

INTRODUCTION

RESULTS

Language production errors affecting speech sounds in aphasic patients → phonetic or phonological origin?

Problem in classical literature and in clinical assessment of these errors :

Distinction between phonological and phonetic paraphasias is generally based on perceptual analyses → could be influenced by the experimenter's perceptual system and/or expectations (Marczyk & Baqué, 2013).

Our approach : Acoustic analyses of the productions of aphasic patients.

Focus : Voice onset time (VOT) in stop consonants

✓ Major cue for implementing the voicing contrast in French and many other languages (Cho & Ladefoged, 1999).

✓ Reliable cue of speech motor control that may be affected in patients with phonemic impairment (Laganaro, 2015).

Hypotheses (based on literature, e.g., Nespoulous et al., 2013; Marczyk & Baqué, 2013).

Phonetic deficit :

- Impairment : Difficulties to maintain voicing in voiced stop consonants.
- French voiced stops have a long and negative VOT → requires to maintain both voicing and supra-glottal closure.
- Expected acoustic observations : Partial or complete devoicing of voiced stops.

Phonological deficit :

- Impairment : Difficulties to select phonemes within the phonological system.
- Expected acoustic observations :
 - No clearly-established tendency in voicing errors
 - And/or phonemes substitution errors (changes of place of articulation)

METHOD

Participants

4 French-speaking aphasic patients with a left hemispheric ischemic stroke

Patient	Gender	Age	Fluency	Type of errors in picture description and naming tasks	Neuropsychological impairment	Hearing level (mean for both ears)	Lesion
IJ	F	44	Non fluent	Errors in phoneme realization Semantic paraphasias Omissions	short-term memory	19.37 dB	Fronto-parietal
CL	M	65	Non fluent	Errors in phoneme realization Semantic paraphasias Circumlocutions Omissions	Executive	27.19 dB	Fronto-temporal
TM	M	62	Non fluent	Errors in phoneme realization Semantic paraphasias Circumlocutions Omissions	Executive and short-term memory	18.75 dB	Fronto-parietal
BD		72	Non fluent	Errors in phoneme realization Semantic paraphasias Omissions	Executive and short-term memory	42.50 dB	Parietal

+ Healthy control participants matched for age

IJ : 50-59 years (N=11)

CL, TM : 60-69 years (N=10)

BD : 70-79 years (N=8).

