PREVALENCE OF VOCAL SYMPTOMS AND VOICE DISORDERS AMONG TEACHER STUDENTS AND TEACHERS AND A MODEL OF EARLY INTERVENTION

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ABSTRACT

Prevalence of Vocal Symptoms and Voice Disorders among Teacher Students and Teachers and a Model of Early Intervention

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The overall aims of the research done for this thesis were to investigate the prevalence of vocal symptoms and voice disorders among students who were studying to become teachers (teacher students) and to develop a model of early intervention, including a voice screening test and group voice therapy for students who have mild voice disorders. Other aims were to investigate whether a cross section of university students studying in a variety of faculties report as high a frequency of vocal symptoms as prospective teachers in comprehensive schools and upper secondary schools do and to explore whether the proportion of teachers reporting vocal symptoms has changed within a twelve-year period. Data gathered from a total of 730 students and 719 teachers are presented in this thesis. All students and teachers filled out a questionnaire concerning vocal symptoms. The voices of 510 teacher students for comprehensive schools, upper secondary schools and day care centers were perceptually assessed, and 120 of these students underwent a clinical examination by a phoniatrician. Twenty students with voice disorders received voice therapy in small groups and the results of that therapy were compared to those of a control group of 20 students with similar voice disorders who did not receive voice therapy.

The results of these investigations showed that about one fifth of the teacher students reported frequently occurring vocal symptoms and that most of these students had an organic voice disorder (Study I and II). Teacher students reported more vocal symptoms occurring weekly or more frequently than students studying other subjects at the same university (Study III). The proportion of teachers reporting vocal symptoms in comprehensive schools and upper secondary schools seems to have increased over a twelve-year period (Study IV). Furthermore, the proportion of teachers reporting two or more frequently occurring vocal symptoms also increased, suggesting that voice problems among teachers are increasing. Voice therapy given in small groups of students with voice disorders identified by means of a voice screening test seems to be a cost-effective method of treating mild voice disorders detected at an early stage (Study V).

Vocal symptoms, voice disorders, voice screening test, teacher students, teachers, voice group therapy

CONTENTS

LIST OF ORIGINAL PUBLICATIONS

I Simberg, S., Laine, A., Sala, E., Rönnemaa, A-M. Prevalence of Voice Disorders Among Future Teachers. Journal of Voice vol. 14 no. 2, 2000; 231–235.

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III Simberg, S., Sala, E., Rönnemaa, A-M. A Comparison of the Prevalence of Vocal Symptoms among Teacher Students and Other University Students. Journal of Voice vol. 18 no. 3; 2004; 363–368.

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1 INTRODUCTION

The importance of the voice as an occupational tool in a number of professions today is unambiguous. More than a fourth of the total labor force in Finland works in such professions although the vocal demands imposed on them vary from profession to profession (Laukkanen, 1995). Singers and actors have traditionally been seen as professional voice users. During the last decades several studies have been devoted to the use of the voice as a tool of the trade for a large number of other occupations (Coyle, Weinrich, & Stemple, 2001; Fritzell, 1996; Herrington-Hall, Lee, Stemple, Niemi, & McHone, 1988; Titze, Lemke, & Montequin, 1997). Among the professions mentioned in these studies are lawyers, telephone operators, broadcasters, priests, counselors and various kinds of teaching professions.

The impact of voice disorders in professions where the voice is an occupational tool is two-fold. They not only have a negative effect on the quality of life of those who suffer from them (Ma & Yiu, 2001; Roy, Merrill, Thibeault, Gray, & Smith, 2004; Smith et al., 1996; Yiu, 2002), but they also burden society with additional health care expenses (Verdolini & Ramig, 2001). Voice problems negatively affect job performance (Roy, Merrill Thibeault, Gray et al., 2004; Russell, Oates, & Greenwood, 1998; Sapir, Keidar, & Mathers-Smith, 1993; Smith et al., 1996), and about 20% of the teachers have been reported to miss workdays because of voice problems (Roy, Merrill Thibeault, Gray et al., 2004; Sapir et al., 1993; Smith, Gray, Dove, Kirchner, & Heras, 1997).

The awareness of voice disorders as a work-related disease has increased, and voice disorders have been accepted as occupational disorders in some European countries, even if not as a rule (Vilkman, 2004). Still, health care and occupational safety for professional voice users are poor, and the duty to prevent voice disorders falls on the employee (Vilkman, 2000). This indicates that voice problems are mainly seen as personal problems that have been caused by one's own voice limitations or by abuse of the voice. In order to develop occupational voice care for those who work in vocally demanding professions, it is essential to demonstrate the relationship between voice use and voice disorders (Rantala, Vilkman, & Bloigu, 2002; Sala, Laine, Simberg, Pentti & Suonpää, 2001; Södersten, Granqvist, Hammarberg, & Szabo, 2002; Vilkman, 2004). Teaching as a profession places high on voice endurance because of the need to speak loudly for long periods, often under unfavorable circumstances caused by loud background noise and poor acoustic conditions (Pekkarinen & Viljanen, 1991; Rantala, Paavola, Körkkö & Vilkman, 1998; Sapienza, Crandell & Curtis, 1999). Finland has seen a rapid growth in the number of persons who work in educational occupations. In 1970 there were about 55, 700 such persons (Statistics Finland, 1995). In 2000, about 112, 200 persons were working as teachers (Statistics Finland, 2003).

1.1 Studies on the prevalence of voice problems in teachers

The teaching voice has been of special interest in several studies conducted in different parts of the world. The results of these studies show that teachers frequently report vocal symptoms (e.g. Pekkarinen, Himberg & Pentti, 1992; Roy, Merrill, Thibeault, Parsa, Gray, & Smith, 2004; Russell et al.,1998; Sala et al., 2001; Sapir et al., 1993; Smith et al., 1997). The statistical data in published reports concerning voice problems among teachers vary depending on the study populations, on the methods used in the studies and on how voice problems and voice disorders are defined. In most of these studies, data have been collected through questionnaires. In their review of published research on voice problems among teachers, Mattiske, Oates and Greenwood (1998) point out that such data are limited and that studies often lack an operational definition of what could be considered a voice problem or a voice disorder. The literature on voice disorders has proposed a variety of definitions of what should be considered as a voice disorder. Voice disorders have traditionally been defined in terms of deviant quality, pitch, and loudness (e.g. Aronson, 1985; Boone, 1983) and by deviant structure and/or function of the laryngeal mechanism (e.g. Stemple, 1995). A broad definition of self-reported voice disorders used in a resent study by Roy, Merrill, Thibeault, Parsa, et al. (2004) was " any time the voice does not work, perform, or sound as it normally should, so that it interferes with communication". The definition of voice disorders in an occupational context depends on the demands set upon the voice, and voice endurance is an essential criterion (Vilkman, 2004).

Although the questionnaires used in different studies vary considerably, the results are in broad agreement as to the self-reported vocal symptoms. The most frequently reported vocal symptoms in several studies seems to be voice tiring, hoarseness, sensations of pain or discomfort in the throat, weak voice and lower pitch (Pekkarinen et al., 1992; Roy, Merrill, Thibeault, Gray et al., 2004; Sala et al., 2001; Sapir et al., 1993; Smith et al., 1997; Smith, Lemke, Taylor, Kirchner, & Hoffman, 1998). The definition of the prevalence period also varies considerably and probably has an impact on the results, at least partly due to the inability of the respondents to remember how long the symptoms persisted. The results of a study by Pekkarinen et al. (1992) showed that 12% of the teachers reported one vocal symptom and 5% reported two symptoms or more occurring weekly or more frequently during a two-year period. In a study by Roy, Merrill**,** Thibeault, Parsa, et al. (2004), 58% of the teachers reported that they had experienced adverse vocal symptoms during their lifetime, and 11% reported current symptoms. In some studies reporting the prevalence of current vocal symptoms, the frequency of symptoms is higher with about 30% of the teachers reporting two symptoms (Smith, Lemke et al., 1998) to 52% of the teachers reporting three or more symptoms (Sapir et al., 1993). The discrepancies in the results reported in different studies have been suggested to be at least partly due to the differences in sample sizes

(Roy, Merrill, Thibeault, Parsa, et al., 2004). Questionnaire studies reporting vocal symptoms among classroom teachers and daycare center teachers performed from 1992 to 2001 are presented in Table 1.

TABLE 1. *Prevalence of vocal symptoms among teachers.*

Authors	N	Symptoms occurring	Percent of teachers reporting symptoms
Pekkarinen et al., 1992	478	Weekly or more frequently over a two-year period	12% (one symptom) 5% (two or more symptoms)
Gotaas & Starr, 1993	201	Symptom at least once a month	28%
		Symptom at least once a week	12%
Sapir et al., 1993	237	Current symptoms	22% (one to two symptoms) 52% (three or more symptoms)
		Career-linked symptoms	26% (one to two symptoms) 33% (three or more symptoms)
Smith et al., 1997	242	Current symptoms	26% (one symptom) 43% (two or more symptoms)
Smith, Lemke et al., 1998	554	Current symptoms	20% (one symptom) 30% (two or more symptoms)
Russel et al., 1998	877	Every six months or more frequently during the career	22% (female); 12% (male)
		Every 2-3 months or more frequently over a one-year period	23% (female); 14% (male)
		On the day of the survey	18% (female); 12% (male)
Sala et al., 2001	262	Symptoms weekly or more frequently over a one-year period	54% (one symptom) 37% (two or more symptoms)
Roy, Merrill, Thibeault, Parsa, et al., 2004	1243	Symptoms during lifetime Current symptoms	58% 11%

Of the studies mentioned in Table 1, two study populations included an unspecified number of daycare center teachers (Russel et al., 1998; Sapir et al., 1993). In the study by Sala et al. (2001), which focused entirely on daycare center teachers, 54% of the teachers reported one symptom and 37% reported two symptoms or more occurring weekly or more frequently during the past year. This study also included a phoniatric examination of all the 262 participants. The results of the examination revealed that almost 30% of the daycare center teachers had organic findings on their vocal folds.

1.2 Teachers as a treatment-seeking population for voice disorders

As to voice disorders, teachers have been reported to be statistically over represented in treatment-seeking populations (Cooper, 1973; Fritzell, 1996; Morton & Watson, 1998; Titze et al., 1997). Persons whose occupations places high demands on the voice might seek help for their voice problems more often than others (Mattiske et al., 1998; Vilkman, 2000). However, teachers are not necessarily very active in looking for help. Studies show that only a small percentage of teachers who report voice problems seek professional help (Roy, Merrill, Thibeault, Parsa, et al., 2004; Russel et al., 1998; Sapir et al., 1993; Smith, Lemke et al., 1998). The reasons for this have not been explored but practical and economic causes have been suggested (Sapir et al., 1993; Smith, Lemke et al., 1998). Teachers might also be ignorant about where to get help, or perhaps help is not easily available. The results of a study by Roy, Merrill, Thibeault, Parsa, et al. (2004) showed that about 14% of the teachers who reported past voice disorders had sought professional help for their disorder. In some studies only about 1% of the teachers who reported voice problems had sought professional help (Russel et al., 1998; Sapir et al., 1993). In a study by Miller and Verdolini (1995), 56% of the teachers of singing who reported current voice problems had sought professional help but no one of these teachers received voice therapy for their problems. Additionally, only a few teachers who reported past voice problems had received voice therapy (Miller & Verdolini, 1995). Teachers might think that their voice problems are a normal inconvenience in their occupation (Morton & Watson, 1998; Russel et al., 1998; Sapir et al., 1993), which may account for why they do not seek help at an early stage. Another reason for ignoring to seek early help may be that persons adapt to such adverse vocal symptoms as hoarseness (Sonninen, 1970). Voice disorders may also be difficult to diagnose. The results of a retrospective study by Hertegård (1988) showed that voice disorders are not necessarily always correctly diagnosed by primary health care units. Those receiving faulty diagnoses do not receive adequate treatment for their disorder.

1.3 Background factors of voice disorders in teachers

During the last decade the definition of voice disorders as occupational disorders for those who work in professions that place high demands on vocal performance has become an important issue (Dejonckere, 2001; Sala et al., 2001; Titze, 2001; Vilkman,

1996; 2000; 2001; 2004). The primary risk factors for voice disorders in persons who work in occupations where the voice is an essential tool is the need for prolonged voice use and factors in the working environment that can affect voice production (Sala et al., 2001; Vilkman, 2000; 2004). The background factors for voice disorders are manifold, and individual factors related to health and stress may also have an adverse effect on the voice (e.g. Aronson, 1985; Sataloff, 1991; Stemple, 1995).

