Portland State University

PDXScholar

Dissertations and Theses

Dissertations and Theses

5-8-1975

A Voice Incidence Study: Portland, Oregon

Ann Lynn Laskey

Portland State University

Follow this and additional works at: https://pdxscholar.library.pdx.edu/open_access_etds

Part of the [Speech Pathology and Audiology Commons](#)

Let us know how access to this document benefits you.

Recommended Citation

Laskey, Ann Lynn, "A Voice Incidence Study: Portland, Oregon" (1975). *Dissertations and Theses*. Paper 2445.

<https://doi.org/10.15760/etd.2441>

This Thesis is brought to you for free and open access. It has been accepted for inclusion in Dissertations and Theses by an authorized administrator of PDXScholar. For more information, please contact pdxscholar@pdx.edu.

AN ABSTRACT OF THE THESIS OF Ann Lynn Laskey for the Master of Science
in Speech Communication: Emphasis in Speech Pathology/Audiology, pre-
sented May 8, 1975.

Title: A Voice Incidence Study--Portland, Oregon.

APPROVED BY MEMBERS OF THE THESIS COMMITTEE:

Mary Gordon, Chairwoman

Robert Casteel

Robert English

Keith Larson

The purpose of this study was to investigate the incidence of
voice disorders among kindergarten and first-grade students selected
from some schools of Portland, Oregon, during early Fall, 1974.

The essential questions to be answered by the investigation were:
1) What is the incidence of voice disorders in a kindergarten and first-
grade sample; 2) what are the types of voice deviations; 3) what is the
severity of each voice problem; and 4) was the incidence similar for

males and females?

The subjects were 619 students from five kindergarten and eight first-grade classrooms in Portland Public School District No. 1, Portland, Oregon. The sample was comprised of 340 males and 279 females, of which 243 were at the kindergarten level and 376 at the first-grade level. The socioeconomic levels ranged from upper-lower to middle-middle class (Hegrenes, 1975).

Voice samples of all subjects were obtained. The voice-disordered samples were recorded on an Ar-Tik' magnetic tape recorder, model 414. The same tape recorder, in conjunction with Ampex 620 speakers, was used to present the voice samples to the three judges. The Jewish Hospital Voice Profile, designed by Wilson (1971), was utilized to evaluate the voice samples. This profile permits a systematic method of consistent description of the prevalence and problems of voice disorders. The voice samples were rated on the profile by this investigator following training by two supervisors in the Voice Clinic, Portland State University. Interjudge reliability of 95 percent agreement was obtained with the two clinical supervisors, and intrajudge reliability of 100 percent agreement was obtained by this investigator on 20 randomly selected voice samples.

Approximately 23 percent of the subjects evaluated exhibited voice disorders. Hoarseness was the most frequently occurring voice disorder with 22.6 percent of the total sample (or 98.6 percent of the voice-disordered sample); whereas, disorders of nasal resonance occurred among only 3.7 percent of the total sample (or 16.2 percent of the voice-disordered sample). The overlapping of percentages resulted

because both hoarseness and nasal resonance deviancies were present in 3.4 percent of the total sample (or 14.8 percent of the voice-disordered sample). Clinically significant voice disorders were found in approximately 18.5 percent of the total sample. The male-female percentage ratio was 25.6 percent and 21.2 percent, respectively. The first-grade-kindergarten ratio was 25.0 percent and 19.8 percent, respectively, Chi square analyses, however, revealed no statistically significant relationship between sex and the incidence of voice disorders, or between grade level and the incidence of voice disorders. The majority (82.1 percent) of severity ratings of disorders of hoarseness ranged from ratings of 3.5 to 5 on the seven-point scale.

The incidence of the present study was greater than the incidence of most other studies reported in the literature. Possible reasons for this are: 1) age of the sample, 2) skills of the evaluator(s), 3) evaluation tool, 4) season, and 5) geographic region. Further studies need to be conducted seasonally and regionally, and to be updated regularly.

Based upon the results of incidence studies, there seems to be a need for speech clinicians to alter their caseloads to include more clients exhibiting voice disorders. Additionally, since speech clinicians seem to be reluctant to work with persons exhibiting voice disorders (Chapman et al., 1961), improved training needs to be instituted in the area of treatment for voice disorders.

A VOICE INCIDENCE STUDY--PORTLAND, OREGON

by

ANN LYNN LASKEY

**A thesis submitted in partial fulfillment of the
requirements for the degree of**

**MASTER OF SCIENCE IN SPEECH COMMUNICATION:
with an emphasis in
SPEECH PATHOLOGY/AUDIOLOGY**

**Portland State University
1975**

TO THE OFFICE OF GRADUATE STUDIES AND RESEARCH:

The members of the Committee approve the thesis of Ann Lynn Laskey presented May 8, 1975.

Mary Gordon, Chairwoman

Robert Casteel

Robert English

Keith Larson

APPROVED:

Robert W. Vogelsang, Head, Department of Speech Communication

David T. Clark, Dean of Graduate Studies and Research

May 8, 1975

ACKNOWLEDGMENTS

I am deeply grateful to many people who have made this study possible. I wish to express my sincere appreciation to the chairwoman of my thesis committee, Mary Gordon, who not only gave me the idea for this study but also offered her undying patience, ready guidance, valuable suggestions, and support, and gave hours of her time freely and frequently.

Special thanks are extended to Robert Casteel, a member of my thesis committee, who gave many hours of his time to serve as a judge for this study and offered supportive guidance and excellent suggestions, as well as invaluable smiles.

Hugs! to Robert English, a member of my thesis committee, to whom I am indebted for his gift of expert criticism of my writing style, which greatly improved this study. His unselfish caring has been a true inspiration to me.

Keith Larson, a member of my thesis committee, offered valuable suggestions and an outstanding sense of humor for which I am grateful.

I wish to thank my entire thesis committee not only for their special contributions to this study but also, more importantly, for their warm, caring friendship and faith in me which gave me the push needed to succeed in this huge task.

To Bill Thornton I extend my deep appreciation for providing me with the opportunity to obtain my data in Portland Public School District

No. 1, Area 2. Thanks to the Area 2 staff and children with whom I worked for making my data collection an enjoyable experience.

To my friends and relatives, thank you for being patient with me and for your unceasing encouragement.

No thank you can adequately express what my parents' (all four) love and blind faith in me have meant during the long months spent working on this study. Thank you, too, Mom and Dad, for all the caring, involvement, and encouragement offered during my nineteen years of schooling.

To my husband, Jim, I offer the greatest love that is mine to give for being so patient, so encouraging, and especially for insisting that I "do it over" until each bar graph was as nearly perfect as possible.

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGMENTS.	iii
LIST OF TABLES	vii
LIST OF FIGURES.	viii
CHAPTER	
I INTRODUCTION AND STATEMENT OF THE PROBLEM.	1
Introduction	1
Statement of Purpose	3
II REVIEW OF THE LITERATURE	4
Incidence Studies.	4
Terminology.	7
Hoarseness	9
Incidence Studies	
Definitions	
Etiology	
Vocal Nodules and Polyps	14
Nasal Resonance.	16
Hypernasality	
Categories of Hypernasality	
Organic Etiology	
Functional Etiology	
Associated Findings	
Hyponasality	

CHAPTER	PAGE
III METHODS	26
General Plan	26
Subjects	26
Instrumentation.	26
Recorder	
<u>Jewish Hospital Voice Profile</u>	
Procedures	31
Data Analysis.	33
IV RESULTS AND DISCUSSION	34
Results.	34
Total Sample	
Type	
Clinical/Nonclinical	
Sex and Grade Level Distribution	
Voice-Disordered Sample	
Type	
Clinical/Nonclinical	
Sex and Grade Level Distribution	
Hoarseness	
Discussion	42
V SUMMARY AND IMPLICATIONS	48
Summary.	48
Implications	50
BIBLIOGRAPHY	53

LIST OF TABLES

TABLE		PAGE
I	Comparison of Voice Disorder Incidence of Males with Females and of Kindergarten with First Grade.	36
II	Percentage of Each Level of Severity of Hoarseness (N=140)	42

LIST OF FIGURES

FIGURE		PAGE
1	The <u>Jewish Hospital Voice Profile</u>	28
2	Types of Voice Disorders in Total Sample	35
3	Sex and Grade Level Distributions in Total Sample. .	36
4	Distribution of Disorders Among Voice-Disordered Sample	38
5	Clinical <u>Versus</u> Nonclinical Among Voice-Disordered Sample	39
6	Sex and Age Distribution Among Voice-Disordered Sample	40
7	Sex and Age Distribution of Hoarse Sample.	41

CHAPTER I

INTRODUCTION AND STATEMENT OF THE PROBLEM

Introduction

Mankind's major mode of communication is speech; therefore, the voice is socially indispensable. Voice deviations may be conspicuous and objectionable, not only auditorily, but also socially. This is due, in part, to the tendency to associate certain voice characteristics with specific personality types. Unfortunately, most voice deviations tend to be associated with undesirable personality types. A child with a voice disorder additionally may suffer educationally because his peers and teachers may not hear or understand his speech. According to Wilson (1971), it is a widely held belief and concern by speech clinicians that voice disorders in children are increasing.

An overall view of the status of children's voice disorders indicates a need for further incidence studies in various age groups and regions of the United States. A few studies have been conducted with varying results. The American Speech and Hearing Association Committee on the Midcentury White House Conference (1952) reported 2 per 1,000 school-aged children have chronic voice disorders. Senturia and Wilson (1968) found 6 percent of their voice survey population exhibited voice deviations; therefore, of the estimated 50 million children between the ages of 5 and 18 years, 3 million may exhibit voice deviations. The investigators suggested that perhaps one-half of this population has

communicatively handicapping voice disorders; the other disorders may not be communicatively handicapping. Therefore, 30 per 1,000 is their more conservative estimate (Senturia and Wilson, 1968). These results represent quite an increase in twelve years; however, even the more recent data were collected nearly ten years ago. If voice disorders are increasing, such information should be updated and augmented by current findings.

