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Compensatory Lengthening Without Moras: A Study in Phonologization¹

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0. Introduction

The term Compensatory Lengthening (CL) refers to a set of phonological phenomena wherein the disappearance of one element of a representation is accompanied by a corresponding lengthening of another element. While both consonants and vowels have been shown to undergo CL, in this paper we are concerned exclusively with CL processes as they affect vowel length.

Lengthening of vowels can result from both consonant deletion, as shown in (1), and vowel deletion, as shown in (2).

(1) s-deletion in Latin (Hayes 1989)

CVC -> CV:

i:dem	< *is-dem	'the same'
ka:nus	< *kasnus	'gray'
ko:mis	< *kosmis	'courteous'
fide:lia	< *fideslia	'pot'

(2) Old Church Slavic > Pre-Serbo-Croatian (Hock 1986)

CVCV -> CV:C

OCS		Pre-SCr.	
bobŭ	>	bo:b	'bean'
bogŭ	>	bo:g	'god'
medŭ	>	me:d	'honey'

Though both types of CL are relatively common and have been treated in the phonological literature, our focus here is on the CVCV -> CV:C pattern alone. For a similar approach to CL through consonant loss, see Kavitskaya 2000.

CL is said to be "compensatory" in so far as its application appears to involve either a literal transfer of some phonological property of a deleting segment X to a new segmental host Y (Hayes 1989, among others), or alternatively the augmentation of some property of that segment Y *in response to*,

¹ Profuse thanks are due to Ian Maddieson for his advice and help with statistics. We also thank Andrew Garrett and Alan Timberlake for much patient and illuminating discussion.

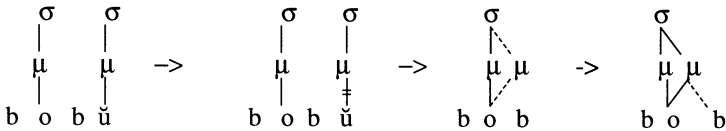
or to *make up* for deletion or shortening of segment X (Timberlake 1983b). While the former approach relies on a notion of preservation and transfer of elements of the phonological representation (moras in the case of Hayes), the latter appeals rather to a more holistic notion of isochrony, or preservation the actual phonetic duration of a word or string.

In this paper we examine the facts of a set of CL phenomena from the history of Slavic. We show that the moraic approach to CL is not sufficient to characterize or explain the development of CL in the languages in question. We propose a new, phonetically-based explanation of the Slavic data. The veracity of this explanation is supported by a phonetic study of vowel duration which we conducted for Modern Russian. This approach, furthermore, can be extended to account for other cases of CL through vowel loss.

1. A Moraic Approach to CL

Perhaps the most influential generative treatment of CL is that devised by proponents of moraic theory (Hayes 1989, Hock 1986, *inter alia*). To capture the appearance of a *transfer* of vowel length from one place in the string to another (as in 2 above), moraic theorists propose that CL occurs when a mora-bearing segment is deleted, but its mora persists in the representation. This stray mora is then reassociated to a nearby vowel, making that vowel long, as shown in (3).

(3) Slavic CVCV CL (after Hayes 1989 on Middle English)



For Hayes, deletion of the final vowel of the CVCV string results in an ill-formed syllable consisting of a consonant onset and an empty nucleus. Through a process of “parasitic delinking”, the onset consonant is detached from its syllable node. At this point, the stray mora is free to reassociate to the vowel of the preceding syllable. Note that this approach correctly derives the observed right-to-left directionality of CVCV CL processes. Were the first vowel of the string in (3) to delete, its mora would be incapable of reassociating to the vowel to the right, blocked, as it were, by the intervening association line of the onset of the following syllable.

Moraic theory thus makes the following prediction: since intervening onset consonants in CVCV CL are not associated to any prosodic structure at the time of the reassociation of the stray mora, they should have no way of interacting with the application of CL. However, in Late Common Slavic (LCS) dialects, the realization of C_1VC_2V CL depends crucially on the identity of the intervening C_2 . While some intervening consonants permit CL to take place, others appear to block it. Moraic theory has no way of accounting for this state of affairs.

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2. Compensatory Lengthening in Late Common Slavic

Toward the end of the Common Slavic period, the two lax high vowels known as *jers*² delete in certain positions, giving rise to lengthening of the vowel in the preceding syllable. This CL takes place only if the intervening consonant is above a certain threshold in the hierarchy shown in (5). Different Slavic dialects set this threshold at different points in that hierarchy³ (Timberlake 1983a. and b., 1993).

- (5) sonorants ≥ voiced fricative ≥ voiced stop ≥ voiceless obstruent

Posavian				
North čakavian				
	Czech	Polish		
		South čakavian	Ukrainian	
			Upper Sorbian	

Thus, the Posavian and North čakavian dialects of Serbo-Croatian permit CL only when the consonant intervening between the deleting vowel and the target is a sonorant, as in (6).

