

# The impact of levodopa on acoustic parameters of prominence marking and tongue body movements in patients with Parkinson's disease

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## Background

### Parkinson's disease (PD)

- neurodegenerative disorder
- affects motor and non-motor functions

### Gross motor symptoms

- smaller, slower, less extended movements
- tremor, rigidity

### Speech symptoms (hypokinetic dysarthria) [1,2]

- quiet, monotone, slurred speech
- reduced vowel space, slower articulation rate

### Dopaminergic medication (levodopa)

- effective treatment for gross motor symptoms
- but unclear how it affects speech

## Methods

### Motor Assessment

- rating motor symptoms in med-OFF and med-ON condition using standard motor test (UPDRS III) [3]: the higher the score, the higher the impairment

### Speech recordings (med-OFF/med-ON)

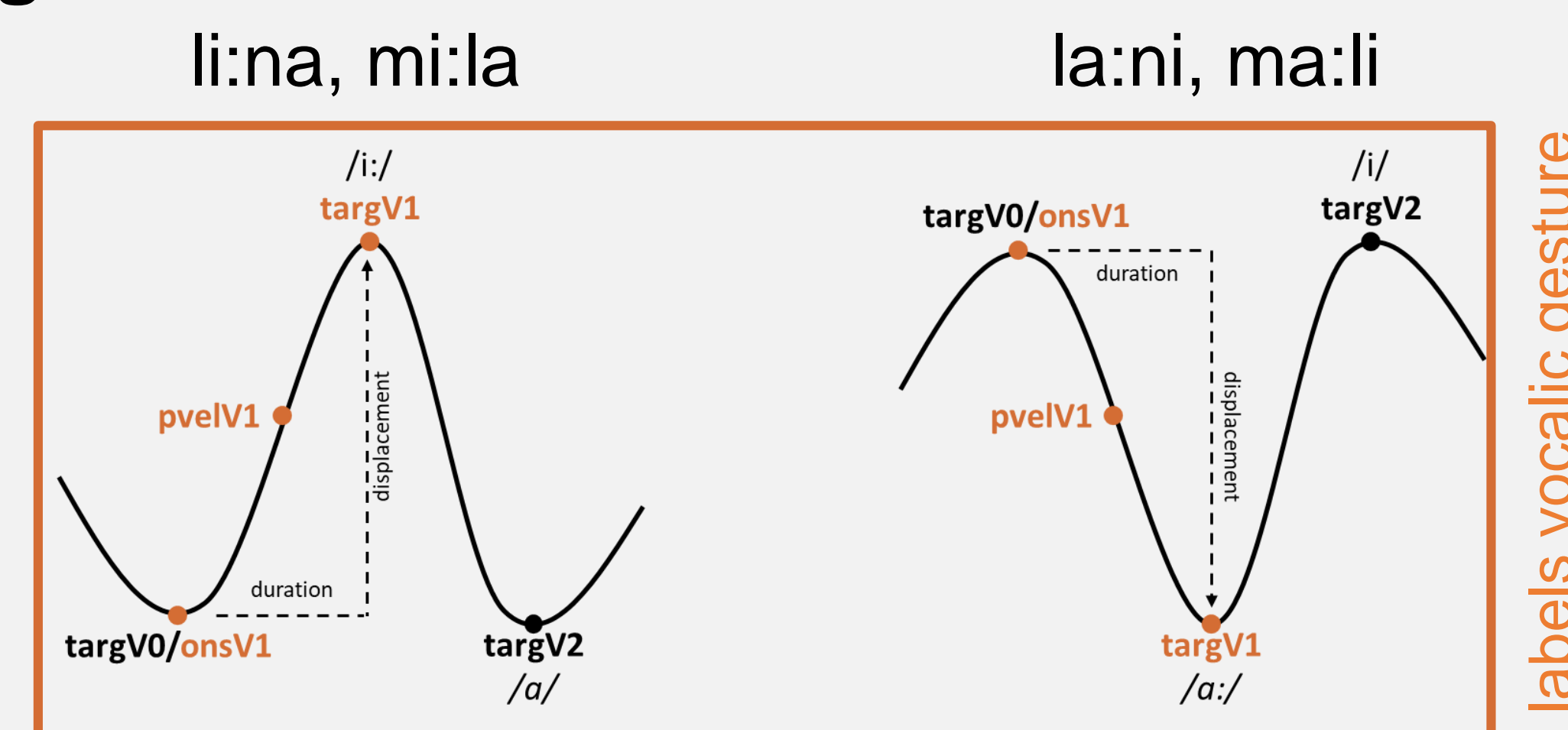
- 3D Electromagnetic Articulograph (AG 501) to track tongue dorsum movements during vowel production
- Acoustic measures: Tonal height (F0) of rising pitch accents, intensity, syllable duration (articulation rate)

