

# CONTROL AND REGULATION OF SUBGLOTTAL PRESSURE IN SPEECH

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## INTRODUCTION

Subglottal pressure (Ps) is maintained at a quasi constant level with some slight fluctuations during speech sentences while the volume of air in the lungs diminishes. During speech, i.e in the expiration phase of respiration, the elastic recoil forces normally trigger a rapid reduction of the pulmonic volume but Ps (sometimes called alveolar pressure) does not fall strongly after the initial rising and before the final falling Ps phases in short sentences, Why?

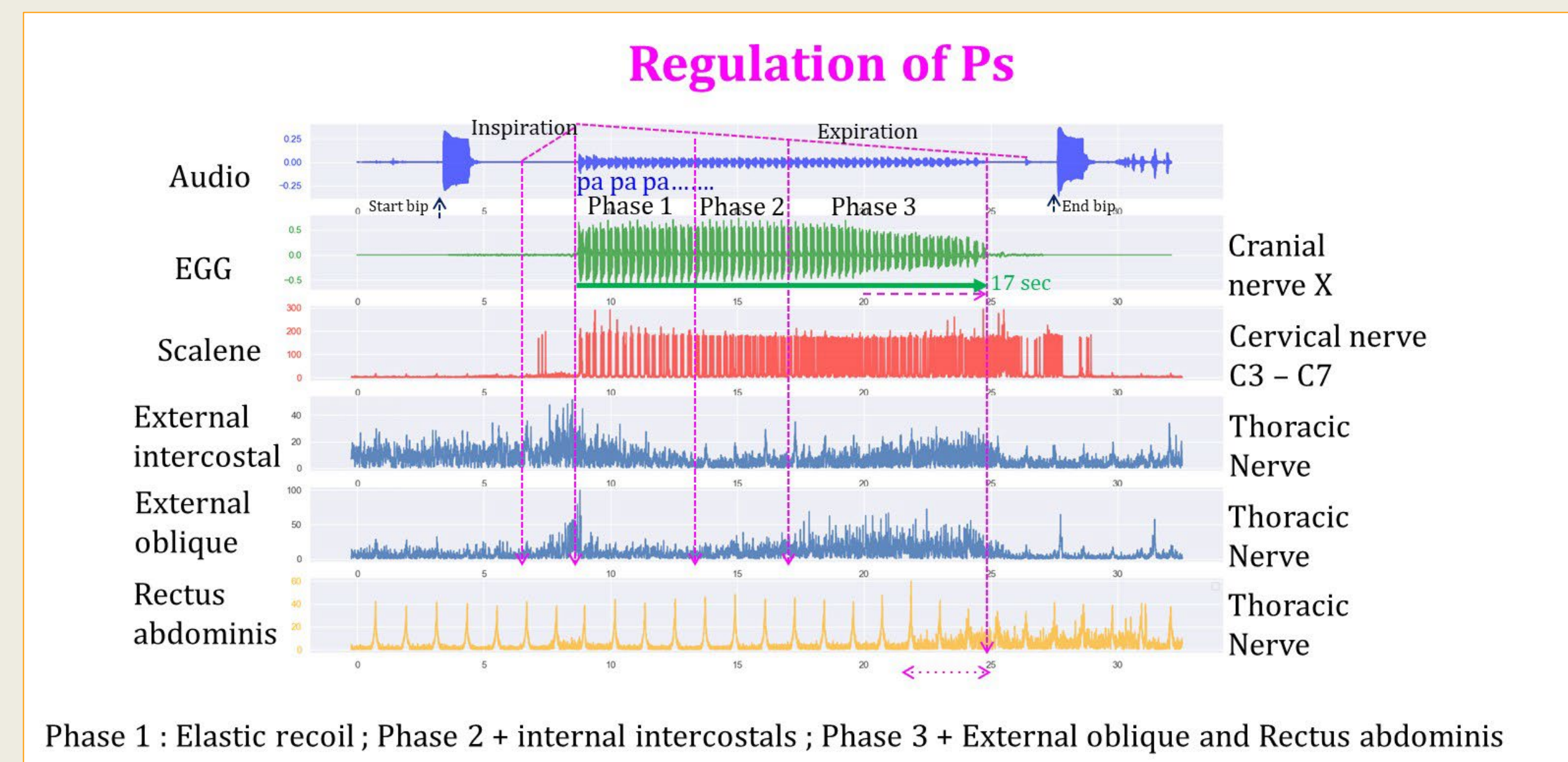
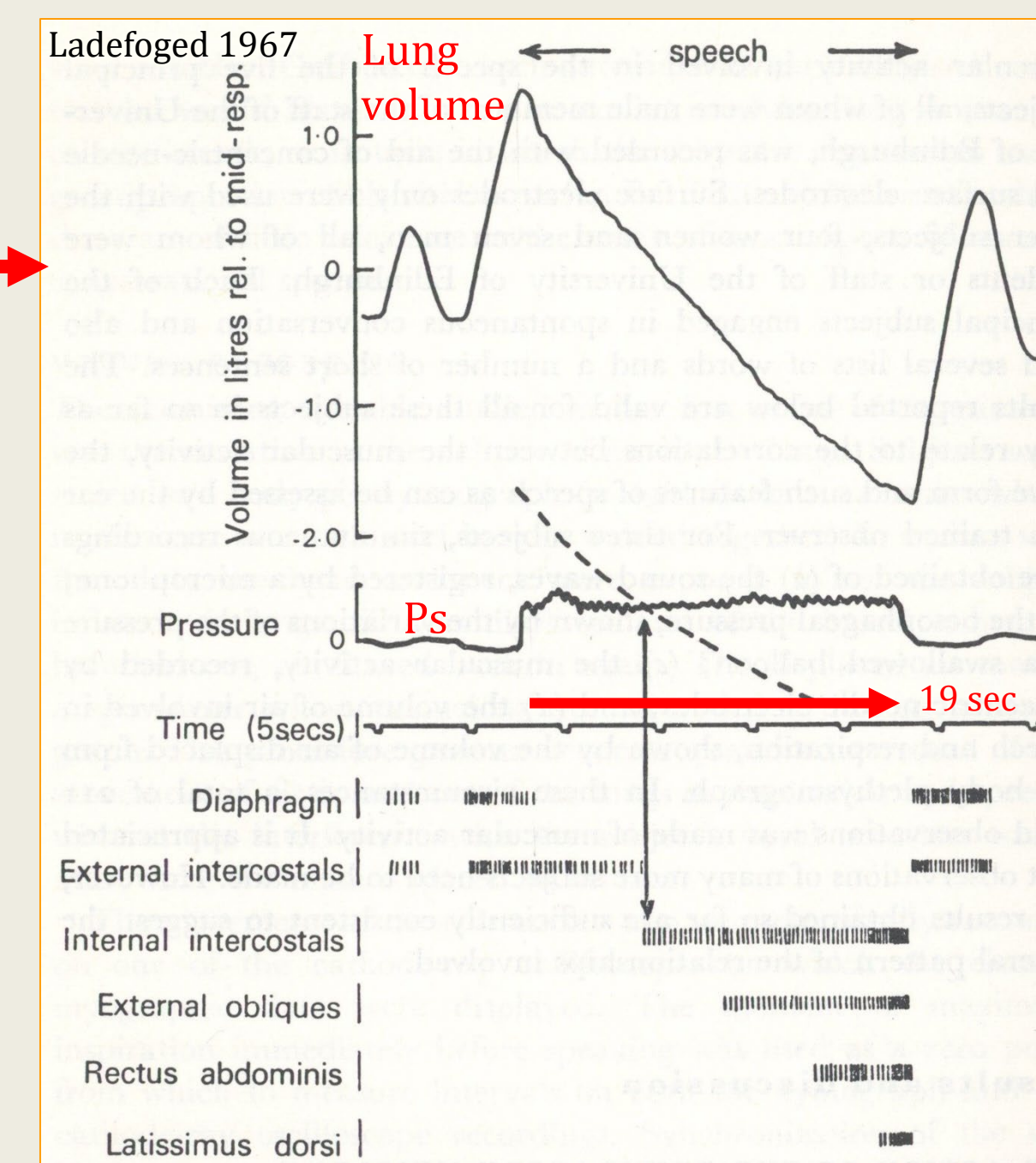
## MATERIAL & METHOD

Data for this paper come from a set of sentences pronounced by 2 native English male speakers (1 English and 1 American), 4 native French speakers (2 female and 2 male) and 1 male native Amharic speaker. Ps was measured with a needle (ID 2 mm) inserted in the trachea. Po with a small tube passed into the oro-pharynx. Oral airflow (Oaf) with a flexible silicon mask. These signals were synchronized with the audio signal. The microphone was at a quasi constant distance of the lips. Ps, Po & Oaf were recorded simultaneously with the Physiologia workstation (Teston & Galindo 1983). The audio signal was digitized at 16 kHz and the physiological data at 2 kHz. Accuracy of measurements are 1 mbar for pressure and 1 ms for time. The procedure preserved the rights and welfare of human research subjects, in respect of the ethical committee's rules. (<https://www.erasme.ulb.ac.be/fr/ethique>).