In addition to incidence studies, surveys have been conducted to determine the number of children with voice disorders in public school caseloads. Frick's study (1960) is a good example of the number of children actually receiving voice intervention compared to actual incidence. In that study fifty speech clinicians in Pennsylvania reported that voice disorders accounted for 2.01 percent of their caseloads, but they estimated the percentage should be nearer to 5 percent. A nationwide sampling (Bingham et al., 1961) of 1,400 public school speech clinicians revealed that voice problems represent 2.3 percent of the average caseload. Black (1964) found a slightly higher percentage in Illinois, i.e., 4 percent of the speech clinicians' caseloads were voice cases. It should be pointed out that 2 to 4 percent of a caseload is a very small number as it seems to fall far short of the conservative estimate of 3 percent or approximately 1,500,000 children in need of voice intervention.

In summary, the knowledge of voice disorder incidence is an area of research which requires continual revision in different geographic regions. This current information should aid public school speech clinicians in determining the percentage of their caseloads which should

consist of children with voice disorders.

Statement of Purpose

The purpose of this study was to investigate the incidence of voice disorders among kindergarten and first-grade students in some schools in Portland, Oregon, during the Fall of 1974. The study was designed to determine the following information: 1) the percentage of voice disorders, 2) the percentage of each type of voice disorder, 3) the severity of each voice disorder, and 4) the percentage of males and of females exhibiting voice disorders.

The essential questions to be answered by the present study were:

1. What is the incidence of voice disorders in a kindergarten and first-grade (approximately five to seven years of age) sample?
2. What are the types of voice deviations?
3. What is the severity of each voice problem?
4. Was the incidence similar for males and females?

CHAPTER II

REVIEW OF THE LITERATURE

For purposes of the present study, a review of the literature relative to the incidence of voice disorders in children will center around five areas: 1) incidence studies, 2) terminology, 3) hoarseness, 4) vocal nodules and polyps, and 5) nasal resonance.

Incidence Studies

Little information has appeared in the literature relative to studies of incidence of voice disorders, especially among children. One of the earliest studies was the Madison, Wisconsin, personal survey (White House Conference, 1931) in which 1.0 percent of 10,033 children examined were found to have voice defects. No details were available on the procedures used.

Mills and Streit (1942) reported the findings of a study conducted during the 1940-41 school year of 4,685 children in the schools of Holyoke, Massachusetts. The results showed 1.5 percent of the children had voice defects. The authors noted that although the ten examiners were not equally well prepared to identify speech disorders, they all had at least one year of training under recognized experts in the field of speech correction.

Pronovost (1951) presented the results of a survey of services for the speech and hearing handicapped in New England. Of the 87,288

individuals tested, about 0.5 percent were found to be defective in voice. Pronovost found these data to be consistent with other published data, even though the survey was conducted by nurses and speech teachers who reported differing findings due to their diverse training and basis of selection of the speech handicapped.

The American Speech and Hearing Association (Midcentury White House Conference, 1952) reported 0.2 percent of an assumed population of 40 million children aged 5 through 21 years with disorders of voice. The report stated this figure was the lowest possible defensible estimate and in certain respects would be regarded by some authorities as an under-estimation. It also was noted that some children with relatively minor voice defects were omitted from the results.

Johnson et al. (1956) estimated from 1 to 2 percent of school-aged children present significant voice problems.

A more recent voice incidence study was conducted by Senturia and Wilson in 1968. The researchers presented findings not only of total incidence but also of the percentages of children with various types of voice disorders. The subjects were 32,500 public school children between the ages of 5 and 18 years who were attending public schools in the St. Louis, Missouri, metropolitan area. The population was from all socioeconomic levels with the majority representing the upper-lower and middle-middle levels. The survey was performed by trained speech clinicians. Of those students screened, 1,962 or 6.0 percent were found to have voice deviations. Further diagnosis by a team of specialists was completed on 1,000 of the 1,962 children during the following two years at the St. Louis Jewish Hospital. Of these 1,000, 76 per-

cent had voice deviations ranging in severity from barely perceivable to severe enough to interfere with the child's ability to communicate. It was the authors' opinion that the children who did not demonstrate voice deviations upon their reexamination had transient disorders which "cleared" between the first and second voice examinations and may have constituted a problem for future study.

Of the voice-disordered children, 87 percent displayed deviations in the category of "laryngeal cavity," primarily voice deviations characterized by hoarseness (see the Jewish Hospital Voice Profile, p. 28), with a concomitant pitch level which was too low. Nasal resonance deviancies were exhibited in 12 percent, 10 percent of which demonstrated hypernasality ranging from assimilated nasality to nasality affecting vowel and consonant sounds as a result of velopharyngeal insufficiency and approximately 2 percent exhibited hyponasality. One percent presented problems in the categories of "vocal range," "intensity," or "rate," with "intensity" predominating in frequency of occurrence. Of the total voice-disordered group, the male-female ratio was approximately 2:1.

Conclusions relative to the incidence of voice disorders from different studies conducted during several widely dispersed years and in various regions, are difficult to make for many reasons. One needs to consider the facts that an attempt is being made to compare studies which used differing manners of data collection, differing criteria for judgment of the type and severity of voice disorders, varying techniques of training persons to judge the disorders, widely varied definitions of voice disorders, et cetera. It is easily apparent that although the

studies initially may appear to be very similar, indeed, they are not and are too dissimilar to provide any basis for valid comparison.

Terminology

It is generally agreed that dysphonia refers to a disordered voice, i.e., to a voice deviating in some way from normal (Greene, 1967). Although many terms have been proposed by various authors, there exists a lack of a clear definition for most voice disorders (Hanley and Thurman, 1970).

Three vocal parameters are usually described: pitch, loudness, and quality. Most authors agree that deviations of pitch include: 1) use of an habitual pitch level that is either too high or too low for the age and/or sex of the speaker, 2) a very narrow pitch range, 3) too many pitch breaks, and 4) too high or too low pitch in specific situations (Wilson, 1972). Similarly, loudness deviations are rated fairly subjectively. A too loud or too soft voice is judged relative to the environmental situation (Moore, 1971a).

A discussion of voice quality deviations is especially difficult because no set of terms is universally accepted. One finds contradictions and disagreements in this respect among writers of textbooks on speech pathology, general voice usage, interpretive reading, public speaking, and acting (Hanley and Thurman, 1970). The vocal parameter of quality includes two general areas: 1) laryngeal tone, associated with sound generated by the vocal folds and transmitted above the level of the vocal folds and 2) resonance, including hypernasality, hyponasality, assimilated nasality, and nasal emission (Wilson, 1972).

Quality deviations are the most frequent and complex of voice problems (Moore, 1957). Moore (1971a) pointed out many varieties of quality disorders and degrees of severity exist which are complicated by changes of pitch and loudness. He added that the "jumble" of terms applied to voice quality deviations is probably due to the countless combinations of the several factors heard in dysphonic voices.

Following are some of the more common terms found in the literature referring to vocal quality disorders:

1. Harsh quality is an unpleasant, rough quality caused by strain and great effort in the larynx (Hanley and Thurman, 1970). It is a quality sounding hard, low-pitched, strained, and flat (Fisher, 1966).
2. Hoarse quality is characterized by rasping, grating, sometimes husky sound, often heard in persons with laryngitis. It may be the result of misuse (Hanley and Thurman, 1970).
3. Breathy quality results when the vocal folds are not brought closely enough together during phonation. Air rushes through the glottis producing friction which is heard as a whisper-like noise, in addition to vocal fold tone (Hanley and Thurman, 1970; and Fisher, 1966).
4. Strident quality sounds hard and piercing. It is apparently caused by strain and tenseness in the resonators during voice production (Hanley and Thurman, 1970). This quality may sound sharp, screechy, metallic, and high-pitched (Fisher, 1966).
5. Throaty quality sounds hollow and heavy as if talking into a barrel or a cavern, or half-swallowing the tongue (Fisher, 1966).
6. Thin quality is essentially lacking in resonance; it is flat and colorless and gives the impression of "smallness" (Hanley and Thurman, 1970).
7. Muffled quality sounds thick and indistinct as if the teeth are clenched or the articulators are over-relaxed (Fisher, 1966).

8. Nasal quality is characterized by strong modification of the vocal fold tone by resonance from the nasal cavities during the production of sounds normally essentially non-nasal (Hanley and Thurman, 1970).
9. Glottal fry sounds like a tickling or noisy scraping (Fisher, 1966).
10. Glottal shock sounds like a small dry cough, or as if the breath was held and then burst out at the start of a word. It usually occurs only before a word beginning with a vowel sound (Fisher, 1966).

Hoarseness

The voice quality of hoarseness will be discussed in more depth here since it has been reported to be the most frequent type of voice disorder in school-aged children.

Incidence Studies

According to Sonninen (1970), although hoarseness is very common, statistics concerning it are "scanty, defective, and even controversial." This is exemplified by two widely varying figures: whereas, Sonninen (1970) cited a study by Nadoleczny in 1926 in which as many as 41.6 percent of school children were reported to have chronic hoarseness, the Midcentury White House Conference survey (1952) reported only 0.2 percent of the 5 to 21 age range as having any type of voice disorder.

At the higher end of the incidence continuum, Seth and Guthrie (1953) reported 40 percent of school children in Germany have hoarse voices; however, most studies revealed more conservative estimates. In 1965 Pont reported a finding of 9.1 percent of 639 kindergarten through

eighth-grade students with hoarse voices. Baynes (1966) conducted three surveys which indicated that 7.1 percent of 1,012 first-, third-, and sixth-grade students demonstrated chronic hoarseness with the first-grade subjects demonstrating the highest incidence. Baynes considered this a conservative figure since mild hoarseness was excluded from the study. Referring again to the Senturia and Wilson (1968) study, 6 percent of the total population were found to be voice-disordered and 87 percent of these voice-disordered subjects had deviations manifesting the symptom of hoarseness; therefore, approximately 5 percent of the total sample exhibited hoarseness (Wilson, 1971). Silverman and Zimmer (1974) conducted a study which consisted of voice screening during the 1972-73 academic year in a Hebrew Day School. The school consisted of 162 children fairly evenly distributed from kindergarten to eighth grade. Of these, 39 children were found to display hoarse voices; 38 or 23.4 percent were found to have chronically hoarse voices. Chronic hoarseness, therefore, was the most common voice disorder of that population, accounting for 84.4 percent of all voice problems detected. Of the 38, 26 or 68.4 percent of the children were in the primary grades, with the highest incidence occurring in the third grade in which 46 percent of the children were hoarse.

