Creaky voice in Slovene

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1. Introduction

Articulatorily, creaky voice is a non-modal phonation type, usually characterized by laryngeal configuration of inward pressed arytenoid cartilages, so that only anterior portions of glottal folds vibrate; glottal adduction is increased, and longitudinal tension is lower, in comparison to modal voice. Subglottal pressure is lower as well, and both speed and open quotients (cf. Ladefoged 1971: 14, Murry 1971, Laver 1980: 109ff., Ní Chasaide & Gobl 1997: 444–451, Berry 2001, Hanson *et al.* 2001, Gordon & Ladefoged 2001). Acoustically, low F0 has been documented, irregular periods and an increased jitter. A positive spectral tilt has been studied thoroughly; normally, amplitudes of F0 are compared to second harmonic (H2) and harmonic closest to F1 (A1), complemented by corresponding harmonics A2 and A3 (Klatt & Klatt 1990, Hanson 1997, Ní Chasaide & Gobl 1997, Hanson & Chuang 1999, Hanson *et al.* 2001, Gordon & Ladefoged 2001). Perceptually, creaky voice was characterized as »rapid series of taps, like a stick being run along a railing« (Catford 1964: 32).

Regardless of seemingly unproblematic descriptions above, authors have been reluctant to use one uniform terminology. Many partially or completely overlapping terms to denote creaky voice phonation exist: glottal fry, vocal fry, vocal cry, pulse phonation, creak, laryngealization and glottalizaton (not as secondary articulation feature). These differences can be observed from the viewpoint of Ladefoged's larynx feature model. According to Ladefoged (1971) and Ladefoged & Gordon (2001), there is a phonation continuum form completely open (as in voiceless phonation) to completely closed glottis (as in glottal stop). Modal voice being at the central point, creaky voice has somewhat more closed glottal configuration, while being more open than glottal stop at the same time. Following Ladefoged (*l.c.*), the part of the continuum from modal voice to glottal stop (but exclusive of both), is discussed further in the text. This window could easily be named laryngealization as well.

However, other classifications exist. For example, Laver (1994: 199) acknowledges six basic phonation types, classified in three basic groups (whisper, voicing and voicelessness). On the other hand, more recent studies of Edmonson & Esling (2005), and Esling & Harris (2005) propose actually six independent laryngeal valves, glottal fold adduction being only one of them. Others are ventricular incursion, sphincteric compression forwards and upwards, epiglotto-pharyngeal constriction, laryngeal raising and lowering of the larynx, and pharyngeal narrowing (*l.c.*).

In the present study, creaky voice in Slovene is studied with particular attention to its distribution and function with reference to natural languages in general. Slovene (or Slovenian) is a south Slavic language, spoken by approximately 2 million speakers of the Republic of Slovenia, and by minorities in adjoining areas of the neighboring countries (Italy, Austria, Hungary and Croatia). There are 48 distinct dialects and 7 dialect groups, of which the central dialects of Gorenjska and Dolenjska regions are relevant to the contemporary standardization process, as realized in educated speech of Ljubljana.

In standard Slovene, stress is distinctive. According to the traditional grammar (Toporišič 2000), vowel quantity is also contrastive in word-final stressed vowels. More recent studies of Srebot Rejec (1988, 1998) and Petek *et al.* (1996) argue that there are no significant durational distinctions in contemporary standard Slovene as spoken in Ljubljana

any more; all stressed vowels are long. Data on formant frequencies confirm that only /a/ retains significant quantitive distinction (Jurgec, forthcoming-b). In respect to tone, Slovene dialects are either tonal or non-tonal; this is retained in the standard form and so, both varieties are permitted. In the tonal standard Slovene there are two lexical tones (tonemes), namely *acute* and *circumflex*. Traditionally (Vodušek 1961, Toporišič 1967, 1968) acute has been described as rising, or low on the tonic and high on the post-tonic syllable, and circumflex *vice versa*. Morphologically related minimal pairs are abundant, but only 100 or less not lexically related minimal pairs exist. Such examples are listed in Table 1.

