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PHONOLOGICAL FORM IN THE MORPHOLOGICAL COMPONENT: A CASE OF SUFFIXES CONTAINING [ɛ] ON THEIR LEFT EDGE

1. Intro

In this paper, I investigate phonological properties of Czech suffixes containing mid front vowel [ɛ] on their left edge. It is well known that some of them require palatilized contexts, for instance suffixes with alternating [ɛ], like diminutive *–(e)k*, some of them not, for instance *–em* for [InstrSg]. I argue that whether mid front vowel [ɛ] triggers particular type of palatalization or not depends on its internal phonological makeup. As a consequence, one *phonetic* object, a sound [ɛ], will represent different *phonological* objects.

Footnote: For the sake of simplicity, I use spelling conventions for suffixes similar to those occuring in Czech grammars where derivational suffixes are notated in the so called citation form, i.e. nominal suffixes with ending for nominative singular (*-b(a)*), adjectival suffixes with ending for agreement with nominative singular masculine (*-ov(ý)*). When I focus on their phonological form, I use IPA transcription. Roots will be notated under √ROOT.

The architecture of grammar I adopt here is that proposed by the generative theory of Distributed Morphology. There is a separate morphological component in which all morphological units (roots and affixes) are stored. Each unit (called *Vocabulary Item*, henceforth VI) in this component has a representation consisting of information about: a) its phonological structure (from which phonological behaviour of this unit is predictable), b) morphosyntactic features which this unit can realize, and c) particular context of insertion. (By context are meant morphosyntactic and/or phonological features. So, insertion of morphological unit into a particular morphosyntactic structure can be determined by morphosyntactic features of the preceding or following morpheme (features such [Masculine], [Animate], [Speaker] etc.) and/or by phonological form of preceding morpheme.) The schema of a VI is outlined in (1) below. (This schema could be paraphrased as a kind of instruction: Realize given morphosyntactic features by this form when a particular context is met.)

(1) Vocabulary Item
/phonological form/ ↔ [morphosyntactic features]/ context

As indicated above, I will focus solely on a phonological representation of morphological units, in other words, on the left side of the double arrow.
Footnote: For the most current overview of this morphological theory see Embick, Noyer (2004).

My paper is organized as follows. In section 2, I observe relevant data. In section 3, I summarize traditional analyses of palatalization before front vowels, which appear in the grammars of modern Czech. The following section (section 4) is the short intro into Government Phonology (henceforth GP), a generative theory of phonological structure. Finally, I would like to demonstrate that this theory gives us powerful tools for explaining behaviour of suffixes in question which on the traditional view seems to be an arbitrary property of each of them.

2. Data observation

In table 1, words which contain suffixes *-k-, -c-, -b-, -n-* with [ɛ] ~ Ø alternation on their left edge are listed. What is important is that their phonological behaviour with respect to the preceding context is apparently independent of morphosyntactic structure which they are assumed to realize; for instance, *-k-* in diminutives (*růž-ek* 'corner', *ruč-k-a* 'hand', *bříš-k-o* 'tummy') has the same phonological properties as *-k-* in deverbatives (*útrž-ek* 'slip', *rozmíš-k-a* 'quarrel') and also as *-k-* in animate female nouns (*učitel-k-a* 'female teacher'). The same holds true also for *-n-* in locative nouns (*střiž-n-a* 'cutting room') and *-n-* in adjectives (*mlž-n-ý* 'foggy'), and for *-c-* in deverbatives (*běž-ec* 'runner') or in bahuvrihi compounds (*hlavonož-ec* 'cephalopod').

By looking at the table below, we can see that the context before the alternation is palatalized in the following way: velars and glottal fricative *h* turn into postalveolars: [k] → [t͡ʃ] (letter c), [g] → [ʒ] (ž), [x] (ch) → [ʃ] (š), [ɦ] (h) → [ʒ] (ž).
Footnote: It must be pointed out that not all suffixes containing aforementioned consonants involve [ɛ] ~ Ø alternation. Consider, for example, the suffix *-k-* in adjectives, like *trpký* 'sour', *krotký* 'tame', *sladký* 'sweet' (which form a closed-set). As examples *vlh-k-ý* 'moist', *křeh-k-ý* 'fragile', *leh-k-ý* 'light', *měk-k-ý* 'soft' show, there is no palatalization before *-k-* in these adjectives. So, this suffix must have a different phonological structure from other *k*-suffixes. It can also be noted that [ɛ] ~ Ø alternation need not occur on the suffix left edge. See the suffixes *-dl-* (*rypa-dØl-o, rypa-del* 'excavator') and *-stv-* (*hor-stØv-o, hor-stev* 'sierra'') where this alternation sits in the middle of them.

