, etc.). This may explain the reason for increased reports of vocal fatigue in teachers that use amplification systems frequently. It may also be that those who frequently use voice amplification have become dependent on the assistance of the amplification system, whether they are rehabilitating their voices after injury or not. For this reason, they may find that not using voice amplification may be more fatiguing and/or difficult. These teachers may become fatigued more easily than those who do not frequently use voice amplification.

Limitations

During the course of this research, several limitations were noted. As discussed above, this survey was written in American English only. For this reason, several teachers throughout the United States who are not native speakers of English may have had a difficult time completing this survey or may have chosen not to complete it.

Several obstacles presented themselves throughout the course of this research. Garnering sufficient and appropriate responses to the survey, collaborating with other institutions (both local and national), ensuring authentic teacher responses, accounting for cultural differences, and maintaining low dropout rates were all difficult hurdles encountered when completing a survey of this length and depth. Additionally, the number of respondents needed to be garnered in a short period of time was very large, even in spite of the connections used and large pools of possible respondents.

Due to the fact that most surveys were distributed by school administrators or to emails obtained directly from school web sites and listserv databases, the authenticity of teachers' responses, it is believed, should remain intact. As the surveys were administered directly to

teachers (and by teachers to other teachers), it can be assumed that all of the surveys collected were in fact the responses of teachers only. Cultural differences and native languages spoken were not accounted for in this survey and may have led to dropouts or fewer completed surveys. There were 254 attempted surveys that were not completed, though it is not believed that all dropouts were caused by language barriers. However, as this survey was issued in American English, those who were not native speakers of this language may have found it difficult to complete. Several teachers contacted the researcher indicating that they did not teach students in kindergarten to twelfth grade (ie. college professors) and thus dropped out prior to completing the survey.

Many different measures were put in place to control for incomplete or faked responses. Survey responses that were completed in a few seconds time were strong indications of faked responses. A question (#30) was placed within the survey that instructed participants to choose the last answer of the list of options. Those responses of teachers who did not correctly answer this specific question were looked at carefully to determine their authenticity. All surveys completed using Qualtrics software provide IP addresses and general coordinates as to where each survey was completed. Fraudulent survey responses were also identified using information provided as each participant was asked the zip code of the school they teach in. Those surveys received from outside the specific area where the survey was sent were examined more closely for validity and authenticity. This data and these responses outside the zip codes of interest (especially outside the United States) may be used in future analysis.

The main method of distribution for this survey was through teacher emails obtained online. Through the count of returned emails, it was found that over 300 teachers were not

accepting emails from non-work related sources or had incorrect contact information available on their school website. Many school teachers simply had no email address available online. It is also not known how many teachers did not see the email asking for their participation in this research due to the email being filed as "Spam" or a similar title. This is believed to be the main explanation for the relatively few responses received in comparison to the many emails sent. The researcher attempted to overcome this limitation by having school supervisors (principals and superintendents) distribute surveys within their buildings, schools, and districts, as described above. However, this method proved to take much more time and was even less efficient than simply contacting teachers directly.

Another limitation to this research was that due to the nature and content of the survey, some teachers assumed that only those with diagnosed or suspected voice problems were desired as participants in this study. This may have had an effect on the reported averages of vocal fatigue of teachers in this research. Though it was explained in the email that was sent to them that all teachers (no matter their passed or current vocal health) were desired as participants in this research, many teachers did not read or understand this language within the email.

The number of male respondents was low in this study. According to the Bureau of Labor Statistics cited above, roughly 22.3% of teachers in the United States from kindergarten to 12th grade are male. This research had a 19.8% rate of male teacher responses. A more comparable number of male responses to that of the national average might have had an effect on teachers' reported vocal fatigue.

Perhaps the most important limitation of this research was the tool used to measure vocal fatigue in teachers. The Vocal Fatigue Index was validated on a limited number of subjects (200) and was only able to discriminate between those with dysphonia (problems with the tone, clarity, or intensity control of the voice) and those without dysphonia. Possible responses on the VFI are *never, almost never, sometimes, almost always,* and *always*. Though it is called an "index," the Vocal Fatigue Index does not provide a true rank order in responses. In other words, a teacher may respond to a question on the Vocal Fatigue Index indicating that they "sometimes" experience pain when speaking, when they experience pain in this way on a monthly basis. Another teacher may also indicate that they experience pain when speaking "sometimes", however, they experience pain on a weekly basis when speaking. The reference for each of these responses is very different depending on the person completing the survey. Responses are extremely subjective in this way and it is very difficult to interpret the results of any completed response to the VFI.

