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Human Beatboxing :

A preliminary study on temporal reduction.

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 the imitation of musical sonorities with the vocal tract.
 → HBB relies on different articulatory skills compared to speech because it does not obey to linguistic constraints.
 → In the present study we are presenting an experiment based on a speeding up task.
 → Speech rate is known to be a factor of reduction affecting supralaryngeal gestures (Byrd & Tan 1996, Lindblom 1963, Ostry & Munhall 1985) and laryngeal gestures (Munhall & Löfqvist 1992) depending on the prosodic structure (Fougeron & Keating 1997).
 → Duration is a major cue of reduction

RESEARCH QUESTIONS

How does beatboxing rate affect sound duration and what is the beatboxer's strategy to speed up ?

HYPOTHESIS

We expect that :
 (1) the faster the production, the shorter sound duration
 (2) affricates, trills and fricatives will shorten more than stops
 (3) position in the beatboxed pattern influences sound reduction.

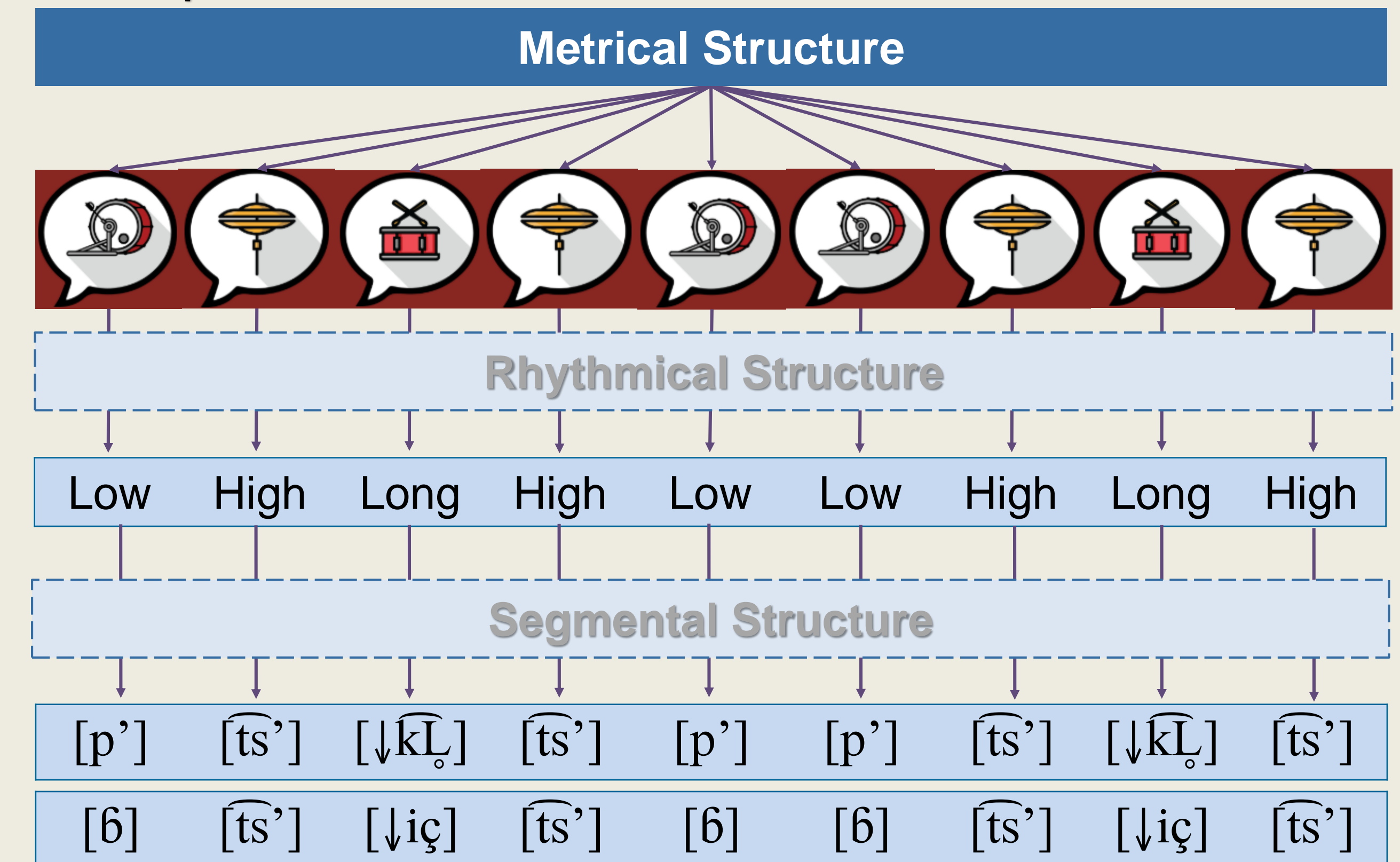
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Methods

- 1 Professional beatboxer
- Recordings in an Anechoic chamber with a cardioid AKG C520 microphone (samp. Freq. = 44kHz)
- 12 Beatboxed patterns (BP) :
 - Each positions in the patterns were annotated from 1 to 9
 - 5 repetitions of each BP at 3 speeds (90, 120, 150 Beat Per Minute) → 12 BP x 5 repetitions x 3 speeds = 180 BP
- Analysis of temporal reduction:
 - Sound duration (ms)
 - Acoustic phase duration (ms)
 - Silence between sounds (ms)
 - Pattern duration (ms)