Considerably more boys than girls were hoarse in the Silverman and Zimmer (1974) study. Several authors have agreed that hoarseness incidence is higher among boys than girls (Baynes, 1966; Greene, 1967; Senturia and Wilson, 1968; Silverman and Zimmer, 1974; and Williams, 1962). Greene (1967) added that the male incidence is higher below the age of ten years and diminishes considerably as the children grow older.

Data from the surveys of Baynes (1966) and of Silverman and Zimmer (1974) supported Greene's conclusion that the higher incidences occurred among the primary grades.

Definitions

The greatly differing results of the previously reported incidence studies of hoarseness may be due to the vague and multi-layered nature of the concept of hoarseness (Sonninen, 1970). Baynes (1966) concurred that a definition of hoarseness is both confusing and inadequate.

Several definitions and descriptions have been formulated. Negus (1939) very generally defined hoarseness as ". . . a pathological alteration of the sound produced at the larynx." Curtis (1956) simply referred to hoarseness as sounding "husky." A voice exhibiting both husky and harsh qualities was the description of Kaplan (1971) and Van Riper and Irwin (1958). Berry and Eisenson (1956) used the terms "throaty-husky, hollow, coarse, and harsh-breathy" to describe it. Fisher (1966) explained hoarseness as ". . . the sound of strained or gargling breathiness." Jackson (1959) referred to hoarse quality as being rough, grating, harsh, and more or less discordant. The several terms used synonymously by Murphy (1964) to explain hoarseness were: breathy, harsh, raspy, strained, coarse, and hollow. He added that it may be more clearly thought of as a breathy, husky harshness.

Baynes (1966) reviewed definitions in twelve different sources and found occurrence of the following adjectives: "rough used seven times; harsh, seven times; grating, five times; lower in pitch, discordant, breathy, and husky used four times; and harsh-husky, deep, guttural, throaty-husky, used once." Baynes' own definition was: "a

quality of voice that is rough, grating, harsh, and more or less discordant."

Kaplan (1971), Murphy (1964), and Williamson (1946) mentioned that the pitch is usually low among hoarse voices. Murphy (1964) added the range is reduced, voice breaks may be present, and fluctuations between periods of phonation and aphonia may be observed.

This investigator chose the following definition for the purposes of this study since it most closely represents Senturia and Wilson's point of view regarding hoarseness: A hoarse voice quality combines the acoustic characteristics of harshness and breathiness with the harsh element predominating in some hoarse voices and the breathy element in others (Darley, 1965; Greene, 1967; and Wilson, 1972). Fisher's (1966) discussion of how hoarseness is produced agrees with the above definition. She stated that hoarseness is produced by a combination of incomplete closure of the vocal folds (breathiness) and excessive strain of laryngeal muscles (harshness).

It is interesting to note that Moore (1957) specified three types of hoarseness: dry, which is of relatively greater phonatory intensity (loud breathiness); wet, which is lower in pitch, breathy (due to noises arising from transient disturbances on the surfaces and edges of the folds), and often with vocal fry (laryngitis); and rough, a complex disorder which is similar to wet hoarseness, but it contains additional low pitched sounds and often a double tone caused by growths which weigh down one fold in relation to the other, thus slowing the vibration rate of the heavier fold.

Etiology

It is generally agreed that hoarseness is the most common dysphonia since it is a symptom common to almost all of the laryngeal diseases (Boone, 1971; Darley, 1965; Isshiki et al., 1969; von Leden, 1958; White, 1946; and Wilson, 1972). Curtis (1956) added that hoarseness is the usual symptom of laryngeal pathology among children. People, however, tend to neglect hoarseness as a problem by continuing to associate it with the common cold even when none is present, assuming that time will take care of the distress (Murphy, 1964).

Hoarseness is often the only symptom present in laryngeal diseases of extreme gravity (Wells, 1940). It can be due to: physical diseases such as diphtheria (Negus, 1939; and Wells, 1940), tuberculosis, syphilis (Berry and Eisenson, 1956; Darley, 1965; Greene, 1967; Van Riper and Irwin, 1958; and Wells, 1940), carcinoma (Berry and Eisenson, 1956; Darley, 1965; Greene, 1967; and Van Riper and Irwin, 1958), papillomata (Negus, 1939), and infected tonsils or adenoids (Negus, 1939; and Williams, 1962). Other causes include: structural abnormalities such as congenital anomalies of the larynx (Greene, 1967; and Wilson, 1972); nasal obstruction or inflammatory changes in the nose, post-nasal space, sinuses, or pharynx (Negus, 1939); peripheral neural lesions affecting the larynx, for example, paralysis of one or both vocal folds (Berry and Eisenson, 1956; Lore, 1950; and Wilson, 1972); endocrine imbalance, especially thyroid (Greene, 1967; and Wilson, 1972); neurotic and psychopathic disturbances (Greene, 1967; Murphy, 1964; and Wilson, 1972); laryngeal trauma (Wilson, 1972); and allergic conditions (Wilson, 1972).

Froeschels (1940) has stated the causes of hoarseness are not only organic but also functional. He cautioned that laryngoscopic findings of redness and swelling are not sufficient to diagnose pathology since it may be due to vocal strain. Greene (1967) also stated that damage to vocal folds or their muscular coordination has been attributed to vocal strain, meaning vocal abuse, misuse, or overuse, especially of hypertonic functioning. Most authors cite vocal hyperfunctions as a major cause of hoarseness (Berry and Eisenson, 1956; Boone, 1971; Darley, 1965; Froeschels, 1940; Greene, 1967; Murphy, 1964; Negus, 1939; Van Riper and Irwin, 1958; White, 1946; Wilson, 1972; Williams, 1962; and Williamson, 1946). Simple acute laryngitis and chronic laryngitis which exhibit hoarseness are often caused by misuse or overuse of the voice (Berry and Eisenson, 1956; Darley, 1965; Negus, 1939; Wells, 1940; and Wilson, 1972). Vocal hyperfunction can and often does result in pathology.

Vocal Nodules and Polyps

Chronic hoarseness is often a symptom of vocal nodules (Silverman and Zimmer, 1974) which result from strain including: excessively loud talking; habitual use of improper pitch level; prolonged talking or shouting (Darley, 1964; and Murphy, 1964); excessive air pressure against the under surfaces of the folds and abrupt initiation of tone (Wilson, 1961). In children, nodules often result from excessive yelling, singing, and vociferous outdoor play (Arnold, 1962). The mechanical laryngeal trauma sustained during faulty vocal use is followed by hyperemia ("excessive amount of blood in any given part of the body,"

from Gould, 1920), edema, inflammation, connective tissue proliferation, and eventual fibrosis (Arnold, 1963).

Arnold (1963) enumerated three factors relative to vocal nodule and polyp etiology including: 1) predisposing factors of physical constitution, personality structure, and local laryngeal morphology; 2) precipitating factors of allergic tendencies and hormonal imbalance; and 3) aggravating factors including smoking and drinking (especially when combined with excessive talking) and vocal efforts such as singing during upper respiratory infection.

Vocal nodules and polyps are the most common of the benign laryngeal tumors. According to Arnold (1962), polyps represent a more advanced stage of the same "disease." Nodules are more frequent in boys prior to puberty and more frequent in females beyond the age of twenty (Arnold, 1963). In both nodules and polyps, the site of the lesion is the border of the anterior and middle third of the entire vocal fold where the vibratory amplitude is widest (Arnold, 1963; Boone, 1971; and Wilson, 1972). Since the nodules occur where the mechanical strain is greatest, they are usually bilateral, occurring exactly opposite each other, although they are occasionally unilateral (Boone, 1971; and Brodnitz, 1953).

Vocal nodules range in diameter from one to three millimeters (Wilson, 1972). Size, composition, and location are major determinants of the degree of hoarseness present (Wilson, 1961). At no time is there any pain connected with the formation of vocal nodules (DeWeese and Saunders, 1968).

Polyps are usually unilateral (Boone, 1971). They result when

early thickenings of the fold become irritated, resulting in hemorrhages which are absorbed causing the tissue at the site to become swollen and somewhat distended, forming the polypoid body (Boone, 1971). Polyps are of two types, pedunculated or sessile (Wilson, 1972).

Nodules in children are usually reducible by voice intervention alone; however, polyps are usually treated by surgical removal followed by voice management to eliminate vocal abuses (Arnold, 1963; Boone, 1971; and Wilson, 1972).

Nasal Resonance

The vocal tone receives its distinctive qualitative characteristics from the resonating cavities which selectively amplify different laryngeal tones, thus altering the wave composition (Darley, 1964). Of the three resonating cavities (pharyngeal, oral, and nasal), the oral cavity is the major resonating cavity in normal speech. Because full nasal resonance is normally produced only on the three nasal consonants which constitute approximately 11 percent of the phonemes occurring in speech (Tobias, 1959), the nasal cavity is the least used vocal resonance cavity (Fisher, 1966). Some nasal resonance, however, is present in all speech (Wilson, 1972) and a certain amount of nasality is usually considered to be pleasant (Greene, 1964; and Zemlin, 1968). Berry and Eisenson (1956) concur that all voices should have a measure of nasal resonance to add richness and brilliance to their voices. Since some nasality is considered pleasant, and since in certain regions of America a variety of hypernasality is dialectal (Van Riper and Irwin, 1958), a diagnosis of excessive nasality and the converse, an acceptance of

nasality, are to a great extent subjective judgments.

There are basically two general categories of deviancies relative to nasal resonance: 1) too much nasal resonance (hypernasality) and 2) too little nasal resonance (hyponasality).

