

Disclosures & Gratitude

Owner of a tempo Voice Center, LLC & Voice Diagnostix, LLC

I am being compensated to speak for you all today

Thank you so much ArSHA for allowing me to speak to you all today about my passion.

Acoustic & Aerodynamic Analysis

CAN IT BE LOW COST?

Kristie Knickerbocker, M.S., CCC-SLP



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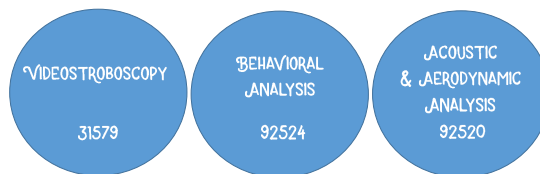


What I hope you take away

Acoustic and Aerodynamic evaluations are vital to documenting voice therapy progress. Ability to perform them should not be limited by equipment cost. My hope is to further your knowledge of how you can implement these measures in your own practice and how they can benefit your practice as an SLP.

Evaluation Overview

OTOLARYNGOLOGY
EXAM MUST PRECEDE
YOUR TREATMENT



• ASHA HAS FINALLY RELEASED ITS RECOMMENDED PROTOCOLS FOR INSTRUMENTAL ASSESSMENT OF VOICE:

• [HTTPS://AJSLP.PUBS.ASHA.ORG/ARTICLE.ASPX?ARTICLEID=2686671](https://ajslp.pubs.asha.org/article.aspx?articleid=2686671)

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Acoustic Evaluations

WHAT IS THE PURPOSE?

- So we have
 - Quantitative Data
- This will help us mark progress in addition to the qualitative data we already take
 - Qualitative data includes
 - Perceptual Rating scale like
 - CAPE-V
 - GRBAS
 - Self-Rating
 - VHI-10
 - Singing VHI-10

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Acoustic Evaluations

WHAT IS THE PURPOSE?

- Helps with progress monitoring
 - Patients can hear what they sounded like before
 - Better self-assessment
 - Better intrarater reliability
 - I know I can't remember what ever person sounded like, so this technology allows us to save it a revisit it

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But....

Acoustic Evaluations

WHAT IF I DON'T WORK AT A TOP VOICE CENTER?

WHAT ABOUT SPECIFICATIONS OF ACOUSTIC EVALUATION?

- Needs to be
 - sensitive to severity of disturbances in voice production
 - Relate to perceptual parameters of loudness, pitch and quality
 - Provide indirect inferences regarding underlying pathophysiology of voice disorders
- Proper use has been researched by Ingo Titze
 - Long standing measures include
 - Vocal Loudness and Vocal Quality

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Acoustic Evaluations

MATERIALS NEEDED

- Software/hardware
- Regardless of which equipment you use on your computer, you need a

CALIBRATED HEAD MOUNTED MICROPHONE AND PREAMPLIFIER

Acoustic Evaluations

TYPES OF PROGRAMS YOU CAN CHOOSE FROM

- Kay Pentax
 - Computerized Speech Lab (CSL) Software
 - Finding CSID (Awan)
 - Cepstral Spectral Index of Dysphonia

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Acoustic Evaluations

TYPES OF PROGRAMS YOU CAN CHOOSE FROM

- Praat with Phonanium Plugins
- Sonetta by Mint Leaf Software
- LingWAVES by Wevosys
- Speech Tool by James Hillenbrand
 - He's retired, but his software Ztool finds CPP

Acoustic Evaluations

I've blogged on what I use:

[Bit.ly/LowBudgetAcoustics](https://bit.ly/LowBudgetAcoustics)



Make sure you capitalize L, B and A

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Praat with phonanium Plugins

- I admittedly have only tried Pentax and Praat with Phonanium
 - I know individuals who use and love the other options out there, but this is what works for me in my clinic.
 - I have no relevant financial interest in Phonanium, Praat is free to the public
 - I will show you around Praat and how I obtain what I need

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CUT TO DEMO OF PRAAT



Praat demo

- Cut to how to do
 - New
 - Record mono Sound
 - Name it what you want
 - Record
 - Save to list OR Save to list & close

Are you calibrated?

- Phonanium has a calibration procedure that is very clear and easy to follow.

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Importance of Calibration

Are you calibrated?

- You need a Sound Level Meter to do this.

- Cut to how to do
 - Regression line shown
 - This is your report example
 - Important because it allows samples to be consistent

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Report Writing

WHAT TO INCLUDE? THIS IS TO GIVE YOU AN IDEA OF WHAT WE GATHER...

