

VOCAL EVALUATION OF OPERA SINGERS

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INTRODUCTION

The first version of the Odological Test¹, designed in 1980, was published in *Folia Phoniatica* in 1982. Its frequent use for almost ten years has brought me to improve it by adding some new medical examinations and several graphs which can be used to summarize the main results.

PURPOSE

The purpose of the Odological Test (O.T.) is to allow specialists in the field of odology to evaluate singers' voices during their studies or carriers, with a regular vocal check-up. It can be performed either in full as a complete vocal examination, or in part to check a specific problem mentioned by the singer.

The O.T. includes an ENT-phoniatic examination, a vocal test with an acoustic and perceptual study of the subject's voice, and a number of other tests (Froechels, Stern) and measures such as intensity, volume of inhaled and exhaled air, length of phonation, duration of vocalization, etc.

TEST PROCEDURES

The ENT-Phoniatic examination and vocal test are preceded by an anamnesis of the subject, and by the preliminary examinations mentioned in item C of the *Odological Test Sheet*, including evaluation of equilibrium disorders (that might influence the singer's posture and explain a number of phonatory and production abnormalities), blood pressure and pulse checks before and after the vocal test, chest size, and lung capacity.

¹Following my proposal, the word "odology" (from the Greek *ôidê* = song and *logos* = science) was accepted in 1975 by the International Council on the French Language to stand for the scientific study of singing.

1. The ENT-Phoniatrical examination:

This examination includes the standard tests given by a phoniatrics specialist during a check-up (laryngoscopy, stroboscopy, endoscopy, audiometry, etc.)

2. The vocal test:

The vocal test *per se* is composed of two stages:

— a) The first stage takes place in an anechoic chamber where the singer is recorded while executing the instructions given. (See *Instruction Sheet*).

— b) The second stage consists of some additional tests carried out:

- on the sonograph, to detect register shifts,
- on the polyphonometer, for the study of aerodynamic phenomena (length of breath groups, inhaled and exhaled air volume),
- on the sonometer, to measure the singer's vocal intensity,
- on the chronometer, to study pneumo-phonic coordination (length of phonation, length of vocalization, etc.)
- on a videotape recorder (simultaneous front and side view of the singer) to show the position of the larynx during singing which enables detection of register shifts and allows for the study of specific functional facial expressions inherent in the singer's vocal technique.

— c) Using the recording made in the anechoic chamber, the singer's voice is then analyzed acoustically (study of vibrato, legato, staccato, trills, attacks, in addition to the value of the singing formant, the distribution of harmonics across the spectrum) and perceptually (accuracy, production quality, homogeneity, agility, etc.).

RESULTS

The results of the various examinations, analyses, and tests are recorded on the *Odological Test Sheet* and represented on four different graphs.

— 1. Pneumo-phonic coordination is plotted on the first graph along a 0-60 second scale. The broken line is the statistical average. When the curve representing the singer's current results is located to

the left of the average, the singer has below average pneumo-
phonic coordination. Inversely, if the curve is located to the right
of the average, the singer's pneumo-phonic coordination is good.

–2. Vibrato parameters, shown as a single point, are plotted
on the second graph, where periodicity (VP) is represented on the
X-axis in number of periods per second, and amplitude (VA) is
represented on the y-axis in quarter tones. The hatched area is the
average range. Any point lying outside this range indicates a defec-
tive vibrato.

3. The sonometric measures are plotted on the third graph,
which is scaled horizontally from 0 to 130 dB. The vertical axis is
divided into three main registers. The singer's vocal intensity range
is defined by taking the minimum intensity and the maximum in-
tensity for each register. The across-register intensity range is in-
cluded between the most extreme points of the graph.

4. The fourth graph is the odological graph itself, or the
odogram. The main vocal and musical characteristics of the singer's
voice are graded on a scale from 1 to 10. A perfect voice would be
plotted as a vertical line with a constant value of 10. The sum of the
points obtained on each item (accuracy, production quality, ar-
ticulation, etc.) provides us with a quantitative score assessing the
current state of the examined singer's voice, and facilitates com-
parison with subsequent examinations.