Hypernasality

Problems of too much nasal resonance have been referred to as 1) excessive nasality (Boone, 1971; Curtis, 1956; Fisher, 1966; Greene, 1964; Johnson et al., 1963; Lintz and Sherman, 1961; Moore, 1957; Van Riper and Irwin, 1958; and Zemlin, 1968); 2) open nasality (Kaplan, 1971; and Moore, 1971b); 3) nasalization or nasal speech (Greene, 1964; and Kaplan, 1971); 4) hyperrhinolalia (Berry and Eisenson, 1956; Greene, 1964; and Kaplan, 1971); 5) rhinophonia or hyperrhinophonia (Greene, 1964; and Kaplan, 1971); 6) rhinophonia aperta (Greene, 1964); 7) rhinolalia aperta (Greene, 1964; Kaplan, 1971; and Van Riper and Irwin, 1958); 8) rhinoglossia (Kaplan, 1971); 9) palatal dysglossia (Kaplan, 1971); and 10) rhinolalia clausa anterior (Moore, 1971b). For the purposes of this review, the term hypernasality will be used.

Hypernasality is a term used to describe several voice qualities associated with excessive nasal resonance (Boone, 1971; Johnson et al., 1963; and Moore, 1971b). Normal nasality on nasal consonants (/m/, /n/, and /ŋ/) is produced by a coupling of the oral and nasal cavities. Correct production of the vowels and of the other consonants depends upon restricting the breath stream primarily to the oral cavity. If the nasal and oral cavities are coupled in vowel production, the voice quality may be perceived as being hypernasal (Kaplan, 1971). If this coupling occurs during the production of non-nasal consonants, the sounds

are distorted, especially sounds requiring air pressure build-up within the oral cavity, such as: /s/, /k/, /ʃ/, /z/, and /g/ (Berry and Eisen-son, 1956; Curtis, 1956; Darley, 1964; Greene, 1964; Moore, 1971b; Van Riper and Irwin, 1958; Wilson, 1972; and Zemlin, 1968). The amount of hypernasality in the voice depends upon the amount of coupling between the resonating cavities; therefore, the voice quality may range from barely to excessively hypernasal (Zemlin, 1968).

Categories of Hypernasality. This section briefly describes six categories of hypernasality predominantly cited in the literature: nasal emission, assimilation nasality, nasal twang, rhinolalia clausa anterior, hyperrhinolalia, and cul-de-sac resonance.

According to Brackett (1971), nasal emission occurs on voiceless consonants when the oral orifice is closed, and the velopharyngeal orifice is open so that the airflow is through the nose. The perceived nasal emission is the acoustic result of air turbulence through the narrow nasal passages. Conversely, Fisher (1975) has indicated nasal emission occurs on both voiced and voiceless consonants, which she described as follows: "If there is audible emission of breath from the nose during speech, it will be most apparent on consonant phonemes and worse on the voiceless consonants than the voiced ones." The audible friction of nasal escape of airflow during the production of these consonants (aperiodic noise) is perceived as a consonant distortion (Boone, 1971; and Greene, 1964). Moore (1971b) has referred to this condition as rhinolalia aperta and as open nasality.

Because of the articulation deviancy associated with nasal emission, a controversy exists among some authors whether the disorder is

one of voice or of articulation. Zemlin (1968) referred to it as a voice disorder probably resulting from faulty articulation; however, he regarded it as a defect of transmission. Darley (1964) stated that velopharyngeal incompetence, which creates the major problem of hypernasality, also causes the associated problem of distorted consonant articulation. Moore (1971b) has proposed that since a nasal component can be added to all vowels and to all normally non-nasal consonants, it is appropriate to treat hypernasality as a voice disorder.

Assimilation nasality is excessive nasal resonance occurring on vowels or diphthongs adjacent to one of the nasal consonants (Boone, 1971; Johnson et al., 1963; and Wilson, 1972). According to Boone (1971), it appears as if the velopharyngeal port is opened too soon and/or remains open too long in conjunction with the production of /m/, /n/, or /ŋ/. If the "carry-over" resonance affects a vowel or diphthong preceding a nasal consonant, it is labelled anticipatory assimilation; whereas, if it affects a vowel or diphthong following a nasal consonant, it is called retentive assimilation (Johnson et al., 1963).

Moore (1971b) has described nasal twang as having the quality of voice that can be produced by pinching the nostrils and "talking into the nose." He further contended that nasal twang is usually functional and is often associated with certain dialects or with "hawker" occupations, such as auctioneering and newspaper vending. Berry and Eisenson (1956) distinguished between "true" and "pseudo" nasal twang. They proposed that the "pseudo" nasal twang is due to a functional origin such as tensions at any point in the supraglottal region. They refer to "true" nasal twang as being due to partial nasal occlusion which results

in inharmonic vibration.

Moore (1971b) mentioned the condition of rhinolalia clausa anterior which he defined as being acoustically similar to nasal twang. This condition is caused by an anterior blockage in the nose and an open velopharyngeal channel in which the nasal passage acts as a closed cul-de-sac resonator as far forward as the region of the blockage. This causes the nasal formants to be emphasized and, therefore, a "twang" sound is heard (Moore, 1971b). This condition can appear to be confusing at first because the individual breathes through his mouth as in hyponasality, and yet the velopharyngeal area between the pharynx and nose remains open.

Most authors refer to hypermnasality as simple hypernasality due to any of the possible causes described below; however, Berry and Eisen-son (1956) defined this condition as a cul-de-sac resonance produced when the faucial isthmus is large and the oral aperture small.

Fisher (1975) described cul-de-sac resonance as follows:

The acoustic effect of lowering the velum during the phonation of vowel sounds is to open a side-cavity resonator that is coupled to the main resonating tube. The nasal cavity from the naso-pharynx forward becomes progressively smaller in volume (or average cross-section diameter). Essentially, it is a cul-de-sac resonator--a blind alley or dead end street sort of cavity.

She added that sound waves do not pass easily through the nasal cavity; due to its "impediments" and "barriers," some harmonics are damped while others are reflected back into the main vocal tract. Berry and Eisen-son (1956) contended that cul-de-sac resonance occurs when the faucial isthmus is large and the oral aperture small. They called the resulting excessive nasal reverberation hypernasality. Posterior or excessively

high tongue carriage due to too large a tongue in relation to the oral cavity or simply faulty positioning of the tongue also can result in cul-de-sac nasal resonance (Berry and Eisenson, 1956; and Boone, 1971).

Organic Etiology. Several possible organic etiologies for hypernasality have been cited in the literature. Velopharyngeal insufficiency (an insufficient amount of palatal tissue to insure proper isolation of the pharyngeal and nasal cavities) and velopharyngeal incompetency (muscular incompetence) often result in a hypernasal voice quality (Berry and Eisenson, 1956; Greene, 1964; Kaplan, 1971; Moore, 1957; Van Riper and Irwin, 1958; Wilson, 1972; and Zemlin, 1968). Several possible congenital causes of velopharyngeal insufficiency are: 1) cleft palate (Greene, 1964; Kaplan, 1971; Moore, 1957; Van Riper and Irwin, 1958; and Wilson, 1972); 2) submucous cleft palate (Greene, 1964; and Wilson, 1972); 3) short hard and/or soft palate(s) usually with the associated deformity of an unusually deep and wide nasopharynx (Berry and Eisenson, 1956; Greene, 1964; Kaplan, 1971; Moore, 1957; and Wilson, 1972).

Possible causes of velopharyngeal incompetency have been cited in the literature: 1) an abnormally capacious pharynx or peculiar structural configuration of the pharyngeal wall, i.e., unusually high occipital bone (Berry and Eisenson, 1956; and Wilson, 1972); 2) narrow faucial pillars (Berry and Eisenson, 1956); 3) a tongue too large for the oral cavity (Berry and Eisenson, 1956); 4) an extremely high palatal arch (Kaplan, 1971); 5) palatal paralysis or paresis (Berry and Eisenson, 1956; Greene, 1964; Kaplan, 1971; Moore, 1957; Van Riper and Irwin, 1958; and Wilson, 1972); 6) tumors (Moore, 1957); 7) syphilis (Moore,

1957); 8) surgical removal of tonsils or adenoids which were blocking off the nasal cavity and leaving the velum functionally weak due to lack of use (Berry and Eisenson, 1956; Greene, 1964; Kaplan, 1971; Moore, 1957; Van Riper and Irwin, 1958; and Wilson, 1972); 9) palatal surgery (Moore, 1957); 10) damage to the velum or to the muscles of the velopharyngeal sphincter due to trauma (Berry and Eisenson, 1956); 11) hypertrophied lingual tonsils (Berry and Eisenson, 1956); 12) emotional or neurotic disorders (Greene, 1964); 13) low energy index (Berry and Eisenson, 1956); 14) simple fatigue (Van Riper and Irwin, 1958); and 15) enfeebled mind (Berry and Eisenson, 1956).

Although hypernasality can result from an absence of or incomplete velopharyngeal seal, it is possible for an individual to produce nearly normal vocal resonance without a complete velopharyngeal closure or without air escape through the nose (Greene, 1964). Research has shown that complete velopharyngeal closure is not necessary on all sounds, but there are definite limits to the amount of opening permitted without hypernasality resulting (Van Riper and Irwin, 1958). Individuals, therefore, may be able to eliminate hypernasality in the presence of velopharyngeal insufficiency because of the wide differences in requirements for minimal velopharyngeal closure.

Functional Etiology. In addition to organic etiologies, functional causes of hypernasality have been proposed. A normal-speaking individual can produce hypernasality by simply relaxing the velum resulting in an opening into the nasopharyngeal port, by relaxing the velum and using the nares as cul-de-sac resonators, or by normally raising the velum but additionally tensing it causing it to become thin so that it acts as a

drum head to increase resonance in the nasal cavity (Wilson, 1972).

Greene (1964) has stated,

. . . the most important factor in the production of excessive nasality appears to be, . . . not the degree of nasal escape of air, but the degree of tension existing in the nasal and oral pharynx and laryngeal cavity, and the size of the orifices leading into the nose and mouth in relation to the size and shape of these air-filled cavities.

