Phonetic evidence for the development of the “acute” tone in Slavic*

Abstract: The paper attempts to give a phonetic reconstruction of the processes surrounding the loss of the glottal stop as the reflex of the inherited Proto-Slavic acute. With support from typological evidence and phonetic analysis, it is claimed that the variation in modern Slavic reflexes of the acute results from differing outcomes of the disappearance of the glottal stop: metathesis, straightforward loss, and laryngealization.

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Among the Slavic languages, Slovene and the dialects corresponding to Bosnian/Croatian/Serbian (BCS)—Kajkavian, Čakavian, and Štokavian—evidence the only pitch-accent systems remaining in Slavic. Elsewhere, older pitch distinctions have been transformed into quantity relations (e.g., Czech, Slovak), further transformed into new quality relations (e.g., Sorbian, Polish), or pitch and quantity relations have become transformed into systems with only distinctive place of stress (e.g., Russian, Ukrainian, Belarusian, Bulgarian). Croatian and Slovene dialects in particular preserve a relatively greater share of direct evidence of pitch relations, particularly with regard to words displaying contrastive “rising” pitch accents (as opposed to “falling”). So, for example, Kajkavian, Čakavian, some varieties of Štokavian, and Slovene preserve a rising pitch in long syllables of the accent type sú:ša

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1 For convenience BCS, which has emerged in American Slavistic usage as a cover term for the Bosnian, Croatian, and Serbian standard languages, is used to refer to the Štokavian–based standard languages and the speech territories defined by them. Western South Slavic (WSS) refers collectively to Slovene and BCS.
'drought'.\textsuperscript{2} Kajkavian and Slovene have a rising accent in historically short syllables of the type \textquotesingle kó:nji 'horses' NOM/ACC-PL. Slovene alone preserves a rising accent in the type \textquotesingle g\textacute{\textacute{r}}:va 'mane', though some northwestern Štokavian and Čakavian dialects also have a rising accent in cases of compensatory lengthening, e.g., the type \textquotesingle s\textacute{t}á:rca 'old man' GEN-SG. The types can be grouped historically by virtue of their origin: the \textquotesingle sú:ša, \textquotesingle kó:nji types are referred to traditionally as reflexes of the “neo-acute” (NA), and the \textquotesingle g\textacute{r}í:va, \textquotesingle s\textacute{t}á:rca types as reflexes of the “old-acute.” For the purpose of this paper, the rising pitch that developed with neo-Štokavian accent shift is left aside, since this development occurred after the dissolution of Slavic unity. (Details, further examples, and a discussion of the origins, as well as references to further literature, can be found in Ivić [1966] and Lisac [2003].) From the perspective of linguistic geography, Slovene presents the most archaic picture, lying as it does on the NW periphery of the WSS dialects and preserving rising

\textsuperscript{2} The term \textit{accent(s)} is used here to reference the traditional designations in the Slavistic literature of “falling,” “rising” (synchronic); “circumflex,” “acute” (diachronic) word-prosodic suprasegmental prominences without regard to their phonetic properties.
pitch from the largest number of historical sources, including the old acute. Slovene rising pitch comes both from old acute and neo-acute. In Croatian dialects the richest—and in most cases the only source—of rising pitch is the neo-acute. Not only do the sources for the rising pitches differ in Slovene and Croatian, but the synchronic phonetics of the rising pitches differ as well. This discrepancy points us towards an explanation of the development of the acute tone, as will be developed in the continuation of this paper.

