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INTRODUCTION

Parkinson's disease (PD) may come with speech motor control disorders: **Hypokinetic dysarthria**. Within dysarthric disorders, imprecision of consonant and vowel production is well documented, in particular for moderate dysarthric PD (e.g. Dias *et al.*, 2016 ; Duez & Ghio, 2020, Martel-Sauvageau *et al.*, 2015 ; Martel-Sauvageau & Tjaden, 2017).

The most commonly used acoustic metric to study imprecision of vowel production is the triangular vowel space area (tVSA) but some authors consider that tVSA is insensitive to mild and moderate forms of dysarthria (Neel, 2008 ; Skodda *et al.*, 2011). An improved understanding of these impairments in mild dysarthria AND non-dysarthric PD may help detect speech deteriorations at early stages of the disease.

Aims of the study :

To analyze the production of oral vowels in PD patients WITHOUT hypokinetic dysarthria compared with PD patients suffering from dysarthric PD (mild – moderate – severe) and with control speakers using acoustic metrics AND

To identify an acoustic metric which is sensitive to early, subclinical alterations in non-dysarthric PD

PARTICIPANTS

98 French-speaking participants (63 participants with PD* – 35 control speakers), divided in three groups:

Dysarthric PD**	Non dysarthric PD**	Control speakers
43 patients (25M, 18F) 44-84 years (mean: 70)	20 patients (11 M, 9F) 38-85 years (mean: 69)	35 healthy controls (19 M, 16F) 41-84 years (mean: 66)
Disease duration : 1 – 24 years Stage of PD (Hoehn & Yahr) : 1-5	Disease duration : 2 – 19 years Stage of PD (Hoehn & Yahr) : 0-3	/

*Diagnosis of PD according to the UK Parkinson's Disease Society brain bank criteria
** following expert perceptual assessment

METHOD



Speech production task

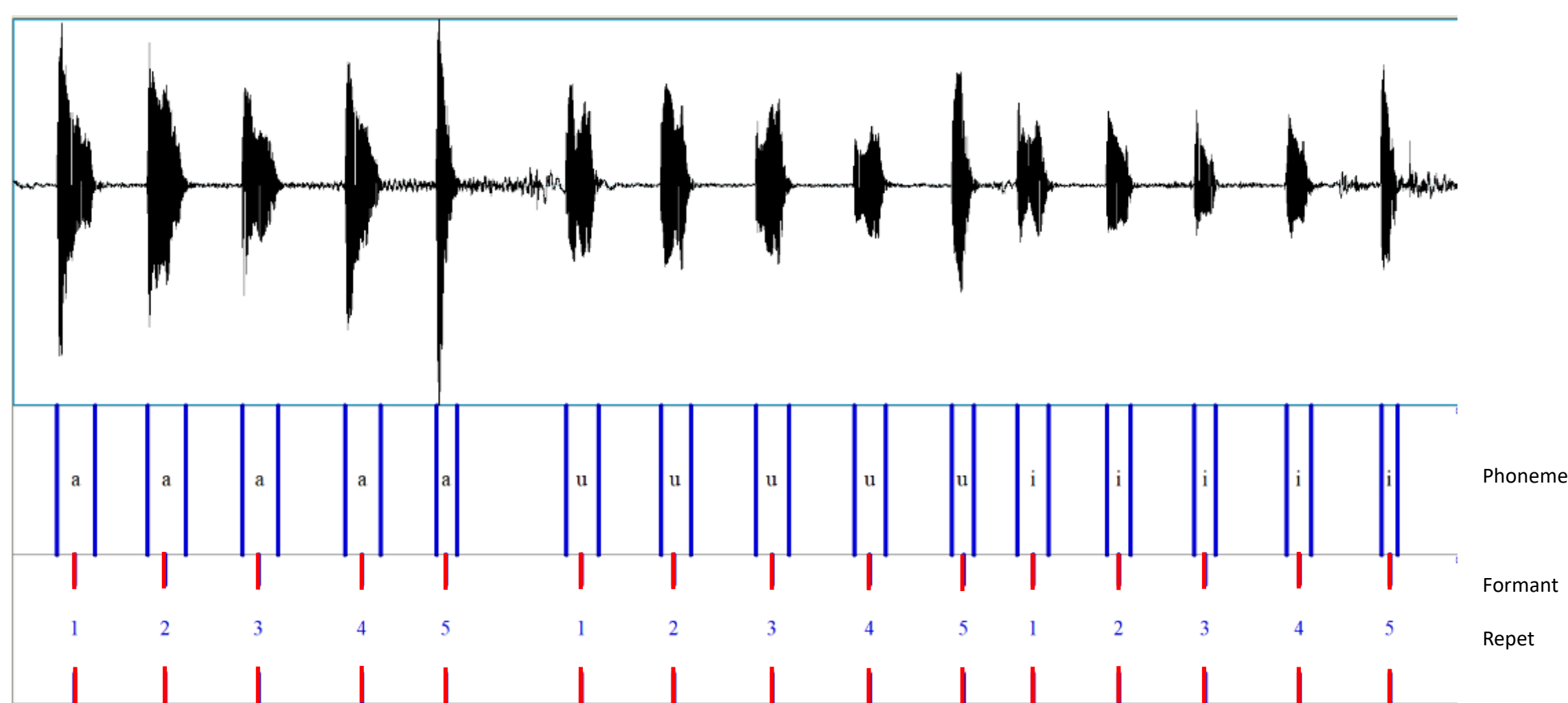
- Production of oral vowels [a, i, u] in isolation
- Production of V1_{a,i,u}Glide_wV2_{a,i,u} pseudo-words
- Picture description
- Repetition of CVCVCV pseudo-words

