Rapid sound change and regional variation: /an/-rime nasalance in the Chengdu and Chongqing varieties in Southwestern Mandarin

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Anticipatory nasalization in the vowel-nasal (VN) sequence often leads to the reduction of the nasal coda consonant (Ohala & Busa, 1995), resulting in either a nasal vowel Ṽ (Rochet, 1976) or a shifted oral vowel V' (Cresci, 2019). Chéng-Dū (CD, 成都) and Chóng-Qìng (CQ, 重庆) are two metropolitan areas in southwest China, both as varieties of the Chéng-Yú (成渝) sub-group within the Chuān-Qián (川黔) group of Southwestern Mandarin (SWM, 西南官话) (Li, 2009). It was reported that both the nasal coda and any nasalization of /an/-rime have been lost in the CD variety, accompanied by a raising and fronting of the pre-nasal vowel (i.e., /an/→/ɛ/) (Liao et al., 2022, 2023). There is some evidence that this is a phonetically motivated sound change in progress (Liao et al., 2024a, 2024b). The goal of this study was to investigate the extent of nasalization of /an/-rime words across two generations and the CD and CQ regions.

For this purpose, we analyzed data from 20 CD and 16 CQ speakers from sex-balanced old (mean age: 58) and young (mean age: 22) age groups. The speech materials consisted of 36 tokens per talker (1296 tokens in total) formed from (CG)V(N) with C = /t, t^h, p, p^h/, G =/ø, j, w/ and with rimes = /a, an, aŋ/. The four lexical tones were equally distributed within each of the final categories. Each participant was recorded with a nasalance device, separating speech signals from the oral and the nasal cavity. The amplitude of the nasal and oral channels was extracted for the sonorant (G)V(N) interval. The nasalance score for each observation was calculated from $A_n/(A_n+A_o)$, resampled to 100 data points and `lowess` smoothed (Cleveland, 1979). Each of these signals was DCT-transformed from which the DCT coefficients k_0 and k_2, which are proportional to the signals' mean and curvature (Harrington, 2010), were extracted. The extent of nasalization in the syllable final was assessed by calculating separately for each speaker the relative proximity of all tokens in the $k_0 \times k_2$ space to the so-called oral and nasal anchors using the orthogonal projection ratio (*op*) (Stevens et al., 2019). The anchors were the mean values across the same speaker's (nasal) /aŋ/- and (oral) /a/-rime. *Op* values of −1 and +1 denote that tokens were coincident with the oral and nasal anchors respectively.

The test was of whether the extent of nasalization in /an/-rime was affected by age group and region. For this purpose, a mixed model was applied with *op* values of /an/-rime as the dependent variable, DIALECT and AGE_GROUP as the fixed interacting factors, and the SPEAKER, GLIDE, and TONE as the random factors. The boxplots in the bottom panel of Fig. 1 shows (predictably) values around −1 and +1 for oral /a/- (blue) and nasal /aŋ/- (black) rimes. For /an/-rime (red), the boxplots show less nasalization in the CD than in the CQ variety and less nasalization for young than for old CD speakers (compare the red boxplots in the right panels). Compatibly, the statistical analysis showed that the *op* ratio for /an/-rime was significantly influenced by AGE_GROUP ($p < 0.01$), DIALECT ($p < 0.001$), and with AGE_GROUP significant in the Chengdu ($p < 0.001$) but not in the Chongqing variety.

