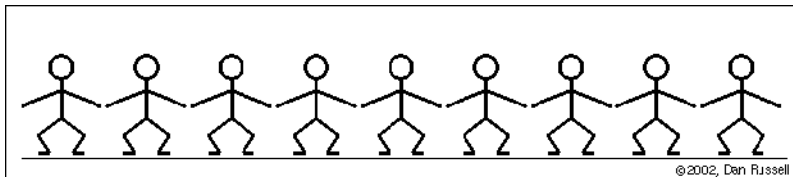


NATALIJA BOLFAN-STOSIC, Ph.D.



**SOME OF PAPERS PRESENTED ON NATIONAL AND
INTERNATIONAL SCIENTIFIC CONFERENCES
PRIMARLY BASED ON ACOUSTIC VOICE ANALYSES OF
CHILDREN AND ADULTS**

Za LONDON, 2002. Radionica o dječjim i pubertetskim glasovima



Have you ever "done the wave" as part of a large crowd at a football or baseball game? A group of people jumps up and sits back down, some nearby people see them and they jump up, some people further away follow suit and pretty soon you have a wave travelling around the stadium. The wave is the disturbance (people jumping up and sitting back down), and it travels around the stadium. However, none of the individual people the stadium are carried around with the wave as it travels - they all remain at their seats (Dan Russell, 2002.)



The 5th International Conference on
Spoken Language Processing
Incorporating The 7th Australian International Speech Science and Technology Conference
Sydney Convention Centre, Sydney Australia
30th November - 4th December 1998

ICSLP'98 Proceedings Volume
3, 711-714

JITTER AND SHIMMER
DIFFERENCES BETWEEN
PATHOLOGICAL VOICES
OF SCHOOL CHILDREN

Authors: Natalija Bolfan-Stosic
and Tatjana Prizl

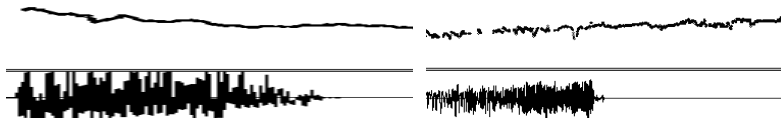
Abstract

A study was undertaken to determine differences between jitter and shimmer in voices of children with different syndromes. Voices of 60 children, both sexes, aged 7-12 years were analysed by EZ Voice Analysis Software (program for jitter and shimmer measuring). The main purpose of this paper has diagnostic background. Obtained results show, which acoustical indicators of pathological voice are in certain group of children, and in which shapes they appear. In that way, we try to find easiest way to explain acoustical characteristics of different voice pathologies as help in diagnostics. The results indicate that the children with stuttering and disarthric symptoms have higher values almost in all applied variables than the average values of children from other groups. Children with Down syndrome and hearing losses exhibited the most disordered voice quality. Finally, the mixed group (stuttering with dysphonia) and group of children with dysphonia exhibited the least pathological characteristics of voice. Obtained results of Analysis of Variance have shown significant statistical differences almost in all applied variables among the groups.

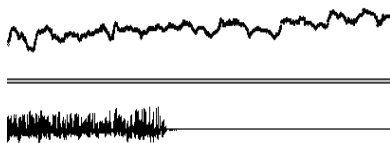
EZ Voice program pictures – jitter and shimmer curves – fonations of vowel /a/

