

Prosodic boundaries and spectral realization of French vowels

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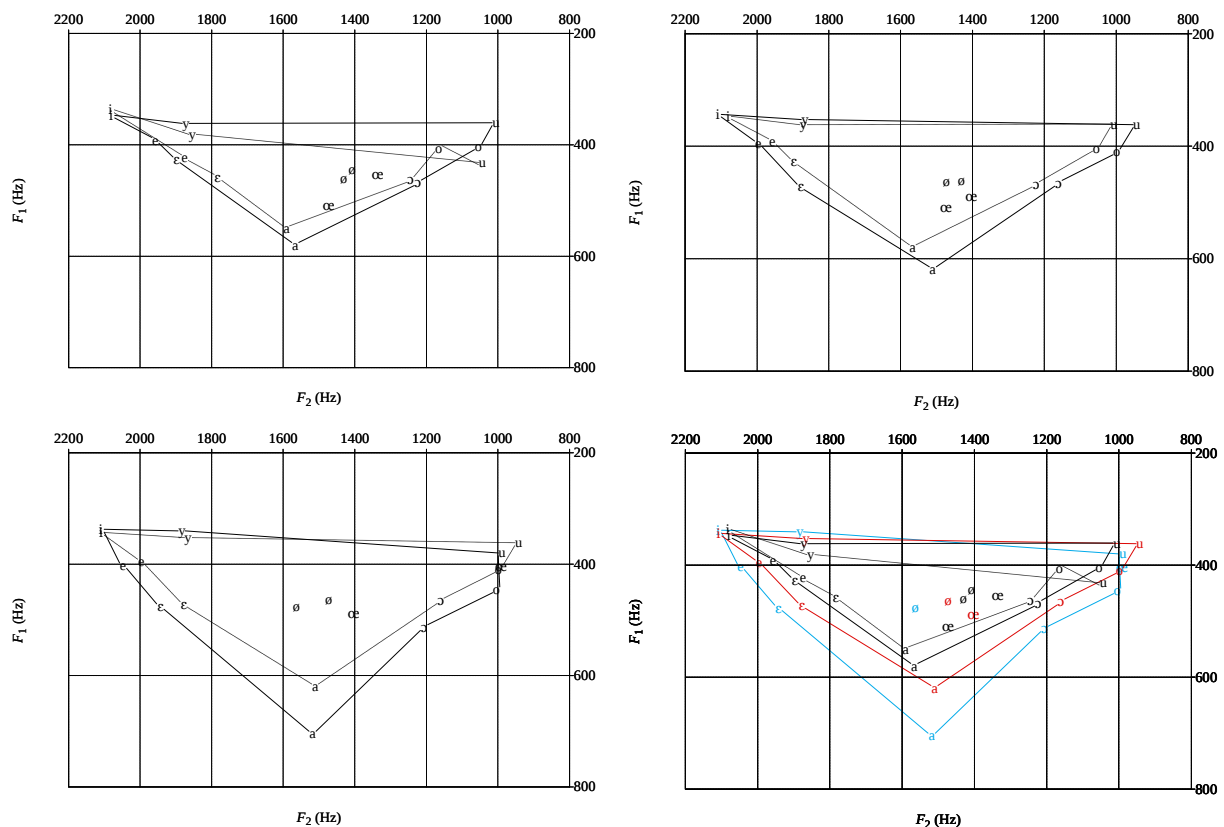
The aim of this study is to relate spectral realization of vowels and prosodic hierarchy in continuous speech. The IRISA speech alignment system is used and formant values of oral vowels are automatically measured in a total of 500,000 segments from around 30 hours of journalistic broadcast speech in French.

This work is part of a larger scale study aiming at describing the variability of French vowels. With the help of very large automatically segmented corpora (Galliano et al., 2005), we were able to study a large number of contexts known to influence the realization of phonemes so as to quantify precisely their influence and their interaction. In previous studies we showed that the spectral realization of vowels was greatly influenced by their duration (Gendrot & Adda-Decker, 2005, accepted). Longer vowels were considerably hyperarticulated compared to shorter vowels. In other words, the longer the vowels, the larger the acoustic space they will occupy, being thus more and more distinct from each other. The link between the duration of vowels and their spectral realization (through their formant values) has been validated for a long time by Lindblom (1963) among many others since then.

Reasons for variation in vowel duration are multiple. Factors such as speaker's style and speech rate can of course greatly influence, but linguistic factors such as the phonemic context, the phoneme position in the syllable, the word, the syntagm or the utterance can be of great influence too. The 4 units lastly mentioned are also considered as prosodic constituents since specific intonation and duration patterns produced by speakers serve a demarcative function. The realized prosodic constituents are considered as being organized in a prosodic hierarchy, each constituent being embedded in a higher one: this is the strict layer hypothesis as claimed by Nespor and Vogel (1986) and followed by many others. In this thread, the relation between prosodic constituent boundaries of different levels and the duration of phonemes adjacent to these boundaries has been demonstrated. These boundaries have been more rarely investigated in terms of articulation and spectral measurements (for French, Fougeron for initial positions, 2001; Tabain for final positions, 2003). Results obtained showed that for a phoneme in an initial or final position of a prosodic constituent, the higher the constituent in the prosodic hierarchy, the more strengthened/hyperarticulated the phoneme will be at its boundary. They also showed that this strengthening is not necessarily linked to duration.

We intend to replicate these results on continuous speech rather than controlled read speech. We consider four prosodic categories which are either selected from segmentation (word internal positions, word boundaries and intonational phrases) or from syntactic chunking (accentual phrases). All French peripheral vowels are investigated - with the use of acoustic measurements only - on both initial and final positions of each prosodic category. Then we evaluate the vocalic space used by all peripheral vowels for each of these categories (keeping initial and final positions apart). According to the hypotheses previously developed, we expect to observe an enlarging of the vocalic space when going upwards in the prosodic hierarchy, i.e. from syllable, to word, then accentual phrase and finally intonational phrase. A measure of dispersion from the acoustic centre is also considered as a statistical validation; if the vowel is moving away significantly from the

acoustic centre (F1: 450 Hz; F2: 1450 Hz), then it is considered as a hint of hyperarticulation. We bear in mind that this measure is inappropriate in some ways as it's related to the measurement of vowels' centralization, which is only a secondary effect of vowel coarticulation. However, with all vowels moving away simultaneously from the acoustic centre, they necessarily get away from one another, thus favouring the phonemic identification (see Lindblom's theory of adaptive dispersion for an interpretation of this in the formation of vocalic systems).



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