Imitation also has been mentioned as a possible functional cause of hypernasality (Berry and Eisenson, 1956; and Van Riper and Irwin, 1958). According to Berry and Eisenson (1956), general bodily hypertonicity due to a familial pattern or an acquired response also might cause hypernasality.

Associated Findings. The literature has revealed the following correlates of hypernasality: laryngeal vibration, pitch, loudness, and phonemes. A discussion of each of these correlates follows:

Fletcher (1947) reported some interesting findings in relation to hypernasality. He observed, in three filmings of vocal fold vibration of hypernasal voices, a consistent peculiarity of vocal fold conformation. The opening phase was quite different from that in normal vocal quality in that the degree of lateral movement was much greater for the right than the left fold. This finding of asymmetrical vocal fold vibration was observed only in hypernasal voice quality.

In answer to the question, Does hypernasality increase or decrease with a high pitch range? Fisher (1966) stated that nasal quality frequently occurs with too-high modal pitch. This data agrees with that of Gray and Wise (1934), Holmes (1932), and Sherman and Goodwin (1954). Conversely, Froeschels (1948 and 1957) reported findings of less per-

ceived nasality at higher pitch levels. In his study of fifteen severe cleft palate speakers, Hess (1959) also found that less nasality was perceived at higher pitch levels.

In relation to more or less hypernasality with greater intensity, Van Riper and Irwin (1958) reported more prominent hypernasality with louder speaking levels. Cotton (1940), Hess (1959), Weiss (1954), and Williamson (1946), however, reported less nasality at more intense sound pressure levels.

Morris et al. (1961) investigated forty-three consonant sounds and blends relative to those misarticulated due to velopharyngeal insufficiency. He found the most commonly misarticulated single consonants to be the fricatives /s/, /ʃ/, /z/, and the plosive /k/; the second most commonly misarticulated phonemes were the affricates /tʃ/ and /dʒ/; and the least frequently misarticulated were the nasals /m/, /n/, and /ŋ/, and glides /l/, /j/, /w/, and /r/.

Hyponasality

Hyponasality has been called denasality (Berry and Eisenson, 1956; Boone, 1971; Greene, 1964; Kaplan, 1971; Moore, 1957 and 1971b; and Van Riper and Irwin, 1958); adenoidal voice (Van Riper and Irwin, 1958); insufficient nasality (Greene, 1964); hyporhinolalia (Greene, 1964); hyporhinophonia (Greene, 1964); rhinolalia clausa (Greene, 1964; and Kaplan, 1971); and rhinolalia clausa posterior (Moore, 1971b). For the purposes of this study the term hyponasality will be used.

Hyponasality refers to a lack of nasal resonance on the normally nasal consonants /m/, /n/, and /ŋ/. It has the quality that accompanies a head cold in which the voice sounds "dull," "congested," "muffled," or

"deadened." In the extreme form /b/ is substituted for /m/, /d/ for /n/, and /g/ for /ŋ/. This often results in intelligibility problems (Moore, 1971b; Van Riper and Irwin, 1958; and Wilson, 1972).

The etiology of hyponasality is usually organic, resulting from an obstruction in the posterior portion of the nasal passage and/or nasopharynx. Possible obstructions are: 1) growths (Moore, 1957), e.g., enlarged adenoids or polypi on the superior turbinates (Berry and Eisenson, 1956; Moore, 1971b; and Van Riper and Irwin, 1958); 2) hypertrophy associated with chronic nasal disease (Moore, 1971b); or 3) trauma resulting in deviated septum, nasal spurs, and congestion (Moore, 1971b). Another organic cause is congestion which may be due to 1) allergies resulting in swelling of the nasal membrane and congestion (Berry and Eisenson, 1956; Moore, 1971b; and Van Riper and Irwin, 1958); 2) post nasal drip (Van Riper and Irwin, 1958); or 3) common cold (Van Riper and Irwin, 1958). Hyponasality, due to any of the etiologies mentioned above, which eliminate the use of the nose as a resonator, is referred to as rhinolalia clausa posterior (Moore, 1971b; and Van Riper and Irwin, 1958).

Possible functional etiologies are: 1) failure to develop full resonance in the nose and mouth (Berry and Eisenson, 1956); 2) unconscious imitation; and 3) intentional raising of the velum to close off the nasal cavity (Moore, 1971b) as in psychological adjustment problems such as: a) using hyponasality to denote sophistication; or b) a response due to a rejection of life (Berry and Eisenson, 1956). Additionally, Van Riper and Irwin (1958) have found that hyponasality may be maintained long after the cause has been alleviated.

CHAPTER III

METHODS

General Plan

The voices of kindergarten and first-grade subjects were evaluated by this investigator. All subjects who demonstrated a possible voice disorder were audio tape recorded. Later these voice samples were analyzed to determine type and severity of voice disorder.

Subjects

There were 619 subjects drawn from five kindergarten and eight first-grade classrooms in the Portland Public School District No. 1, Portland, Oregon. At the time of screening the subjects were approximately five to seven years of age. There were 340 male and 279 female subjects, of which 376 were first-grade and 243 kindergarten subjects. The socioeconomic level ranged from upper-lower to middle-middle class, and was found to be a representative sample of the kindergarten and first-grade population of Southeast Portland, Oregon (Hegrenes, 1975).

Instrumentation

Recorder

An Ar-Tik' magnetic tape recorder, model 414, was used in conjunction with the standard microphone provided for the recorder to record the voice samples. No specifications were made available for this

machine. The same tape recorder, in conjunction with Ampex 620 speakers, was used to present the voice samples to the judges.

Jewish Hospital Voice Profile

Wilson (1971), during his affiliation with the Jewish Hospital of St. Louis, developed a systematic method to permit consistent description of the prevalence and problems of voice disorders in school-age children. This consisted of a scale which described the various audible characteristics of voice. The profile developed was based on work completed by Brackett who attempted to describe in considerable detail the various components of voice. Brackett served as a consultant to Wilson and made modifications in his own descriptive approach (Wilson, 1971).

The Jewish Hospital Voice Profile (see Figure 1) is useful as a clinical method for describing voice disorders in children and adults for clinicians in public schools or community service centers. It is brief and its simplicity increases diagnostic effectiveness (Wilson, 1971). Training in the use of the Voice Profile is a necessary prerequisite.

The Jewish Hospital Voice Profile has been described by Wilson (1971) as follows:

1. Voice Severity: The voice severity rating is the section used to describe on a comparative basis the voice as it affects the clinician. A rating of "1" indicates the problem is barely perceptible; a rating of "7" indicates the problem significantly interferes with communication. The judgment of severity of the voice disorder affects the decision to provide voice treatment and the determination of progress during treatment.

THE JEWISH HOSPITAL VOICE PROFILE

NAME _____ AGE _____ B.D. _____ GRADE _____ SEX _____

How long has the problem existed?

Voice Rating: 1 2 3 4 5 6 7

In what situations is the voice better or worse?

Articulation Disorder: Yes No

Length of sustained "ah" _____

LARYNGEAL CAVITY
 PITCH
 HIGH
 B
 +3
 +2
 A open -4 -3 -2 1 2 3 closed
 -2
 -3
 LOW

RESONATING CAVITY
 NASALITY
 HYPERNASAL
 C
 +4
 +3
 +2
 1
 -2
 HYPONASAL

Constant _____

Rate

Intensity

Vocal Range

Variable _____

-2 1 +2 -2 1 +2
 Slow Fast Soft Loud

-2 1 +2
 Monotone Variable Pitch

Comments: _____

Examiner: _____

Figure 1. The Jewish Hospital Voice Profile.

2. Sustained "Ah": Wilson and his associates (Wilson, 1971)

found that the length of time an individual can sustain the tone "Ah" has considerable relationship to laryngeal efficiency, provides an acceptable measure of change in air loss during phonation, and in management can indicate the reduction of the obstruction of vocal fold closure.

3. Open--Closed: The horizontal line "A" deals with the open and closed position of the vocal folds. A -4 indicates the folds are abducted so that the flow of air is nonrestricted, producing little, if any, friction noise in attempted communication. This would be described in a clinical model as aphonic production. The -3 represents narrowing of the vocal chink which results in a whisper; the individual's attempt at voicing is characterized by considerable friction. Breathiness is indicated by -2 and generally is characterized by turbulence and some friction. A normal voice is represented by 1, at the center point of line "A."

A voice characterized by much tension is indicated by +2. The individual maintains vibratory motion, but has vocal characteristics that give the listener an impression of vocal strain. The acoustic product is harshness. At the extreme right, +3 represents extreme tension, or more accurately, a random closure with inability of the individual to sustain normal vocal fold vibration. The acoustic product is spastic dysphonia.

4. Pitch: The vertical line "B" deals with the vocal parameter of pitch. Pitch is considered primarily on a social basis. Neither extreme, +3 at the high pitch or -3 at the low pitch, represents a fixed pitch. Rather, they denote pitches which are sufficiently deviant to

cause the individual to be inappropriately heard as male or female when the judgment is made on voice alone. Pitch levels at these extremes are rarely heard in children. The -2 and +2 represent more common pitch deviations that cause concern primarily to the critical listener, usually the speech clinician. They rarely cause the speaker social anxiety.

5. Resonating Cavity: On line "C," -2 represents a lack of nasal resonance in the production of normally nasalized sounds. Normal is represented by 1. Assimilation nasality is denoted by +2; nasalization of vowels with some shading of a nasal nature to the consonants is represented by +3; and +4 represents hypernasality of all sounds, including frequent nasal distortions of consonant sounds.

6. Rate, Intensity, and Vocal Range: Three additional components of voice (rate, intensity, and vocal range) appear at the bottom of the form. Wilson and associates reportedly refer to these dimensions as descriptive aspects of voice more than as primary components.

7. Variable or Constant: The terms "variable" and "constant" refer to the existence of the voice deviation over time and under differing conditions; in other words, one notes whether the deviation remains constant or whether it is variable, occurring at only specific times or in specific situations.

8. Comments: The comments section is the portion of the form provided for noting clinical subtleties not included in the profile, such as pitch breaks, vocal fry, and varying types of voice production which change with the complexity of the communicative situation.

