

The paper addresses the question of the **phonetic implementation of phonological voicing in French**. It is investigated by means of **aerodynamic** measures made at the **subglottal, glottal and supraglottal production of fricatives** in modal voice and in soft and loud **whisper** for one speaker. The results show that the **[±voice]** feature is systematically associated only with the **categorical constrictions of the glottis, even without vocal fold vibration**.

Background

The phonological voicing contrast

Various feature specifications : \pm voice, fortis/lenis, tense/lax, \pm aspiration...

Different non universal phonetic correlates: *v. f. vibration, VOT, duration*

Among which the intraoral pressure may be an universal candidate: *Burarra, Dutch, English, French, Italian, Japanese, Murrinh-Patha, Norwegian...*

But, *Pio* remains confusing, depending on passive vocal tract adjustments, position of the articulators, articulatory constriction size, position and constriction of the larynx, expiratory aero. force...

The paradigm of whisper

Open glottis > absence of vocal fold vibration

The voicing contrast remains perceptible : *English, French, Japanese*

The few studies on *Pio* according to voicing in whisper are equivocal in English, Japanese, but not in French.

Its phonetic implementation in French ?

How is the **[±voice]** feature phonetically implemented? At which levels: subglottal, glottal and/or supraglottal?

Is voicing defined by vocal fold vibration? What about in whisper?

Corpus

1 French speaker (the author) reading non-sense $eC_{[\alpha \text{ voix}]}eC_{[-\alpha \text{ voix}]}e$

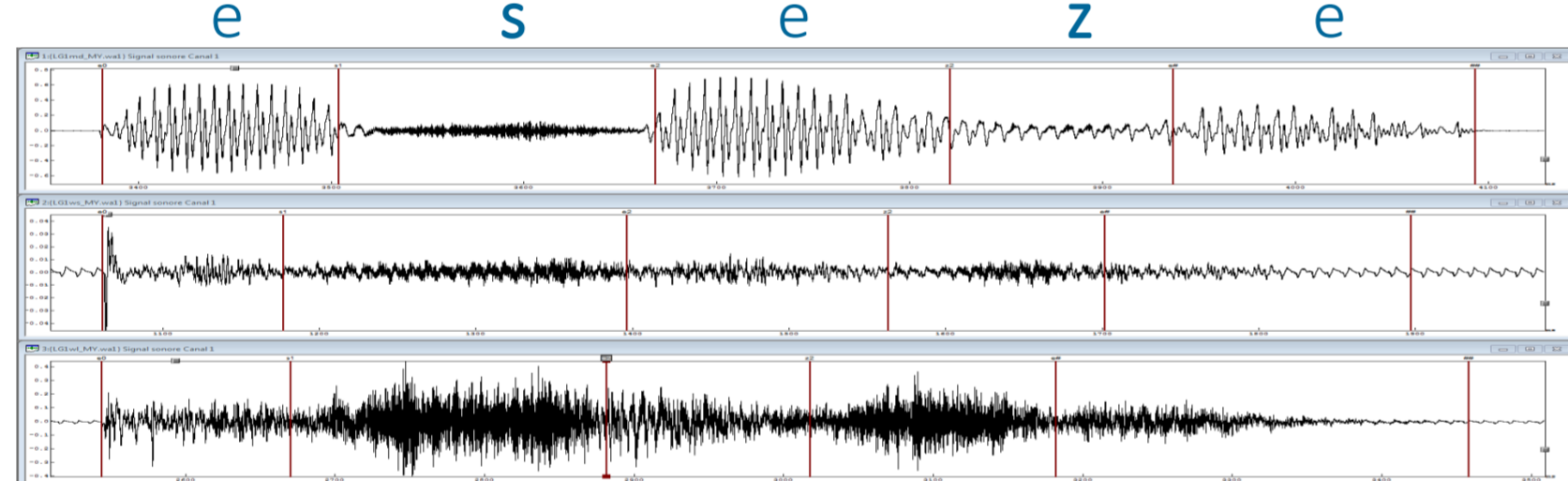
6 paired **[±voice]** fricatives : /f s j/ vs /v z ʒ/ with 5 repetitions