Experimental task



Repetition of 84 CVCV nonwords

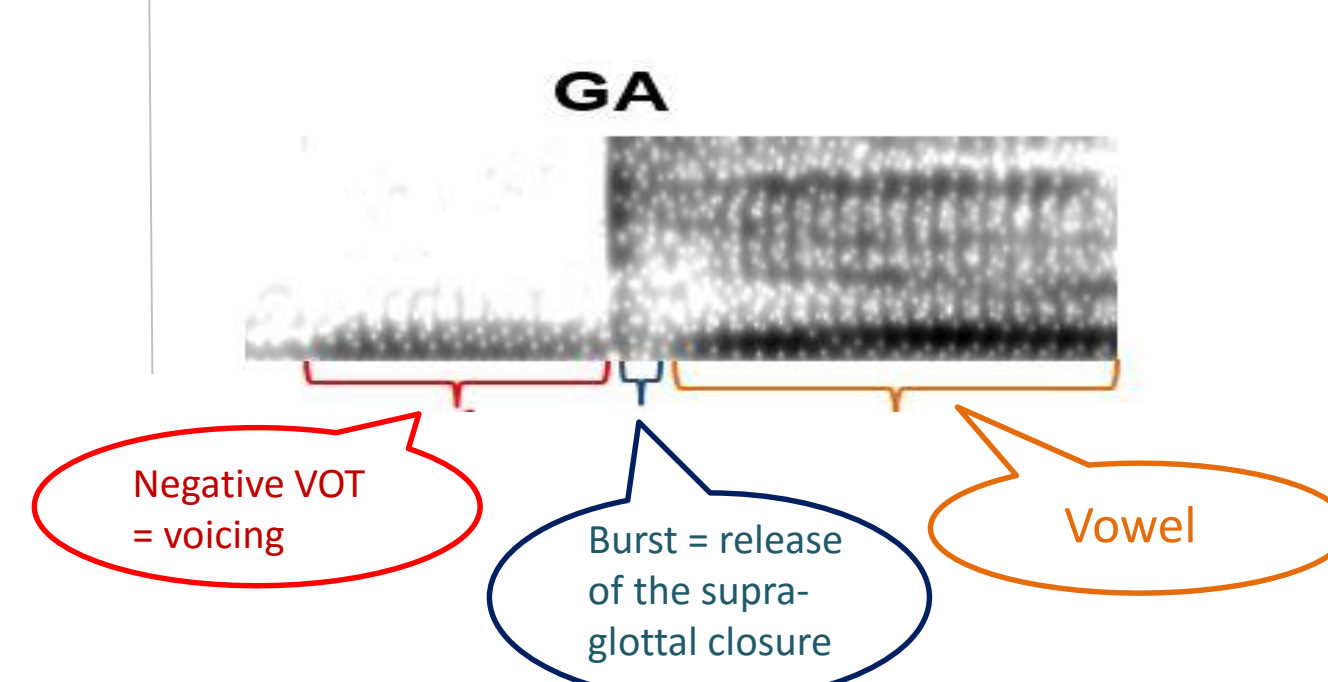
- C = 6 French stop consonants, voiced /b,d,g/ and voiceless /p,t,k/
- V = 3 French cardinal vowels /a,i,u/

Acoustic analyses

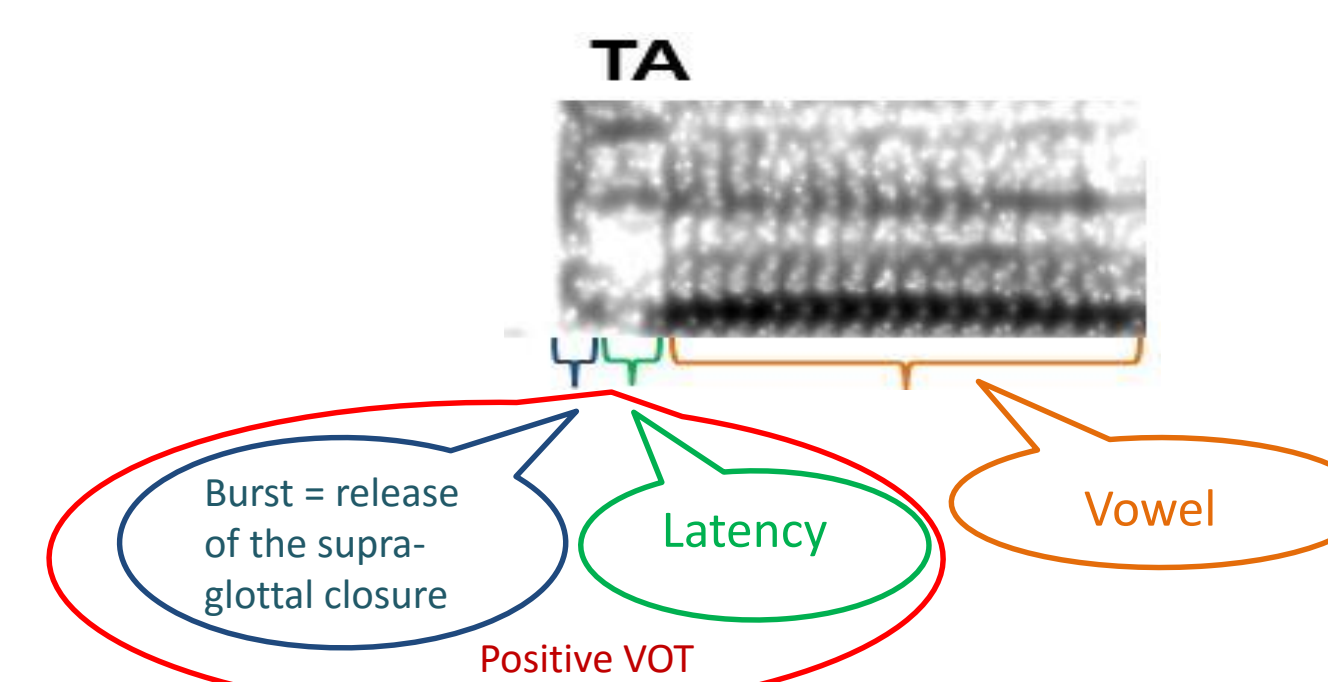
VOT duration for each stop consonant : time gap between the beginning of the burst and the onset of the voiced signal (Lisker & Abramson, 1964).

