

Functional factors in contrast preservation

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Talk outline

- Introduction: Defining functional factors
- Examples
 - Compensatory lengthening
 - Vowel reduction
- Case study: palatalization
 - Secondary palatalization
 - Palatalization of rhotics
- Conclusion

Introduction: Defining functional factors

Introduction

- Phonetic/phonological pressures on contrast
 - Perception/production
- Example: Palatalization in Russian (Jakobson 1929; Lunt 1956, Kalnyn' 1961; Živov 1996; Wandl and Kavitskaya 2022)

Pre-Russian

Contemporary Russian

NOM.SG.M *dъnъ > *dъnʲъ > *dъnʲ > Ru день /dʲenʲ/ 'day'

NOM.SG.F *melъ > *mʲelʲъ > *mʲelʲ > Ru мель /mʲelʲ/ 'sandbank'

NOM.SG.F *korъ > *korʲъ > *korʲ > Ru корь /kɔrʲ/ 'measles'

Introduction

- At least some explanations lie outside of the phonological system: functional pressures
- The *Actuation Problem* (Weinreich et al. 1968): Why, under similar conditions, a sound change happens in one language but not in the other?
 - Similar conditions – similar phonetic properties and similar environments
- Several functional solutions were proposed to account for the **Actuation Problem** (Kaplan 2011; Cohen Priva 2012, 2017; Wedel et al. 2013; but see Ceolin 2020 for a view that sound change can be modeled without reference to functional considerations)

Introduction

- Types of functional pressures
 - Pressures from within the inventory organization (e.g., dispersion)
 - Informational pressures (from within or outside phonology), which refer to the information structure, or the amount of information certain contrasts carry with respect to the others
- How can this amount of information be assessed?

Introduction

- The functional load hypothesis (Jakobson 1931; Mathesius 1931; Trubetzkoy 1939; Martinet 1952; among others): the amount of information transmitted by the participants in a contrast is inversely correlated with the possibility of the loss of that contrast.
- Information transmission can be interpreted as
 - the amount of work a certain contrast does, that is, as the number of contrastive positions of a given phoneme (a broad interpretation)
 - the number of contrasting lexical items due to the contrast in question (a narrow interpretation). The more minimal pairs with a contrast are present in the language, the higher functional load the contrast has.

Introduction

- It has been difficult to decide between the two hypotheses (number of contrasting positions vs. the number of lexical items).
- Wedel et al. (2013) study:
 - 56 phonological mergers, 578 phoneme pairs that have not merged in 8 languages (English (RP and Standard American), Korean, French, German, Dutch, Slovak, Spanish, and Hong Kong Cantonese)
 - The probability of merger is inversely related to functional load as defined by the number of minimal pairs participating in the contrast.
 - Thus, the results support the narrower interpretation of functional load.

A couple of examples from Slavic:
compensatory lengthening, vowel reduction

Compensatory lengthening

- Independent length contrast is a necessary condition for the phonologization of vowel length through compensatory lengthening (CL) (de Chene and Anderson 1979)
- Schematically, *CVC > CV:
- The presence of independent contrastive length may not be a universal condition on CL (Gess 1998), but it is a strong tendency (Kavitskaya 2017a)
- De Chene and Anderson's proposal is functional: the phonologization of duration happens in those languages that already have the length contrast

Compensatory lengthening

- In Slavic, CL of a vowel is a response to the loss of another vowel in the following syllable: $CV_1.CV_2 \rightarrow CV_1:C$ where V_2 is a weak jer ъ or ь

*borъ	NOM ~ GEN	
BCS	[bo:r] ~ [bora]	'forest'
Upper Sorbian	[bor] ~ [bɔru]	
Polish	[bur] ~ [bɔru]	
Ukrainian	[bir] ~ [boru]	

(CL: Timberlake 1983a,b; Carlton 1991; Langston 1998; not CL: Kurylo 1928, Shevelov 1985)

Compensatory lengthening

- Slavic CL is an example of the phonologization of vowel length in a language with the pre-existing vowel length
- Proto-Slavic inherited long vowels from PIE
- Early Proto-Slavic vowel inventory (Schenker 1995)

	Front	Back
High	i i:	u u:
Low	e e:	a a:

Vowel reduction

- There is no vowel reduction in BCS (as opposed to Belarusian, Bulgarian, Russian)
- The absence of vowel reduction in BCS is connected to the presence of the phonologically contrastive vowel length (Lehiste and Ivić 1986, Browne 1993)
- Slovenian – a special case