ACOUSTIC MEASUREMENTS:

Vowel Prolongation: ___ seconds
 Loud-Soft dB range: ___ dB
 Physiological Hz Range: ___ Hz
 Semitone Range: ___ - (above 23 is WNL)
 Habitual Speaking F0: ___ Hz
 Cepstral Peak Prominence (CPP): _____
 Acoustic Voice Quality Index: _____ (Below 3.46 is WNL)

Cepstral Peak Prominence (CPP) reflects how stable the Vocal Fold vibration is. The less stable, the more it reflects a pathology. The lower a CPP, the worse it is. AVQI below 3.46 is considered WNL, and between 3.46-10 abnormal. Abnormal findings suggest the presence of dysphonia. (Halberstam, B 2004; Marin & Weenink 2015; Marin, De Bodt, & Roy 2010)

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Acoustic Evaluations

WITH ANY SOFTWARE, HAVE YOUR PATIENT...

- Sustained /a/ for 3-5 seconds
- I ask the patient to do this at "a comfortable volume" at a "comfortable loudness level"
- I am consistent in asking this every time
- Take 3 examples to get the one with best phonation

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We use this for Cepstral Peak Prominence and AVQI. Save as sv in Praat



Acoustic Evaluations

WHAT DOES YOUR PATIENT DO?

- Loudness range
 - Glide on /a/ from loudest to quietest
 - (use for maximum and minimum vocal dB)
 - Messa di voce activity
 - Explain starting soft and growing loud
 - Try 3 times, take average

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Acoustic Evaluations

Are you calibrated?

WHAT DOES YOUR PATIENT DO?

- Standard Reading Passage and/or Standard Sentences
 - Rainbow Passage
 - Or Grandfather passage
 - Trip to the Zoo
- Are you testing all languages the patient speaks?
- I use "We were away a year ago" for CPP & AVQI
 - I have them read all 6 though, then extract what I need
 - Label it CV

(use for vocal frequency mean, habitual dB, vocal frequency standard deviation, and CPP)

CAPE V Sentences:
 1. The blue spot is on the key again
 2. How hard did we hit him?
 3. We were away a year ago.
 4. We eat eggs every Easter.
 5. My mama makes lemon muffins
 6. Peter will keep at the peak

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Acoustic Evaluations

WHAT DOES YOUR PATIENT DO?

- Pitch range
 - (use for maximum and minimum pitch Hz)
 - I ask the patient to "glide to your highest pitch on 'ah'
 - Do this 3 times, take average
 - Then "glide to your lowest pitch on 'ah'
 - Do this 3 times, take average
- In CSL from Pentax, this will be Voice Range Profile

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Acoustic Evaluations

HOW TO ANALYZE

- Subtract lowest pitch from highest to get the pitch range....then
 - To obtain semitone range: $39.86 \times \log(\text{highest frequency} / \text{lowest frequency})$
- Example:
 High Fo: 600Hz
 Low Fo: 100Hz
- Semitone range = $39.86 \times \log(600/100) =$
 $39.86 \times \log(6) =$
 $39.86 \times 0.778 =$
31.02 semitones

THANK YOU OURS @AJTTS

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Acoustic Evaluations

HOW TO ANALYZE?

- So you've saved Connected speech sample, high, low, loud, soft, sentences, cs and sv
- Save them to a folder in your computer. If you close the program, they're gone.
- Then, drag and highlight to obtain.....
 - Average pitch and dB for reading sample
 - Point click for highest on blue line for Hz, drag and highlight for dB for /a/ as well.

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Acoustic Evaluations

HOW TO ANALYZE?

- To Get
 - Cepstral Peak Prominence (CPP)
 - Acoustic Voice Quality Index (AVQI)
- Make sure you have downloaded the scripts and put them in the corresponding folder, or the program won't know where to pull it from.
- Drop to Clinical Voice Lab and drag down to AVQI v02.04
- Fill out the corresponding table
 - Your AVQI threshold for the language you are taking
 - 2.95 threshold is for Dutch
 - 3.46 threshold is for English
 - I like the illustrated version, Fill in new information, then click OK

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Reading AVQI

HOW TO READ IT

- For AVQI, score between 0 and threshold is normophonia. Threshold-10 is dysphonia.

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Reading AVQI

HOW TO READ IT

- CPP is the top in the left lower area
- AVQI is the line with the arrow on the green/red picture.
- CPP is currently being researched by Youri, I have reached out to get norms. But
 - To measure it pre and post therapy, *the higher it is, the better the voice sounds.*

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Report Writing

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Aerodynamic Evaluations

WHAT IS IT?

