Nasality and Nasal Excrescence of the Nasal Vowels in Shanghai Chinese

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The nasal vowels of Shanghai Chinese (Shanghainese) have been described using a range of distinct transcriptions and analyses. These differences reflect both present-day interspeaker variations, as well as sound change throughout the past century. Three general classes of transcription can be found, including (i) phonemic nasal vowels which occur in the absence of nasal coda consonants, transcribed as [Ã][1] or [ã ɔ̃] [1-3], (ii) nasal vowels followed by a weak [ɲ] or [ŋ], transcribed as [Ãⁿ] or [ãᵑ] [4, 5], which may show only partial nasalization [4], and (iii) contextually nasalized vowels followed by [ŋ] [6, 7]. There is insufficient acoustic and articulatory data to decide between these conflicting accounts, however. This study examines the acoustic and articulatory configuration of the Shanghainese nasal vowels, with the aim of understanding the phonetic features of nasal vowels in general.

The presence of coda [ŋ] following Shanghainese nasal vowels [6, 7], as well as partial vowel nasalization [4], raises the possibility that [ã$^{(ŋ)}$ ɔ̃$^{(ŋ)}$] are in fact contextually nasalized, and/or that the historical nasal coda was never fully dropped during VN → Ṽ sound change. Beddor [8] observes for English that the duration of vowel nasalization is negatively correlated with coda nasal duration. She attributes this finding to variability in the timing of velar lowering, while the velum gesture itself exhibits a constant duration. A similar pattern may be predicted for Shanghainese if vowel nasality is the result of contextual nasalization. On the other hand, incomplete vowel nasalization and coda nasal consonants may also arise as the result of nasal excrescence, in which coda nasal consonants are introduced or restored in a Ṽ → VN sound change. Cross-linguistic data show that excrescent nasals are typically velar, which are favored on perceptual grounds [9, 10]. In Portuguese, nasal vowels with excrescent nasal consonants show varying degrees of nasalization (e.g., [11]), although the proportion of vowel nasalization has not been found to correlate with nasal consonant duration [12]. This study therefore seeks to determine (i) whether Shanghainese nasal vowels show full or incomplete nasalization, (ii) whether they are realized with or without a following nasal consonant, (iii) whether the duration of vowel nasality correlates with that of a following nasal consonant, and (iv) the place of articulation of the following nasal consonant.

Data from 6 native speakers of Shanghainese (3 men, 3 women) were analyzed. All speakers were born and raised in urban Shanghai through age 18 and predominantly speak Shanghainese with their families. Speakers were asked to recite a word list containing 17 (near) minimally contrastive sets containing [a ɐ ã$^{(ŋ)}$ ɔ̃$^{(ŋ)}$] in (C)V and (C)Vʔ syllables, as well as 57 fillers. Each set was composed of four words, e.g., [aɦ] 鞋 “shoes”, [ɐʔɦ] 匣 “box”, [ã$^{(ŋ)}$ɦ] 杏 “apricot”, [ɔ̃$^{(ŋ)}$ɦ] 項 “item”. Words were uniquely pseudo-randomized, and each word was repeated four times in succession. The experimental setup resembled that of Carignan [13]. Simultaneous ultrasound (SonoSpeech Micro in AAA at 84 fps), nasalance (Glottal Enterprises NAS Separator Handle), electroglottographic (Voce Vista), lip video (at 60 fps), and acoustic data were recorded.

Nasalance was measured at 20% intervals throughout the vowel duration and was calculated as the ratio (A_N / (A_O + A_N)) of the RMS amplitude of the oral (A_O) and nasal (A_N) channels; a higher value indicates greater nasalization. SSANOVA was used to compare the oral and nasal vowels. Mean nasalance during each speaker’s production of oral [a] served as baseline for determining the onset of nasalization. Nasalization was considered to begin at the point when nasalance exceeded the baseline. This point was used to calculate the duration of vowel nasalization throughout the vowel excluding any nasal codas. To examine the place of articulation of the nasal consonant, ultrasound tongue contours were extracted at a single point during the nasal consonant. Reference tongue contours extracted during the stops [t k] (which preceded a low vowel) were

[1] In Chinese studies, the central low vowel [ä] is usually transcribed as [A].

analyzed and compared using polar SSANOVA. Shading around the splines indicates 95% confidence interval and overlap of the shading suggests no significant difference.

