

Variegated VC rime restrictions in Sinitic languages

Introduction: Restrictions on the nucleus+coda combinations have been conventionally analyzed as co-occurrence markedness constraints, e.g., RIME HARMONY [1] for Standard Chinese, or, *IK (*[-cons, +hi][+cons, +hi]) for Cantonese [2]. In this study, we argue that monolithic markedness constraints like the above are not only dispensable, but also pernicious to a typology of VC rime restrictions. Table (1) illustrates the points. First, no restrictions are found when (i) the nucleus vowel is /a/ and (ii) when the coda is “placeless” (-ʔ). Second, /e/ is more restricted in VC rimes among front vowels {i, e}. Finally, and more importantly, back vowels {u, o/ɔ} are in complementary distribution in Taiwanese VC rimes but that’s not the case for comparable VC combinations in Hakka (and Cantonese). These observations raise the question whether impermissible/non-existing VC rimes can merely be explained away by re-ranking markedness and faithfulness constraints for different languages/dialects. Equally remarkably, it is left unexplained in a markedness account as to why co-occurrence restrictions are absent *only* when the nucleus is, for example, vowel /a/.

(1)Taiwanese	-pʰ	-tʰ	-kʰ	-ʔʰ	Hakka	-pʰ	-tʰ	-kʰ	Cantonese	-pʰ	-tʰ	-kʰ
a	✓	✓	✓	✓	a	✓	✓	✓	{a, ɐ}	✓	✓	✓
i	✓	✓	✓	✓	i	✓	✓	×	i	✓	✓	✓
e	×	✓	×	✓	e	✓	✓	×	e	✓	×	✓
u	×	✓	×	✓	u	×	✓	✓	u	×	✓	✓
{o, ɔ}	✓	×	✓	✓	o	×	✓	✓	o	×	✓	✓

Working Hypotheses: Following [3] and references cited therein, we assume that, unlike many other languages, Chinese VC rimes involve a larger degree of coarticulation. That is mainly because Chinese codas are invariably unreleased across the board. Consequently, the nucleus vowel may serve as an “indicator” for the place of articulation of a coda, by means of (contrast-enhancing) vowel quality change. Meanwhile, vowel reduction (as a result of undershoot) occurs because vowel duration is significantly diminished in VC rimes. Taken together, vowel reduction, or, centralization, endangers vowel contrasts in VC rimes, hence the gaps (e.g., shaded cells with a × in Taiwanese). To this end, a duration-based analysis predicts that there should be significant difference between Taiwanese and Hakka/Cantonese in the acoustic properties of VC rimes, but not in the (dis-)preferred cooccurrence constraints.

Experiment: 10 native speakers of Taiwanese and 5 native speakers of Hailu Hakka (all male) participated in the experiments (Cantonese data are based on [4] and [5]). Meaningful monosyllabic words with all possible CV, CVN and CVS(top) combinations were embedded in a carrier phrase and repeated 10 times in a randomized order. The recordings were analyzed with Praat. Formant frequencies were normalized using the Lobanov method [6] and were subsequently converted back to Hz.

Results: There are several noteworthy observations in the results of our acoustic studies.

(2) Dur.	CV	CVS	CVS/CV=
Taiwanese	218ms	94ms	43%
Hakka	227ms	124ms	55%

Firstly, we can see from (2) that comparable CVS syllables are indeed significantly longer in Hakka than in Taiwanese ($p < 0.001$).

Secondly, vowel space shrinks in a decreasing order in these syllable structures: CV > CVN > CVS (NB: measurement taken at the midpoint of the nucleus vowel). The differences are again statistically significant ($p < 0.001$) in terms of (a) vowel space area and (b) formant centralization ratio in both Taiwanese and Hakka (not included here due to space limit, but see (3) and (4)). Finally, F1/F2 trajectories from the midpoint of the nucleus to the coda are plotted for Taiwanese (3) and Hakka (4). Some asymmetrical patterns are observed: (i) low vowel /a/ primarily undergoes raising in closed syllables, (ii) F2 movement of high vowels {i, u} is significant, leading to the