→ Corpus :



Results

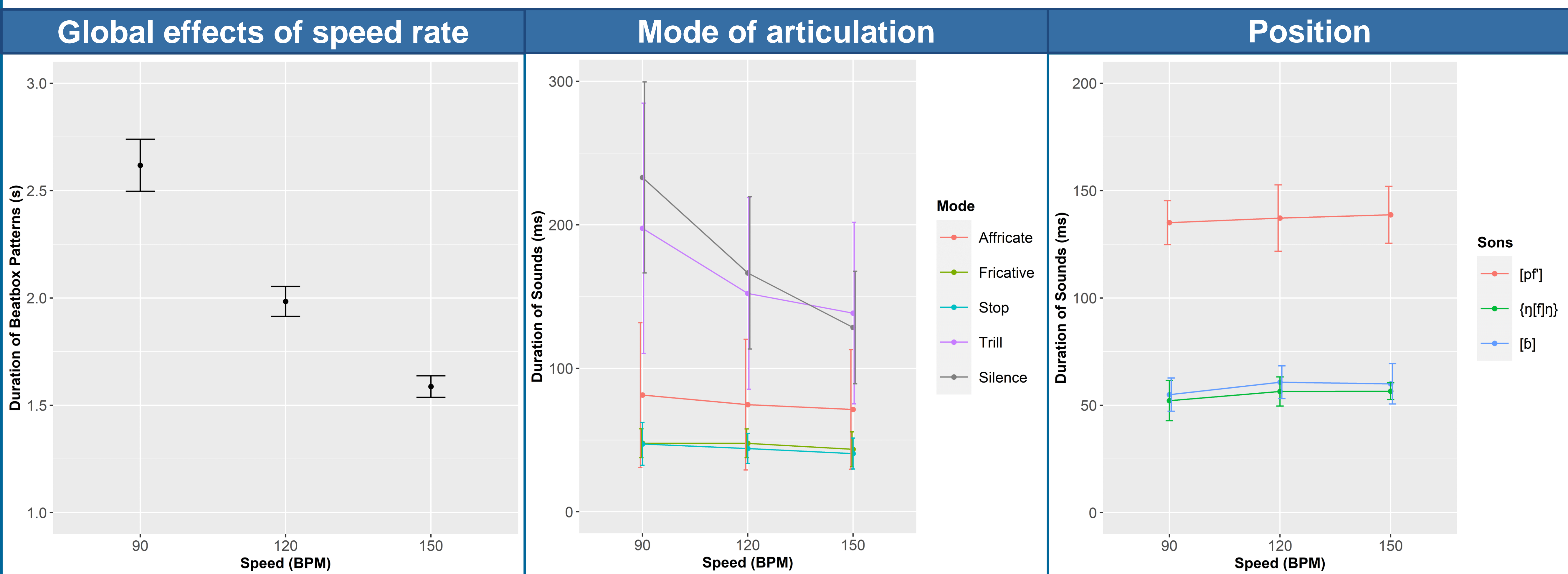


Fig.1 : Duration of Beatbox Patterns (s) as a function of speed rate.

Fig.2 : Sound Duration (ms) as a function of speed rate for different modes of articulation.

Fig.3 : Sound Duration (ms) as a function of speed rate for sounds that lengthen.

→ Duration of BP is decreasing as the speed rate increases & less standard deviation

→ Few beatboxing errors
 ➢ 1566 targets → 1544 produced sounds (18/22 were not produced at 150 BPM)
 ➢ 97 tokens that shows sound changes (e.g. [↑l] → [l]; [↓p] → [↓p̥])
 ➢ but they will not be analyzed here
 ➢ we removed all tokens that did not match the targeted sound.

→ Reduction → trills > affricates > fricative & stops
 ➢ Trill reduction → reduction of the number of vibration (9 vibrations → 2 vibrations) + increase of the frequency of vibration (40Hz → 70 Hz)
 ➢ Affricate reduction → reduction of the frication noise.
 ➢ Stops & fricative reduction → less reduction
 ➢ However some sound do not reduce depending on the position
 → Silences reduce most
 ➢ gestures are getting closer

→ Lengthening :
 ➢ Kick [b] lengthens in position 5 → articulatory constraint with [b] in position 6 ?
 ➢ Hi-hat {ŋ[f]ŋ} lengthens in position 2 & 7
 ➢ Snare [pʰ] lengthens in position 3 but shortens in position 8
 → More reduction in position 4, 8 and 9
 ➢ Position 4 = final position of the 1st half
 ➢ Positions 9 = final position
 ➢ Position 8 = anticipatory effect of the final position ?

Conclusion

→ Global reduction of pattern duration when speed increases
 → Sound reduction + silence reduction when speed increases
 ➢ Silence reduction = gestures are closer → risks of articulatory overlap but few beatboxing errors
 ➢ Strategy = temporal reduction of gestures + same intergestural interval

→ More participants needed