Vowel reduction

- Slovenian has contrastive vowel length and no vowel reduction (Bezljaj 1939, Priestly 1993, *inter alia*)
- In stressed syllables, all vowels except [ə] can be long [i: u: e: o: ε: ɔ: a:], and all vowels except [e o] can be short [i u ε ɔ a ə]
- Long vowels are always stressed, but stressed vowels are not always long (cf. [sit] ‘full’ vs. [si:n] ‘son’).
- Both tense and lax mid vowels, /e/ vs. /ε/ and /o/ vs. /ɔ/, contrast only in the stressed syllable

Stressed

[ˈgɔ:ra]

‘mountain-nom.sg’

[ˈmɔ:f]

‘man-nom.sg’

Unstressed

[gɔ're:]

‘mountain-gen.sg.’

[mɔ'ɜje:]

‘man-nom.pl’

Vowel reduction

- Vowel length in Slovenian is no longer distinctive at least in multisyllabic words (Šuštaršič et al. 1999; Jurgec 2011).
- The system has been restructured and shows a pattern of height neutralization in unstressed syllables, characteristic of vowel reduction
- Stressed and unstressed vowel inventories of Slovenian

Stressed vowels

i		u
e		o
ɛ	ə	ɔ
	a	

Unstressed vowels

i		u
ɛ	ə	ɔ
	a	

Interim summary

- CL: the phonologization of additional contrastive vowel length is possible (or at least more plausible) if long vowels are already present in the inventory
- Vowel reduction: the presence of long vowels that do not sufficiently reduce, does not support the generalization that vowels are shorter/more central in unstressed positions, preventing the phonologization of reduction.
- The presence or absence of a contrastive segment in the inventory affects the outcome of sound change, influencing the development of contrast

Case study: Slavic palatalization

(In collaboration with Florian Wandl and Khalil Iskarous)

Defining palatalization

- Primary palatalization:
 - Refers to palatal consonants where primary place of articulation is the palate
 - Diachronically, a consonant's place of articulation is altered by moving towards the palate
- Secondary palatalization:
 - A consonant is realized with a primary articulation modified by moving the tongue body towards the palate
 - Produces palatalized consonants

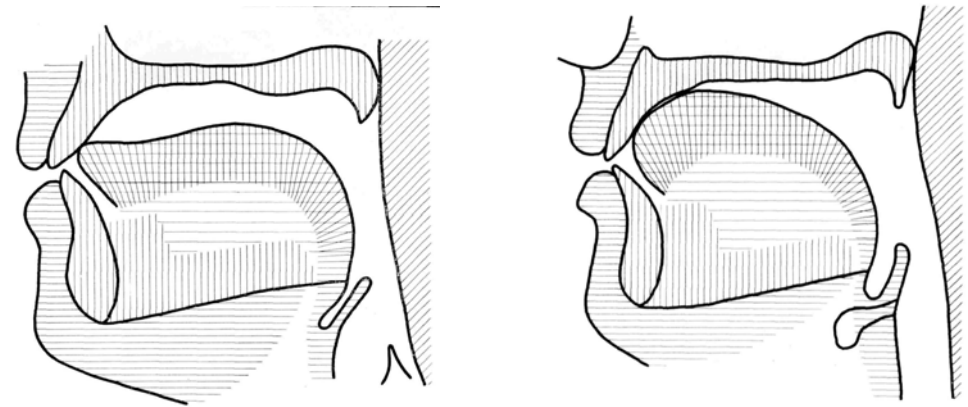


Figure 1: Russian [t] and [tʲ] (Bolla 1981)

Contrastive secondary palatalization

- Russian (East Slavic)
- Ukrainian (East Slavic)
- Eastern Bulgarian (South Slavic)
- Upper Sorbian, Lower Sorbian (West Slavic)

Contrastive secondary palatalization: East Slavic (Russian)

mat	‘foul language’	m ^j at	‘crumpled-PPL.MASC’
dna	‘bottom-GEN.SG’	dn ^j a	‘day-GEN.SG’
brat	‘brother’	brat ^j	‘to take’