Focus here



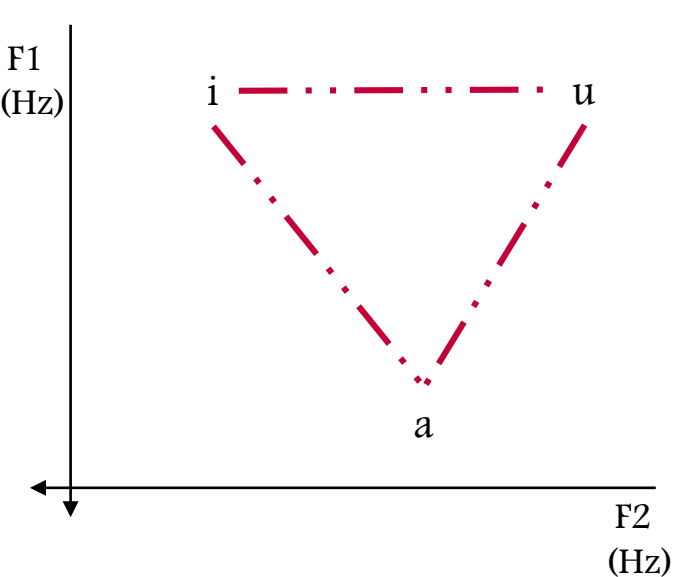
Acoustic analyses

Formant frequencies (F1-F2) : measured from the stable part of each vowel
5 * each vowel * 98 participants => 1.470 vowels

