Behavioral Treatment of Voice Disorders in Teachers

Aaron Ziegler^a Amanda I. Gillespie^{a, b} Katherine Verdolini Abbott^{a, b}

^aDepartment of Communication Sciences and Disorders, University of Pittsburgh, and

^bDepartment of Otolaryngology, University of Pittsburgh Voice Center, Pittsburgh, Pa., USA

Key Words

Teachers · Voice disorders · Behavioral treatment

Abstract

Introduction: The purpose of this paper is to review the literature on the behavioral treatment of voice disorders in teachers. The focus is on phonogenic disorders, that is voice disorders thought to be caused by voice use. **Methods:** Review of the literature and commentary. **Results:** The review exposes distinct holes in the literature on the treatment of voice problems in teachers. However, emerging trends in treatment are noted. For example, most studies identified for review implemented a multiple-therapy approach in a group setting, in contrast to only a few studies that assessed a single-therapy approach with individual patients. Although the review reveals that the evidence around behavioral treatment of voice disorders in teachers is mixed, a growing body of data provides some indicators on how effectively rehabilitation of teachers with phonogenic voice problems might be approached. Specifically, voice amplification demonstrates promise as a beneficial type of indirect therapy and vocal function exercises as well as resonant voice therapy show possible benefits as direct therapies. Finally, only a few studies identified even remotely begin to meet guidelines of the Consolidated Standards of Reporting

Trials statement, a finding that emphasizes the need to increase the number of investigations that adhere to strict research standards. **Conclusions:** Although data on the treatment of voice problems in teachers are still limited in the literature, emerging trends are noted. The accumulation of sufficient studies will ultimately provide useful evidence about this societally important issue.

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Data from the past decade and more clearly identify teachers as the high-volume occupation with the greatest risk for a voice disorder. Specifically, data indicate that voice problems are more frequent among teachers than among those in any other common occupation (>2% of the population [1–3]; see also Mjaavatn [4] and Urrutikoetxea et al. [5] cited in Mattiske et al. [6]). More specifically, estimates from the USA have indicated that anywhere from about 11 to 38% of teachers experience a *current* voice problem [7–9]. Similar estimates are seen for teachers in other countries including China, Poland, Finland, The Netherlands, Norway, Spain, Portugal, Brazil, and Australia [10–19]. Roy et al. [7] further reported that the prevalence of having at least one occurrence of dysphonia during the life span was as high as 57.7% for teachers as compared to 28.8% for nonteach-

ers, and Marks [20] reported that about 46% of teachers surveyed in Minnesota had experienced some form of voice dysfunction since the start of teaching. Teachers of vocal music, performing arts, drama, physical education, and interestingly, chemistry appear to be disproportionately affected by voice problems [9, 21]. Voice problems in teachers are also a clear women's health issue. In the USA, women teachers are affected at a ratio of about 2.7:1 compared to men [9, 16, 21], and gender distributions are generally similar for teachers in other countries [10, 11].

There is little doubt that high rates of voice problems in teachers arise from the vocal demands of the job. The internet-based Voice Academy sponsored by the National Center for Voice and Speech indicates that teachers spend an average of about 49.3 h per week on teaching duties [Voice Academy, 2003]. Dosimetry reveals that as part of their jobs, teachers typically produce approximately 1,000,000 vocal fold vibratory cycles daily during a total voicing period of 1.5 h (<http://www.ncvs.org/ncvs/groups/occupational/status.html>). Moreover, background noise in classrooms has been reported to range from about 50 to as great as 80 dB, depending on the setting [22–27]. These values patently exceed the 35-dB ANSI standard [28]. In fact, teachers routinely raise their voices during teaching – according to one report by an average of 9.1 dB and about one-half octave [26].

A corollary is that while most teachers with voice problems appear high-functioning and carry no visible signs of a disorder, consequences of voice disorders can be nontrivial and may include physical injury to the laryngeal tissue [17, 29], limitation in job satisfaction, job performance, and job attendance [6, 9, 19] and a reduction in social, psychological, emotional, physical, and communicative functioning [19]. In fact, although benign voice problems typically occurring in teachers are not life-threatening, many repercussions from them have been found to be similar to those occurring with life-threatening conditions [19, 30]. Persistent or severe problems can also cause teachers to leave the classroom altogether [6]. Moreover, economic costs of voice problems in teachers are ponderous, and were conservatively estimated at USD 2.5 billion annually in the USA as long ago as 1998 [3]. Finally, some data point to what may be among the most distressing consequences of voice problems in teachers: the potential for a compromise in the quality of education delivered. In fact, some reports indicate that students' cognitive functioning around materials orally delivered by teachers is reduced even when teachers are only mildly dysphonic [31, 32]. In sum, it is clear that

voice problems in teachers matter and deserve public attention.

Regrettably, despite such robust data documenting the negative effects of voice problems in teachers, there is a surprising paucity of research on the prevention and treatment of voice disorders in this population. The purpose of this article is to review the current literature on the treatment of voice disorders in teachers, and further to provide a synopsis of how voice care for teachers has developed over the past decade.

Methods

To conduct the review, the search terms 'voice disorders, teachers, treatment' were run through the PubMed database. This search produced a total of 74 articles. To restrict the review to the past decade, the search was then limited to articles published between January 1, 1998 and October 28, 2008 (the last search completed). Additional criteria for inclusion in the review were 'teachers' as the only subject population, and articles in English due to our own limitations in evaluating work in most other languages. Studies indicating a focus on 'prevention' of voice disorders were also included if inspection of the methods section indicated that subjects generally had characteristics consistent with a disordered voice, even if the disruption was only mild. After the original article set was evaluated for the established inclusion and exclusion criteria, 11 articles remained for review.

For those articles, a 4-tiered taxonomy was developed to classify studies according to: (1) type of treatment [direct – involving actual voice work – vs. indirect – involving primarily education about voice and vocal hygiene and possibly voice amplification (VA)], and within each of those categories, (2) number of treatment approaches used (single vs. multiple), (3) type of treatment approach [vocal function exercises (VFE), resonant voice therapy (RVT), voice hygiene (VH), other, or combination therapy], and (4) delivery method (individual vs. group; fig. 1). The taxonomy was used to organize the review of the findings, and also to help identify gaps in the literature.