3 conditions of phonation

mo: modal voice

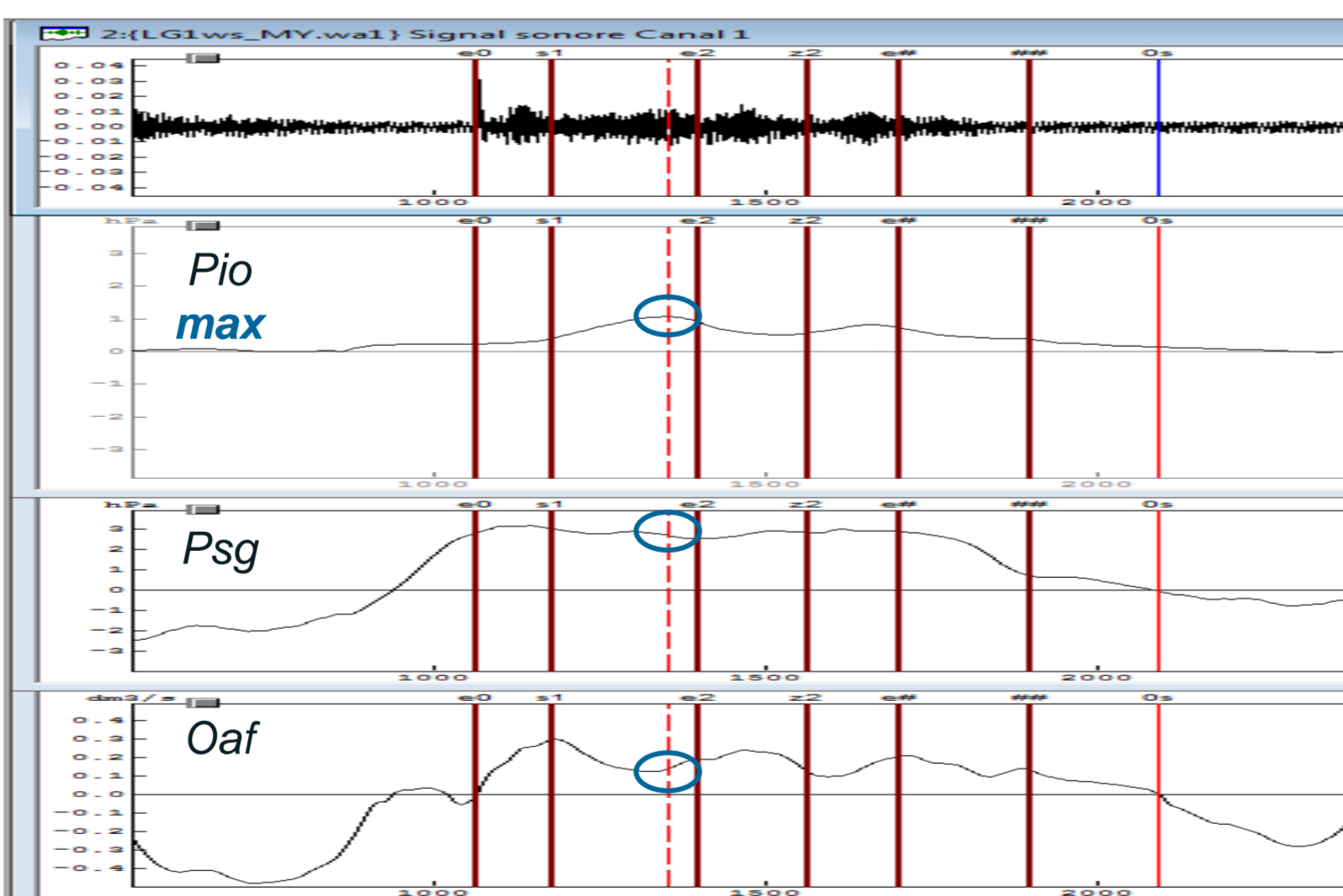
