FRICATIVE RHOTICS IN NUSU

Elissa Ikeda & Sigrid Lew

Department of Linguistics, Payap University, Chiang Mai, Thailand
elissa.ikeda@gmail.com; sigrid_l@payap.th.ac

ABSTRACT

Among the world's languages fricatives are the rarest types of rhotics. They are found in a few African and European languages [13] and as allophones in some Romance languages [4, 8, 9, 12, 17]. Data from Nusu demonstrate the presence of rhotic alveolar fricatives in Asia. Even though they have sometimes been transcribed as retroflex sibilants in earlier studies [11, 20], phonotactic patterns suggest an interpretation as rhotics. A spectrogram comparison of Nusu alveolar sibilant and non-sibilant fricatives shows that the sibilant criterion of increased spectral intensity for higher frequencies is not met for the postulated rhotic. The tradition of interpreting alveolar fricatives as sibilants might at least partially be caused by the gap for non-sibilant alveolar fricatives in the chart for the International Phonetic Alphabet. The Nusu data and evidence from other Tibeto-Burman languages provide further support for Whitley's [22] plea for a more comprehensive treatment of rhotics.

Keywords: alveolar fricatives, retroflex sibilants, non-sibilant fricatives, rhotics, Tibeto-Burman.

1. INTRODUCTION

Nusu is a Tibeto-Burman language spoken in Southwestern Yunnan Province, China and Northeastern Kachin State, Myanmar. Most likely it belongs to the Loloish subgroup [3], also referred to as Yi or Ngwi [4]. Previous analyses of Nusu conflict in their portrayals of the rhotic as both an initial and medial consonant in clusters [20], or as merely occurring in consonant clusters [11]. Both sources also postulate initial sibilants /z̨/ and /ʐ̨/. The Nusu varieties under study have the alveolo-palatal sibilant /ʑ/ but the sound transcribed previously as initial [z̨] can be interpreted as a rhotic non-sibilant fricative allophone. We utilize wordlists from five varieties to establish the dialectal and allophonic variation of the Nusu rhotic. These include an apicoalveolar approximant [ɹ], and palatalized approximant [ɹʲ], a voiced non-sibilant fricative [ɻ̝], and a voiceless non-sibilant fricative [ɻ̊]. The divergence in the interpretation of alveolar fricatives might partially be caused by the tradition of transcribing alveolar fricatives as sibilants. This study seeks to challenge this practice by giving evidence that the segment in question is a non-sibilant fricative with rhotic status.

The case for non-sibilant fricative rhotics in Nusu is presented by first giving evidence that the fricatives in question should be treated as rhotics based on phonotactic features. Acoustic data show the range of approximant and fricative realizations of Nusu /r/. Finally, an acoustic comparison shows that the fricative rhotics lack the intensity in higher frequencies expected for sibilants. Evidence from other Tibeto-Burman languages is presented to demonstrate the challenges faced in transcribing alveolar non-sibilant fricatives.

2. METHODOLOGY

Data for this paper are drawn from wordlists of 461 basic vocabulary items recorded in five Nusu varieties as spoken in Myanmar: Myagu, Topya, Wawa, Zileng, and Yotolo. Rhotic consonants were identified in 90 words in which a rhotic consonant occurred in the corresponding word across at least two Nusu varieties, or the word was transcribed with a rhotic consonant [r] in one of the previous linguistic descriptions of Nusu. Speech Analyzer 2.7 (SIL 2005) software was used for acoustic analysis of the Topya and Myagu data. Fricatives were distinguished from approximants by aperiodicity [4, 8] and evidence of increased turbulence in the spectrogram. In turn, fricatives were differentiated from sibilants by spectral peak measures below 3000 Hz [8, 18, 22].

3. THE NUSU ALVEOLAR RHOTIC

Rhotics cannot be seen as a phonological class on the basis of articulatory properties because their places and manners of articulation vary greatly [13, 15] and can often only be linked to other types of rhotics through synchronic and diachronic variation, especially in languages with uvular rhotics such as German, French, or Portuguese [23]. Rather, it is phonotactics and shared phonetic features of rhotic subsets that constitute the main arguments for grouping rhotics together. This includes lack of positional constraints like (a) being the only medial consonant allowed in a cluster [13] and (b) their

position within a syllable not being limited by their degree of constriction as in Dutch and German [23]. Importantly, rhotics may phonetically be more obstruent-like and still pattern as sonorants in Czech, French, Spanish, and German [1, 7, 23]. The same is true for Nusu.