Table 1: Suffixes containing [ə̨] ~ Ø alternation on their left edge

palatalized contexts			gloss
after velar stop [k]	noč-Øk-y	noč-ek	‘dumpling’
	potyč-Øk-a	potyč-ek	‘fray’
	smyč-Øc-e	smyč-ec	‘bow’
	léč-Øb-a	léč-eb	‘cure’
	společ-Øný	společ-en-stv-í	‘common’ ‘community’
	tělocvič-Øn-a	tělocvič-en	‘gym’
after velar stop [g]	filolož-Øk-a	filolož-ek	‘female philologist’
	dialůž-Øk-u	dialůž-ek	‘dialogue’
after velar fricative [x]	bříš-Øk-o	bříš-ek	‘tummy’
	rozmíš-Øk-a	rozmíš-ek	‘quarrel’
after glottal fricative [h]	služ-Øk-a	služ-ek	‘female servant’
	stož-Øk-u	stož-ek	‘haystack’
	hlavonož-Øc-i	hlavonož-ec	‘cephalopod’
	trž-Øb-a	trž-eb	‘takings’
	střiž-Øn-a	střiž-en	‘cutting room’
	sněž-Øn-ý	sněž-en-k-a	‘snowy’, ‘snowdrop’

Footnote: The affricate [t͡s] undergoes palatalization [t͡s] → [t͡ʃ] only when it is a part of a suffix, otherwise it remains unchanged. See the following examples: *blb-**ec**, blb-**eč**-ek* vs. *palác, palác-ek; nemocn-**ic**-e, nemocn-**ič**-Øk-a* vs. *nic, nic-Øk-a; krup-**ic**-e, krup-**ič**-n-ý* vs. *ovoc-e, ovoc-n-ý*. This different behaviour of affricates has its origin in diachrony. *c* in suffixes arose from velar *k* and still undergoes the same type of palatalization like velar.

In table 2, words with [ɛ] ~ Ø alternation setting in the root are listed. As we can see, there is no palatalization in these roots, and this holds true also for roots with non-alternating *e*, see for example roots in words like *keř* ‘bush’*, hecovat* ‘egg on’*, ochechule* ‘sirenian’*, hegemonie* ‘hegemony’ etc.

Footnote: I know only few exceptions, among others the root √HN ‘drive’ in which *h* is palatalized only when [ɛ], but not Ø follows: *hØn-á-t* vs. *žen-u*.

Table 2: Roots with [ę] ~ Ø alternation

non-palatalized contexts			gloss
after velar stop [k]	jiskØra	jisker	‘sparkle’
	jikØra	jiker	‘fish egg’
	makØro	maker	‘macro’
	okØno	oken	‘window’
after velar stop [g]	ségØra	séger	‘sister’
after velar fricative [x]	buchØta	buchet	‘cake’
	plachØta	plachet	‘canvas’
	jachØta	jachet	‘yacht’
after glottal fricative [h]	nehØty	nehet	‘nail’
	hØra	her	‘play’
	bahØno	bahen	‘mud’
	uhØlí	uhel	‘coal’

However, despite of its different behaviour with respect to preceding velars and *h*, [ɛ] ~ Ø alternation in both suffixes and roots is apparently governed by the same mechanism. It is triggered by phonological context immediately following it: [ɛ] and Ø are in complementary distribution with respect to their right context. When the site of alternation is followed by a consonant sitting in the end or by two consonants or by a consonant to which another [ɛ] ~ Ø alternation is adjacent, [ɛ] occurs, in residual contexts Ø appears. The relevance of the right context is illustrated in table (3) below.

So, it is obvious that this alternation should not be treated as morphophonological (i.e. triggered by a particular morphological context), which is common within the structuralist framework and adopted by all grammars of modern Czech.

Footnote: This alternation is interpreted as either insertion of the vowel ("vzniková alternace") or deletion of it ("zániková alternace"), but without any reasonable criterion; see MČ1 (1986:184). [ɛ] insertion is sometimes also assumed to be phonetically motivated: [ɛ] is inserted to break down allegedly unpronounceable consonant clusters; see for example Dokulil (1962:175): „Vkladná samohláska [...] objektivně usnadňuje výslovnost hláskových skupin, např. *karta/karetní*." [An epenthetic vowel obviously facilitates pronunciation of speech sound clusters.] But examples of adjectives with *rtn* cluster, like *apa**rtn**í* ‚chic', *zán**ártní* ‚metatarsus', *koncertní* ‚concert', *exportní* ‚export', or the minimal pair *firmě* [firmɲɛ] ‚firm, dat/loc' and *firemně* [firɛmɲɛ] 'firm - adverb', make a phonetic explanation of this phenomenon misleading.