1.3.1 Vocal loading

Most of the communication in classrooms is verbal, and teaching involves sustained and extensive use of the voice, usually referred to as vocal loading. In studies involving control groups teachers have reported more vocal symptoms and voice problems than persons in other occupations, indicating that the vocal loading is an increased risk factor for developing voice disorders (Gotaas & Starr, 1993; Morton & Watson, 1998; Ohlsson, Järvholm & Löfqvist, 1987; Pekkarinen et al., 1992; Roy, Merrill Thibeault, Gray et al., 2004; Roy, Merrill, Thibeault, Parsa, et al., 2004 ; Sala et al., 2001; Smith, Lemke et al.,1998). Teachers use a higher fundamental frequency (F0) during lessons than during breaks (Rantala & Vilkman, 1999) and their F0 increases toward the end of the working day, which might be an effect of vocal loading (Rantala et al., 2002). Teachers report that they have had more vocal symptoms since they began teaching than they had previously (Sapir et al., 1993). These symptoms have been found to appear more often in the afternoon and at the end of the week (Pekkarinen et al., 1992; Sala et al., 2001), and voice quality appears to improve during the school holidays (Morton & Watson, 1998). These reports indicate that there is a strong connection between vocal symptoms and teaching.

As to laryngeal pathologies associated with occupations, vocal nodules has been found to be the most common pathology of both students and teachers, and teachers have been reported to have a higher incidence of vocal nodules than persons in other occupations (Coyle et al., 2001). From a clinical perspective, vocal fold nodules are associated with vocal abuse and misuse (Aronson, 1985; Boone 1983; Chagnon & Stone, 1996; Stemple, 1995). According to Vilkman (2000), the use of such terms as vocal abuse can conceal the fact that teaching involves prolonged voice use, which is a risk factor for voice disorders. For example, a study by Sala et al. (2001) showed that daycare center teachers had significantly more findings of vocal nodules and laryngitis compared to hospital nurses. The daycare center teachers were found to have used their voices for significantly longer periods than the nurses. Additionally, they used significantly higher voice levels, indicating a strong relationship between the prevalence of voice disorders and long speaking times with high voice levels associated with their occupation (Sala et al., 2002).

Methods have been developed in order to measure vocal loading in field conditions among persons who work in vocally demanding occupations. Voice use can be documented by voice accumulators (Airo, Olkinuora, & Sala, 2000; Buekers, Bierens,

Kingma, & Marres, 1995; Cheyne, Hanson, Genereux, Stevens, & Hillman 2003; Ohlsson, Brink, & Löfqvist, 1989) and with portable DAT recorders (Rantala, Haataja, Vilkman & Körkkö, 1994; Rantala & Vilkman, 1999; Rantala et al., 2002; Södersten et al., 2002; Szabo, Hammarberg, Håkansson, & Södersten 2001). In order to have voice disorders acknowledged as occupational disorders for those who work in vocally demanding occupations, measuring vocal loading during work is of great importance. Since individual factors should be distinguished from work-related factors, it is also important to assess voice use during leisure time (Szabo, 2004).

1.3.2 Environmental factors associated with vocal loading

Prolonged voice use is not the only risk factor for voice disorders in vocally demanding occupations, for environmental factors, such as background noise, acoustic conditions and air quality, also contribute to voice disorders (e.g. Morton & Watson, 1998; Pekkarinen & Viljanen, 1991; Vilkman, 1996). In some studies, classrooms have been found to provide poor acoustic conditions (Knecht, Nelson, Whitelaw, & Feth, 2002; Pekkarinen & Viljanen, 1991). The acoustics of the rooms in daycare centers and preschools have also been found to be unsatisfactory (Sala et al., 2002; Truchon-Cagnon & Hétu, 1988). There are several sources of background noise in the classroom. Noise from the activity of the pupils and from ventilation and air conditioning can be disturbing. In addition, external background noise, such as noise from traffic or from the schoolyard, can be disturbing (Crandell & Smaldino, 2000; Knecht et al., 2002). Background noise affects the pupils' ability to perceive speech (Crandell & Smaldino, 2000). Accordingly, teachers have to raise their voice to ensure that their voices are heard in noisy and reverberant classrooms (Nelson & Soli, 2000; Pekkarinen & Viljanen, 1991). Studies have shown that teachers frequently report that they have to speak over background noise (Pekkarinen et al., 1992; Smith et al., 1997; Smith, Kirchner, Taylor, Hoffman, & Lemke, 1998), and teachers have even reported that they commonly feel that they have to shout in order to be heard at work (Ohlsson et al., 1987). The Finnish Ministry of the Environment provides specifications for background noise levels and reverberation times in classrooms. Nevertheless, classrooms in Finnish schools have been found to be too reverberant and to have excessively high levels of background noise that causes teachers to increase their vocal effort (Pekkarinen & Viljanen, 1991).

Two studies on vocal loading of persons working in daycare centers and preschools have shown that the background noise levels were high for speech communication and that the persons working in that environment used their voice for long times at high levels (Sala et al., 2002; Södersten et al., 2002). The study by Sala et al. (2002) showed that the persons working in daycare centers used their voice more and used higher voice levels than nurses in a control group. This probably explains why teachers in daycare centers reported significantly more vocal symptoms than the nurses in the control group (Sala et al., 2001).

Low air humidity also has a negative impact on voice production (Hemler, Wieneke, & Dejonckere, 1997; Vilkman, Lauri, Alku, Sala, & Sihvo, 1997; 1998; Verdolini, Titze, & Fennell, 1994; Vintturi, Alku, Sala, Sihvo, & Vilkman, 2003). There do not seem to be recommendations as to the relative humidity levels (Vilkman, 2004) but dry air has been associated with strenuous voice production and vocal symptoms during vocal loading tests in laboratory conditions (Vintturi, 2001). Finnish teachers' complaints about dry air in the schools have been found to be frequent (Viljanen & Pekkarinen, 1989).

1.3.3 Health-related factors

Infections of the upper airways caused by common colds constitute a general cause of temporary voice problems (Stemple, 1995; Woo, 1996). One factor implicated as cause of voice problems among teachers is that they are frequently exposed to viruses associated with upper respiratory tract infections (Sala et al., 2001; Smith et al., 1997). The results of a study by Roy, Merrill, Thibeault, Parsa, et al. (2004) showed that teachers reported significantly more colds annually compared to non-teachers. In a similar vein, Sala et al. (2001) showed that daycare center teachers reported a higher prevalence of rhinitis symptoms of long duration and sinusitis compared to a control group of hospital nurses.

Teachers have also been found to have laryngitis significantly more often than non-teachers (Roy, Merrill, Thibeault, Parsa, et al., 2004; Sala et al., 2001). Laryngitis can be acute, due to viral or bacterial infection, or it can be a chronic disorder (e.g. Aronson, 1995; Stemple, 1995; Woo, 1996). Reflux laryngitis is one form of chronic laryngitis that has an impact on the voice (Coyle, 2001; Koufman, Sataloff, & Toohill, 1996; Sataloff, 1991; Woo, 1996). The work of teachers with young children includes bending and lifting, which might provoke reflux, and the vocal loading itself might be a factor contributing to laryngitis (Sala et al., 2001).

Allergies also seem to be a risk factor contributing to voice disorders (Roy, Merrill, Thibeault, Parsa, et al., 2004; Sala, Hytönen, Tupaselä, & Estlander, 1996; Gotaas & Starr, 1993; Spiegel, Hawkshaw, & Sataloff, 1991; Stemple, 1995; Woo, 1996), and special attention should be paid to the treatment of allergies in professional voice users (Jackson-Menaldi, Dzul, & Holland, 1999; Spiegel et al., 1991). Allergic reactions to mold have also been mentioned as one risk factor for voice disorders (Spiegel et al., 1991), and exposure to mold has been associated with respiratory tract problems in adults who live in houses with mold problems (Koskinen, Husman, Meklin, & Nevalainen, 1999). During the last few years, an increasing number of reports of mold problems due to water damage in schools and daycare centers have appeared in Finnish newspapers. Children attending a school with mold problems have been found to report significantly more respiratory tract infections and prolonged cough symptoms compared to children from a school without mold problems (Taskinen, Hyvärinen, Meklin, Husman, Nevalainen, & Korppi, 1999). Although the effect of exposure to mold on

teachers has apparently not been studied, mold exposure in schools might be related to adverse vocal symptoms in teachers working in such schools.

1.3.4 Stress-related factors

Several authors have mentioned psychological stress as a factor contributing to voice problems among teachers (Gotaas & Starr, 1993; Morton & Watson, 1998; Sapir et al., 1993). The numerous stress factors that have been linked to teachers work include disrespectful behavior of pupils and noise in classrooms caused by misbehaving pupils (Boyle, Borg, Falzon, & Baglioni, 1995; Friedman, 1995; Griffith, Steptoe, & Cropley, 1999; Jacobsson, Pousette, & Thylefors, 2001; Santavirta, Aittola, Niskanen, Pasanen, Tuominen, & Solovieva, 2001). Poor classroom acoustics might also have a negative effect on disciplinary issues, as it might have an impact on the pupils' concentration and thus raise noise levels (Knecht et al., 2002). The attitudes of an undergraduate student population towards teachers with moderate voice disorders have been found to be more negative than attitudes towards teachers without voice disorders (Lallh & Rochet, 2000). This could have a negative effect on the pupils' behavior in the classroom, which, in turn, might increase stress in teachers. Teachers who experience stress may deal with a vicious cycle: stress contributes to voice problems and voice problems contribute to stress. In educational settings communication is based on speech. The results of several studies show that teachers report that their voice problems have a negative effect on their performance at work (Roy, Merrill Thibeault, Gray et al., 2004; Russel et al., 1998; Sapir et al., 1993; Smith et al., 1997; Smith, Lemke et al., 1998). The occurrence of vocal symptoms and voice disorders in professions where the voice is an essential tool may cause stress and anxiety (Wellens & van Opstal, 2001).

1.4 Studies on voice disorders in students

There are some epidemiological studies concerning voice disorders and vocal symptoms in students. The results from the different studies vary to a high degree depending on how voice disorders or adverse vocal symptoms are defined, on the methods used in the studies and on the study populations.

In a ten-year survey of speech disorders in more than 30,000 university students studying a variety of subjects, Morley (1952) found that 0.65 % of the students had a voice disorder. In that study, speech examiners performed the screening, which included a brief questionnaire and a perceptual evaluation during a reading task and conversation. Unfortunately, Morley's study lacks a description of the definitions or criteria used for classifying a voice as disordered. A Finnish questionnaire study by Linnasalo (1990) showed that 13% of the 906 first-year university students participating reported that their voice tired if they talked for a long time and 0.6% had received voice therapy as children or adolescents.

Some studies focused on students studying for vocally demanding occupations. The results of a study by Yiu (2002) showed that 10% of 67 teacher students, representing almost all of the teacher students in their final year at that university, had seen a laryngologist one or two times because of voice problems. The results of the studies of voice problems among future elite voice users show high numbers of vocal symptoms. A survey by Sapir (1993) showed that the most common symptoms reported by voice students (students studying in order to become singers) were dryness of the throat, throat tightness and vocal fatigue, throat discomfort, hoarseness, reduced pitch and pain in the throat. Forty-seven percent of the voice students had been to a doctor because of voice problems. Of the students, 61% reported that three or more of the symptoms were occurring frequently. These students also often reported that they were worried, depressed or anxious because of their voice problems. In another study (Sapir, Mathers-Schmidt & Larson, 1996) voice students were found to have reported dryness, discomfort and tightness in the throat significantly more often than other students of the same age. Voice students were found to have sought medical help for their voice problems significantly more often than other students, and they were significantly more likely to have reported vocally abusive speech habits (Sapir et al., 1996). A study of vocal risk profiles of first-year full-time acting students by Winkworth and McCabe (2001) showed that 54% of the students reported current vocal symptoms ranging from deviant voice quality to chronic respiratory tract problems. Additionally, 20% of the acting students had a maximum phonation time on 16 seconds or less. In a study by Timmermans, De Bodt, Wuyts, Boudewijns, Clement, Peeters, & Van de Heyning (2002) using a multidimensional voice assessment protocol on future elite vocal performers and professional voice users, first-year students were found to have a high incidence of poor voice quality, and 27% had inflammatory lesions on their vocal folds. A study of radio students (Timmermans, De Bodt, Wuyts & Van de Heyning, 2003) revealed that 48% had reported hoarseness and that 37% had reported vocal fatigue. Students who study for vocally demanding occupations and have voice disorders should preferably be treated before they enter the workforce in order to prevent the disorders from becoming more severe. However, there do not seem to be any studies on voice therapy for students or any reports including information on how this therapy should be arranged. The results of some studies of voice problems among university students or other students of the same age are presented in Table 2.