Results

A synopsis of the studies' details is shown in table 1. That table displays authors (in alphabetical order by first author), year of publication, information about study design, subject characteristics, treatment type, outcome measures, and summary of results. A textual review follows in the next pages. Due to space constraints, the review provides at most cursory descriptions of the interventions themselves. The reader is referred to the original articles for further information.

Fig. 1. Taxonomy for the classification of behavioral treatment of voice disorders in teachers.

Indirect Treatment

Voice Hygiene

VH intervention generally involves treatment that does not address voice production directly, or only addresses it marginally. Rather, VH programs typically focus on exposures that may influence the health of the vocal fold mucosa generically, such as phonotraumatic behaviors, hydration, laryngopharyngeal reflux, aggressive throat clearing, or phonatory onset type. Also, traditionally, VH programs have been nonspecific in the sense that they have usually not been tailored to the individual patient's profile but have rather involved general lists of do's and don'ts believed to pertain to vocal health.

Unfortunately, despite their widespread use, support for the utility of generic VH programs for teachers with voice problems is somewhat underwhelming. Among the most notable studies conducted along these lines were those by Roy et al. [33, 34] and Niebudek-Bogusz et al. [35]. All of these studies reported poorer outcomes

for voice following a standard VH intervention as compared to a direct intervention that explicitly addressed voice production or an indirect treatment consisting of VA. Specifically, in a prospective, randomized study, Roy et al. [33] reported that teachers with self-declared voice problems failed to obtain significant improvements in a classic quality-of-life measure, the Voice Handicap Index (VHI) [36], following individual VH intervention, in comparison to an individually delivered voice exercise program (VFE, described in Direct Treatments below; see also Stemple et al. [37]), which did generate VHI improvements. Moreover, subjects who received VH reported significantly less improvement in voice overall and in vocal ease and clarity specifically compared to the VFE group. Similar findings were reported in a follow-up prospective, randomized study that compared individual VH intervention to results from VA, discussed shortly [34]. Finally, in a nonrandomized study, Niebudek-Bogusz et al. [35] reported that teachers who received an individual VH program

Table 1. Summary of studies reviewed on the behavioral treatment of voice disorders in teachers

Reference	Design	Subjects	Treatment	Time points	Measures	Results
Amir et al. [51], 2005	Nonrandomized Prospective Noncontrolled	Group with voice disorders: 16 males, 25 females Group without voice disorders: 3 males, 5 females	All subjects received: 8-week 'voice course' including VH, chant, yawn-sigh, open-mouth, chewing techniques	Baseline (pre-treatment) 2 months (post-treatment)	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: clinician-rated voice quality - <i>Visual-perceptual</i>: N/A - <i>Acoustic</i>: jitter, shimmer, F_0, NHR 	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: clinician-rated voice quality: no significant training effect for either group; disordered group showed trend towards improvement ($0.051 < p < 0.090$) - <i>Visual-perceptual</i>: N/A - <i>Acoustic</i>: improvement in both groups: jitter: $p = 0.010$; shimmer: $p < 0.001$; NHR: $p = 0.021$; F_0: NSR; greater improvement in disordered group with group $\times$ training interaction for jitter ($p = 0.030$) and shimmer ($p = 0.004$) - <i>Aerodynamic</i>: N/A - <i>Patient perceptual</i>: N/A - <i>Informal questionnaire</i>: N/A
Bovo et al. [48], 2007	Randomized Prospective Controlled	64 (females) with dysphonia enrolled 41 (females) completed protocol Treatment group: $n = 21$ Control group: $n = 20$	Treatment group: theoretical voice course by a laryngologist, two group therapy sessions by a speech-language pathologist, targeting abdominal-diaphragmatic breathing, laryngeal relaxation, circumlaryngeal massage, easy onset voicing, LMRVT, and exercises to increase 'oral opening' Daily home therapy with journal of voice use patterns	Baseline 3 months 12 months	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: global grade of dysphonia - <i>Visual-perceptual</i>: laryngeal exam - <i>Acoustic</i>: NHR, jitter, shimmer, MPT 	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: treatment group: significant improvement ($p = 0.0001$); control group: NSR - <i>Visual-perceptual</i>: NSR for either group - <i>Acoustic</i>: NHR: NSR for either group; jitter and shimmer: significant improvement in treatment group when compared to control group ($p = 0.0001$); MPT: significant increase for the treatment group only ($p < 0.0001$) - <i>Aerodynamic</i>: N/A - <i>Patient perceptual</i>: treatment group: improved at 3 months, some decline at 12 months ($p = 0.0273$); control group: NSR - <i>Informal questionnaire</i>: at end of the course, treatment group: 85% reported improved vocal hygiene practice and 90% had reduced classroom vocal demands
Chen et al. [47], 2007	Nonrandomized Prospective Noncontrolled	24 females with at least one voice symptom occurring frequently	Group intervention: weekly 90-min sessions of RVT (adapted from LMRVT by Verdolini [49])	Baseline (pre-test) 8 weeks (post-test)	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: clinician-graded voice severity - <i>Visual-perceptual</i>: stroboscopy - <i>Acoustic</i>: jitter, shimmer, NHR, max speaking F_0 range, max speaking intensity range - <i>Aerodynamic</i>: PTP, MPT, airflow rate - <i>Patient perceptual</i>: VHI, WHOQOL-BREF Taiwanese version for functional impact of voice disorder - <i>Informal questionnaire</i>: N/A 	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: reduction (improvement) in roughness, strain, monotone, hard glottal attack, glottal fry, vocal fatigue ($p < 0.05$) - <i>Visual-perceptual</i>: improvement in mucosal wave and amplitude, glottal closure, and laryngeal pathology ($p < 0.05$) - <i>Acoustic</i>: significant improvement in speaking F_0, speaking range F_0, range and intensity only ($p < 0.05$) - <i>Aerodynamic</i>: improvement (reduction) in PTP only ($p < 0.05$) - <i>Patient perceptual</i>: reduction (improvement) in physical subscale of VHI only ($p < 0.05$), NSR for the WHOQOL-BREF - <i>Informal questionnaire</i>: N/A