Wilson produced an audio tape recording for training in the use of

the Jewish Hospital Voice Profile as an evaluation tool. The training tape was revised in 1972. The tape presents samples of hoarseness (+2-2) at each level of severity, from a rating of "1" through "7" at half-point interval steps, in order to familiarize the voice evaluator with each level of severity. Ratings of +2-2 voices at "1" and "2" represent barely noticeable hoarseness when judged by a speech clinician with a trained ear. Ratings of "2" through "4" increase from barely perceivable to consistent hoarseness. Ratings from "4.5" through "7" are consistently hoarse. Voice breaks are present in the ratings of "5" and "5.5," extreme roughness occurs at "6," and "painful to listen to" hoarseness occurs at "6.5" and "7."

Procedures

Data for this study were collected during the Fall speech screening which was conducted in September and early October of 1974.

Under supervision of Mary Gordon, M.S., and Robert Casteel, Ph.D., voice clinical supervisors at Portland State University, this investigator was trained to use the Jewish Hospital Voice Profile to diagnose voice disorders.

The voice screening material consisted of: requesting the subject to say his name; instructing the subject to talk about his family, pets, et cetera, in order to elicit a spontaneous sample of speech; and, as necessary, instructing the subject to repeat sentences after the examiner and/or count to ten.

Voice diagnoses were made utilizing the Jewish Hospital Voice Profile scale for each subject. All subjects exhibiting a voice disorder

were recorded on a tape recorder for further voice analysis. During recording sessions, the children were seated in chairs suited to their size. The examiner held the microphone within approximately four to six inches from the subject's mouth. The voice sample tapes were made in the subject's school. In each environment the acoustic noise levels varied; however, the investigator sought to find a room in each school which was relatively free of environmental noises, such as traffic or playground activities. This was possible in all but one school which was under construction during the time of taping. The tapes made in the latter school, however, were reviewed and found acceptable for the purposes of this study.

The voice samples were rated on the Jewish Hospital Voice Profile by this investigator. Interjudge reliability was established by the procedure described below:

1. A training session was conducted, including this investigator, Mary Gordon, M.S., and Robert Casteel, Ph.D., during which time the Jewish Hospital Voice Profile training tape was presented.
2. During the training period, recordings of voice samples from this study were played and rated on the Jewish Hospital Voice Profile. The ratings were compared and discussed after each group of ten samples had been played and rated.
3. Twenty randomly selected voice samples from this study were played and rated by the three judges with 95 percent agreement among the judges.

Finally, intrajudge reliability was established by re-judging the twenty randomly selected samples with 100 percent agreement with previous ratings made by the same judge.

Data Analysis

Each subject was rated on the Jewish Hospital Voice Profile.

Data relative to the total sample and to the voice-disordered sample were analyzed as follows: 1) total incidence of voice disorders, 2) type of disorders, 3) male-female ratio, 4) kindergarten-first grade ratio, and 5) incidence of severity levels.

A chi square analysis was used to determine if a statistically significant difference existed in the incidence of voice disorders between male and female subjects, and between first-grade and kindergarten level subjects.

CHAPTER IV

RESULTS AND DISCUSSION

Results

The data were analyzed relative to the total sample and to the voice-disordered subjects.

Total Sample

Of the total number of kindergarten and first-grade subjects evaluated, 22.9 percent exhibited voice disorders.

Type. Hoarseness, in isolation or in combination with other voice deviations, was found among 22.6 percent of the sample. Figure 2 illustrates the distribution of types of voice disorders among the total sample. Hoarseness in isolation was exhibited in 16.8 percent of the subjects; whereas, 2.4 percent exhibited hoarseness in combination with too low pitch, 3.1 percent in combination with disturbances of nasal resonance, and .3 percent in combination with too low pitch and disturbances of nasal resonance. Disorders of nasal resonance alone were found in .3 percent.

Clinical/Nonclinical. For the purposes of this investigation, a clinically significant voice disorder was defined as any voice disorder with a severity rating of "4" or above based on the Jewish Hospital Voice Profile, and nonclinical was defined as any voice disorder with a severity rating of "3.5" or below on the same seven-point scale.

Clinically significant voice disorders were found in 18.6 percent of the total sample.

Figure 2. Types of voice disorders in total sample.

Sex and Grade Level Distribution. Figure 3 represents the sex and grade level distributions among the total sample. The male subjects displayed a voice disorder incidence of 25.6 percent as compared to the lower incidence of 21.2 percent of the female sample.

The percentage of voice disorders present in the first-grade group exceeded the kindergarten group in the total sample by 5.3 percent with percentages of 25.0 and 19.8 respectively.

A chi square analysis was used to determine if a statistically significant difference occurred between the incidence of voice disorders in males and the incidence in females. The resulting chi square value of 3.02 did not indicate a significant relationship between sex and the incidence of voice disorders at the .05 level (Table I).

Figure 3. Sex and grade level distributions in total sample.

TABLE I
COMPARISON OF VOICE DISORDER INCIDENCE
OF MALES WITH FEMALES AND OF
KINDERGARTEN WITH
FIRST GRADE

Classification	df	Chi Square
Voice disorders vs. sex	1	3.02*
Voice disorders vs. grade level	1	2.75*

*Not significant at .05 level

Similarly, a chi square analysis was computed to determine if a statistically significant difference occurred between the incidence of voice disorders in kindergarten level and in first-grade level subjects. No statistically significant difference was shown (Table I).

Voice-Disordered Sample

Type. Disorders of hoarseness in combination with other voice deviations were found among 98.6 percent of the voice-disordered subjects. Figure 4 illustrates the distribution of types of disorders among the voice-disordered sample. Hoarseness alone was exhibited among 73.2 percent of the voice-disordered population; whereas, 10.6 percent exhibited hoarseness in combination with too low pitch, 13.4 percent in combination with disorders of nasal resonance, and 1.4 in combination with too low pitch and disorders of nasal resonance. Disorders of nasal resonance alone were found in 1.4 percent.

Clinical/Nonclinical. Clinically significant voice disorders existed in 81.0 percent of the voice-disordered sample. The nonclinically significant group consisted of 19.0 percent of those with voice disorders as shown in Figure 5.

Sex and Grade Level Distributions. Sex and grade level distributions among the voice-disordered sample are shown in Figure 6. Male subjects comprised 61.3 percent of the voice-disordered group as compared to only 38.7 percent female.

First-grade subjects comprised 66.2 percent of the voice-disordered group, and 33.8 percent were at the kindergarten level.

Hoarseness. Hoarseness was the most frequently occurring voice disorder, i.e., 98.6 percent of the voice-disordered sample. Of those exhibiting hoarseness alone or in combination with other voice disorders, 60.7 percent were male and 39.3 percent female; 65.7 percent were first-grade level while only 34.3 percent were at the kindergarten level. Figure 7 shows these percentages.

Figure 4. Distribution of disorders among voice-disordered sample.

Figure 5. Clinical versus nonclinical among voice-disordered sample.

Figure 6. Sex and age distribution among voice-disordered sample.

Figure 7. Sex and age distribution of hoarse sample.

The majority (82.1 percent) of the severity ratings of hoarseness ranged from "3.5" to "5." See Table II for the percentage distribution of each level of severity among the sample exhibiting hoarseness.

TABLE II
PERCENTAGE OF EACH LEVEL OF
SEVERITY OF HOARSENESS
(N=140)

Severity Level	Percent
1	0.
1.5	0.
2	0.7
2.5	1.4
3	5.7
3.5	11.4
4	27.1
4.5	28.6
5	15.0
5.5	4.3
6	5.0
6.5	0.7
7	0.

Discussion

This study was designed to investigate the incidence of voice disorders among a selected age group of public school students in a specific geographic region. Four essential questions were asked. The first question was: "What is the incidence of voice disorders in a kindergarten and first-grade sample?" In this study, 23.0 percent of the subjects exhibited voice disorders.

The literature has reported diverse results relative to the few incidence studies of voice disorders among children. From 1931 to 1966

incidence estimates varied from 0.5 percent to 6.1 percent of the total population of children in the United States. The present study resulted in a much higher percentage, i.e., of 619 kindergarten and first-grade subjects aged five through seven years, 23.0 percent exhibited voice disorders. Even though only 18.6 percent of the total sample were found to exhibit clinically significant voice deviations, this number greatly exceeds the findings in the literature. In 1974, however, Silverman and Zimmer's study resulted in a voice-disorder incidence of 28.0 percent in the total sample, a number exceeding that found in the present study.

There are several possible reasons for the diversity in these findings; one possible variable is age range. Most of the studies reported in the literature surveyed a wide sample of ages with some including subjects termed "school-aged" and with others including subjects from five to twenty-one years of age; whereas, this study involved a limited age range. Silverman and Zimmer's (1974) data showed the majority (68.4 percent) of subjects displaying hoarseness were in the primary grades. Senturia and Wilson (1968) found the highest incidence rate among six- and seven-year-old subjects in their study. That specific age group comprised the majority of subjects in the present study, which may be the reason for the much higher incidence in the present study.

A second variable to be considered in the results of voice incidence studies is the diagnosis of voice disorders. Since a problem exists in defining types of voice disorders within the entire field of speech pathology, precise and concurring diagnoses of voice disorders are impossible. Few of the incidence studies reviewed in the literature offered information as to how the voice disorders were defined or as to

what severity levels constituted a voice disorder. Another problem in the area of diagnosis is that, in most studies, diverse methods were used to collect data, i.e., investigators who collected the data were of various degrees of training and experience in the field of speech pathology, and some were non-speech pathologists, such as nurses. Great variations, therefore, were found in the training of investigators to diagnose voice disorders.

The variables of weather conditions and geographic region also may relate to the higher incidence of voice disorders found in this study as compared to other studies. These factors will be discussed in a later section.

The second question was: "What is the incidence of each type of voice disorder?" Hoarseness occurred with far greater frequency than disorders of nasal resonance. Hoarseness occurred in 22.6 percent of the total sample (or 98.6 percent of the voice-disordered sample); whereas, disorders of nasal resonance occurred among 3.7 percent of the total sample (or 16.2 percent of the voice-disordered sample). Both hoarseness and nasal resonance deviancies were combined in 3.4 percent of the total sample (or 14.8 percent of the voice-disordered subjects).