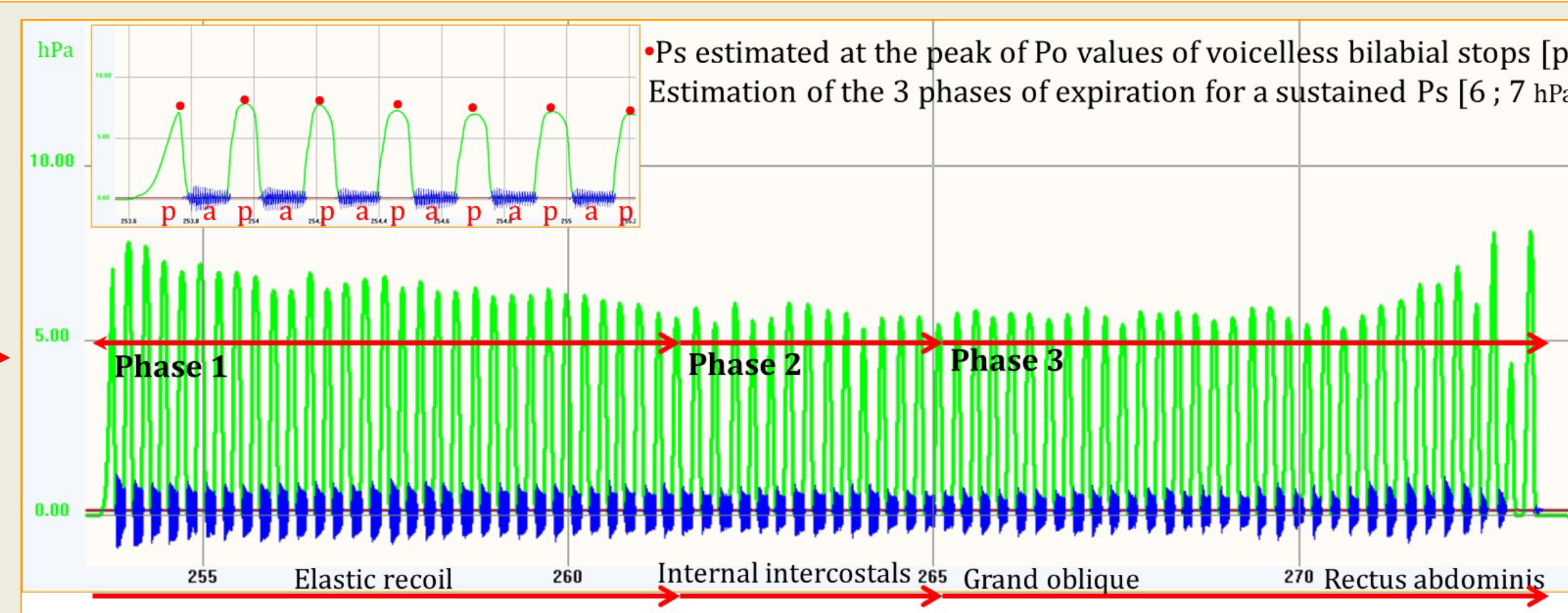
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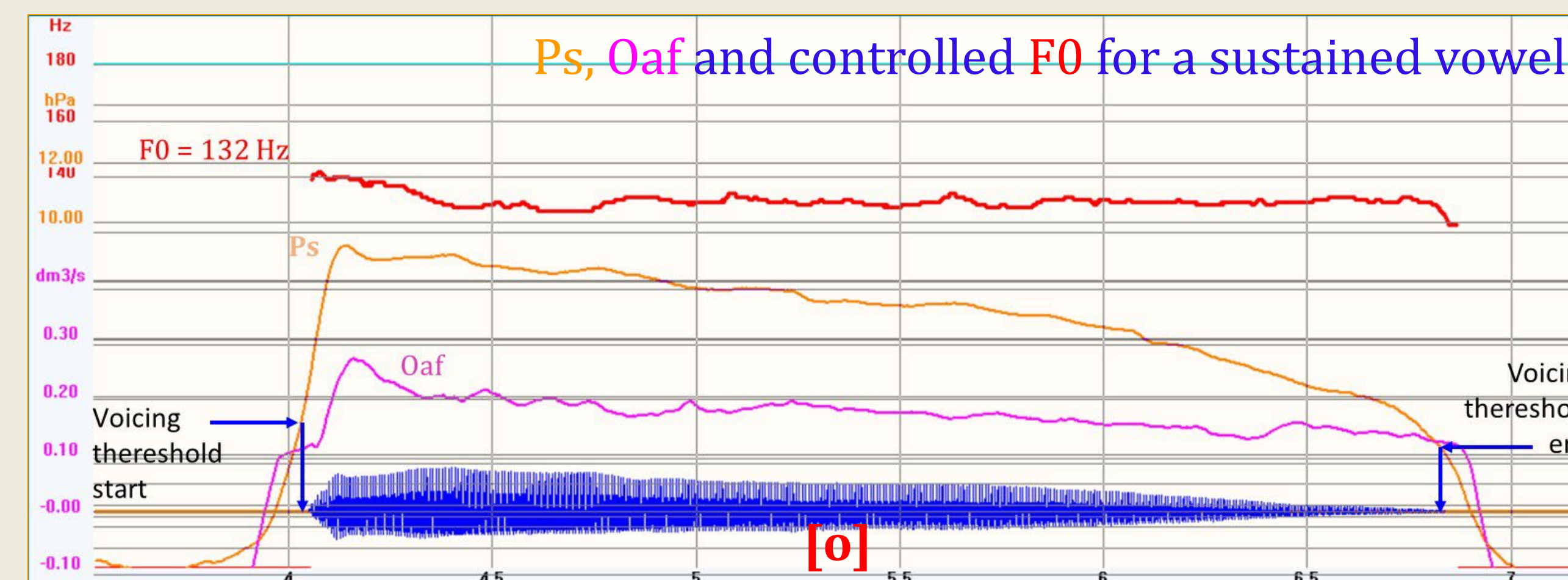
How is Ps controlled and regulated in speech? What makes Ps quasi constant in sentences? What is the role of respiration, glottal (R) and vocal tract (C) resistances?