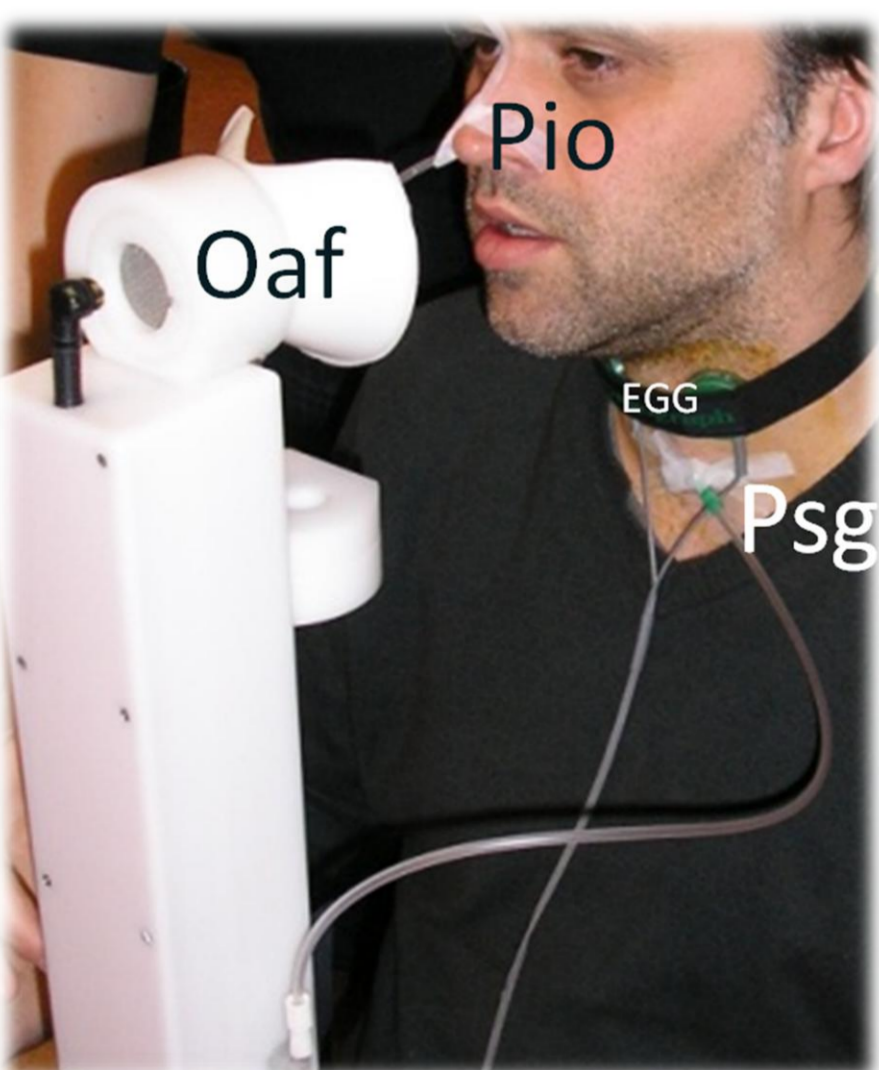
whi: soft whisper