Table 3: Contexts of [ə̨] ~ Ø alternation: roots and suffixes go together

	context of Ø	**contexts of** [ɛ]		
	Ø /_ CV	[ɛ] **/_C#**	[ɛ] **/_CC**	[ɛ] **/_C([ɛ]~Ø)**
suffixes with [ɛ] ~ Ø on the left edge	výjim-Øk-a 'exception'	výjim-ek		výjim-eč-Øk-a, výjim-eč-ek výjim-eč-Øn-ý
	dodat-Øk-u 'supplement'	dodat-ek		dodat-eč-ek, dodat-eč-Øk-u dodat-eč-n-ý
	chlap-Øc-i 'boy'	chlap-ec	chlap-ec-sk-ý	chlap-eč-ek, chlap-eč-Øk-a
	her-Øc-i 'actor'	her-ec	her-ec-sk-ý	her-eč-Øk-a, her-eč-ek
	služ-Øb-a 'service'	služ-eb		služ-eb-Øn-a, služ-eb-en služ-eb-Øk-a, služ-eb-ek
	díl-Øn-a 'workshop'	díl-en	díl-en-sk-ý	
	podob-Øn-ý 'similar'	podob-en	podob-en-stØv-í	podob-en-Øk-a, podob-en-ek
suffixes with [ɛ] ~ Ø in the middle	vří-dØl-o 'thermal spring'	vří-del		vříd-dél-Øk-o, vříd-dél-ek
	diva-dØl-o 'theatre'	diva-del		diva-dél-Øk-o, diva-dél-ek
	druž-stØv-o 'team'	druž-stev		

roots	sestØr-a 'sister'	sester	sester-sk-ý	
	barØv-a 'color'	barev		barev-Øn-ý
	hØr-a 'play'	her		her-ec, her-Øc-i
	okØn-o 'winow'	oken		okén-Øk-o, okén-ek

Finally, in table 4, suffix *–em* for [InstrSg] with non-alternating [ɛ] is listed. It doesn't trigger any type of palatalization previously described.

Table 4: Suffix with non-alternating [ę] on its left edge

non-palatalized contexts		gloss
after velar stop [k]	rybník-em	'pond'
	bok-em	'side'
	kluk-em	'boy'
	vík-em	'lid'
after velar stop [g]	grog-em	'grog'
	gong-em	'gong'
	tang-em	'tango'
	mang-em	'mango'
after velar fricative [x]	hoch-em	'boy'
	sluch-em	'hearing'
	břich-em	'stomach'
	such-em	'dry'
after glottal fricative [h]	boh-em	'god'
	stoh-em	'haystack'
	kruh-em	'ring'
	blah-em	'bliss'

3. Palatalization before [ɛ] as a morpho-phonological alternation

Within the structuralist framework, palatalization before the mid front vowel [ɛ] is interpreted as a morpho-phonological alternation, a change of phonological structure triggered by a particular morphological context. (The same analysis is also proposed for palatalization before the high front vowel [i].) This analysis posits that the cause of palatalization is not a front vowel as phonological object, but rather suffixes containing it, i.e. morphological units.

Footnote: For definition of morpho-phonological alternation see MČ1 (1986:182): „Fonologicky nepodmíněná zákonitá záměna téhož morfému při tvoření slov a tvarů nazývá se střídáním fonémů (morfonologickou alternací)." [A necessary change of form of a particular morpheme in course of derivation of words and their forms, which is not conditioned by phonology, is called a phoneme alternation, i.e. a morpho-phonological alternation.] The only alternation which is traditionally

treated as phonological in essence is the alternation of voiced consonants and their unvoiced pendants. For further details of phonological (syntagmatic) and morpho-phonological (paradigmatic) alternations see Šefčík (2004).

Let me now track arguments for such an interpretation. In phoneme-based models of phonology (developed outside of a generative framework), speech sounds (phonetic units) are assumed to realize pieces of phonological structure (phonemes). A speech sound [ɛ] is regarded to realize just one phonological unit, phoneme /e/, defined as a unique bundle of phonological features. (There are several possibilities how to define this phoneme by means of distinctive features, for them see Palková (1994:201nn.), however, the following definition is the most common: [střední] 'mid', [přední] 'front', [vokál] 'vowel'.) Considering the vowel [ɛ] in examples cited above in tables 1 - 4 to realize the same phonological unit, palatalization on its left cannot be interpreted as a phonologically driven process without avoiding one phonological unit to have a disjunctive context. Therefore, a capability to trigger palatalization cannot be considered as a feature internal to phoneme /e/, but as a feature peculiar to a particular morpheme.