Two more graphs are added to the singer's file: his/her
audiogram and phonetogram. (The standardized phonetogram
used here was devised by Schutte and Seidner in 1983.)

CONCLUSION

The O.T. (Odological Test), which can be used to detect both im-
provements made by beginning singers and the first signs of vocal
deterioration in professional singers, provides all the necessary data
to evaluate and compare a given singer's voice as it evolves in time².

²I would like to express my sincerest gratitude to Vivian Lamongie, Vincent Russo
and Philippe Quintard who were kind enough to translate this article into English.

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Le bilan vocal des chanteurs. *Folia Phoniatica*, 1982, 34, 6: 300-304.

SUMMARY

Designed as a vocal evaluation for singers, the Odological Test comprises an ENT-Phoniatic examination supplemented by an acoustic and perceptual analysis of the subject's voice.

The results are compiled into four graphs making it possible to quickly assess the progress made by young singers or to detect the first signs of vocal deterioration in experienced singers.

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Date:

ODOLOGICAL TEST SHEET

A. GENERAL INFORMATION

- 1. Last Name:
- 2. First Name:
- 3. Date of Birth:
- 4. Profession:
- 5. Address:
- 6. Phone Number:
- 7. Number of Years of Study:
- 8. Vocal Category:
- 9. Tessitura:

B. ANAMNESIS

- 1. Height:
- 2. Weight:
- 3. General Health:
- 4. Current Treatment:
- 5. Past History:
 - A. Lungs:
 - B. Heart:
 - C. Digestive System:
 - D. Genital-Urinary Systems:
 - E. Endocrine Gland:
 - F. Nervous System:
- 6. ENT Area:
 - A. Sinus:
 - B. Ears:
 - C. Nose:
 - D. Larynx:
 - E. Buccal Cavity:
 - Velum:
 - Tonsils:

- 7. Abdominal Muscles:
 - A. Muscular System:
 - B. Hernial Orifices:

C. PRELIMINARY EXAMINATIONS

- 1. Posture:
 - A. Shoulder Alignment:
 - B. Wrist Alignment:
 - C. Mid-Pelvic Alignment:
 - D. Scapulo-Gluteal Alignment:
 - E. Cervical and Lumbar Gaps³:
 - F. Scapulum:
 - Anterior:
 - Posterior:
 - G. Ilium:
 - Anterior:
 - Posterior:
 - H. Spinal Column:
 - Cervical:
 - Dorsal:
 - Lumbo-Sacrum:
 - I. Temporo-Mandibular Joint:
 - J. Facial Dismorphosis:
- 2. Cardio Vascular System:
 - A. Blood Pressure at Rest:
 - B. Blood Pressure after Vocal Effort:
 - C. Pulse at Rest:
 - D. Pulse after Vocal Effort:
- 3. Respiratory System:
 - A. Chest Measurements (Perimeter):
 - Inhaling:
 - Exhaling:
 - B. Lung Capacity:

³The expressions “*cervical gap*” and “*lumbar gap*” are used in posturology to refer to the distance between the most internal point of the cervical and lumbar lordoses and the vertical plane behind the standing subject viewed from the side. In normal adults, the cervical and lumbar gaps are approximately 6 cm and 4 cm, respectively.

D. ENT-PHONIATRICAL EXAMINATION

- 1. Diaphanoscopy:
- 2. Otoscopy:
- 3. Audiometry:
- 4. Rhinoscopy:
- 5. Rhinometry:
- 6. Laryngoscopy:
- 7. Stroboscopy
- 8. Glottography:
- 9. X-Rays:
- 10. Tomography:
- 11. Laryngeal Endoscopy:
- 12. Velar Endoscopy:

E. VOCAL TEST

- 1. Production Quality:
- 2. Articulation:
- 3. Agility:
- 4. Homogeneity:
- 5. Carry:
- 6. Trills:
- 7. Attacks:
- 8. Finales:
- 9. Legato:
- 10. Staccato:
- 11. Crescendo:
- 12. Diminuendo:
- 13. Messa Di Voce:
- 14. Straight Tone:
- 15. Glide Up:
- 16. Glide Down:
- 17. Portamento:
- 18. Deguelando:
- 19. Register Shifts:
- 20. Above Upper Register:
- 21. Upper Register:
- 22. Upper-Middle Register:
- 23. Middle Register:
- 24. Lower-Middle Register:

- 25. Lower Register:
- 26. Below Lower Register:
- 27. Vocal Range:
- 28. Tessitura:
- 29. Froechels' Test⁴:
- 30. Stern's Test⁵:

F. PHONIC BEHAVIOR

- 1. Pneumo-Phonic Coordination:
 - A. Phonation Length (N10+)⁶:
 - B. Vocalization Length (N15+):
 - C. Length of Nasal Exhalation (N10):
 - D. Exhalation Length on Voiceless Fricatives (N30):
 - E. Maximum Speed of Staccato (N5+):
- 2. Larynx Position During Production:
 - A. Glide Up:
 - B. Glide Down:

G. SPECTROGRAPHIC ANALYSIS

- 1. Frequency Vibrato:
 - A. Amplitude ($\frac{1}{4} < N < \frac{3}{4}$):
 - B. Periodicity ($5 < N < 7$):
- 2. Intensity Vibrato:
 - A. Random:
 - B. Cyclical:
 - C. Synchronous:
 - D. Asynchronous:
 - E. Amplitude:

⁴Froechels' test consists of having the singer do a series of vocal exercises and then immediately read a text. If hoarseness follows, muscular fatigue is taking place, indicating poor use of the vocal system.

⁵Stern's test consists of having the singer interpret a musical piece before and after substantial vocal effort. If the second singing of the piece is different from the first, the singer is considered to be subject to fatigue. This test is used to confirm the results of Froechel's test.

⁶The letter N stands for **NORM**. See for example paragraph F1: **Length of phonation (N10+)** means that for phonation length, the norm is 10 seconds or more. Likewise in paragraph G1, **Amplitude of the frequency vibrato ($\frac{1}{4} < N < \frac{3}{4}$)** means that the amplitude of the normal vibrato falls between $\frac{1}{4}$ and $\frac{3}{4}$ of a tone.

- 3. Distribution of Harmonics Across the Spectrum:
 - A. Compact:
 - B. Diffuse:
 - C. Grave:
 - D. Acute:
- 4. Singing Formant Value:
- 5. Register Shifts On:
- 6. Formant Values in Speech and in Song:

Speaking	Singing
[]=	[]=
[]=	[]=
[]=	[]=
[]=	[]=
[]=	[]=
[]=	[]=
- 7. Vocal Range:
- 8. Tessitura:

H. POLYPHONOMETRIC ANALYSIS

- 1. Mean Duration of the Breath Groups:
 - A. In Speaking:
 - B. In Singing:
- 2. Pre-Phonation Inhaled Air Volume:
- 3. Pre-Vocalization Inhaled Air Volume:
- 4. Within-Phonation Inhaled Air Volume:
- 5. Within-Vocalization Inhaled Air Volume:
- 6. Post-Phonation Residual Air Volume:
- 7. Post-Vocalization Residual Air Volume:

I. SONOMETRIC MEASURES

- 1. Maximum Intensity (Measured 1 Meter Away):
 - A. Lower Register:
 - B. Middle Register:
 - C. Upper Register:

- 2. Minimum Intensity (Measured 1 Meter Away):
 - A. Lower Register:
 - B. Middle Register:
 - C. Upper Register:
- 3. Piano-to-Forte Intensity Range:
 - A. Lower Register:
 - B. Middle Register:
 - C. Upper Register:
- 4. Overall Intensity Range:
 - A. From Lower Register to Upper Register:

J. PERSONAL APPRAISAL

- 1. Fundamental Musical Quality:
 - A. Accuracy:
 - B. Rhythm:
- 2. Vocal Quality:
 - A. Production Quality:
 - B. Agility:
 - C. Register Homogeneity:
 - D. Timbre:
 - E. Volume:
 - F. Carry:
 - G. Vibrato:
 - H. Legato:
 - I. Phrasing:
- 3. Linguistic Quality:
 - A. Articulation:
 - B. Phonemic Distinctiveness:
- 4. Musical Interpretation:
 - A. Musical Quality:
 - B. Musical Sensitivity:

K. OVERALL APPRAISAL

L. AUDIOGRAM

NAME _____ DATE _____
 ADDRESS _____ AGE _____
 BY _____

Bellone **AUDIOGRAM**

This Audiogram plotted to:
ANSI 1969

TEST	Right Ear (Red)	Left Ear (Blue)
AIR	○ ○	X-X
AIR OPP EAR MASKED	△-△	□-□
NO RESPONSE	○ ↓	X ↓
BONE	>	<
BONE OPP EAR MASKED	▷	◁

HEARING EVALUATION		
AVE. P.T.		
SRT		
PH % CORRECT		
MFL		

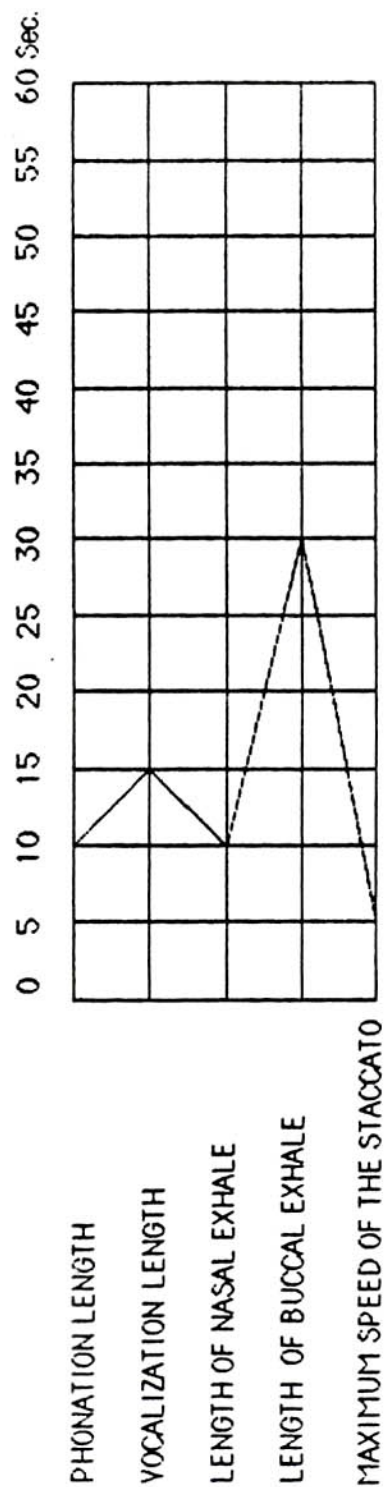
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M. PHONETOGRAM

dB (A)	Name		Date	
	First name	Date of birth	Diagnosis	Examiner
	Microphone distance 30 cm		/a/blue /l/red /u/green	
120				
110				
100				
90				
80				
70				
60				
50				
40				

49 55 65.5 82.5 98 110 131 165 196 220 262 330 392 440 524 660 784 880 1,048 1,320 1,568
Frequency, Hz