whL: loud whisper



Acquisition

EVA station and Phonedit software (SQLab, LPL)



Measures

Supraglottal resistance

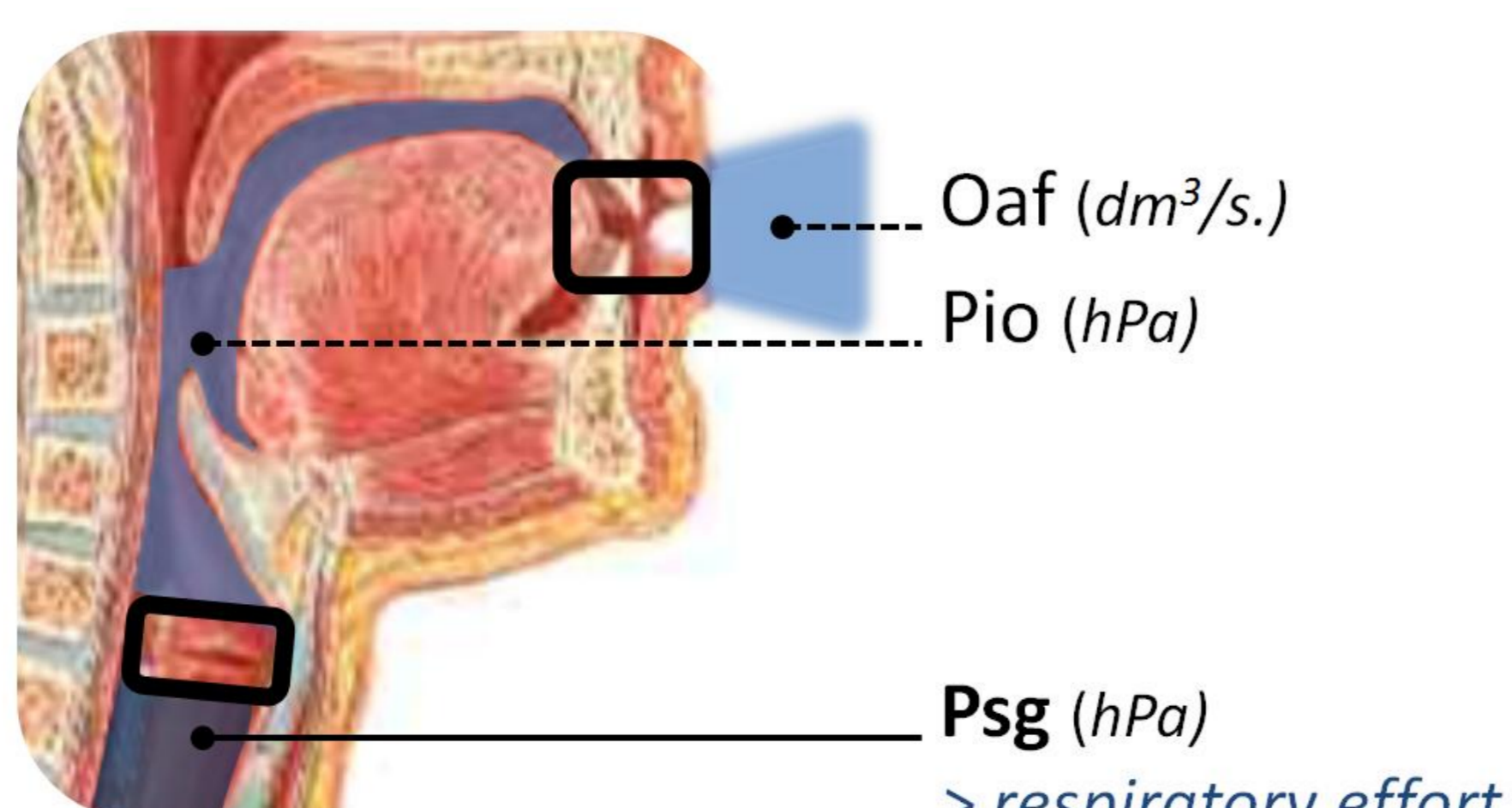
> *articulatory constriction*

$$R_{sup} = \frac{P_{io} - P_{atm}}{O_{af}}$$

Glottal resistance

> *laryngeal constriction*

$$R_{glo} = \frac{P_{sg} - P_{io}}{O_{af}}$$



Results

air pathway		mo	whi	whL
speech	<i>Oaf</i>	Fs > Fv -0.16	ns (-0.02)	ns (-0.03)
	<i>Rsup</i>	ns (-0.2)	ns (-1.2)	ns (-2.9)
vocal tract	<i>Pio</i>	Fs > Fv -1.4	Fs > Fv -0.4	ns (-1.5)
	<i>Rglo</i>	Fs < Fv 22.2	Fs < Fv 6.6	Fs < Fv 7.7
lungs	<i>Psg</i>	Fs < Fv 1.1	Fs < Fv 0.5	Fs < Fv 1.1

