

**Closed Syllable Vowel Laxing: a strategy to enhance coda consonant place contrasts -  
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**Background.** Closed Syllable Vowel Laxing (CSVL) describes a common pattern of allophonic distribution where tense vowels are laxed in closed syllables (e.g., French *nous votons* /votɔ̃/ “we vote”, with tense /o/ in open syllable and *il vote* /vɔt/ “he votes”, with lax /ɔ/ in closed syllable). CSVL has been argued to be driven by the effect of syllable structure on vowel duration and the relationship between vowel quality and duration in tense and lax vowels. For instance, Féry (2003) builds her account of CSVL in French on the following assumptions: tense vowels are inherently long, lax vowels are inherently short; closed syllables do not allow long vocalic nuclei, open syllables do not allow short ones. Put together, these hypotheses derive the allophonic, syllable-conditioned distribution of tense and lax vowels (French /votɔ̃/\*-/vɔtɔ̃/ and /vɔt/\*-/vot/).

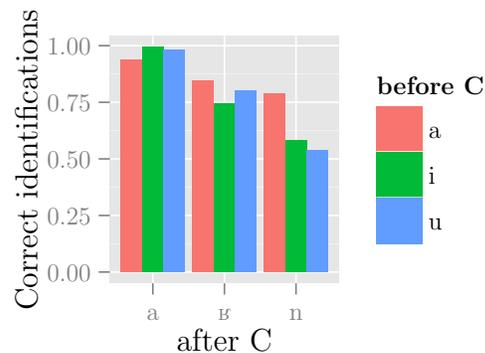
**Acoustic experiment.** This account predicts that if a language has tense and lax vowels in complementary distribution in open and closed syllables, then there should be a significant durational difference between the two series of vowels in this language. I present results of an acoustic experiment showing that this prediction is not borne out. The language used as a test case is a variety of Southern French spoken in Auvergne. Southern French has been argued to be a case of CSVL (Lyche 2003): tense vowels /eøo/ occur in open syllables only and lax vowels /ɛœə/ in closed syllables almost exclusively (open syllables followed by schwa pattern with closed syllables). Six male speakers of Auvergne French were recorded pronouncing nonce words with vowels /iyueøoa/ in unstressed and stressed open syllables, and nonce words with vowels /iyueœəa/ in unstressed and stressed closed syllables. Linear mixed effects models were fit to the acoustic data. The mid vowels were found to be significantly lower in closed than in open syllables as compared to the high and low vowels ( $\chi^2(9) = 77.7, p < 0.001$ ). These results support the claim that the distribution of mid vowels in this variety of French is a case of CSVL. However, the tense mid vowels were not found to be significantly longer than the lax ones ( $\chi^2(1) = 0.79, p = 0.37$ ), contrary to the prediction of the duration-based account of CSVL.

**Height-based account.** I propose an alternative analysis of CSVL where the relationship between vowel quality and syllable structure is not derived via duration, but via the role of vowel height in the perceptibility of consonant place contrasts. I propose that vowel lowering in closed syllables (e.g., /i/ → /ɪ/, /e/ → /ɛ/, etc...) is used as a repair to avoid having a sequence of a higher vowel followed by a coda consonant. Having a coda consonant preceded by a higher vowel would result in poorer identification of the coda consonant place. There is evidence that place contrasts are better identified between low vowels than between high vowels (Benoit et alii 1994) and after low vowels than after high ones in word final positions (Marty 2012). It remains to be shown whether place contrasts are less perceptible (i) in medial coda positions after high than low vowels (e.g., /i{p,t,k}na/ vs /a{p,t,k}na/) and (ii) in medial coda positions than in medial onset clusters after high vowels (e.g., /i{p,t,k}na/ vs /i{p,t,k}ɲa/).

**Perception experiment.** To test the predictions of the height-based account of CSVL, an online perception experiment with 13 French hearers was run. 27 nonce words of the form /as{a,i,u}{p,t,k}{a,ɲa,na}/ were recorded by a French speaker, with 4 repetitions for each word. The words were embedded in a carrier sentence and played to participants with a background noise with a signal-to-noise ratio of 5 dB. The percentage of correct place identifications across speakers as a function of the preceding vowel and the following context

is plotted below. A mixed effects logistic regression was run. As predicted under the height-based account of CSVL, the quality of consonant place contrasts was found to be the worst in coda positions preceded by high vowels /i/ and /u/ ( $p < 0.001$ ).

**Analysis of CSVL in Meridional French.** The allophonic distribution of tense and lax vowels in Meridional French is modeled with perceptual constraints in an OT framework (see Flemming 2004). Vowel laxing in closed syllables results from the interaction of vowel dispersion constraints and a constraint requiring that vowels be lowered before coda consonants lacking clear burst or good release transitions (see \*POORLY-CUEDC below).



- (1) \*POORLYCUEDC: Penalize a vowel preceding a consonant C lacking a clear burst or good release transitions proportionally to its height: assign 4 \* to high vowels (eg. /i/), 3 \* to lax high vowels (eg. /ɪ/), 2 \* to tense mid vowels (eg. /e/), 1 \* to open mid vowels (eg. /ɛ/) and 0 \* to low vowels (eg. /a/).

The inventory /ieøaou/ with tense mid vowels incurs 3 more violations of \*POORLYCUEDC in closed syllables than the inventory /iɛœaɔu/ with lax mid vowels, and hence is dispreferred in this context. To derive the inventory with tense mid vowels in open syllables, I propose a ranking of OT constraints deriving a default preference for good vowel dispersion along F2: the higher mid vowels /eø/ are more dispersed along F2 than the lower ones /ɛœ/ (as shown in the acoustic experiment), and then should be more distinct from each other. When the following consonant lacks a clear burst or good release transitions, this default preference is overridden by \*POORLYCUEDC and mid vowels are lowered. The final challenge is to understand why CSVL does not apply across the board in Meridional French (high vowels do not have lax counterparts). From a dispersion-theoretic perspective (Lindblom 1990), maintaining some tense vowels in closed syllables could be a way not to compromise dispersion along F2 too much. This might be particularly important for a language like French which has both front rounded and unrounded vowels. From a quantal-theoretic perspective (Stevens 1989), maintaining high vowels /i,y,u/ in closed syllables could be motivated by the need to maximize the number of acoustically stable vowels across contexts. More research on the typology of partial CSVL is needed in order to decide between these explanations.

**Benoit, C. et alii (1994).** Effects of Phonetic Context on Audio-Visual Intelligibility of French. In: *Journal of Speech, Language, and Hearing Research* 37; **Féry, C. (2003).** Markedness, Faithfulness, Vowel Quality, and Syllable Structure in French. In: *Journal of French Studies* 13; **Flemming, E. (2004).** Contrast and perceptual distinctiveness. In: *Phonetically-Based Phonology*; **Lindblom, B. (1990).** Explaining phonetic variation: A sketch of the H&H theory. In: *Speech Production and Speech Modeling*. **Lyche, Chantal (2003).** La loi de position et le français de Grenoble". In: *Corpus et variation en phonologie du français contemporain: méthodes et analyses*. **Marty, P. (2012).** The role of release burst in final stop perception (manuscript for CLS 2012). **Stevens, K. N. (1989).** On the quantal nature of speech. In: *Journal of Phonetics*