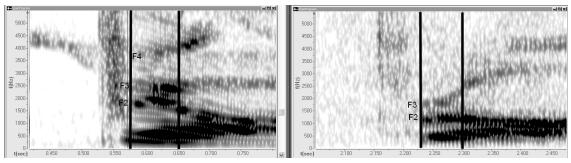
3.1. Phonotactic evidence

The Nusu alveolar non-sibilant fricative under study is variably realized as an alveolar approximant or fricative, but it patterns as a sonorant. First, it is found as the second segment in consonant clusters, a position available to the semivowels /j, w/ but not to obstruents. Second, it occurs preglottalized as in /ˀɹɯɯ^{33}/ ‘retract’. Other preglottalized initials are restricted to voiced nasals, the voiced lateral, and semivowels as in /ˀwər^{53}/ ‘wet’, /ˀni^{53}/ ‘twist’, /ˀlɑ^{53}/ ‘turn something over’, /ˀju^{53}/ ‘person’. The phonotactic patterning of the alveolar non-sibilant fricative suggests that this alveolar fricative patterns like a sonorant, not an obstruent, and should be viewed as a rhotic instead of a sibilant. The transcription as a voiced retroflex sibilant [11, 20] appears to be based on the clearly audible frication but has no phonotactic grounds.

3.2. Phonetic realization

The Nusu rhotic has approximant as well as voiced and voiceless fricative allophones. Fig. 1 shows a palatalized [ɹʲ] in Myagu Nusu and an alveolar approximant [ɹ] in Topya Nusu. The creaky Topya syllable on the right shows the drastic F3 lowering typical of rhotics.

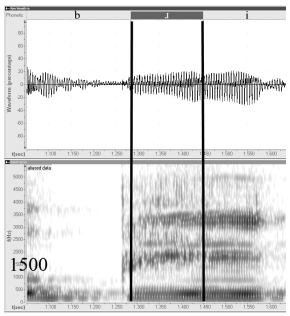
Figure 1: Approximant variants in /pɹɟ^{55}/ ‘fly (n.)’



In the palatalized Myagu rhotic on the left, F3 stays low, indicating a retroflexed or retracted tongue tip. In addition, the degree of periodicity is similar to that of the vowel. The high degree of periodicity is characteristic for approximants and not found in sibilants [4, 8].

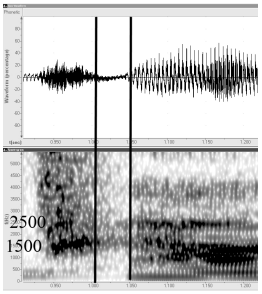
Fig. 2 illustrates a voiced fricative realization of the Nusu rhotic which frequently occurs in the context of closed and mid vowels. The spectrogram reveals greater turbulence indicating frication. The highest intensity is in the middle frequencies, not the upper frequencies as for sibilance.

Figure 2: Voiced fricative [ɻ̬] in /bɹi^{33}/ ‘river’ (Myagu)



In the Myagu variety, /ɹ/ is realized as a voiceless fricative allophone [ɻ̊] in clusters with /p^{h}/ as in [bɔ^{33}p^{h}ɻ̊a^{33}] ‘cockroach’ (see Fig. 3). The waveform displays aperiodic friction, and the spectrogram shows a less-intense noisy signal with only a hint of the peak frequencies close together at about 1600 Hz (close to F2) and 2400 Hz (close to F3).

Figure 3: Voiceless fricative [ɻ̊] in [bɔ^{33}p^{h}ɻ̊a^{33}] ‘cockroach’ (Myagu)



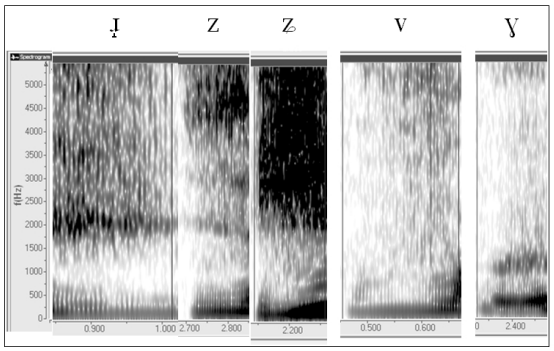
3.3. Distinction of Nusu non-sibilant fricatives and sibilants

This section compares the different Nusu fricatives and demonstrates that what previously has been transcribed as a retroflex sibilant shares more features with non-sibilants than with sibilants. Acoustic studies differentiating coronal non-sibilant fricatives from sibilants are lacking (cf. [8]), possibly because such a distinction is rare and difficult to maintain due to perceptual and acoustic similarity.