TABLE 2. *Studies concerning voice disorders and vocal symptoms among students.*

Study	Study population	N	Methods	Voice problems
Morley, 1952	University students	33,139	Questionnaire, perceptual evaluation	0.65% (voice disorders)
Linnasalo, 1990	University students	906	Questionnaire study	13% (voice tiring after prolonged voice use)
Sapir, 1993	Voice students	74	Questionnaire study	61% (three or more vocal symptoms)
Winkworth & McCabe, 2001	Acting students	200	Voice screening	54% (vocal symptoms)
Timmermans et al., 2002	Future elite vocal performers and professional voice users	86	Multi-dimensional voice assessment protocol	27% (inflammatory lesions on the vocal folds)
Yui, 2002	Prospective teachers	67	Questionnaire study	10% (consulted laryngologist because of voice problems)
Timmermans et al., 2003	Radio students	27	Questionnaire study	48% (hoarseness)

1.5 Prevention of voice disorders

Several authors have addressed the importance of the prevention of voice disorders among those who work in vocally demanding occupations, such as teachers (e.g. Buekers et al., 1995; Cooper, 1973; De Bodt, Wuyts, Van de Heyning, Lambrechts, & Abeele, 1998; Fritzell, 1996; Morton & Watson 2001a; Ohlsson, 1989; Roy, Merrill Thibeault, Gray et al., 2004; Russel et al., 1998; Sapir et al., 1993; Smith et al., 1997; Verdolini & Ramig 2001; Yui 2002). Ohlsson (1989) has suggested that speech therapists should be included on the health care teams of the occupational health care units in order to facilitate preventative voice care for employees. Marge (1991) has identified two types of prevention. Primary prevention refers to elimination of something that might cause a voice disorder, for example to stop smoking so as to prevent future voice disorders, while secondary prevention involves early detection and treatment of voice disorders.

1.5.1 Vocal hygiene education and training programs

Several studies have reported on the outcome of vocal hygiene education and voice training for subjects who do not suffer from voice disorders but who belong to risk groups for getting them. Kaufman and Johnson (1991) developed a preventative voice program for teachers including a videotape and a booklet in which the anatomy and physiology of voice production, common voice pathologies, prevention strategies and early warning symptoms for voice disorders were described. According to the authors, the program received a positive response from the teachers; however, no further evaluation of the effectiveness of this program seems to have been made. In a prospective experimental study by Chan (1994) concerning the effects of preventive vocal hygiene education for daycare center teachers, the participants attended a 90-minutes workshop session and followed a vocal hygiene regimen for two months. The results indicated that the participants showed significant voice improvement compared to daycare center teachers in a control group who did not participate in the vocal hygiene education program. According to Yui (2002), teachers would like to learn more about voice care and voice production and they think that vocal hygiene strategies would help them to prevent voice problems. As content for a vocal hygiene program teachers suggested voice care strategies, breathing exercises and proper voice production methods. As for the most common strategies to avoid voice problems, they mentioned speaking softly, hydration (to drink water), speaking less and the use of amplifiers (Yui, 2002). Education in vocal hygiene might be effective as a preventative measure, but the results of two studies (Holmberg, Hillman, Hammarberg, Södersten, & Doyle, 2001; Roy, Gray, Ebert, Dove, Corbin-Lewis, & Stemple, 2001) indicate that, if not combined with more direct treatment approaches, vocal hygiene education does not seem to be an effective method of treatment for those who have already suffered from voice disorders.

Since 1989, preventative voice workshops for teachers have been arranged in the United Kingdom, and the response of the teachers attending the courses has been positive (Comins, 1992). In Finland, the results of a two-day vocal training course using both an indirect and a direct approach, including vocal hygiene education and vocal exercises for call-center customer service advisors as reported by Lehto, Rantala, Vilkman, Alku and Backström (2003), showed that the participants perceived that their vocal symptoms had decreased and that the vocal hygiene education and the vocal training had improved their vocal habits. In the studies by Comins (1992) and Lehto et al. (2003) the participants themselves assessed the effectiveness of the treatment. The results of a study by Ohlsson (1993) showed that teachers and daycare center personnel who received voice training in groups for 15 sessions during two terms including some individual training were of the opinion that their vocal symptoms had decreased and that their voice quality had improved. This result was supported by acoustical and perceptual analyses of the participants' voices. In a six-week course for professional voice users consisting of six weekly sessions of two hours each, the overall aim was to increase the

participants' ability to use their vocal apparatus and to make them more aware of the context in which they use their voices (Comins, 1995). The participants' subjective opinion was that they benefited greatly from the course. A follow-up study reporting the results from the acoustic analyses of the recordings made of the participants' voices before and after the course supported this opinion (Rossiter, Howard, and Comins, 1995).

Some studies have focused on the benefits of voice training for students. A study by Broaddus-Lawrence, Treole, McCabe, Allen and Toppin (2000) evaluated the effects of vocal hygiene education in a group of undergraduate voice students where the students attended four one-hour lectures on vocal hygiene issues. The results of that study showed minimal changes in vocal behaviors even though the students reported a high degree of satisfaction with the education. Sabol, Lee and Stemple (1995) evaluated the effectiveness of systematic vocal function exercises performed twice a day for15-20 minutes during four weeks for graduate-level voice students. The results showed that the exercises had had a positive effect on the phonation systems of healthy young singers; there were significant improvements in the aerodynamic measures of the students in the vocal function exercise group compared to the students in the control group. Forty hours of voice training for prospective speech therapists who had incomplete vocal fold closure has been reported to have a positive effect (Södersten & Hammarberg, 1993). Even if the glottal chink was still observed in most of the subjects, the perceptual and acoustic outcome measures showed that their voice quality had improved significantly. The results of a study by Timmermans, De Bodt, Wuyts and Van de Heyning (2004) showed that 30 hours of vocal hygiene education and 60 hours of voice training during a two-year period for prospective actors and radio directors improved the participants' voice quality compared to students in a control group who did not receive vocal hygiene education and voice training. Some of the studies concerning training programs are presented in Table 3.

TABLE 3. *Studies concerning voice-training programs for professional voice users and students studying for vocally demanding occupations.*

Study	Population	Method	Control group	Outcome
Kaufman & Johnson, 1991	Teachers, N unknown	Videotape and booklet	No control group	Positive response from the teachers
Ohlsson, 1993	Teachers and daycare center personnel, N=45	Group training and individual training, 15 sessions	No control group	Acoustic and perceptual analysis: progress
Södersten & Hammarberg, 1993	Prospective speech therapist with incomplete vocal fold closure, N=8	Voice training, 40 hours	No control group	Acoustic and perceptual analysis: progress
Chan, 1994	Kindergarten teachers, N=12	Workshop session and practice of vocal hygiene for two months	Control group, kindergarten teachers, N=13	Acoustic analysis: progress
Comins, 1995; Rossiter et al., 1995	Professional voice users, N=9	Six voice training sessions	No control group	Acoustic analysis: progress
Sabol et al., 1995	Voice students, N=10	Vocal function exercises during four weeks	Control group, graduate-level voice students, N=10	Acoustic and aerodynamic analysis: progress
Broaddus-Lawrence et al., 2000	Voice students, N=11	Four lectures on vocal hygiene issues.	No control group	Minimal changes in vocal behaviors
Lehto et al., 2003	Call-center customer service advisors, N=48	Two-day vocal training course	No control group	Decrease of vocal symptoms and better vocal habits
Timmermans et al., 2004	Prospective actors and radio directors N=23	Vocal hygiene education, 30 hours and voice training, 60 hours	Control group, prospective film and TV directors, N=23	Acoustic and perceptual analysis: progress

One component of prevention is screening for voice disorders (Marge, 1991). One massive form of voice screening of prospective students in vocally demanding occupations, such as different kinds of teaching, acting, singing and similar occupations, took place in the former German Democratic Republic over several decades (Seidner & Wendler, 2001). All candidates for these occupations were required to undergo voice and speech examinations before they were accepted into the educational programs and were assessed as 'fit' or 'unfit'. If the condition was classified as treatable, the person received treatment and attended a follow-up examination where suitability for the occupation was re-evaluated. Even though these fitness examinations are no longer obligatory, they have probably contributed to the development of preventive voice care (Seidner & Wendler, 2001).

According to Buekers (1998), teachers who develop voice complaints and have only a few years of teaching experience have chosen the wrong profession. To prevent this, he recommends measuring vocal performance in order to assess suitability for a voice demanding profession. A longitudinal study by De Bodt et al. (1998) investigating whether voice problems among teachers could be predicted showed that the vocal endurance test used in the study was not adequate for this purpose but that a combination of laryngeal examination, measurement of maximum phonation time and a perceptual examination of voice quality of first-year teacher students served this purpose. According to the authors, this combination could be used as a preventative measure in order to identify and help students at risk of voice disorders.

Since students studying for vocally demanding occupations have been found to have voice problems (Sapir, 1993; Timmermans et al., 2002; 2003; Winkworth & McCabe, 2001; Yui, 2002), they should preferably receive information on voice related issues and voice training during their studies. In some teacher training schools it is a standard practice that all students undergo a voice examination (Orr, De Jong, & Cranen, 2002) but these measures probably vary significantly between different schools and countries. According to Comins (1992), primary school teachers in the United Kingdom do not receive any statutory training in voice care. This also seems to be the case in the Netherlands (Buekers, 1998). In Sweden, the educational program for preschool teachers offers limited or no voice training (Södersten et al., 2002). In Finland, issues relating to voice receive little attention in educational programs for teachers. Most students at Finnish universities take part in a compulsory course (1-2 credits) in communication skills. However, the content of this course varies from university to university and information about ergonomic factors in vocal behavior is not necessarily included at all, not even for those who are preparing themselves for careers as teachers (Laine & Simberg, 1999). A beneficial effect of voice training for students studying in order to become teachers was reported in a longitudinal study by Bistrizki and Frank (1981, cited by Sapir et al., 1993). The results of that study revealed that elementary school teachers who received weekly lessons on vocal hygiene and voice use during one year of their studies reported significantly fewer vocal symptoms 2 - 4 years after they had begun teaching compared to a group of teachers who did not receive such training.

Morton and Watson (2001a) have proposed that health professionals and educational authorities should be informed about occupational voice disorders and that specific modules focusing on voice protection should be included in teacher training.

1.5.2 Use of amplifiers as a preventive measure

Modern technology has developed new devices, such as amplifiers, in order to prevent voice disorders. Amplification has been reported to reduce the vocal loading of teachers (Jónsdottir, Rantala, Laukkanen & Vilkman, 2001; Sapienza et al., 1999), and the use of amplifiers might be the fastest way to reduce vocal load (Vilkman, 2004). In perceptual evaluation, overall voice quality has been found to be better, and the teachers' voices have been perceived as less strained when using amplifiers. Additionally, the teachers also reported that they found it easier to speak and experienced less voice tiring when using amplifiers (Jónsdottir, Laukkanen, & Siikki, 2003). The use of amplifiers has been found to be more effective than vocal hygiene instruction for teachers who already have voice disorders (Roy et al., 2002). According to the results of a study by Jónsdottir (2002), teachers reported that they had a reduced need for repetition when using amplifiers. Furthermore, they reported that the students performed better due to higher concentration levels. The students were mostly positive to the teachers' use of amplifiers and were of the opinion that they could hear more clearly. However, both students and teachers reported that they encountered several technical problems that were partly due to the teachers' lack of skill in using the equipment (Jónsdottir 2002). These are, of course, problems that can be corrected, and Jónsdottir (2003) recommends that the use of amplifiers should be general standard practice and that classrooms in the future should be automatically provided with amplification systems. Like Yui (2002), who considers the use of amplifiers as a passive or conservative strategy, Jónsdottir (2003) emphasizes that amplification should not be looked on as a substitute for education in vocal hygiene or voice training, and that acoustical conditions in classrooms should be improved. Since adding amplified sound through speakers into noisy and reverberant rooms can cause problems, including heightened noise levels, Nelson and Soli (2000) point out that the need to improve classroom acoustics is more crucial than the use of amplifiers. Because, according to Titze (2001), amplification might even worsen poor vocal habits and make teachers' speech less interesting and expressive, he emphasizes the need to develop vocal skills prior to amplification.

1.6 Summary

As described in this chapter, the results of several studies show that teachers frequently report vocal symptoms and that studies involving control groups reveal that teachers seem to be at high risk of having voice problems. Teachers are over represented in treatment-seeking populations even if they do not necessarily seem to seek professional help for their voice problems at an early stage. This indicates that the number of

teachers who might need voice therapy and medical care might actually be even higher than is revealed by statistics from treatment-seeking populations.