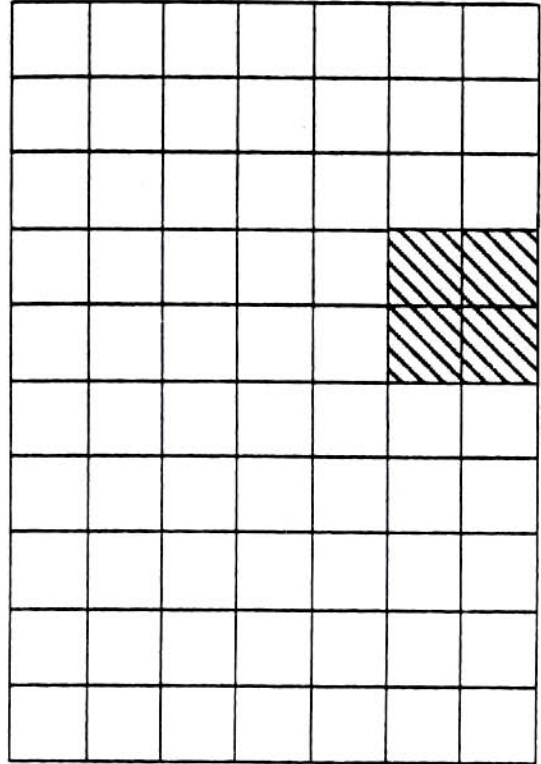
PNEUMO-PHONIC COORDINATION



VIBRATO

0 1 2 3 4 5 6 7 8 9 10 VP

VA (in tones) **2**
1 3/4
1 1/2
1 1/4
1
3/4
1/2
1/4



ODOGRAM

1 2 3 4 5 6 7 8 9 10

ACCURACY
PRODUCTION QUALITY
ARTICULATION
HOMOGENEITY
AGILITY
VOLUME
CARRY
VIBRATO
LEGATO
MUSICAL QUALITY

TOTAL : /100

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INSTRUCTION SHEET

A. GENERAL INSTRUCTIONS

- 1. For recordings made in the anechoic chamber, the code number must be recorded before the corresponding vocal sequence (for example, B1, B2, etc.).
- 2. Choose a representative note for each register, and use it throughout the test (for example a soprano might choose C4 for the lower register, C5 for the middle register, and C6 for the upper register).

B. ANECHOIC CHAMBER RECORDINGS

- 1. Phrase chosen to sing. (E1, 2, 29, 30, G6)⁷
- 2. Same phrase spoken. (E29, G6)
- 3. Upward chromatic progression on the vowels [i] and [a], over the entire tessitura. (E4, 19, 20 to 26, 28, G5, 8)
- 4. Downward chromatic progression on the vowels [i] and [a], over the entire tessitura. (E4, 19, 20 to 26, 28, G5, 8)
- 5. Upward progression by commas (*and not half-tones*) on the vowels [i] and [a], over the entire tessitura without breathing in. (E15, 19, 20, 26, 27, G5, 7)
- 6. Downward progression by commas on the vowels [i] and [a] over the entire tessitura without breathing in. (E16, 19, 20, 26, 27, G5, 7)
- 7. Sequence [teikjutll] (take you'til) sung in the three registers. (E1, 9)
- 8. Note held on [a] in lower, middle and upper registers. (G1, 2, 3, 4)
- 9. Portamento over one octave on [a] in the middle register. (E1, 17)

⁷The numbers in parentheses following each instruction refer to the various items of the *Odological Test Sheet* to which those instructions pertain. For example, instruction 1, **Sentence of choice sung. (E1, 2, 29, 30, G6)**, means that this instruction asks for an evaluation of production quality (E1), articulation (E2), etc.

