Variability in realization of focal accent in Hungarian – articulatory and acoustic data

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While earlier studies focused predominantly on the role of f_0 in realization of focal accent in Hungarian, recent papers found that vowels occurring in accented syllables were significantly longer than their non-accented counterparts [1, 2, 3]. Several models (e.g., [4]) suggest that longer duration may lead to more accurate articulatory movements and thus the target might be better reached. Therefore, we may also assume that longer vowels in the accented position may be articulated with a greater effort (and with smaller variability, see [5]) in Hungarian, similarly to several other languages. However, as for Hungarian, there is an apparent consensus in the literature that vowel quality is not expected to co-vary with prominence (which is also a common pattern in several languages). Apart from a few earlier studies (see a review in [6]), which were largely inexplicit about the details of their methods, and a pilot study on a rather unbalanced material [3], acoustic correlates of vowel quality, i.e., formant structure, were not analysed reliably. Moreover, linguo-articulatory correlates of vowel quality in focal accent was not analysed with respect to Hungarian either. Nevertheless, recently a study revealed that in Hungarian pitch-accent has an effect on the variability of vowel both in the acoustic and in the articulatory domain [7].

In our study, utterance-initial vowels (/i u ɛ ɒ/) in preverbal focus vs. prefocal topic positions (both occurred sentence-initially) were compared with respect to their articulatory and acoustic parameters. Parallel acoustic and ultrasound recordings were made with 20 female speakers. With each participant, 40 target utterances (5 repetitions for each vowel in each condition) and 80 filler utterances were recorded. In a previous study carried out on the same material we found that vowel duration and the f0-peak alignment is different between the two conditions [8], therefore we may assume that focus bears higher prominence than topic. Since longer durations were observed in the focus condition we hypothesized that **formant values** and **tongue contours** differ as a function of condition. In accordance with [5, 7], we expected smaller variability in both measures in the focus condition.

F_1 and F_2 (mean, Hz) were automatically measured at the temporal midpoint of the vowel in Praat [9]. Formant frequencies were standardized within speakers using *z*-transformation [10] in the phonR package [11]. On the basis of F_1 and F_2 data, the Euclidean distance of the centroid of the vowel space and each token was also calculated [12]. Euclidean distances were compared using modified signed-likelihood ratio tests (MSLRTs) for equality of coefficient of variations [13, 14]. Tongue contours were manually traced on the ultrasound frame extracted from the temporal midpoint of the vowel, and variability of the tongue contours was measured by the Nearest Neighbour Distance (NND [15]) method. Linear mixed models were used to assess the effect of prominence and vowel quality on the measured variables.

Tongue contours showed smaller variability (NND) in the focus condition (Fig 1) for all vowels, but this tendency was not confirmed by statistical analysis. As for NND, smaller SDs were observed in focus, except for /u/. Statistically, acoustic vowel space (Fig 2) and formant frequencies did not appear to differ between the two conditions. However, while the variance of F_1 values did not differ significantly across conditions either, we found a significant difference in the variance of F_2 (MSLRT = 7.77, $p < 0.01$).

We assume that these patterns is in part due to the fact that some of the speakers tended to better reach the articulatory target in the focus condition than the others. Therefore, we plan to extend the above analysis looking in more depth into interspeaker variability.

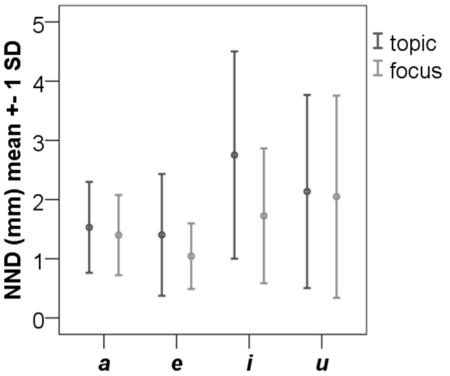

Figure 1. *Variability in tongue contour measured in NND (mm, mean±1 SD).*

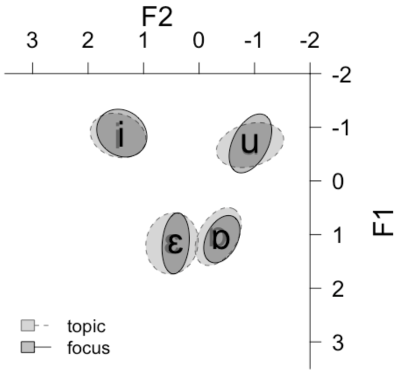

Figure 2. *Standardised F1 × F2 space of the analysed vowels as a function of condition*

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