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Final Lengthening in Parkinsonian French speech

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Abstract

The ensuing study examined the impact of Parkinson disease (PD) on the duration of CV syllables in different positions within phrases and the distribution of final lengthening (FL) on syllable subcomponents. The results showed that PD patients produced normal FL and that the FL effects can be attributed primarily to vowels. This suggests that the syntactic function of prosody is intact in PD patients at least at the early and mild stages of the disease and that the basal ganglia are implicated in the linguistic representation of prosody.

I. Introduction

The speech produced by patients suffering from Parkinson's disease (PD), a neurological disease resulting from an impairment of basal ganglia (BG), is characterised by prosodic distortions such as disordered speech rate and abnormal temporal variables. However, despite these abnormalities PD patients were shown to achieve normal syllable duration in languages such as German [1], American English [2] and French [3]. In French [4] syllabic productions combine shorter consonants and slightly longer vowels than in normal speech [4], this may enable syllable duration in parkinsonian speech (PS) to match normal speech.

Studies on German revealed that PD patients tend to maintain linguistic contrasts such as phonemic length [5] and lexical stress [6]. Boundary-related lengthening was also found to affect phrase-final syllables in French PS [4]. However, this result remains to be confirmed since non-phrase final syllables and phrase-final syllables were not of similar structures.

Final lengthening (FL) is a biological phenomenon and its linguistic use is acquired in the early ages of childhood; it is an inherent characteristics of motor programming which offers speakers an extra fraction of timing during which a following phrase can be planned, it signals the boundaries of linguistic units on the basis of durational differences, at least in European Languages. Its realization is of crucial importance for the integration of linguistic information.

The pattern of duration of syllables conveys information about the constituent structure of an utterance, as a consequence temporal distortions may impair linguistic information. Thus, examining the impact of PD on the duration of syllables and their subcomponents in different positions in different languages should both permit a better understanding of whether basal ganglia dysfunction impairs FL processing and clarify language-specific effects. In this context, PD effects on the duration of CV syllables and consonants and vowels were investigated in read French PS. French is a non-lexical stressed language with a pattern of accentuation based on final prominence and a pattern of syllable structure where most syllables are of CV form.

The ensuing study had two main objectives. The first was to examine the impact of PD on the duration of CV syllables in French and ascertain whether FL is normally produced or impaired. The second objective was to examine the distribution of FL and determine whether there is a constant degree of lengthening or an increasing degree of lengthening of C's and V's.

2. Method

2.1. Participants

They were 24 French native speakers composed of 12 individuals (9 males and 3 females) diagnosed with Parkinson disease (age, M: 62.16; SD: 13) and 12 age and gender matched control speakers (age, M: 58.8; SD: 12.1). The PD participants were between 7 and 19 years post-PD diagnosis (M=8.3; SD: 5.34), recruited by the Department of Neurology at the Hospital of Aix-en-Provence. They had no histories of neurological, respiratory, laryngeal, speech and voice diseases or disorders, apart from those associated with PD, they were being treated with L-Dopa and were experiencing motor fluctuations in response to their treatment and they had adequate vision with corrective lenses and claimed not to suffer from hearing loss. In order to make the effects of PD more discernable, antiparkinsonian medications were withheld overnight and the first recordings started after at least 10 hours without medication. Before recording, the motor disability of each patient (M: 43.12; SD: 10.3) was assessed using the Unified Parkinson's Disease Rating Scale (UPDRS), especially dysarthria severity (M: 1.9; SD: 0.9) as defined by item 18 [7].

2.2. Speech sample and recording equipment

The read speech sample was a paragraph of "La chèvre de Monsieur Seguin". Each subject was asked to read at his habitual speech rate. High-quality recordings were obtained in a sound-treated room of the Aix-en-Provence Hospital. The acoustic signal was transduced using an AKG C410 head mounted microphone and recorded directly onto a PC hard disk at a sampling rate of 20 KHz.

2.3. Temporal measurements

Temporal acoustic measures were obtained by hand, using the Praat program. Measurements were made on combined wideband spectrograms and oscillograms displayed on a screen, and by listening to selected segments of the waveform in regions of specific interest. The overall recording was segmented into pauses and sounded sequence; then each sounded sequence was segmented into syllables. Syllables were then segmented into consonants and vowels. The limits between consonants and vowels were carefully marked using a set of consistent rules which utilise spectral changes and formant transitions.