➢ Voicing is evidenced by the observation of periodicity in the spectrogram.

Example for a voiced stop consonant

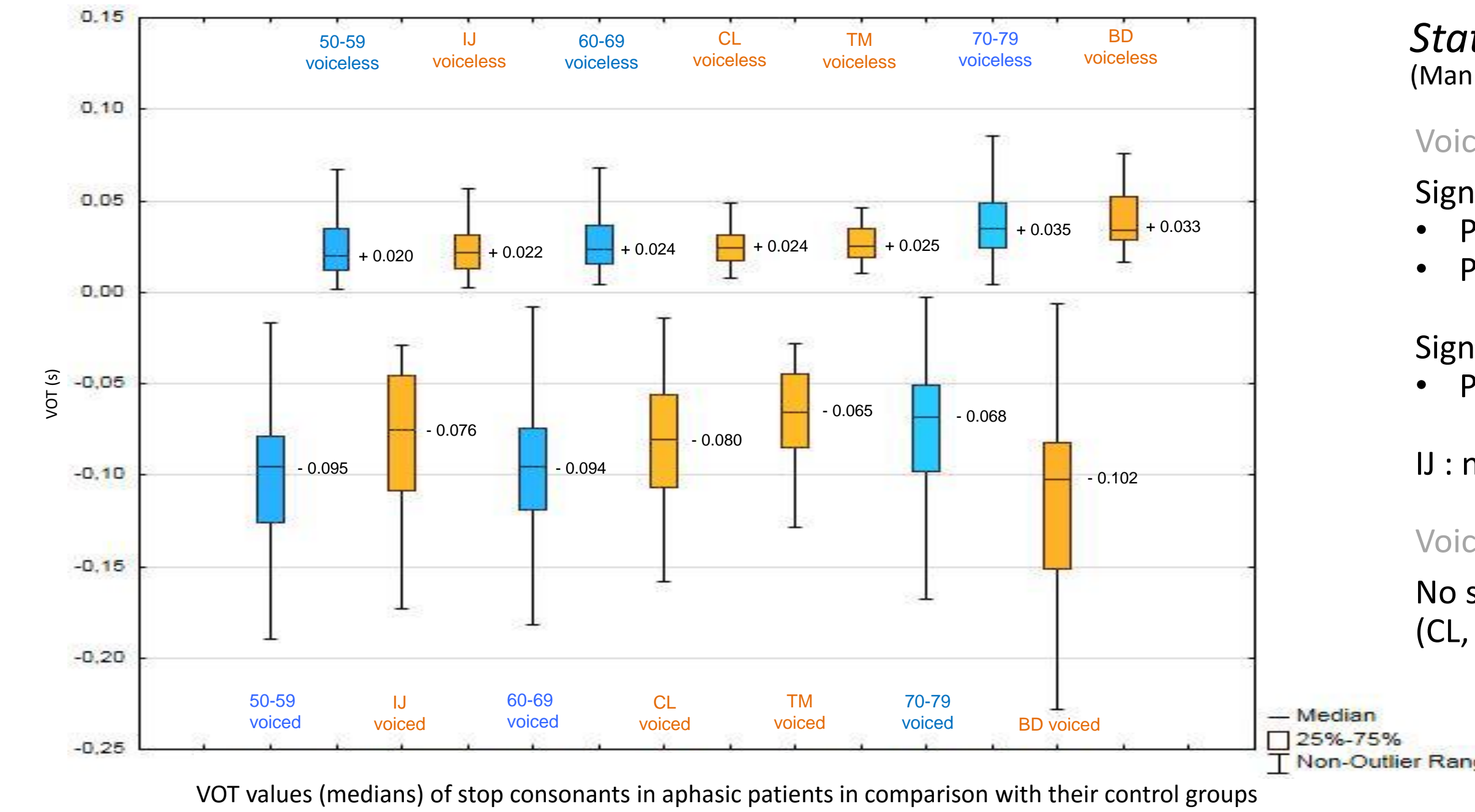


Example for a voiceless stop consonant



VOT values of stop consonants : correct productions only

Complete voicing and devoicing errors, changes of place of articulation, changes of manner of articulation are excluded.



Statistical analyses

(Mann-Whitney U tests between each patient and his control group)

Voiced stops

Significant shorter VOT values

• Patient CL (U = 8210.5, p = .02)

• Patient TM (U = 4119, p < .001)