Orthographic form	Acute	Circumflex
MONOSYLLABLES		
pot [poːt]	'path'	'sweat'
vrat [wɾaːt]	'neck'	'door, *gen. pl.*'
DISYLLABLES		
kila [ˈkʰiːla]	'hernia'	'kg'
kura [ˈkʰuːɾa]	'chicken'	'cure, treatment'
TRISYLLABLES		
šalica [ˈʃaːlit͡sa]	'joke, *dimm.*'	'cup, *coll.*'
šibica [ˈʃiːbit͡sa]	'rod, *dimm.*'	'match, *coll.*'

Tab. 1. Standard Slovene minimal pairs in tone.

Creaky voice has not been mentioned in connection to standard Slovene until very recently (Jurgec 2005b). However, there have been previous studies of Carinthian dialects of Rož and Podjuna, which have [ʔ] as a reflex of Proto-Slavic */k/, and it is in free variation with creaky voice either word-initially or word-internally (Neweklowsky 1970, Priestly 1976, 1980). In connection to standard Slovene, the present author found the same variation in vowels word-initially or as hiatus resolution (Jurgec 2004, 2005b). These phenomena are discussed further in this text (Section 3).

2. Method

The collection of three spoken corpora has been selected to evaluate the extent of creaky voice in Slovene. The main corpus consists of 275 mono-, di- and trisyllables, compiled according to segmental and suprasegmental criteria. 10 speakers, representative of standard Slovene (5 per gender, geographically diverse, 5 of them tonal) were selected and instructed to read the words from the computer screen in citation form. The words appeared in random order, each twice non-consecutively. The recordings took place in the studios of the Department of phonetics in Zagreb (Croatia) and at Radio Slovenia in Ljubljana. Digitalized under standard conditions, 204 minutes of recordings (or 5,500 words in total) were examined by ear and confirmed by means of digital acoustic analysis (*Praat* program). The data collected were later averaged and analyzed statistically.

Two supporting corpora were used principally to corroborate the findings in the main corpus. The first supporting corpus consists of five live radio broadcastings (306 min in total) *Studio ob sedemnajstih*, a quality talk show, transmitted by the national radio station (Radio Slovenia). 39 speakers from various parts of Slovenia and of different social origin spoke standard Slovene. The recordings were examined by ear.

The second supporting corpus consists of selection from longer (approximately 4 and

3.5 hours, respectively) guided fieldwork interviews of a northwestern dialect of Zilja (Carinthian dialect group, tonal) as spoken in Kanalska Dolina Valley (Italy), see Jurgec, forthcoming-a for a detailed phonetic analysis. There were two speakers, one female and one male, and the total duration of speech analyzed was 60 minutes (approximately 30 minutes per speaker). The ear examination was reconfirmed acoustically.

3. Results

In the main corpus, 585 words (or 11.6%) had some form of creaky voice in one or more of the segments. In the supporting corpus #2, 61 and 19 cases of creaky voice were found, whereas in the supporting corpus #1 these were numerous (>1,000). However, individual speakers differ considerably in degree of creaky voice present. This was also a conclusion of the previous studies for other languages (Umeda 1978, Streeter 1978, Klatt & Klatt 1990, Holmberg *et al.* 1996, Dilley *et al.* 1996, Hanson 1997, Redi & Shattuck - Hufnagel 2001). However, neither speakers' gender (m – male, f – female) nor the variety of standard Slovene (t – tonal, n – non-tonal) is statistically significant ($p = .453$, $p = .714$) in respect to creaky voice. In Table 2, frequency of creaky voice for individual speakers of the main corpus can be found.

Speaker	No. of instances	Percentile
01fn	31	6.1
02fn	118	23.4
03ft	69	13.7
04ft	100	19.8
05ft	24	4.8
06mn	18	3.6
07mn	47	9.3
08mt	66	13.1
09mt	9	1.8
10mn	103	20.4
Total	585	11.6

Tab. 2. Creaky voice ratio for individual speakers.

