Dysarthria across languages in Parkinson’s disease

Serge PINTO
Laboratoire Parole et Langage
LPL - UMR 7309
serge.pinto@lpl-aix.fr

Ana Margarida NUNES
Department of Portuguese
University of Macau
ananunes@umac.mo
Rest tremor

Akinesia

Slowness of movement initiation (akinesia)
Slowness of movement execution (bradykinesia)
Reduction of movement amplitude (hypokinesia)

Hypertonia/Rigidity

Gait impairment

Postural instability
Freezing of gait
Hypomimia
Speech impairment
Hypersialorrhea
Micrographia
Orthostatic hypotension
Depression
Cognitive decline...
Impaired mesial frontal and putamen activation in Parkinson's disease: a positron emission tomography study

Impaired activation of the supplementary motor area in Parkinson's disease is reversed when akinesia is treated with apomorphine

The ipsilateral cerebellar hemisphere is overactive during hand movements in akinetic parkinsonian patients

Cortical motor reorganization in akinetic patients with Parkinson's disease: a functional MRI study
Movement exploration of combined hand and speech movements in Parkinson’s disease.

Description of 6 patients (50-72 years old)

**Speech impairment in 3 patients**

After 8 years of disease duration

“His words are now scarcely intelligible”

“The power of articulation is lost”

“Speech was very much interrupted”

“Dysarthria is a collective name for a group of speech disorders resulting from disturbances in muscular control over the speech mechanism due to damage of the central or peripheral nervous system. It designates problems in oral communication due to paralysis, weakness, or incoordination of the speech musculature.

It differentiates such problems from disorders of higher centers related to the faulty programming of movements and sequences of movements (apraxia of speech) and to the inefficient processing of linguistic units (aphasia)”

James Parkinson (1755-1824)

Premotor & motor cortices

Motoneurons
Interneurons

Speech production musculature

Basal ganglia

Cerebellum

thalamus

HYPOKINETIC
HYPERKINETIC

SPASTIC

FLACCID

ATAXIC

MIXED

Frederic L. Darley (1918-1999)

The 32 patients in the parkinsonism group presented phenomena constituting what may be called "hypokinetic dysarthria" (Table 10). All four of the neurologic groups previously reviewed displayed monopitch and monoloudness, but the severity of these dimensions is decidedly greater in parkinsonism; together with reduced stress they comprise the most striking phenomena. Related prosodic changes distinctively present here are inappropriate silences, short rushes of speech, and variable rate. It will be seen that this is the only type of dysarthria in which rate is not characteristically slow; it is typically quite variable and, considering the group as a whole, is rated as slightly fast (mean scale value of 1.34) rather than on the slow side. Imprecise consonants is prominent, apparently being the result of reduced excursion of the articulators rather than simply the rate of articulation. Both harsh voice and breathy voice are heard.
Laryngeal deficits (*dysphonia*)

**Pitch**  modulation of the mean F0  
**Loudness**  decrease of the average loudness  
**Timbre**  harsh, breathy

Supra-segmental deficits (*dysprosody*)

**Incompetence**  monopitch, monoloudness  
**Rhythm**  festination, freezing, pseudo-stuttering, variable speech rate  
**Variable rate**  pause lengthening  
*syllable duration conservation* (vowel/consonant modification)

Supra-laryngeal (*arthric*) deficits

*altered orofacial EMG*  
*compromised articulatory forces*  
*imprecised consonants* (*spirantization*)  
*vowel space reduction*
Fact 1
Parkinson’s disease induces **limb/orofacial** movement disorders universally across patients

Fact 2
Languages do not involve the same **orofacial** movements for the same purposes

When comparing patients with Parkinson’ disease with similar movements and speech severity degrees, does the language spoken by the patients modulate the severity degree of dysarthria?

→ Multi-level approach
  → Physiological
  → Prosodic
  → Psychosocial
  → Intelligibility
  → Quality of life
  → Social network

Change occurred in social networks
Changes occurred to either the size and/or the composition of their social network
Not all change was negative with an increase in the number of communication partners who were involved in the person with dysarthria’s care
While family social networks remained fairly stable, there was a marked decrease in the amount of social interaction with friends

The main objective of our project is to evaluate and compare the physiological parameters (acoustics), prosodic markers, intelligibility and psychosocial impact of speech in Parkinson’s disease (PD) patients *speaking 2 different languages*

- Aero-phonatory parameters will be altered in PD patients similarly and independently from the language

- Prosodic markers in controls will differ significantly according to the language and will be similar in PD patients, due to the loss of speech prosody associated with the disease

- The impact of speech impairment on intelligibility and psychosocial state might be worse in patients speaking the language that requires the highest prosodic modulations as compared with the other language
French → Fixed-stress language

- A primary stress regularly assigned to the final full syllable of the last lexical item of a stress group
- A second stress, initial and optional, more generally assigned to the first syllable of a content word

- Pitch prominence
- Thus, French intonation is generally characterized by a fundamental frequency \( (F0) \) rise on the last syllable of a phrase that is not utterance final; additional, an optional early, or initial, rise may occur somewhere before the late, or final, rise

Portuguese → Timed-stress language

- The lexical stress is not restricted, as in French, to one fixed syllabic position in all words: words may be stressed on one of the last three syllables, although the vast majority of words are stressed on the penultimate syllable;
- Thus, lexical stress is distinctive

- Key-role of assimilation and co-articulation
- Decrease of \( F0 \) on the final syllable

Do French people think that all Portuguese people are Parkinsonian??

Portuguese, as compared with French, is a language with a rather lax articulation and presenting with various phonetic modifications: \( e.g. \) vowel articulation is often reduced
2 levels of difference expectations
- Phonological
- Prosodic

On one hand, French stress occurs systematically to the last syllable and is generally linked to prosodic boundaries
on the other hand, Portuguese stress is mobile across the syllables and provides a distinctive function

In fact, of great importance in the context of speech impairment that implies a loss of prosodic features such as Parkinson’s disease

Fact 3
Portuguese is a language spoken in many different countries, and for example, differences between European Portuguese (EP) and Brazilian Portuguese (BP) are numerous

<table>
<thead>
<tr>
<th>Brazilian Portuguese</th>
<th>European Portuguese</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much less reduction and devoicing, and no elision, of unstressed vowels on final word context</td>
<td>Reduction, devoicing, even elision of unstressed vowels</td>
</tr>
<tr>
<td>Preference for open syllables, allowing only syllable-final sibilants, the affricate allophones [tʃ, dʒ]</td>
<td>General tolerance of syllable-final consonants</td>
</tr>
</tbody>
</table>
Very few studies of PD dysprosody have looked beyond global measures to examine the extent to which linguistically important, language-specific patterns are affected.


...the prosodic profile of Cantonese PD patients was similar to those of other languages...
... but with Portuguese speakers, is there any modulation caused by the tonal language environment and knowledge?...

Our research plan is to acquire a **Portuguese speech corpus** with bilingual (Portuguese/Cantonese) participants living in Macau, with both healthy and PD individuals, in order to assess potential **prosodic differences** induced by the **Asian tonal language** influence when compared with healthy and PD individuals speaking either European Portuguese, Brazilian Portuguese or French.

**Monolingual Cantonese** speakers and patients will be also recorded as reference groups.
Merci !
Obrigado!
Thank you!
多謝