- (6) North čakavian: CL only before sonorants
- | | | | |
|-----------|---|--------|---------|
| a. *konь | > | [ko:n] | 'horse' |
| b. *morzь | > | [mrɜz] | 'frost' |

In Czech, however, CL occurs when the intervening consonant is either a sonorant or a voiced fricative, as in (7).

- (7) Czech: CL before sonorants and voiced fricatives
- | | | | |
|---------------|---|--------|---------|
| a. *domь | > | [du:m] | 'house' |
| *bogь > *boγь | > | [bu:h] | 'god' |
| b. *rodь | > | [rod] | 'kin' |

Polish allows CL across sonorants, voiced fricatives, and voiced stops, as shown in (8).

- (8) Polish: CL before sonorants, voiced fricatives and voiced stops
- | | | | |
|----------|---|--------|----------------------|
| a. *domь | > | [do:m] | 'house' (Old Polish) |
| *dōbь | > | [dā:b] | 'oak' |
| b. *sokь | > | [sok] | 'juice' |

More permissive still are Ukrainian and Upper Sorbian, in which CL takes place regardless of the identity of the intervening consonant.

² These ultra-short vowels are the reflexes of earlier short /i/ and /u/, and are traditionally represented by the symbols 'ь' and 'ъ'.

³ In fact, accent type, position in the word and identity of the vowel can also play a role in determining the outcome of CL. See Timberlake 1983a. and b. for details. Most importantly, in the majority of dialects showing CL, only mid vowels /e/ and /o/ are targeted for lengthening.

3. A Hypothesis

As noted above, the mora-reassignment account fails to derive the asymmetry of application of CL found in the Slavic dialects, as there is nothing in the representations which could be made to block the reassignment in some cases, while allowing it in others. Manipulation of formal representations thus offers little insight into the problem of CL in Slavic. In what follows, we show that CL is readily explained not through the transfer or insertion of moras or other phonological units, but through phonologization of already existing phonetic duration of target vowels.

It has been widely observed as a universal phonetic tendency that vowels in open syllables are realized cross-linguistically longer than vowels in closed syllables (Maddieson 1985, Rietveld and Frauenfelder 1987, *inter alia*). Additionally, vowels tend in many languages to be longer before voiced consonants than before voiceless (Hualde 1990 on CL in Friulian, Kluender, Diehl and Wright 1988). These facts by themselves, however, are not enough to explain the range of phenomena detailed above.

Armed solely with the first of the above generalizations concerning vowel durations and syllable structure, we can now approach most examples of CVCV CL in a completely new way. We propose that CL in Slavic does not in fact involve any transfer of length or weight. Rather, phonetic vowel durations found intrinsically in the CVCV environment are reinterpreted as phonologically significant upon the change in syllable structure. Prior to the deletion of the final vowel, the longer vowel duration characteristic of open syllables is correctly parsed by listeners as a phonetic consequence of syllable structure in the first syllable of a CVCV sequence, and is discounted. The vowel is interpreted as phonologically short, as is intended by the speaker. Upon deletion of the final vowel⁴, however, the longer duration of the first vowel in the newly- closed syllable becomes inexplicable. The listener therefore parses the longer duration as intended by the speaker, and reinterprets the vowel in question as phonologically long. This view of sound change, wherein intrinsic phonetic properties of the speech signal are misparsed and reinterpreted, yielding phonologization, is proposed and advocated in the works of Ohala (*passim*), and further developed in Blevins and Garrett 1998 among others.

The above is sufficient to account for the instances of Slavic CL in which intervening consonants play no role, and therefore for most examples of CVCV CL known to us. To account for the interaction of the consonants with CL, though, some additional facts must be invoked. Noting the implicational relationship between consonant sonority⁵ and participation in CL processes in Slavic, we hypothesized that vowel durations might be greater not only before voiced obstruents than before voiceless, but that this generalization might represent only the bottom end of a hierarchy of vowel duration differences along a larger scale. Were it the case that vowel duration, at least in LCS (and potentially

⁴ Or more likely, simultaneously with the deletion of the final vowel, as it is precisely the listener's failure to perceive the the final vowel which makes reinterpretation of the duration of the initial vowel possible.

⁵ Taking "sonority" in its loosest possible sense only as a way of referring to the tendency for certain groups of consonants to behave as classes along a generally-accepted sonority scale (i.e. as in Blevins 1995:211), and not to any specific phonetic features of those classes.

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more generally), was longer before consonants toward the left edge of the scale in (5), and shorter before consonants toward the right edge, then the picture we sketch of Slavic CL becomes markedly clear.