There were three distinctive types of creaky voice in respect to word-position, or function (in a more general sense, as evident from the discussion below).

Type I denotes a boundary type of creaky voice. It is present as an allophonic realization of [ʔ] in word-initial position (to satisfy ONSET constraint), or between two vowels word-medially (to satisfy NOHIATUS constraint). In total, 108 instances of type I creaky voice were detected in the main corpus, and in 30.2% of all words beginning on phonological vowel, either [ʔ] or creaky voice was present. This kind of variation has already been observed in Rož and Podjuna dialects, first noted by Neweklowsky (1970) and later studied by Priestly (1976, 1980), who concludes that "the variation between glottal stop and laryngealization in the Sele Fara dialect depends on speech tempo, and also (directly or indirectly) on the rhythm of the sentence" (1976: 272–273). This is comparable to data for standard German (Kohler 1994) and standard Slovene (Jurgec 2004, 2005b). An example of this type of creaky voice is Figure 1a.

In both supporting corpora, this type I creaky voice is frequently attested. In the supporting corpus #1, numerous compound words like *makroekonomski* 'macro-economic' or

severnoevropski ‘northern European’ are frequently pronounced with creaky phase in hiatus. Furthermore, creaky voice is present on a prosodic boundary, most prominently on the beginning of a prosodic unit (sentence, utterance), normally with high sonority segment. However, this phenomenon is highly speaker-dependent; while some speakers in the supporting corpus #1 almost always insert glottal or creaky voiced segment word-initially, other almost never do.

