

# Human Beatboxing: Laryngeal Articulations

*14th Pan-European Voice Conference*

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Vibration bass

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Epiglottal oscillation

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# What is Human Beatboxing ?

TRUNG BAO | VENOM | Grand Beatbox Battle 2019 WILDCARD

# Paralinguistic approach

Proctor et al. (2013)<sup>1</sup> : « *[Human Beatboxing (HBB)] exhibits many of the properties of a discrete combinatorial system [...] ultimately reducible to coordinative structures of a small set of primitives* »

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1. Proctor, M., Bresch, E., Byrd, D., Nayak, K. & Narayanan, S. (2013). Paralinguistic mechanisms of production in human "beatboxing" : A real-time magnetic resonance imaging study. *The Journal of the Acoustical Society of America*, 133(2), 1043-1054.
  2. Blaylock, R., Patil, N., Greer, T. & Narayanan, S. S. (2017). Sounds of the Human Vocal Tract.. *INTERSPEECH*, 2287-2291.

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Blaylock et al. (2017)<sup>2</sup> points out that beatboxers use both linguistic and non-linguistic production mechanisms → are there more primitives in HBB compared to speech? Or does HBB allows more combinations than linguistic systems?

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1. Proctor, M., Bresch, E., Byrd, D., Nayak, K. & Narayanan, S. (2013). Paralinguistic mechanisms of production in human "beatboxing" : A real-time magnetic resonance imaging study. *The Journal of the Acoustical Society of America*, 133(2), 1043-1054.

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# (Paralinguistic approach

HBB production mechanisms rely on the combination of all possible initiation mechanisms and articulatory mechanisms (Dehais-Underdown et al., 2022)<sup>3</sup>

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3. Dehais-Underdown, A., Vignes, P., Crevier-Buchman, L. & Demolin, D. (2022). In and out : production mechanisms in Human Beatboxing. *Proceedings of Meetings on Acoustics, Vol. 45, 060005*. <https://doi.org/10.1121/2.0001543>.

4. Paroni, A., Henrich Bernardoni, N., Savariaux, C., Loevenbruck, H., Calabrese, P., Pellegrini, T., Mouysset, S. & Gerber, S. (2021). Vocal drum sounds in human beatboxing : An acoustic and articulatory exploration using electromagnetic articulography. *The Journal of the Acoustical Society of America, 149*(1), 191-206.

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Articulatory activity is reorganized and new synergical patterns occurs (e.g. linguo-labial or linguo-laryngeal synergies) (Paroni et al., 2021)<sup>4</sup>.

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How these new emerging patterns are expressed from a physiological point of view ?

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# Epi-larynx

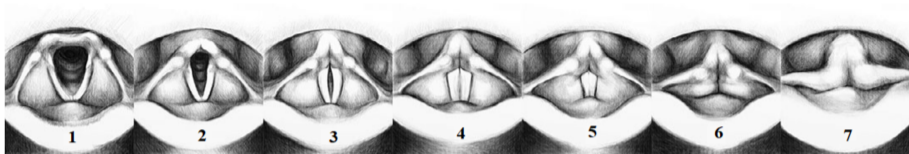


Figure – Revised Open-Closed Continuum (Esling et al., 2019)<sup>5</sup>

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5. Esling, J., Moisk, S., Benner, A. & Crevier-Buchman, L. (2019). *Voice Quality : The Laryngeal Articulator Model*. Cambridge University Press. <https://doi.org/10.1017/9781108696555>.



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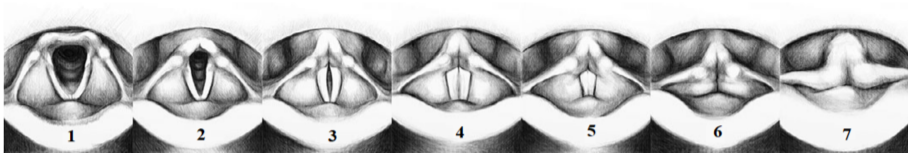


Figure – Revised Open-Closed Continuum (Esling et al., 2019)<sup>5</sup>

Multiplanar *Open-Close* continuum :

- Glottal closure (4&5)
- Ventricular closure (6)
- Epilaryngeal closure (7)

5. Esling, J., Moisk, S., Benner, A. & Crevier-Buchman, L. (2019). *Voice Quality : The Laryngeal Articulator Model*. Cambridge University Press. <https://doi.org/10.1017/9781108696555>.

