Variation in responses to conflicting articulatory targets in the Mandarin VN rimes

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Introduction: This work is an electromagnetic articulography (EMA) study of a well-established phonotactic constraint in Mandarin (and other Sinitic languages), i.e., Rime Harmony (RH), or, a constraint dictating that the nucleus and the coda agree in backness ([1]). RH is special in that (a) restrictions of this sort are not attested in other languages since generally restrictions are not levied on vowel-coda sequences, (b) there is cross-dialectal variation in implementing RH, and more importantly, (c) unlike many other languages, it is the *velar* coda, but not the previously claimed ones such as the uvular and liquid codas ([2]), that may involve in RH, the phonotactic constraint in question (cf. [3]).

Rime Harmony: Mandarin Chinese has five phonemic vowels, /i, y, ɤ, a, u/ and two nasal codas, /n, ŋ/. Only (phonemic) vowels /i, ɤ, a/ may precede the two nasal codas. The effect of RH may be illustrated with the case of the low vowel /a/.
(i) /An/ → [an] vs. /Aŋ/ →[ɑŋ] (where /A/ means an underlyingly unspecified low vowel)
In contrast, previous impressionistic and/or acoustic studies of Taiwanese Mandarin (TM), a variety of Mandarin, report that the coda nasals undergo place neutralization when the nucleus vowel is nonlow (/i, ɤ/). The patterns are summarized in (ii). Also, the neutralizing target may be either [in] or [iŋ], depending on different regional varieties ([4], *a.o.*).

(ii) Taiwanese Mandarin	/in/	/iŋ/	/ɤŋ/	/ɤn/→[ən]
Velarization	[iŋ]	N/A	N/A	N/A
Conorization	N/A	[in]	[ən]	N/A
(iii) Standard Chinese	N/A	[iᵊŋ]	N/A	N/A

Coronization, at first blush, may be treated as a "conflict" between an advanced tongue body target for the nonlow vowels (/i, ɤ/) and a retracted target for the following tongue dorsum constriction for /ŋ/, although it is less clear how velarization may be analysed in a similar fashion. Therefore, the first goal of this study is to investigate if the variation in (ii) can be instrumentally confirmed with the help of EMA. It is also remarkable that both coronization and velarization have never been reported for the VN rimes in Standard Chinese (SC; a.k.a. Beijing Mandarin). The specific conflict is resolved by yet another possible strategy: an "excrescent schwa," i.e., [iᵊŋ] in SC ([1], [2], *a.o.*). An articulatory study of the cross-(sub)dialectal variation helps better understand the nature of variation.

Method: Four speakers of Standard Chinese (SC) and six speakers of Taiwanese Mandarin (TM) participated in the study (aged 20-26 y.o.). They are all monolingual speakers, meaning that they don't speak any other Chinese dialects. Kinematic data were captured using an NDI Wave with a sampling rate of 100 Hz and acoustic data were simultaneously collected during the experiments. All possible monosyllabic words containing the five monophthongs {/i/, /y/, /a/, /ɤ/, /u/} and the two nasal codas {/n/, /ŋ/} were embedded in the carrier phrase: "mà ___ ba." 'Scold ___ SFP' and were produced, together with the other fillers, ten times in a randomized order. Articulatory data are processed (specifically, x=front-back; z=up-down in mm.) of the sensors attached to the tongue tip (TT), tongue blade (TB), tongue dorsum (TD), upper and lower lips (UL, LL), with the help of MView. Following [5]'s method, the trajectories of the sensors attached on the articulators in multiple dimensions over time are reconstructed, and individual variation may also be compared accordingly.

Results: From Figure 1 (Left), the data from two representative speakers show that in /pan/ and /paŋ/, TD moves upwards in SC but that's not case in TM. In Figure 1 (Right), we see

that there is an obvious back-to-front movement of TD in TM's /kɤn/; otherwise, the two varieties of Mandarin pattern alike.