Significant longer VOT values

• Patient BD (U = 2711, p < .001) + important variability

IJ : non significant, U = 1696, ns

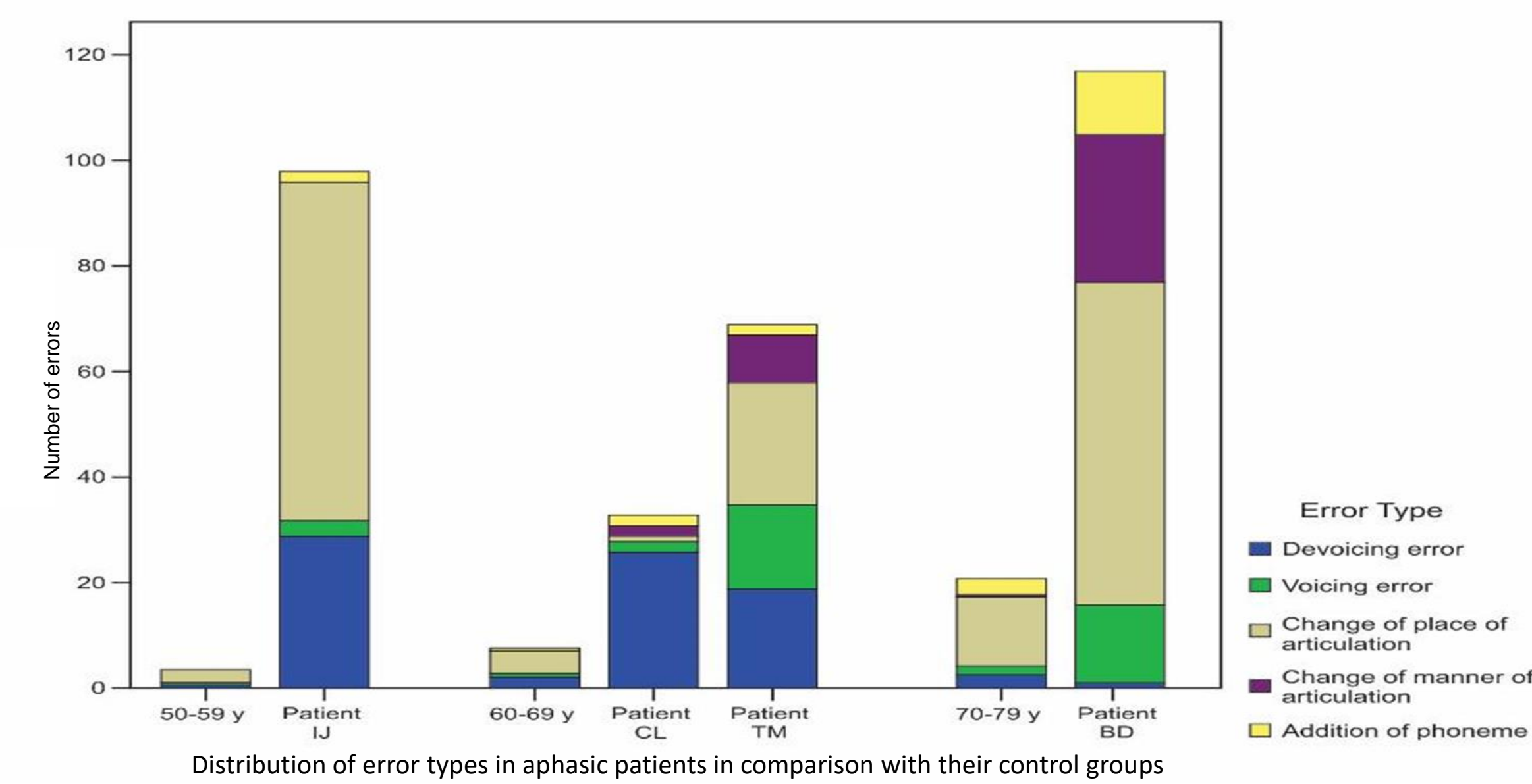
Voiceless stops

No significant differences

(CL, U = 36733, ns – TM, U = 20113, ns – BD, U = 6293, ns – IJ, U = 27537, ns)

