

lingWAVES Voice Protocol norms

The norms shown in Voice Protocol are colour coded (green is normal to red - pathological) - the exception is on the "Spoken Text" screen where red represents how frequently the subject's voice is recorded at each frequency and loudness. Red is more often and green is less often. This helps you and your client to see at a glance their usual pitch and loudness and their range in running speech.

Most of the screens in Voice Protocol are simplified adaptations of screens already used in lingWAVES Voice Diagnostic Centre so the norms used are the same.

The exception is screen 1 which is new. Here are the norms used for each screen. They are also colour coded and marked in the graphs.

Screen 1: s/z ratio, MPT (Maximum Phonation Time)

95% of people who have some difficulty affecting the movement of their vocal folds have an s/z ratio of greater than 1.40. Consequently, a ratio of 1.4 or above may indicate a degree of vocal fold dysfunction.

Norms for sustaining [s:]

Age range (years) Duration (seconds)

- 7-10 8
- 11-15 12
- 16 + (women) 15
- 16 + (men) 20

Eckel FC, Boone DR. The S/Z ratio as an indicator of laryngeal pathology. *J Speech Hear Disord.* 1981 May;46(2):147-149.

MPT - adult females sustain phonation of "ah" from 15 to 25 seconds; while males range from 25 to 35 seconds.

Screen 2: F0 / pitch, loudness, glide, voice quality, jitter, shimmer, irregularity, noise (GNE)

The jitter, shimmer, irregularity and noise (GNE) calculations and graph display are the same as that used for Vospector in other lingWAVES sets.

Jitter and Shimmer calculations are different in every voice analysis computer program, (eg, Kay, Praat)

lingWAVES norms are

- Jitter - normal voice below 0.5%
- Shimmer - normal voice below 5%

See below:

Specifications of the lingWAVES Jitter/Shimmer calculation: 100 successive period (PPQ, EPQ with K = 3) with 25 periods offset Short: 100 periods, PPQ, EPQ with K = 3, 25 periods window offset

The algorithm is based on the work and evaluation of the Göttingen Hoarseness Diagram with 1,500 patient records with different degrees of dysphonia. The algorithm is optimized for clinical assessment. Norms: jitter - normal voice below 0.5%, shimmer - normal voice below 5% Note that norms for jitter and shimmer may be unspecific for normal and pathological voices (see articles below and others). We recommend the use of irregularity and GNE noise because of the multidimensional and perception related (roughness, breathiness) measurement. Irregularity and noise have a scale from 0 - 3. Normal voices are between 0-1, mild to moderate degree of roughness/breathiness 1-2 and severe degree of roughness/breathiness 2-3.

Article on the Göttingen Hoarseness Diagram –

Fröhlich M, Michaelis D, Strube HW, Kruse E., Acoustic voice analysis by means of the hoarseness diagram., *J Speech Lang Hear Res.* 2000 Jun;43(3):706-20.

http://www.wevosys.com/knowledge/data_knowledge/106.pdf

Articles on GNE (Glottal to Noise Excitation ratio) -

Michaelis, D.; Gramss, T.; Strube, H.W., Glottal-to-Noise Excitation Ratio - a New Measure for Describing Pathological Voices., *Acustica*, Volume 83, Number 4, July/August 1997 , pp. 700-706(7)

<http://wwwuser.gwdg.de/~istuerm/doc/acustica97.pdf>

Michaelis, D., Fröhlich, M., Strube, H.W., Selection and combination of acoustic features for the description of pathologic voices. *J.Acoust. Soc. Am.* 103 (3) 1998 Acoustical Society of America

http://www.wevosys.com/knowledge/data_knowledge/107.pdf

Pitch Range : Use the norms you are familiar with in your country. In Australia we commonly use the norms recommended by Jenni Oates taken from Laver (1980) - these figures are also useful to see evidence of improvement in Pitch Range in HZ and Semitones (HT)

Screen 3: DSI (Dysphonia Severity Index)

The DSI in the Voice Clinic Suite Pro is a reliable measure of severity as it takes pitch range, dynamic range in SPL (absolute dB) and Max phonation time as well as quality measures into its calculation. It is a reliable outcome measure.