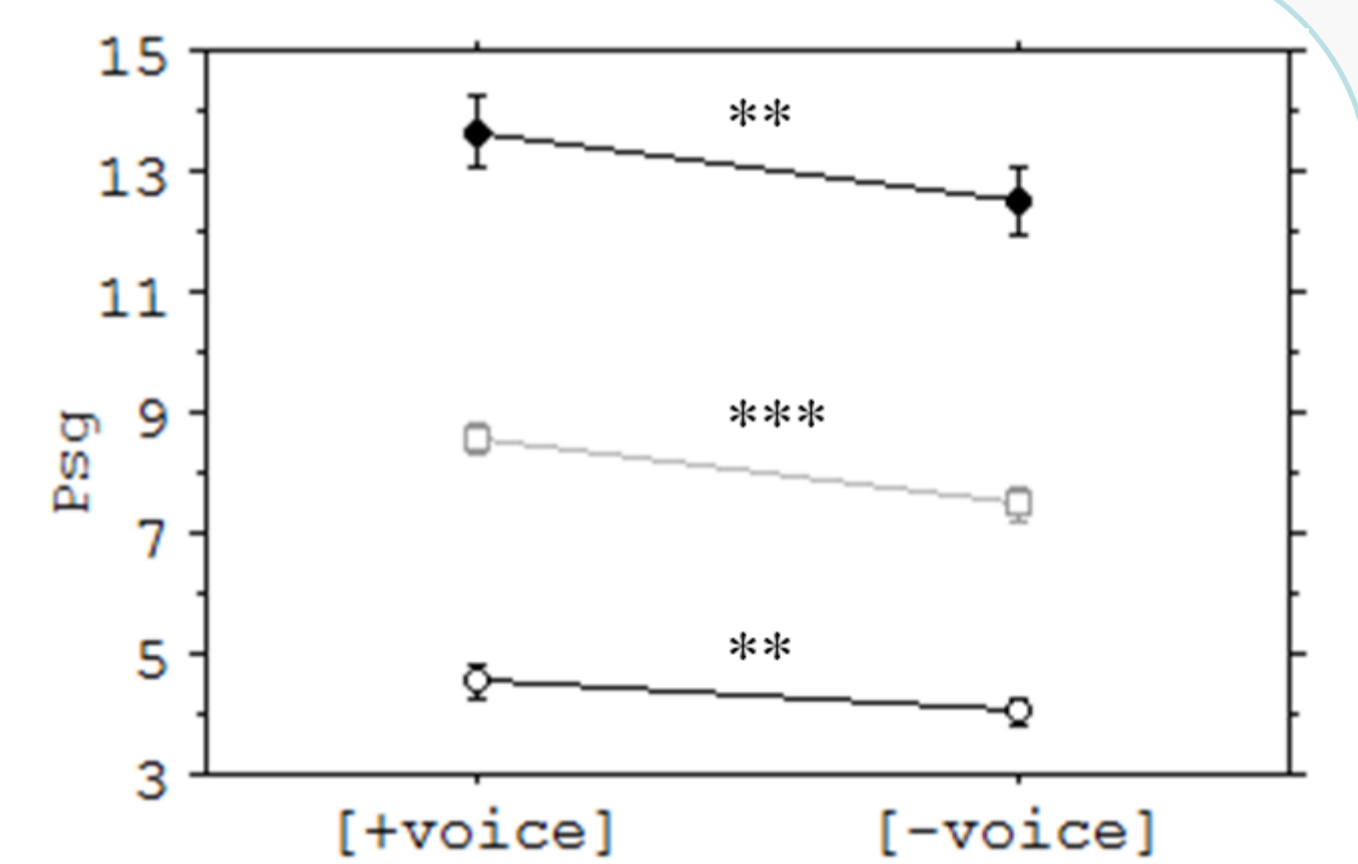
Significant differences (F-test, 0.05) and Δ values between **[+voice]** (Fv) and **[-voice]** (Fs) fricatives