GROUP WITH STUTTERING

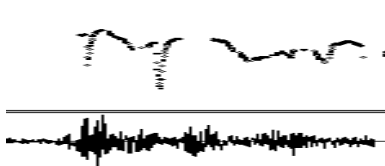
WITH STUTTERING AND DYSPHONIA



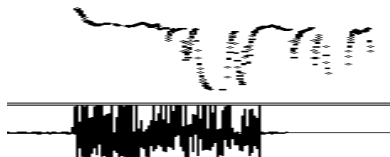
GROUP WITH DYSPHONIA



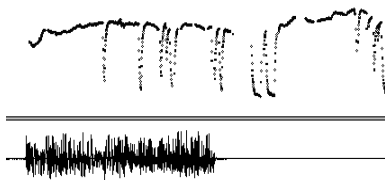
GROUP WITH DYSPHONIA



GROUP WITH DOWN SYNDROME



GROUP WITH HEARING LOSSES



XIVth World Congress of
the International Association of
Linguistics & Phonetics

Proceedings 24th IALP Congress

Authors: Natalija Bolfan-Stosic, Vesna Tokic and
Suzana Jelcic-Jaksic

SOME DIFFERENCES OF VOICE QUALITY OF CHILDREN FROM DIFFERENT SOCIAL ENVIRONMENTS

Abstract

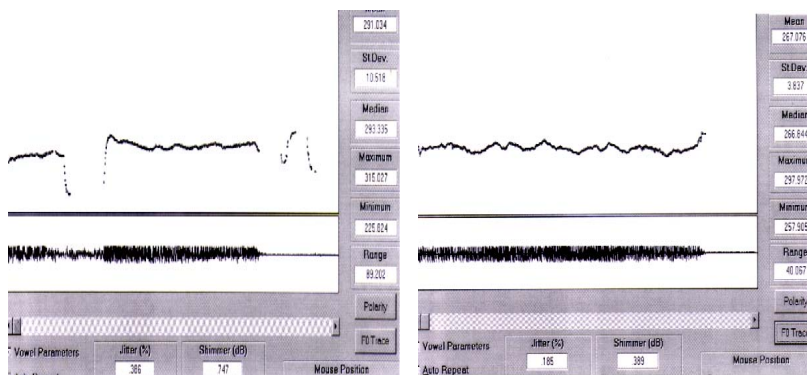
Many researches of children's voices indicate that the phonation is influenced by the external stimulation. The aim of this research is to find some differences in voice quality between the aforementioned groups of children, using four samples of examiners of both sexes. A total of 65 children was examined (31 girls, 34 boys) in the age among 63 and 80 months. The results indicate that the children from the third group (children

from the Institution for abandoned children from urban environment) exhibit the most disordered voice quality. Following are the children from the second group (children from regular kindergartens from urban environment), then the first group (children from SOS -- child's village Lekenik, suburb of Zagreb). Finally, the best voice qualities exhibit the fourth group (children raised in regular families, suburb of Zagreb).

EZ Voice analyses - fonation of vowel "a"

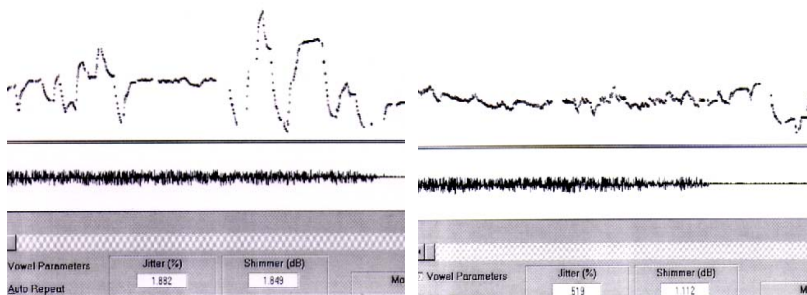
SOS village Lekenik
Child with "substitute" mother

Child raised in regular families



Child from regular kindergarten

Abandoned child



EUROSPEECH97 RHODOS

Proceedings, 2, 1019-1022

ACOUSTICAL CHARACTERISTICS OF SPEECH AND VOICE IN SPEECH PATHOLOGY

Authors: Natalija Bolfan - Stosic and Mladen Hedjever (1997)

Abstract

Thirty six hoarse voices of preschool children and fifty speech productions of school children was analyzed using an acoustic analysis by Bruel and Kjaer, Real-time Frequency Analyzer, Type 2123. Thirty six specific oscilograms of sustained vowel productions were divided to oscilograms shapes in three subgroups of specific shimmer values, inside the same group. The purpose of this part of our research is a help in recognition and usage of acoustical terms in diagnostic of disordered voices. Therefore, we obtained "staccato shimmer", the "narrow" total intensity or shimmer, and finally the "wide" shimmer with following oscillations of jitter. The differences in fundamental frequency and intensity between three subgroups of different shimmer were analysed using one-way variance analysis.

The purpose of the second part of this research has been to examine and analyze temporal segments in normal and disordered speech. Temporal segments of school children's speech have been measured starting from the subsound level (VOT - voice onset time and SGD - stop gap duration), and also at the levels of sound, syllable and word. Principal axis analysis showed specific differences between normal and pathological speech in all types of variables.