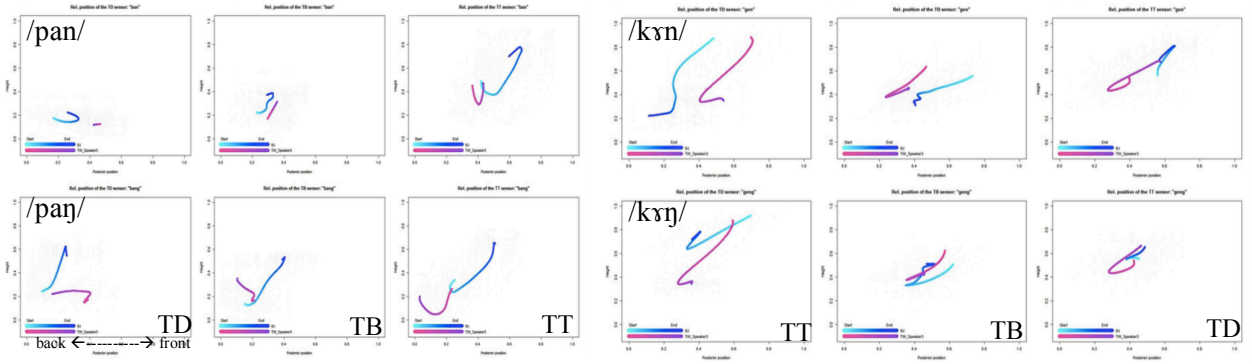

Figure 1. *Trajectoires for pan/paŋ (Left) & kɤn/kɤŋ (Right)*: SC in Blue and TM in Red; Light color means the beginning of the syllable, dark colored part the end of the syllable.

Regarding /iN/ rimes, cross-dialectal variation can be identified in Figure 2. Type 1 (Left) shows the so-called coronization in TM (see (ii)), whereas /pin/ and /piŋ/ in SC and TM pattern alike in Type 2 (Right). Notably, substantial back-to-front movement of TB occurs in both SC and TM in Type 2 (Right), suggesting a possible presence of the excrescent schwa (iii). Finally, velarization in (ii) is not confirmed in the present results (cf. [4]).

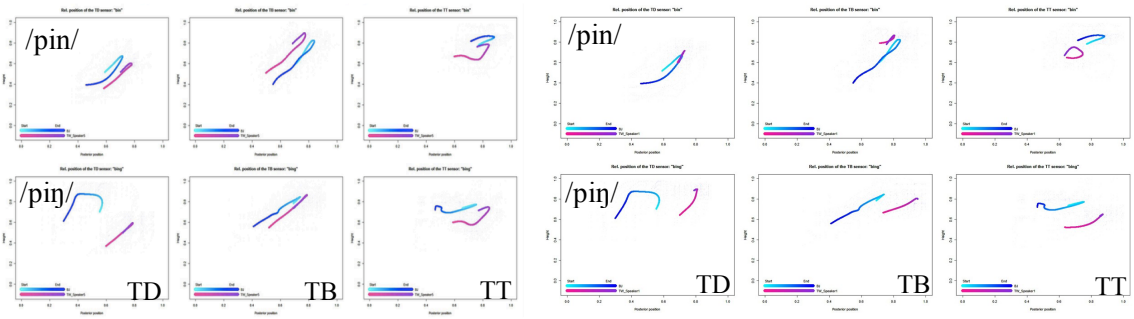

Figure 2. *Trajectoires for pin/piŋ*: Type 1*(Left)* vs. Type 2 *(Right)*: SC in blue and TM in red

Discussion : Our results indicate that the nasal codas in {/ɤn/, /in/} and {/ɤŋ/, /iŋ/} may be neutralized (Figure 1, Right and Figure 2, Left, both TM in red) and the neutralizing target is coronal. In other words, the velar may be fronted in the wake of contextual influences (see [3], *a.o.*). On the other hand, the velar may also be resistant to coarticulatory pressure, resulting in an excrescent schwa (see (iii) and Figure 2 Type 2, SC in blue). In conclusion, it is remarkable that the velar can be articulatorily "resistant" in Mandarin, resulting in a typologically distinct phonotactic constraint from other (non-East Asian) languages.

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[5] Wieling, M., Tomaschek, F., Arnold, D., Tiede, M., Bröker, F., Thiele, Wood S., & Baayen, R. H. 2016. Investigating dialectal differences using articulography. *Journal of Phonetics*, 59, 122-143.