	LABIAL	APICAL	(ALVEO)PALATAL	VELAR
VOICELESS STOP	p p ^j	t t ^j		k (k ^j)
VOICED STOP	b b ^j	d d ^j		g (g ^j)
VOICELESS AFFRICATE		ts	tʃ ^j	
VOICELESS FRICATIVE	f f ^j	s s ^j	ʃ ʃ ^j :	x (x ^j)
VOICED FRICATIVE	v v ^j	z z ^j	ʒ	
GLIDE			j	
NASAL	m m ^j	n n ^j		
LATERAL		l l ^j		
TRILL		r r ^j		

Contrastive secondary palatalization: East Slavic (Ukrainian)

- Standard Ukrainian contrasts most apical consonants in all positions, except for the /r/-/rʲ/ contrast that is no longer present in the coda.
 - hirkij ‘bitter’
- Ukrainian palatalization contrast has not been preserved in labials.
 - holup ‘pigeon’

Contrastive secondary palatalization: South Slavic

- (Eastern) Bulgarian (Scatton 1993)

l/l ^j	kral	'king'	kral ^j at	'the king'
n/n ^j	dɛn	'day'	dɛn ^j at	'the day'
r/r ^j	tsar	'czar'	tsar ^j at	'the czar'
z/z ^j	kn ^j az	'prince'	kn ^j az ^j at	'the prince'

Contrastive secondary palatalization: West Slavic

Upper Sorbian (Stone 1993, Schaarschmidt 1997)

p/p ^j	pana	‘mister-GEN.SG’	p ^j ana	‘piano-GEN.SG’
m/m ^j	mεskank	last name	m ^j εskank	last name
R/R ^j	Rat	‘glad’	R ^j at	‘row’

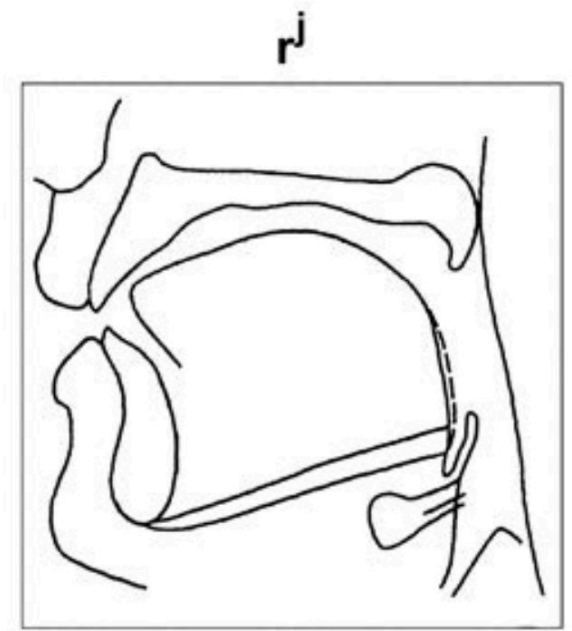
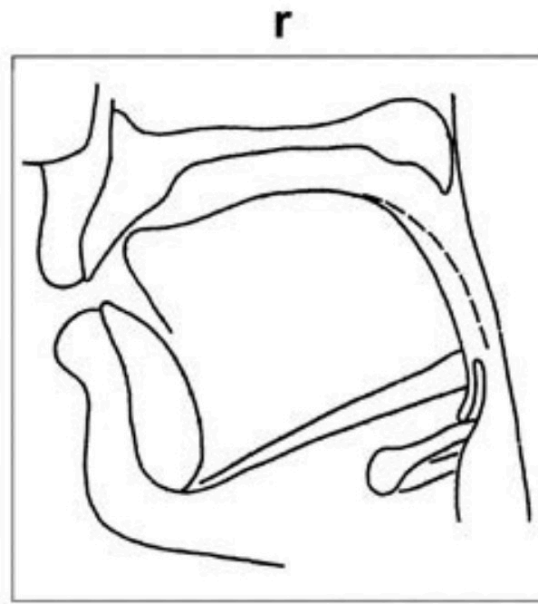
Contrastive palatalization of rhotics

- Phonetic palatalization is common, while phonological/contrastive secondary palatalization is rare (Bhat 1978, Stadnik 2002, Bateman 2011, Krämer & Urek 2016)
 - In a balanced 100 language sample, only 6 languages showed a secondary palatalization contrast (Easterday 2019)
- /r/ : /rʲ/ contrast is even more rare, present, for instance, in Irish, Japanese, Marshallese, Tundra Nenets, and Slavic (Żygis 2005, Jaworski 2018, Nikolaev & Grossman 2020)