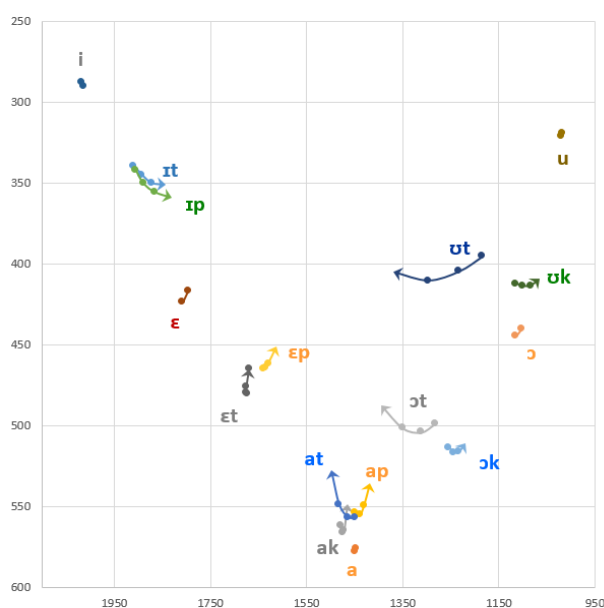
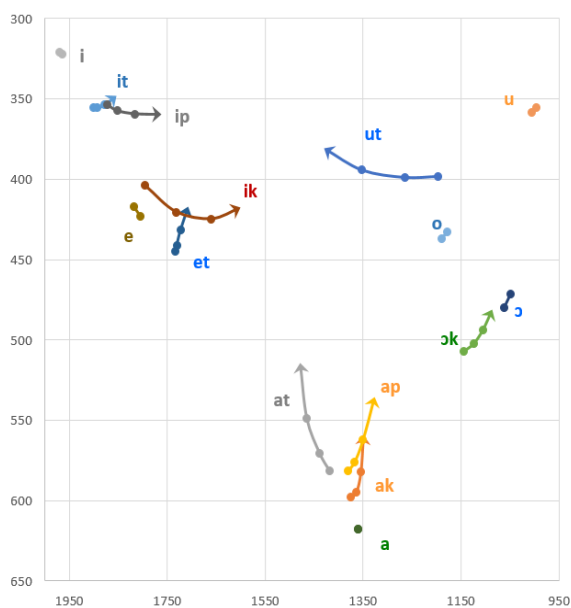
emergence of a diphthongized (short) vowel in these contexts, (iii) mid vowels {e, o} exhibit less pronounced formant movement, (iv) the magnitude of formant movement is significantly greater in Taiwanese than in Hakka (again, not included here due to space limit).

Discussion: Our results lend (partial) support to a duration-based account to variegated VC rime restrictions. On the one hand, the effect of vowel centralization is robust in closed syllables (probably as a result of target undershoot). Consequently, longer phonetic length in Hakka VC rimes help inhibit mergers such as {-ut, *-ɔt} or {*-uk, -ɔk} in Taiwanese (1). On the other hand, however, a closer examination reveals a tantalizing fact that diphthongization (or vowel gliding), presumably *more effortful* in articulation, is more pronounced in Taiwanese VC rimes. By contrast, vowel gliding is surprisingly less pronounced in Hakka VC rimes, which are in fact longer in duration (2). In other words, the above observations seem to vitiate the role of duration in vowel reduction, at least in Sinitic languages. Returning to the gap [*-ɔt, *-ɔk] in Taiwanese, phonological distinctiveness still plays a vital role here. More precisely, we see in (4) that [-ɔt/-ɔk] are pushed substantially downwards and remain sufficiently dispersed with respect to [ɔk] in Hakka. Why are these options not possible in Taiwanese (3)? Recall from (1) that *[-ɔk] vs. [-ɔʔ] is potentially possible in Taiwanese but *not* in Hakka (and Cantonese). Confusability increases especially when both [k] and [ʔ] are unreleased. Likewise, *[-ɔt] vs. [-ɔk] cannot be “repaired” by vowel gliding because formant movement is less pronounced for mid vowels, as summarized in Results.

Conclusion: In this study, we have shown that even in phonotactics, Sinitic languages are not homogenous as one might expect. From a perceptual perspective, we have argued why restrictions on Chinese VC rimes should be more stringently enforced. As a result, the gaps in Chinese VC rimes cannot be simply attributed to co-occurrence markedness constraints.

(3) Taiwanese (10 male speakers)

(4) Hakka (Hailu variety: 5 male speakers)



References: [1] Duanmu, S. 2007. *The Phonology of Standard Chinese*. 2nd edition. OUP. [2] Kenstowicz, M. 2012. Cantonese loanwords: conflicting faithfulness in VC rime constraints. *Catalan Journal of Linguistics* 11:65-96. [3] Hsieh, F.-F. 2010. Rhyme phonotactics in Taiwanese: A dispersion-theoretic perspective. *Proceedings of the 22nd NACCL and the 18th IACL*. Cambridge, MA: Harvard University (pp. 316-30). [4] Bauer, R. & P. Benedict. 1997. *Modern Cantonese Phonology*. Berlin: Mouton De Gruyter. [5] Zee, E. 2003. Frequency Analysis of the Vowels in Cantonese from 50 Male and 50 Female Speakers. *Proceedings of the 15th ICPHS*: 1117-1120. [6] Adank, P. et al. 2004. A comparison of vowel normalization procedures for language variation research. *JASA* 116.5: 3099-3107.