

Italian Alveolar Geminate: typical and disordered production (Parkinson's Disease)

Massimiliano M. Iraci^{1,2}, Mirko Grimaldi¹ & Barbara Gili Fivela¹

¹CRIL-DREAM – Università del Salento; ²LPP – CNRS & Sorbonne Nouvelle
massimiliano.m.iraci@gmail.com

Most powerful correlates of singleton vs. geminates contrast in Italian seem to be the lengthening of the consonantal acoustic interval, the reduction of the vocalic acoustic duration preceding geminates (Bertinetto, 1981), and the lengthening and widening of the consonantal release gesture (Gili Fivela et al., 2007). Concerning kinematics, for Italian, these have been observed on the bilabial articulation (e.g., Zmarich & Gili Fivela, 2005) and on the alveolar articulation (Zmarich et al., 2007). Since in the second case, V and C share the main articulator (i.e., the tongue), slightly different results were found, but expected correlates were confirmed.

Speakers affected by hypokinetic dysarthria following Parkinson's Disease (PD) are supposed to show reduction of the kinematics of gestures (amplitude, duration, speed), and alterations to movements onset (for a review, Sapir 2014) among other symptoms. This type of disordered speech has already been investigated as regards geminates in Italian, given the need to enhance amplitude and duration for the realisation of these segments compared to the respective singletons (Gili Fivela et al. 2015; Iraci et al. 2017). In these studies, pathological speakers managed to realise the linguistic contrast though recurring to some compensatory strategies. However, the speech material was based on the bilabial articulation, thus avoiding any interferences due to C and V sharing the main articulator.

Since slight differences due to segmental type are reported in the literature on typical speech, in order to test PD's realisation of geminates when C and V share the main articulator (i.e., the tongue), acoustic and kinematic data by 5 Italian PD speakers affected by hypokinetic dysarthria and 5 healthy controls (HC), age-matched and coming from the same area, were recorded through Electromagnetic Articulography during the production of 'CVC(C)V sequences, where Cs= /t/, Vs=/a/ in order to have a constant motor constraint due to the sharing of the main articulator, but not to elicit effects due to the vowel type. Acoustic segmental durations and Vs formant frequencies (F1, F2) have been manually labelled and calculated. The kinematic signals have been semi-automatically labelled in order to obtain amplitude, duration, stiffness and peak velocity of tongue tip (for alveolar Cs) and tongue dorsum's sensor (for Vs kinematics). It is hypothesised that HCs will show the expected correlates of geminates' production though exploiting adjustments to the phasing of gestures. Since we do not expect PD speakers to produce fine modifications at the level of gestural coordination, it is possible that their gestures will be reduced in space and time but triggered without differences in phasing relations.

Acoustic results confirm expectations. Results concerning HCs confirm geminates' greater duration of both consonantal closure and release (compared to respective singletons) but, unexpectedly, the amplitude of the closure is reduced compared to singletons. Vowel kinematics mirror the acoustic effects of compression (before) and lengthening (during geminates). Given the shared articulator issue and the fact that gestures cannot overlap as

when articulators are independent (e.g. bilabials), gestures have to be triggered almost sequentially, and the only way to provide the acoustic effects required for geminates is to lengthen all relevant intervals, and compress the preceding ones. PDs realised the expected acoustic correlates of geminates but not the kinematic ones. Rather, they showed a preference for modulating the consonantal closure instead of the release: this one corresponds to greater duration and reduced peak velocity. Thus, when C and V share the main articulator, PD speakers can produce the singletons vs. geminates contrast by modulating the closure in order to anticipate the preceding vowel and (a certain degree of) the consonant lengthening crucial for the recovery of geminates.

References

BERTINETTO, P.M. (1981). *Strutture prosodiche dell'Italiano*. Florence: Accademia della Crusca.

GILI FIVELA, B., IRACI, M.M., GRIMALDI, M., ZMARICH, C. (2015). Consonanti scempie e geminate nel Morbo di Parkinson: la produzione di bilabiali. In C. AVESANI, M. VAYRA, F. TAMBURINI (ed.), *Il farsi e disfarsi del linguaggio. Acquisizione, mutamento e destrutturazione della struttura sonora del linguaggio / Language acquisition and language loss. Acquisition, change and disorders of the language sound structure*, Milano: Studi AISV.

GILI FIVELA, B., ZMARICH, C., PERRIER, P., SAVARIAUX, C., TISATO, G. (2007). Acoustic and kinematic correlates of phonological length contrast in Italian consonants. *Proceedings of International Conference of Phonetic Sciences (ICPhS'07)*, Saarbrücken, Germany, 6-10 August 2007, pp. 469-72.

IRACI, M.M., ZMARICH C., GRIMALDI M., GILI FIVELA B. (2017). Il parlato nel morbo di Parkinson: ampiezza dei gesti articolatori e distintività dei suoni linguistici. In P. SORIANELLO (ed.), *Il Linguaggio disturbato. Modelli, strumenti, dati empirici*, Roma: Aracne.

SAPIR, S. (2014). Multiple Factors Are Involved in the Dysarthria Associated With Parkinson's Disease: A Review With Implications for Clinical Practice and Research. In *Journal of Speech, Language, and Hearing Research*, Vol. 57, pp. 1330-43.

ZMARICH, C. & GILI FIVELA, B. (2005). Consonanti scempie e geminate in italiano: studio cinematico e percettivo dell'articolazione bilabiale e labiodentale. *Proceedings of the AISV Conference "Misura dei parametri"*, Padova, 2-4 December 2004, Torriana: EDK, pp. 429-48.

ZMARICH, C., GILI FIVELA, B., PERRIER, P., SAVARIAUX, C., TISATO, G. (2007). Consonanti scempie e geminate in italiano: studio acustico e cinematico dell'articolazione linguale e bilabiale. *Proceedings of the AISV Conference "Scienze vocali e del linguaggio. Metodologie di valutazione e risorse linguistiche"*, Povo di Trento, 29th November – 1st December 2006, Torriana: EDK, pp. 151-63.