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Acoustic correlates of laryngealization in Kammu

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Introduction

Some dialects of the Kammu language of northern Laos present an unusual distinction between plain (IPA /j, w/, here transcribed <y, w>) and laryngealized (IPA /j̃, w̃/, here transcribed <ỹ, w̃>) glides. The distinction is subtle to an untrained ear; in phrase-initial position, it is almost imperceptible. The aim of the present paper is to examine possible acoustic correlates of this notoriously evasive contrast.

1 Background

1.1 Acoustic correlates

It should be noted that the term 'acoustic correlate' in this paper refers to any acoustic property which systematically co-occurs with the presence – or absence – of a phonetic or phonological quality, whether it is judged (or suspected) to be perceptually relevant or not. That is, whether it is an acoustic cue or a redundant feature.

1.2 Kammu

Kammu is spoken by about 500 000 people in northern Laos and the adjacent parts of Thailand, Viet Nam and China. It belongs to the Mon-Khmer branch of the Austro-Asiatic language family. Kammu does not have a writing system.

The phonology and morphology of Kammu (Yuan dialect) is described in *Kammu phonology and morphology* by Jan-Olof Svantesson (Svantesson 1983). Vamling & Svantesson 2000 contains a brief presentation (in Swedish) of the language, also written by Svantesson, which includes remarks upon its syntax. There are some studies on Kammu syntax and on its tone system, but nothing on spectral aspects.

The Kammu phoneme inventory is rather extensive. There are 23 consonants and 20 vowels. Some aspects of the consonant system are particularly noteworthy from a European point of view, such as the distinction between unaspirated (p, t, c, k) and aspirated stops (p^h, t^h, c^h, k^h), and the series of palatal consonants (ç, ç^h, ɲ). Another example is the subject of this paper, the phonemic status of laryngealization, which occurs only with the two glides (/y, w/ vs /ỹ, w̃/). It is also confined to high-tone syllables. The plain glides may occur with both tones, which renders triplets such as shown in Table 1.

Table 1. Kammu tone and laryngealization triplets

<i>Kammu</i>	<i>English</i>	<i>Kammu</i>	<i>English</i>
yàaŋ	'one crop area'	wàak	'worm'
yáaŋ	'female'	wáak	'worn' (pottery)
ỹáaŋ	'rubber'	w̃áak	'oink'

The basic word order is SVO, and generally, the word order is the only clue to the grammatical functions of the constituents. It should be noted that any noun may occur in

phrase-initial position, and that the plain/laryngealized distinction should be equally important in phrase-medial as in phrase-initial context.

1.3 Describing voice quality

The terminology concerning voice quality is abundant and little standardized, and the underlying mechanisms are not fully understood. The main problem is perhaps that most labels may be attached to various levels, phonetic and phonological, of the speech signal. For instance, "creak": does it refer to articulatory activities (a certain phonation type), to acoustic properties (a certain glottal waveform, or a certain resulting spectrum, or a certain part of the fundamental frequency register) or to auditory impressions (a certain perceived effect)? Or should it be regarded as part of phonology (classifying the accompanying sound as member of one group rather than another, the creak "register", like voiced vs voiceless consonants)? Also, when defining creak in phonetic terms, it soon becomes clear that it is not something which might be turned on or off: any of the given correlates may occur in higher or lesser degree.

For the purposes of this paper, 'laryngealized' refers to a not fully understood and therefore rather unspecified process involving a narrowing of the glottal stricture. 'Creak', on the other hand, describes here only the peculiar auditory effect which often goes with laryngealization. Laver 1980:124 cites Catford describing it as a "rapid series of taps, like a stick being run along a railing". Creak probably presupposes laryngealization and a low F₀, but laryngealization may occur without creak.