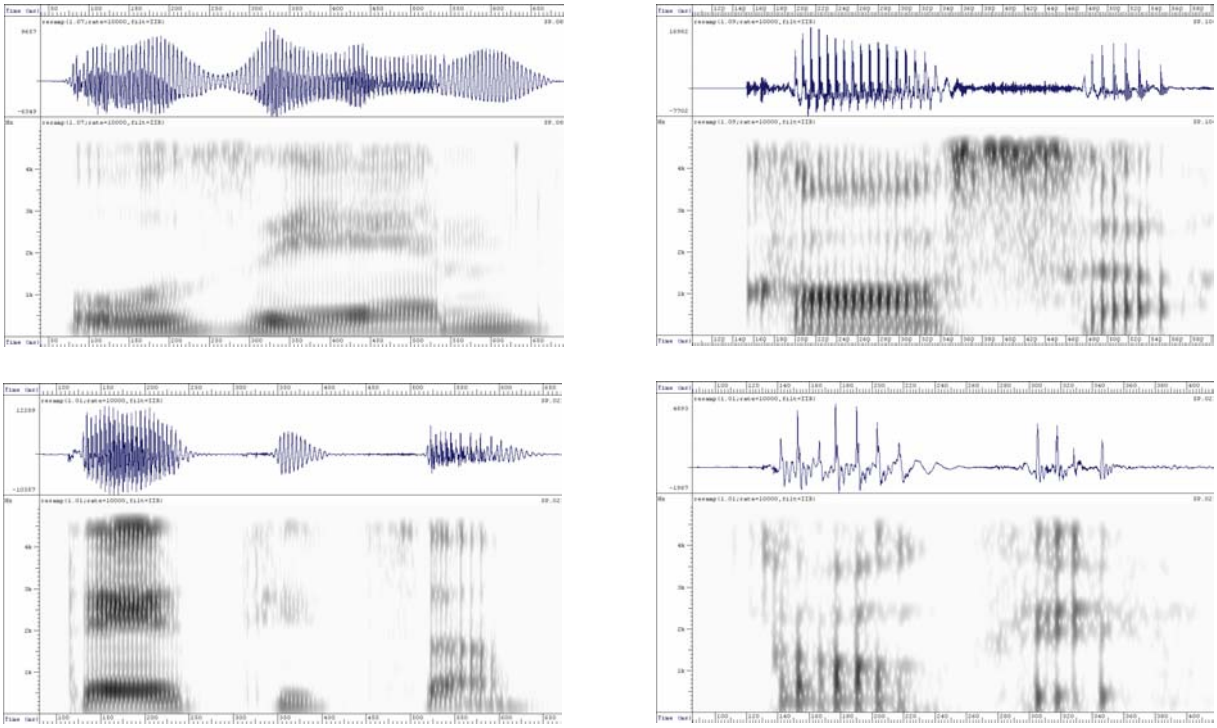


Fig. 1a–1d. Different types of creaky voice. 1a (above left): *OZN* [ˌʔozeˈɛ̃n] ‘UN’. 1b (below left): *tetica* [ˈtɛ̀ːt͡ít͡sa̰] ‘auntie’. 1c: *kosa* [ˈkɔːsa̰] ‘scythe’. 1d: *okej* C [ˈɔ̀ːˌkéi̯] ‘OK’.

Creaky voice of type II is word-internal and most prominent in word-final position. In the main corpus, 385 cases of this type were detected (examples are in Figures 1b and 1c). The present author initial hypothesis, based on previous research on other languages (see below) was, that creaky voice is significantly affected by suprasegmental (or prosodic) variables. A detailed analysis of the main corpus was conducted. These factors were considered: stress, quantity, tone and length of the word.

As regards the latter, no monosyllables were found with creaky voice of this type, but no conclusion can be drawn from di- and trisyllables (see Tables 3a and 3b for individual combinations). Moreover, stressed syllables are significantly less frequently creaky voiced (see similar findings in Ogden 2001), and this is true for short (stressed) vowels as well. In Slovene, short stressed vowels are limited to word-final position and so, only a few (<5) were detected. Furthermore, the data from the main corpus suggest post-stressed syllables are decisively more prone to creaky voice than both stressed and pre-stressed.

Disyllables	Tonal		Non-tonal		Σ
	A	C	A	C	
¹V̲V	3	3	1	5	12
¹VV̲	9	21	25	22	77
V̲¹V	0	2	1	1	4
V¹V̲	3	3	1	0	7
Σ	15	29	28	28	100
Trisyllables					
¹V̲VV	3	4	0	5	12
¹VV̲V	2	2	6	7	17
¹VVV̲	37	29	40	34	140
V̲¹VV	1	2	1	1	5
V¹V̲V	6	1	1	2	10
V¹VV̲	13	27	34	21	95
V̲V¹V	0	0	0	0	0
VV̲¹V	0	2	0	1	3
VV¹V̲	0	1	1	1	3
Σ	62	68	83	72	285

Disyllables	Tonal		Non-tonal		Σ
	A	C	A	C	
¹V̲V	1.9	1.9	.63	3.1	1.9
¹VV̲	5.6	13.1	15.7	13.8	12.0
V̲¹V	.00	1.4	1.2	1.2	.91
V¹V̲	3.8	2.1	1.2	.00	1.6
Σ	6.8	9.7	12.7	9.3	18.5
Trisyllables					
¹V̲VV	1.8	2.5	.00	3.3	1.9
¹VV̲V	1.3	1.3	4.0	4.7	2.7
¹VVV̲	23.1	18.1	25.0	22.7	22.6
V̲¹VV	.63	1.3	.63	.63	.78
V¹V̲V	3.8	.63	.63	1.3	1.6
V¹VV̲	8.1	16.9	21.3	13.1	14.8
V̲V¹V	.00	.00	.00	.00	.00
VV̲¹V	.00	1.3	0	.63	.71
VV¹V̲	.00	.63	2.0	.63	.71
Σ	16.8	14.5	22.4	15.3	16.9