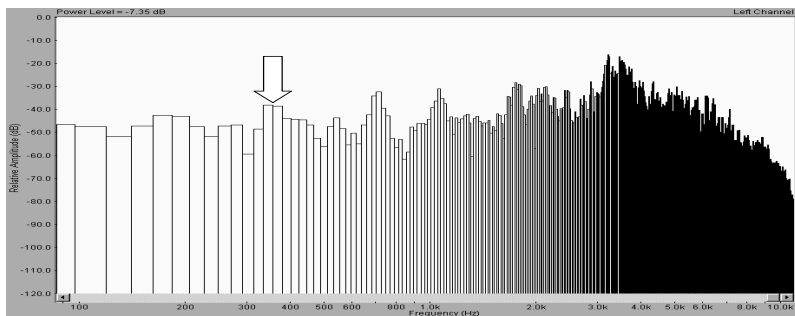
ACOUSTICAL ANALYSIS OF INFANT CRIES*

Authors: Behlul Brestovci and Natalija Bolfan-Stosic

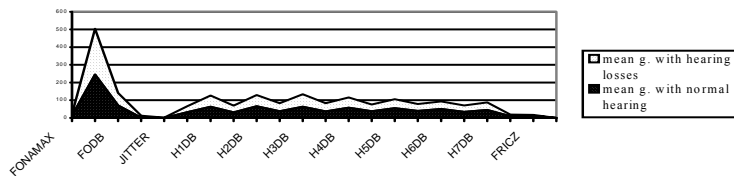
Abstract

The purpose of the research is establishing acoustical data in 13 infants crying (6 infants - 2 cries each, and one infant - one cry). Cry analysis is made on two types of cries: very first cry (birth stimulus) and following continuous signal or several short phonations. Results of acoustic analysis of 7 very first cries has shown lower fundamental frequencies then in six following cries of the same infants. Peak frequencies were lower in most of infant's first than in second cries while obtained values of peak amplitudes

are equal in both cry types. Signal to noise ratio showed higher values of four infants in first cries than in following cries. Some of obtained spectral pictures show bi-phonation phenomena.



Picture 1. Split Fo in very first cry



Graph 1. Means of variables between groups

Advances in Quantitative Laryngoscopy

Proceedings of the 4rd International Workshop,
Jena, Germany, April, 7-8, 22-28 and 29-33*

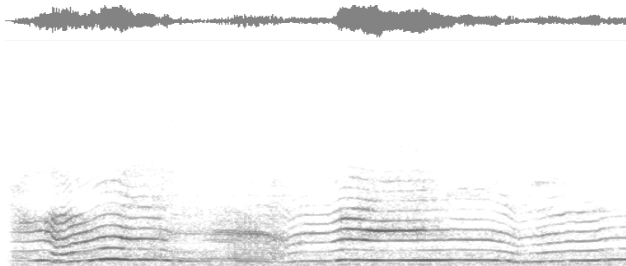
QUALITY OF THE TEACHERS' AND LECTURERS' VOICES

Authors: Natalija Bolfan-Stosic and Luka Bonetti

Abstract

The purpose of this research was to find and explain disordered features of the thirty-eight teachers' and the lecturers' voices, smokers and non-smokers, who teach from one year up to thirty years, three to eight hours per day. The values of the basic acoustic parameters obtained by EZ Voice Ver. 1.2. and

Phonation of vowel /a/ – boy with dysarthria



ACOUSTICAL VOICE CHARACTERISTICS OF CHILDREN WITH DOWN SYNDROME

Croatian Review of Rehabilitation Research, 99-104.

Authors: Natalija Bolfan - Stosic and Mladen Hedjever (1999)

Children with Down syndrome show different voice characteristics than normal children. Their speech is often characterised by a deep voice with harsh and hoarse quality. In this research we applied acoustical analyses made by a Real Time Frequency Analyser, type 2123. The phonation of the vowel “a” and the frictions of the consonants “s” and “z” of 8 boys with Down syndrome and 10 without voice pathology, aged 11, 4 to 10 was recorded by the Real Time Frequency Analyser. The results of acoustical analyses and t-test showed significant differences between two groups in terms of the following: fundamental tone, number of columns around F0, intensity of noise on the spectra and maximal duration of “a”, and “s” and “z” sounds. The differences in acoustical characteristics between groups are attributed to structural anomalies in Down group and an insufficient obstacle between the nasal and oral cavities. Voice picture in Down group showed diplophonia, or phenomenon of having two fundamental frequencies.

