Prosodic effects on L2 French vowels: a corpus-based investigation

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Vowels in strong prosodic positions are produced with increased articulatory effort and expand farther apart within the vowel space. Such *prosodic strengthening* is correlated to the level of the prosodic hierarchy [2]. For instance, in French, the higher the prosodic domain (Intonation Phrases (IP) vs Accentual Phrases (AP)), the more vowels are acoustically expanded and hyper-articulated [4, 5]. Similarly, in English, vowels produced at IP-initial positions are more dispersed into the vowel space than those in accented positions [1]. These studies claim that vowels in strong prosodic positions are more *canonical*, since speakers enhance certain phonological features. Yet, it is unclear whether prosodic strengthening occurs similarly in other languages: according to [8, 9] the presence of pitch accents and/or lexical stress is not a good predictor of acoustic dispersion for Spanish vowels.

 In this investigation, we examine whether the prosodic structure affects vowel quality in L2 French in the speech of learners coming from different L1s (English vs Spanish). We try to determine (a) to what extent the expansion of L2 French vowels depends on the increase of prosodic hierarchy, and (b) whether prosodic strengthening favours the L2 pronunciation accuracy of vowels that are commonly found difficult by learners.

We analyse read speech produced by 30 participants [3, 6]: 10 French native speakers, 10 English learners and 10 Spanish learners (B1 proficiency level of L2 French). Two levels of analysis were retained for examining the effects of prosodic strengthening: vowels produced in (i) IP-final positions, (ii) AP-final edges (obligatory accent) and/or at AP-initial rises (non-obligatory accent on the first syllable of the first content word). We compare vowels produced in these conditions with those produced in simple word-internal non-accented position (WD).

IPs and APs were determined according to a syntax-prosody approach following [10]: the former were associated to coordinated root clauses, extra-sentential elements, main clause edges, etc., whereas the latter consisted in any lexical word and their related grammatical words on its left side. A semi-automatic analysis with Prosogram [7] allowed us to label the vowels produced with melodic movements (glissando threshold: $0.32/T^2$) indicating the realization of the predicted prosodic edges/positions. We measured F1-F2-F3 at the mid point of each vowel for the following set: /i, e, ɛ, a, o, ɔ, u, y, ø, œ/. After filtering aberrant formant detections, we analyzed 12,383 vowels in terms of formant dispersion (convex hull area of F1*F2 and F2*F3 vowel spaces).

The results show that L2 vowels in strong prosodic positions (IP or AP) are more expanded than in weak positions (WD). This observation can be attributed to a positive transfer from L1 in the case of English learners, but probably not for Spanish learners, since [8, 9] claim that pitch accents do not affect vowel quality in this language. Additionally, vowels are clearly more expanded in IP than AP in L1 French. However, the level of prosodic hierarchy in L2 French does not affect vowel dispersion: only marginal differences were found in both groups of learners in these two conditions.

Finally, we performed a Linear Discriminant Analysis (LDA) in order to examine the degree of pronunciation accuracy in L2 [11]. The model was trained on L1 French data, and then used to predict vowel categories on learners' productions. The accuracy of the model's predictions increases by 11% for vowels produced in IP or AP than in WD for both groups of learners. This suggests that prosodic strengthening and L2 pronunciation accuracy could be correlated. We discuss these results in the light of L2 acquisition universals, and the role of prosodic strengthening on the production of new L2 sounds.

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