The background factors for increasing the risk that teachers will have voice disorders seem to be well recognized. The principal factor is the vocal loading associated with the work itself in combination with environmental factors, such as background noise and poor acoustics in the classrooms. Problems related to general health and stress are background factors contributing to voice problems, and teachers are exposed to these factors at work.

Authors have agreed on the importance of preventing voice disorders in persons working in vocally demanding occupations. Vocal hygiene and voice training programs, individually and in combination, have been developed and evaluated in different parts of the world. The issue of preventative voice care unambiguously leads to the students studying for vocally demanding occupations. These students have been found to have voice problems, and several authors have addressed the need for preventative voice care for students. Some authors strongly emphasize that voice training should be a part of the curriculum for the students during their studies.

1.7 Aims of the present thesis

The overall aims of the research done for the present thesis were

- to investigate the prevalence of vocal symptoms and voice disorders among those who study in order to become teachers,

- to develop a model of early intervention which includes a voice screening test and group voice therapy for students who have mild voice disorders.

The results of Study I and Study II made it advisable

- to explore whether other university students report as high frequency of vocal symptoms as teacher students report, and

- to explore whether the proportion of teachers reporting vocal symptoms has changed within a twelve-year period.

2 SUBJECTS AND METHODS

2.1 Subjects

Data gathered from a total of 730 students and 719 teachers are presented in the five studies comprising this thesis. The subjects in Study I (N=226) were first-to sixth-year students who were studying at the Department of Teacher Education at the University of Turku, Finland, in order to become teachers in comprehensive schools and upper secondary schools. Their mean age was 24 years. The subjects in Study II (N=76), mean age 23 years and in Study V (N=40), mean age 21 years, were also students from the Department of Teacher Education but only first-year students were included in these studies. The subjects in Study V were chosen from 208 first-year students attending a voice screening test. These students were studying in order to become teachers in preschools and in comprehensive schools and upper secondary schools. The study populations were different in each study except for the 175 teacher students from Study I (N=226) who were included in the study population in Study III (N=395). For Study III, the data obtained from the first- to fourth-year teacher students were chosen, while data from the fifth-and sixth-year teacher students were excluded because some of them were already working full time as teachers even though they were still studying. The mean age of the subjects in Study III was 23 years. In Study IV (N=241) the subjects were teachers in comprehensive schools and upper secondary schools. Their mean age was 44 years.

Control groups were included in Studies III, IV and V. The control group in Study III consisted of 220 students studying various subjects at the University of Turku. Their mean age was 23 years. In Study IV, data were compared to the results from an earlier study (Pekkarinen et al., 1992). The data from that study were gathered in 1988 and consisted of response data from 478 teachers from 26 randomly selected schools in Turku. Their mean age was 41 years. Most of the teachers were working in comprehensive schools and upper secondary schools, while 23% of the teachers were teaching in vocational schools or some other kind of school. In Study V, 20 first-year students from the Department of Teacher Education at the University of Turku formed the control group. Their mean age was 23 years. The basic characteristics of the subjects in the studies are summarized in Table 4.

TABLE 4. *Basic characteristics of the subjects in Studies I-V: number of subjects, mean age (and range) and percentage of female subjects.*

Study	Study group (N)	Mean age (range)	Female %	Control group (N)	Mean age (range)	Female %
I	226	24 (19-47)	85			
II	76	23 (19 – 44)	70			
III	175	23 (19 – 46)	86	220	23 (18 – 50)	72
IV	241	44 (24 – 60)	78	478	41 (20 – 64)	66
V	20	21 (19 – 24)	100	20	23 (20 – 37)	100

2.2 Methods

2.2.1 Questionnaires

Questionnaires were used in all studies. The questionnaires varied to some extent in the different studies, but mainly they followed the guidelines of the Tuohilampi Questionnaire, which is a pool of questions for epidemiological studies that was developed for the Finnish Institute of Occupational Health (Susitaival & Husman, 1997). The questionnaire in Study I consisted of sixteen main groups of questions with numerous, mostly multiple-choice sub questions (in total 80 questions). The questionnaire was designed to provide information about the prevalence of vocal symptoms. Questions about respiratory tract health problems, previous voice problems, hobbies such as singing and sports and time spent in pubs or discotheques were also included. In Study II, the questionnaire only included the questions that turned out to be the most effective eliciting information about voice disorders in Study I. These were the questions concerning vocal symptoms. The questionnaire consisted of a total of nine questions and is included as an appendix in Study II. The questionnaire used in Study III consisted of eight questions and the questionnaire in Study V of seven questions. In Study I a question concerning the prevalence of morning hoarseness was included. The questionnaire in Study II also included this question but it was left out in the studies III and V. According to comments from the students this question was unclear and they interpreted it in various ways. The questionnaire used in Study V is now in normal use as a part of a voice screening test and is presented in the Appendix. The questionnaires in Studies I, II, III and V included questions about the following vocal symptoms: 1) *throat clearing or coughing,* 2) *the voice becomes low (low pitched) or hoarse without a cold,* 3) *the voice becomes strained or tires,* 4) *voice breaks while talking,* 5) *a sensation of pain or lump in the throat,* 6) *difficulty in being heard,* and 7) *loss of voice*. There are no standardized questionnaires for voice disorders (Carding, 2000), but similar symptoms are included in various ways in a large number of questionnaire studies. Additionally, six of these symptoms were studied in a questionnaire study concerning the prevalence of vocal symptoms among teachers (Pekkarinen et al., 1992) and in other, still unpublished studies in Finland. In Study I, the subjects were asked to report symptoms occurring *during the past month, the past year, and the past two years.* In Studies II, III and V the subjects were asked to report the vocal symptoms that had occurred *during the past year*. In all studies the frequency alternatives for the occurrence of vocal symptoms were 1) *every day or most days,* 2) *weekly or most weeks,* 3) *monthly or most months,* 4) *less often,* 5) *only periodic symptoms* and 6) *no symptoms.* In Studies I, II and III, a question inquiring whether the vocal symptoms had had an effect on the subjects' mood was included. This question was requested by the authorities from the Student Health Care Center.

The questionnaire in Study IV consisted of 25 main groups of questions with numerous, mostly multiple-choice sub questions (in total 60 questions). In Study IV the

subjects were asked to report the vocal symptoms that had occurred *during the past two years.* This study was a replication of an earlier study concerning voice disorders among teachers (Pekkarinen et al., 1992), and the information concerning vocal symptoms was inquired in identical form in both studies. Thus, in Study IV the question for the symptom *throat clearing or coughing* was left out since that question was not inquired in 1988. The questionnaire in Study IV included questions about health-related factors such as respiratory tract problems and previous voice problems. Questions concerning the working conditions, such as factors that disturb normal work routines, were asked with reference to a five-point scale (e.g. 0 = no disturbance, 5 = very much disturbance). Questions related to the indoor air quality and dust were also included. These questions were inquired with reference to a three-point scale (e.g. "have you been bothered by …"yes, every week" yes, less often", "never").

In Studies I – IV the questionnaires were completed once. In Study V the subjects completed the questionnaire three times: at onset of the study (during their first semester at the university), three months after the onset of the study and one year after the onset of the study. In Studies I, II and III the questionnaires were given to the subjects at the Student Health Care Center. In Study IV, the principals in the schools distributed the questionnaires to the teachers. In Study V, the questionnaires were given twice to the subjects at the Student Health Care Center and once the questionnaires were mailed to the subjects with a prepaid return envelop.

2.2.2 Perceptual analysis

Perceptual analysis of voice quality was used in Studies I, II and V.

2.2.2.1 Parameters and rating scales

The main parameter used for perceptual analysis in Studies I and II was Grade, (G) that is overall degree of dysphonia (Hirano, 1981). In Study II, two nurses and one speech therapist assessed the subjects' voice quality using all the GRBAS parameters. Since the results of that study showed that the highest inter- and intra judge correlation in the perceptual assessment was for the parameter Grade, this was chosen for the voice screening test used in Study V where Grade was assessed by the nurses performing the test. Additionally, in Study V the other GRBAS parameters, that is, Rough (R), Breathy (B), Asthenic (A) and Strained (S), and the parameters vocal fry and pitch (Table 5) were also used for perceptual assessment of recorded voice samples. In Studies I, II and V the perceptual assessments were made on visual analogue scales (VAS) (Wewers & Lowe, 1990). The parameters were evaluated using a 100 mm long VAS with the end anchors marked "no degree of" and "high degree of" except for the parameter pitch in Study V. For pitch, a 200 mm long VAS was used with "normal" set in the middle and "too low" and "too high" at the ends, respectively. Additionally, in Study V recorded vowel samples were rated for voice quality using one of three alternatives: "vowel A

better", "vowel B better" and "no difference". The parameters used for perceptual analysis in Study V were chosen by two senior speech therapists with more than 30 years of experience in voice evaluating based on a pilot listening to the voice samples.

TABLE 5. *The voice quality parameters evaluated on visual analogue scales.*

Parameter	Definition
Grade (G)	Overall degree of hoarseness or abnormality (Hirano, 1981), "overall degree of dysphonia"
Rough (R)	Impression of the irregularity of vocal cord vibrations (Hirano, 1981)
Breathy (B)	Impression of the extent of air leakage through the glottis (Hirano, 1981)
Asthenic (A)	Weakness or lack of power in the voice (Hirano, 1981)
Strained (S)	Impression of a hyperfunctional state of phonation (Hirano, 1981)
Vocal fry	A rapid series of taps, like a stick being run along a railing; low frequency periodic vibration (Askenfelt & Hammarberg, 1986)
Pitch	The chief auditory correlate of fundamental frequency (Askenfelt & Hammarberg, 1986)

In Study I, a score on 34 mm or higher on the VAS for the parameter Grade was chosen as the breakpoint between normal and deviant voice quality. This criterion was based on a pilot study made by two senior speech therapists listening to recordings of normal and disordered voices. A closer analysis of the results from Study I by plotting the evaluations for the parameter grade of 226 subjects in rank order showed that the graph exhibited an "elbow" with a rather abrupt associated discontinuity at 38.5 mm. This method has been used in some studies for evaluating voice quality and can be used as a breakpoint to separate normal from deviant values in a particular population (Sederholm, McAllister, Sundberg, & Dalkvist, 1993; Sederholm, 1995). Since the meaning of the voice screening test was to find possible subjects with voice disorders at an early stage, a score of 35mm was set as breakpoint in the screening test in Study II and Study V.

2.2.2.2 Recordings of the voice samples and materials for perceptual evaluation

In Study V, the subjects' voices were recorded during two phoniatric examinations conducted with an interval of about three months. Each recording consisted of a short reading passage of 55 words, lasting for about 30 seconds, and six prolonged /a/ vowels at a normal pitch and volume. The samples were recorded with a Sony DAT TCD-D8 recorder using a Sony ECM-MS 907 microphone. The microphone was positioned 30 cm from the subject's lips. In order to calibrate the intensity of the productions the recording levels were monitored for an approximately constant level on the VU meter of the recorder across subjects. A CD was prepared for perceptual evaluation of the voice

quality in two sentences produced by each subject. The sentences, which consisted of 13 words, were extracted from the middle of a reading passage and took about 10 seconds to read. Another CD was prepared for the perceptual evaluation of voice quality during prolonged /a/ vowel phonation. The middle 1.50 seconds of the third vowel of the six successive phonations was chosen for evaluation. The onsets and offsets of the vowel samples were smoothed using a 50 ms linear ramp, and the intensity of the vowels was normalized (root mean square) using the CoolEdit96 software. The voice samples were randomized on the CDs so that the judges did not know whether the sample was recorded at the start of the study or three months later when the subjects in the treatment group had received voice therapy. The voice samples of 15 subjects were selected randomly and duplicated for intra-rater reliability.

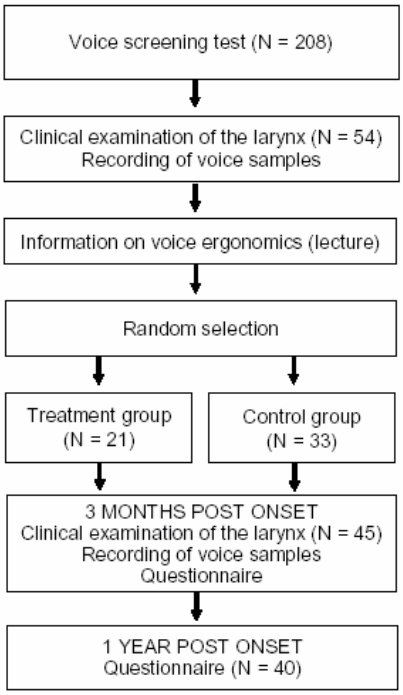
2.2.2.3 Procedures of the perceptual evaluations

In Study I, the perceptual evaluations were performed by a speech therapist, in Study II by a speech therapist and two nurses who had been trained in perceptual evaluation of voice quality. The training consisted of a one-hour long lecture covering the most common voice disorders and vocal symptoms, illustrated by samples of disordered voices. The lecture was followed by two listening sessions during which the nurses listened to tape recordings of a total of 21 voice samples from students (10 normal and 11 deviant voices). The nurses were encouraged to use the whole scale. Of the deviant voice samples on the tape three were severely disordered, almost aphonic.