The analysis has shown that the Chengdu but not the Chongqing variety is undergoing nasal loss in /an/-rime words. In addition, the results show a sound change in progress, given that there is less nasalization for younger than for older Chengdu speakers. We suggest the possibility of a continuum of denasalization of /an/-rime nasalance in the Sichuan basin, with younger Chengdu speakers taking the lead.
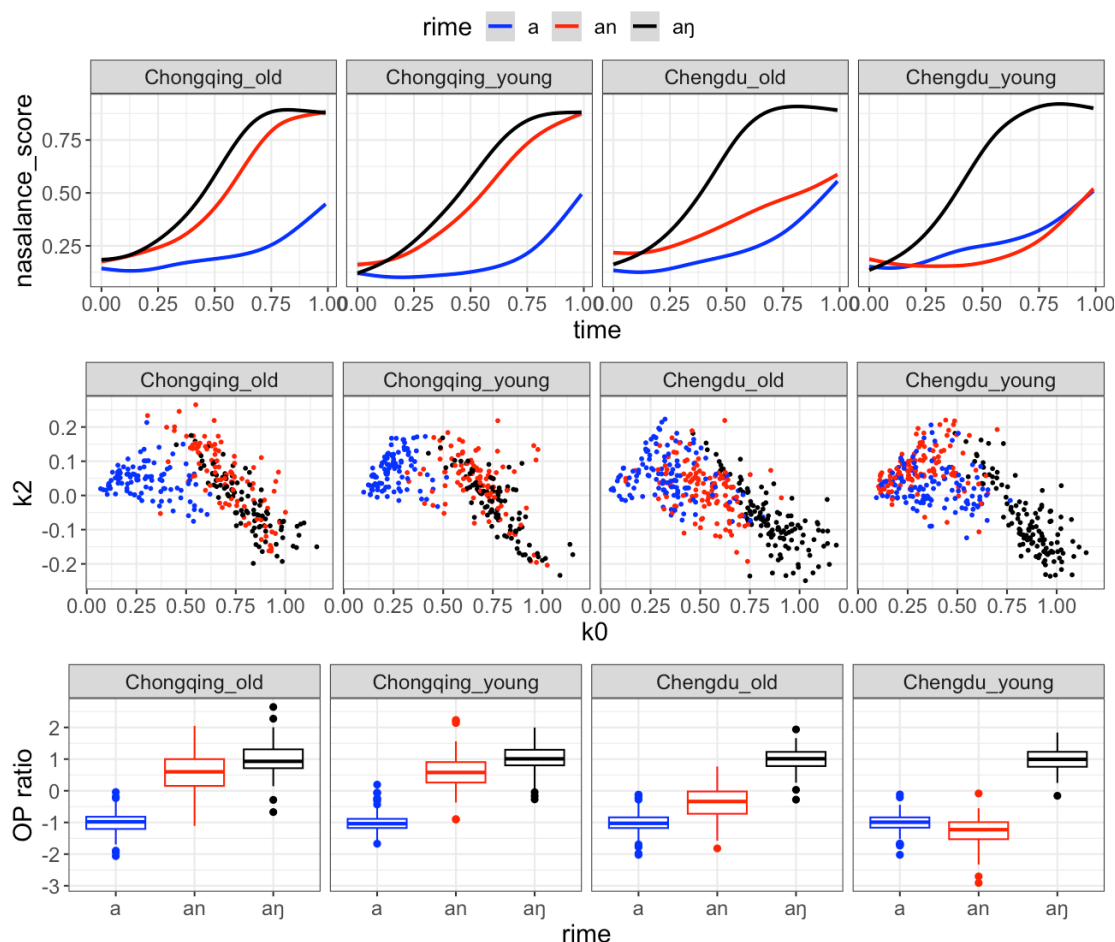
Fig.1. Top: nasalance score as a function of time in each speaker group; mid: the tokens distributed in the k0 × k2 space; bottom: box plots of the *op* ratio (proximity to +1/−1 denote closer to /a/-rime or /aŋ/-rime anchors).

References

Cleveland, W. S. (1979). Robust Locally Weighted Regression and Smoothing Scatterplots. *Journal of the American Statistical Association*, *74*(368), 829–836. https://doi.org/10.1080/01621459.1979.10481038

Cresci, M. (2019). VN > V in Camuno: An alternative historical pathway to nasal loss. *Italian Journal of Linguistics*, *31*(1), 61–92. https://doi.org/10.26346/1120-2726-132

Harrington, J. (2010). *Phonetic Analysis of Speech Corpora*. Wiley-Blackwell.

Li, L. (2009). Xi'nan Guanhua de Fenqu [Classification/Distribution of Southwestern Mandarin]. *Fangyan [Dialect]*, *1*, 72–87.

Liao, S., Hoole, P., Cunha, C., Kunay, E., Cui, A., Shigemori, L. S. B., Kleber, F., Voit, D., Frahm, J., & Harrington, J. (2022). *Nasal Coda Loss in the Chengdu Dialect of Mandarin: Evidence from RT-MRI*. Interspeech. 1347–1351.

Liao, S., Hoole, P., & Harrington, J. (2023). The relationship between vowel change and nasal loss in the chengdu dialect of mandarin Chinese: Evidence from RT-MRI. In R. Skarnitzl & J. Volín (Eds.), *Proceedings of the 20th ICPhS* (pp. 1072–1076). Guarant International.

Liao, S., Hoole, P., & Harrington, J. (2024a). *A sound change happening in just one generation: Nasal coda lost in the Chengdu variety of Southwestern Mandarin*. 13th International Seminar on Speech Production (ISSP2024), Autrans, France.

Liao, S., Hoole, P., & Harrington, J. (2024b). *Comparison of Velum Movement in /an/-rime Words between Chengdu Variety and Standard Mandarin using rt-MRI*. 13th International Seminar on Speech Production (ISSP2024), Autrans, France.

Ohala, J. J., & Busa, M. G. (1995). Nasal loss before voiceless fricatives: A perceptually-based sound change. *Rivista Di Linguistica*, *7*, 125–144.

Rochet, B. L. (1976). The formation and evolution of the French nasal vowels. *The Formation and Evolution of the French Nasal Vowels*. https://doi.org/10.1515/9783111328287

Stevens, M., Harrington, J., Schiel, F. (2019). Associating the origin and spread of sound change using agent-based modelling applied to /s/-retraction in English. *Glossa*, *4*(1). https://doi.org/10.5334/GJGL.620