Reference	Design	Subjects	Treatment	Time points	Measures	Results
Gillivan-Murphy et al. [40], 2006	Randomized Prospective Controlled	20 female teachers with self-reported voice problems Treatment group: n = 10 Control group: n = 10	Individual intervention for treatment group: 5–6 1-hour sessions targeting VFE, VH, posture, and breathing training	Baseline (pre-treatment) 8 weeks (post-treatment)	<ul style="list-style-type: none">– <i>Auditory-perceptual</i>: N/A– <i>Visual-perceptual</i>: N/A– <i>Acoustic</i>: N/A– <i>Aerodynamic</i>: N/A– <i>Patient perceptual</i>: VQROL: NSR between groups, treatment group: improvement in impairment and emotional subscales only of the VoiSS– <i>Informal questionnaire</i>: Voice Care Knowledge VAS	<ul style="list-style-type: none">– <i>Auditory-perceptual</i>: N/A– <i>Visual-perceptual</i>: N/A– <i>Acoustic</i>: N/A– <i>Aerodynamic</i>: N/A– <i>Patient perceptual</i>: VQROL: NSR between groups, treatment group: improvement in impairment and emotional subscales only of the VoiSS– <i>Informal questionnaire</i>: between group significant differences with improvement in the treatment group in all areas except voice use ($p \leq 0.001$)
Ilomaki et al. [39], 2008	Randomized Prospective Controlled	60 vocally functional females demonstrating at least one characteristic of a voice problem. Treatment group: n = 30 VH-only group: n = 30	Group intervention for both groups All subjects participated in 3-hour VH lecture Treatment group also received nonspecific voice training consisting of 1-hour voice exercises in 3 groups of 10 subjects each (5 sessions over 9 weeks) plus individualized homework	Baseline (pre-treatment) 4 months (post-treatment)	<ul style="list-style-type: none">– <i>Auditory-perceptual</i>: VAS– <i>Visual-perceptual</i>: N/A– <i>Acoustic</i>: F_0, Leq, alpha ratio, jitter, shimmer– <i>Aerodynamic</i>: N/A– <i>Patient perceptual</i>: phonation difficulty, throat tiredness, voice quality, voice change during the day– <i>Informal questionnaire</i>: effect of intervention	<ul style="list-style-type: none">– <i>Auditory-perceptual</i>: treatment group: improved voice quality (0.025)– <i>Visual-perceptual</i>: N/A– <i>Acoustic</i>: VH group: increased F_0 ($p = 0.026$); treatment group: increase (improvement) in alpha ratio ($p = 0.047$), F_0 in loud reading ($p = 0.003$), decrease (improvement) in shimmer ($p = 0.002$) and jitter ($p = 0.015$)– <i>Aerodynamic</i>: N/A– <i>Patient perceptual</i>: VH group: increased (worsened) phonation difficulty ($p = 0.030$) and throat tiredness ($p = 0.046$)– <i>Informal questionnaire</i>: treatment group: self-reported more improvement due to intervention ($p = 0.000$)
Niebudek-Bogusz et al. [35], 2008	Nonrandomized Prospective Controlled	186 females with voice complaints enrolled 133 completed protocol, 53 served as VH-only controls (unable to attend full treatment)	Individual intervention with 5 clinicians from 4 outpatient clinics Treatment consisted of breathing and relaxation, VH, VFE, and RVT 9–18 40- to 60-min therapy sessions, once or twice per week for 2–4 months, 8–10 min of daily practice outside of therapy session	Baseline (pre-treatment) 2–4 months (post-treatment)	<ul style="list-style-type: none">– <i>Auditory-perceptual</i>: clinician evaluation of posture, breathing, resonance and muscle tension– <i>Visual-perceptual</i>: laryngoscopy– <i>Acoustic</i>: MPT, F_0, Hz range in speaking, loudness in speaking– <i>Aerodynamic</i>: N/A– <i>Patient perceptual</i>: N/A– <i>Informal questionnaire</i>: patient evaluation of course, voice use and symptoms questionnaire	<ul style="list-style-type: none">– <i>Auditory-perceptual</i>: treatment group: improvement in breathing technique, neck tension, and achieving soft phonation– <i>Visual-perceptual</i>: treatment group: improvement in regularity, mucosal wave, and amplitude of vocal fold vibration, and vocal fold closure ($p < 0.05$ for all) decrease in hyperfunction ($p = 0.001$), and vocal fold nodules ($p = 0.008$)– <i>Acoustic</i>: treatment group: increase (improvement) in MPT ($p = 0.017$) and speaking frequency range ($p = 0.045$)– <i>Aerodynamic</i>: N/A– <i>Patient perceptual</i>: N/A– <i>Informal questionnaire</i>: treatment group stated voice as more 'normal' post-intervention ($p = 0.004$), with a decrease in hoarseness ($p = 0.039$), voicelessness ($p = 0.001$), voice tiredness ($p < 0.001$), and frequency of aphonia ($p < 0.001$)