2.4. Syllables

A syllable is a linguistic unit which contains an onset (optional or not) and a rhyme, this rhyme consisting of a nucleus (obligatory) and a coda (optional). The number of components strongly influences syllable duration. To neutralise this effect, the present study was limited to CV syllables which are predominant in French. In French there is also isosyllabicity of successive non-prominent syllables, the differences in duration being inferior to the durational perception threshold (20%). The analysis was limited to CV syllables where C's and V's were effectively produced, thus excluding intended CV's with an omitted speech segment (mostly a C).

2.5. Location

Table 1. Number of syllables as a function of position within phrases in Parkinsonian speech (PS) and Control speech (CS). The distribution is as follows: non phrase final (NF), phrase final without a pause (F), phrase final with a pause (F+), and non phrase final followed by a pause

	NF	F	F+	NF+
PS	1499	228	207	108
CS	1515	228	207	60

Phrase-final syllables were located at the edge of major and minor phrases (as defined by Blanche-Benveniste et al [8]), either prepausal or non-prepausal. Syllables located within phrases were considered as non-final. To focus on phrase-final lengthening, syllables containing a schwa produced before a pause and non phrase-final syllables before within-phrase or within-word pauses were excluded from the analysis (the number of syllables as a function of position in both PS and CS can be seen in Table 1). Consonants and vowels were classified as phrase-final and non-phrase final following the same criteria. The durations obtained for phrase-final syllables, consonants and vowels were compared with the durations of non-phrase final syllables, consonants and vowels in both PS and CS.

2.6. Statistical analysis

Repeated-measure ANOVA's were conducted with duration as the dependent variable and between-subjects factor as the group (PD or control); the

following variables were selected as within-subject factors: syllables, segment type (C or V), syllable and segment locations (non-phrase final, phrase final with and without a silent pause), respectively. There were twelve entries per group, where each entry was the mean duration for each speaker and each syllable and speech segment location. Independent t-tests were conducted to compare mean duration differences between the different locations.

3. Results

3.1. Syllable duration as a function of position within phrases

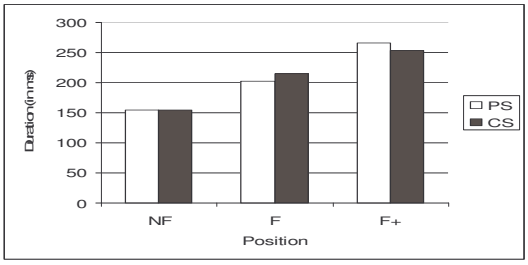

Figure 1. Duration of syllables (in ms) as a function of position within a phrase in Parkinson speech (PS) and control speech (CS). Syllables are non final (NF), final without a pause (F) and final followed by a pause (F+)

As seen in Figure 1, there is a similar pattern of FL in both PS and CS. All final syllables (followed by a pause or not) were longer than non-final syllables (PS, M: 202.74 ms; CS, M: 215.1 ms) and non-prepausal final syllables (PS, M: 202.74 ms; CS, M: 215.1 ms) were shorter than prepausal final syllables (PS, M: 266.45; CS, M/ 253.71 ms). The ANOVA points out significant differences on syllable length ($F(2,44)=206.607$ $p< 0.05$) depending on its position in the phrase and also confirms that these differences depend on whether Parkinsonian Subjects or Control Subjects are considered ($F(2,44)=3.212$ $p <0.05$). The percentage of FL for prepausal syllables was slightly greater in PD speech (73.1%) than in control speech (64.25%); for non-prepausal final syllables, it was 30.7% (PS) and 39.25% (CS).

3.2. Vowel and consonant duration as a function of syllable position within phrases

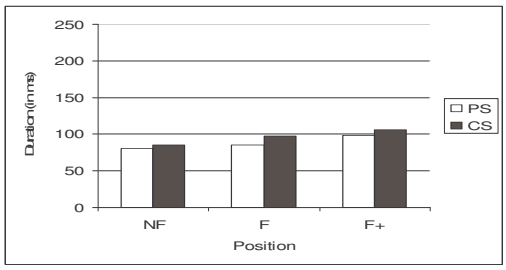

Figure 2. Duration of consonants (in ms) as a function of position within phrases in Parkinson speech (PS) and control speech (CS). Consonants are non final (NF), final without a pause (F) and final followed by a pause (F+)

As seen in Figure 2, the duration of C's as a function of location within phrases demonstrates slight FL effects (with significant differences, $F(2,44)=46.198$; $p < 0.05$)) in both PS and CS. Differences in the magnitude of lengthening are lesser in PS (NF, M: 80.58, SD: 39.15; F, 85.34, SD: 32.07; F+, M: 98.62, SD: 40.75) than in CS (NF, M: 85.48, SD: 39.16; F, 97.95, SD: 39.27; F+, M: 105.91, SD: 36.05); this may be due to the fact that C's tend to reduce in PS, compared to CS [4].