CONCLUSION

Occupational, environmental, and specific individual teacher characteristics were considered in this research. Together these factors, according to previous research, may have an effect on the vocal fatigue experienced by those who require the use of their voices in order to complete the day to day tasks of their jobs. Kindergarten through twelfth grade school teachers were the subjects of this research. Teachers in the United States were surveyed using an online survey system in order to gain an understanding of vocal fatigue they experienced.

Consistent with previous research (Roy et al., 2004), the school teacher population was found to be at high risk for experiencing vocal fatigue. In response to the first research question introduced in this paper, "*To what extent do teachers experience vocal fatigue, as quantified by the Vocal Fatigue Index?*" teachers surveyed reported an average VFI total of 24.3. This average score indicates a high amount of vocal fatigue as compared to non-occupational voice users and vocally healthy individuals. The Vocal Fatigue Index (VFI, Nanjundeswaran, 2015) was used to quantify the amount of vocal fatigue experienced by school teachers in the United States. It was anticipated that the Vocal Fatigue Index would adequately quantify the voice issues displayed in teachers exhibiting symptoms of vocal fatigue. According to the results of this study roughly 73 percent of teachers who responded to the administered survey indicated that they were currently experiencing symptoms of vocal fatigue. These findings are consistent with those of Dr. Nelson Roy and his colleagues (2004) that indicated that 58% of teachers reported having issues with proper voice use or sound at the time they were surveyed. Further, Roy reported that a higher percentage of teachers than non-teachers were experiencing voice disorders at the time they were surveyed. Females in this study reported experiencing a higher instance of

vocal fatigue than males (see Figure 4b.) This gender difference is consistent with Titze and Hunter's 2010 research.

Future research will undoubtedly examine teachers' voices in person by recording them and comparing acoustic measures to reported outcomes on the Vocal Fatigue Index. This could be done at several different locations throughout the United States. Comparisons for similarities and differences may be examined.

The limitations of this study may have had an effect on the reported vocal fatigue outcomes in teachers. The proportion of males to females that responded may have had an effect on the data received as well as the fact that the survey was largely distributed via teacher emails. The VFI measurement tool, though still considered a reliable one for this research, may also have had an effect on the outcomes of this research due simply to the possible responses for each question and the setup of the questionnaire (discussed above).

Future examinations of teachers may also look to keep grade structure the same throughout schools where the survey is completed. As mentioned previously, it is possible that teachers of grades that are considered a "transition" grade (kindergarten: children transition to school setting; 4^{th}-6^{th} grade: children transition from elementary school to middle school; 8^{th}-10^{th} grade: children transition from middle school to high school) may experience more vocal fatigue than those teachers of "non-transition" grades. This would be a simple difference to see if all teachers surveyed taught in schools of the same grade structure (ie. Kindergarten- 5^{th} grade: elementary school; 6^{th} through 8^{th} grade: middle school; 9^{th} through 12^{th} grade: high school.)

Research conducted in this survey form should also provide some incentive for participants to receive a gift card or monetary compensation for their participation in the research. This may prove to be a way to inspire more to respond to the survey.

Future research in this area will also examine the influence of teaching pedagogy on reported outcomes of vocal fatigue. Teaching style and manner may be difficult for some teachers to quantify, however, it may have an effect on the amount of speaking teachers do in the classroom. Teachers who address students in several small groups may be able to decrease the amount of speaking effort that they exert throughout the day and thus, may report lower amounts of vocal fatigue.

APPENDICES

APPENDIX I. Current Draft of Letter to Administrators and Teachers

Dear Educator,

I am inviting you to participate in a survey to help understand some of the vocal demands teachers like yourself experience within your profession. This survey will take between 10 and 15 minutes. To begin the survey, go to the bottom right-hand corner of the screen and click on the arrow. By clicking on the survey link below and proceeding, you consent to allow the use of the information you provide in this survey for the purposes of this study ONLY.

To introduce myself, my name is Russ Banks and I am a Master's Degree student studying Speech and Language Pathology at Michigan State University. For my thesis project, I have developed a survey which I am sending to teachers throughout the US.