Reference	Design	Subjects	Treatment	Time points	Measures	Results
Pasa et al. [38], 2007	Nonrandomized Prospective Noncontrolled (control group named as such, but participated in unexplained structured phonatory tasks)	37 females with self-reported voice symptoms	Group intervention Treatment consisted of a VH group and VFE group Treatment groups met 4 times in a 10-week period Control group met 3 times in a 10-week period	Baseline (pre-treatment) 10 weeks (post-treatment)	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: N/A - <i>Visual-perceptual</i>: N/A - <i>Acoustic</i>: MPT, maximum frequency range, - <i>Aerodynamic</i>: N/A - <i>Patient perceptual</i>: N/A - <i>Informal questionnaire</i>: self-report questionnaires detailing voice knowledge, symptoms, and phonotraumatic behaviors 	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: N/A - <i>Visual-perceptual</i>: N/A - <i>Acoustic</i>: NSR for all groups - <i>Aerodynamic</i>: N/A - <i>Patient perceptual</i>: N/A - <i>Informal questionnaire</i>: VH group: compared to the control group had a significant increase in voice knowledge ($p = 0.004$) as well as increasing voice pre-post intervention ($p = 0.002$), improved voice symptoms pre-post intervention ($p = 0.021$), at follow-up this group reported similar phono-traumatic behaviors to the control group; VFE group: NSR for voice knowledge, at follow-up reported increased phonotraumatic behaviors as compared to the VH group, NSR for voice symptoms
Roy et al. [33], 2001	Randomized Prospective Controlled	60 subjects (sex unspecified) with history of voice problems 58 completed protocol Randomized to one of three groups: VH: $n = 20$ VFE: $n = 19$ Control: $n = 19$	Treatment groups: individual intervention provided by 11 speech-language pathologists 4 biweekly interventions were provided over 6 weeks Control group met at baseline and 6 weeks	Baseline (pre-test) 6 weeks (post-test)	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: N/A - <i>Visual-perceptual</i>: N/A - <i>Acoustic</i>: N/A - <i>Aerodynamic</i>: N/A - <i>Patient perceptual</i>: control: NSR improvement; VFE: significant reduction in mean score ($p < 0.0002$); VH: NSR - <i>Informal questionnaire</i>: control: NSR; VFE: reported higher ratings of improvement ($p < 0.05$), vocal clarity ($p < 0.02$), and ease of voicing ($p < 0.01$); VH: NSR; levels of compliance were comparable across treatment groups 	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: N/A - <i>Visual-perceptual</i>: N/A - <i>Acoustic</i>: N/A - <i>Aerodynamic</i>: N/A - <i>Patient perceptual</i>: control: NSR improvement; VFE: significant reduction in mean score ($p < 0.0002$); VH: NSR - <i>Informal questionnaire</i>: control: NSR; VFE: reported higher ratings of improvement ($p < 0.05$), vocal clarity ($p < 0.02$), and ease of voicing ($p < 0.01$); VH: NSR; levels of compliance were comparable across treatment groups
Roy et al. [34], 2002	Randomized Prospective Controlled	50 subjects with history of voice problems Enrolled 44 (37 F, 7 M) Completed protocol (3 groups): VA: $n = 15$ VH: $n = 15$ Control: $n = 14$	Individual treatment: 4 biweekly sessions over 6 weeks for treatment groups Control group met at baseline and 6 weeks	Baseline (pre-test) 6 weeks (post-test)	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: N/A - <i>Visual-perceptual</i>: N/A - <i>Acoustic</i>: jitter, shimmer, NHR - <i>Aerodynamic</i>: N/A - <i>Patient perceptual</i>: VH - <i>Informal questionnaire</i>: voice severity self-rating scale: 4-point categorical scale, and post-treatment questionnaire (perceived degree of improvement and compliance), 5-point scale 	<ul style="list-style-type: none"> - <i>Auditory-perceptual</i>: N/A - <i>Visual-perceptual</i>: N/A - <i>Acoustic</i>: VA: trending reductions (improvements) in all areas ($p = 0.078$); VH: NSR; control: trending increase (worsening) in NHR ($p = 0.060$) - <i>Aerodynamic</i>: N/A - <i>Patient perceptual</i>: VA: significant reduction (improvement) in scores ($p = 0.045$); VH: NSR; control: significant increase (worsening) in scores ($p = 0.012$); both treatment groups differed significantly from the control group pre-post test ($p = 0.004$ for VA, and $p = 0.012$ for VH); neither treatment group differed significantly from the other pre-post - <i>Informal questionnaire</i>: VA: significant improvement in self-rated severity ($p = 0.012$); VH: NSR; control: NSR; between groups there was a significant difference between VA and control ($p = 0.033$), NSR between VH and control; VA group was significantly improved over the VH and control group in ease of voice production ($p = 0.001$) and compliance ($p = 0.045$)

Reference	Design	Subjects	Treatment	Time points	Measures	Results
Roy et al. [42], 2003	Randomized Prospective Noncontrolled	87 subjects with a history of voice problems (sex unspecified) 64 completed protocol Randomly assigned to three groups: VA: n = 25 RT: n = 19 RMT: n = 20	Individual therapy For all groups, 4 biweekly sessions over 6 weeks	Baseline (pre-test) 6 weeks (post-test)	<ul style="list-style-type: none"> - Auditory-perceptual: N/A - Visual-perceptual: N/A - Acoustic: N/A - Aerodynamic: N/A - Patient perceptual: VHI 	<ul style="list-style-type: none"> - Auditory-perceptual: N/A - Visual-perceptual: N/A - Acoustic: N/A - Aerodynamic: N/A - Patient perceptual: VA: significant reduction (improvement) in scores (p = 0.002); RT: significant reduction (improvement) in scores (p = 0.007); RMT: NSR; the VA group improved significantly compared to the RMT group (p = 0.025) but not the RT group; RT group also did not significantly improve compared to the RMT group - Informal questionnaire: VA and RT: self-rated voice as less severe (improved) (p = 0.008 and 0.019, respectively); RMT: NSR; no significant improvement in one group when compared to another; VA and RMT reported significantly higher compliance (p values not reported); VA: reported significantly greater improvement, clarity and ease of voicing (p values not reported) - Other: RMT group: significant improvement in MEP (p = 0.003)
Silverio et al. [14], 2008	Nonrandomized Prospective Noncontrolled	42 females, 26 of whom had diagnosis of a voice disorder Only 29 completed laryngeal examination	Group treatment for all subjects: 'vocal experience group' consisting of 12 1-hour meetings addressing participants' self-perception of voice, anatomy and physiology, VH, modifications to everyday environment and work setting, and voice exercises as warm-ups and cooldowns	Baseline (pre-treatment) Post-test after 12th meeting (pre-post duration not specified)	<ul style="list-style-type: none"> - Auditory-perceptual: GRBASI - Visual-perceptual: laryngological evaluation - Acoustic: N/A - Aerodynamic: N/A - Patient perceptual: N/A - Informal questionnaire: N/A 	<ul style="list-style-type: none"> - Auditory-perceptual: NSR in G, R, B, A, I, significant improvement in S (p = 0.0277) - Visual-perceptual: no follow-up reported - Acoustic: N/A - Aerodynamic: N/A - Patient perceptual: N/A - Informal questionnaire: N/A

