JITTER AND SHIMMER DIFFERENCES BETWEEN PATHOLOGICAL VOICES OF SCHOOL CHILDREN

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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 disartric 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 in all applied variables among the groups.

1. INTRODUCTION

There is evidence that the magnitude of voice perturbations in persons with normal voice characteristics is small or that the healthy vocal fold's form produces small periodic oscillations. In contrast, pathological vocal cord produces perturbations of jitter and shimmer (Horii, 1979; Milenkovi• , 1987). Many authors describe a measure of vocal jitter as a small fluctuation from one glottis cycle to the next in the duration of the fundamental period of the voice source, and shimmer as a cycle-to-cycle variation in the amplitude of the acoustic waveform (Schoentgen, 1997; Wolfe 1995). According to Bolfan (1998) acoustical terms are often a problem for professionals from practice because they are not understandable for them. What means the voice picture – oscillogram with very variable jitter or shimmer if you don't know to identify those values? This research is one in a row of researches of disordered voices made by our Acoustic Lab. with purpose to improve diagnostic procedures and choose adequate voice therapy.

2. METHODS

2.1. Subjects and Instrumentary

Measures of fundamental frequency (F0 in Hz), jitter (%) and shimmer (dB) in 60 school children's voices, both sexes, aged 7-12 years, were obtained using an acoustic analysis by EZ Voice (TM) Version 1.2, © 96/97, Voice Tek Enterprises & S. N. Awan. The subjects (25 girls, 35 boys) were seated in a sound-treated room and their voices were immediately recorded on PC. The microphone was placed 30 cm from the subject's lips. In this way we obtained 60 voice pictures of groups with different voice pathologies. Because of limited space, in this paper we have presented 6 voice pictures out of 60 of sustained vowel productions (vowel "a") for each group of children.

2.2. Tasks and Selections of Variables

There was one phonatory task - sustained vowel production in which the subjects were asked to articulate vowel /a/ (as long as they can). In order the following variables were selected to obtain an acoustical evaluation of the parameters: F0 - fundamental frequency in Hz, jitter – frequency cycle-to-cycle fluctuations in %, and shimmer in dB - cycle-to-cycle variation in the amplitude.

2.3. Statistical Method

The differences in variables between six groups were established by One-way Analysis of Variance. The data was processed on PC computer (Program STATISTICA for Windows, Release 4.5 A (Statsoft, Inc. 1993)).

3. RESULTS AND DISCUSSION

Results from Table 1 show bold values of parameters – frequency of F0, jitter in percents and shimmer in dB, which are significant differ groups. Marked effects are significant at $p < .05000$. The variable "shimmer" most differs groups than other variables (Figure3). It is interesting to notice that groups with disartric symptoms, Down syndrome and hearing losses have higher values of jitter (above normal – 1 %) than other groups (Figure 2). According to these results there are following voice pictures and certain shapes of jitter and shimmer oscillation curve obtained by EZ Voice program (Appendix). In the group with stuttering, the jitter and shimmer curve is in decreasing with sharp peaks. On the contrary, in the group with stuttering and dysphonia, the curve is in increasing with sharp peaks, too. Similar curve shape has the group with dysphonia but with significant more sharp peaks of the curve. Completely different curve shapes were obtained in group with dysarthria, Down syndrome and hearing losses. In "dysarthria" group, the curve of voice oscillations assumes "mild shape of waterfall" with

"occasional" intensity falls. In "Down syndrome" group shape of curve assumes "moderate shape of waterfall" with great intensity and frequency falls during vocal cords vibrations and finally, the "severe shape of waterfall" with strong intensity and frequency falls is observed in the group with hearing losses.

Variable	mean g 1	mean g 2	mean g 3	mean g 4
fohz	282,2	257,7	243,9	238,5
jitter	,234	,238	,858	,298
shimm	,437	,374	,718	,786
	mean g 5	mean g 6		
fohz	212,3	236,8		
jitter	1,015	1,094		
shimm	1,304	,788		
	df	F-ratio	p	
fohz	5	4,05	**,0033**	
jitter	5	4,28	**,0023**	
shimm	5	11,69	**,0000**	

Table 1: One-way Analysis of Variance of variables between six groups

Legend: G1 – group with stuttering
G2 – group with stuttering and dysphonia
G3 – group with dysarthria
G4 – group with dysphonia
G5 – group with Down syndrome
G6 – group with hearing losses

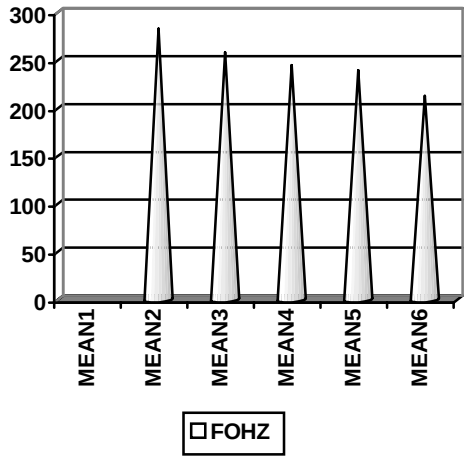

Figure 1.