Respiratory effort: Psg

no interaction *voicing*phonation*

passive response to the higher resistance of a closer glottis

> no specific subglottal control



Glottal resistance: Rglo

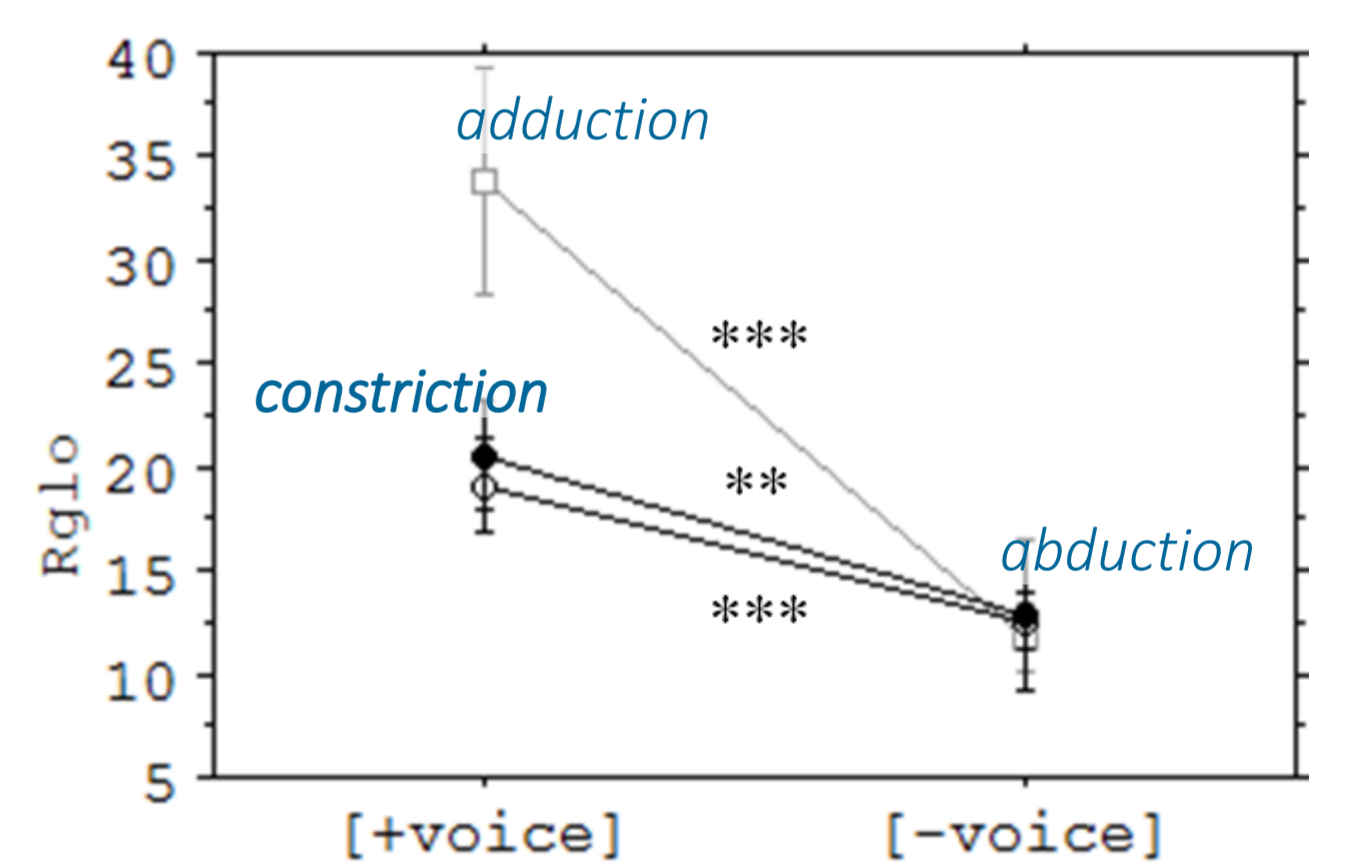
3 laryngeal categories

- adduction > modal voiced

- constriction > whispered voiced

- abduction > voiceless

> specific glottal control

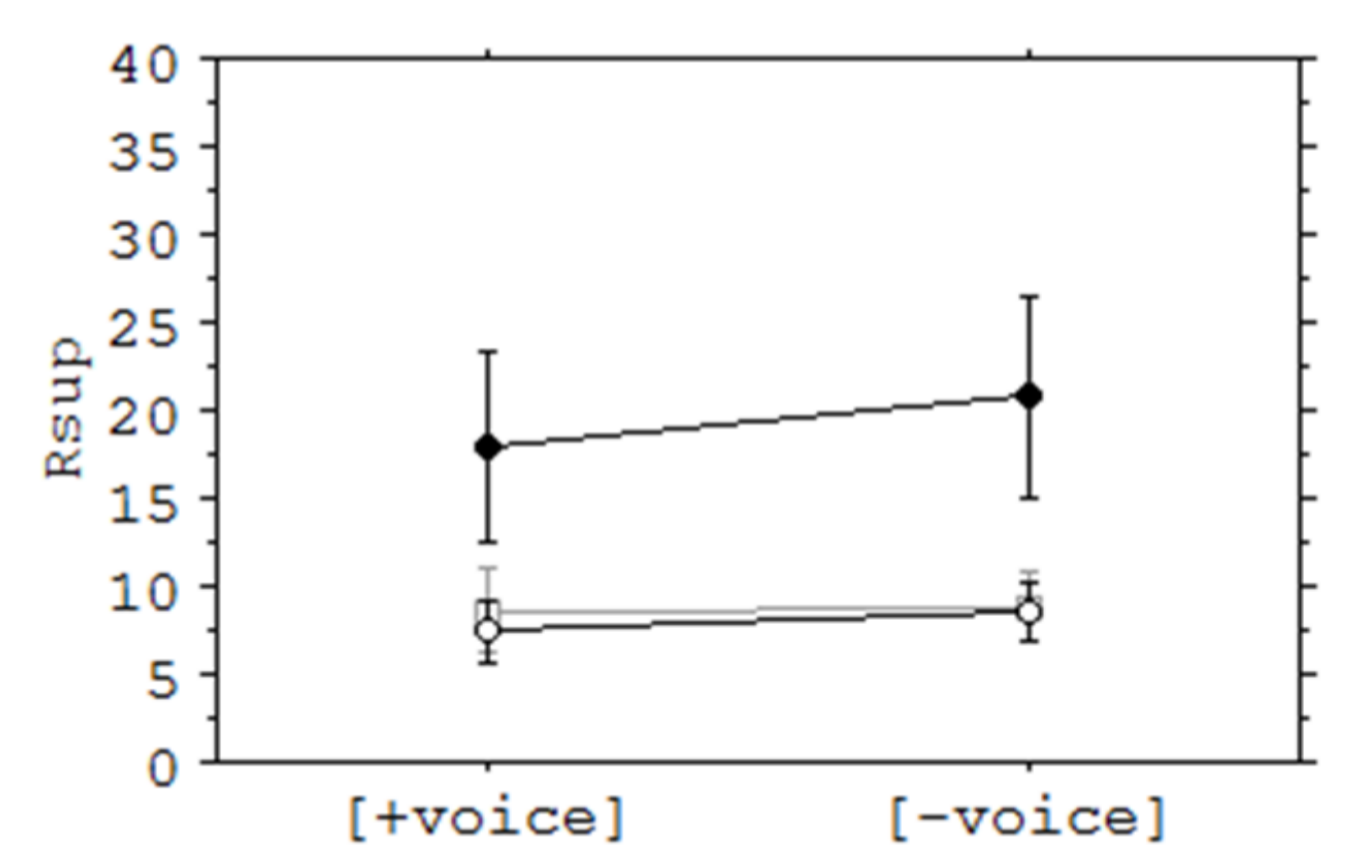


Supraglottal resistance: Rsup