F₀ = Fundamental frequency; NHR = noise-to-harmonic ratio; NSR = no significant results; WHOQOL-BREF: World Health Organization Quality of Life Questionnaire, shortened version [55]; PTP = phonation threshold pressure; VQROL = Voice-Related Quality of Life Scale [41]; VoiSS = Voice Symptom Severity Scale [44]; VAS = visual analog scale; Leq = equivalent sound level; alpha ratio = [(Leq 1–5 kHz) – (Leq 50 Hz – 1 kHz)] in habitual loudness and text reading; RT = resonance therapy by Stemple [56]; RMT = respiratory muscle training, modified from Sapienza et al. [57]; MEP = maximum expiratory pressure; GRBAS = grade, roughness, breathiness, asthenia, strain, instability from Hirano [58].

did not show significant improvements in any of a series of voice measures following treatment, in contrast to teachers who received individual combination treatment involving VH, breathing, relaxation, VFE, and RVT training (described below), who did show improvements (table 1). Interestingly, clinician confidence in their delivery of the interventions did not necessarily explain the results. At least in one study, clinicians reported greater confidence in their administration of the VH program than in the direct intervention program (VFE [33]), yet subjects showed improvements in the latter but not former group.

Results from the foregoing studies are fairly intuitive. Assuming that voice production is a primary contributor to voice problems in teachers, it seems sensible that attention to voice production would generally be required to reverse the problems. However, other data as well as logic suggest conclusions in that direction may be premature. For example, Pasa et al. [38] found that teachers who completed a group VH program reported a significant decrease in voice symptoms and their maximum phonation times (MPTs) improved from before to after treatment. In contrast, subjects who received a group VFE program did *not* report a significant improvement in symptoms, and their MPTs showed a trend towards worsening. Moreover, whereas subjects in the VH group reported that their phonotraumatic behaviors remained stable across the duration of the study, subjects in the VFE group reported a paradoxical increase in their phonotraumatic behaviors. Somewhat weaker findings in support of some potential benefit from VH programs for teachers with voice problems were reported by Ilomaki et al. [39], who found that 1/3 of teachers who received a group VH intervention felt their voices had improved as a result of it. However, 2/3 of teachers who received non-specific group voice treatment in addition to participation in the VH lecture reported improvements with their program. Along somewhat similar lines are results reported by Gillivan-Murphy et al. [40]. Those authors found that teachers who received a *combined* VH with VFE intervention showed a significant improvement in scores on the Voice-Related Quality of Life questionnaire [41], as well as an improvement in voice care knowledge when compared to subjects in a nontreatment control group. Finally, it should be noted that even the generally negative data by Roy et al. [33, 34] provided oblique support for VH interventions: although teachers who received VH interventions failed to show voice-related changes with it, the same data set revealed that teachers who did not receive any intervention at all had worsened

voice functions following the nonintervention period. At that level, a reasonable conclusion might be that VH programs may be better than no intervention at all, for teachers with dysphonia.

In addition to these fairly isolated reports, logic suggests it may be premature to discard the possibility that VH programs may have some value for some teachers. Specifically, all of the VH programs that have been studied in the literature thus far have been *generic* programs that were not tailored to a particular subject's individual profile. It seems likely that some targets in the programs were irrelevant for some subjects, and other targets that were relevant were either not included or were lost in the matrix, which involved a large number of fairly detailed instructions that subjects may have found daunting. Arguably, *targeted, individualized, and slimmed-down* VH programs could have value for teachers, in contrast to the generic programs that have typically been evaluated. Interestingly, some preliminary data suggest that such programs may indeed have value in the *prevention* of voice problems in student teachers [Verdolini, unpubl. data]. However, countering optimism in this regard is the observation that the same unpublished data set suggested that even when VH programs were targeted and slimmed, they were insufficient to improve voice problems in student teachers who already had them [Verdolini, unpubl. data].

Voice Amplification

It is reasonable to think that if voice problems in teachers are partly caused by increased phonatory loudness, VA might help to reduce them. Thus far, this idea has been evaluated in two studies by Roy et al. [34, 42], both of which used an individual treatment delivery model. Results from these studies were favorable. In both reports, the use of VA over a 6-week period resulted in significant improvements in VHI scores and self-ratings of symptom severity, in addition to other measures. Moreover, in one of the studies, VA resulted in significantly better reported compliance with treatment and greater perceived benefit from intervention as compared with a generic type of RVT, and greater clarity and ease of voice production than either RVT or a respiratory muscle training (RMT) program. Some caution is warranted in the interpretation of the comparative findings due to different attrition rates across the groups: from the intention-to-treat pool of participants, attrition was highest in the RVT group, followed by the RMT group and there were no dropouts in the VA group. Potentially, attrition in the RVT and RMT groups was

partly due to the increased complexity of the treatments and subjects' difficulty adhering to them. Conversely – for the sake of argument – attrition could also have been due to a perceived benefit from the programs and thus early dropout.

Direct Treatment

Vocal Function Exercises

As implied by its name, the 'vocal function exercises' program targets 'exercises' of the phonatory mechanism [37]. In brief, the program involves twice daily repetitions of maximally prolonged vowels at pitches within the general speech range, as well as ascending and descending pitch glides, all with 'extreme forward focus "almost but not quite nasal"'. The authors reason that rehabilitation of the larynx should be approached much in the same way as physical therapy addresses injury of other areas of the body. Therefore, VFE employs principles of exercise physiology that target the subcomponents of voice production in order to achieve 'balance in laryngeal muscular activity' accompanied by adequate airflow [37]. The implied assumption regarding teachers and others with a high risk of benign mucosal lesions is that such muscular training will orient the patient towards phonation patterns that reduce negative influences on the mucosa, which is where most if not all benign vocal fold lesions develop [43].