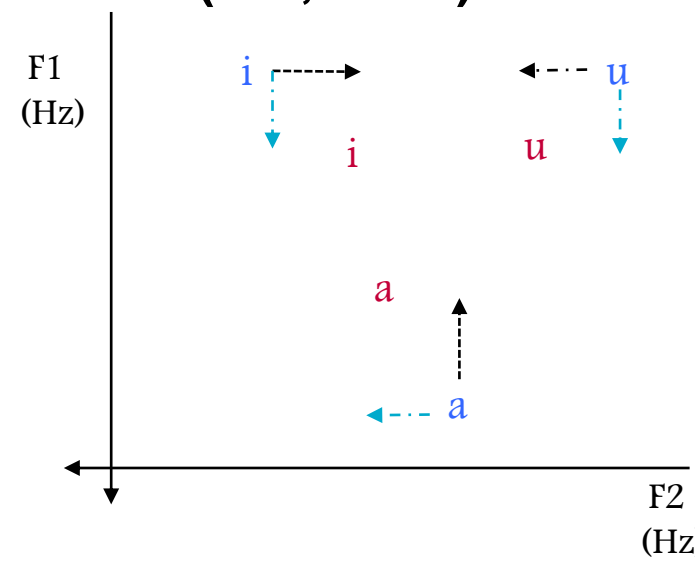


Acoustic metrics

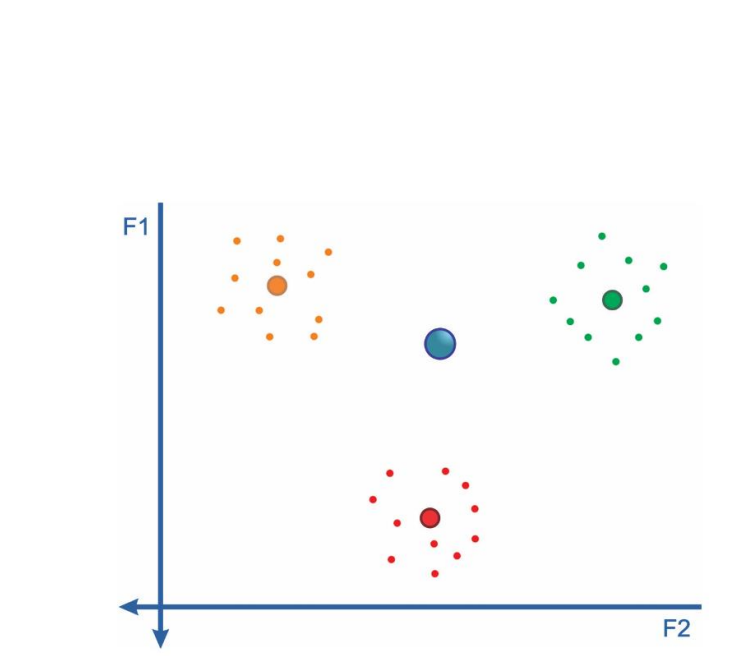
Triangular vowel space area (tVSA, in Hz²)



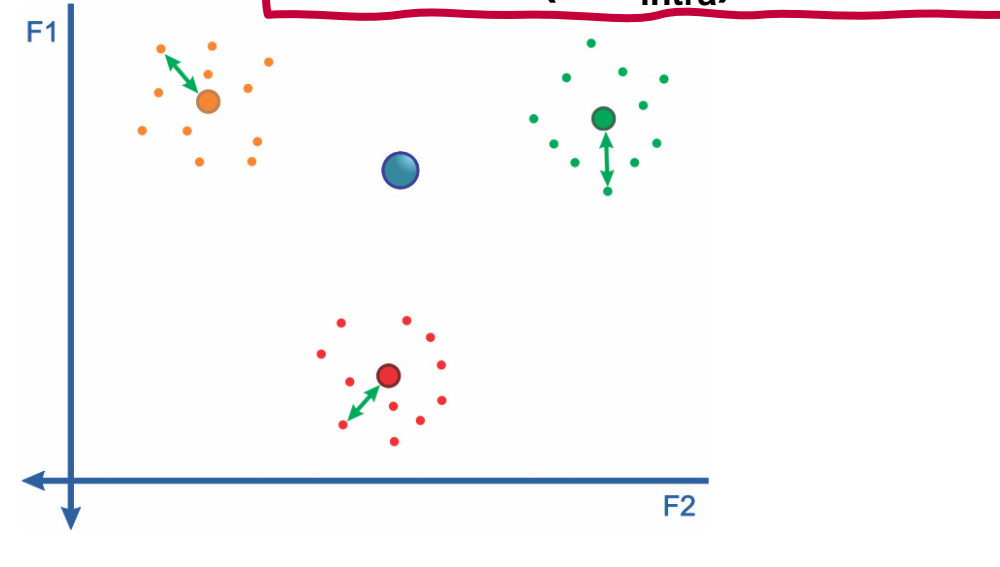
Vowel articulation index (VAI, in Hz)