- Measurements of airflow and air pressure
 - Determines if vocal folds are using air to vibrate efficiently
 - You obtain glottal aerodynamic parameters

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Aerodynamic Evaluations

HOW TO OBTAIN THESE MEASURES?

- ▶ Kay Pentax Phonatory Aerodynamic System (PAS)
 - ▶ This is the easiest, because you collect airflow, pressure and microphone data simultaneously with the facemask and the catheter.
 - ▶ Calibration is important here too.

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Aerodynamic Evaluations

WHAT DOES YOUR PATIENT DO? USING PAS

- Make sure your pneumotachograph is calibrated
- Catheter through mask hole for intraoral pressure
 - Attached to transducer
- Microphone attached to far end of pneumotachograph tube
- Short /pi : pi: pi: pi:/ habitual pitch and intensity **AND** at raised loudness levels
 - Finds average glottal airflow rate, average interpolated air pressure and mean vocal SPL dB and Hz

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Aerodynamic Evaluations

HOW TO OBTAIN THESE MEASURES LOW COST?

- ▶ Digital Spirometer
 - ▶ Can use Contec SP10
 - ▶ Clean tubes
 - ▶ Paper or plastic options
- ▶ Timer or Stopwatch

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Report Writing

WHAT TO INCLUDE?

AERODYNAMIC MEASUREMENTS:

S/Z Ratio: ___ (under 1.4 is WNL)
 Vital Capacity: ___ ml
 Predicted Vital Capacity: ___ ml
 Maximum Phonation Time: ___ sec
 Predicted Maximum Phonation Time: ___ sec
 Phonation Quotient: ___ ml/s
 Estimated Mean Flow Rate: ___ cc/s

Phonation Quotient upper limits of normal for females is 150ml/s and for males is 164ml/s. Estimated Mean Flow Rate upper limits of normal for females is 113cc/s and for males is 116cc/s Anything above this suggests a poor coordination of airflow and vocal fold vibrations (Rau & Beckett 1984)

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Aerodynamic Evaluations

WHAT DOES YOUR PATIENT DO?

• To get S/Z Ratio...

Use stopwatch to time

- I ask the patient to "Take a deep breath and hold out 's' as long as you can
- Do this 3 times, take average
- I ask the patient to "Take a deep breath and hold out 'z' as long as you can
- Do this 3 times, take average
- Then divide the two averages. Below 1.4 is normal.

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Aerodynamic Evaluations

WHAT DOES YOUR PATIENT DO? USING SPIROMETER AND TIMER

- Take Vital Capacity:
 - Take 2 easy breaths then on the third breath take in as much air as you can, then blow as much air as possible into the tube until there's no air left in your lungs.
 - Use Spirometer and nose clip (or have patient hold nose)
 - American thoracic society predicted values for norms.
- Take Maximum Phonation Time & s/z ratio

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Aerodynamic Evaluations

Aerodynamic Evaluations

Aerodynamic Evaluations

WHAT DOES YOUR PATIENT DO?

• Maximum Phonation Time

- I ask the patient to "Take a deep breath and hold out 'ah' as long as you can
- Do this 3 times, take average
 - Predicted MPT values (Yanagihara & von Leden, 1967) for norms
 - Male: (Vital Capacity/100)*0.67 seconds
 - Female: (Vital Capacity/100)*0.59 seconds
 - Use stopwatch to time

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HOW DO YOU CALCULATE MEASURES WITHOUT P/Q/S?

▶ Find Phonation Quotient

- ▶ $PQ (mL/sec) = VC/MPT$
- ▶ Means from Rau & Beckett 1984 can be your comparison
- ▶ This is a measure of glottis efficiency and indicates balance or imbalance between phonation and respiration

Higher rates: Glottic Insufficiency
Lower rates: Glottic hyperfunction

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Aerodynamic Evaluations

HOW DO YOU CALCULATE MEASURES WITHOUT P,AS?

Find PQ FIRST ...

- Find **Estimated Mean Flow Rate**
 - EMFR (cc/sec) = $77 * (0.236 * PQ)$
 - Means from Rau & Beckett 1984 can be your comparison
- This is a measure of airflow through glottis during phonation.

Higher rates: Glottic insufficiency
Lower rates: Glottic hyperfunction

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Report Writing

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My Tips...

FROM MY CLINIC TO YOU...

- I use Microsoft excel to precalculate formulas for me, so I can just input the data and get it right away
 - This includes averaging any data I need
 - Formulas for PQ, EMFR, MPT
 - Norms are there and I can toggle down to find female vs male
 - This helps with efficiency

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Questions?

- Email me: info@atempvoicecenter.com
- www.atempvoicecenter.com
- Thank you!



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