Prosodic Prominence in Parkinsonian Speech: A dynamical approach

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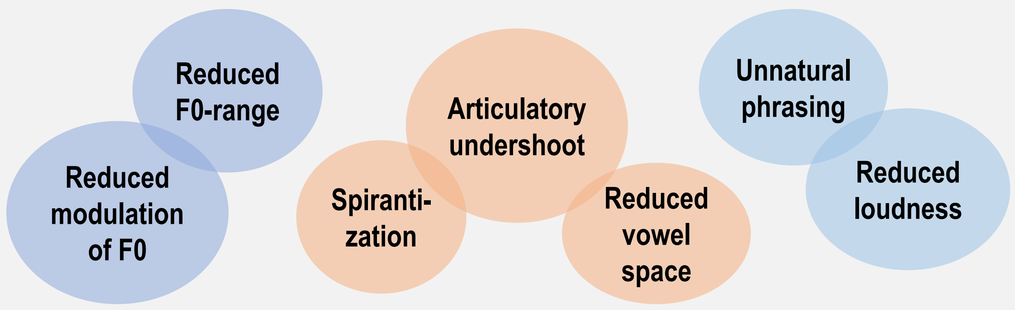
Morbus Parkinson

- Neurodegenerative disorder of the nervous system
- Progressive death of dopaminergic cells in the brain
- Problems with motor and non-motor functions [3, 6, 7]

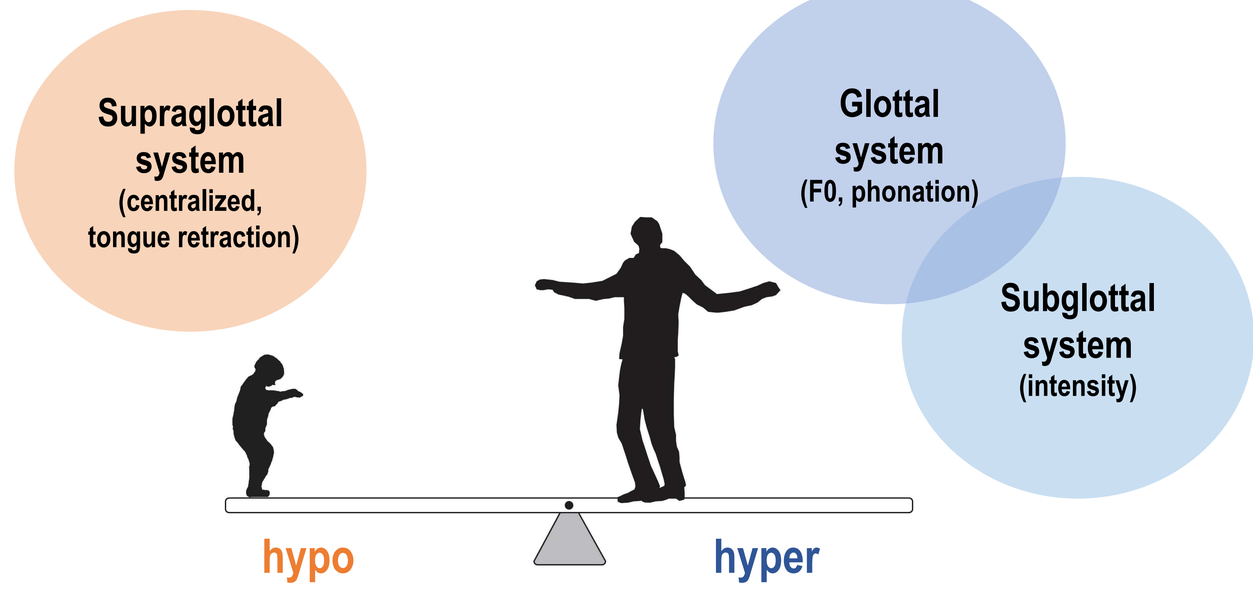
- **Motor:** rigidity, tremor, bradykinesia, postural instability
- **Cognition:** executive functions, cognitive flexibility, memory, attention
- **Speech:** signs related to Hypokinetic Dysarthria [1, 2, 5, 6, 7]