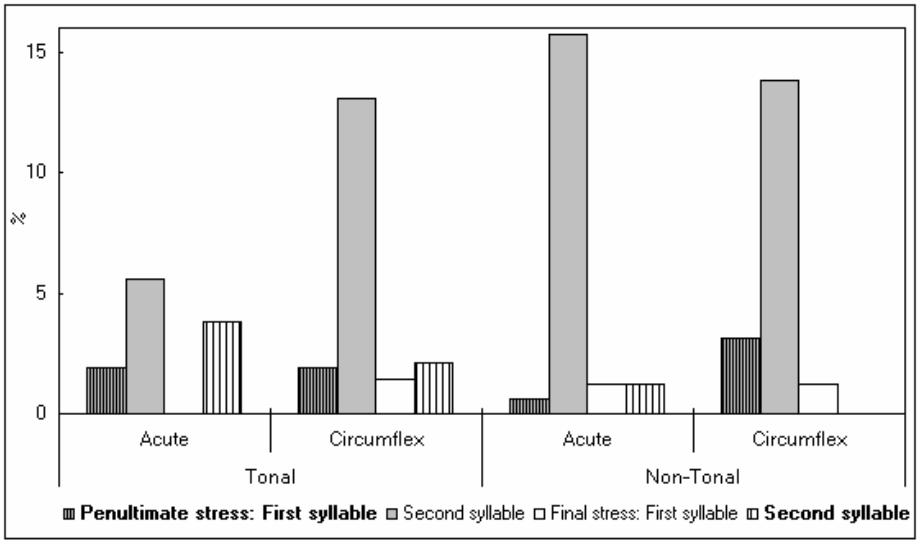
Tab. 3a–3b. Type II creaky voice in the main corpus according to the suprasegmentals (A – acute tone, C – circumflex tone). 3a (left): Absolute values. 3b: Percentiles.

In connection to tone, there is statistically significant ($p<.001$) difference between acute and circumflex tone in the post-stressed syllables: post-tonic acute is less frequently creaky voiced, for tonal speakers only. This is an expected phenomenon, as low F0 is frequently associated with creaky voice cross-linguistically.

On the other hand, we cannot explain differences in lexical tones for both tonal and non-tonal speakers; circumflex tone seems to be somewhat less affected by creaky voice than the acute tone (Figures 2a and 2b). Perhaps, as it has been stipulated in more traditional frames (e.g. Toporišič 1967, 2000), circumflex is indeed shorter than acute, and would be more probable to experience creaky voice. No sufficient corroborating acoustic phonetic data exist yet, however.

In the supporting corpus #2 however, creaky voice was more frequent in post-stressed syllables of the acute tone, but it is also attested in the circumflex, so no definite conclusion can be drawn.

In both supporting corpora, this type of creaky voice is considerably more frequent at the end of prosodic units, where F0 is low by default, and creaky voice has a demarcative function (cf. Umeda 1978, Dilley et al. 1996, Redi & Shattuck - Hufnagel 2001). This is highly speaker dependent as well.



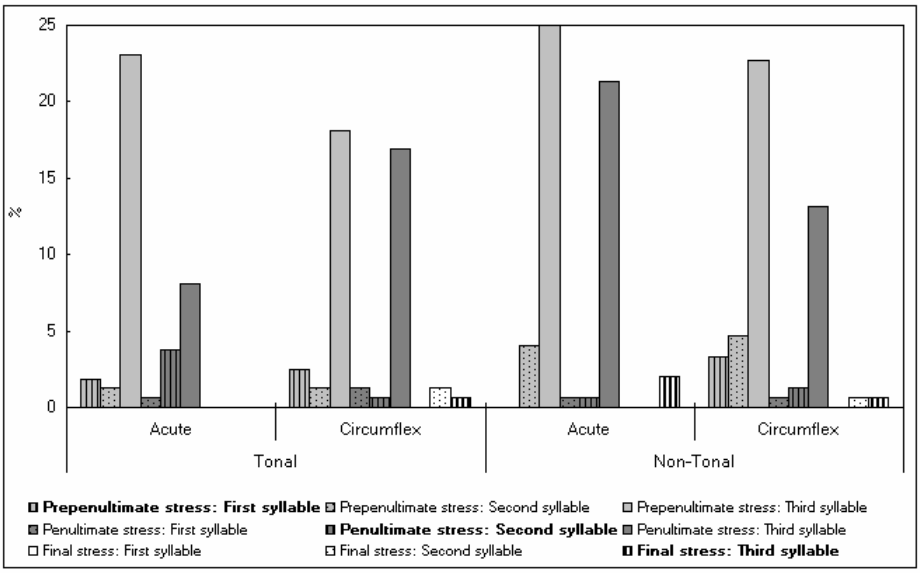


Fig. 2a–2b. Type II creaky voice in the main corpus according to the suprasegmentals (in percentiles). 2a (above): Disyllables. 2b: Trisyllables.