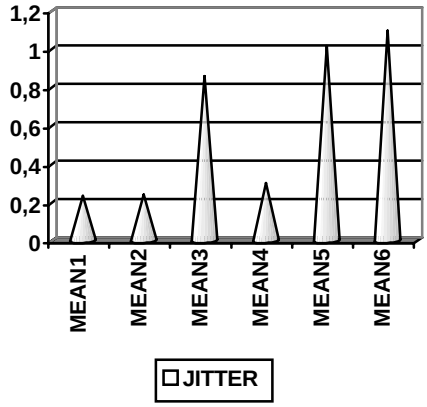

Figure 2.

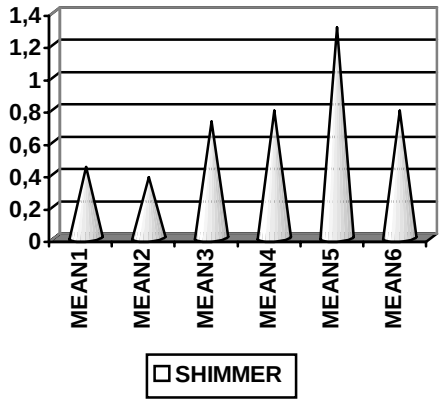

Figure 3.

4. CONCLUSION

Obtained results show bigger oscillation of Fo (JITTER variable) in groups with Down syndrome and hearing losses, and higher values in the group with disartric symptoms. We found statistical differences between all groups in "shimmer" and "Fo" variables with the accent on the higher values of Fo in groups with stuttering, stuttering and dysphonia and disartric symptoms. According to authors from this field of researching children with Down syndrome and cerebral palsy show deviations from periodicity during fonation and speech like biphonation. Acoustical characteristics of disartric voice indicate the problem of the time controlling in extending of speech segments (Biondi, 1990; Kent, 1979). Some authors found significant high values between disartric and control group of children in Fo variability. People with hearing losses have inadequate fundamental frequencies (Fo) characterized as monotone (Nickerson, 1975; Youdelman, MacEachron, McGarr, 1989). Hearing-impaired people may also have unusual voice quality, characterized by over-aspiration, spectral noise and so on. The main problem is in controlling during voicing from auditive, respiratory and laryngeal level. Results of shimmer measuring indicate that intensity oscillations are great in all

groups of children and above normal values. Different levels of variations of "quasi" periodicity during the vocal fold vibrations is the sign of vocal fold lesion (Hecker and Kruel, 1971), than irregularity movement of vocal cords (Moore, Thompson, 1965) and perceptions of hoarseness (Wendahl, 1966). We obtained different shapes of jitter and shimmer curve for different group of children (Appendix). These results can be helpful in diagnostics of disordered voices and therapy from acoustical viewpoint of voice disorders.

5. REFERENCES

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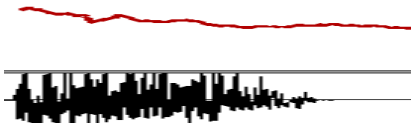
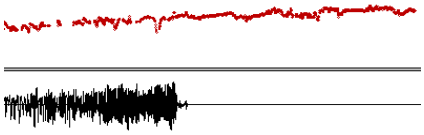
APPENDIX

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

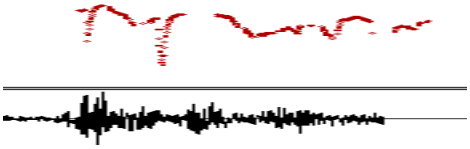
GROUP WITH STUTTERING



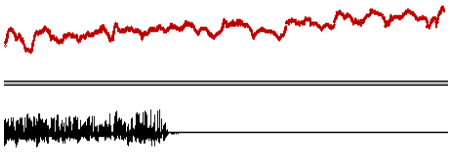
GROUP WITH STUTTERING AND DYSPHONIA



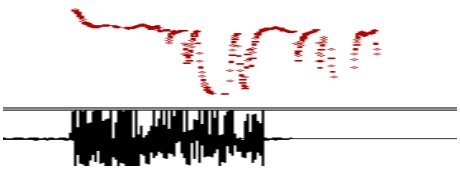
GROUP WITH DYSARTHRIA



GROUP WITH DYSPHONIA



GROUP WITH DOWN SYNDROME



GROUP WITH HEARING LOSSES