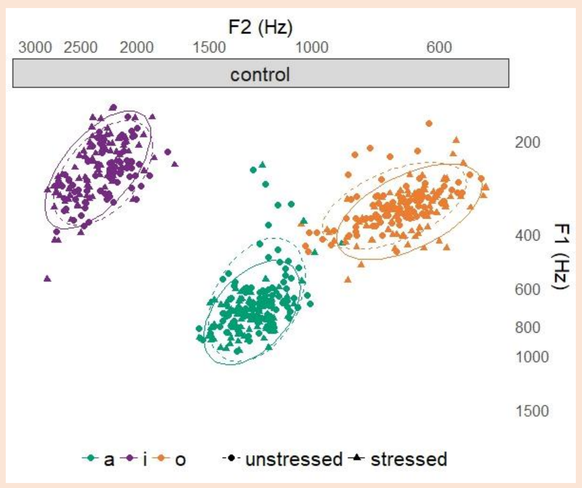
How does the Parkinson's disease affect prosodic prominence?

Discussion: Regulation Strategies in a Dynamical System

Hyper- and Hypoarticulation [4]

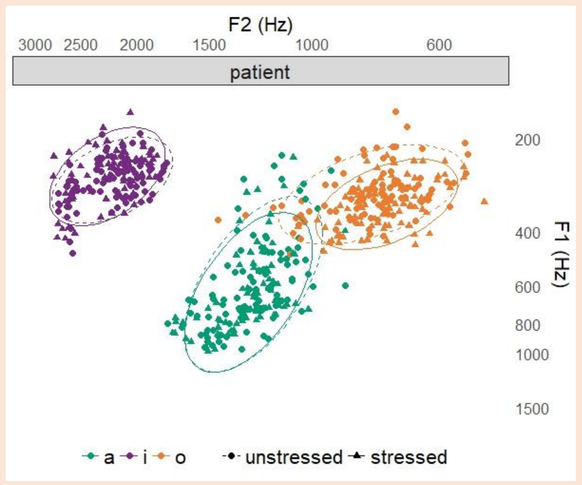


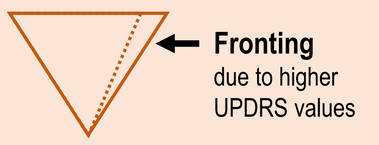
Supraglottal System



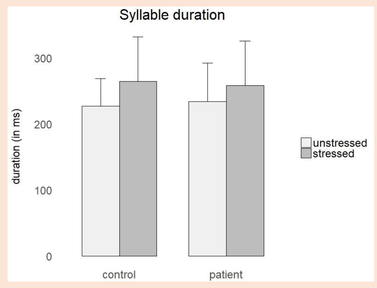
	control	patient
F2 /i/	2354 Hz	2269 Hz
F2 /o/	677 Hz	748 Hz
F1 /a/	735 Hz	657 Hz

Motor impairment (UPDRS) correlates with the patients' tongue retraction for /o/ ($p = 0.0458$)

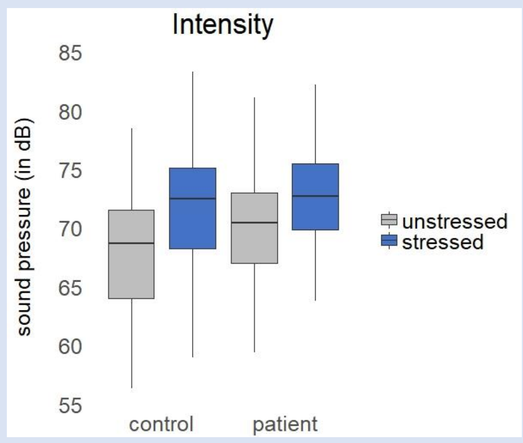




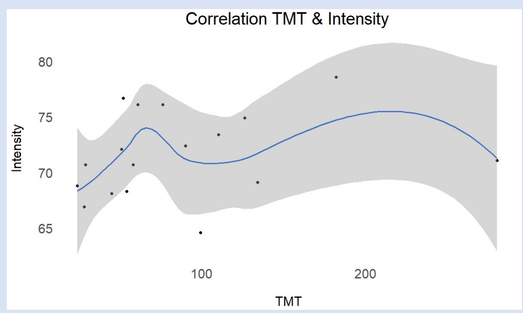
Fronting due to higher UPDRS values



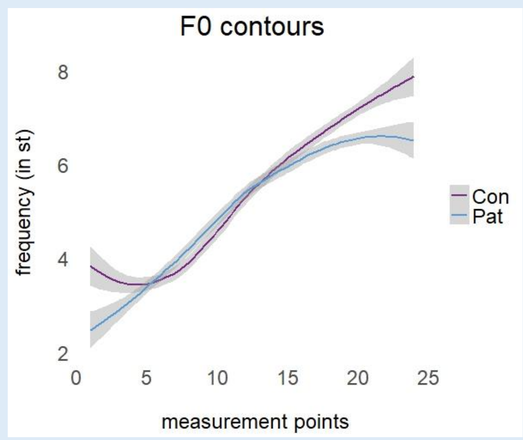
Subglottal System



Executive dysfunction (TMT) is associated with intensity overshoot ($p = 0.004422$)