2 The present study. Method

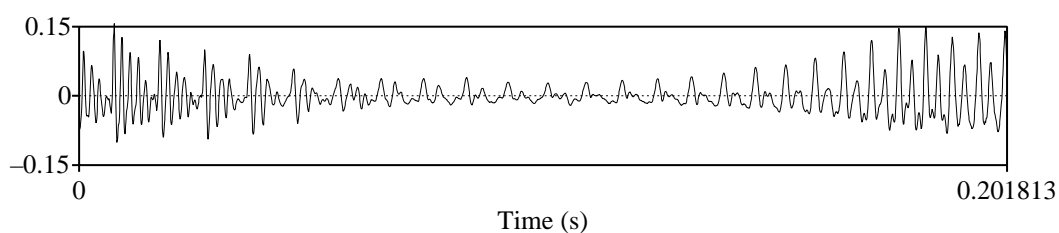
A list of two minimal or near-minimal pairs for each glide was constructed and recorded in isolation and preceded by a carrier sentence (kəə lə... 'he said'...) by the informant (man, aged 63, native speaker of the Yüan dialect of Kammu). Several tokens of each recorded pair were analyzed acoustically in the Praat, an analysis tool for phonetic studies developed by Paul Boersma and David Weenink at the Institute of Phonetic Sciences of the University of Amsterdam, the Netherlands.

3 Results. Discussion

3.1 Phrase-medial position

There are no systematic temporal differences between laryngealized and plain glides in phrase-medial position. However, there is one most obvious correlate to phrase-medial laryngealization, namely creak, recurring in all tokens. The creak is clearly visible in a spectrogram, and also in the waveform, as can be seen in Figure 1. The auditory impressions of the excerpts are very different from each other, especially when listening to the mid third only.

In all cases, there is a slight but clear decrease in the overall intensity in the glide, and the decrease is consistently steeper and more marked for the laryngealized glides. As for F₀, the F₀-extracting algorithm does not treat creak reliably and leaves no suggestion (although modal voice glides are analyzed flawlessly).



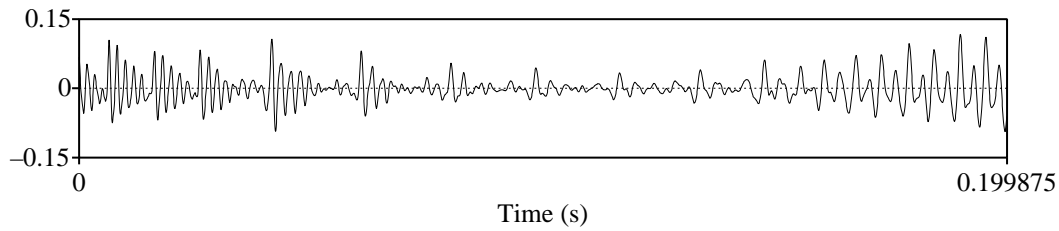


Figure 1. Waveform of a 200 ms window centered around the /w/ glide, taken from the phrases *kəə lʌ wiat* 'he said shrink' (previous page) and *kəə lʌ wiat* 'he said tired'

3.2 *Phrase-initial position*

The contrast between laryngealized and plain glides in phrase-initial position is generally much more evasive than phrase-medially. There are no obvious correlates in the waveform. Creak does occur in the laryngealized glides, but often only slightly, and not in all cases. What is more, in the case of [wáak] 'worn', slight creak is also present in the plain glide. This makes it improbable that creak is the only acoustic correlate of laryngealization, however reliable an indication it seemed in a phrase-medial context.

A mean power spectrum of each glide, taken from the initial, more or less steady-state (the first five or six periods, some 50 ms), gives a rough indication of the spectral properties (Figure 2). It is not easy to consistently delimit the time interval; however, in most of the cases, the laryngealized glide shows an extra peak around 4 kHz. It is generally absent or less marked in the plain glides.