Discussion of the VFE for teachers was partly embedded in the preceding review. In sum, the literature on the VFE for teachers reports results for the VFE in isolation [33, 38] and as part of a multiple-therapy approach [35, 40]. When the VFE have been used as a single-treatment approach, results have been somewhat mixed. As noted, Roy et al. [33] reported robust improvements in VHI scores and self-reported voice change following *individual* VFE – despite less than perfect clinician confidence in the administration of the program – in comparison to no VHI change and poorer results for voice change following individual VH intervention. Results in the study by Pasa et al. [38] were essentially 180° out of phase with those from Roy et al. Pasa et al. reported no improvement in voice symptoms, increased self-declared phonotraumatic behaviors following *group* VFE treatment in comparison to baseline, whereas the same measures improved following a group VH intervention.

One possible explanation for the disparity in results across the studies is that *individual* VFE treatments may benefit teachers [33], whereas *group* VFE may be less effective. Another possibility is that the studies' intended

purpose may have influenced the results. The purpose of Roy et al. was to conduct a 'treatment' study, whereas Pasa et al. framed their work as a 'prevention' study, even though subjects had self-reported voice symptoms at the outset. Possibly, differences in the degree of impairment and thus subject motivation and rigor around implementation of the VFE explain the difference in results across studies. Another possibility is that perhaps clinicians in the study by Roy et al. were better versed in the VFE – despite the former clinicians' declared imperfect confidence in their ability to deliver the program. In fact, the originator of VFE, Joseph Stemple, was involved in Roy's study and trained the clinicians himself. Moreover, clinicians in that study received videotapes of Dr. Stemple providing the therapy, and they also received audiotapes of the exercises, made by Dr. Stemple, to be completed twice daily [Roy, pers. commun., January 1, 2009]. Thus, considerable care was dedicated to high-quality clinician training, uniform clinician training, and a uniform exercise program in Roy's VFE studies. In Pasa's study, subjects were given audio recordings of examples of VFE to assist in home practice. Therefore, while the subjects in Pasa's study were trained, there was perhaps less clinician uniformity and attention to specific detail than in the study by Roy et al. Stated differently, possible differences in clinician and patient training are a potential source of difference in the results across studies. This possibility points to the critical need for good clinician and patient training in interventions for teachers and others.

Findings for the VFE have been more consistent when these exercises have been used in conjunction with other treatment modalities. For example, Gillivan-Murphy et al. [40] found significant improvements in the Voice-Related Quality of Life scale for teachers who had received a combined group VFE-posture-breathing program in conjunction with VH. As important, teachers in the VFE-VH-posture-breathing group also obtained significant improvements in the emotional subscale of the Voice Symptom Scale [44] and significantly greater knowledge about voice as compared to the control group. Similarly, Niebudek-Bogusz et al. [35] reported on results for teachers following combination therapy involving work on breathing, relaxation VFE, and resonant voice exercises, in addition to VH education – although it should be noted that treatment was adapted for each participant to meet individual needs. Results showed that the combination therapy group obtained significant improvement in chronic hoarseness, vocal fatigue, dry throat/cough, aphonia, globus sensation, hyperfunction,

vocal fold nodules, MPT, voice frequency range, regularity and amplitude of vocal fold vibration, mucosal wave, and vocal fold closure following treatment. Subjects in that group also reported that their voices were closer to 'normal' after treatment as compared to before it. Subjects in the VH group did not demonstrate any of those improvements.

Taken as a whole, the evidence on the VFE suggests that this program in isolation may have value in the treatment of voice disorders in teachers. However, benefits may be clearest when the program is delivered using a 1:1 format when both clinicians and patients receive good training in the approach. The evidence has been more consistently favorable when the VFE have been used in combination with other treatment approaches. Of course, interpretation of that evidence is somewhat challenging. It is unclear what part of the benefits shown in those cases was due to the VFE versus other aspects of the interventions. Appealing in the VFE is the relative simplicity of the approach and the minimal temporal load they impose on both clinicians (in training) and patients (in implementation).

Resonant Voice Therapy

Resonant voice therapy is the generic name used to describe therapies targeting a sensation of 'forward focus', or anterior oral vibrations during easy phonation [45]. The rationale for this kind of therapy is linked to observations that the 'resonant voice' phenomenon, defined in this way, tends to be associated with barely touching or barely separated vocal folds, which tend to optimize the relation between voice output intensity (large) and vocal fold impact intensity (small) [46]. Thus, individuals producing resonant voice can achieve fairly good voice output while at the same time achieving relative protection from phonotrauma. Moreover, recent data suggest that the characteristic large-amplitude vocal fold oscillations involved in resonant voice may have actual reparative value in the reversal of acute if not chronic vocal fold injury [Verdolini, unpubl. data].

The utility of RVT has been evaluated in several studies on the treatment of voice problems in teachers. RVT was used as a single-therapy approach in work by Roy et al. [42] and Chen et al. [47]. It was used in combination with other direct and indirect treatment approaches by Bovo et al. [48] and Niebudek-Bogusz et al. [35].

When used as a single-treatment approach, RVT has appeared successful in reducing voice problems in teachers across a series of parameters. In a prospective, randomized study by Roy et al. [42], teachers who received a

generic form of individual RVT showed a significant reduction in mean VHI scores, and also self-rated their voice symptoms as less severe after as compared to before therapy. However, subjects in that group also reported less benefit from the program as compared to a VA intervention, and poorer compliance with the program than subjects in VA and RMT groups.