Data for the two Shanghainese nasal vowels [ã$^{(ŋ)}$ ɒ̃$^{(ŋ)}$] are presented separately, although results indicate that the two vowels are merged for all speakers. Observed in 96% of tokens, the nasal consonants are velar or post-velar nasal approximants. Representative results for the nasal consonant from a single speaker are presented in Figure 1. Nasalance data presented in Figure 2 reveal that both nasal vowels (which overlap) show little nasalization in the first fifth of their duration and steadily increasing nasality thereafter. This pattern differs from French, in which nasal vowels show a high degree of nasalance as early as the vowel onset [13]. Although this finding indicates that the Shanghainese nasal vowels are only partially nasalized, there is no clear relationship between proportion of vowel nasality and duration or presence of the nasal consonant. A linear mixed effects regression model with fixed effects of nasal consonant duration, vowel, and tone, as well as random effects of speaker and word, was constructed. ANOVA comparison of two models with and without the fixed effect of consonant duration shows no significant difference in model fit ($\chi^2(1) = 0.09, p = 0.77$). Individual speaker data (Figure 4) indicate that while the duration of nasalization varies, duration of the nasal consonant remains relatively stable, suggesting variable duration of the velar lowering gesture. This pattern more closely resembles the nasal vowels of Portuguese [12] than the nasalized vowels of English [8]. While it remains to be determined to what extent the English and Portuguese patterns generalize to other languages, it is possible that the velar/postvelar nasal consonant in Shanghainese, which has weak consonantality [14], was appended as a result of misperception between nasalized vowels and back nasal consonants [9].

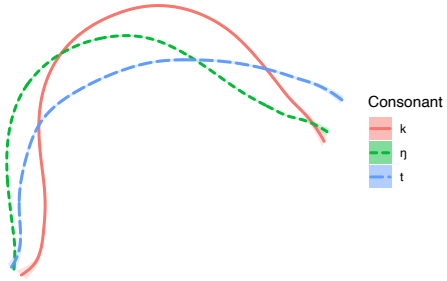

Fig.1 Polar SSANOVA tongue contours of nasal consonant [ŋ] comparing with stops [t k]; the tongue root is to the left.

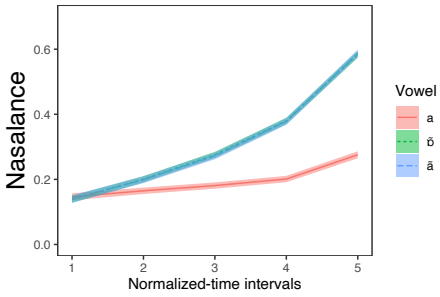

Fig.2 Nasalance of 6 speakers; the two nasal vowels are compared with the oral vowel [a].

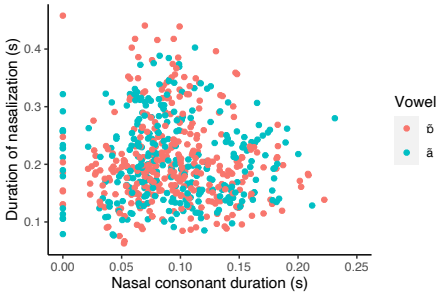

Fig.3 Scatter plot of nasalization duration and nasal consonant duration (zero duration indicates no nasal consonant).

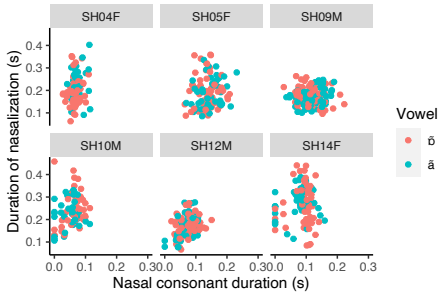

Fig.4 Duration data of individual speakers.

References:

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