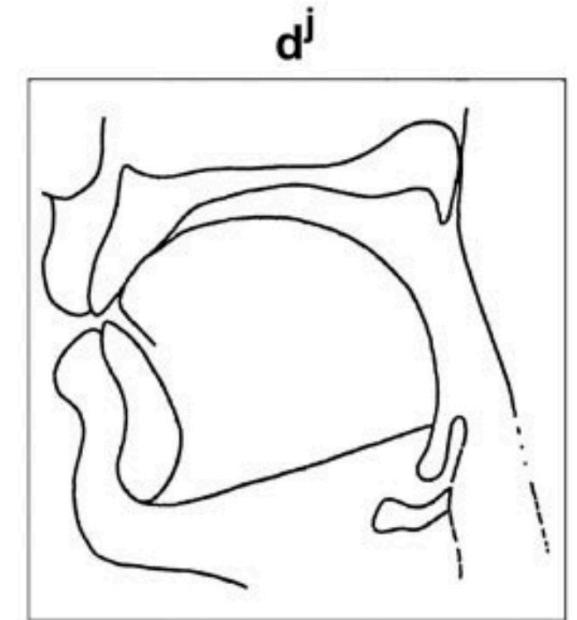
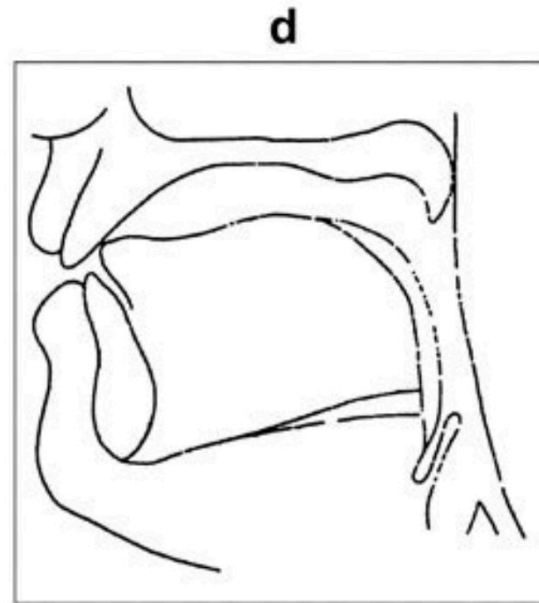
The properties of /r^j/

- There are conflicting articulatory demands on palatalization and trilled rhotics (Iskarous & Kavitskaya 2010, Jaworski 2018, etc.)
- The palatalization gesture affects the apical gesture through retraction or by reducing the ability to control the stiffness and inertia, which allows the tip to vibrate, thus weakening trilling (Keating 1993)
- Palatalization, which involves tongue dorsum raising and fronting, has conflicting articulatory demands with rhotics, which require tongue root lowering and backing (Hall 2000, Kochetov 2005, etc.)

Tracings of the articulatory structures for [r] and [rʲ] in Russian (Iskarous and Kavitskaya 2018, adapted from Bolla 1981)



Tracings of the articulatory structures for [d] and [dʲ] in Russian (Iskarous and Kavitskaya 2018, adapted from Bolla 1981)



Palatalization of rhotics

- /r/ : /rʲ/ contrast is attested in several Slavic languages from different subgroups

Ukrainian (East Slavic)

rad 'glad'

rʲad 'row'

Russian (East Slavic)

rad 'glad'

rʲad 'row'

Upper Sorbian (West Slavic)

Rad 'glad'

Rʲad 'row'

Eastern Bulgarian (South Slavic)

gora 'forest'

gorʲa 'burn'

Questions

- How and when did the /r/ : /rʲ/ contrast emerge in Slavic?
- How did the contrast /r/ : /rʲ/ develop in Slavic?
- What were the factors that influenced the preservation or loss of the contrast in Common Slavic and in individual Slavic languages?

