

Consonant F_0 is not intrinsic perturbations:

A case study of Nuosu Yi

Yubin Zhang

Department of Linguistics, University of Southern California, Los Angeles, CA, USA

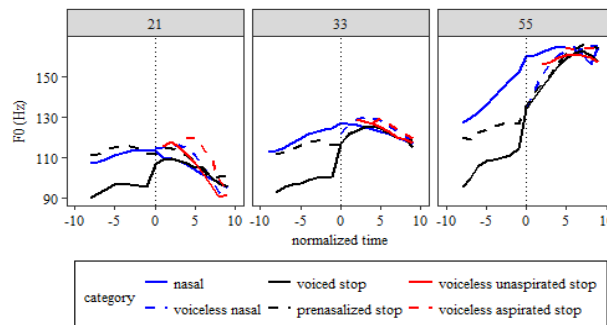
1. Theoretical background

The speech F_0 is altered by consonantal characteristics¹— a phenomenon known as ‘intrinsic consonant F_0 ’ (CF_0 hereafter). For instance, F_0 is low and rising immediately after voiced stops, whereas it is high and falling immediately after voiceless stops². Some classical phonological and sound change theories describe CF_0 as ‘unintended and unplanned intrinsic by-product’ (e.g., Hyman, 1976). However, this view cannot explain why CF_0 is not always language-universal. For example, it is still debated whether voiced nasals are F_0 depressors while voiceless nasals are F_0 raisers⁴. Burmese voiced/voiceless nasals seem to fit this CF_0 pattern⁴, but the generalizability of this finding remains to be explored. In addition, the CF_0 of prenasalized stops has been reported to be inconsistent across languages^{5,6}. Another challenge is that CF_0 varies across prosodic or tonal contexts. For instance, high tones in tonal languages seem to induce the largest CF_0 effects². Thus, a better understanding of CF_0 in cross-linguistic voicing contrast may be achieved by conceptualizing the surface CF_0 as the acoustic output of the language-specific laryngeal consonant gestures controlling phonation and their language-specific coordination with tonal/phonatory gestures^{7,8}.

2. The current study

The current study examines the CF_0 in different tonal contexts in Nuosu Yi, a Loloish-Burmese language spoken in southern China. The goal of this study is to provide more empirical data for the CF_0 of prenasalized voiced stops, voiced nasals and voiceless nasals, and tentatively explore the underlying laryngeal gestures and their coordination with tonal gestures. Seventeen consonants (3 places: bilabial, alveolar, and velar x 6 manners: voiced stops, voiceless unaspirated stops, voiceless aspirated stops, prenasalized voiced stops, voiced nasals and voiceless nasals, excluding voiceless velar nasals) were combined with three vowels (i, a and u) and three tones (H, M and L) to yield a list of 136 monosyllabic words or morphemes. As of now, one native speaker of Standard Nuosu Yi was instructed to read each item twice in isolation.

3. Results and discussion



Voiced nasals in Nuosu Yi exhibit a rising F_0 contour for all three tonal contexts both during and immediately after the oral closure, but the rising contour in this language may not indicate a low CF_0 for voiced nasals. It could be that a higher tonal target needs to be reached from a default resting state of the glottis, which may further explain why tonal targets seem to be reached relatively early for voiced nasals, especially in M and H tone contexts. Compared with voiced nasals, voiced stops exhibit a global rising F_0 contour beginning at an extremely low value. A local convex F_0 contour is also superimposed on the early portion of the global trajectory. This pattern might be explained by the possible interaction between the voicing gesture involving larynx lowering⁹, and the lexical tone gestures, i.e., a low tone gesture involving larynx lowering or a high tone gesture involving larynx raising and/or cricothyroid muscle activations¹⁰. Compared with voiced nasals, the F_0 trajectory of voiceless stops generally falls from a relatively high value, especially in the L and M tone contexts. This might be caused by a higher-pitched devoicing gesture by engaging the cricothyroid muscle¹¹ and its interaction with different tonal gestures. Prenasalized stops lie between voiced stops and voiced nasals in terms of CF_0 , especially in M and H tone contexts. This result is broadly consistent with Chichewa CF_0 data, but contradicts Shona CF_0 data^{5,6}. The discrepancy may be due to the timing differences in oral and nasal components of prenasalized stops across languages¹². For voiceless nasals, the F_0 at voicing onset seems to be low initially, especially in M and H contexts. This result contradicts the finding that CF_0 is higher for voiceless nasals than for voiced ones in Burmese. The variegated internal structure of voiceless nasals across languages¹³, or/and presumably the distinct laryngeal gestures underlying voiceless nasals may account for this discrepancy. In summary, the results suggest that CF_0 cannot be directly inferred from the symbolic segmental representations. Rather, probing the consonant laryngeal gestures and their coordination with other tonal/phonatory gestures may be required to fully understand the CF_0 phenomenon^{7,8}.

References

1. House AS, Fairbanks G. The influence of consonant environment upon the secondary acoustical characteristics of vowels. *J Acoust Soc Am.* 1953;25(1):105-113.
2. Hombert J-M, Ohala JJ, Ewan WG. Phonetic explanations for the development of tones. *Language (Baltim).* 1979;55(1):37.
3. Hyman LM. Phonologization. In: A J, ed. *Linguistic Studies Offered to Joseph Greenberg.* Saratoga, CA: Anma Libri; 1976:407-418.
4. Maddieson I. The effects on F_0 of a voicing distinction in sonorants and their implications for a theory of tonogenesis. *J Phon.* 1984;12(1):9-15.
5. Chavez-Peon ME. The effects of implosives and prenasalized stops on pitch in Shona. *J Acoust Soc Am.* 2005;117(4):2461-2461.
6. Cibelli E. The phonetic basis of a phonological pattern: Depressor effects of prenasalized consonants. In: *The Phonetics-Phonology Interface.* ; 2015:171-192.
7. Cho T, Whalen DH, Docherty G. Voice onset time and beyond: Exploring laryngeal contrast in 19 languages. *J Phon.* 2019;72:52-65.
8. Goldstein L. Representation of voicing contrasts using articulatory gestures. *J Phon.* 1986;14:339-342.
9. Honda K, Hirai H, Masaki S, Shimada Y. Role of vertical larynx movement and cervical lordosis in F_0 control. *Lang Speech.* 1999;42(4):401-411.
10. Moisik SR, Lin H, Esling JH. A study of laryngeal gestures in Mandarin citation tones using simultaneous laryngoscopy and laryngeal ultrasound (SLLUS). *J Int Phon Assoc.* 2014;44(01):21-58.
11. Löqvist A, Baer T, McGarr NS, Story RS. The cricothyroid muscle in voicing control. *J Acoust Soc Am.* 1989;85(3):1314-1321.
12. Cohn A, Riehl A. The internal structure of nasal-stop sequences: Evidence from Austronesian. *Lab Phonol.* 2008:1-20.
13. Bhaskararao P, Ladefoged P. Two types of voiceless nasals. *J Int Phon Assoc.* 1991;21(2):80-88. doi:10.1017/S0025100300004424