Interpretation of the DSI score

The Dysphonia Severity Index (DSI) is designed by Marc S. De Bodt and Floris L. Wuyts - University of Antwerp as an objective and quantitative correlate of voice quality. It is based on a multivariate analysis of an extended database of more than 1000 normal and pathologic voices for the multi-center study trial initiated by the Belgian Study Group on Voice Disorders (Van de Heyning, et al., 1996).

It combines several voice measures into one single measure. It is a calculation of a weighted combination of four voice characteristics: maximum phonation time (MPT, sec.) highest frequency (Fo-high, Hz), lowest intensity (I-low, dB(A)) and jitter (%). The calculated weights are given in the following formula:

$$DSI = 0.13 * MPT + 0.0053 * Fo\text{-high} - 0.26 * I\text{-low} - 1.18 * jitter + 12.4$$

It is a continuous measure +5 for normal voice and -5 for severe dysphonia. Excellent voices can have higher scores.

According to a clinical survey, the voice quality as perceived by the clinician correlates (0.75) with the calculated DSI level. The DSI is reported to be very sensitive to the slightest changes in voice quality.

Using the DSI index, voices can be classified into 6 groups of DSI - related impairment level (0 to 5).

The table below shows the impairment groupings using lingWAVES DSI scores (note that these figures are a little different to the original article published by M de Bodt and F Wurtz who used an older jitter algorithm from a Kay system)

Impairment Group	Level	DSI range	Description of Impairment Level
•	0	< - 2.0	Severe persisting aphonia: patient has no voice, is unable to phonate
•	1	-1.9 to +0.3	Constant dysphonia: Sporadic periods of phonation, aphonic periods may be present
•	2	+0.4 to +2.2	Moderate dysphonia: patient can produce voice, but there are frequent periods of dysphonia
•	3	+2.3 to +3.3	Slight to moderate dysphonia: less frequent periods of disturbed phonation or slight persisting dysphonia
•	4	+3.4 to +4.3	Slight dysphonia: sporadic dysphonic moments for short periods
•	5	> 4.4	No dysphonia

Screen 4: Spoken Text Analysis - Pitch and SPL range in running speech

This screen is an adaptation of the Phonetogram or Voice Range Profile from the lingWAVES Voice Diagnostic Centre (also Voice Clinic Suite and Voice Clinic Suite Pro)

These use the Union of European Phoniaticians (UEP) norm for Standardizing Voice Area Measurement/Phonetography

Norm criteria:

- 30 cm distance to microphone
- Loudness measurement in db(A) with normed sound level meter, A-weighting (most available systems don't meet criteria because they use calibrated or not calibrated computer sound cards for loudness calculation)
- Quiet room (below 40 dB(A))

The UEP norm is from 1982 and at this time it was published in German:

Seidner, W. Schutte H.I.K. 1982 Empfehlung der UEP: Standardisierung, Stimmfeldmessung / Phonetographie. In: HNO-Praxis 7, S. 305-307

But there is also an English article:

Schutte H.K. , Seidner W., Recommendation by the Union of European Phoniaticians (UEP): Standardizing Voice Area Measurement/Phonetography, Phoniatic/Logopedic Department, Ear, Nose and Throat Clinic (Dir.: Prof. P.E. Hoeksema), University Hospital Groningen, The Netherlands; Ear, Nose and Throat Clinic (Dir.: Prof. H.-J. Gerhardt), Faculty of Medicine (Charité), Humboldt University, Berlin, GDR

<http://www.karger.com/Article/Abstract/265703>

As I mentioned earlier, on the Spoken Text Screen red represents how frequently the subject's voice is recorded at each frequency and loudness. Red represents more frequent and green is less often. This helps you to see the subject's usual pitch and loudness in running speech at a glance.

The figures displayed are accurate measures of SPL dB loudness and frequency in running speech, including the mean, minimum and maximum frequency in Hz and as a musical note, as well as pitch range in semitones (HT) and Hz as well as mean SPL loudness and loudness range in running speech.

You can interpret these yourself - look for improvements in pitch range and loudness variation in your clients, but I don't think there is any research on what is considered normal intonation in running speech for Australians - perhaps because this is the first time this equipment has been made available. This presents a great research opportunity!