Fig. 4 juxtaposes the spectrograms of voiced fricative onsets for the Myagu speaker. The frequency range displayed is between 0-5500 Hz. The sibilants [z] and [ʑ] show the expected concentrations of energy in the higher frequencies, with the peak for [z] coming down around 5000 Hz

and higher amplitudes for [ʑ] reaching down near 3000 Hz. The non-sibilant rhotic fricative involves a noisy portion reaching down around 3000 Hz but the greatest concentration of energy is closer to 2000 Hz.

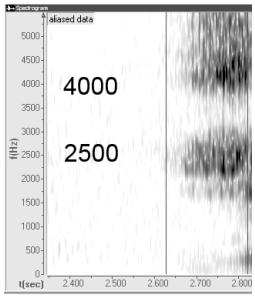
Figure 4: Comparison of Nusu voiced fricatives (Myagu speaker). Examples are [ɻ] in 'to be big' [(mɯ^{55}) ɻ^{21} (xa^{33})], [z] in 'child' [za^{55} ɲe^{33}], [ʑ] in 'urine' [ʑi^{53}], [v] in 'belly' [va^{21} lɔ^{53}], [ɣ] in 'pigeon' [ɣɯ^{33}].



The words representing [ɻ] and [ʑ] were chosen because they were given in Sun and Lu's [20] phonological inventory as examples of sibilants [ʐ] and [ʑ] respectively. The Myagu speaker clearly has a rhotic onset for 'to be big' instead of a sibilant. This is evident in the variation across tokens. The first token involves the non-sibilant rhotic displayed under [ɻ] in Fig. 4. This fricative is syllabic, caused by an underlying high front vowel /i/ which often merges with preceding alveolar or retroflex fricatives and affricates. In the speaker's second and third tokens, the onset is realized as the palatalized approximant allophone [ɹʲ].

The voiced fricative variant [ɻ] can be very close to a sibilant in terms of auditory cues and acoustic representation. If the lower jaw is raised enough to allow the tongue blade to form the alveolar constriction necessary for an alveolar non-sibilant fricative, it would be only a small step to create a sibilant. This would involve bringing the teeth closer together, causing a secondary obstruction which creates a diffraction of the airstream and adds the high frequency boost to the source spectrum which is a sibilant property (cf. [19]). This is observed in one of the Topya speaker's variants of the rhotic (see Fig 5), further casting doubt on a phonemic distinction between the initial /ɹ/ and initial /ʐ/ reported in earlier studies. This speaker's pronunciation varies between an approximant turning into a voiced fricative in one token, and a voiced fricative in the second.

Figure 5: Fricative realization in [ɻe^{55}] 'to be swollen' for one Topya Nusu speaker (Token 2)



Spectral measures taken at two points near the center of the fricative show peaks around 4000 and 2500 Hz, and the dark voice bar indicates increased F0 intensity like for the Nusu sibilants /z/ and /ʑ/. While this single fricative realization may qualify for a retroflex sibilant, comparative evidence indicates a rhotic, e.g. alveolar approximants, or in some instances rhotacized velar fricatives (one Wawa and one Topya speaker). Furthermore, none of the other speakers produced sibilant-like fricatives similar to the token displayed in Fig. 5 in this word.

4. DISCUSSION

In summary, the consonant under investigation has been described as a retroflex sibilant in former studies on Nusu but is found to be realized as an alveolar approximant or non-sibilant fricative. Phonotactics and phonological evidence provided by comparison with other varieties allow for an interpretation as a rhotic. Some of the rhotic allophones are clearly realized as approximants or retroflexed velar fricatives and cannot be interpreted as sibilants.

Acoustic characteristics also speak against the interpretation as a sibilant. Some of the rhotic allophones have non-sibilant characteristics like higher periodicity for approximant realization. Most importantly, all but one of the measures show no spectral peak in the higher frequencies.

Auditory and acoustic similarity may be one reason why this sound was interpreted as a sibilant before. The close relationship between rhotics and sibilants is reflected in the phenomenon of rhotacism [6]. One illustration for the possible similarity between alveolar sibilant and non-sibilant fricatives is seen for the one speaker who revealed non-sibilant/sibilant variation. This is related to raising the jaw to the degree of bringing the teeth together close enough to create sibilance, no different in nature from stop/fricative variation (cf, stop

spirantization in languages like Spanish, North German, Thai, Vietnamese).

Another reason for the interpretation as a sibilant may be the lack of a distinct phonetic symbol representing non-sibilant alveolar fricatives. In addition, it is commonly reported that an initial retroflex rhotic can be realized as sibilant [ʐ] in Beijing Chinese. In Nusu, scholars seem to associate syllable-initial rhotic fricatives with retroflex sibilants.

