



Acoustic and Aerodynamic Analysis of Voice

Acoustic and aerodynamic analyses of voice production are objective ways to evaluate voice efficiency and quality respectively. Acoustic data commonly collected include fundamental frequency (Hz), loudness (dB), and cepstral information. This can be collected by voice analysis software including PRAAT, Analysis of Dysphonia in Speech and Voice (ADSV, Pentax Medical), and Voice Analyst. Aerodynamic data commonly collected includes data related to phonation threshold pressure (PTP), and airflow during phonation. This is typically collected using a Phonatory Aerodynamic System (PAS, Pentax Medical).

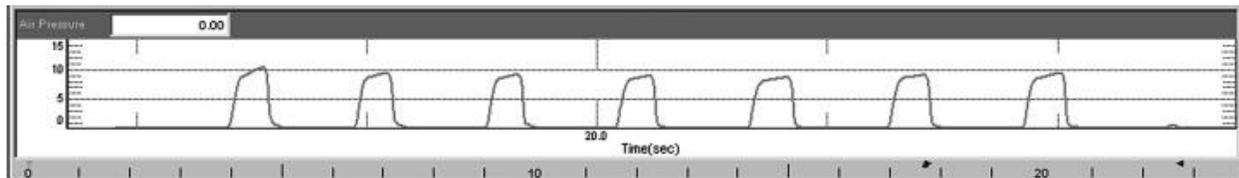
Acoustic Analysis

- **Fundamental Frequency** (F0) represents pitch and refers to the number of vocal fold vibrations per second. Average F0 is collected during sustained vowel /a/ or a connected speech sample.
 - Normal ranges: Male: 85-180 Hz Female: 165-255Hz¹
- **Decibels** (dB) represents loudness and is typically collected in connected speech as well as sustained /a/. This value is dependent on distance to microphone.
 - Normative conversational dB range: 50-65 dB
- **Cepstral Analysis** may be the most robust objective measure of voice quality as it is not reliant on a periodic signal. It uses spectral analysis combined with other voice quality factors including pitch or loudness. Cepstral analysis has demonstrated sensitivity to changes in voice quality similar to subjective measures of voice, although it is unclear as to how changes in vocal fold vibrations affect cepstral values². There are several types of acoustic data that may be reported using cepstral components including: Cepstral Peak Prominence (CPP), Cepstral Spectral Index of Dysphonia (CSID) and the Acoustic Voice Quality Index (AVQI). There are no normative data for these measures although there has been a reported CSID screening cutoff score of less than 24 that may indicate the presence of a voice disorder³.



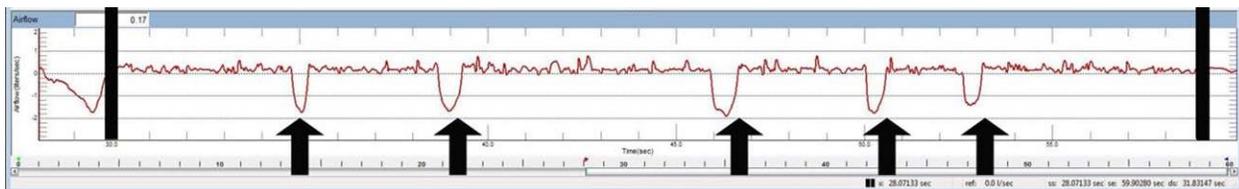
Aerodynamic Analysis:

- Phonation Threshold Pressure (PTP): This is a measure of intra-oral pressure that is inferred to be equal to subglottic pressure. PTP represents the pressure required to initiate sustained vocal fold vibration at a certain pitch and loudness and is measured in centimeters of water (cm H₂O). This measure is sensitive to changes in thickness of the vocal fold, tissue damping, pre-phonatory glottal width, and mucosal wave velocity making it a clinically valuable parameter⁴. This measure is typically obtained by taking the average pressure of the middle-five productions of seven consonant-vowel repetitions (typically /pa/ or /pi/) using the PAS system.
- Normal PTP: 3-6 cm H₂O⁵ depending on pitch and loudness



Air Pressure window for seven repetitions of /pa/

- Airflow: Measured in milliliters per second, this is an evaluation of voicing efficiency and can be evaluated in connected speech using the rainbow passage, the all voiced sentence “we were away a year ago” or using a sustained /a/.
- Normal Airflow in connected speech: 120-160 mL/second with significant effects for gender and age⁶



** Airflow window during rainbow passage. Arrows indicate negative airflows or breaths**



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