A contrast-based account of word-final tensing

1. Introduction. In some languages with tense-lax contrasts, tense and lax vowels are allowed to contrast in word-final syllables before consonants (e.g. Parisian French *rauque* [ʁok] 'hoarse' vs. *roc* [ʁɔk] 'rock') but not word-finally, where only tense vowels are permitted (e.g. Parisian French *maux*/*mot* [mo] 'evils'/'word' vs. *[mɔ]). What motivates word-final tensing in these languages?

Hyperarticulation has been suggested as a mechanism: (i) vowels are lengthened word-finally, (ii) lengthening results in vowels being hyperarticulated, and (iii) hyperarticulation results in vowels being more peripheral, i.e. closer to the acoustic targets of tense vowels (for an analysis along those lines, see Botma & van Oostendorp 2012). However, this proposal is problematic: hyperarticulation is expected to result in greater contrast distinctiveness but not in contrast neutralization (Flemming 2005). In particular, contra hypothesis (iii), hyperarticulated lax vowels do not get closer to their tense counterparts, but more distant from them (e.g. in French, underlying /ɔ/ gets lower and further away from [o] as it gets longer; Gendrot & Adda-Decker 2005).

2. Proposal. This paper proposes an alternative analysis according to which tensing is an indirect consequence of the loss of duration contrasts word-finally. Word-final positions are well known contexts for the neutralization of duration contrasts (Myers & Hansen 2007). In languages where tense and lax vowels differ both quality- and duration-wise, word-final neutralization of duration contrasts results in tense-lax pairs differing only quality-wise. If this quality difference is not sufficient to support a phonemic contrast, speakers might be reluctant to maintain the contrast in this context, resulting in neutralization of tense-lax quality distinctions word-finally. The preference for tense vowels in case of loss of quality distinctions can be explained as an effect of vowel dispersion: tense vowels are more peripheral in the F1/F2 space (Stevens 1998) and therefore should be more distinct from each other than lax vowels.

3. Predictions. The contrast-based account crucially predicts that word-final tensing should be observed only in languages where tense and lax vowels differ both in quality and duration. There is support for this prediction: languages reported to allow both tense and lax vowels before word-final consonants but only tense vowels word-finally happen to have tense-lax pairs differing in quality and duration, with tense vowels being more peripheral and longer than their lax counterparts (Stevens 1998 on Germanic, Gottfried & Beddor 1988 on Parisian French [o]-[ɔ]).

This paper tests yet another prediction of the contrast-based account: in a language using duration as a cue for tense-lax contrasts and allowing tense and lax vowels both in __C# and in __#, the durational cue to tense-lax contrasts is weaker in __# than in __C#. This prediction can be tested in languages that allow some tense-lax contrasts in both contexts, e.g. Swiss French. Swiss French differs from Parisian French in allowing [o] and [ɔ] to contrast both in __C# and in __# (e.g. [ʁok] vs. [rɔk], [mo] vs. [mɔ]). The contrast-based account predicts that the durational difference between [o] and [ɔ] will be larger in __C# than in __#.

To test this hypothesis, we used the acoustic data collected in Nyon (12 speakers) and Neuchâtel (13 speakers) in Switzerland by PFC (*Projet de phonologie du français contemporain*; Andreassen 2003, Racine & Andreassen 2012). These data include lists of words read by the 25 Swiss speakers
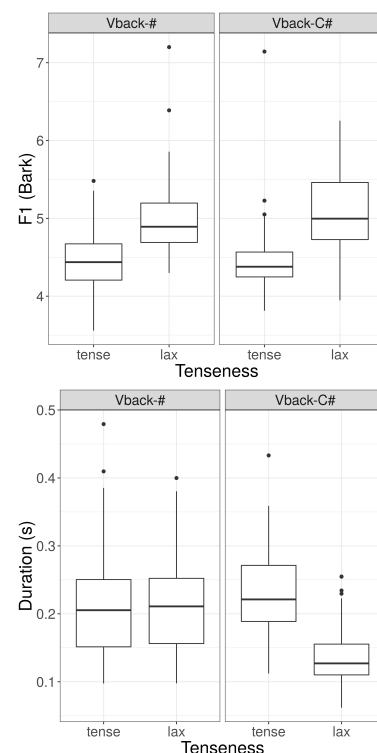
and with occurrences of /o ɔ/ in the relevant contexts. Vowel duration, F1, and F2 were measured. Mixed-effects analyses were carried out, with duration, F1, and F2 as dependent variables and tenseness (tense vs. lax), context (_# vs. _C#), and geographic origin as fixed effects (with all interactions). The models also included random intercepts for speaker, word, and segmental context. The results are compatible with the predictions of the contrast-based account (see figures): quality distinctions are maintained both word-finally and before word-final consonants ($p < .001$) but tense and lax vowels differ in duration only before word-final consonants ($p < .001$). Word-finally, tense vowels are not significantly longer than lax ones ($p = .46$).