My research is aimed at helping teachers who experience voice problems throughout their teaching careers. I anticipate that this survey will help to identify common practices in everyday life that may contribute to voice problems in teachers. By participating in this survey, you will help us collect data related to characteristics of physical classroom and teaching styles. This data will be used to gain a better understanding of the occurrence of voice problems in teachers and what can be done to minimize the risk of long term damage to the voice. Your participation in this survey will also help us identify which grade levels might be most affected by voice problems.

If you choose to participate, your responses will remain anonymous and no identifying information will be gathered. Participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. You have the right to say no. You may change your mind at any time and withdraw. You may choose not to answer specific questions or to stop participating at any time. Whether you choose to participate or not will have no effect on your relationship with your school district or Michigan State University.

My survey can be accessed through this link:
https://msuccas.co1.qualtrics.com/SE/?SID=SV_8jj1yKlB5XEDEgd or http://goo.gl/GmHgvf

I have chosen to use Qualtrics services for the survey.
If you have questions please feel free to contact me. My contact information can be found below.
Thank you in advance for your participation and your desire to help further our knowledge base!

Russell E. Banks

APPENDIX II. Current Survey

Face Page of Survey

Dear Educator,

You are being asked to participate in a research study to help understand some of the vocal demands on teachers. This survey will take between 10 and 15 minutes. We hope this research will help us better understand teachers who may experience voice problems at some point throughout their teaching careers. I anticipate that this survey will help to identify common practices in everyday life that may contribute to voice problems in teachers. By participating in this survey, you will help us collect data related to characteristics of physical classroom and teaching styles. This data will be used to gain a better understanding of the occurrence of voice problems in teachers and what can be done to minimize the risk of long term damage to the voice. Your participation in this survey will also help us identify which grade levels might be most affected by voice problems. If you have questions please feel free to contact me. My contact information can be found below.

Thank you in advance for your participation and your desire to help further our knowledge base!

Russell E. Banks
banksru1@msu.edu
Michigan State University
Master's Degree Program
Department of Communicative Sciences and Disorders

Consent to Participate in a Research Study

Purpose: You are being asked to participate in a research study to help understand some of the vocal demands on teachers. This survey will take between 10 and 15 minutes.

Your Rights: Participation in this research project is completely voluntary. You have the right to say no. You may change your mind at any time and withdraw. You may choose not to answer specific questions or to stop participating at any time. Whether you choose to participate or not will have no impact on your relationship with MSU or any formal evaluation related to your current teaching assignment. If you choose to participate, your responses will remain anonymous and no identifying information will be given to the research team. If you have any questions about this survey or participation, please contact:

Russell E. Banks
banksru1@msu.edu
Michigan State University
Master's Degree Program
Department of Communicative Sciences and Disorders

You indicate your voluntary agreement to participate by continuing to the next page and completing the survey.

Consent to Participate

By continuing to the next page and proceeding, you consent to allow the use of the information you provide in this survey for the purposes of this study ONLY.

If you choose to participate, your responses will remain anonymous and no identifying information will be gathered. Participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled. You have the right to say no. You may change your mind at any time and withdraw. You may choose not to answer specific questions or to stop participating at any time. Whether you choose to participate or not will have no effect on your relationship with your school district or Michigan State University.

Perceptions of My Voice

Instructions: For the following statements, please mark your response that best matches your perceptions of your voice and voice use.

1. I don't feel like talking after a period of voice use
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

2. My voice feels tired when I talk more
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

3. I experience increased sense of effort with talking
    - Never
    - Almost Never
    - Sometimes

- Almost Always
- Always

4. My voice gets hoarse with voice use
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

5. It feels like work to use my voice
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

6. I tend to generally limit my talking after a period of voice use
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

7. I avoid social situations when I know I have to talk more
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

8. I feel I cannot talk to my family after a work day
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

9. It is effortful to produce my voice after a period of voice use
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

10. I find it difficult to project my voice with voice use
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

11. My voice feels weak after a period of voice use
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

12. I experience pain in the neck at the end of the day with voice use
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

13. I experience throat pain at the end of the day with voice use
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

14. My voice feels sore when I talk more
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

15. My throat aches with voice use
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

16. I experience discomfort in my neck with voice use

- Never
- Almost Never
- Sometimes
- Almost Always
- Always

17. My voice feels better after I have rested
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

18. The effort to produce my voice increases with rest
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

19. The hoarseness of my voice gets worse with rest
    - Never
    - Almost Never
    - Sometimes
    - Almost Always
    - Always

--- please continue to the next page ---

Professional Teaching Environment

Instructions: Please answer the following questions about your professional life as a teacher.