In considering the incidence of hoarseness, the results of this study (22.6 percent) were considerably larger than Pont's (1965) and Baynes' (1966) findings of 9.1 percent and 7.1 percent respectively. Baynes, however, indicated his findings were a conservative figure since subjects displaying "mild" hoarseness were excluded from his study. On the other hand, the incidence of hoarseness in this study closely agrees with Silverman and Zimmer's (1974) findings of 23.4 percent, which ac-

counted for 84.4 percent of all voice problems detected in their sample. In both studies, therefore, the majority of voice problems was hoarseness. Although the figures of the four studies mentioned above vary, they seem to indicate that hoarseness is a major problem among school-aged children.

Further information derived from Silverman and Zimmer's (1974) data showed that the majority (68.4 percent) of subjects displaying hoarseness were in the primary grades. Senturia and Wilson (1968) found the highest incidence rate among six- and seven-year-old subjects in their study. Baynes' (1966) data found the highest incidence of hoarseness to be among first-grade subjects, which is supported by the findings of the present study. This seems to indicate that hoarseness is not only a major problem among school-aged children, but especially among those in the primary grades.

In the studies reviewed in the literature, no reference was provided relative to time of year or weather factors which may have affected results. Data for this study was collected during September and early October at which time unusually warm, sunny "Indian summer" weather existed in the greater Portland area. Many teachers and parents of the voice-disordered subjects reported the subjects had been engaging in much outdoor play and in excessive "yelling" and "shouting" behaviors. This vocal abuse may account for the high percentage exhibiting hoarseness alone or in combination with other voice disorders. Conversely, the weather may have been the determinant of the low percentage of subjects exhibiting disorders of nasal resonance (3.7 percent as compared to 12 percent in the Senturia and Wilson study), especially of hyponasality,

since it was beyond the peak "hay fever season" and few subjects displayed head colds.

The geographic region in which a study is conducted also may account for differences in incidence findings and in types of disorders. In regions with severe winter weather little opportunity is afforded for outdoor yelling; whereas, in milder regions children can play outdoors most of the year. Dry regions may inhibit nasal resonance problems due to colds and some allergies; whereas, wet, rainy regions may expand the incidence of nasal resonance disorders.

In considering the third essential question, "What is the severity of each voice problem?" it was difficult to relate the findings of the present study to those in the literature because few studies specified what was considered a "serious" enough voice disorder to be included in the incidence figures. Some investigators noted that "mild" disorders were excluded, but a "mild" disorder was not defined. In contrast to this procedure, the Senturia and Wilson (1968) study used the seven-point severity scale of the Jewish Hospital Voice Profile. Their study thus included various severity levels including those which were classified as "nonclinical," as well as those classified as "clinically significant" in the present study. Until more researchers use refined judging procedures, such as those used in the Senturia and Wilson (1968) study, accurate comparison of studies will be impossible.

Lastly, the final essential question will be considered: "Was the incidence similar for males and females?" Although the percentages of males exhibiting voice disorders exceeded that of females in the total sample, a statistically significant difference did not exist. The male-

female ratio, however, of the voice-disordered sample was 61.3 percent to 38.7 percent. When these results were compared with results found in the Senturia and Wilson (1968) study, a definite similarity was observed. Senturia and Wilson reported 65.7 percent male subjects and 34.3 percent female subjects, or an approximate 2 to 1 male-female ratio, which compared to the nearly 2 to 1 male-female ratio in the present study.

CHAPTER V

SUMMARY AND IMPLICATIONS

Summary

The purpose of this study was to investigate the incidence of voice disorders among kindergarten and first-grade students selected from some schools of Portland, Oregon, during early Fall, 1974.

The essential questions to be answered by the investigation were:

1) What is the incidence of voice disorders in a kindergarten and first-grade sample; 2) what are the types of voice deviations; 3) what is the severity of each voice problem; and 4) was the incidence similar for males and females?

The subjects were 619 students from five kindergarten and eight first-grade classrooms in Portland Public School District No. 1, Portland, Oregon. The sample was comprised of 340 males and 279 females, of which 243 were at the kindergarten level and 376 at the first-grade level. The socioeconomic levels ranged from upper-lower to middle-middle class (Hegrenes, 1975).

Voice samples of all subjects were obtained. The voice-disordered samples were recorded on an Ar-Tik' magnetic tape recorder, model 414. The same tape recorder, in conjunction with Ampex 620 speakers, was used to present the voice samples to the three judges. The Jewish Hospital Voice Profile, designed by Wilson (1971), was utilized to evaluate the voice samples. This profile permits a systematic method of consistent

description of the prevalence and problems of voice disorders. The voice samples were rated on the profile by this investigator following training by two supervisors in the Voice Clinic, Portland State University. Interjudge reliability of 95 percent agreement was obtained with the two clinical supervisors, and intrajudge reliability of 100 percent agreement was obtained by this investigator on twenty randomly selected voice samples.

Approximately 23 percent of the subjects evaluated exhibited voice disorders. Hoarseness was the most frequently occurring voice disorder with 22.6 percent of the total sample (or 98.6 percent of the voice-disordered sample); whereas, disorders of nasal resonance occurred among only 3.7 percent of the total sample (or 16.2 percent of the voice-disordered sample). The overlapping of percentages resulted because both hoarseness and nasal resonance deviancies were present in 3.4 percent of the total sample (or 14.8 percent of the voice-disordered sample). Clinically significant voice disorders were found in approximately 18.5 percent of the total sample. The male-female percentage ratio was 25.6 percent and 21.2 percent, respectively. The first-grade-kindergarten ratio was 25.0 percent and 19.8 percent, respectively. Chi square analyses, however, revealed no statistically significant relationship between sex and the incidence of voice disorders, or between grade level and the incidence of voice disorders. The majority (82.1 percent) of severity ratings of disorders of hoarseness ranged from ratings of "3.5" to "5" on the seven-point scale.

The incidence of the present study was greater than the incidence of most other studies reported in the literature. Possible reasons for

this are: 1) age of the sample, 2) skills of the evaluator(s), 3) evaluation tool, 4) season, and 5) geographic region. Further studies need to be conducted seasonally and regionally, and to be updated regularly.

Based upon the results of incidence studies, there seems to be a need for speech clinicians to alter their caseloads to include more clients exhibiting voice disorders. Additionally, since speech clinicians seem to be reluctant to work with persons exhibiting voice disorders (Chapman et al., 1961), improved training needs to be instituted in the area of treatment for voice disorders.

Implications

Results of different incidence studies vary greatly due to several reasons; the two variables of geographic region and weather seem to play a role in the differences. These variances, thus, suggest incidence studies need to be conducted regionally and seasonally, and to be updated regularly.

Incidence studies reviewed in the literature have surveyed different grade levels or age groups. The results of these studies collectively generally indicate the greatest incidence of voice disorders are found in the primary grades, specifically among the first- and third-grade levels. Considering this information, it seems that future incidence studies should particularly survey the primary grade levels. In reference to the present study, although a chi square analysis resulted in no statistically significant difference between grade level and incidence of voice disorders, first-grade subjects did exhibit a higher percentage

of voice disorders (5.3 percent more) than kindergarten level subjects. Further research would clarify whether the incidence increases or decreases at higher grade levels. It is, therefore, suggested that the voices of second-, third-, and fourth-grade students be evaluated to determine incidence at those grade levels.

In considering the variable of diagnosis of voice disorders, a problem was found to exist in defining types of voice disorders and, therefore, in precise and concurring diagnosis of voice disorders. In view of this problem, it is clear that some standard methodology needs to be adopted nationally so that valid comparisons can be made among incidence studies of voice disorders. For example, if speech pathologists were trained in the use of an agreed upon diagnostic method (e.g., the Jewish Hospital Voice Profile) for obtaining data in voice disorder incidence studies, valid comparisons would most likely be possible.

Although results of incidence studies found in the literature vary, they generally indicate a great number of clinically significant voice deviancies do exist, especially voices exhibiting the symptom of hoarseness. Chapman et al. (1966), however, reported that only three children of an average public school caseload of 130 are treated for voice disorders. As indicated by incidence studies, this number (2.3 percent of a caseload) seems to fall far short of those in need of clinical attention due to voice disorders. A possible explanation is that many speech clinicians are not adequately trained to deal with voice disorders. For example, Moore (1971a) indicated,

Many speech pathologists and others concerned with voice therapy are reluctant to work with voice problems because they believe their education and training have not prepared them adequately for that responsibility. This attitude is widespread, despite

the venerable age of vocal reeducation as a specialty and the existence of a substantial bibliography.

The knowledge which incidence studies afford speech clinicians enables them to realize the frequency with which each type of disorder, including voice, occurs. The present study showed that the majority of voice disorders occurred at ratings of "4," "4.5," and "5," deviations which are clinically significant. This, in turn, should inspire clinicians to improve their abilities to deal with these existing problems by augmenting their educational background. Additionally, speech clinicians may alter their caseloads to serve those in need as indicated by the results of current incidence studies.

Damitz and Dill (1940) and Murphy (1964) have pointed out that hoarseness, the major symptom of voice disorders, is continuously neglected by patients and physicians because the majority of people continue to associate it with the common cold, even when none is present, and assume time will take care of the disorder. Yet, several authors continue to stress that hoarseness is a symptom common to almost all laryngeal diseases and is, in fact, often the only symptom present in laryngeal diseases of extreme gravity (Boone, 1971; Curtis, 1956; Darley, 1965; Isshiki et al., 1969; von Leden, 1958; Wells, 1940; White, 1946; and Wilson, 1972). It is clear speech pathologists must better educate the general public so that parents and teachers will be more alert to symptoms of hoarseness among their children and students and that these children might receive the attention necessary for their symptoms.