The transcription problem is reflected in the transcription /rʰ/ for a voiceless fricative rhotic in a description of another Tibeto-Burman language, Para Naga [14]. The rhotic in this language has voiced and voiceless alveolar fricative allophones.

Matisoff's [16] discussion of the retroflex affricates in the Dayang variety of Pumi also underscores the importance of resolving transcription problems for representing rhotics in Tibeto-Burman languages. Dayang Pumi has both a retroflex and palatal affricate series that developed from clusters of *labial-plus-liquid. The retroflex affricates are characterized by what he transcribes as sibilant off-glides /pʐ/ [př], /pʂh/, and /bʐ/. He mentions that in the first, "the off-glide varies between [ʐ] and a fricative **r**-sound similar to Czech /ř/" [16: 76]. Moreover, these affricates can be distinguished from **r**-clusters that derive from the optional elision of schwa in a sesquisyllabic word like [br] 'snake' brá~bərá. Here Matisoff wants to distinguish between a retroflex sibilant and a non-sibilant rhotic fricative, and what is lacking is an accepted transcription convention for an alveolar/retroflex "fricative **r**- sound."

Alveolar non-sibilant fricative rhotics (including palato-alveolar and retroflex) are rare but have been attested in Karbadian, Hopi, Eastern Armenian, Araucanian, Burushaski, and Chukchi [15], South African English [21], the KiVunjo dialect of KiChaka, Czech, and Edo [13]. Contrasting voiced and voiceless alveolar fricative rhotics have also been reported for the Tibeto-Burman language Mongsen Ao [10]. Consistent with the previous literature on rhotics, the best evidence for classifying these fricatives as rhotics derives from phonotactics and phonological patterning. As rhotic allophones, alveolar non-sibilant fricatives have been found in Romance languages [4, 7, 9]. In Bradley's study on several varieties of Latin American Spanish [5], in some contexts voiced alveolar fricatives are nearly as frequent as approximant realizations of the rhotic.

5. CONCLUSION

Phonotactics, dialectal comparison, and acoustic features indicate that the sound described as a retroflex sibilant in former studies on Nusu is a rhotic with approximant and fricative allophones. Next to auditory and acoustic similarity, the reason for the sibilant interpretation might be inadequate symbols for alveolar fricatives.

Allophonic variation between sibilants and non-sibilant alveolar fricatives is not unlikely; it appears to be the reason for rhotacism and is found for one speaker in the Nusu varieties under study.

Since there is no contrast reported for retroflex sibilants and alveolar fricative rhotics, a cross-linguistic acoustic comparison of alveolar rhotic and sibilant realizations is recommended to investigate the acoustic properties of alveolar non-sibilant fricatives.

Meanwhile, Tibeto-Burman scholars struggle to transcribe non-sibilant fricative rhotics. In Tibeto-Burman descriptions, voiced alveolar fricatives have been transcribed most commonly as [r] and [ʐ], but also as [ɪ] and, following the Czech convention, [ř]. These transcriptions do not allow for specification of the kind of variation exhibited in Nusu and other languages like Para Naga or Dayang Pumi. The common practice of transcribing [ʐ], especially in consonant clusters, erases the rhotic aspect of the voiced fricative. Voiceless non-sibilant rhotic fricatives are also difficult, with various transcribers resorting to [rʰ, rh, hr, xr, ʂ, ʂ̥h].

Whitley [22] outlines the problems for transcribing rhotics using current IPA diacritics and conventions in Hispanic linguistics with regard to phones that are allophones or dialect variants of flap and trill phonemes and calls for the Association to expand or redefine the symbols and diacritics associated with rhotics. A similar set of problems is faced in transcribing alveolar non-sibilant rhotic fricatives in Tibeto-Burman languages like Nusu.

Current IPA standards for representing a voiceless rhotic fricative would engage two diacritics that are usually positioned under the letter: [◌̥] and [◌̞] as seen in Ladefoged and Maddieson's example from Edo [ɹ̝̊] [13]. Following Whitley's proposal of using the ˚háček as a diacritic for non-sibilant fricatives would allow for a less awkward representation of the voiceless fricatives [ř̥]. As Whitley argues, the háček has precedent in the IPA, remains widespread, and has a better articulatory basis for indicating airstream turbulence than the [◌̞] adopted in 1989. Indeed, the háček has already surfaced in Tibeto-Burman literature [16] subsequent to that decision. Another, possibly more reader-friendly solution would be the use of the retired IPA symbol ɼ, approved as the replacement of ř in 1945 and withdrawn in 1989, with the voiceless diacritic positioned over the letter for voiceless non-sibilant fricatives.

