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To cite this version:

Daria d'Alessandro, Michaela Pernon, Cécile Fougeron, Marina Laganaro. Anticipatory VtoV coarticulation in French in several Motor Speech Disorders.. Phonetics and Phonology in Europe (PAPE 2019), Jun 2019, Lecce, Italy. hal-02427864

HAL Id: hal-02427864

https://hal.science/hal-02427864

Submitted on 4 Jan 2020

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Anticipatory VtoV coarticulation in French in several Motor Speech Disorders

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V-to-V anticipatory coarticulation is frequently taken as an indicator of the anticipated planning of an up-coming vowel, and thus the manifestation of a process where context-dependent speech targets or coordinated gestures are planned together before execution (e.g. [1], [2], [3]). In this study, V-to-V anticipatory coarticulation in French is compared in 4 groups of patients presenting different Motor Speech Disorders --Apraxia of Speech (AoS) and 3 types of dysarthrias associated with Amyotrophic Lateral Sclerosis (D-ALS), Parkinson (D-Pk) and Wilson (D-Wl) diseases-- with the aim of getting further insights into the understanding of the control of coarticulation in speech (as in [4], [5], [6]). It is hypothesized that perturbed coarticulatory patterns may arise as a consequence of disruption in the planning and sequencing of speech targets into cohesive speech units, as expected in AoS where speech is often described as 'syllabified' or 'segmentalized'. However, it can also derive from deficits in the motor programming or execution of speech whose consequences are slower movements, restricted displacement and/or perturbed coordination between gestures, as can be encountered in dysarthria. So far, inconsistent results have been found in the literature regarding coarticulatory patterns in different MSD (see [5] & [6]). Moreover, AoS patients are more often compared to patients with aphasia than to patients with dysarthria. More data is thus needed to understand whether deficits linked to distinct cerebral disorders do impact coarticulation, and how they can shed light on the levels and units over which coarticulation is planned.

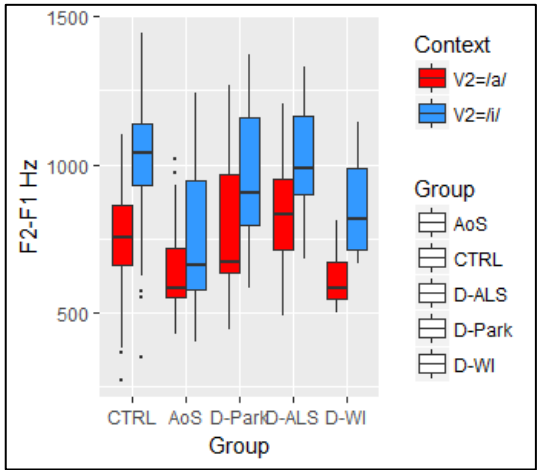
Twenty patients (five per groups) suffering from mild to moderate speech impairments, and 40 healthy control speakers (age and sex matched) were recorded while reading a short text containing twelve disyllabic [pV_1pV_2] French words with V_1=/a/ and V_2=/a/ or /i/. The pivot bilabial consonant /p/ was chosen in order to maximize the effect of V_2 on V_1 shown by a lowering of F1 and a rising of F2, leading to a less compact F2-F1, when /a/ is followed by /i/.