20. What grade(s) do you currently teach? Check all grades that apply.
    - Kindergarten
    - 1
    - 2
    - 3
    - 4
    - 5

- 6
- 7
- 8
- 9
- 10
- 11
- 12

21. What is your PRIMARY teaching grade?
- Kindergarten
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12

22. Do you teach a core knowledge class? (math, English, history, or science)
- Yes
- No

23. What does your PRIMARY classroom look like? Choose the closest description of your PRIMARY classroom.
- Small Room: (i.e., office, special needs room, 5-10 student capacity)
- Medium Room: (i.e., general core classroom, art room, 16-35 capacity)
- Large Room: (i.e., shop, music or performance room, 35+ capacity)
- Very large Room: (i.e., gymnasium, cafeteria, auditorium, outdoors)

24. Compared to the average classroom in your building, what size is the PRIMARY classroom in which you teach?
- Much smaller size
- A little smaller size
- about the same size
- A little larger size
- Much larger size

25. What does your SECONDARY classroom look like? If not applicable, do not answer.
- Small Room: (i.e., office, special needs room, 5-10 student capacity)

- Medium Room: (i.e., general core classroom, art room, 16-35 capacity)
- Large Room: (i.e., shop, music or performance room, 35+ capacity)
- Very large Room: (i.e., gymnasium, cafeteria, auditorium, outdoors)

26. For how many years have you been teaching?
- 0-5
- 6-10
- 11-15
- 16-20
- 21 or more

27. How many hours per day do you use your voice for job related purposes?
- 1 hour
- 2 hours
- 3 hours
- 4 hours
- 5 hours
- 6 hours
- 7 hours
- 8 or more hours

28. How many hours per day on average do you use your voice for non-job related purposes?
- 1 hour
- 2 hours
- 3 hours
- 4 hours
- 5 hours
- 6 hours
- 7 hours
- 8 or more hours

29. Do you have a daily preparation time or hour (during the workday), a weekly preparation day or both?
- Daily preparation time
- Weekly preparation day
- Both
- Neither

30. Please select "Almost Always" as the answer for this question
    - Never (1 time per year)
    - Almost Never (1 time per 6 months)
    - Sometimes (1 or 2 times per month)
    - Almost Always (1 or 2 times per week)

- Always (1 time per day or more)

31. How often do you participate in vocally demanding school related extracurricular activities such as coaching, cheering at sports events, choir, club advising, etc.?
    - Never (1 time per year)
    - Almost Never (1 time per 6 months)
    - Sometimes (1 or 2 times per month)
    - Almost Always (1 or 2 times per week)
    - Always (1 time per day or more)

****If "Never" was selected for number 31, please skip to number 33.**

32. During the school year, how many hours per week do you participate in this (these) extracurricular activities?
- 0 hours (no extracurricular activities)
- 1
- 2
- 3
- 4
- 5 or more hours

33. How often do you participate in vocally demanding weekday or weekend activities outside of school such as coaching, cheering at sports events, choir, club advising, etc.?
    - Never (1 time per year)
    - Almost Never (1 time per 6 months)
    - Sometimes (1 or 2 times per month)
    - Almost Always (1 or 2 times per week)
    - Always (1 time per day or more)

34. For the activities in question 33, on average, how many hours per week do you participate in this (these) activities?
- 0 hours (no activities)
- 1
- 2
- 3
- 4
- 5 or more hours

--- please continue to the next page ---

Microphone Use in Teaching

Instructions: Please answer the following questions about your use of or access to voice amplification in your teaching.

35. Do you have access to a vocal amplification or sound system to help your students hear you in your classroom?

- Yes
- No
- I don't know

****If "No" was selected for number 35, please skip to question number 46.**

36. Which of the following best describes the system or how you use it? Check all that apply.

- The microphone is worn around the neck (necklace)
- Microphone is worn around the ear
- Microphone is mounted on the wall.
- Microphone is clipped to clothing
- Microphone is hand held
- The microphone is worn on the waist
- Other _____

37. How often do you use the vocal amplification system?

- Never (1 time per year)
- Almost Never (1 time per 6 months)
- Sometimes (1 or 2 times per month)
- Almost Always (1 or 2 times per week)
- Always (1 time per day or more)

****If "Never" was selected for number 37, please skip to question number 45.**

38. How would you rate your overall satisfaction with the amplification system?

- Very unsatisfied
- Somewhat unsatisfied
- Indifferent
- Somewhat satisfied
- Very satisfied