6. ACKNOWLEDGEMENTS

We express our deep respect for Sun Hongkai, Lu Liu, and Fu Ailan. Their careful documentation of endangered languages in China has been an immense contribution to the field. The framework laid in their phonological descriptions of Nusu helped us an incredibly complex sound system with a mystifying amount of variation.

7. REFERENCES

[1] Ballard, E, Starks, D. 2004. Liquids: Laterals and Rhotics or Much More? *Proc. 2004 Australian Linguistic Society.*

[2] Bradley, D. 1979. *Proto-Loloish.* London and Malmo: Cuzon Press.

[3] Bradley, D. 2012. The characteristics of the Burmish family of Tibeto-Burman. *Language and Linguistics* 13(1), 171–192.

[4] Bradley, T.G. 2004. Gestural timing and rhotic variation in Spanish codas. In: Face, T.L (ed.) *Laboratory approaches to Spanish phonology.* Berlin: Walter de Gruyter. 195-220.

[5] Bradley, T.G. 2006. Phonetic realizations of /sr/ clusters in Latin American Spanish. In Díaz-Campos, M. (ed) *Selected Proc. 2nd Laboratory Approaches to Spanish Phonetics and Phonology.* Cascadilla Proceedings Project. Somerville, MA: Cascadilla. 1-13.

[6] Catford, J.C. 2001. On Rs, rhotacism and paleophony. *JIPA* 31, 171-185.

[7] Colantoni, L and Steele, J. 2004. Phonetically-driven epenthesis asymmetries in French and Spanish obstruent-liquid clusters. In Gess, R, Rubin, E *Selected Proc. Linguistic Symposium on Romance Linguistics (LSRL)* 34. 2004. Amsterdam: John Benjamins.

[8] Colantoni, L., 2006. Increasing periodicity to reduce similarity: an acoustic account of deassibilation in rhotics. Díaz-Campos, M. (ed) *Selected Proc. 2nd Laboratory Approaches to Spanish Phonetics and Phonology.* 2006. Cascadilla Proceedings Project. Somerville: Cascadilla. 22-34.

[9] Colantoni, L., Steele, J. 2005. Liquid asymmetries in French and Spanish. *Toronto Working Papers in Linguistics* 24, 1-14.

[10] Coupe, A.R. 2007. *A grammar of Mongsen Ao.* Berlin: Walter de Gruyter.

[11] Fu, A. 1991. Nuyu [The Nu language]. In Dai, Q., Huang, B., Fu, A., Renzengwangmu & Liu Juhuang. (eds). *ZangMianyu shiwu zhong [Fifteen Tibeto-Burman languages]*. Beijing: Yanshan Chubanshe.

[12] Jesus, L.M.T., Shadle, C.H. 2005. Acoustic analysis of European Portuguese uvular [χ, ʁ] and voiceless tapped alveolar [ɾ̝] fricatives. *JIPA*. 35, 27-44.

[13] Ladefoged, P., Maddieson, I. 1996. *The sounds of the world's languages*. Oxford: Blackwell.

[14] Lubbe, M. 2005. Para Naga orthography statement. Unpublished document. SIL.

[15] Maddieson, I. 1984. *Patterns of sounds*. Cambridge: Cambridge University Press.

[16] Matisoff, J. A. 2003. *Handbook of Proto-Tibeto-Burman: system and philosophy of Sino-Tibetan reconstruction.* UC Publications in Linguistics. Oakland CA: University of California Press.

[17] Recasens, D. 2002. Weakening and strengthening in Romance revisited. *Italian J. of Ling.* 14, 327–373.

[18] Shadle, C., Mair, S.J. 1996. Quantifying spectral characteristics of fricatives. *Proc. Interspeech, Philadelphia,* 1521-24.

[19] Shadle, C.H. (2012). The Acoustics and Aerodynamics of Fricatives. Ch. 20, *The Oxford Handbook of Laboratory Phonology,* eds. A. Cohn, C. Fougeron, M. K. Hoffman, Oxford University Press, pp. 511-526.

[20] Sun H., Lu L. 1986. A brief overview of the language of the Nu nationality (Nusu language). *Brief Overview of Minority Languages of China Series.* Beijing: Nationalities Press.

[21] Wells, J. C. 1982. *Accents of English*. Cambridge: Cambridge University Press.

[22] Whitley, M.S. 2003. Rhotic representation: problems and proposals. *JIPA* 33, 81-86.

[23] Wiese, R. 2001. The phonology of /r/. In Hall, T. A. (ed) *Distinctive feature theory*. 2001. Berlin: Walter de Gruyter. 335-368.