The realization of pitch contrasts in Slovene and Croatian

A sense of the difference in phonetic realization of pitch between the Slovene and Croatian accent types can be obtained by comparing the results of instrumental analyses carried out by Srebot-Rejec (1988) for Slovene and by Lehiste and Ivić for Kajkavian (1986). These studies are particularly apt for comparison as they each focus on corpuses of recorded and instrumentally measured examples of disyllabic frames for the occurrence of falling and rising pitches in the respective languages. In each of the studies, measurements of pitch height based on fundamental frequency ($F_0$) were taken in the stressed and first-pretonic syllable and the samples averaged so that composite measurements can be compared for each language. The Slovene speakers were from Ljubljana, which reflects the prosodical system of the central (Upper and Lower Carniolan)
dialects (1988: 13). The Kajkavian informants were from Donja Pušća in
the Lower Sutla dialect (about 26 km west of Zagreb). Lehis and Ivić
report that essentially the same pattern of pitch movement observed in
Donja Pušća Kajkavian was found also in Čakavian (1988: 75ff, 81) and
Slavonian (83—92). For this reason I assume that the Kajkavian evidence
is reasonably representative of the Croatian pitch contrasts.

In Slovene the difference between “falling” and “rising” accents is
reflected in the contrast between the relative height of the pitch in the
stressed vs. the first post–tonic syllable and, importantly, the relative
height of falling vs. rising pitch stressed syllables (see Figure 1). With
both falling and rising pitches the first post–tonic syllable is
approximately the same, falling gradually from 130 to 110 Hz in the
“falling” case and from 125 to 110 in the “rising” case. The larger contrast
is in the stressed syllable, which is rising (!) in both instances. In the case
of the “falling” pitch, the rise is from 125 to 155 Hz (an increase of 30 Hz
of 24%), completed in about a tenth of a second before falling rapidly to
130 Hz in the post–tonic syllable. The “rising” pitch is almost level, going
from 100 to 110 Hz (a rise of only 10 Hz or 10%) in a tenth of a second.
But, crucially, the highest point of the pitch in the stressed syllable does
not exceed the lowest pitch of the first post–tonic syllable. Moreover, the
lowest pitch of the stressed syllable is lower than the lowest pitch of the
post–tonic syllable (100 Hz vs. 110 Hz). The contrast between “falling”
and “rising” accent in Slovene is therefore not really falling and rising at all, but rather a contrast between a high-pitched stressed syllable and a low-pitched stressed syllable. The post-tonic syllables, being more or less the same for either pitch–accent, form a sort of target or platform with which the higher– or lower–pitched stressed syllable contrast. To employ IPA contour symbols, the Slovene pitch contrast might be symbolized thus: “falling” accent: [äï] vs. “rising” accent: [üï] (where the dot indicates the syllable break), or, to use the numerical stylization, [5.3] vs. [1.3].

The Kajkavian data for the accent contrasts are similar to the Slovene in one respect, that is, that the post–tonic syllable is roughly the same regardless of the pitch properties of the stressed syllable (see Figure 1). Unlike Slovene, however, the Kajkavian stressed syllables of each type (i.e., “falling” and “rising”) are roughly in the same pitch range as one another and consequently the contrast between the two pitch types can hardly consist of a distinction between high and low pitch. The falling accent is defined by a quick rise from 120 to 128 Hz within the first tenth of a second of the duration of the first syllable, then falling to 113 Hz by the end of the vocalic portion of the syllable, some 9/100ths of a second later. The rising pitch starts at the same height (120 Hz) as with the falling accent syllable and reaches a peak of 127 Hz at 18/100ths of a second, just before the completion of the vocalic portion
of the syllable, and the falling in the final 2/100ths to 120 Hz. The contrast in Kajkavian is produced by a fall vs. a rise in the stressed syllables. The Kajkavian pitch contrast might be stylized as follows: “falling” accent: [\-\-] vs. “rising” accent: [\-\-] or [53.3] vs. [35.3]. The data for the Slovene and Croatian accents are presented in tabular form in Figure 1.
Figure 1. Slovene and Croatian pitch measurements based on Srebot-Rejec (1988: 108ff) and Ivić and Lehiste (1986: 83ff)