Advances in Quantitative Laryngoscopy

Proceedings of the 3rd International Workshop,
Aachen, Germany, June, 19-20, 1998., 35-45

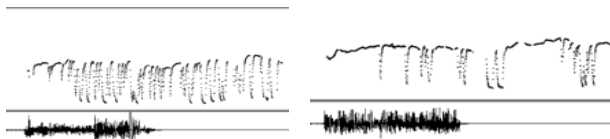
VOICE QUALITY OF HEARING-IMPAIRED CHILDREN

Authors: Natalija Bolfan-Stosic and Behlul Brestovci

Abstract

The aim of this research was to determine voice characteristics of hearing-impaired boys aged 10-12 years by Bruel and Kjaer, Real-time Frequency Analyser, Sound forge 4.0 and EZ Voice (PC programs for spectral analyses) in relation to control group of boys the same age without hearing disorders. In this research we have reported higher than normal Fo perturbations, higher Fo frequency and spectral noise levels between 1 kHz and 2 kHz than in control group for 12 hearing-impaired boys. The results showed shorter vowel and consonant production (“a”and “z”) characterised by over-aspiration in hearing-impaired group. Obtained results of T-test have shown significant statistical differences in seven applied variables among the tested groups.

The research gives spectrograms for each group in three graph types of presenting voice characteristics and audiograms: as a “bar graph type”, oscillogram form and as a jitter and shimmer curve form. Each of voice-graph types is a good for identification and recognition specific voice characteristics as well as a noise levels on “bar graph type”.



Phonations of vowel “a” of the hearing-impaired children

SpectraLab, Ver. 4.32.13. The results showed that frictions and phonations are weaker by their intensity, unexpected and explosive with uneconomical use of the air energy, even with clumsy motions. The results were also showing that the groups of smokers and non-smokers differ in basic voice characteristics, even though, taken generally, all of them showed small values in temporal variables related to normality. Statistically important correlation between voice parameters was established on the whole sample regarding the length of the teaching period within the group of non-smokers.

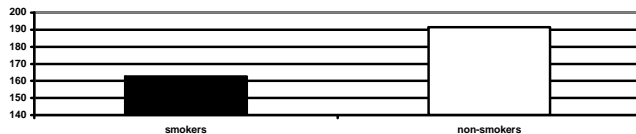
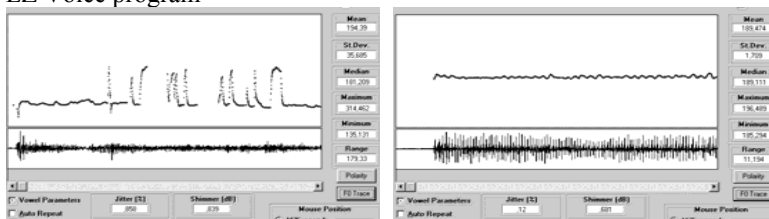


Figure 1. Arithmetical means of F0 (Hz)

EZ Voice program



Smoker – phonation of the vowel “A”

Non-smoker – phonation of the vowel “A”

ART AND SCIENCE IN LIFE POTENTIAL DEVELOPMENT Hvar, May, 16th – 21st, Croatia

Proceedings of the International Symposium, 299-305 and 311 - 317

CANONICAL RELATIONS BETWEEN DIFFERENT ACOUSTICAL AREAS OF VOICE MEASURING

Authors: Natalija Bolfan-Stosic and Behlul Brestovci

Abstract

The purpose of this research was to establish relations between groups of variables of acoustical area of voice measuring on 56 boys, aged 10 do 12 without voice disorders and boys, same age with pathological voice and different disorders (hearing loss, mental retardation, cerebral palsy).

Relations between variables made by SPSS statistical program for Windows. Results of Canonical Analysis showed statistically significant relations between group of variables which describe intensity levels of first seven harmonics and the highest intensity level of harmonic in consonant “z” and group of variables which show intensity levels of noise between first seven harmonics and the highest intensity level of noise in consonant “z”. We found statistically significant relations between “noise” group of variables and Fo oscillation group of variables (frequency and intensity of Fo, jitter, shimmer, number of columns around Fo above 40 dB as an indicator of laryngeal pathology). Children’s voices were acoustically analysed by Real Time Frequency Analyzer and EZ Voice program for Fo oscillation measurement. The knowledge about influence and relations between voice parameters in this research has diagnostic and therapeutic value with regard to influences of one voice parameter on another and on that way they make complex phenomena – sound or voice.