Sources of Common Slavic palatalization (Wandl & Kavitskaya 2022, Kavitskaya & Wandl forthcoming)

- Jotation (a.k.a. yod palatalization)
- Palatalization of consonants before front vowels
 - Secondary palatalization before front vowels was areally restricted and allophonic
 - Secondary palatalization became contrastive in Russian
 - when * ϵ > *a
 - when * ь > \emptyset
 - cf. pre-Ru * $\text{p}\epsilon\text{t}\text{ь}$ [$\text{p}^{\text{j}}\tilde{\text{æ}}\text{t}^{\text{j}}\text{I}$], or [$\text{p}^{\text{j}}\tilde{\text{ɛ}}\text{t}^{\text{j}}\text{I}$] > Ru *пять* [$\text{p}^{\text{j}}\text{at}^{\text{j}}$]
 - Not a source of Common Slavic palatalization

Yotation

- C_j-sequences: *t_j, *d_j, *s_j, *z_j, *n_j, *l_j, *r_j

Yotation

- Cj-sequences: ***tj**, ***dj**, ***sj**, ***zj**, ***nj**, ***lj**, ***rj**

CSI	*tj	*světja 'candle'	*dj	*medja 'border'
OCS (Bulg)	[ft]	svě [ft] a	[zd]	me [zd] a
Mac	[c]	sve [c] a	[j]	me [j] a
B/C/S	[tɕ]	svijè [tɕ] a	[dz]	mè [dz] a
Sln	[tʃ]	své [tʃ] a	[j]	mé [j] a
Ru (Ukr, Bru)	[tʃ]	sve [tʃ] á	[dʒ] > [ʒ]	me [ʒ] á
Slk (Po)	[ts]	svie [ts] a	[dz]	me [dz] a
Cz	[ts]	sví [ts] e	[z]	me [z] e

Yotation

- Cj-sequences: *tj, *dj, *sj, *zj, *nj, *lj, *rj

*sj	CSl *nosja 'burden'	*zj	*kozja 'skin'
[ʃ] (> [s])	Cz nů[ʃ]e	ž [ʒ] (> [z])	Cz ků[ʒ]e
	Sln nó[ʃ]a		Sln kó[ʒ]a
	Ru no[s]a		Ru ko[z]a

Yotation

- Cj-sequences: *tj, *dj, *sj, *zj, *nj, *lj, *rj

*lj	CSI *volja 'will'	*nj	*vonjati 'to smell'
	BCS vo[ʌ]a		BCS vo[ɲ]ati
	Ru vo[lʲ]a		Ru vo[nʲ]at'

Yotation

- $lj > lj^j > \lambda j > \lambda$; $nj > nj^j > nj > n$
- The philological evidence from the 11th and 12th East Slavic points to a change in the place of articulation of laterals and nasals
- Laterals and nasals in the jotation context are marked orthographically in some manuscripts, secondarily palatalized laterals and nasals are not (Kalnyn' 1961; Živov 1996).
- Thus, Russian, Ukrainian, and Belarusian [lj] and [nj] in the jotation context developed from [λ] and [ɲ].
- **The /r/ : /r^j/ contrast is the only secondary palatalization contrast that can be reconstructed for Common Slavic** (Wandl & Kavitskaya 2022).

Common Slavic /r/ : /rʲ/

- Palatal rhotics are impossible segments
 - “Since trills and flaps can only be produced if the vibrating articulator has a small mass, the implication is that places of articulation like palatal, which necessitate an articulator with a large mass, are highly unlikely.” (Hall 2000)
- “... ‘palatal trills’ and ‘palatal flaps’ are nonexisting speech sounds.”

	plain	palatalized	palatal
lateral	[l]	[lʲ]	[ʎ]
nasal	[n]	[nʲ]	[ɲ]
rhotic	[r]	[rʲ]	∅

Preservation or loss of /rʲ/

Common-Slavic (post-jotation)		r	rʲ
East Slavic	Belarusian	[r]	[r]
	Russian	[r]	[rʲ]
	Ukrainian	[r]	[rʲ]
West Slavic	Polish	[r]	[ʒ]
	Czech	[r]	[r̥]
	Slovak	[r]	[r]
	Upper Sorbian	[R]	[Rʲ]
	Lower Sorbian	[R] or [r]	[Rʲ] or [rʲ]
South Slavic	Slovenian	[r]	[rj]
	BCS	[r]	[r]
	Macedonian	[r]	[r]
	Eastern Bulgarian	[r]	[rʲ]
	Western Bulgarian	[r]	[rj]

Preservation or loss of /rj/?