Replication of Ladefoged et al. (1967) experiment without EMG for internal intercostals. EGG, Scalene & Po/Ps (estimated Ps) are added. A speaker produces a series of [pa] in one breath. Po/Ps values are [6 ; 7 hPa] but at the end. Titze (1994) 3 phases of expiration regulating Ps are estimated from Ladefoged et al. (1967) & new EMG data. Scalene & External intercostals activation at the end slow the expiration process.

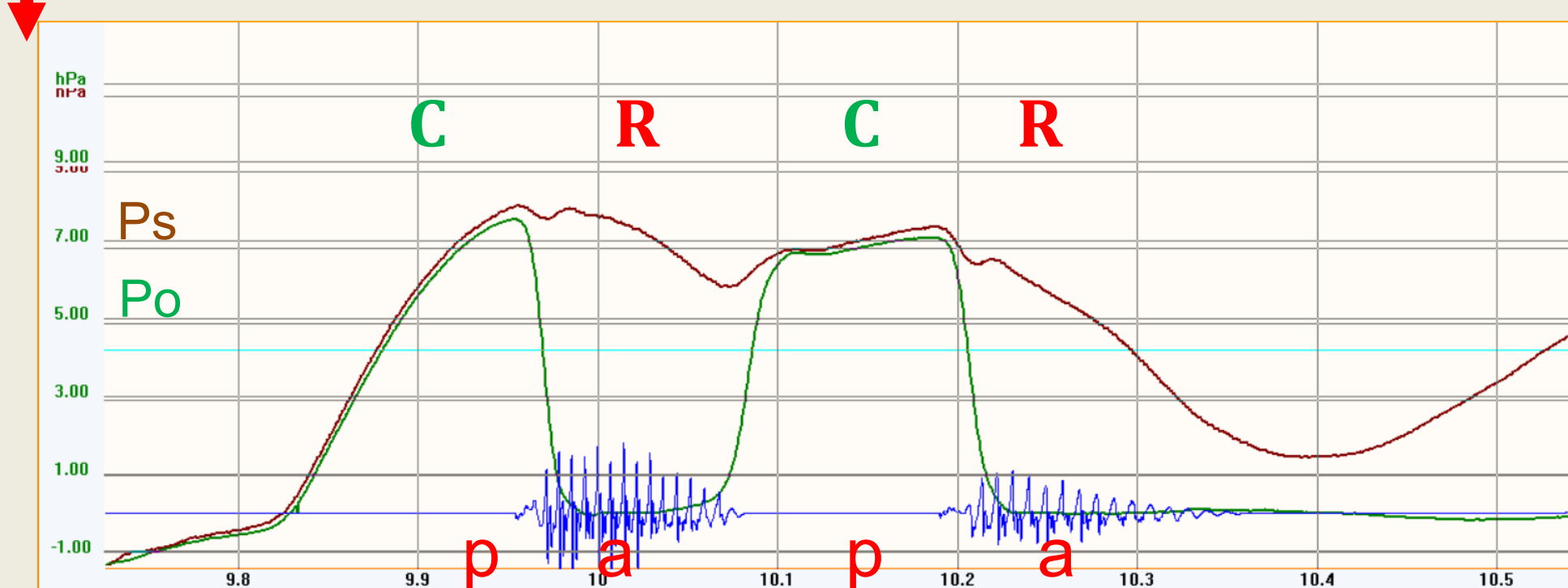


Ps can not be maintained at a constant level during a sustained vowel because the VT is open. This vowel is produced with a constant (controlled) F0 and a stable glottal resistance (R)

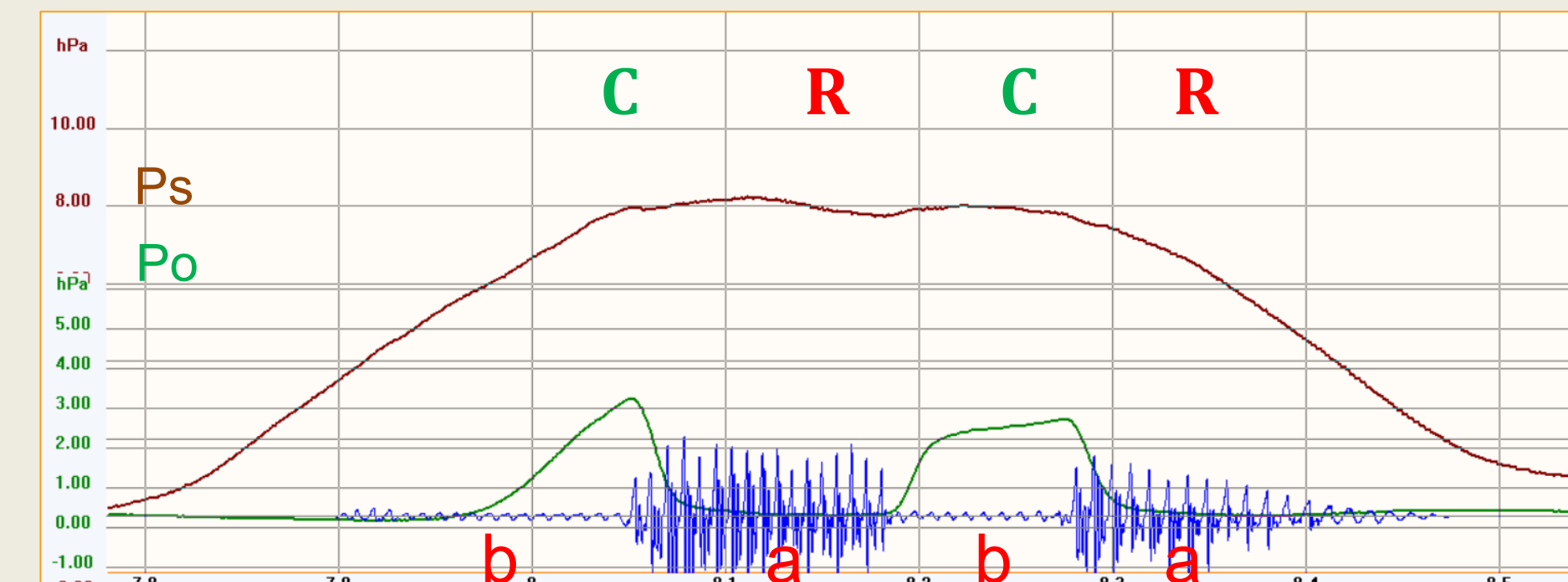
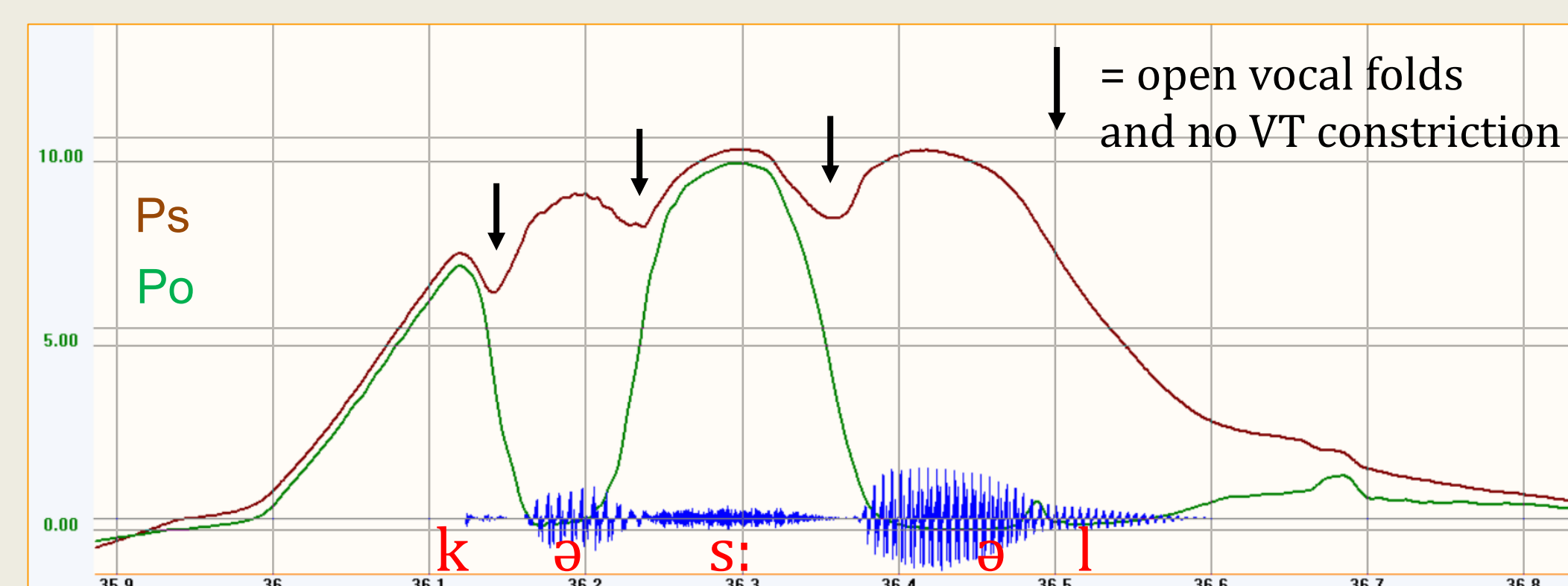