In Study V, two types of perceptual evaluation were performed. First, the perceptual evaluation was performed by nurses during a voice screening test. The nurses had been trained in perceptual evaluation of voice quality for Study II, and one training session listening to voice samples of normal and disordered voices was repeated before the onset of Study V. The perceptual assessments made by the nurses were performed in a live situation during normal conversation and a reading task. Additionally, in Study V six speech therapists, who had an average of 13 years (ranging from 6 to 15 years) of experience working with voice disorders, performed perceptual evaluation of recordings of voice samples. The speech therapists were experienced in evaluating voices on the basis of the parameters used in the study. The perceptual evaluation took place in an ordinary room, and all recordings were played back from a computer over headphones of good quality. A separate session was arranged for each judge. Each judge performed the perceptual evaluation in one session with one or two pauses according to their wish, and there was no limit as to how many times the judges were allowed to listen to the voice samples.

2.2.3 Procedures and study design in Study V

In Study V, the effectiveness of group voice therapy for teacher students with mild voice disorders detected in a voice screening test was evaluated. In order to be able to evaluate the treatment effects the results of twenty students who received voice therapy in groups seven times over a seven-week period were compared to the results of 20 subjects with similar voice disorders who did not receive voice therapy. The study design is presented in Figure 1.



Of the 208 students of a total of 260 first year students attending the voice screening test (questionnaire and perceptual assessment), 54 were referred to a phoniatric examination because of two or more vocal symptoms occurring weekly or more frequently and/or deviant voice quality. About two weeks after the phoniatric examination, the students were offered a lecture including information on voice ergonomics. At the end of the lecture, the students were randomly selected for a control group and a treatment group (see Figure 1).

One week after the lecture voice therapy begun. The students who were chosen for the treatment group received voice therapy in three small groups with 6-8 students in each group. The students in the control group did not receive voice therapy.

FIGURE 1. The study design used in Study V.

The therapy included indirect and direct voice therapy and was the same for each group. Each therapy session lasted for about 90 minutes. The same speech therapist gave therapy to all groups. The main therapy method involved modifications of the vocal rehabilitation exercises using a so called 'resonance tube' (Laukkanen, 1992; Simberg, 2001; Sovijärvi, 1965; 1969). This method was chosen because the speech therapist that performed the voice therapy had extensive clinical experience in using it. Other methods used were the Accent method (Smith & Thyme, 1978) and voiced bilabial fricative exercises (e.g. Laukkanen, Lindholm, & Vilkman, 1998; Laukkanen, Lindholm, Vilkman, Haataja, & Alku, 1996). These methods were also a part of the speech therapist's normal clinical practice. After the last group therapy session, the

subjects received approximately half an hour of personal counseling, which was individually planned for each subject, and a personal home training program. Three months after the onset of the study the subjects attended a second phoniatric examination and filled out the questionnaire concerning vocal symptoms. One year post onset of the study they filled out the questionnaire for a third time.

2.2.4 Phoniatric examinations

In Studies I, II and V, some of the subjects were examined by a phoniatrician. The subjects were asked to postpone for the appointment if they had a cold. Since the examinations were carried out at the Student Health Care Center in order to make it easier for the subjects to participate, equipment was not available for stroboscopic examinations and video recordings.

The phoniatric examination comprised indirect laryngoscopy with mirror, anterior and posterior rhinoscopy, and inspection of the pharynx for signs of infection. The same equipment (Welch Allyn Lumi View REF 20501) was used for all subjects. In assessing laryngeal status, signs of erythema and oedema both in the vocal folds and in the hypopharynx were rated separately on a four-point scale (0=no, 1=mild, 2=moderate, and 3=abundant). Values from zero to one were interpreted as normal. If both erythema and oedema were rated 2 or 3, the status was defined as laryngitis (Sala et al., 1996). Indications of vocal nodules, polyps, and minor changes such as signs of swelling between the frontal two thirds of the vocal folds were also noted.

In Studies I and II, phoniatric examination was performed once. In Study V the phoniatric examination was performed at the onset of the study and three months thereafter. A summary of the main methods used in the studies is presented in Table 6.

TABLE 6. *The main methods used in the different studies.*

Methods	**Studies**
Questionnaire	I, II, III, IV, V
Perceptual evaluation	I, II, V
Phoniatric examination	I, II, V
Repeated questionnaire, perceptual evaluations and phoniatric examinations	V

A summary of the aims of Studies I – V with the number of subjects and the main methods used is presented in Figure 2.

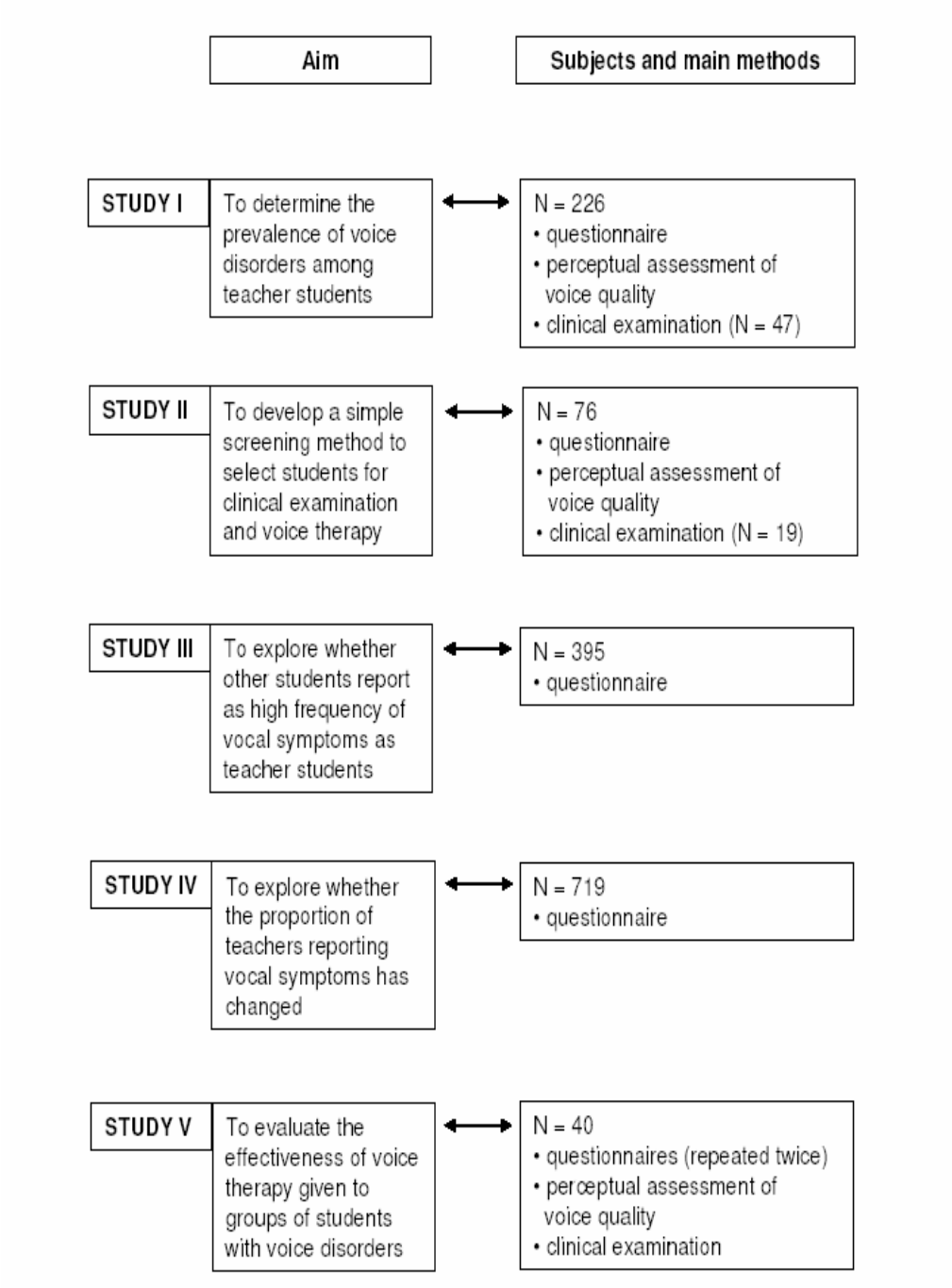


FIGURE 2. A summary of the aims of Studies I – V with the number of subjects involved and the main methods used.

3 RESULTS

3.1 Study I

The purpose of Study I was to determine the prevalence of vocal symptoms and voice disorders among those who were studying in order to become teachers in comprehensive schools and upper secondary schools. Of the 402 students who were called to the Student Health Service Center for a voice examination, 226 (56%) participated.

The subjects reported a high frequency of vocal symptoms. Of the subjects, 49% reported no symptoms occurring weekly or more frequently during the past month, 60% during the past year and 66% during the past two years. One symptom was reported by 16% during the past month, 20% during the past year and 19% during the past two years. Finally, 34% of the subjects reported two or more vocal symptoms within the past month, 20% within the past year, and 16% within the past two years.

The most common symptoms occurring weekly or more frequently within the past year were *throat clearing or coughin*g (29%), *tiredness of the voice* (19%), *sore throat or globus* (14%), and *hoarseness without a cold* (14%). Of the 226 subjects, 54 (24%) had deviant voice quality according to the perceptual evaluation of the speech therapist and/or reported two or more vocal symptoms weekly or more frequently during the past year. These subjects were referred to a phoniatric examination, and 47 subjects followed the request. The phoniatric examination revealed that 42 of these subjects, that is 19% of all participants in the study, had an organic voice disorder. The most common finding was laryngitis, diagnosed in 28 subjects, while 10 subjects had vocal nodules. One subject had a polyp and three subjects had minor findings. The subjects who reported two or more weekly or more frequently occurring vocal symptoms and/or deviant voice quality judged by the phoniatrician, but had no organic findings in the vocal folds, were defined as having a functional voice disorder. Of the subjects, five had a functional voice disorder. All subjects who attended the examination were referred to voice therapy and/or medical care.

Possible background factors that could have contributed to the prevalence of voice disorders, such as vocally demanding leisure time activities, were not associated with the occurrence of voice disorders in this population. The answers to the health-related questions showed that students with voice disorders indicated symptoms of chronic rhinitis (χ^2 (1) = 7.712, $p < 0.0548$), and morning hoarseness (χ^2 (1) = 40.9395, $p < 0.00001$) significantly more frequently than those who had no voice disorders.

In summary, the results of the study revealed that voice disorders were common among teacher students.

3.2 Study II

The aim of this study was to develop a simple screening method for health care personnel in order to select teacher students for phoniatric examination and voice therapy. The subjects were first-year teacher students who took part in a voice screening test at the beginning of their first semester at the university when attending a voluntary physical examination that is offered to all first-year students at the Student Health Service Center. The screening test consisted of perceptual assessment of voice quality by nurses and a questionnaire concerning vocal symptoms.

Of the 80 first year students 76 attended the physical examination. Their voices were assessed by two nurses who had been trained in evaluating voices, and by a speech therapist. The nurses and the speech therapist used the GRBAS categories to evaluate the voice quality of the students. The strongest inter- and intra-rater correlation of the assessments of voice quality performed by the nurses during the training sessions and the strongest correlation between the speech therapist's and the nurses' estimations in the actual screening test situation was for the main parameter Grade ($p < 0.001$).

According to the responses recorded on the questionnaire, 44 (58%) of all the subjects reported no vocal symptoms occurring weekly or more frequently within the past year, while 18 (24%) reported one symptom and 14 (18%) reported two symptoms or more. The instruction for the nurses was to refer those subjects who scored 35 mm or above for Grade on a VAS to phoniatric examination. Additionally, if a subject had reported two or more vocal symptoms occurring weekly or more frequently during the past year, she/he should be referred to phoniatric examination even if voice quality was normal. Twenty-five subjects met these criteria. Of the 25 subjects referred to the phoniatric examination, 19 followed the request. Of these 17, that is, 22% of the whole study population, had an organic voice disorder. The most common finding was laryngitis, which was diagnosed in 15 subjects, while one subject had sulcus vocalis and one subject had minor findings. Two of the subjects had a functional voice disorder. All subjects who attended the examination were referred to voice therapy and/or medical care.