4. Analysis. To model word-final tensing, we use Dispersion Theory (DT; Flemming 2002). In particular, we adopt the serial model introduced in Flemming (2008), where phonemes are selected in the inventory module and phoneme sequences are selected in a subsequent, phonotactic module. Assume that the inventory module has delivered a pair of tense and lax vowels differing both quality- and duration-wise (e.g. [oː ɔ]) and a single consonant (noted C). In the phonotactic module, the analysis selects the inventory of rimes (i.e. V# and VC# sequences) that realizes the best compromise among a set of phonological constraints, including distinctiveness constraints.

The candidate including all four rimes (i.e. (a) in the tableau) violates the constraint penalizing short vowels word-finally, i.e. *V#. Candidate (b) solves this problem by lengthening the lax vowel word-finally. However it does so at the cost of making vowel contrasts less distinct: lengthening of the lax vowel results in the loss of the durational difference between tense and lax vowels. This loss of distinctiveness is penalized by the distinctiveness constraint MinDist. This constraint assigns one penalty to vowel pairs differing both quality-wise and duration-wise and two penalties to pairs differing only quality-wise or duration-wise. Candidate (c) solves the problem of insufficient distinctiveness by neutralizing the tense-lax contrast all together word-finally. Candidate (d) also solves the problem with neutralization but it is worse than candidate (c) because it features a vowel with a lax quality word-finally and lax vowels are penalized by *Lax. (In this simplified analysis, *Lax is stated as a markedness constraint but, in a full analysis including other vowel qualities beyond [o ɔ], it could be stated as a distinctiveness constraint penalizing poor vowel contrasts.) The analysis also correctly predicts the asymmetry between _# and _C#: candidate (d) is harmonically bounded by candidate (c), as it gets rid of a tense-lax contrast in a context where it is not problematic phonotactically (i.e. in _C#) but maintains one in a context where it is problematic phonotactically (i.e. in _#, where the short vowel violates *V#). The analysis correctly derives the pattern of word-final tensing under the ranking illustrated in the tableau. But it can also derive the pattern attested in Swiss French, with tense and lax vowels differing only quality-wise word-finally (this pattern is derived when *V# and MaxContrast are top ranked).

	*V#	MinDist	*Lax	MaxContrast		Languages
(a) oː ɔ oːC ɔC	*	$*_{oː-ɔ}\,*_{oːC-ɔC}$	**	✓✓✓✓		?
(b) oː ɔː oːC ɔC		$**_{oː-ɔː}\,*_{oːC-ɔC}$	**	✓✓✓✓		Swiss French
☞ (c) oː oːC ɔC		$*_{oːC-ɔC}$	*	✓✓✓		Parisian French
(d) ɔː oːC ɔC		$*_{oːC-ɔC}$	**	✓✓✓	harmonically bounded	?
(e) oː ɔ oːC	*	$*_{oː-ɔ}$	*	✓✓✓	harmonically bounded	?

5. Conclusion. In this paper, it was proposed that word-final tensing is due to the indirect effect of word-final lengthening on vowel distinctiveness. A key prediction of this account was supported by data from Swiss French. The analysis also has deeper theoretical consequences: it makes a strong case for the inclusion of vowel duration (along with F1 and F2) in DT models of vowel-inventory selection.