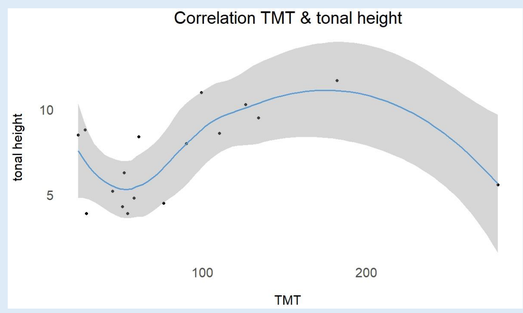
Glottal System



Executive dysfunction (TMT) is associated with tonal overshoot

F0-range ($p = 0.01811$)

tonal height ($p = 0.00808$)



Production Study

Participants

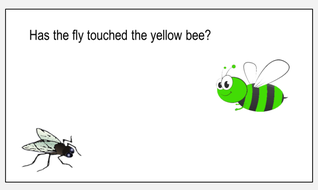
- 19 Patients with idiopathic Parkinson
  - 13 male, 6 female, aged 50 – 80 years
- 19 gender & age matched healthy controls

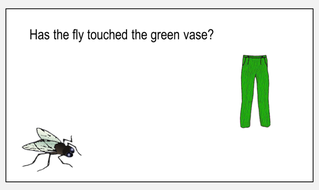
Assessments

- Motor: UPDRS III
- Cognition: TMT, BTA
- Speech: reading passage

Contrastive Focus Task

- Either noun or adjective in focus condition
- 1368 Tokens = 9 nouns x 2 adjectives x 38 speaker x 2 focus conditions





Conclusion

Patients

- mainly mild dysarthria
- part of the group show motor and executive dysfunctions
- could produce prosodic prominence (modulation of duration, intensity & F0)

The regulation of the dynamic speech system is not balanced (H&H model [4])

- patients have problems to control forces when highlighting prominent elements via intonational and articulatory cues
  - **undershoot:** reduced vowel space (supraglottal system)
  - **overshoot:** too much effort of the glottal and subglottal system

References

[1] Ackermann, H., & Ziegler, W. (1991). Articulatory deficits in parkinsonian dysarthria: an acoustic analysis. Journal of Neurology, Neurosurgery & Psychiatry, 54(12), 1093-1098. **[2]** Darley, F. L., Aronson, A. E., & Brown, J. R. (1969). Differential diagnostic patterns of dysarthria. Journal of Speech, Language, and Hearing Research, 12(2), 246-269. **[3]** Kalbe, E., Rehberg, S. P., Heber, I., Kronenbuerger, M., Schulz, J. B., Storch, A., et al. (2016). Subtypes of mild cognitive impairment in patients with Parkinson's disease: evidence from the LANDSCAPE study. J Neurol Neurosurg Psychiatry, 87, 1099-1105. **[4]** Lindblom, B. (1990). Explaining Phonetic Variation: A Sketch of the H&H Theory. In William J. Hardcastle & Alain Marchal (Hrsg.), Speech Production and Speech Modelling. Dordrecht: Springer Netherlands, 403–439. **[5]** Ramig, L. O., Sapir, S., Fox, C., & Countryman, S. (2001). Changes in vocal loudness following intensive voice treatment (LSVT®) in individuals with Parkinson's disease: A comparison with untreated patients and normal age-matched controls. Movement Disorders, 16(1), 79-83. **[6]** Skodda, S. (2015). Die Dysarthrie des Morbus Parkinson: Klinische Präsentation, pathophysiologische und diagnostische Aspekte. Sprache· Stimme· Gehör, 39(4), 182-186. **[7]** Ziegler, W., & Vogel, M. (2010). Dysarthrie: Verstehen, untersuchen, behandeln. Georg Thieme Verlag.