In short CVCV sequences Ps level depends of the combination of the glottal (R) and vocal tract (C) resistances.

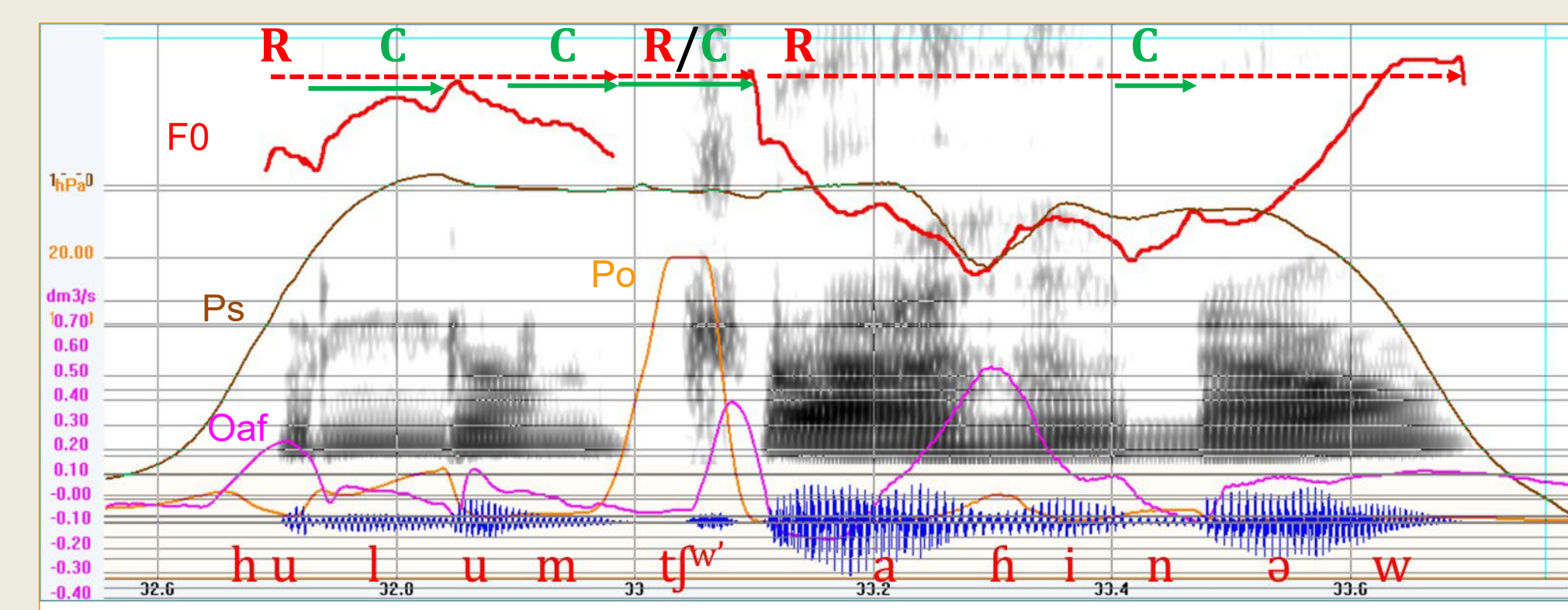
Ps ↗ Consonants [C (R)]; Stress [R (C)]; Trills [C (R)]; vowels after VOT+ [R]; Ps ↘ Vowels, diphthongs, VOT +