The results of this study indicate that a nurse in a health care setting who has received a brief orientation in the assessment of voice quality can reliably perform a perceptual evaluation of the parameter Grade. In combination with the questionnaire concerning vocal symptoms, health care personnel can use this method in order to select students for phoniatric examination and voice therapy.

3.3 Study III

The rather large amount of vocal symptoms among teacher students found in Study I and Study II raised the question whether students studying other subjects at the same university would report as high a frequency of vocal symptoms. Data from 175 teacher students were compared with data from 220 students studying various subjects (the

control group). The mean age of the students in the control group was 23.46 years (range 18 – 50 years), and the mean age of the teacher students was 23.04 years (range 19 – 46 years). The two groups of students did not differ significantly according to age (t-test $p > 0.05$)[1].

The results of this questionnaire study showed that of all students participating in the study, 67% reported no symptoms occurring weekly or more frequently, 14% reported one symptom and 19% reported two symptoms or more occurring weekly or more frequently during the past year. The teacher students reported significantly more symptoms than the other students (χ^2 (2) =18.343, $p < 0.001$). Of the teacher students, 58% reported no symptoms while 76% of the students in the control group reported no symptoms. One symptom was reported by 21% of the teacher students and by only 8% of the other students and 21% of the teacher students and 17% of the other students reported two or more frequently occurring vocal symptoms. There was no significant difference according to gender and number of symptoms occurring weekly or more frequently, either in the teacher student cohort or in the students in the control group. The seven vocal symptoms referred to in the questionnaire were reported more frequently by the teacher students than by the other students, and the difference between the groups was significant regarding the symptoms *throat clearing or coughing* (χ^2 (1) = 7.124, $p = 0.008$), *the voice becomes strained or tires* (χ^2 (1) = 8.695, $p = 0.004$) and *difficulty in being heard* (χ^2 (1) = 5.586, $p = 0.021$). The number of vocal symptoms according to the year of study showed that the number of students reporting no symptoms was larger in the control group than in the group of teacher students for every year. The prevalence of vocal symptoms among the second-and third-year teacher students was significantly grater than among the second-and third-year students in the control group, and only about half of them reported no symptoms. Among the teacher students, the third year of studying seemed to be the time period with the highest prevalence of reports of two or more symptoms. The third-year teacher students reported significantly more frequently the symptoms *the voice becomes strained or tires* (χ^2 (1) = 10.497, $p = 0.001$) and *sensation of pain or lump in the throat* (χ^2 (1) = 7.283, $p = 0.007$) than the other students did.

The results of this study showed that vocal symptoms were more prevalent among the teacher students than among students studying other subjects at the same university.

3.4 Study IV

The purpose of this cross-sectional questionnaire study was to find out whether the proportion of teachers reporting vocal symptoms over a twelve-year period between 1988 and 2001 had changed. Information provided by teachers from two different

[1] Please notice that in the original publication of Study III on page 364, the "larger than" sign is mistakenly reversed.

studies performed in Turku was compared. There are about 1500 teachers working in comprehensive schools and upper secondary schools in Turku. Since the schools were randomly selected in both studies, it is possible that some teachers might have taken part in both studies, made slightly more than twelve years apart. The mean age of the teachers in 2001 was 44 years (range 24 – 60 years). In 1988 the mean age was 41 years (range 20 – 64 years). The difference was significant (t(717) =3,929, $p < 0.0001$).

The results showed that the 241 teachers responding to a questionnaire concerning vocal symptoms in 2001 (response rate 56%) reported more symptoms occurring weekly or more frequently during the past two years than the 469 of teachers responding to the same questionnaire did in 1988 (response rate 80%). In both studies the most common symptom was *voice tiring*, which was reported by 22% of the teachers in 2001 and by 9% of the teachers in 1988 (χ^2 (1) = 25.115, $p < 0.001$). Eighteen percent in 2001 and only 4% in 1988 reported *hoarseness without a cold* (χ^2 (1) = 36.880, $p < 0.001$). *Pain around larynx* was reported by 14% of the teachers in 2001 and by 4% in 1988 (χ^2 (1) = 25.020, $p < 0.001$) and 9% of the teachers in 2001 reported *difficulty in being heard* as compared to only 2% in 1988 (χ^2 (1) = 25.067, $p < 0.001$). The symptom *voice breaks* was reported by 7% in 2001 and by 3% in 1988 (χ^2 (1) = 5.853, $p < 0.002$). The symptom *aphonia without a cold* was reported by 2% in 2001. In 1988, none of the teachers reported this symptom (χ^2 (1) = 36.880, $p < 0.001$).

The proportion of teachers reporting symptoms occurring once a week or more frequently in 2001 and in 1988 differ significantly (χ^2 (2) = 41.191, $p < 0.001$). In 2001, 71% of the teachers reported no such symptoms compared to 88% in 1988. One symptom was reported by 9% in 2001 and by 7% in 1988, while 20% of the teachers in 2001 reported two or more symptoms compared to only 5% in 1988. In 2001, as opposed to the results of the study in 1988, there was no significant difference between female and male teachers in the frequency of symptoms. In 2001, 69% of the female and 79% of the male teachers reported no frequently occurring symptoms. One symptom occurring at least every week was reported by 11% of the female and 2% of the male teachers, while two or more frequently occurring symptoms were reported by 20% of the female and 19% of the male teachers. In 2001, 3% of the teachers reported that they had been diagnosed as having vocal nodules, compared to 1% in 1988. The difference was significant (χ^2 (1) = 4.578, $p = 0.033$).

Factors that disturbed the normal work routines, such as noisy and/or misbehaving pupils had increased significantly between 1988 and 2001 (χ^2 (4) = 161.194, $p < 0.001$). In 2001, the teachers also complained more frequently about teaching big groups of children than they did in 1988 (χ^2 (4) = 16.862, $p = 0.002$).

The results of this study show that vocal symptoms among teachers have increased during the twelve-year period from 1988 to 2001 and that the increase in pupil misbehavior and the large sizes of the groups of pupils may be factors that increase the risk for teachers getting voice problems.

3.5 Study V

The aim of this longitudinal study was to evaluate the effectiveness of group voice therapy for teacher students with mild voice disorders (6-8 students in each group). The therapy was given seven times to 21 of the students, while 33 students with similar voice disorders formed the control group. The students in the control group were not given voice therapy or any other treatment for their voice disorder.

According to the results of the phoniatric examination at onset of the study, 13 of the 54 students participating had laryngitis, two had minor findings and 39 had a functional voice disorder. Since there were 13 dropouts from the control group and one subject was excluded from the treatment group, the data from the remaining twenty subjects in the treatment group and twenty subjects in the control group, all female, were reported.

Five of the subjects in the treatment group and three in the control group had laryngitis. In both groups, one subject had minor findings, while fourteen of the subjects in the treatment group and sixteen in the control group had a functional voice disorder.

At the onset of the study, no significant differences emerged among the subjects in the treatment group and the subjects in the control group as to the perceptual evaluation of voice quality performed by the nurses in the screening test, as to laryngeal status or as to the number of self-reported symptoms. The perceptual evaluation of voice quality made by an independent panel of judges three months after the onset of the study showed that the voice quality of the subjects in the treatment group had improved significantly in sentence voice samples for the parameters Grade, Rough, Breathy and Vocal fry ($p < 0.001$). A comparison of the assessment of vowel samples showed that the judges found the overall voice quality of the vowel from the recording three months post onset of the study to be significantly better (χ^2 (2) = 39.939, $p < 0.0001$) in the treatment group, while there was no change in the control group.

The results of the second phoniatric examination three months after the onset of the study revealed a trend-like difference in the amount of oedema between the groups ($p = 0.056$). Scrutiny of the data suggests that this was due to reduced oedema in the subjects in the treatment group. One of the subjects in the treatment group and twelve in the control group were diagnosed as having a functional voice disorder. Five of the subjects in the treatment group and three in the control group still had laryngitis, and one subject in the control group had minor findings. Fourteen of the subjects in the treatment group and four in the control group had no voice disorder.

Three months after the onset of the study there was a decrease in all vocal symptoms except for the symptom *voice breaks* in the subjects in the treatment group. A comparison of the subjects in the treatment group with those in the control group revealed that the change in numbers of subjects reporting symptoms after treatment was significant for the symptom *voice becomes low or hoarse* (Fisher's exact test $p = 0.020$). Three months after the onset of the study significantly fewer subjects reported

symptoms occurring weekly or more frequently in the treatment group than in the control group (Fisher's exact test $p = 0.008$), and the difference between the numbers of symptoms was still significant one year after the onset of the study (Fisher's exact test $p = 0.041$). The most obvious difference at the start of the study and one year after the onset of the study occurred in the symptom *the voice becomes strained or tires.* At start of the study, five subjects in each group reported this symptom occurring weekly or more frequently. One year later two subjects in the treatment group and ten subjects in the control group reported this symptom occurring weekly or more frequently. The difference was significant (Fisher's exact test $p = 0.014$).

To judge from the results from this study, voice therapy given in small homogenous groups may be a cost-effective method to treat mild voice disorders at an early stage.

4 DISCUSSION

Since it seems to be well documented that teachers have voice problems and that the problems are linked to their work, prevention of voice disorders among teachers has become a crucial issue (e.g. Buekers et al., 1995; De Bodt et al., 1998; Morton & Watson, 2001a; Russel et al., 1998; Sapir et al., 1993; Smith et al., 1997; Verdolini & Ramig, 2001; Yui, 2002). Buekers (1998) emphasizes that teachers who have voice complaints after a few years of working as teachers are in the wrong profession. However, measuring vocal performance in order to exclude students from teacher education because of current or possible future voice disorders is a rather radical suggestion. Since studies have shown that voice training for students is effective (e.g. Sabol et al., 1995; Södersten & Hammarberg, 1993; Timmermans et al., 2004), one means of early prevention of voice disorders among teachers is to provide systematic voice training to teacher students. Other preventive measures are screening for voice disorders and early treatment (Marge, 1991).

The aims of the series of studies reported in this thesis were to investigate the prevalence of vocal symptoms and voice disorders among teacher students, to develop a voice screening test for teacher students and to evaluate the effectiveness of group voice therapy for students with mild voice disorders detected in the voice screening test. Additional aims were to investigate whether other university students reported as high a frequency of vocal symptoms as teacher students reported and to explore whether the proportion of teachers reporting vocal symptoms had changed during a twelve-year period.

4.1 Prevalence of vocal symptoms and voice disorders among students

The results of Study I covering all students at the Department of Teacher Education of the University of Turku in 1997 indicate that vocal symptoms and voice disorders are common among teacher students. Of the 402 teacher students who were called to the Student Health Service Center for a voice examination performed by a speech therapist in Study I, 56% participated. The rather low percentage of participation might have had an impact on the results since it is possible that the students who had already experienced voice problems were more motivated to participate. However, the results of a mail survey to the students who did not participate revealed that there were no significant differences between the students participating and those not participating on this issue (Laine & Simberg, 1999). This indicates that the cohort examined by the speech therapist was representative and not biased.

About 20% of the teacher students reported two or more weekly or more frequently occurring vocal symptoms. This prevalence is considerably lower than the prevalence of vocal symptoms among voice students (Sapir, 1993; Sapir et al., 1996) and acting

students (Winkworth & McCabe, 2001). It is plausible to assume that students studying to become singers and actors, are more sensitive to changes in their voice quality or to sensations in the throat. Since teacher students' vocal loading presumably is less than that of teachers it would seem reasonable to assume that they have less vocal symptoms than teachers have. However, the amount of reported symptoms among the teacher students is similar to that reported by teachers in epidemiological studies (e.g. Russel et al., 1998; Sapir et al., 1993).

A considerable number of the teacher students' voice disorders were organic. The most common diagnoses for the 47 subjects who attended the phoniatric examination in Study I were laryngitis (N=28), vocal nodules (N=10) and functional voice disorder (N=5). As to the health-related questions, the students with voice disorders were significantly more likely to report symptoms of chronic rhinitis, which might indicate that allergy was a contributing factor (Roy, Merrill, Thibeault, Parsa, et al., 2004; Stemple, 1995; Woo, 1996). This is in line with the results of a study by Linnasalo (1990), where the students who reported vocal symptoms also reported occurrence of allergies and a predisposition to respiratory tract infections more often than the students who did not report vocal symptoms. The contribution of allergies to voice disorders in students needs further research. Morning hoarseness in combination with frequently reported symptoms of throat clearing, sore throat and globus has been associated with laryngopharyngeal reflux (e.g. Koufman et al., 1996). In a study of the prevalence of laryngeal pathologies in a treatment-seeking population by Coyle et al. (2001) reflux laryngitis was the most common diagnosis, and this may also be a common cause of voice disorders in students. Voice disorders that might be caused by laryngopharyngeal reflux should be properly examined and treated.

