

Human Beatboxing : Physiological Aspects of Drum Imitation

Alexis Dehais Underdown¹, Paul Vignes¹, Lise Crevier Buchman^{1,2}, Didier Demolin¹
¹Laboratoire de Phonétique et Phonologie, UMR 7018 CNRS-Sorbonne Nouvelle, ²Hôpital Foch, Univ. VSQ

INTRODUCTION

- Human Beatboxing (HBB) is a musical technique that uses the vocal tract to imitate musical instruments (i.e. non-linguistic sounds)
- Similar to speech => selection and combination of smaller units into larger ones
- characterized, mostly, by (1) articulatory precision and (2) breathing control
- Speech ≠ HBB => Different Goals and constraints
- Speech = efficient communication & linguistic constraints
- HBB = Music & Aesthetic Constraints
- Different use of the vocal tract

RESEARCH QUESTION

What are the capacities of the human vocal tract ?

HYPOTHESIS

Beatboxers acquire a more accurate and extended control on aeromechanical constraints of the vocal tract allowing them to use a larger number of production mechanisms.

REFERENCES

1. Catford, J. C. (1977). *Fundamental problems in phonetics*. Midland Books.
2. Eklund, R. (2008). Pulmonic ingressive phonation: Diachronic and synchronic characteristics, distribution and function in animal and human sound production and in human speech. *Journal of the International Phonetic Association*, 38(3), 235–324.
3. Esling, J., Moisiak, S., Benner, A., & Crevier-Buchman, L. (2019). *Voice quality : The laryngeal articulator model*. Cambridge University Press.
4. Ghio, A., & Teston, B. (2004). Evaluation of the acoustic and aerodynamic constraints of a pneumotachograph for speech and voice studies. *International Conference on Voice Physiology and Biomechanics*, 55–58.

Acknowledgement

We thank Hopital Foch for helping with the RCB-ID n° 2020-A00246-33 and to the LABEX EFL for Financial support. Many thanks to the beatboxers !

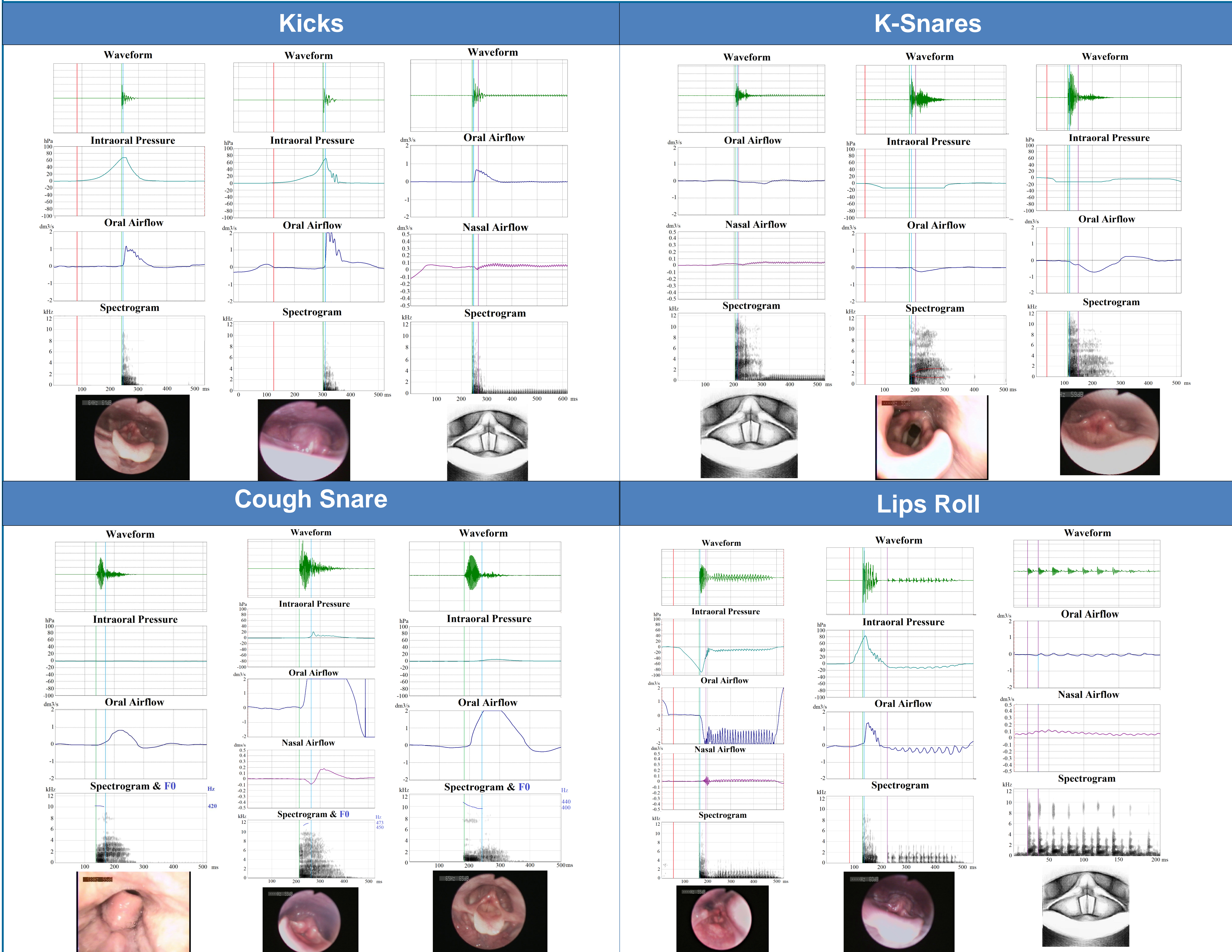
Methods

- 5 Professional beatboxers
- Aerodynamic and acoustic = EVA2 Workstation
- Laryngoscopy = Xion video-stroboscopic & flexible fibroscope
- Data Analysis :
 - Aerodynamics => *Pressure & Airflow measurements*
 - Laryngoscopy => *Laryngeal Articulator Model & multiplanar Open-Close Continuum*
 - Acoustics => *Waveform & Spectrogram*

→ Corpus :

Sound	Beatboxing Category	Transcription	Description
Classic Kick		[p']	glottalic egressive bilabial stop
Humming Kick		{p}	velaric egressive bilabial stop
Closed Hi-Hat		[tʰ]	glottalic egressive coronal affricate
Humming Hi-Hat		{tʰ}	velaric egressive coronal affricate
Inward K-Snare		[k̠]	pulmonic ingressive lateral velar affricate
Humming K-Snare		{k̠}	velaric ingressive lateral velar affricate
Cough Snare		[ʔh]	pulmonic egressive epilaryngeal affricate
Lips Roll		[ɸ]	pulmonic ingressive lateral bilabial trill
Lips Roll Humming		{ɸ}	pulmonic ingressive lateral bilabial trill

Results



Conclusion

- Beatboxers have an extended knowledge on Vocal Tract capacities
- Atypical bursts => Acoustic wave propagates at higher velocity than particles
- Alternation between ingressive and egressive sounds may insure sufficient air in the lungs for gas exchange
- When beatboxers produce Beat Patterns, what are their strategy to coordinate articulation and breathing ?
- HBB paradigm may provide (1) new perspective on articulatory complexity and phonetic diversity and (2) useful and an original contribution for speech pathology

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