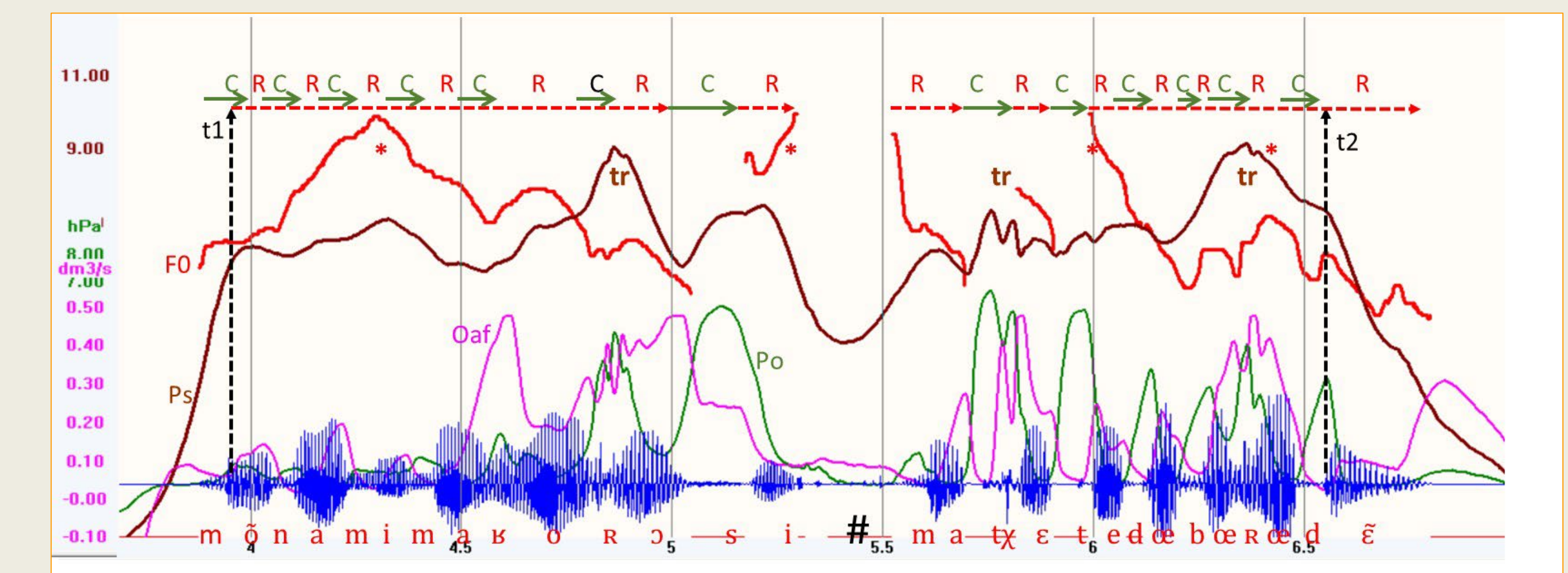
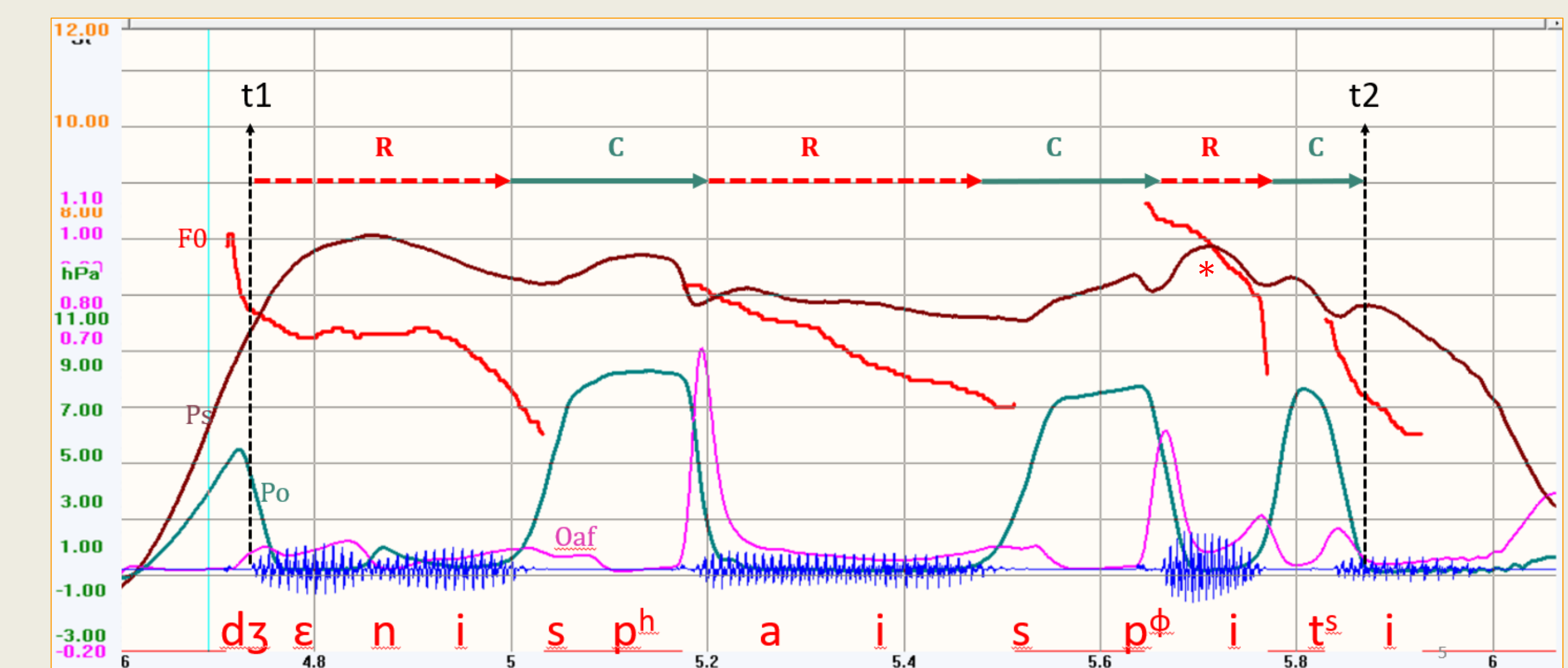
Amharic voiceless velar stop [k] and geminated alveolar fricative [s:] in the word /kə'sə:l/ 'charcoal'



Amharic short utterance /hulumtʃ'əhinəw/ 'they are all noisy' with a palatal labialized affricate ejective [tʃʷ]



⇒ Ps quasi constant level in short and average long sentences (< 4/5 sec) is mostly regulated by glottal (R) and vocal tract (C) resistances.



Ps and Po in (hPa); Oaf (oral airflow) in dcm<sup>3</sup>/s and F0 curves; t1 = end of initial Ps rising phase, t2 = the start of the Ps falling phase. R = glottal resistance and C = VT constriction; Tr increase of Ps for trills. \* indicates stressed syllables. # shows a pause between the 2 sentence phrases.

## Control of Ps

Ps in stressed syllables \* is controlled by an increase (2 hPa) in respiratory activity (thoracic nerves) while F0 (cranial nerve X) is controlled by a specific setting of the VF in stress position for these declarative and interrogative sentences.