Author: Natalija Bolfan-Stosic

DIFFERENT IMAGES OF ACOUSTICAL CHARACTERISTICS OF VOICE AS HELP IN DIAGNOSTICS AND THERAPY OF DISORDERED VOICES

Abstract

The purpose of this paper was to establish, compare and explain laryngeal and resonant voice characteristics of 56 boys the same age (10 to 12) but with different impairments (sensorial hearing loss, dysarthria, Down syndrome and dysphonia). Acoustical analysis made by Bruel and Kjaer Frequency Analyser, EZ Voice program for jitter and shimmer oscillation measures and Spectrogram 2.3. Obtained results showed differences in shapes of spectrograms and on that way it is help in diagnostics and therapy of disordered voices. Results of One way analysis of variance and Discriminative analysis showed significant statistical differences between groups for frequency of fundamental (Fo), jitter and shimmer, number of columns around Fo as a laryngeal pathology indicator, and noise intensity levels between five harmonics. The voice parameters were measured in digitised live-voice productions of sustained vowel and consonants [a], [s], and [z] produced by 56 boys. Obtained results showed differences in resonant characteristics especially in group of children with dysarthria, Down syndrome and hearing losses (diphonia, wide first formant - hypernasality, antiresonant characteristics or zeros phenomena – less of sound energy, and spectral noise).

VOICEDATA98
Utrecht, Netherlands

Proceedings of Voicedata98, 27-31 and 22-26

VOICE CHARACTERISTICS IN APHASIC PATIENTS

Authors: Natalija Bolfan-Stosic and Tatjana Prizl (1998)

The aim of this research was to determine whether there were differences of certain voice characteristics in aphasic patients as to the location of brain damage. A pattern of 10 aphasic patients of both sexes and the average age of $X = 39,8$ was included in the research. As far as the location of injury is concerned, 5 patients suffered the injury of the right cerebral hemisphere while the other 5 suffered the injury of the left hemisphere. Using PC sound spectrograph 2.3, we selected a narrowband where harmonic lines were clearly visible in the overall voice pattern - the phonation of the vowel a. The height of the basic laryngeal tone (Fo) was established and the variability of harmonics was monitored. We were interested in the differences of voice characteristics in aphasic patients suffering from the damage of the left and right cerebral hemispheres, such as the height of the basic laryngeal tone (Fo), variability of harmonics, the duration of the vowel "a" phonation, the voice quality (harsh, hoarse, or tense voice). The results of T-test have not shown any considerable statistical differences among the tested groups. The spectrograms show the equal hoarseness of voice of both groups, with short phonations. However, the tremor is characteristic in all patients who suffered from the damage of the left cerebral hemisphere. The research will give a detailed spectrograms of both groups of tested subjects.