<table>
<thead>
<tr>
<th></th>
<th>FALLING ACCENT</th>
<th>RISING ACCENT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stressed</td>
<td>First post-</td>
</tr>
<tr>
<td></td>
<td>syllable</td>
<td>tonic</td>
</tr>
<tr>
<td>Slovene (Ljubljana)</td>
<td>125 ↗ 155/.10 s.</td>
<td>130 ↘ 110</td>
</tr>
<tr>
<td>Croatian (Donja Pušća Kajkavian)</td>
<td>120 ↗ 128/.10 s. ↘ 113/.19</td>
<td>116 ↘ 112</td>
</tr>
</tbody>
</table>

To summarize, Slovene differs in its realization of accentual contrasts from Croatian in the configuration of pitch over two syllables, the stressed syllable and the first post-tonic. Slovene contrasts a lower vs. a higher stressed syllable with the following unstressed syllable. In the case of the “falling” accent, the pitch is raised in the stressed syllable; in the case of the “rising” accent, the pitch is lowered in the stressed syllable. In Kajkavian the pitch distinctions are signaled by the relative timing of the pitch peak in the stressed syllable and the second syllable is irrelevant to the interpretation of pitch: in both cases—falling and rising pitch—the pitch trajectory of the stressed syllable occurs in a higher
range than that of the following syllable. Therefore, the relevant feature in the Kajkavian contrast is the movement of the pitch in the stressed syllable, i.e., falling vs. rising.

**Diachronic issues**

We may now turn to the origins of the accent contrasts. Both with respect to origins and the general outline of the pitch contours, the “falling” accent patterns similarly in Slovene and Croatian: by and large, the falling accent comes from inherited Proto-Slavic falling pitch (*őko ‘eye’ > Sln. oˈkò: Cr. ˈòko) or the neo-circumflex (*gověːdina ‘beef’ > Sln/Kaj goˈvɛːːdina) (for further details on sources see Lončarić 1996: 49).

We have also noted the similarity in shape of the pitch contour of the Slovene and Croatian falling accent: [5.3] (Sln.), [53.3] (Cr.). The same is not true of the “rising” accent. In Slovene, the two oldest sources for this pitch–accent are the old acute (*kărva ‘cow’ > Sln. kˈravːa) and the neo–acute (*súša ‘drought’ > Sln. ˈsúša); in Croatian dialects the old acute has merged with the short falling accent (Kaj. kˈravːa) and the neo–acute is the principal source for rising pitch (Kaj. ˈsúša). It is the contour of the “rising” accent that is strikingly different in Slovene vs. Croatian, to wit: [1.3] (Sln.) vs. [35.3]. This discrepancy needs to be explained.

Since the neo–acute stress results in a rising pitch in Slovene and Croatian, it is a reasonable assumption that the pitch has always been a
“rising” one and that the Slavic languages that no longer contrast pitch have rephonologized the rising tone as part of a quantity contrast (length in West Slavic) or simply a prominent, stressed syllable (East Slavic, Eastern South Slavic). The situation with the old acute is less straightforward. Slovene presents the only direct evidence that the old acute had anything to do with pitch in the narrow sense: most of the evidence is conflicting: Czech has length (k’řa:va); Slovak (k’rava) and Croatian shortness (k’ràva); and, again, the Slovene (Central dialect) evidence shows length and rising pitch (k’rá:va).

The heterogeneity of reflexes can be explained better if one assumes that pitch is not the source of the contrast, but, rather, phonation type. For this reason, I proceed from Kortlandt’s reconstruction of the Slavic accentual developments, which posits retention of a laryngeal feature, inherited from Indo-European, for Slavic until 800 A.D. (Kortlandt 1975: 20, going back to an idea from Vaillant 1936). However, I depart from Kortlandt’s view that in Slavic the “old laryngealized vowels fell together with the short rising vowels” (1975: 33). Rather, I believe that in some areas of Slavic the laryngeal feature persisted as glottalization before becoming rephonologized as pitch or quantity. Moreover, I shall give an account with phonetic and typological evidence that explains the variation found in Slavic dialects.
Excursus on a pilot study on laryngealization in Slovene

At this point in the discussion I would like to digress a bit on the genesis of the ideas presented in this paper. As many who have become interested in Slavic accentology, I have long been intrigued by Kortlandt’s laryngealist theory of the history of the Baltic and Slavic accent systems. I thought I was on to something that would confirm a piece of the laryngealist approach when I came across, in the course of doing fieldwork in Upper Carniola (Srednje Jarše pri Domžalah), cases of laryngealized phonation in conjunction with rising pitch. Instrumentally rendered images\(^3\) of such examples are presented in Figure 2 and Figure 3.