Type III creaky voice applies to whole words, utterances, or their semantically independent fragments. In the main corpus, creaky voice is found in words not predicted by the experiment, e.g. *pardon* 'pardon me', *okej* 'all right', *v redu* 'all right', *ja* 'yes' (see Figure 1d for an example spectrogram and waveform). This kind of paralinguistic use has also been confirmed in the supporting corpora.

4. Discussion and conclusion

All three types of creaky voice are attested in languages of the world. The most prominent are the phonemic contrasts in creaky vowels of Jalapa Mazatec or San Lucas Quiaviní Zapotec. Creaky voice is also found in sonorants (of Kwakw'ala, Hupa, Montana and Columbian Salish), while obstruents are fully phonemic quite rarely; examples include Chadic languages, e.g. Hausa. See Ladefoged 1971, Laver 1994, Ladefoged & Maddieson 1996, and Gordon & Ladefoged 2001, for a review. It is very improbable to find these contrasts in contemporary Slovene, although breathy voice might exist in the dialect of Rezija (Resia), but

acoustic studies so far are fairly inconclusive.

Phonation contrasts can also be suprasegmental. The most well known example is Danish *stød* (Fischer - Jørgensen 1989, Grønnum & Basbøll 2001), while in many other tonal languages creaky voice can be a accompanying feature to a certain tone, e.g. in Chinese (Belotel - Grenié in Grenié 2004), Hmong (Huffman 1987), or Latvian *lauzta intonacija*, Swedish *Accent 1* (Laver 1994: 464) and Croatian *dugosilazni naglasak* (Elen Mari Pletikos, p.c.). In Slovene, this type has been confirmed (so called type II).

A more frequent use of creaky voice cross-linguistically is the allophonic, either replacing a certain consonant phoneme – usually a stop, for example in German (Kohler 1994) or American English (Patterson in Connine 2001) –, or preceding a vowel (German, Slovene).

Creaky voice is also attested as a boundary marker in several languages. Different variables, including word frequency, boundary level, pitch-accent, speed, rhythm, pauses and segmental variables were studied, in English (Allen 1970, Umeda 1978, Dilley *et al.* 1996, Redi & Shattuck - Hufnagel 2001), Swedish, Czech, Finnish, Serbian/Croatian (Lehiste 1965, 1970; Ogden 2001), Chinese (Belotel - Grenié & Grenié 2004) or Huaulta Mazatec (Ladefoged and Maddieson 1996: 74). In Slovene, further studies of this type creaky voice are needed.

Pragmatic variables do influence creaky voice distribution as well, and are common in English (Laver 1980: 126) or other European languages. Paralinguistic use is very diverse in its effect, see *l.c.* In Slovene, embarrassment as well as the end of utterance frequently correlate with creaky voice (the main and the supporting corpus #1). Sometimes, creaky voice can be used ironically.

Sociolinguistically, creaky voice has been detected in Edinburgh English (Ní Chasaide & Gobl 1997: 457) and Copenhagen Danish (Laver 1980: 196). The present investigation could not address this question in full. Female vs. male voice characteristics – male voices being characterized as more creaky than female, on average (Holmerg *et al.* 1988, Klatt & Klatt 1990, Hanson 1997, Hanson & Chuang 1999, Redi & Shattuck - Hufnagel 2001) – fall in this category as well. In Slovene, creaky voice can be found both in very low-pitched male voices or female voices at certain prosodic positions (see above).

Further studies will address boundary effects and distribution as well as other pragmatic and paralinguistic phenomena of non-modal phonation in Slovene.

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