Background factors such as vocally demanding leisure time activities were not associated with the occurrence of voice disorders in the population in Study I. However, a study by Laine and Simberg (1999) revealed that the teacher students in general often spent time in vocally demanding activities such as coaching children in various athletic activities or as scoutmasters. This may be an additional cause of voice disorders in teacher students and the question about leisure time activities as a contributing factor for voice disorders among teacher students could be further explored.

The high number of teacher students with voice disorders in Study I and Study II led to the decision to launch Study III. The aim of Study III was to investigate whether other university students would report as high frequency of vocal symptoms as teacher students report. The results of Study III suggest that vocal symptoms are more prevalent among teacher students than among students studying other subjects at the same university. It is possible that the teacher students might be more aware of their voice as a tool in their future occupation. Additionally, the data concerning vocal symptoms from the two study populations in Study III were obtained under different circumstances. The teacher students responded to the questionnaire when attending a voice examination while the other students did so while attending a dental check-up and were perhaps less focused on vocal concerns. However, since there was no significant

difference in the prevalence of frequently occurring symptoms reported by first- and fourth-year students, the different testing situations might not have affected the results.

Of the 52 first-year students studying other subjects in Study III, 19% reported one or more vocal symptom occurring weekly or more frequently. This is somewhat higher than the number presented by Linnasalo (1990). The results of her study revealed that 13% of the 906 first-year university students participating reported that their voice tired if they talked for a long time. The discrepancy might be due to the considerable difference in the number of subjects. Additionally, in study III the prevalence of seven vocal symptoms was enquired, while the questionnaire used by Linnasalo (1990) only included the question "voice tiring if talking for long times", and no time parameter was defined. Thus, the results of the two studies cannot be accurately compared. No generalizations can be made based on the prevalence of reported vocal symptoms in Study III as to prevalence of vocal symptoms in university students in general, as this would require a far larger study population.

The results of Study III showed that the vocal symptoms among teacher students peaked during their third year of study. At this point during their studies the teacher students had already engaged in teaching practice as a part of their studies and accordingly might have become more aware of their vocal endurance. This might indicate that the demands placed on vocal endurance in teacher students are higher than those placed on students studying other subjects, at least during the third year of study. It is also possible, that the peak in vocal symptoms among the third-year students is due to inexperience in teaching. The results of a pilot study of classroom noise levels and teachers' reactions by Hay and Comins (1995) showed that teacher students had to use their voices against higher background noise levels than experienced teachers and that female teacher students spoke more loudly and at a higher pitch than the experienced teachers.

Since the vast majority of the teacher students were female, the results of Study I and II were not analyzed as to gender. The results of Study III revealed that there was no significant difference according to gender and number of symptoms occurring weekly or more frequently, either in the teacher student cohort or in the students in the control group. Voice disorders among females are reported to be more common than among males, at least in treatment-seeking populations (Coyle et al., 2001; Fritzell, 1996; Herrington-Hall et al., 1988). That gender was not a significant parameter in Study III might be due to the low proportion of male students (22%) in the whole study population.

4.2 Screening for voice disorders

The results of Study I revealed a surprisingly high number of students with voice disorders. Students who have voice disorders should preferably be offered voice therapy at an early stage, and a voice screening test was developed to identify them. It would appear that no detailed descriptions of simple voice screening tests for students studying

for vocally demanding occupations have been reported. Since students who study for such professions have been found to have voice problems (Sapir, 1993; Timmermans et al., 2002; Winkworth & McCabe, 2001; Yiu, 2002), screening for voice disorders for students seems to be an important issue. The screening test developed for Study II focused on teacher students, and it included a questionnaire concerning vocal symptoms and a perceptual assessment of voice quality.

4.2.1 The questionnaire

The questionnaire used in Study I was extensive. It included questions about the prevalence of vocal symptoms, health-related questions and questions about vocally demanding leisure time activities. The purpose of Study II was to develop a voice screening test that health care personnel could administer quickly and easily. The focus of this study was on the prevalence of vocal symptoms and voice disorders, not on the possible background factors causing them. Accordingly, in Study II the questionnaire only included those questions that seemed to be the most effective in detecting voice disorders in Study I. These were the questions concerning vocal symptoms. The results of Study I showed that the vocal symptoms reported by the teacher students became less frequent with the passage of time. It is possible that requesting information about symptoms that had been observed during the past month might reflect the influence of recent colds or allergic reactions, and that the students found it difficult to remember symptoms occurring during the past two years. For this reason, the screening test was designed to detect symptoms that had been occurring during the previous year only.

In Studies I and II, 79 students were referred to a phoniatric examination because they had reported two or more weekly or more frequently occurring vocal symptoms and/or had deviant voice quality. Of the 66 subjects who followed the request, 12 reported no frequently occurring vocal symptoms and nine of these had organic findings in their vocal folds (Simberg, 1999). Accordingly, the questionnaire did not succeed in identifying some subjects with voice disorders. This indicates that questionnaires should not be used as the only screening method for finding voice disorders. Perceptual assessment by a speech therapist or by a medical professional with training in perceptual assessment of voice quality is essential. A medical examination for those who have deviant voice quality and/or who report frequently occurring vocal symptoms is important because the underlying cause of the disorder is often organic.

4.2.2 Perceptual evaluation, rating scales and criteria for the voice screening test

The results of Study II indicate that nurses in health care settings who have received brief training in the assessment of voice quality are able to perform a perceptual evaluation of the overall degree of dysphonia (Grade). According to Kent (1996), different types of errors and variability are common in perceptual evaluations. Thus, he suggests that judging only one parameter probably is easier than judging several.

Several studies has confirmed that Grade is an uncomplicated parameter to assess (e.g. De Bodt, Wuyts, Van de Heyning, & Croux, 1997; Dejonckere, Obbens, De Moor, & Wieneke, 1993; de Krom, 1994; Revis, Giovanni, Wuyts, & Triglia, 1999; Timmermans et al., 2003; Yamaguchi, Shrivastav, Andrews, & Niimi, 2003). In the original publication of Study II, the parameter "Grade" was incorrectly translated to "overall grade of hoarseness". The Finnish translation of the GRBAS categories by Hurme (1986) was used for the perceptual assessment. In that translation, Grade is defined as "yleislaadun huonous" (literally: badness of general quality). The Finnish term used for Grade in Studies I, II and V was "äänen laadun poikkeavuuden aste", and a closer English equivalent to that would be "overall impression of voice deviance" or "overall degree of dysphonia". In the literature, the parameter Grade has been defined variously as overall impression of voice deviance (Dejonckere, 1998), grade of severity (Dejonckere et al., 1993), overall voice quality (Dejonckere et al., 2001; Yu, Revis, Wuyts, Zanaret, & Giovanni, 2002), general quality rating (Hurme & Sonninen, 1986), overall degree of deviance (de Krom, 1994; Millet & Dejonckere, 1998), pathology (Leinonen, Hiltunen, Laakso, Rihkanen, & Poppius, 1997), overall degree of hoarseness (De Bodt et al., 1997); overall grade (Bassiouny, 1998), global dysphonia (Revis et al., 1999) and overall impression of abnormality in voice (Yamaguchi et al., 2003).

In the screening test the students' voice quality was assessed using a 100 mm long visual analogue scale (VAS). VAS has been in common use in perceptual evaluation of voice quality since the beginning of the 1990's as a more discrete rating scale than equal-appearing interval scales (Bless & Hicks, 1996). Computer programs using VAS for perceptual assessment have recently been developed (Chan & Yiu, 2002; Granqvist, 2003). These programs are advantageous both for researchers and raters. According to Wuyts, De Bodt and Van de Heyning (1999) the GRBAS categories should be scored on an ordinal scale (ORD) because their results show that the VAS GRBAS scale has a tendency to score in the middle and that it considerably decreases inter-rater agreement. However, in several studies, the GRBAS categories have been transformed from an ORD scale to a VAS scale or a modified VAS scale (e.g. Dejonckere, 1998; Dejonckere et al., 1993; de Krom, 1995; Yu et al., 2002). According to Sederholm et al. (1993) a VAS scale can be used to advantage for perceptual evaluation of voice quality because it allows the listener to discriminate among various degrees of a voice parameter. Kreiman, Gerratt, Kempster, Erman and Berke (1993) have found the VAS scale to be reliable despite the risk for some random error, and they point out that every scale has its advantages and disadvantages.

In Studies I, II and V the subjects who had deviant voice quality and/or reported two or more vocal symptoms occurring weekly or more frequently were referred to a phoniatric examination. It is of course possible that subjects with laryngeal pathologies were among those who were referred to the examination but did not attend it. It is also possible that such pathologies might have been present in subjects who were not referred to the examination. A study by Elias, Sataloff, Rosen, Heuer and Spiegel (1997) revealed abnormal laryngeal findings in more than half of the subjects in a population of

65 professional singers without voice complaints. Another study showed a high incidence of reflux laryngitis and vocal fold cysts in a population of 13 singing teachers without voice complaints (Heman-Ackah, Dean, & Sataloff, 2002). Conceivably, the screening test may not have been sensitive enough to detect some subjects who might have had laryngeal pathologies. However, from the perspective of the current study this possibility has only minor practical consequences because the subjects with possible pathologies neither had deviant voice quality nor reported frequently occurring vocal symptoms. From a practical point of view this could be interpreted to mean that they did not have a voice disorder.

In Studies II and V a total of 73 first-year students with voice disorders detected through a voice screening test took part in a phoniatric examination. The most common diagnoses were functional voice disorders (N=41) and laryngitis (N=28). None of the subjects in Studies II and V had vocal nodules. The voice disorders detected in Study I, covering all students at the Department of Teacher Education, were more severe, and the voice therapy periods for those students were generally longer compared to the time period from 1998 on, when voice screening started. First-year teacher students seem to have less severe voice disorders than the students who have studied for a longer time. Thus, screening of first-year teacher students for voice disorders seems to be beneficial. As the first-year students have required shorter voice therapy periods, this has given an opportunity for more students studying at the university to receive voice therapy.

4.3 The increase in vocal symptoms among teachers

The high number of teacher students reporting vocal symptoms led to the question whether the proportion of teachers reporting vocal symptoms has changed within a twelve-year period. In Study IV, data obtained from two cross-sectional studies conducted with an interval of 12 years were compared, and questionnaires were the only methods used. The questionnaires were self-explanatory in both studies and no explanations or definitions were provided. The results of prevalence studies relying on data obtained by questionnaires can be reliable and valid, but the results cannot unambiguously be compared to those of other questionnaire studies because of differences in definitions and criteria (Mattiske et al., 1998). However, the questions concerning the prevalence of vocal symptoms were asked in identical form in the two studies compared in Study IV. The results revealed that more teachers reported vocal symptoms in 2001 than in 1988.

The proportion of teachers reporting two or more vocal symptoms occurring weekly or more frequently during the previous two years had increased from 5% in 1988 to 20% in 2001. The number of teachers reporting symptoms in 2001 is in line with the results of other studies (e.g. Sapir et al., 1993; Russel et al., 1998). It is however lower than the number of daycare center teachers reporting vocal symptoms in a study by Sala et al. (2001) using the same questionnaire. The results of that study showed that 37% reported two or more vocal symptoms occurring weekly or more frequently. The work

of daycare center teachers is different from that of schoolteachers, as it involves more reading aloud, more singing and more outdoor activities. The background noise is probably more continuous in daycare centers than in schools. Additionally, Sala et al. (2001) reported one-year prevalence data for the vocal symptoms in daycare center teachers. In several studies (e.g. Sapir et al., 1993; Smith et al., 1997; Smith, Lemke et al., 1998; Smith, Kirchner et al., 1998) the number of teachers reporting two or more current symptoms seems to be higher than in Study IV. This is in line with the results of Study I, in which the vocal symptoms reported by the teacher students became less frequent over time, that is, the teacher students reported the highest prevalence of vocal symptoms during the past month and the lowest during the previous two years. It is possible that the number of teachers reporting two or more frequently occurring symptoms would have been even higher if the one-month or one-year prevalence had been used instead of the two-year prevalence.