\(^3\) The images were obtained using PRAAT 4.3.04 by Paul Boersma and David Weenink.
Figure 2. *V knjigi je pisalo:* ‘in the book it said ...’ spoken by adult female speaker of standard Slovene from Upper Carniola (Sr. Jarše pri Domžalah). Creaky voice is seen in the wider-spaced striations on the right, corresponding to the final vowels a-o.
Figure 3. ... razlagati ‘to explain’. Sentence-final word spoken by adult female speaker of standard Slovene from Upper Carniola (Sr. Jarše pri Domžalah). Creaky voice is evident virtually throughout the word.

It was not at all clear to me that these instances were regularly a feature of Slovene rising pitch and I had a hunch they might be idiolectal, but I thought that if it turned out to be the case that there was a regular correspondence between creaky voice and rising pitch, this would demonstrate that the laryngeal feature remained intact—at least in Srednje Jarše pri Domžalah—considerably later than 800 A.D. Possessing only rudimentary skills in experimental phonetics, I was fortunate to have
been able to engage the assistance of a phonetician colleague, Dr. Peter Jurgec (Fran Ramovš Slovene Language Institute, Ljubljana), who conducted a preliminary investigation into the phenomenon.\footnote{The idea for the collaboration arose during the Slavistic Congress in Novo mesto, Slovenia, in October 2004. I would like to take this opportunity to thank Dr. Jurgec for his assistance with this project. I am pleased that the investigation has taken on a life of its own in Dr. Jurgec’s work, unconnected with the historical problem I had in mind.}

Jurgec (2005) examined the role of creaky voice (one of several variants he collectively terms “laryngealization”) in Slovene, analyzing a corpus of 204 minutes of studio-recorded samples of speech from Ljubljana (10 speakers) and 29 minutes of field-recorded speech in context from a single informant in Kanal Valley (Zilja dialect, Carinthia). In these corpora, laryngealization occurs in 11.6% of the words. Three types of laryngealization were considered: (1) Word-initial and morpheme-boundary laryngealization; (2) Word-internal laryngealization; and (3) paralinguistic laryngealization (connected with speaker hesitation, etc.). Of these, for the purposes of studying the diachronic situation with regard to inherited word-prosody, we are concerned only with (2).
Jurgec's major findings relevant to the present study are that:

1. Laryngealization was found more frequently in post-tonic syllables than tonic.
2. The more post-tonic syllables in the word, the more likely is the occurrence of laryngealization.
3. Laryngealization (in post-tonic syllables) is more likely in circumflex- than in acute-stressed words.
4. The distribution in 3 is relevant only for tonemic speakers.

From this it follows that laryngealization is a concomitant phenomenon in the realization of pitch in tonemic Slovene. However, it is not found as the realization of the stressed syllable. The synchronic state of affairs can be explained as follows: laryngealization occurs optimally in low-pitch and low intensity syllables, therefore it is more likely to occur post-tonically than under stress. It is more likely to occur in syllables in which pitch is relatively low, therefore it is more frequent after the high pitched-stress (circumflex, FP), than the low pitched (acute, RP).

It can be inferred that from the group sampled, laryngealization is not found as the reflex of the acute ("rising") stress per se. This does not exclude the possibility that other dialect variants might reveal a different patterning. Some caveats: Jurgec’s sampling is from other localities than
the one that originally drew my attention to the phenomenon; moreover, as Jurgec himself indicates, his investigation is as yet only preliminary. Nevertheless, there is no evidence as yet that there is a direct continuation of laryngealization today as the reflex of the acute stress.