Chen et al. [47] conducted a prospective, nonrandomized study on RVT for teachers, without a control group. Teachers with at least one voice symptom occurring frequently received a group form of RVT modeled after a formal standardized version of it now called Lessac-Madsen Resonant Voice Therapy (LMRVT; early versions described in Verdolini-Marston et al. [45] and Verdolini [49]). Results showed significant improvement in a series of auditory-perceptual ratings of voice, as well as in visual ratings of vocal fold pathology, mucosal wave, and amplitude of tissue vibration following treatment. The only acoustic measure that showed improvement was maximum speaking fundamental frequency range and speaking intensity range (table 1). Similarly, among aerodynamic measures, only phonation threshold pressure improved. For the VHI, only the physical subscale score improved with treatment (table 1). The authors speculated that lack of significant improvement in some of the foregoing parameters was related to floor effects, as parameter values were close to normal or only 'mildly' disrupted at the outset of the study, despite participants' complaints of voice problems.

When used in conjunction with other treatment approaches, RVT has also appeared useful or at least not obviously harmful. Bovo et al. [48] randomized largely symptomatic teachers into either a nontreatment control group or a direct treatment protocol that included training of abdominal-diaphragmatic breathing maneuvers, laryngeal relaxation, circumlaryngeal massage, easy onset voicing, Lessac-Based Resonant Voice Therapy (a precursor to LMRVT), and exercises to increase 'oral opening'. Results of the treatment revealed a significant improvement, impressively at both 3- and 12-month follow-up compared to baseline – among the longest-term follow-up data available in the literature on teachers – in total VHI scores, jitter, shimmer, MPT, and clinician-rated global grade of dysphonia, although laryngeal findings did not change. It should be noted that VHI scores worsened between 3- and 12-month follow-up for the experimental group, but still remained better than baseline. In contrast, no robust improvements were found for any of the parameters at the

3-month follow-up for the control group (12-month data were not available).

Similarly, as reported in an earlier section of this paper, Niebudek-Bogusz et al. [35] found that teachers in a treatment group involving VFE and a generic form of RVT demonstrated significant postintervention improvements in chronic hoarseness, vocal fatigue, dry throat/cough, aphonia, globus sensation, hyperfunction, vocal fold nodules, MPT, voice frequency range, regularity and amplitude of vocal fold vibration, normal mucosal wave, and vocal fold closure. Subjects also self-reported that their voices were more 'normal' after treatment. As for multiple-modality therapies already discussed under the rubric of VFE, findings from these studies are difficult to interpret in terms of the relative contributions of RVT versus other forms of therapy.

In summary, evidence regarding the utility of various forms of RVT for teachers with voice problems indicates it can help to improve a series of voice-related parameters when delivered as a single-treatment modality, and is helpful or at least not harmful when included as part of a larger treatment program. Thus far, this pattern of results has been obtained for both individual and group therapies.

Other Approaches

The utility of an RMT intervention for teachers was briefly mentioned in a previous section of this paper. To recapitulate, in a prospective study, Roy et al. [42] randomized teachers into a VA group, a resonant therapy group and an RMT group, all of whom received individual therapy. Although subjects in the first two groups showed significant improvement in VHI scores and self-ratings of voice symptoms after compared to before treatment, subjects in the RMT group did not show any of those improvements. Subjects in the RMT group further indicated weaker benefits from the intervention as compared to those in the VA and resonant therapy group. The RMT group did improve in maximum expiratory pressure. These findings are interesting in light of reports indicating improvements in a series of voice-related parameters after compared to before RMT intervention for symptomatic street actors [50]. The authors suggested that the respiratory training, which was intense, may have been relevant for the actors due to the large respiratory demands required by their performance, but was not relevant for teachers whose phonatory demands are less demanding.

Amir et al. [51] enrolled teachers in a 'voice course' consisting of training on breathing and respiratory con-

trol techniques and voice production. Participants were divided into a group of individuals with characteristics of voice disorders ($n = 41$) and those without voice disorders ($n = 8$). Both groups were trained primarily in the chant therapy approach. However, they were also instructed in the yawn-sigh, open-mouth, and chewing facilitating approaches [52]. Acoustic analyses of jitter, shimmer, fundamental frequency and noise-to-harmonic ratio, as well as clinician-based audioperceptual measurements were evaluated. Results of the intervention revealed significant improvement in both groups in jitter, shimmer, and noise-to-harmonic ratio, with the group with voice disorders exhibiting greater improvement than the group without voice disorders. There were no statistically significant changes in any of the clinician-based perceptual measures, although measures for the group with voice disorders trended more towards improvement than measures for the normal control group. The authors concluded that based on the results of acoustic analyses, the treatment program improved the voices of subjects in both groups, with greater improvement seen in the group that originally presented with voice disorders.

Ilomaki et al. [39], who cast their study as a 'prevention' study, evaluated the effects of a brief VH intervention versus VH plus nonspecific group voice training – focusing on 'economic voice production' – for teachers who were vocally functional, but many of whom also reported at least one symptom of a voice problem. Subjects who were randomized to the direct treatment group showed significant improvements in jitter and shimmer, vocal effort at the end of the working day, and knowledge about voice after compared to before intervention. Two thirds of those subjects also felt their voices had improved as a result of treatment, and clinician ratings of voice quality also indicated improvement. As noted previously, subjects who received the VH program alone showed more sparse results, with only 1/3 indicating their voices had improved with treatment. Paradoxically, the VH group self-reported symptoms actually increased.

Finally, Silverio et al. [14] reported an observational study without a control group. In that study, teachers were recruited to participate in a 'vocal experience group'. The experience consisted of a mixture of education on voice production and voice, vocal hygiene, ergonomic modifications that might benefit voice, and voice warm-ups and cooldowns. Results were relatively limited. The only significant difference in voice before compared to after intervention was seen in the so-called 'stress de-

Table 2. Checklist of items to include when reporting a randomized trial (paraphrased from the CONSORT standards [53, 54])