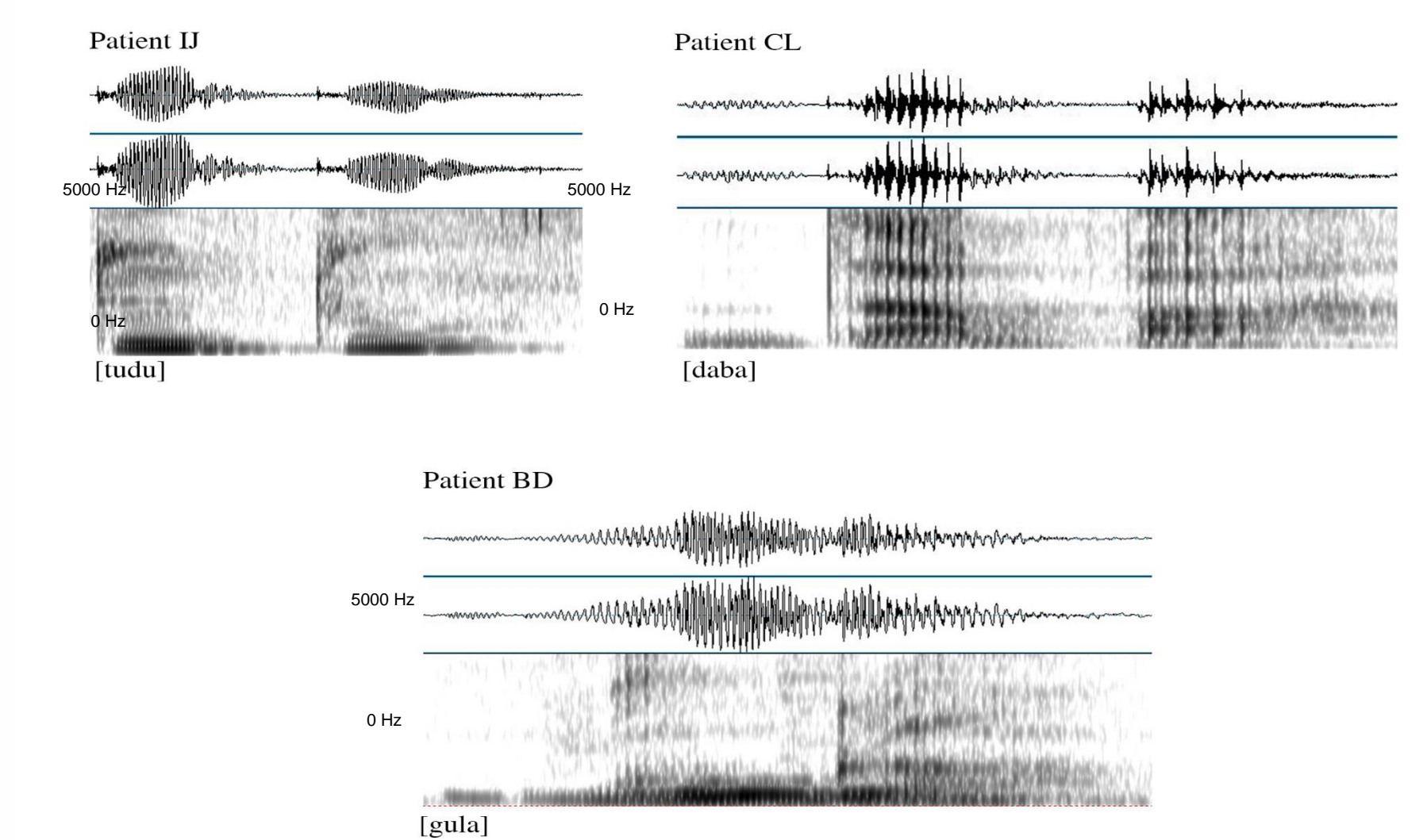
Distribution of error types

Error types analyzed : Complete devoicing of voiced stops, complete voicing of voiceless stops, changes of places of articulation, changes of manners of articulation, addition of phonemes



Other observations

Irregularities (including disruptions) of voiced consonants in IJ, CL and BD



DISCUSSION

	Phonetic impairment ?	Phonological impairment ?
IJ	<ul style="list-style-type: none"> • Devoicing errors > voicing errors • Stops of voicing 	<ul style="list-style-type: none"> • Changes of places of articulation • ... But mainly /t,d/ → [k] : difficulties to raise the tongue?
CL	<ul style="list-style-type: none"> • Devoicing errors > voicing errors • Shorter negative VOT values • Stops of voicing 	
TM	<ul style="list-style-type: none"> • Shorter negative VOT values 	<ul style="list-style-type: none"> • Voicing errors ≈ devoicing errors • Changes of places & manners of articulation
BD	<ul style="list-style-type: none"> • Important variability of negative VOT values • Stops of voicing 	<ul style="list-style-type: none"> • Voicing error > devoicing error • Changes of places & manners of articulation

Interest of acoustic measures to distinguish between phonetic and phonological impairment

➢ Shorter negative VOT values in some patients : confirm the hypothesis of difficulties to maintain voicing and supra-glottal closure.