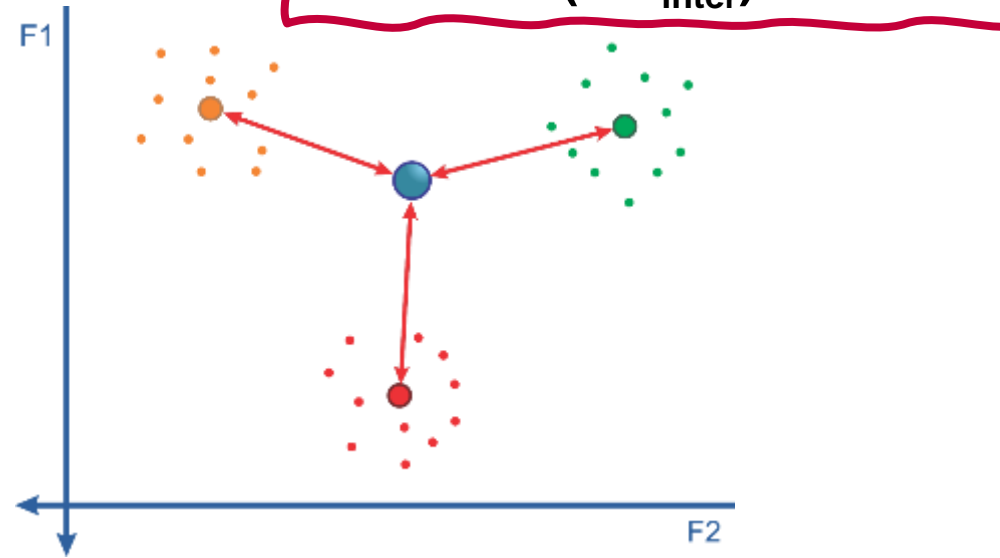
Phi index (PHI, in Hz)



Intra-categorical dispersion (CM_{intra})



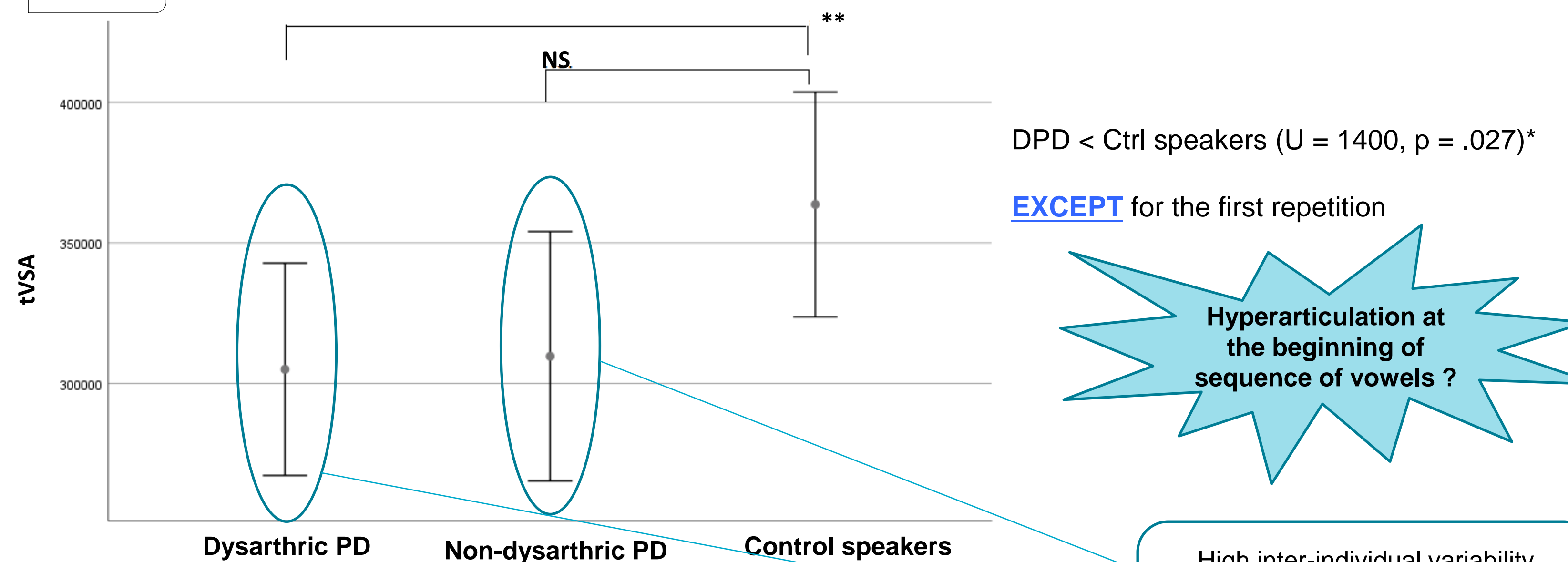
Inter-categorical dispersion (CM_{inter})