Though I am reasonably convinced that laryngealization as a reflex of the Proto-Slavic acute (and, by extension, Indo-European laryngeals) is not a feature of modern Slovene dialects, I do however think that laryngealization played a role in the variation of reflexes that we find in Slavic dialects today. I shall turn now to some phonetic preliminaries and finally to a reconstruction of the processes I think must have taken place to give rise to the reflexes.

**Phonetic considerations**

To place laryngealization in a wider typological context, this phonation type makes up a part of a spectrum of states of the glottis that affect the realization of voicing. Towards the extremes of this continuum are breathy voice on the one hand and creaky voice on the other. According to Ladefoged, “Breathy-voiced sounds have a greater flow but less pressure than in regular voicing, and creaky-voiced sounds have the reverse. In breathy voice the vocal cords are further apart and let more air through, whereas in creaky voice they are pressed tightly together, largely blocking the airflow” (Ladefoged 2003: 169). The endpoint on
spectrum, toward which creaky voice tends, is the complete closure of
the glottis, the glottal stop. In languages the realization of a glottal stop
can range into less than full closure, in other words, creaky-voice can be
an allophonic variation of the glottal stop (Ladefoged 2003: 175;
Thurgood 2002: 346—347). The general linguistic literature on the
effects of laryngealization has grown richer with increasingly detailed
phonetic and phonological analyses of world languages. Laryngealization
has been demonstrated to play a role in both quantity and pitch effects
with widely varying outcomes. For example, in the context of a general
linguistic survey of compensatory lengthening, Kavitskaya points out that
“[t]he fact that the deletion of glottal stops can be correlated with CL
[compensatory lengthening] is rather puzzling […]. Glottal stops do not
share phonetic characteristics with segments that trigger vowel
lengthening, such as glides, liquids or fricatives. […] [V]oiced stops often
cause the lengthening of preceding vowels. However, glottal stops are
voiceless and should thus pattern with voiceless stops, which usually
have a shortening effect on preceding vowels” (2002: 79). Kavitskaya
goes on to show for a range of sample languages that the loss of glottal
stops results in compensatory lengthening in cases of laryngealization,
whereas simple loss of a glottal segment does not result in vowel
lengthening (79—80).
Writing on tonogenesis in Vietnamese, Thurgood says that “[t]he pitch raising effect of final glottal stop is widely attested; however, there are also cases of a pitch lowering effect. [...] [T]his apparent discrepancy is reconcilable if the abrupt, complete glottal closure accompanying a final glottal stop is distinguished from the less complete, less abrupt glottal stricture found, for example, in Burmese ‘creaky’ tone” (2003: 342). Referring to earlier work by Mauzadon, Thurgood indicates that “the more abrupt, more complete glottal stop leads to pitch raising, while the more imperfect, less abrupt variant leads to often–sharp pitch lowering accompanied by tenseness” (loc. cit.). As Ní Chasaide and Gobl indicate, creaky–voice (laryngealized) phonation correlates with low pitch for mechanical reasons: “Pitch has been observed to be extremely low, and would appear to be controlled by aerodynamic factors [...]” 1999: 450. The evidence for pitch raising with the glottal stop proper is provided by Hombert. Hombert’s experiment with male Arabic speakers demonstrated that a glottal stop, representing one end of the spectrum, and [h], representing the other, result in a minimum pitch rise of 9hz and a lowering of at least 25hz, respectively (Hombert 1978: 93—94).

Kavitskaya, Thurgood, and Hombert demonstrate that loss of glottal stops can result in a range of variation and even seemingly contradictory results as the contrasts in which they participate become rephonologized in terms of quantity and pitch. When they are simply lost,
glottal stops do not lengthen syllables and they raise pitch. When glottal stops weaken to laryngealized phonation or creaky voice, they can lengthen syllables, make vowels tense, and lower pitch.