Language	PSl. *marja 'sea-nom.sg', *marjā 'sea-gen. sg.'	jotation reflex of *r (preserved/lost)	secondary palatalization before front vowels
Russian	mo[rʲ]e, mo[rʲ]a	preserved	+
Ukrainian	mo[r]e, mo[rʲ]a	preserved	+
Belarusian	mo[r]e, mo[r]a	lost (15th/16th c.)	+
Polish	mo[ʒ]e, mo[ʒ]a	preserved	+
Upper Sorbian	mo[Rʲ]jo, mo[Rʲ]ja	preserved	+
Lower Sorbian	mó[Rʲ]jo, mó[Rʲ]ja	preserved	+
Czech	mo[r̝]e, mo[r̝]e	preserved	+
Slovak	mo[r]e, mo[r]a	lost	+ (lost 15/16 c)
Slovenian	mo[rj]e, mo[rj]a	lost	-
B/C/S	mo[r]e, mo[r]a	lost	-
Bulgarian	mo[r]e, mo[rʲ]a	preserved	+
Macedonian	mo[r]e, mo[r]a	lost	-

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Polish	mo[ʒ]e, mo[ʒ]a	preserved	+
Upper Sorbian	mo[Rʲ]jo, mo[Rʲ]ja	preserved	+
Lower Sorbian	mó[Rʲ]jo, mó[Rʲ]ja	preserved	+
Czech	mo[r̝]e, mo[r̝]e	preserved	+
Slovak	mo[r]e, mo[r]a	lost	+ (lost 15/16 c.)
Slovenian	mo[rj]e, mo[rj]a	lost	-
BCS	mo[r]e, mo[r]a	lost	-
Bulgarian	mo[r]e, mo[rʲ]a	preserved	+
Macedonian	mo[r]e, mo[r]a	lost	-

Preservation or loss of /rʲ/?

Language	PSl. *marja 'sea-nom.sg', *marjā 'sea-gen. sg.'	jotation reflex of *r (preserved/lost)	secondary palatalization before front vowels
Russian	mo[rʲ]e, mo[rʲ]a	preserved	+
Ukrainian	mo[r]e, mo[rʲ]a	preserved	+
Polish	mo[ʒ]e, mo[ʒ]a	preserved	+
Upper Sorbian	mo[ʀʲ]jo, mo[ʀʲ]ja	preserved	+
Lower Sorbian	mó[ʀʲ]jo, mó[ʀʲ]ja	preserved	+
Czech	mo[ɾ̥]e, mo[ɾ̥]e	preserved	+
Bulgarian	mo[r]e, mo[rʲ]a	preserved	+

Preservation or loss of /rj/?

Language	PSl. *marja 'sea-nom.sg', *marjā 'sea-gen. sg.'	jotation reflex of *r (preserved/lost)	secondary palatalization before front vowels
BCS	mo[r]e, mo[r]a	lost	-
Macedonian	mo[r]e, mo[r]a	lost	-

Preservation or loss of /rʲ/?

- In Belarusian, rhotics depalatalized in the 15th-16th centuries (Kalnyn' 1961, Wexler 1977)
 - /rʲ/ was reintroduced later by hypercorrection (e.g., [rʲat] 'glad', cf. Russian [rat])
- Slovak: Late loss of palatalization

Language	PSl. *marja 'sea-nom.sg', *marjā 'sea-gen. sg.'	jotation reflex of *r (preserved/lost)	secondary palatalization before front vowels
Belarusian	mo[r]e, mo[r]a	originally preserved, lost around the 15 th - 16 th centuries	+
Slovak	mo[r]e, mo[r]a	originally preserved, lost around the 15 th - 16 th centuries	+ (lost around the 15 th - 16 th centuries)

Preservation or loss of /rʲ/?

- Breaking of **rʲ* to **rj* in Slovenian is dated between 9th and 10th centuries (Greenberg 2000)
- Secondary palatalization resulting from palatalization before front vowels had not yet arisen

Language	PSl. <i>*marja</i> 'sea-nom.sg', <i>*marjā</i> 'sea-gen. sg.'	jotation reflex of <i>*r</i> (preserved/lost)	secondary palatalization before front vowels
Slovenian	mo[rj]e, mo[rj]a	lost	-

Preservation or loss of /rʲ/?