To wit, Proto-Slavic had disyllables of the form CVCV, in which the first vowel was phonetically longer before certain segments than before others. With the loss of the second vowel, the language acquired a set of newly-closed syllables. The inherited phonetic duration of the vowel in these yielded in some cases closed syllables with vowels uncharacteristically long for their phonetic environment. This length, previously phonetically conditioned, was now reinterpreted as phonological, producing, in effect CL. Below a certain point in the hierarchy discussed above, however, the aberrant duration was perceptually insignificant and was not phonologized. Different Slavic dialects set this cut-off point for lengthening in different places, resulting in CL before some consonants, and none before others.

4. An Experiment

To demonstrate that the state of affairs we describe for LCS is plausible, it would be desirable to locate a similar set of phonetic facts as yet unphonologized in a living language. To this end, we conducted an experiment with the vowels of Contemporary Standard Russian (CSR), in which we examined vowel durations in closed and open syllables before a variety of consonants.

4.1. Methodology

Subjects were three native speakers of CSR. They were asked to read a list of 78 real Russian words of at least two syllables each. Each word was repeated three times, of which repetitions only the first two were analyzed⁶. Analog recordings were made in a sound booth, and the recordings were digitized and spectrograms and waveforms were produced using CSL. Standard measuring techniques were used to determine vowel durations.

All tokens had stressed vowels /o/ and /a/ in open and closed syllables. Intervening consonants were voiceless stops, voiceless fricatives, voiced stops, voiced fricatives, nasals and liquids. (9) shows some examples of tokens taken from the experiment. To compare the duration of stressed /a/ in open and closed syllables, for example, we used the words *papa* 'dad', and *papka* 'folder'.

(9)	CVCV		CVCCV	
	papa	'father'	papka	'folder'
	vata	'cotton wool'	vatka	'small wad of cotton wool'
	proba	'test'	lobzik	'fretsaw'
	noſa	'load'	noſka	'little foot'
	saza	'soot'	zaſda	'thirst'
	mama	'mother'	mamka	'mother' (coll.)
	ſkola	'school'	xolka	'withers' (equestr.)

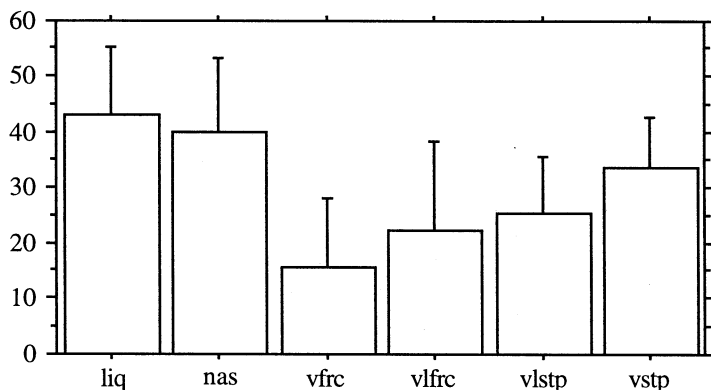
⁶ Features of list intonation gave the third repetition of each word both lower amplitude and pitch, and shorter duration, making it less amenable to analysis.

4.2 Results

To interpret the results we obtained, we subjected the mean differences in vowel duration between open and closed syllables to pairwise comparisons for each following consonant. This preliminary statistical analysis using ANOVA tests suggested that further analysis of the data with consonants grouped together into the classes discussed above could be fruitful. Variation between speakers was seen to be insignificant. Note that the crucial measurement for our purposes must be not the durations of the vowels themselves in various preconsonantal environments, but precisely the *differences* between those durations in closed and open syllables. Vowel durations might well be longer before sonorants than before obstruents, but if they were equally longer in both closed and open syllables, there would be no basis for a reinterpretation to take place upon loss of the vowel in the second syllable.

The table in (10) shows that in comparison of vowel duration differences in open and closed syllables, consonant class is indeed significant. Mean differences in vowel durations between open and closed syllables are greatest for liquids, followed by nasals, voiced stops, voiceless fricatives, and finally if somewhat mysteriously, voiced fricatives. If we discount for the moment these latter, this corresponds to the hierarchy of consonant interaction found in Slavic CL.