But... No clear-cut dichotomy between both deficits

➢ Non homogeneous characteristics of phonetic and phonological impairment across patients

➢ Possibilities of mixed deficits

➢ Compensatory strategies used by some patients ?

➢ Influence of other deficits on the patients' errors such as their executive impairment (TM & BD)

References: Cho, T. & Ladefoged, P. (1999). Variation and universals in VOT: Evidence from 18 languages. *Journal of Phonetics*, 27, 207-229. - Lisker, L., & Abramson, A. S. (1964). A cross-language study of voicing in initial stops: Acoustical measurements. *Word*, 20, 384-422. - Marczyk, A., & Baqué, L. (2013). De l'origine des erreurs de substitution consonantique chez les patients aphasiques hispanophones : une étude acoustique. *Recherches en Parole : La voix et la parole perturbées, Travaux en Phonétique Clinique*, 1(1), 157-170. - Laganaro, M. (2015). Paraphasias phonémiques et/ou phonétiques ? Des raisons et des difficultés de cette distinction. *Revue de neuropsychologie*, 7, 27-32. - Nespoulous, J.-L., Baqué, L., Rosas, A., Marczyk, A., & Estrada, M. (2013). Aphasia, phonological and éphonetic voicing within the consonantal system: preservation of phonological oppositions and compensatory strategies. *Language Sciences*, 39, 117-125.

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