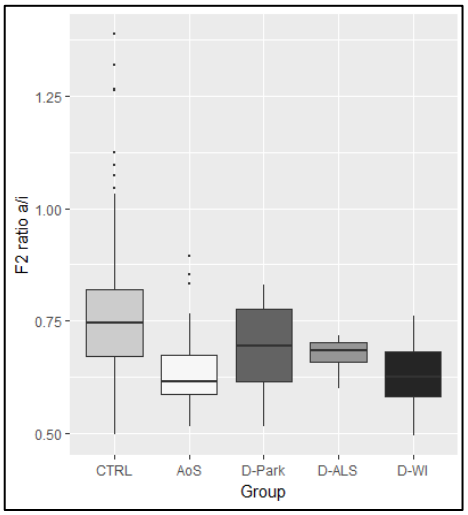
Results show a significant contextual effect of V_2 on V_1 on F2-F1 in all groups of patients with dysarthria and in the control group, but not in the group of patients with AoS (Fig. 1), as found in [8], for instance. Nonetheless, some contextual effect is also present for some speakers in the AoS group, with a certain speaker- and token-dependent variability (Fig.3). In order to compare further the groups, the amount of coarticulation in the /papi/ (V_2= /i/) words was computed as the ratio between the F2 of the first vowel /a/ and the F2 of the following /i/. Reduced amount of coarticulation (more distance between [a] and [i] F2's) is found in both the D-Wl group and AoS groups, compared to the CTRL and other MSD groups (Fig. 2).

Altered coarticulatory patterns (absent or reduced) for the patients in the AoS and D-Wl groups can both be related to deficits in speech coordination and timing, but over different domains. In the Wilson group, reduced coarticulation is associated with longer V_1 and with restricted articulatory movements' displacement, as shown by a reduced acoustic space for all Wilson patients especially in the F1 dimension (linked to reduced jaw displacements). Taken together this could suggest that it is at the segment level that spatio-temporal coordination is altered for these speakers, with a pressure towards articulatory accuracy rather than speed, and potentially less overlap between V_1 and V_2. The AoS group presents longer V_1 targets but also longer intervals between V_1 and V_2, due to either long pivot Cs and/or internal pauses, suggesting an altered phasing between the two syllables in the [$pV_1.pV_2$] word. Together with the lack of anticipation of the up-coming V_2 during the first syllable, AoS

patients seem to proceed with syllable-sized phonetic plans lacking inter-syllable coordination.

While more speakers per patient groups are needed, and local anticipatory coarticulation remains to be examined, theoretical implications of these results will be discussed at the conference.





Apraxia of Speech (AoS) ; Dysarthia associated with Wilson disease (D-Wl), with Amyotrophic Lateral Sclerosis ((D-ALS); with Parkinson disease (D-Pk) ; healthy control speakers (CTRL)

***Figure 1**. Acoustic compacity of V_1=/a/, measured as F2-F1, per context(V_2=/a/ or V_2= /i/) and per group*

***Figure 2**. Degree of coarticulation, measured by the ratio of F2 in V1/a/ and V2/i/ in /api/ words, per group (smaller ratio = less coarticulation)*

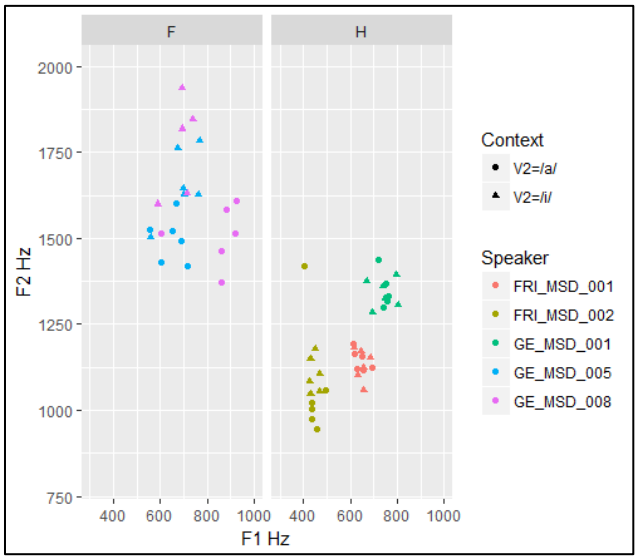


***Figure 3**. F1 and F2 of /a/ according to V2 context (/a/ or /i/) for the 5 patients with Apraxia of Speech (different color per patient, 12 tokens each, F=female, H= male speakers).*

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