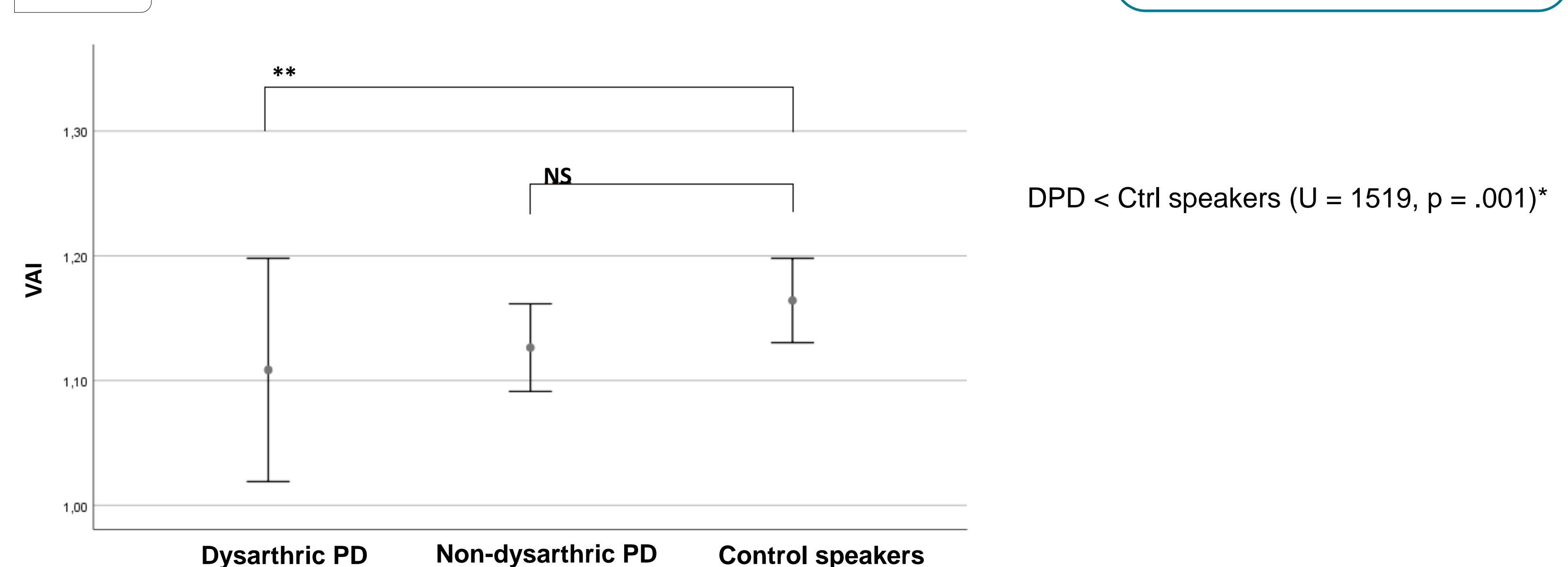
$$\Phi = \frac{CM_{inter}}{CM_{intra}} \gg \Phi = \frac{CM_{inter}}{CM_{intra}}$$