The mean age of the teachers was significantly higher in 2001 than in 1988. The prevalence of voice disorders has been reported to increase with age (Coyle et al., 2001; Herrington-Hal et al., 1988; Roy, Merrill, Thibeault, Parsa, et al., 2004). The results of a study by Roy, Merrill, Thibeault, Parsa, et al. (2004) evaluating the prevalence of voice disorders in 1243 teachers showed that voice disorders systematically increased with age and were most frequent in the age group of 50-59 years. Thus, the higher mean age of the teachers in 2001 might have had some effect on the results. However, as in 1988, the length of the teaching career was not a significant variable for the prevalence of reported symptoms in the population in 2001. This is in line with the results of some studies in which teaching experience showed little correlation with the prevalence of voice problems among teachers (Pekkarinen et al., 1992; Russel et al., 1998; Sapir et al., 1993; Smith et al., 1997). The discrepancies in the results between the different studies might be due to the different methods used and to differences in the sizes of the study populations.

A surprising result of Study IV was that no significant difference in the prevalence of adverse vocal symptoms reported by male versus female subjects was observed in 2001. About one fifth of both the female and the male teachers reported two or more symptoms occurring weekly or more frequently. In questionnaire studies, female teachers have been found to report a higher incidence of vocal symptoms than male teachers (Pekkarinen et al., 1992; Roy, Merrill, Thibeault, Parsa, et al., 2004; Russel et al., 1998; Smith, Kirchner et al., 1998). The lack of a gender difference in the teachers in 2001 might be due to low response rates, as only 56% of the teachers returned the questionnaire. Of the respondents, 22% were male. In 1988 the response rate was 80%, and 34% of the respondents were male (Pekkarinen et al., 1992). It is possible that the teachers who felt that they had experienced problems with their voices were more motivated to fill out the questionnaire, which might have had an impact on the results. Male teachers have been reported to be less likely to respond than females (Russel et al., 1998), and the male teachers who experienced vocal symptoms may have been more active in responding than those who had not experienced any symptoms. On the other

hand, of the more than 42, 400 teachers in comprehensive and upper secondary schools in Finland, only 30% are male (Statistics Finland 2004). On this bases, the return rate from the male teachers cannot be considered to be low. It is possible that voice problems among male teachers are becoming more common. However, no generalizations on this issue can be made on the basis of the results of this study. This question requires further research with larger study populations.

The difference in response rates in 2001 (56%) and in 1988 (80%) might have had some general influence on the results of Study IV. The lower response rate in 2001 compared to that in 1988 may have been due in part to the method of distributing the questionnaires. In 2001, the questionnaires were sent by mail to the schools, and the principal of each school distributed the forms to the teachers. The response rates differed considerably among the schools, and it is possible that the principals' attitude towards the study and the lack of personal contact between the research team and the principals might have affected the low response rate. The study made in 1988 (Pekkarinen et al., 1992) involved more personal contact with the principals who distributed the questionnaires, which might have had a positive effect. However, in a similar study by Sapir et al. (1993), the response rate was 40%. In that study the rates also varied considerably across schools despite the fact that speech therapists made announcements about the study during teacher meetings and encouraged the teachers to participate. According to Sapir et al. (1993), it cannot be ruled out that the fact that the questionnaires were administered by school administrators might have had an impact on the outcome of the study and that a direct contact with the teachers could have resulted in a higher response rate. A questionnaire study on voice problems among teachers by Russel et al. (1998) had a response rate of 75%. In that study the questionnaires were mailed to the teachers along with a prepaid return envelope, and non-responders received two reminders, which most likely had an effect on the high response rate in that study. The response rate in Study IV might have been higher if the research team had sent the questionnaires to the teachers instead of to the principals.

The fact that more teachers reported frequently occurring vocal symptoms in 2001 than teachers did in 1988 may be due to an increased awareness of voice-related issues. On the other hand, there was hardly any discussion in the mass media or in the professional journals for teachers in Finland on this issue during the twelve years between the two investigations. Despite a possible increased awareness of voice-related issues among the teachers responding in 2001, the results of the study are still quite alarming. Study IV was a questionnaire study and no phoniatric examination was included. The results of Studies I, II and V revealed that more than half of the students who reported two or more vocal symptoms weekly or more frequently and attended the phoniatric examination had organic findings on their vocal folds. This was also confirmed by the results of a study by Sala et al. (2001), in which all participants underwent a phoniatric examination. Thus, the results of Study IV indicate that voice disorders are a growing problem among teachers.

One background factor that might have had an effect on the increase in vocal symptoms in 2001 compared to 1988 is related to noisy and/or misbehaving pupils. The increase in reported disturbance caused by noisy and misbehaving pupils in 2001 is in line with the results of several studies of stress among teachers (Boyle et al., 1995; Friedman, 1995; Griffith et al., 1999; Jacobsson et al., 2001; Santavirta et al., 2001). Not only the disrespectful pupils but also the larger groups of children taught in the classes in 2001 probably affected background noise and talking distance unfavorably and caused more adverse vocal symptoms in teachers.

One aim of the education of young children is to enhance their language development. However, poor listening conditions in the preschools and schools caused by background noise have a negative impact on the pupils' ability to hear what is being said (Vilkman, 2004). Additionally, the results of a study By Morton and Watson (2001b) showed that children's ability to recall words and draw final target inferences was lower if the teacher had a dysphonic voice. As pointed out by Morton and Watson (2001a), providing information on voice related issues to health care professionals, educators and administrators involved with the teaching profession is of the utmost importance, and speech therapists should play a key role in this. The Finnish Institute of Occupational Health (a research and specialist organization in the sector of occupational health and safety), has taken the initiative by arranging the first course for speech therapists specializing in occupational health in 2004. One purpose of this course was to educate speech therapists to promote improvements of the work environment, work communities and organizations in their discipline. The initiative of the Finnish Institute of Occupational Health to educate speech therapists in order to enhance occupational health safety can be regarded as an important step towards greater understanding of the voice as an occupational tool. A resent review of epidemiological and acoustic-physiological research on voice disorders by Vilkman (2004) refers to evidence provided by several studies that voice disorders should be accepted as a subcategory of occupational safety and health problems. These findings will be most beneficial for the speech therapists involved in occupational health issues related to the use of the voice as a professional tool for educators.

4.4 Voice therapy given in groups

If voice screening tests lead to the diagnosis of voice disorders it hardly needs mentioning that adequate resources for treatment of voice disorders should be available. Despite a small increase, the resources for voice therapy at the Student Health Care Centers in Finland are still limited. This shortage led to a study designed to explore whether voice therapy given to small groups of students with mild voice disorders is effective. Ramig and Verdolini's (1998) review of studies evaluating the effectiveness of voice therapy, of which most were published during the last two decades, generally demonstrates that voice therapy is effective. However, there do not seem to be many

reports on studies of the effectiveness of group therapy for persons with voice disorders, and Boyle (1995) points out that there is a need for such studies.

The design of Study V mainly followed suggestions made by Carding (2000) for evaluating the effectiveness of voice therapy. The outcome of the study was encouraging. The perceptual evaluation of the voice samples made by a panel of six independent judges, all experienced speech therapists, showed a significant improvement in the voice quality of the subjects in the treatment group compared to that of the subjects in the control group, who did not receive voice therapy three months after the onset of the study. No major differences in the laryngeal status between groups were noted in the second phoniatric examination three months after the study was begun. In both groups, erythema and oedema in the vocal folds had decreased. Fourteen of the subjects in the treatment group and four in the control group were classified by the phoniatrician as no longer having a voice disorder. It is possible that the lecture on voice ergonomics had some effect on the subjects in the control group. Alternatively, there might have been some spontaneous improvement. This question needs further research involving a larger number of subjects and a control group that is not given any information on voice-related issues. Another positive finding was that significantly fewer subjects reported symptoms occurring weekly or more frequently in the treatment group than in the control group still one year after the onset of the study. Whether this effect persists even three years post onset of the study remains to be seen.

The study could have been strengthened by having a panel of independent phoniatricians to evaluate videostroboscopic recordings of the vocal folds. In addition, a videostroboscopic examination might have exposed subtle differences in the laryngeal status of the subjects, but equipment for that was not available. Subjects whose voice disorders have been detected in a screening test are not necessarily motivated to participate in clinical examinations, at least if they do not feel that they have a voice disorder. The clinical examinations were performed at the Student Health Care Center in order to make it easier for the students to participate; this is a place that they are used to visit. It is possible that there would have been more drop-outs if the students had been asked to go to a larger hospital clinic.

In Study V, voice therapy was given in three groups. The therapy was the same for each group and the same speech therapist worked with all groups. The aim was to investigate the effectiveness of group therapy in general, not that of a specific treatment program, and the speech therapist used the methods that were part of her normal clinical praxis. The individual qualities of the speech therapist performing the voice therapy might be a potential variable in determining the effectiveness of voice treatment (Carding, Horsley, & Docherty 1999; Verdolini-Marston K, Burke, Lessac, Glaze, & Caldwell, 1995). In order to further explore the effectiveness of group voice therapy, more studies involving several speech therapists and more outcome measures, such as evaluations of videostroboscopic examinations of the vocal folds and acoustical analyses of the voice samples, are required. Different techniques for voice therapy given in groups could also be evaluated.

Group voice therapy has been criticized by Cooper (1973). As one reason for not recommending group voice therapy he mentions insufficient individual attention and guidance. In Study V the groups were small and the therapy sessions lasted for about 90 minutes, which made individual guidance possible. As a major problem with group therapy for patients with voice disorders Cooper (1973) mentions heterogeneous groups experiencing problems with time scheduling. In Study V the groups were very homogenous and the time scheduling was planned so that participation in the group therapy sessions was easy for the subjects. In that way, the arrangements were ideal. It is possible that the outcome would have been different if the groups had been more heterogeneous and if the participants had had to arrange their schedule to suit the speech therapist. A study evaluating the outcome of voice therapy given in small groups from the clients' perspective by Boyle (1995) revealed that the participants were motivated in the therapy and that all of them later reported that their vocal symptoms had been alleviated. The motivation factor is of outmost importance in all voice therapy, and the high motivation of the students in Study V most certainly had a positive effect on its outcome. The results of Study V suggest that voice therapy given in small homogenous groups might be an effective model for early treatment of students with mild voice disorders found in a voice screening test.

4.5 Conclusions

- Since vocal symptoms and voice disorders seem to be common among teacher students, voice training programs should be offered and required for all those who are studying to become teachers. Additionally, access to voice therapy and vocal medical care should be offered to teacher students and other students studying for vocally demanding occupations. Voice therapy given in groups to students with mild voice disorders detected in a voice screening test seems to be an effective means of early prevention. This model of early intervention might also be used with other groups of students with mild voice disorders.

- Regular voice screening tests should be offered to students who study for vocally demanding occupations. One possibility might be to train health care personnel in a voice screening procedure to enable them to perform an initial classification of normal versus deviant voice quality and function in order to select students for medical examination and voice therapy.

- As shown in Study IV, vocal symptoms among teachers have increased over a twelve-year period. The ergonomic conditions for voice use in schools and daycare centers should be improved. Furthermore, those who provide occupational health care service should be informed about voice-related issues, and needs of teachers for treatment of their voice disorders should be more effectively addressed.

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APPENDIX Questionnaire concerning vocal symptoms

Name _____

How often have you had the following vocal symptoms during the past year?

My voice gets strained or tires (*only one answer)*

every day or most days	□ 1
weekly or most weeks	□ 2
monthly or most months	□ 3
less often than above	□ 4
only seasonal symptoms	□ 5
no symptoms	□ 6

My voice gets low or hoarse while talking *(only one answer)*

every day or most days	□ 1
weekly or most weeks	□ 2
monthly or most months	□ 3
less often than above	□ 4
only seasonal symptoms	□ 5
no symptoms	□ 6

I have voice-breaks while talking *(only one answer)*

every day or most days	□ 1
weekly or most weeks	□ 2
monthly or most months	□ 3
less often than above	□ 4
only seasonal symptoms	□ 5
no symptoms	□ 6

I lose my voice for at least a couple of minutes while talking *(only one answer)*

every day or most days	□ 1
weekly or most weeks	□ 2
monthly or most months	□ 3
less often than above	□ 4
only seasonal symptoms	□ 5
no symptoms	□ 6

Appendix continues

Appendix (continued)

I have difficulty in being heard *(only one answer)*

every day or most days	☐ 1
weekly or most weeks	☐ 2
monthly or most months	☐ 3
less often than above	☐ 4
only seasonal symptoms	☐ 5
no symptoms	☐ 6

I have to clear my throat or cough while talking *(only one answer)*

every day or most days	☐ 1
weekly or most weeks	☐ 2
monthly or most months	☐ 3
less often than above	☐ 4
only seasonal symptoms	☐ 5
no symptoms	☐ 6

I feel pain or a lump in my throat *(only one answer)*

every day or most days	☐ 1
weekly or most weeks	☐ 2
monthly or most months	☐ 3
less often than above	☐ 4
only seasonal symptoms	☐ 5
no symptoms	☐ 6