Levodopa response and acoustic parameters of prominence marking as well as tongue body movements in patients with Parkinson's disease

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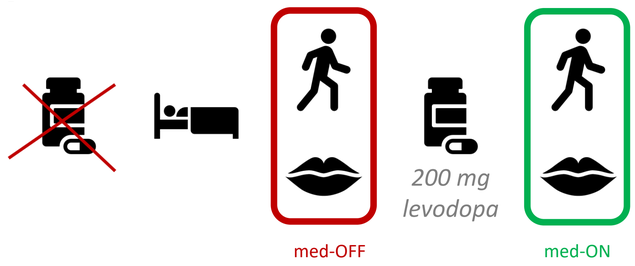
Background

- Parkinson's Disease affects non-motor and motor functions
- Slower, smaller and less extended movements of limbs and oral articulators
- The drug 'levodopa' improves gross motor skills [1], but unclear if it also influences speech motor control

Does Levodopa influences speech production?

Method

- 12 Patients with Parkinson's disease
- Rating motor ability using standard assessment [2]
- Speech Recordings with an Electromagnetic Articulograph



Measurements

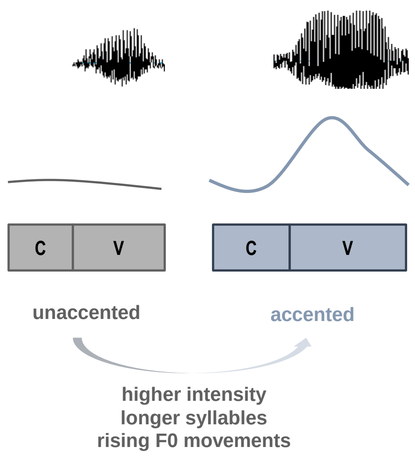
Levodopa Response

$$\frac{Motor\ Rating_{med-ON} - Motor\ Rating_{med-OFF}}{Motor\ Rating_{med-OFF}}\ x\ 100$$

Intensity

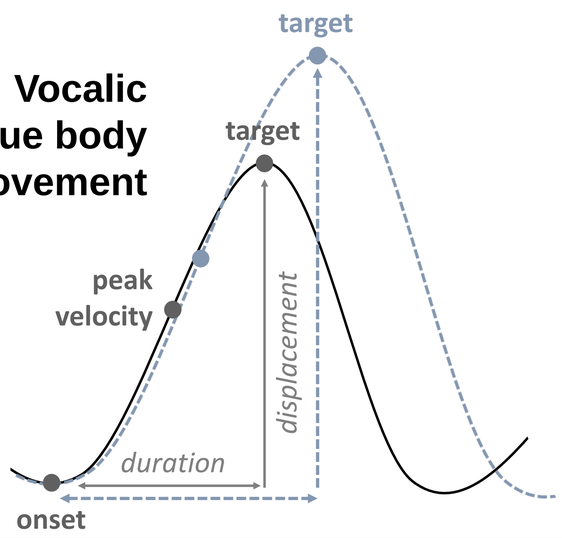
F0

Syllable duration



background < broad focus < contrastive focus

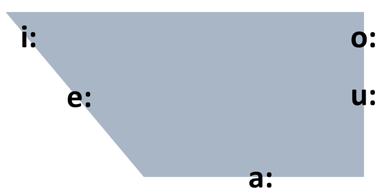
Vocalic tongue body movement



Speech Material

- Speech Production Task: Question-Answer-Scenario to elicit different degrees of prominence
- disyllabic target words containing one of five cardinal vowels

Vowel Space



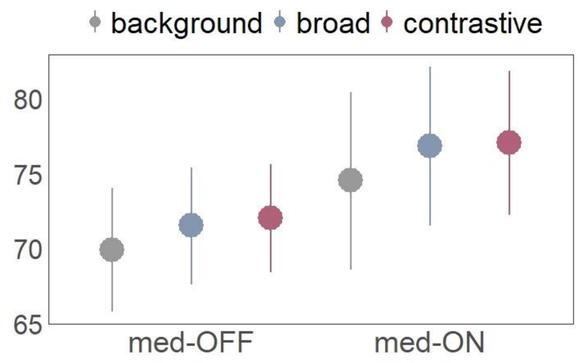
Levodopa Response

- 10 out of 12 patients responded to levodopa intake
- 42.5 % motor improvement
- Levodopa influences speech production – in med-ON:

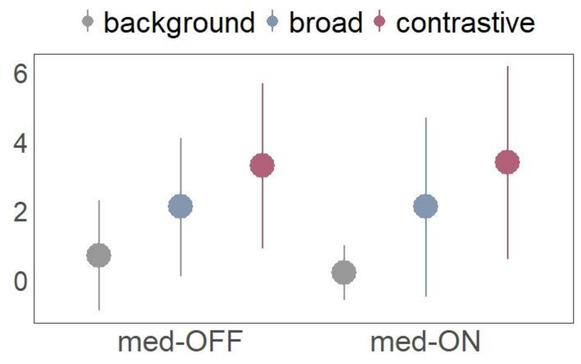
louder speaking style
faster tongue body movements
in less time

Acoustic

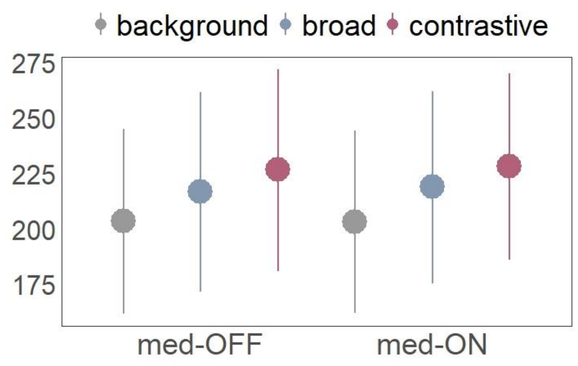
Intensity (dB)



Tonal height (st) of F0 movement

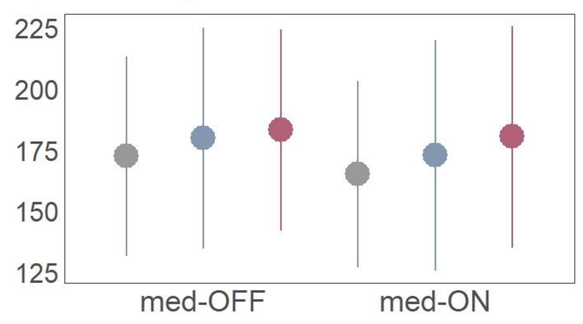


Syllable Duration (ms)

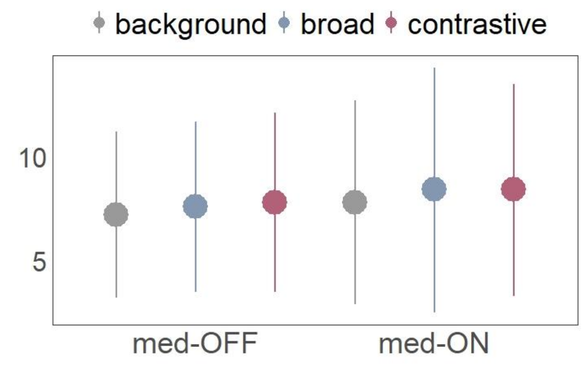


Articulation

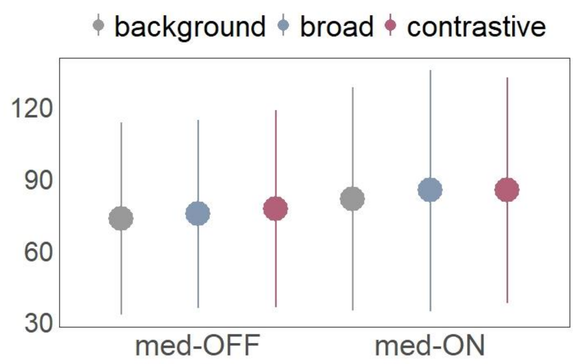
Vocalic Gesture Duration (ms)



Displacement (mm)



Peak velocity (mm/s)



Prominence Marking

- Patients keep prominence relations in the acoustic [3] and articulatory dimension.
- With increasing prominence:
  - prolonged and louder target syllables, higher F0 peaks
  - longer and larger tongue body movements during vowel production

Bewegungsstörungen und Tiefe Hirnstimulation
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References: [1] Katzenschlager, R., & Lees, A. J. (2002). Treatment of Parkinson's disease: levodopa as the first choice. Journal of neurology, 249(2), ii19-ii24.; [2] 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.; [3] Thies, T., Mücke, D., Lowit, A., Kalbe, E., Steffen, J., & Barbe, M. T. (2020). Prominence marking in parkinsonian speech and its correlation with motor performance and cognitive abilities. Neuropsychologia, 137, 107306.

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