A Comparative Study of Acoustic Voice Measurements by Means of Dr. Speech and Computerized Speech Lab

*Ilse Smits, *†Piet Ceuppens, and ‡Marc S. De Bodt

*,‡*Antwerp and* †*Brussels, Belgium*

Summary: In this study, the calculations and results of acoustic voice analysis as calculated by two different analysis systems (*Doctor Speech* (*DRS*), Tiger Electronics, Neu-Anspach, Germany, and *Computerized Speech Lab* (*CSL*), Kay Elemetrics Corporation, Lincoln Park, NJ) are compared. A group of 120 normal voices was selected for analysis of the objective parameters: fundamental frequency (F_0), variation of F_0 (F_0SD), jitter, shimmer, and harmonics-to-noise ratio (HNR). The subject group was a random selection of normal voices of adults. The aim of this comparison was to find determined differences and similarities in data measurements between both systems to make data transfer possible. A significant correlation was found for F_0, HNR, and shimmer relative. The correlation for jitter (relative and absolute) and F_0SD was weak. *DRS* and *CSL* are not comparable in absolute figures, but their judgment against normative data is identical. Further research is necessary to explore the affect on pathological voices or child voices.

Key Words: Normal voice—Acoustic measurements—*Doctor Speech*—*Computerized Speech Lab*.

INTRODUCTION

Objective measurements in general and acoustic measurements in particular have become a substantial aspect of voice assessment during the last few decades. Measurements do not replace the perceptual judgment, but they allow a more precise diagnosis, provide more evidence for therapeutic interventions, and are useful as feedback for patients in therapy.[1] Acoustic measurements became more popular since personal computers were introduced in clinical settings. This democratization entailed the development of affordable software for speech and voice analysis. A literature review of 263 scientific publications between 1991 and 1995 on voice showed that acoustic measurements are reported in 42.2% of the articles.[2] Among all systems mentioned

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From the *Department of Speech Pathology and Audiology, Lessius Hogeschool, Antwerp, Belgium; †Department of Education and Training, Flemish Radio and Television (VRT), Brussels, Belgium; ‡Department of Otolaryngology, Head & Neck-Surgery, Department of Communication Disorders, University Hospital, Antwerp, Belgium.

Address correspondence and reprint requests to Ilse Smits, Lessius Hogeschool, Department Logopedics and Audiology, Sanderusstraat 45, B 2018 Antwerpen, Belgium. E-mail: ilse.smits@lessius-ho.be

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TABLE 1. *Normative Average Data for Normal Adult Male Voices as Reported in Literature*

Authors	F_0 (Hz)	F_0SD (Hz)	Rel. jitter (%)	Abs. jitter (μs)	Rel. shimmer (%)	Abs. shimmer (dB)	HNR (dB)
Decoster[6]	115.0	2.2	0.46	-	-	0.36	12.2
Wuyts et al[7]	122.0	1.4	0.81	69.0	3.60	0.31	17.5
Vosters[8]	129.4	-	0.37	-	5.17	-	-
Higgins et al[9]	-	-	0.37	-	-	-	-
Orlikoff et al[10]	-	-	-	42.8	-	-	-
Horii[11]	-	-	0.61	-	-	0.47	-
Gould et al[12]*	-	-	-	-	-	0.04–0.21	-

*Gould et al only reports the range of the measurements.

in the literature (*Cspeech*, *CSRE*, *ILS-PC*, *MacSpeechLab*, *Signalyse*, and several analysis systems developed by individual laboratories), the *Computerized Speech Lab* (*CSL*; Kay Elemetrics Corporation, Lincoln Park, NJ) was cited most frequently (17.1%). Recently, *Dr. Speech* (Tiger Electronics, Neu-Anspach, Germany) has become very popular, thanks to its low-priced software. Scientific publications, however, rarely refer to *Dr. Speech* (*DRS*). Smaller voice clinics and students often use *Dr. Speech* for analyzing voice samples. It is not clear to what extent the findings of these systems can be compared. To date, no comparative study between data collected by these two systems is published.

Results of comparative studies of acoustic analysis systems performed by different systems are reported by Read et al,[3] Karnell et al,[4] and Bielamowicz et al.[5] Read et al[3] showed that most systems perform quite well but differ greatly in the details of how these operations are performed. They concluded that improved algorithms were necessary and that signal acquisition with digital audiotape should be a standard. Karnell et al[4] and Bielamowicz et al[5] compared different commercially available acoustical analysis programs and found a strong agreement for fundamental frequency but not for perturbation measurements where different algorithms are used.

Reference data collected by different researchers show divergent results. Tables 1 and 2 show a number of mean values of acoustical measurements for men and women as reported in literature. These tables show that mean values can differ substantially. It is not clear whether these differences can be attributed to different factors such as type and age of the subjects, the selected voice sample, analysis system, or procedure.

The parameters used in this study are F_0, F_0SD, absolute and relative jitter, relative shimmer, and HNR. These are the parameters most used in literature for comparing measurement systems and voice analysis in clinical situations. Those parameters are also available in both programs with the same formulas.

F_0 is the lowest frequency in a periodic waveform and is called the first harmonic frequency.

F_0SD is the variation on the target fundamental frequency of the production.

Absolute jitter is the short-term (cycle-to-cycle) variability in fundamental frequency.

Relative jitter represents the relative (cycle-to-cycle) variability in fundamental frequency within the analyzed voice sample.

Shimmer is the short-term (cycle-to-cycle) variability in amplitude. Relative shimmer represents the relative (cycle-to-cycle) variability in amplitude in the analyzed voice sample.

HNR is an average ratio of energy of the harmonic components in the range ratio 70–4500 Hz to the inharmonic components energy in the range 1500–4500 Hz. It is a general evaluation of the noise presence in the analyzed signal. It is the proportion of the component whose frequency is an integer multiple of the fundamental frequency and the noise component in the voice sample.[17]

The aim of this study is to compare acoustic measurements performed by *CSL* and *DRS* to find differences and/or similarities between both systems. This information might allow researchers to use data from both systems to compare and analyze their findings.