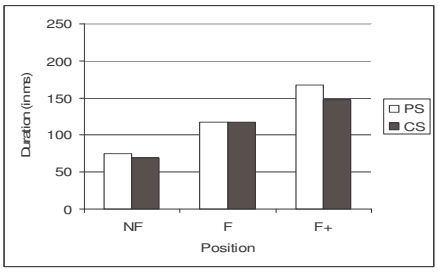

Figure 3. Duration of vowels (in ms) as a function of position within phrases in Parkinson speech (PS) and control speech (CS). Vowels are non final (NF), final without a pause (F) and final followed by a pause (F+)

As seen in Figure 3, FL strongly affects (with significant differences $F(2,44)=166.191$, $p <0.05$)) the nucleus both in PS and CS. The mean duration of non final vowels (M: 74.5ms; SD: 34.24) is 57.5% inferior to the mean duration of final vowels (M: 117.34; SD58.61) and 125.2% inferior to this of prepausal vowels (M: 167.83; SD: 59.28) in PS. FL effects are comparable in CS, with a mean duration of non final vowels (M: 78.9ms; SD: 25.46) 69.8% shorter than the mean duration of non-prepausal vowels (M: 117.15; SD: 60.06) and 114.2% shorter than this of prepausal vowels (M: 147.8; SD: 51.73).

4. Concluding remarks

The principal finding of the present study is the normal production of FL by PD speakers. FL is a local tempo slowing down not accompanied by any significant difference in articulator displacement, the fact that FL does not require stronger movements or increased effort and amplitude of articulators would explain why PD patients had no difficulty with FL.

Interestingly, the results obtained for consonants and vowels in different positions within phrases indicate that the degree of lengthening is comparable in both groups and that the lengthening effects can be attributed primarily to vowels. This suggests a progressive lengthening across the subconstituents of the final syllable. An investigation of syllables with coda consonants is intended, it would confirm this assumption.

The marking of FL at the edge of syntactic phrases suggests that the syntactic function of prosody is intact in PD patients at least at the early and mild stages of the disease and that the basal ganglia are not implicated in the linguistic representation of prosody.

References

[1] Ackerman, H., Ziegler, W.: Articulatory deficits in parkinsonian dysarthria : an acoustic analysis. J*ournal of Neurology, Neurosurgery and Psychiatria* 1991; 54: 1093-1098.

[2] Ludlow, C.L., Connor, N.P. and Bassich, C.J.: Speech timing in Parkinson's and Huntington's disease, *Brain and Language* 1987; 32: 195-214.

[3] Duez, D. (2006) Syllable structure, syllable duration and final lengthening in Parkinsonian French speech, *Journal of Multilingual Communication Disorders,* 4(1), 45-57.

[4] Duez, D. (to appear) Segmental duration in parkinsonian French Speech, *Folia Phoniatrica Logopaedica.*

[5] Ackerman, H., Konczak, J. and Hertrich, I. (1997) The temporal control of repetitive articulatory movements in Parkinson's disease, *Brain and language*, 56, 312-319.

[6] Ackerman H., Gräber S., Hertrich I. and Daum I.: Phonemic Vowel Length Contrasts in Cerebellar Disorders, *Brain and language* 1999*;* 67(2) 95-109.

[7] Fahn S, Elteon RL. and members of the UPRDS Dev. Committee: The Unified Parkinson's Disease Rating Scale. In Fahn, S, Marsden, CD, Calnen DB et al.(eds): *Recent developments in Parkinson's disease*. New Jersey, MacMillan Healthcare Information, 1987, pp. 153-164.

[8] Blanche-Benveniste, C. Bilger, M.; Rouget, C. and Eynde, K. van den : *Le français parlé. Etudes grammaticales. Sciences du langage* Ps: Ed. du CNRS, 1990.