no interaction *voicing*phonation*

similar resistance of the articulatory constriction according to voicing

> no specific supraglottal control



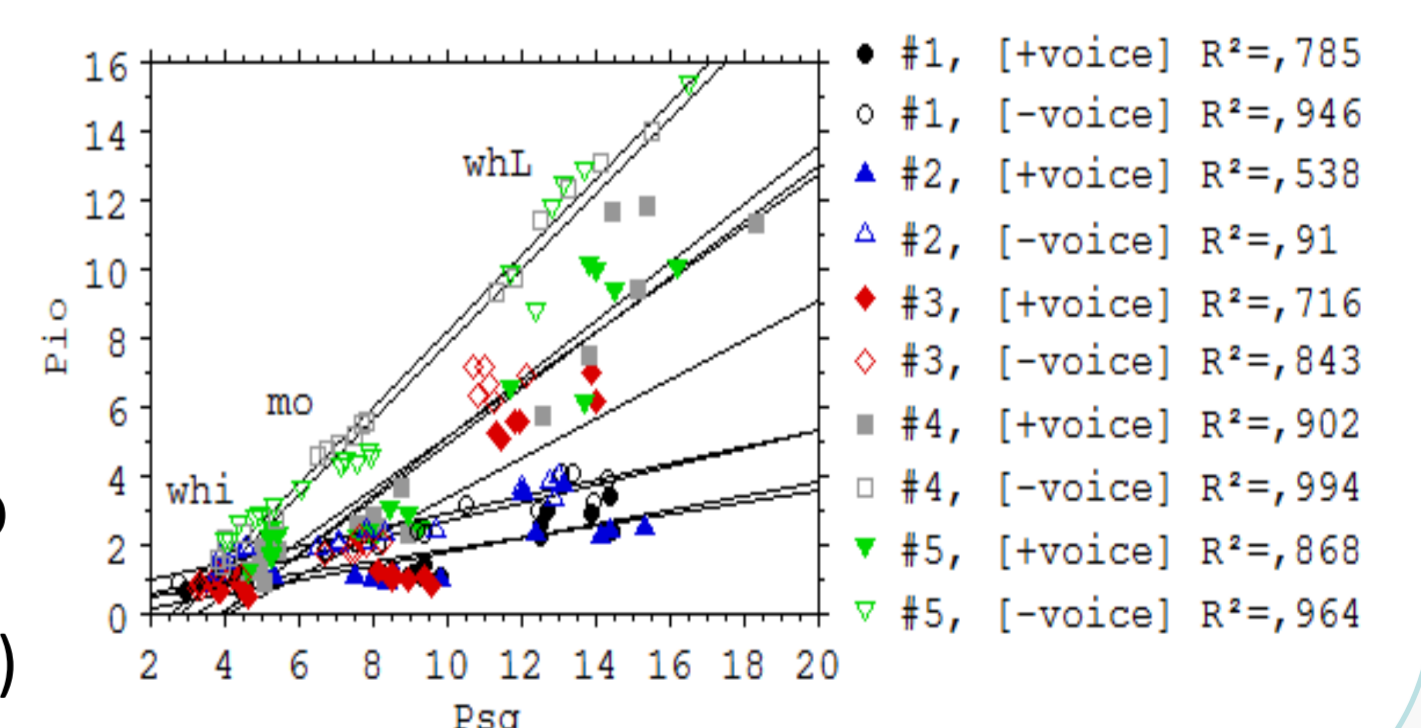
Pio as unstable echo of voicing

too variable in loud whisper

modal: high ΔR_{glo} > high ΔP_{io}

whisper: low ΔR_{glo} > variable ΔP_{io}

highly supported by Psg (correlations)



Conclusion

In French, with or without vocal fold vibration, the **[±voice]** contrast is **essentially controlled by the size of the glottis alone**, estimated by the resistance to the lung airflow.

The **[+voice]** feature is phonetically associated with a **narrow laryngeal area producing the acoustic source**: periodic by adduction or noisy by constriction.

Pio seems only a **variable echo of the glottal and subglottal components**. The discrepancy between studies in whisper may come from the experimentally uncontrolled vocal effort.