Section	Explanation
<i>Title and abstract</i>	Methodology for subject-group distribution
<i>Introduction</i>	
Background	Rationale for research
<i>Methods</i>	
Participants	Subject inclusion/exclusion, how and where data collected
Interventions	Includes specific details of all interventions administered
Objectives	Clearly defined objectives and stated hypotheses
Outcomes	Includes specifics of outcome measures used, including pertinent details of clinical training administered, reliability, validity of measures, etc.
Sample size	Details sample size establishment
<i>Randomization</i>	
Sequence generation	How the randomization was generated
Allocation concealment	How the randomization was enacted, and if the randomization was exposed prior to the treatment
Implementation	Person responsible for all aspects of randomization
Blinding	Provides details on whom was blinded (assessors, administrators, participants) and how blinding was carried out
Statistical methods	Methods used for all analyses
<i>Results</i>	
Participant flow	Plan of intervention and data collection for each subject and any variations from the original plan and the rationale for such variations
Recruitment	Provide specific enrollment, intervention and follow-up dates
Baseline data	Group similarities and differences at baseline
Numbers analyzed	Number of subjects analyzed per group, 'intention to treat' numbers, preferably not reported in percentage but in whole number
Outcomes and estimations	Effect size, confidence interval (or similar precision measure), and group results summary for each measure
Ancillary analyses	Report all analyses completed including exploratory and adjusted
Adverse events	Report all adverse events and/or side effects for all groups
<i>Discussion</i>	
Interpretation	Include all hypotheses, biases, and false interpretations based on multiplicity of analysis
Generalizability	External validity of the findings
Overall evidence	Findings interpreted appropriately in light of evidence gathered

gree', a rating of vocal strain on a scale measuring the degree of dysphonia, hoarseness, breathiness, asthenia, stress, and instability, in a sustained vowel task and in spontaneous speech. Although formal measures of self-care of voice were not made, the researchers observed that subjects improved in voice care and displayed increased knowledge of how to alter their voice in a teaching situation.

Discussion

The studies evaluated in this review represent an encouraging start to research on treatments for voice problems in teachers. Taken at face value, the following conclusions might be drawn from published studies satisfying our search criteria. (1) Both individual and group VH interventions, which are primarily instructional in nature, may produce some benefits for some aspects of voice, for some teachers with voice problems. However,

generally, benefits from VH interventions appear poorer than benefits from actual voice training programs with or without VH instructions – although the data generally suggest that VH intervention produces better results than no intervention at all for teachers with voice problems. Possibly, VH program effects might be enhanced by reducing the number of instructions to subjects and tailoring instructions to individual subjects. However, that possibility remains speculative at present. (2) VA may help to improve teachers' vocal function, for teachers who have voice problems. (3) VFE in isolation appear to produce positive results for teachers with voice problems if therapy is provided in an individual (rather than group) format, and if the teachers' problems are more than minimal. As is probably the case for most therapies, good clinician and patient training may be critical. The VFE program may be a valuable component of multiple-approach group therapy as well, although the contribution of VFE, specifically, to the results is difficult to ferret out given existing data. (4) RVT in both generic and specific forms (e.g. LMRVT or its precursors) has generally produced positive results for teachers with voice problems, whether delivered as a single-treatment modality or part of a larger treatment package. A caveat reported in one study is that compliance was poorer with RVT than with VA or RMT [42]. However, particular compliance problems for RVT have not been noted in other studies, especially in studies involving LMRVT, which is specifically constructed to offset them [Verdolini et al., in preparation]. (5) Although RMT has shown benefits for street actors whose jobs demand 'extreme phonation' [50], similar benefits were not shown for teachers with voice problems but smaller vocal demands.

It is tempting to leave the discussion of the results at that. However, taken both individually and as a whole, the studies also present a series of limitations that are cause for caution. First, none of the articles fully adheres to what are often considered the 'gold standard' for clinical studies, as for example reflected by the CONSORT statement (Consolidated Standards of Reporting Trials; e.g. <http://www.consort-statement.org/?o=1011> [53, 54]), which lists 22 standards against which to evaluate clinical studies. A paraphrase of the standards is shown in table 2. In this discussion, we would like to focus on three parameters related to methods, in particular. The first parameter has to do with the interventions, their rationale, and especially their details. With few exceptions, the published studies fail to provide a specific rationale for the approaches taken, and which measures should be affect-

ed by them and why. Also with few exceptions, the studies provide extremely sparse information about the actual content of the interventions. Thus, the ability to generalize many of the results is nearly nil, and the ability to replicate the procedures is similarly poor. In those cases, we have learned precious little about what may actually help our teacher patients. Exceptions are found with studies using standardized treatments in isolation of other treatments (e.g. VFE, RVT, or LMRVT and its precursors).

A second class of problems highlighted by the CONSORT statement has to do with measures. Cross-study comparisons are made difficult by the lack of consistent measures across studies. Some studies have emphasized voice-related quality-of-life measures, whereas others have not. Similarly, the studies have variably included clinical-based perceptual measures, acoustic and aerodynamic data, and subject self-ratings – or not. Further, almost none of the studies have provided information about laryngeal status. Thus, our ability to conduct anything like a meta-analysis of the data, across studies, is practically nil at present. Moreover, we know almost nothing about the effects of the interventions on actual laryngeal health.

A third concern, also pertinent to measures, is that information about the reliability and validity of the measures is generally lacking in the literature, and even single blinding has generally been ignored or not reported. Finally, long-term follow-up data on the treatments' effects are generally lacking in the literature.

We are thus both encouraged by the recent increase in the number of reports on interventions for voice problems in teachers, and also motivated to improve the quality of the research in future efforts. Suggestions for future research directions are provided to conclude this article.

Future Research Directions

The foregoing comments highlight needs to be considered in future research on the treatment of voice problems in teachers. At the most general level, it would seem to be a good idea to follow CONSORT or other accepted standards in study designs and reporting. Among standards that have been most lacking in studies thus far are (1) detailed description of the interventions, and ideally also their rationale; (2) the use of a consistent corpus of measures across studies, at least in part to allow for cross-study comparisons; (3) the inclusion of laryngeal measures in particular, to allow for evaluation of the interventions' effects on laryngeal health; (3) at least single blinding of measures; (4) information about the measures' re-

liability and validity, and (5) long-term follow-up data. We are hopeful that these approaches will help to improve the quality of data on behavioral treatments for voice problems in teachers, and ultimately, improve treatment outcomes themselves.

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