(10) Mean differences between open (O) and closed (C) syllables for both vowels

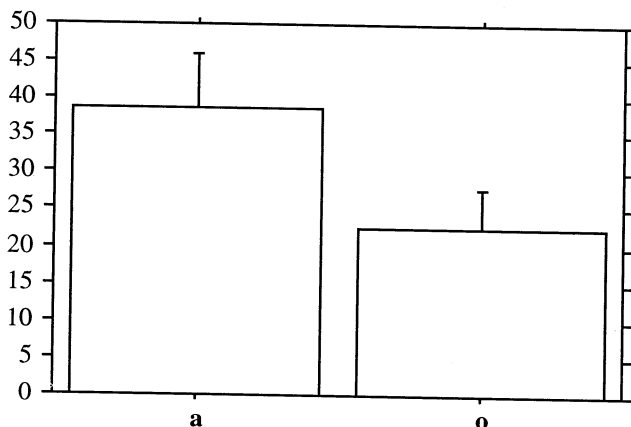


The results pertaining to the voiced fricatives are unexpected. For these the differences between open and closed syllables were either very small, or even negative for at least one speaker. A possible explanation for this lies in the peculiarities of Russian syllabification patterns. Specifically, because Russian has both voicing assimilation in consonant clusters and word-final devoicing, it is difficult to find uncontroversial examples of voiced fricatives as codas. It is entirely possible, indeed perhaps even likely, that the voiced fricatives in our “closed syllable” examples are in fact syllabified as onsets (*no-zdri* ‘nostrils’, rather than *noz-dri*). If this is true, then all the relevant vowel durations were taken from open syllables, and the lack of any appreciable difference in durations is explained.

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Since CL in many dialects of LCS affected only mid vowels, leaving peripheral vowels unlengthened, we compared also the mean differences between the durations of mid vowels before all consonants in closed and open syllables to the mean differences for other vowels in CSR. The table in (11) shows these results.

(11) Mean differences between closed and open syllables for all consonants



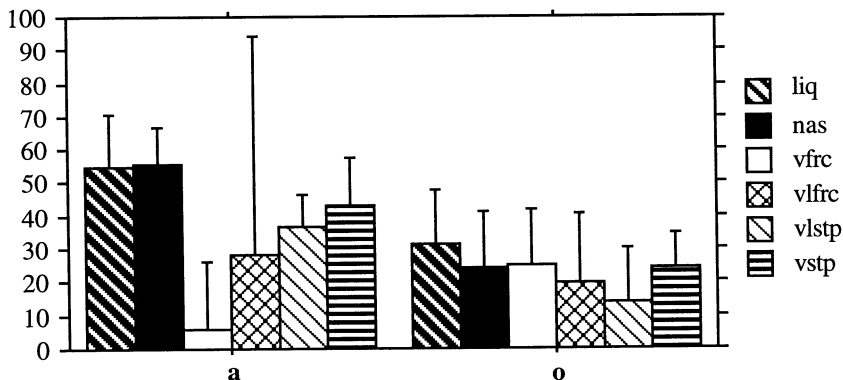
Curiously, the differences for /a/ are much more dramatic than for /o/ in CSR. If this were also the case in LCS, it is difficult to understand why mid vowel *s* should often undergo CL, while low vowels resisted it. We propose that the reason for this is to be found in the synchronic facts of the LCS vowel system. In LCS, all high and low vowels are reflexes of earlier distinctively long vowels. All non-peripheral vowels are reflexes of originally short vowels. This is shown schematically in (12).

(12) Common Slavic	>	Late Common Slavic
ī, ĭ ī		i i u
ǔ, ū		b b
		e o
ǣ, ǣ		æ a
ǫ, ǫ		

If at the time of the change peripheral vowels still retained some of their inherited duration, then they were substantially longer at this point than non-peripheral vowels. Thus, even if the difference between the durations of peripheral vowels in open and closed syllables was greater than that difference for non-peripheral vowels, this difference would nonetheless be a smaller proportion of the total duration of those vowels. Simply put, 20 ms is a much less significant chunk of a 200 ms vowel than it is of a 100 ms vowel. It is therefore less likely to be noticed and reinterpreted.

The table in (13) shows the mean differences in vowel durations in open and closed syllables with the effects of both consonant class and vowel height. While a larger sample might have helped to eliminate a certain amount of statistical noise, one can nevertheless see the same pattern emerging in CSR as there was in LCS.

(13) Mean differences with effects of class and vowel displayed



5. Conclusion

Our experimental results suggest that the phonetic situation we reconstruct for Late Common Slavic is plausible indeed, and provides an explanation for CVCV CL in Slavic. The extent to which the hierarchy we find there represents a cross-linguistic generalization concerning the interaction of syllable structure and consonant class remains to be seen. While the moraic approach sketched above may well be a desirable notational device for the description of synchronic alternations, it not particularly insightful with regard to the origin and typological variation observed for CVCV CL in general, and has nothing at all to say concerning the additional complications found in the Late Common Slavic dialects. Our approach, on the other hand, accounts for the facts of Slavic using only the facts of phonetic vowel duration and syllable structure and requires no additional formal machinery. It is extended with no complication to other cases of CVCV CL, such as, for example, Friulian. For all their usefulness elsewhere, this study renders the formal notion of the mora irrelevant to the explanation of CL and adds another case to the list of sound changes which are better understood in terms of the reinterpretation of intrinsic phonetic properties, rather than through the manipulation of phonological representations.

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