# Methodology

- 5 participants : 1 male pilot subject, 2 females, 2 males
- Video recordings with a Xion video-stroboscopic flexible fiberscope (25 frames/s)
- Aerodynamic and acoustic recordings with EVA2 workstation (intraoral pressure, oral & nasal airflow)
- Subjects were asked to perform electronic music imitations (these sounds make extensive use of vibratory mechanisms of laryngeal structures)

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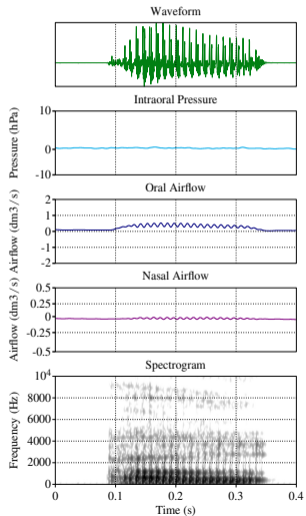
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# Throat Bass



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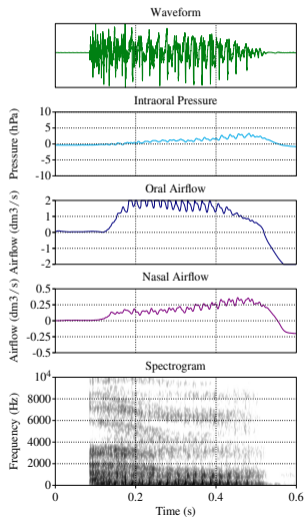
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# Vibration Bass



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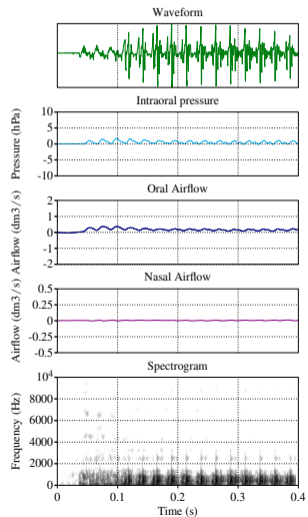
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# Chest Bass



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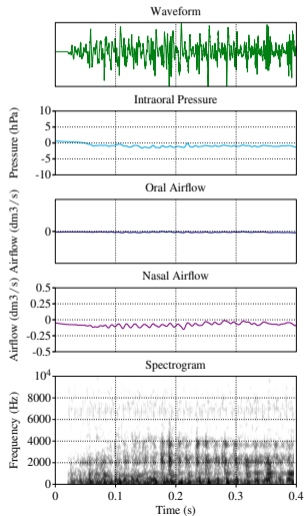
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# Epiglottal oscillation



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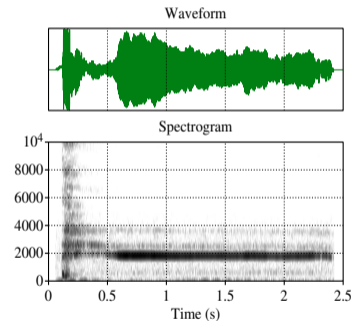
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# Bonus : Glottal Whistle



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# Conclusion

- Phonation and voice cannot be reduced to vocal fold vibration ; it must be investigated (and taught) in a broader way



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- Phonation and voice cannot be reduced to vocal fold vibration ; it must be investigated (and taught) in a broader way
- Ventricular phonation can be ingressive, ingressive phonation has been investigated, however studies report ventricular dilatation and high F0 (Eklund, 2008 ; Kelly & Fisher, 1999 ; Lehmann, 1965 ; Orlikoff et al., 1997 ; Vanhecke et al., 2016)

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- Phonation and voice cannot be reduced to vocal fold vibration ; it must be investigated (and taught) in a broader way
- Ventricular phonation can be ingressive, ingressive phonation has been investigated, however studies report ventricular dilatation and high F0 (Eklund, 2008 ; Kelly & Fisher, 1999 ; Lehmann, 1965 ; Orlikoff et al., 1997 ; Vanhecke et al., 2016)
- Aryepiglottic Folds and mucosa can produce vibration and allows a formant structure (= phonation)
  - A better understanding of the acquisition of these sounds may be useful for voice therapy

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