**Reconstruction of the developments**

Assuming that the glottal stop persisted in Slavic up until 800 A.D., I believe it is not all that farfetched to think that the segment did not simply disappear uniformly in all dialects after leaving a pitch-perturbation effect. The diachronic progression from a glottal stop to a laryngealized vowel phonation, essentially, a spread of a segmental feature throughout a syllable (or even across syllables), can be seen as a particular instantiation of a general tendency in the last stages of Proto-Slavic. One may compare, for example, the spread of nasality from coda-final nasal segments giving rise to nasal vowels or the metathesis of CVr/C > Cr/NC, one of a number of innovations leading to the lightening of inherited heavy syllables. Following Bethin’s observation, this tendency amounts to the shift of less sonorous elements from syllable–coda position (see Bethin 193ff).

In Figure 4 are sketched out the logical outcomes of glottal-stop loss according to the processes that we might expect to have developed in the context of Slavic in the 9th century. For each of the outcomes it is assumed that in subsequent developments the glottal stop or
laryngealization was lost, having been evaluated by speakers as a secondary manifestation of the primary contrast(s) (that is, pitch and/or quantity). Were a syllable–final glottal stop to undergo metathesis in a parallel fashion to liquid metathesis, the effect would be to raise the pitch contour of the syllable onset and, possibly, lengthen the syllable. As far as I know, this is not one of the outcomes in Slavic, though it may be the relevant development needed to explain phenomena in Latvian and the Žemaitian dialect of Lithuanian, which show broken tone or falling pitch as a reflex of the inherited Balto–Slavic acute (see Young 1994 for details). Simple deletion of the glottal stop in final position would yield a short syllable with a high tone, conceivably a rising tone, but one in which the salience of the intrasyllabic rise, by virtue of its short duration, would be minimal in comparison with the contrast between the stressed syllable (H) and the decay (L) in the post–tonic syllable. The result is the short “falling” stress found as a reflex of the old acute characteristic of eastern Slovene dialects and BCS; in central Slovak dialects, which have lost pitch distinctions, the reflex is simply a short syllable. The third possibility—glottal stop loss yielding laryngealization—parallel to the loss of syllable–final nasals resulting in nasalization, would result in a long syllable with a lowered tone. In languages such as Upper Sorbian and Czech, where pitch has been lost, we see only the lengthening effect. In central and western Slovene dialects we find the lower tone described
earlier in this paper. If this was indeed the process that obtained in
Slovene, then positing relengthening of formerly short acute syllables
becomes unnecessary (Greenberg 2000: 128—130). The final steps would
then be the merger of the pitch contour of redundant rising tone in
short-stressed words (of the type *ˈnósiːʃt̚e̞ː/) with the low-pitched-
stressed (formerly laryngealized) words and the loss of quantity contrasts
by lengthening the short-stressed syllables.

**Figure 4: Possible outcomes of glottal-stop resolution ca. 800 A.D.**

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>SYLLABLE STRUCTURE</th>
<th>PITCH EFFECT</th>
<th>QUANTITY EFFECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>metathesis</td>
<td>CV?C &gt; C?VC</td>
<td>falling pitch</td>
<td>long syllable?</td>
</tr>
<tr>
<td>glottal–stop deletion</td>
<td>CV?C &gt; CVC</td>
<td>high tone</td>
<td>short syllable</td>
</tr>
<tr>
<td>laryngealization</td>
<td>CV?C &gt; CVC</td>
<td>low tone</td>
<td>long syllable</td>
</tr>
</tbody>
</table>

To sum up, there is evidence for a series of related developments
ensuing in the late stages of the dissolution of Slavic continuity as
regards the reflex of the Proto-Slavic acute. A syllable–final glottal stop
can either be lost directly, resulting in a high–pitched short syllable (BCS),
or give rise to a laryngealized syllable and, finally, a low–pitched long
syllable (Slovene). In non–pitch–distinguishing dialects, the results are
limited to quantity contrasts, i.e., short (Slovak) vs. long (Czech), respectively.
References