39. How would you rate the overall student satisfaction with the amplification system?

- Very unsatisfied
- Somewhat unsatisfied
- Indifferent
- Somewhat satisfied

- Very satisfied

40. Why do you use your microphone? Check all that apply.
- It helps students to hear me better
- It improves class behavior and focus
- I don't have to put in as much effort just to be heard in the classroom
- It improves my students' grades and learning
- I don't feel as tired at the end of the day
- Other _____

41. In what situations do you always wear your microphone? Check all that apply.
- Talking to the class as a whole (general information/administration)
- Instructing to the class as a whole
- Reading aloud to the class
- Discussing in small groups
- During free or unstructured time
- It depends on the student needs or specific class
- Other _____

42. What frustrations, if any, do you have with your microphone?

43. When you use your microphone, at what point does it become an annoyance (e.g. heavy, cause discomfort)?
- Never
- After one hour using it
- After a half day using it
- After using it all day

44. Has the use of the amplification system in the classroom affected the following? Check all that apply.
- Classroom or student behavior
- Instructions or teaching style
- General student attention
- Vocal endurance or vocal strength
- How loud you speak
- Reduced vocal discomfort
- The sound of your voice
- Other _____

45. What reasons contribute to you choosing not to use the amplification system? Check all that apply.

- Comfort
- Unfashionable
- Unreliable/broken
- Setup is time consuming
- Noise or feedback in the sound
- Sounds or feels unnatural
- Conflicts with my teaching style
- Distracting in class
- Students don't respond well
- Too expensive
- School does not support it
- None available
- Other _____

46. If you don't have access to a voice amplification system, how interested would you be in having access to a vocal amplification system?

- Very interested
- Somewhat interested
- Indifferent
- Somewhat disinterested
- Very disinterested

--- please continue to the next page ---

Other Questions Related to Voice

47. Do you commonly experience symptoms of reflux or heartburn?
    - Never (1 time per year)
    - Almost Never (1 time per 6 months)
    - Sometimes (1 or 2 times per month)
    - Almost Always (1 or 2 times per week)
    - Always (1 time per day or more)

48. Do you commonly experience symptoms of respiratory allergies?
    - Never (1 time per year)
    - Almost Never (1 time per 6 months)
    - Sometimes (1 or 2 times per month)
    - Almost Always (1 or 2 times per week)
    - Always (1 time per day or more)

49. How often would you say you experience the following:

	Never (1 or 2 times per year)	**Almost Never** (1 or 2 times per 6 months)	**Sometimes** (1 or 2 times per month)	**Almost Always** (1 or 2 times per week)	**Always** (1 time per day or more)
Colds?	•	•			
Sinus infections?	•	•			
Laryngitis?	•	•			

50. In the last year, how often would you say that you smoked?
- Never (1 or 2 times per year)
- Almost Never (1 or 2 times per 6 months)
- Sometimes (1 or 2 times per month)
- Almost Always (1 or 2 times per week)
- Always (1 time per day or more)

51. How often do you consume caffeinated beverages?
- Never (1 or 2 times per year)
- Almost Never (1 or 2 times per 6 months)
- Sometimes (1 or 2 times per month)
- Almost Always (1 or 2 times per week)
- Always (1 time per day or more)

52. How often do you consume alcoholic beverages?
- Never (1 or 2 times per year)
- Almost Never (1 or 2 times per 6 months)
- Sometimes (1 or 2 times per month)
- Almost Always (1 or 2 times per week)
- Always (1 time per day or more)

53. Please enter your school's Zip Code._____

54. Would you accept future email contact to follow up on responses?
- Yes
- No

55. If “Yes" on the above, please enter your preferred email._____

General Demographics

56. What is your ethnicity?
- Hispanic or Latino
- Not Hispanic or Latino
- Prefer not to answer

57. What is your race?
- American Indian/ Alaska Native
- Asian
- Native Hawaiian or Other Pacific Islander
- Black or African American
- White
- Prefer not to answer

58. What is your age in years? _____

59. Are you male or female?
- Male
- Female

60. If you have any additional information you would like to provide about the topics covered in this survey or would like to comment on the survey itself, please do so in the space provided below.

Thank you for your participation! Please click the Submit button to complete the survey. Please feel free to contact me with any questions or concerns. You can also visit our website to find out more about what we do in the Voice Biomechanics and Acoustics Laboratory on Michigan State University's campus. !

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