ACOUSTICAL CHARACTERISTICS OF VOICE IN VOICE
PATHOLOGY OF SCHOOL CHILDREN

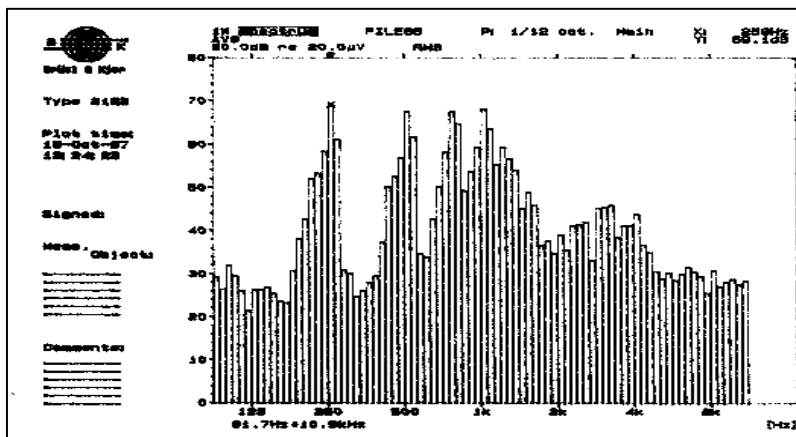
Author: Natalija Bolfan-Stosic

Abstract

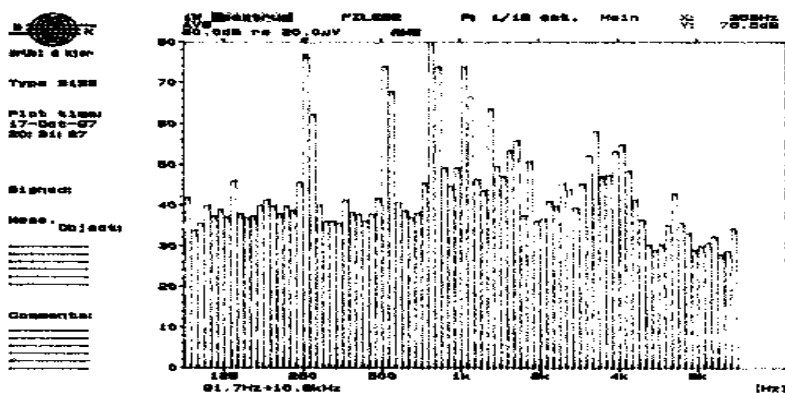
The purpose of the paper is in recognition and usage of acoustical terms as help in diagnostics of voice disorders and in voice therapy. Ten hoarse voices of school children (boys aged 10-12) and ten voice productions of school children without voice disorders the same age and sex was analyzed using an acoustic analysis by Bruel and Kjaer, Real-time Frequency Analyzer, Type 2123, Sound forge 4.0 (PC program for spectral analyses) and spectrogram 2.3 (PC program, copyright 1994/95 by R.S. Horne). Acoustical characteristics of school children's voices have been measured starting with basic characteristics of voice - fundamental frequency and

intensity, maximal duration of vowel “a” as a laryngeal measure, maximal duration of consonants “s” as a respiratory measure and consonants “z” as a combination of laryngeal and respiratory measure, and finally noise level between first seven harmonics as an indicator of disordered voice. The differences in variables between two groups were established by T-test (statistics for Windows). The results have shown significant differences between normal and pathological voice almost in all variables. This paper includes voice pictures, which are represents of each group of school children.

Bar graph type - group with voice disorders



Bar graph type - group without



INFLUENCE OF SMOKING ON THE QUALITY OF THE VOICE IN
UNDERGRADUATE FEMALE STUDENTS
Croatian Review of Rehabilitation Research, 36, 179-185

Authors: Natalija Bolfan – Stosic, Mladen Hedjever and Mirjana Znaor
(2000)

Abstract

The aim of this paper was to examine the influence of smoking and nicotine on the quality of the voice of female students on the Faculty of Special Education and Rehabilitation.

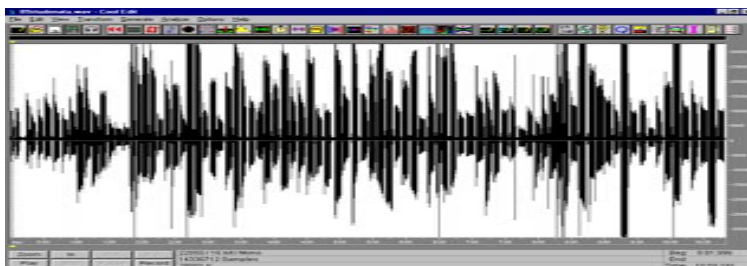
Examined were female university undergraduates (n=79), age 19 to 27.

Acoustic analyses was done by EZ Voice program for measuring voice characteristics. The following variables were measured: hight of fundamental tone (Fo), maximal and minimal Fo, range of Fo, median Fo, jitter and shimmer. Analyses was obtained by using the program Statistica for Windows, Ver. 4.5.

Differences between the group of smokers and non-smokers were done by t-test. The results of these acoustic analyses and t-test showed that smokers and non-smokers differentiate in the following variables: hight of fundamental tone, maximal fundamental tone and median of fundamental tone (stated variables were significantly lower within group of smokers).

The results of corelation matrice showed corelation between acoustic measuring area and variables describing age, years of singing, number of smoked cigarettes within one day and years of smoking. The quantity of cigarettes smoked within one day i.e. longer smoker's period brought to lower fundamental tone.