## Patients Characteristics

| patient | age | gender | PD duration (years) | UPDRS III med-OFF | UPDRS III med-ON | Dopa response (%) |
|---------|-----|--------|---------------------|-------------------|------------------|-------------------|
| PD01    | 53  | m      | 4                   | 45                | 24               | 47                |
| PD02    | 54  | m      | 6                   | 44                | 27               | 38                |
| PD03    | 58  | m      | 2                   | 20                | 11               | 45                |
| PD04    | 52  | f      | 6                   | 41                | 20               | 51                |
| PD05    | 56  | f      | 6                   | 45                | 29               | 36                |
| PD06    | 70  | f      | 20                  | 27                | 14               | 48                |

## Speech Material

### Target Words

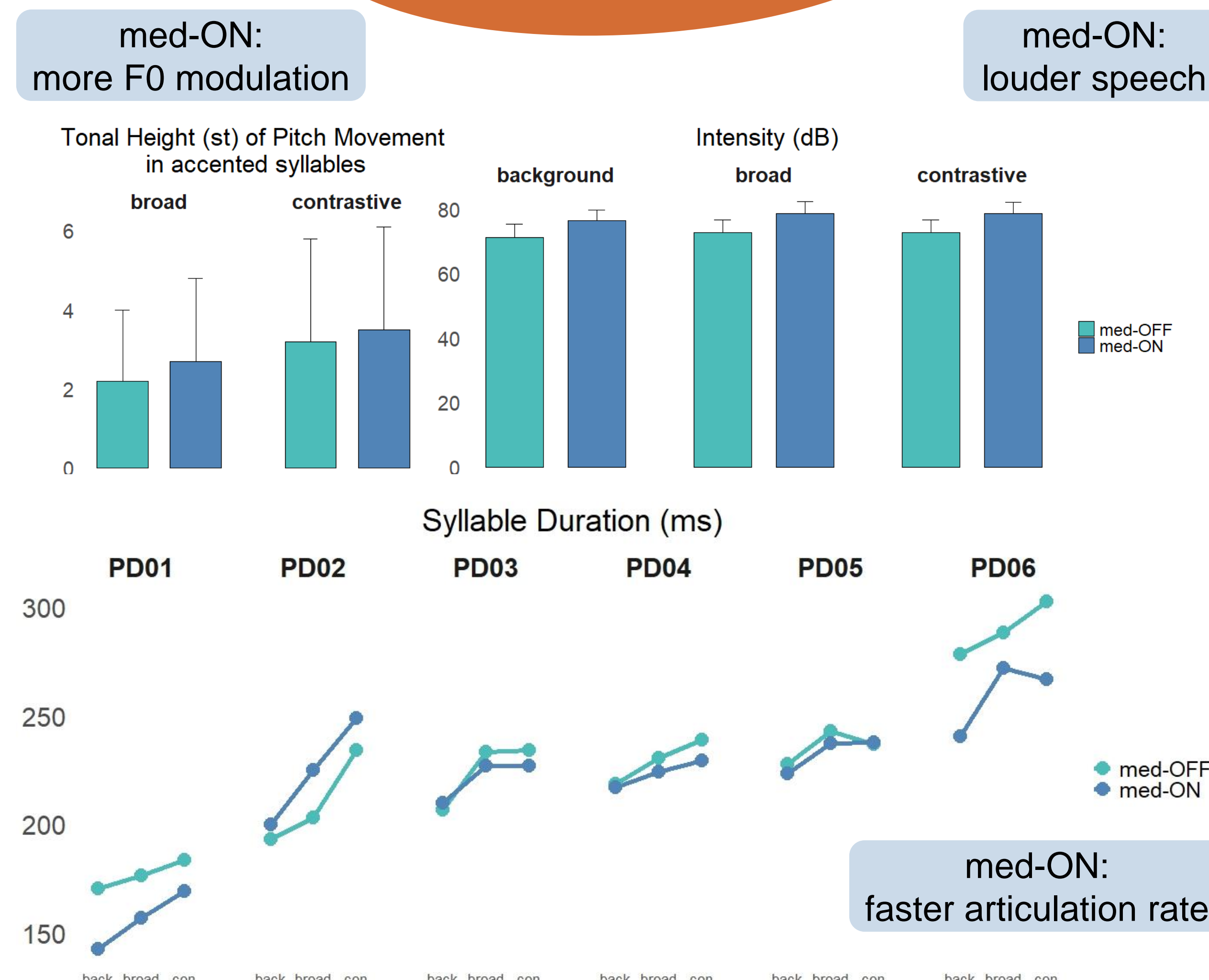


### Question-Answer-Scenario

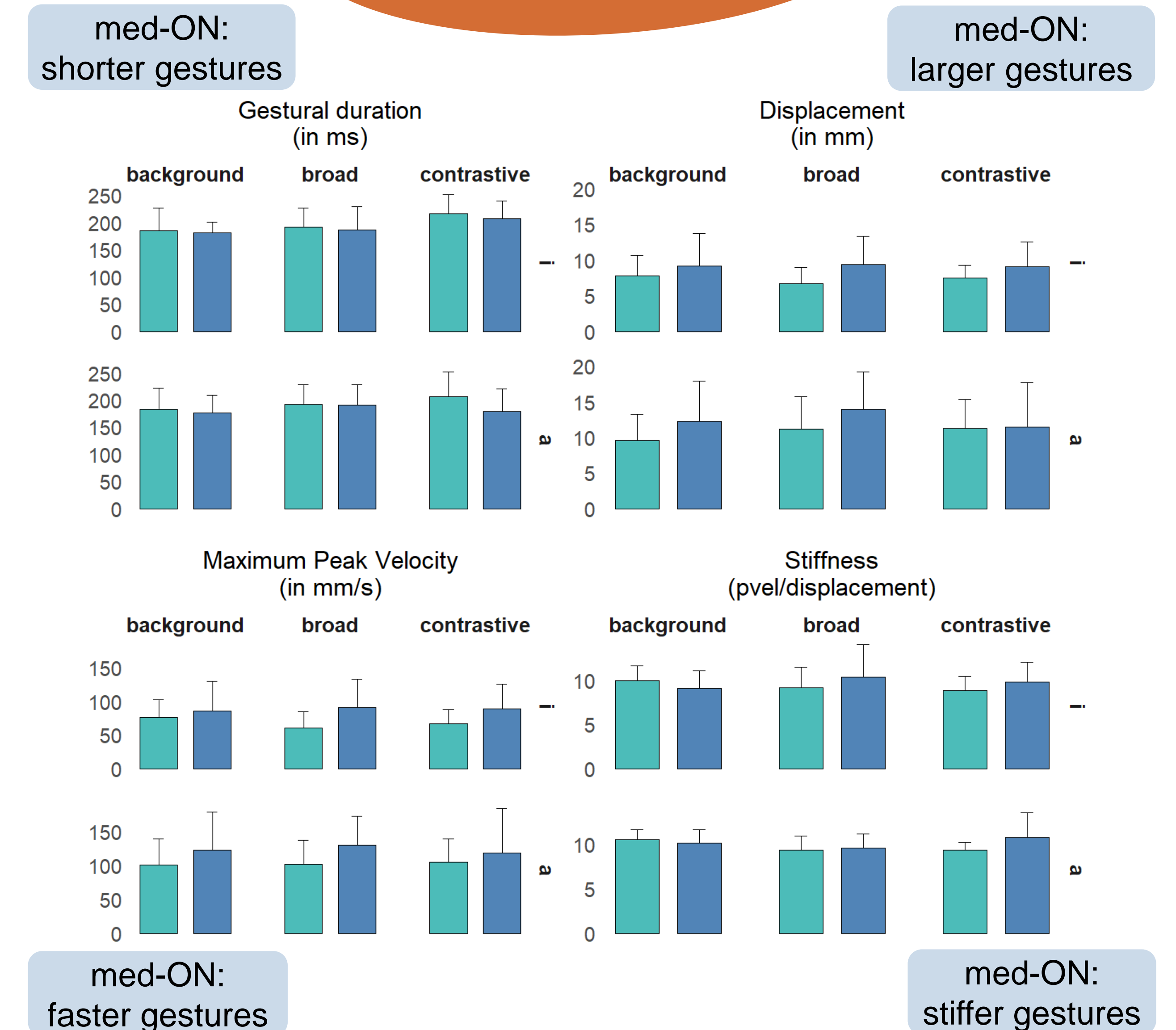
- Elicitation of focus structure: background (*unaccented*) < broad focus (*accented*) < contrastive focus (*accented*)

increasing prominence / phonetic parameter modulation

## Acoustics



## Articulation



## Levodopa influences speech

PD patients ability to speak improves in med-ON: faster articulation rates, louder, higher pitch range & longer, faster, larger tongue body movements

PD patients can mark prominence with and without medication – but different strategies are used:

- phonetic modulations are more efficient in med-ON: hyperarticulation of all phonetic parameters to express prominence
- in med-OFF PD patients use a mixture of hyper- and hypoarticulation: no modulation of intensity, but modulation of F0 and durations

[1] Duffy, J. R. (2013). Motor Speech disorders: Substrates, differential diagnosis, and management. Elsevier Health Sciences. [2] Thies, T. et al. (2020). Prominence marking in parkinsonian speech and its correlation with motor performance and cognitive abilities. *Neuropsychologia*, 137(3), 107306. [3] Goetz, C. G., & the Movement Disorder Society Task Force on Rating Scales for Parkinson's Disease (2008). Movement Disorder Society-sponsored revision of the Unified Parkinson's Disease Rating Scale: Scale presentation and clinimetric testing results. *Movement Disorders*, 22, 2129-2170.