Language	PSl. *marja 'sea-nom.sg', *marjā 'sea-gen. sg.'	jotation reflex of *r (preserved/lost)	secondary palatalization before front vowels
Russian	mo[rʲ]e, mo[rʲ]a	preserved	+
Ukrainian	mo[r]e, mo[rʲ]a	preserved	+
Belarusian	mo[r]e, mo[r]a	lost (15th/16th c.)	+
Polish	mo[ʒ]e, mo[ʒ]a	preserved	+
Upper Sorbian	mo[Rʲ]jo, mo[Rʲ]ja	preserved	+
Lower Sorbian	mó[Rʲ]jo, mó[Rʲ]ja	preserved	+
Czech	mo[r̝]e, mo[r̝]e	preserved	+
Slovak	mo[r]e, mo[r]a	lost	+ (secondarily lost)
Slovenian	mo[rj]e, mo[rj]a	lost	-
BCS	mo[r]e, mo[r]a	lost	-
Bulgarian	mo[r]e, mo[rʲ]a	preserved	+
Macedonian	mo[r]e, mo[r]a	lost	-

Preservation or loss of /rʲ/?

- Common Slavic /rʲ/ resulting from yod palatalization (*rj > *rʲ) has been preserved only in those languages which at a later stage acquired secondary palatalization before front vowels.

Proposal:

- It was the increase in functional load of the /r/ : /rʲ/ contrast due to the introduction of additional palatalized rhotics that played the crucial role in the preservation of the contrast.

Summary: The development of Slavic palatalization

- The rare /r/ : /rʲ/ contrast is present in several Slavic languages
- We have posited a reconstruction of the /r/ : /rʲ/ contrast to Common Slavic
- The contrast has been preserved only in those Slavic languages that acquired additional palatalization contrasts in positions other than the jotation context
- Functional pressures are crucial for the contrast preservation

Two interpretations of the functional load hypothesis

- The functional load hypothesis: the amount of information transmitted by the participants in a contrast is inversely correlated with the possibility of the loss of that contrast.
- Information transmission can be interpreted as
 - the number of contrastive positions of a given phoneme (a broad phonological interpretation)
 - the number of minimal pairs due to the contrast in question (a narrow lexical interpretation)

Functional pressures on Slavic palatalization

- Jotation introduced palatalized rhotics before non-front vowels before **a*, **u*, **o*
 - **morʲa* (< **morja*) ‘sea-gen.sg’
- The loss of **b* introduced new palatalization contrast pre-consonantly and word-finally
 - **korʲ* (< **korb*) > ‘measles-nom.sg’
- In Old East Slavic, the position before **a* was already contrastive when vowel backing introduced phonemic /rʲ/
 - **morʲa* (< **morja*) ‘sea-gen.sg’; **rʲad* (< **rɛdъ*) ‘row-nom.sg’
- The introduction of further contrastive positions cannot be responsible for the contrast preservation in only a part of the Slavic speech area since it affected all of Slavic.

Functional pressures on Slavic palatalization

- However, the absolute frequency of the phoneme /rʲ/ is increased
- In turn, this potentially increased the number of minimal pairs
 - Note 1: It is impossible to evaluate functional load for earlier stages due to the lack of exhaustive word lists and frequency counts.
 - Note 2: Minimal pairs are a function of the average word-length (see Ceolin 2020 for discussion), which may be connected to the amount of morphology – potentially problematic for Slavic

Functional pressures on Slavic palatalization

- Palatalization before front vowels affected most consonants
 - **p, *b, *m, *t, *d, *s, *z, *n, *l, *r, *w*
- The result: secondary palatalization correlation
 - **p p^j, *b b^j, *m m^j, *t t^j, *d d^j, *s s^j, *z z^j, *n n^j, *l l^j, *r r^j, *w w^j*
- The **r r^j* pair (from jotation), which have been the only pair with contrastive secondary palatalization in the system, became integrated into the larger system of palatalization oppositions
- The integration of a contrastive pair into a larger opposition has a stabilizing function due to the high functional yield of the correlated oppositions (Martinet 1952)

Functional pressures: summary

- Dispersion (inventory-driven)
 - Potential example: unconditioned chain shifts (not discussed here)
- Informational pressures
 - CL
 - *V > V: only if V: is already present in the inventory
 - Vowel reduction
 - *V ≠ reduced if V: in the inventory
 - Palatalization
 - r : r^j remains if there is palatalization in the inventory
 - More instances of r^j = potentially more minimal pairs
 - More C : C^j correlations

Conclusions

- Many instances of contrast development are readily and thoroughly accounted for by solely phonetically- and phonologically-based pressures on the contrasting segments.
- However, there are cases of contrast development where such accounts are not sufficient and require a functional explanation.
- In many cases this explanation lies in the structure of the phonological inventory, which is closely connected to the informational pressures on the system.

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