89 phonations «a» of students of ERF University of Zagreb



SOME ESSENTIAL DIFFERENCES IN THE VOCAL
CHARACTERISTICS OF CHILDREN WITH AND WITHOUT VOICE
DISORDERS

Croatian Review of Rehabilitation Research, 32, 1, 37-49

Authors: Natalija Bolfan – Stosic

Abstract

When children come into contact with their peers in pre-school institutions, conflicts for domination begin. The children often shout and speak outside their register. The purpose of the present work is to determine the differences between groups with and without voice disorders. Three dimensional acoustical analyses showed shorter voice onset time than in group without voice disorders as well as differences in frequency and intensity perturbations and in maximal duration of «s» sound between groups.

CORRELATION BETWEEN OBJECTIVE VOICE CHARACTERISTICS
AND ASSESSMENT OF SPEECH RATE IN PRESCHOOL CHILDREN

Proceedings of the 5th scientific conference of Faculty of Special Education
and Rehabilitation, University of Zagreb, 71-80.

Authors: Natalija Bolfan-Stosic (1997)

Abstract

In children with high speech rate it is difficult to detect and change inveterate speaking habits if “staccato” with glottal stops occurs in such speech. Fast speech in pre-school children with laryngeal pathology is not a rare phenomenon.

This paper points to a significant correlation between voice characteristics measured by three component voice analyses and the speech rate criteria variable adopted from the “Buffalo Voice Profile” (Wilson, 1979) as a subjective scale of voice assessment in a group of pre-school children with voice disorders in Zagreb kindergartens.

ASSA CONVENTION, NEW ORLEANS, USA

EFFECTS OF HEARING LOSS ON THE VOICE IN CROATIAN
CHILDREN

Authors: Natalija Bolfan-Stosic Shaheen N. Awan (2001)

Abstract

This study investigated voice and resonance characteristics of Croatian children with and without sensorineural hearing loss. Differences were observed in perturbation measures; F_0 variability; vocal intensity. Spectral deviations were also observed. Discussion focuses on application of these findings by Croatian speech and hearing specialists with the hearing impaired population.

Patients with hearing losses have been reported to show a wide variety of voice disturbances such as deviant intonation contours (both flat and highly variable); increased mean speaking F_0 's; reductions in overall loudness variability; inappropriately high or low loudness/intensity levels; breathy voice quality; diplophonia; harsh voice quality and increased spectral noise. In addition, poor control of the velopharyngeal port may lead to hypernasality and nasal emission. The purpose of this paper is to report on preliminary acoustic characteristics obtained from a group of 10 to 12 year old males with more than mild sensorineural hearing losses.

Subjects were 10 school-age boys (ages 10 to 12 yrs.) from Zagreb, Croatia. All subjects were diagnosed with congenital sensorineural hearing losses of more than mild severity (i.e., greater than 40 dB loss on average across test frequencies). The hearing impaired subjects possessed no other significant disabilities. All hearing impaired subjects consistently used amplification. In addition to the hearing impaired subjects, a control group of 20 similar aged boys was also included for comparison purposes.

There is no argue about importance of voice, especially children's voice, but how to characterise communication potential of speech, normal or pathological voice? One way is acoustic waveform – signal carrying the message with information.

Webster's dictionary defines a wave as "a disturbance or variation that transfers energy progressively from point to point in a medium and that may take the form of an elastic deformation or of a variation of pressure, electric or magnetic intensity, electric potential, or temperature."

Acoustical analyses of various pathological voice types were conducted in the Laboratory for Hearing and Speech Acoustics (Faculty of Education and Rehabilitation, University of Zagreb). Acoustical analyses was conducted using a battery of diverse voice software/hardware systems including the Bruel and Kjaer Frequency Analyser; Kay Elemetrics MDVP and RTP programs; EZVoice and EZVoicePlus; Spectrogram 2.3. Spectralab; and Cool Edit Pro. Results from various acoustical analysis methods indicated that voice types may differ in terms of oscillographic and spectrographic characteristics; presence of non-linear phenomenon in vocalizations; F_0 variability; addition of spectral noise; and the presence of antiresonant characteristics. The disordered voice signal presents as a highly complex phenomena, influenced by the presence of a diverse set of acoustic parameters.