- 10. Deguelando over one octave on [a] in the middle register. (E1, 18)
- 11. Half-tone trills in lower, middle, and upper registers. (E6)
- 12. Whole-tone trills, in the three registers. (E6)
- 13. Vocalises on [i], [a] and [u] (= oo). (E4, 9, G1, 2, 3, 4)
- 14. Legato vocalises on C4, E4, G4, C5, G4, E4, C4. (E9)
- 15. Staccato vocalises on C4, E4, G4, C5, G4, E4, C4. (E10)
- 16. Rossini's arpeggio sung as fast as possible, first in legato then in staccato. (E3, 9, 10)
- 17. Attacks: Soft, breathy, and glottalized in the middle register on [a] sung piano. (E7)
- 18. Attacks: Soft, breathy, and glottalized in the middle register on [a] sung forte. (E7)
- 19. Finale: Soft, breathy, and glottalized in the middle register on [a] sung piano. (E8)
- 20. Finale: Soft, breathy, and glottalized in the middle register on [a] sung forte. (E8)
- 21. Vowel [a] sung diminuendo in the middle register. (E1, 12)
- 22. Vowel [a] sung crescendo in the middle register. (E1, 11)
- 23. Vowels [i] and [a] sung in the middle register in messa di voce (pp, p, mf, f, ff, f, mf, p, pp). (E1, 5, 13)
- 24. Vowels [i] and [a] sung pianissimo in the 3 registers. (E4, 5, G4)
- 25. Vowels [i] and [a] sung fortissimo in the 3 registers. (E4, 5, G4)
- 26. Diphthong [ia] sung in the middle register without pausing between the two vowels. (E1, 4, 5, G3, 4)
- 27. Vowel [a] sung in the middle register without vibrato (straight tone). (E14)
- 28. Same phrase as in item B1 sung. (E1, 2, 30)
- 29. Reading of text 2. (E29)
- 30. Series of staccato tones on [a] sung as fast as possible on the same note in the middle register. (E3, F1)
- 31. Vowel [a] sung forte in lower, middle and upper registers with an orchestral simulation at 100 dB. (E5)
- 32. Singing of an extract from singer's repertoire. (E1, 2, 3, 4, 9, G1, 2, 3, 4, J)

C. ADDITIONAL TESTS

A. Sonometric Measures in an Anechoic Chamber

- 1. A tone is sung pianissimo on [a] in the lower, middle and upper registers. (I 2, 3, 4)
- 2. A tone is sung fortissimo on [a] in the same three registers. (I 1, 3, 4)

B. Audiogram (L)

C. Phonetogram (M)

D. Measures with the Chronometer (F)

- 1. After taking a deep breath, text 1 is read without any new breathing.
- 2. A tone is held as long as possible on [a] in the middle register, after a deep breath.
- 3. After a deep breath, the inhaled air is exhaled through the nose as slowly as possible.
- 4. After a deep breath, the consonant [s] is held until all air has been exhaled.

E. Measures taken on the Polyphonometer

- 1. Text 1 is read without breathing. (H2, 4, 6)
- 2. Text 1 and 2 are read normally. (H1, 2, 4, 6)
- 3. A few musical phrases are sung. (H1, 3, 5, 7)

F. Front-Side View Videotape Recording (F2, G5)

The singer is filmed as he/she sings on [a] across his/her entire tessitura:

- 1. from the lower to the upper registers in half steps.
- 2. from the upper to the lower registers in half steps.
- 3. from the lower to the upper registers, by commas and without breathing.
- 4. from the upper to the lower registers, by commas and without breathing.

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ODOLOGICAL TEST

TEXT 1

I had already noticed, in the same garden, his shabby overcoat that buttoned right up to the neck, his out-of-shape felt that no brush had ever brushed, his weeping-willow long hair combed like a bush, his scrawny ossuary-like hands, his sneering, sly, sickly physiognomy from which a Nazarene beard tapered off, and my conjectures charitably classified him among those third-rate artists, violin players and portrait painters that insatiable hunger and unquenchable thirst condemn to running around the world tracking the wandering jew.

L. Bertrand
(Gaspard de la Nuit)

*AERODYNAMIC PHENOMENA DURING
SPEECH PRODUCTION
POLYPHONOMETRIC ANALYSIS
BREATH GROUP LENGTH
INHALED AND EXHALED AIR VOLUME*

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ODOLOGICAL TEST

TEXT 2

I was going to perch on a branch where a half a dozen birds of different species were lined up. I timidly took the last spot on the end of the branch, hoping that I would be tolerated. Unfortunately, my neighbor was an old dove, as dry as a rusty weathervane. Just as I was approaching her, the few feathers that covered her bones became the object of her care; she pretended to prune them, but was too afraid to pull one out: she simply took stock of them to see whether they were all there. I had hardly touched her with the tip of my wing when she pricked up majestically. "What, then, are you doing, Sir?" she said pinching her beak with that British modesty and flattening me with a broad elbow swing, she cast me down with a kind of vigor that would do honor to a porter.

A. DE MUSSET
(Histoire d'un Merle Blanc)

FROEHEL'S TEST

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