

Italian vowels in Parkinson's disease under different stress and syllable conditions

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Motor symptoms of Parkinson's Disease (PD), even if captured at the level of (non-speech) oral motor performances, can differ from those individuated during the speech motor performance (Bunton, 2008; Skodda et al., 2012). As a consequence, the understanding of dysarthria in PD needs to rely on data elicited by speech events rather than non-speech oral motor tasks. For this type of investigations, a good number of studies in several languages (Weismer, 1984; Forrest et al., 1989; Yunusova et al., 2008 for American English; Skodda et al., 2011, 2012 for German; Rusz et al., 2013 for Czech; Audibert & Fougeron, 2012 for French; Gili Fivela et al. 2014, 2015; Iraci, 2017 for Italian) have already focussed on linguistic units, such as the vowels. However, some ambiguities arise from the findings across different languages. These ambiguities may depend on the language-specific constraints that are attributed to vowels production and that may lead one pathological speaker to differently compensate coherently with its own language requirements. Modulation of vocalic gestures as a function of syllable and stress in Italian are found in the healthy speakers' literature (e.g., Bertinetto, 1981) and indicate that stress modifications (stressed vs. unstressed vowel) have the effect of a global reduction/enhancement of the gestural articulation (as in hypo/hyper-articulation, Avesani et al., 2009); syllabic structure effects seem to manifest at the level of vowels' duration and timing (Gili Fivela et al., 2007) with acoustic shortenings attributed to more complex syllabic structures, and lengthening of timing intervals as a function of intervocalic consonants insertion. As a consequence, this study provides an observation of speech alterations by 5 Italian PD dysarthric speakers (compared to 5 healthy age-matched controls) when vocalic gestures are expected to be modified in space and time because of stress and syllabic structure changes.

In particular, it is hypothesised that 1a) HC show more centralised unstressed vowels compared to stressed ones, 1b) PD show centralisation of unstressed vowels compared to stressed ones as well, though a general centralisation could be found in both conditions compared to HC; 2a) HC increase the timing of vowels when more intervening consonants occur in the syllabic structure; 2b) PD increase the timing of vowels when intervening consonants are added in the syllabic structure though this modification could be obtained through alternative gestural phasing strategies; 3a) HC reduce the duration of vowels in closed vs. open syllable; 3b) PD reduce the duration of vowels in closed vs. open syllable though pathological durations may be even more reduced than HC's in both conditions. Kinematic (tongue dorsum) and acoustic data of 'CVC(C)V disyllables (/ 'pi.pa, 'pip.pa, 'pa.pi, 'pap.pi/) have been collected through Electromagnetic Articulography (EMA – AG501). For each vowel and condition (/i/ vs /a/; stressed vs unstressed; CVCV vs CVC.CV), F1, F2, and tongue dorsum (TD) position have been measured as well as timing between TD targets, timing between vocal folds activation, acoustic durations and duration of gestural attainment phases.

Results confirm all hypotheses. However, HC exhibit timing modulation only through vocal folds activation while PD also through TD targets. The most important fact seems the reduced range of PD observations compared to HC in crucial measures. When this happens for the position of TD, the effect is a centralisation of vowels articulation; concerning duration measures, this coincides with shorter lags than HC when lags are expected to be lengthened, and longer lags when expected to be shortened. Findings show that pathological observations needs to vary across linguistic context in order to be interpreted: in fact, durations have been found to be both reduced or increased depending on the syllabic structure. Moreover, the reduced range of PD results observed in both space and time may be connected to an alteration of the auditory feedback though this consideration is only speculative and needs further studies.

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