BIBLIOGRAPHY

- ARNOLD, G. E., Vocal nodules and polyps: Laryngeal tissue reaction to habitual hyperkinetic dysphonia. J. Speech Hearing Dis., 27, 205-217 (1962).
- ARNOLD, G. E., Vocal nodules. In J. F. Daly, Voice problems and laryngeal pathology. New York J. Med., 63, 30-96 (1963).
- BAYNES, R., An incidence study of chronic hoarseness among children. J. Speech Hearing Dis., 31, 172-176 (1966).
- BERRY, M., and EISENSEN, J., Speech Disorders: Principles and Practices of Therapy. New York: Appleton-Century-Crofts (1956).
- BINGHAM, D. S., VAN HATTUM, R. J., FAUK, M. E., and TAUSSIG, E., Program organization and management. In Research Committee of the American Speech and Hearing Association, Public School Speech and Hearing Services. J. Speech Hearing Dis. Monogr. Suppl. 8 (1961).
- BLACK, M. E., Speech Correction in the Schools. Englewood Cliffs: Prentice-Hall, Inc. (1964).
- BOONE, D. R., The Voice and Voice Therapy. Englewood Cliffs: Prentice-Hall, Inc. (1971).
- BRACKETT, I. P., An Analysis of the vibratory action of the vocal folds during the production of tones at selected frequencies. Doctoral dissertation, Northwestern University (1948).
- BRACKETT, I. P., Parameters of voice quality. In L. E. Travis (Ed.), Handbook of Speech Pathology and Audiology. New York: Appleton-Century-Crofts (1971).
- BRODNITZ, F. S., Keep Your Voice Healthy. New York: Harper (1953).
- CHAPMAN, M. E., HERBERT, E. L., AVERY, C. B., and SELMAR, J. W., Clinical practice: Remedial procedures. J. Speech Hearing Dis. Monogr. Suppl. 8, 58-77 (1961).
- COTTON, J. C., A study of certain phoniatric resonance phenomena. J. Speech Dis., 5, 289-293 (1940).
- CURTIS, J. F., Disorders of voice. In W. Johnson, S. J. Brown, J. F. Curtis, C. W. Edney, and J. Keaster, Speech Handicapped School Children. New York: Harper (1956).

- DAMITZ, J., and DILL, J., Chronic hoarseness. Ann. Otol. Rhinol. Laryng., 49, 996-1007 (1940).
- DARLEY, F. L., Diagnosis and Appraisal of Communication Disorders. Englewood Cliffs: Prentice-Hall, Inc. (1964).
- DELATTRE, P. C., LIBERMAN, A. M., and COOPER, F. S., Acoustic loci and transitional cues for consonants. J. Acoust. Soc. Amer., 27, 769 (1955).
- DeWEESE, D. D., SAUNDERS, W. H., Textbook of Otolaryngology. (3rd ed.) St. Louis: C. V. Mosby Co. (1968).
- FAIRBANKS, G., Voice and Articulation Drillbook. (2nd ed.) New York: Harper and Brothers (1960).
- FISHER, H. B., Improving Voice and Articulation. Boston: Houghton Mifflin Co. (1966).
- FISHER, H. B., Improving Voice and Articulation. (2nd ed.) Boston: Houghton Mifflin Co. (1975).
- FLETCHER, W. W., A high-speed motion picture study of vocal fold action in certain voice qualities. Master's thesis, University of Washington (1947).
- FRICK, J. V., The incidence of voice defects among school-age speech defective children. Penn. Speech Ann., 17, 61-62 (1960).
- FROESCHELS, E., Laws in the appearance and the development of voice hyperfunctions. J. Speech Dis., 5, 1-4 (1940).
- FROESCHELS, E., Should the speech therapist be a voice therapist? J. Speech Hearing Dis., 3, 346-350 (1948).
- FROESCHELS, E., Nose and nasality. Arch. Otolaryng., 66, 629 (1957).
- GOULD, G. M., A Pocket Medical Dictionary. (8th ed.) Philadelphia: P. Blakiston's Son and Co. (1920).
- GRAY, G. W., and WISE, C. M., The Bases of Speech. New York: Harper (1934).
- GREENE, M., The Voice and Its Disorders. Philadelphia: Lippincott (1964).
- GREENE, M., The Voice and Its Disorders. (2nd ed.) Philadelphia: Lippincott (1967).
- HANLEY, T. D., and THURMAN, W. L., Developing Vocal Skills. (2nd ed.) New York: Holt, Rinehart and Winston, Inc. (1970).

- HEGRENES, J., Personal consultation (1975).
- HESS, D. A., Pitch, intensity, and cleft palate voice quality. J. Speech Res., 2, 113 (1959).
- HOLMES, F. L. D., The qualities of the voice. Quart. J. Speech, 18, 249-255 (1932).
- ISSHIKI, N., OKAMURA, H., TANABE, M., and MORIMOTO, M., Differential diagnosis of hoarseness. Folia Phoniatica, 21 (1), 9-19 (1969).
- JACKSON, C., Hoarseness. In C. Jackson and C. L. Jackson (Eds.), Diseases of the Nose, Throat, and Ear. (2nd ed.) Philadelphia: W. B. Saunders Co. (1959).
- JOHNSON, W., BROWN, S. F., CURTIS, J. F., EDNEY, C. W., and KEASTER, J., Speech Handicapped School Children. New York: Harper and Brothers (1956).
- JOHNSON, W., DARLEY, F. L., and SPRIESTERSBACH, D. C., Diagnostic Methods in Speech Pathology. New York: Harper and Row (1963).
- KAPLAN, H., Anatomy and Physiology of Speech. New York: McGraw-Hill (1971).
- LINTZ, L. B., and SHERMAN, D., Phonetic elements and perception of nasality. J. Speech Hearing Res., 4, 381-396 (1961).
- LORE, J. M., Hoarseness in children. Arch. Otolaryng., 51, 814-825 (1950).
- MIDCENTURY WHITE HOUSE CONFERENCE, Speech disorders and speech correction. J. Speech Hearing Dis., 17, 129-137 (1952).
- MILISEN, R., The incidence of speech disorders. In L. E. Travis (Ed.), Handbook of Speech Pathology and Audiology. New York: Appleton-Century-Crofts (1971).
- MILLS, A., and STREIT, H., Report of a speech survey, Holyoke, Massachusetts. J. Speech Dis., 7, 161-167 (1942).
- MOORE, G. P., Voice disorders associated with organic abnormalities. In L. E. Travis (Ed.), Handbook of Speech Pathology. New York: Appleton-Century-Crofts (1957).
- MOORE, G. P., Organic Voice Disorders. Englewood Cliffs: Prentice-Hall (1971a).
- MOORE, G. P., Voice disorders organically based. In L. E. Travis (Ed.), Handbook of Speech Pathology and Audiology. New York: Appleton-Century-Crofts (1971b).

- MORRIS, H. L., SPRIESTERSBACH, D. C., and DARLEY, F. L., An articulation test for assessing competency of velopharyngeal closure. J. Speech Hearing Res., 4, 48-55 (1961).
- MURPHY, A., Functional Voice Disorders. Englewood Cliffs: Prentice-Hall (1964).
- NEGUS, V. E., The significance of hoarseness. New York J. Med., 39, 9-12 (1939).
- PALMER, C. E., Speech and Hearing Problems. Springfield, Ill.: Charles C. Thomas (1961).
- PONT, C., Hoarseness in children. W. Mich. Univ. J. Speech Ther., 2, 6-8 (1965).
- PRONOVOST, W., A survey of services for the speech and hearing handicapped in New England. J. Speech Hearing Dis., 16, 148-156 (1951).
- SENTURIA, B. H., and WILSON, F. B., Otorhinolaryngic findings in children with voice deviations. Ann. Otol. Rhinol. Laryng., 77, 1027-1041 (1968).
- SETH, G., and GUTHRIE, D., Speech in Childhood. Oxford: Oxford University Press (1953).
- SHERMAN, D., and GOODWIN, F., Pitch level and nasality. J. Speech Hearing Dis., 19, 423-428 (1954).
- SILVERMAN, E. M., and ZIMMER, C. H., Incidence of chronic hoarseness in a Hebrew day school. Speech presented at the 50th annual meeting of the American Speech and Hearing Association, Las Vegas (November 1974).
- SONNINEN, A., Phoniatric view points on hoarseness. Acta Otolaryng. Suppl. 263, 68-81 (1970).
- TOBIAS, J. V., Relative occurrence of phonemes in American English. J. Acoust. Soc. Amer., 31, 631 (1959).
- VAN RIPER, C., and Irwin, J. V., Voice and Articulation. Englewood Cliffs: Prentice-Hall (1958).
- VON LEDEN, H., The clinical significance of hoarseness and related voice disorders. Lancet, 78, 50-53 (1958).
- WEISS, A. I., Oral and nasal sound pressure levels as related to judged severity of nasality. Doctoral dissertation, Purdue University (1954).

- WELLS, W., The significance of hoarseness. Ann. Otol. Rhinol. Laryng., 55, 537-542 (1940).
- WHITE, F. W., Some causes of hoarseness in children. Ann Otol. Rhinol. Laryng., 55, 537-542 (1946).
- WHITE HOUSE CONFERENCE ON CHILD HEALTH AND PROTECTION. Special Education. New York: The Century Co. (1931).
- WILLIAMS, R. M., Speech Difficulties in Childhood. London: George G. Harrap and Co. Ltd. (1962).
- WILLIAMSON, A. B., Diagnosis and treatment of eighty-four cases of nasality. Quart. J. Speech, 30, 471-479 (1944).
- WILLIAMSON, A. B., Diagnosis and treatment of seventy-two cases of hoarse voice. Quart. J. Speech, 31, 189-202 (1946).
- WILSON, F. B., The voice-disordered child: A descriptive approach. Lang. Speech and Hearing Services in Schools, 1 (4), 14-22 (1971).
- WILSON, K. D., Children with vocal nodules. J. Speech Hearing Dis., 26, 19-26 (1961).
- WILSON, K. D., Voice Problems of Children. Baltimore: Williams and Wilkins Co. (1972).
- ZEMLIN, W. R., Speech and Hearing Science Anatomy and Physiology. Englewood Cliffs: Prentice-Hall, Inc. (1968).