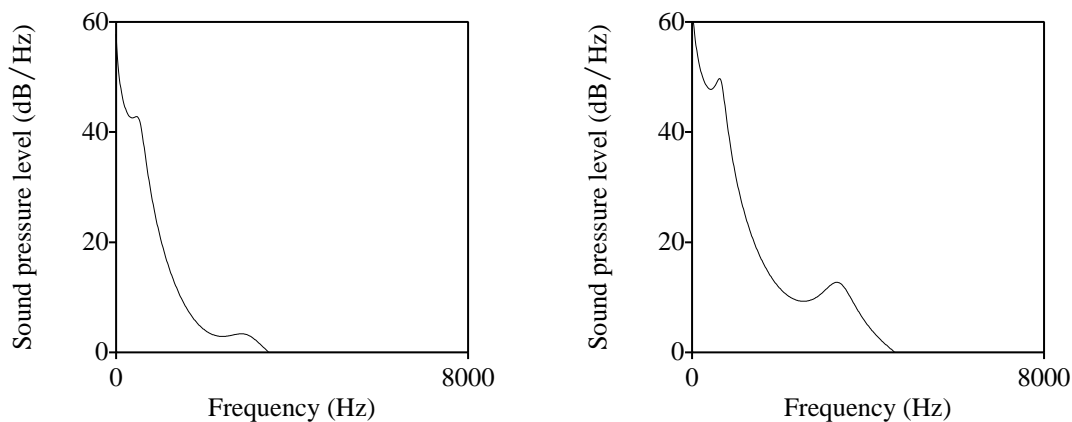


Figure 2. Mean power spectrum (LPC-smoothed) of the first 50 ms of near-steady state of the /w/ glide in the words *wáak* 'worn' (left) and *wáak* 'oink'

A more reliable correlate, however, is temporal. Both glides, plain as well as laryngealized, in practically all cases presented an initial, fairly stable phase, with clearly less intensity for higher formants (above 1 kHz) and little formant movement (Figure 3). This phase was in all cases shorter for laryngealized than for plain glides, typically 50 and 80 ms respectively (Table 2).

No differences were found in fundamental frequency. As for intensity, the attack seems more sudden (i. e., stop-like) for the laryngealized glides in several cases, but the differences are neither conspicuous nor consistent.

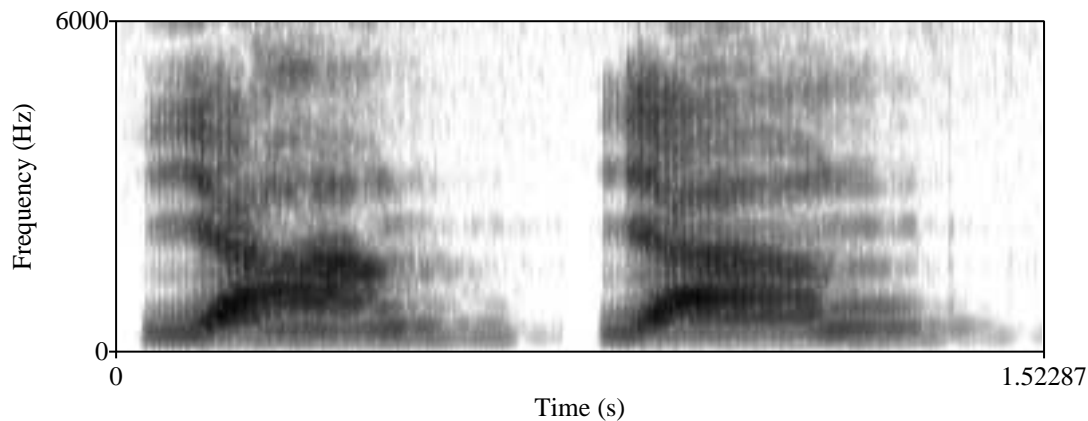


Figure 3. Spectrogram of the words *yáaŋ* 'female' (left) and *ỹáaŋ* 'rubber', uttered in isolation.

Table 2. Duration of initial steady-state for /y, w/ and /ỹ, w̃/ (means, four readings) [ms]

<i>yáaŋ</i>	75	<i>ỹáaŋ</i>	48
<i>yú</i>	80	<i>ỹúu</i>	40
<i>wáak</i>	97	<i>w̃áak</i>	60
<i>wíat</i>	85	<i>w̃íat</i>	57

4 Summary

The most pervading acoustic correlates of laryngealization in Kammu, then, are creak and lower intensity in phrase-medial position and a slightly shorter duration of an initial steady state together with a formant peak around 4 kHz in phrase-initial context. Svantesson (personal communication) suggested that the temporal difference is a secondary effect from an articulatory point of view; however, it may of course still be an important acoustic cue. This paper has not dealt with acoustic cues; such decisions, naturally, require perception tests with native speakers and controlled stimuli. Not all of the suggested correlates are easily tested by resynthesis, but at least the temporal aspects could be simulated.

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