RESULTS

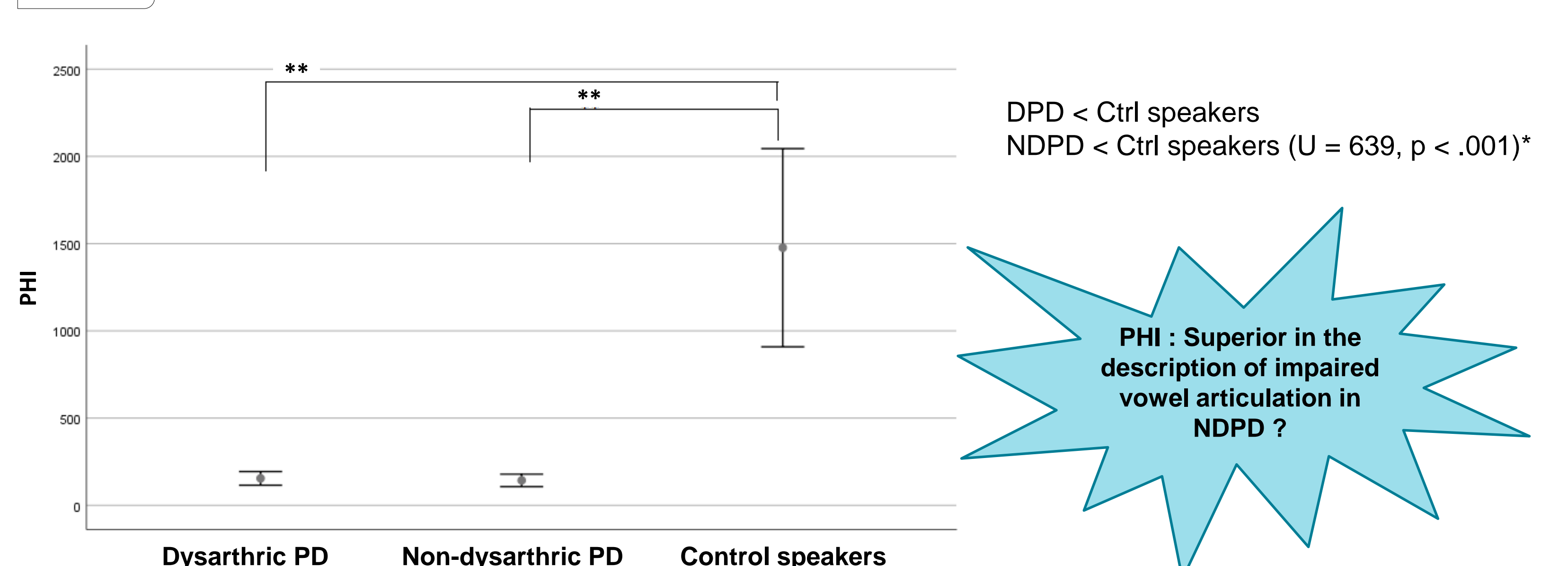
tVSA



VAI



PHI



*Mann-Whitney U test

DISCUSSION

Our acoustic analysis suggests that among the 3 metrics, the PHI index (Huet & Harmegnies, 2000) is the only one which is sensitive to early, subclinical differences in vowel articulation between non-dysarthric PD patients and healthy control speakers

* the total vowel acoustic space/articulatory range is not significantly reduced

BUT

* the internal organization of the vocalic system is significantly reduced for non-dysarthric PD patients compared to control speakers in particular, **intra-categorical dispersion** is significantly higher in non-dysarthric PD patients → larger **imprecision** in vowel production

Reduced PHI was measured in Parkinsonian speakers without dysarthria
The PHI index could be applicable to identify subclinical changes in vowel articulation

Further investigations :

Acoustic analysis based on a picture-description task :

* extraction of vowels /a, i, u/

* formant frequencies (F1-F2) : to confirm results for the PHI index in non-dysarthric PD