In the model of grammar I have adopted here, this interpretation cannot be captured without positing an array of ad hoc rules operating in the morphological component. The suffixes in question would be represented as having the same phonological unit on their left edge. Role of these rules would then be to change a phonological form of given base in the context of some of these suffixes. These rules might take the following forms. (I use only informal notation.)
Footnote: In DM framework, they are termed re-adjustment rules.

(2) Readjustment rules of palatalization
Rule 1: {k, g, h, x} → {č, ž, š} / _ +(e)k
Rule 2: {k, g, h, x} → {č, ž, š} / _ +e [VocSg]
Rule 3: {k, g, h, x} → {c, z, š} / _ +(e)b(a)
Rule 4: ...

This type of representation obviously leads to a loss of generality. For one thing, there are more morphological units realizing the same features (i.e. allomorphs). None of them, however, triggers palatalization if it does not contain a front vowel on its left edge. On the traditional view, this has to be regarded as an arbitrary feature of each of them. Consider, for example, three allomorphs of the morpheme [VocSg]: *-e, -u, -o*. Only one of them, with form *–e*, triggers palatalization, while the others do not. From this it follows that it isn't the morpheme [VocSg] as such which requires a palatalized context before it, but only one of its allomorphs. For further examples see the following two tables:

Table 5: Palatalizing suffixes

palatalizing suffixes		
-í **[Adj.]**	***-k(a)*** **[Noun]**	***-e*** **[VocSg]**
rač-í ‘crayfish’	horeč-ka ‘fever’	nešťastníč-e ‘unfortunate’
mustanž-í ‘mustang’	jóž-ka ‘yoga’	
mniš-í ‘monk’	ploš-ka ‘spot	
rarož-í ‘saker’	tuž-ka¨ ‘pencil’	bož-e ‘god’

Table 6: Non-palatalizing suffixes

non-palatalizing suffixes					
-y **[InstrPl]**	***-em*** **[InstrSg]**	***-ův*** **[Poses. Adj.]**	***-ost*** **[Abstr. Noun]**	***-u*** **[VocSg]**	***-o*** **[VocSg]**
rak-y	rak-em	rak-ův	hork-ost ‘fever’	rak-u	ruk-o ‘hand’
mustang-y	mustang-em	mustang-ův		mustang-u	jóg-o ‘yoga’
mnich-y	mnich-em	mnich-ův	ploch-ost ‘flatness’	mnich-u	blech-o ‘flea’
raroh-y	raroh-em	raroh-ův	tuh-ost ‘solidity’	raroh-u	sluh-o ‘servant’

Considering the suffixes in tables 5 and 6, the following question arises: Is it really a coincidence that suffixes with back vowels [u] and [ɔ] on the left edge never have a palatalizing effect, while suffixes with front vowels [i] and [ɛ] (including alternating [ɛ]) either have it or not, as the structuralist representation outlined above suggests?

Furthermore, from the structuralist point of view a phonological structure consists of a linear chain of phonemes. Because silence doesn’t represent any phoneme, Ø alternating with [ɛ] doesn’t occupy any position in a phonological structure, while [ɛ] does. So, as far as phonological structure of diminutives like *ráček* ‘crayfish’ or *růžek* ‘corner’ is concerned, the suffix consonant is either adjacent to the root final velar: *ráčka* (*rak+k+a* ‘gen. sg.’)*, růžku* (*roh+k+u* ‘gen. sg.’) or they are separated by phoneme /e/: *ráček* (*rak+ek*)*, růžek* (*roh+ek*)*.* Consequently, palatalization of root velars cannot be motivated by suffix phonological structure.

Footnote: For argumentation, see MČ1 (1986:182): „Tak např. je střídáním záměna fonémů *k/č, h/ž, ch/š* před sufixem *–k(a)* ve slovech jako *ručka, nožka, soška*. Záměna tu, jak patrno, nezávisí od fonologické povahy počátečního konsonantu sufixu.“ [The phoneme alternations *k/č, h/ž, ch/š* before [diminutive] suffix *–k(a)* in words like *ručka* ‘hand’*, nožka* ‘legg’*, soška* ‘statue’ are examples of morpho-phonological alternations. It is obvious that these alternations don’t depend on the phonological status of the initial consonant of suffix.]

4. Palatalization before [ę] as a phonologically driven process

In this section I introduce a rather different analysis of suffixes with [ɛ]. I argue that their behaviour with respect to the preceding context can be fully predictable from a phonological representation they have in the morphological component. First, I give starting points for my analysis (3.1). Then I will introduce keynotes of GP and I will focus especially on a subpart of it, Theory of elements (3.2). Finally, a phonological representation of suffixes in question is proposed (3.3).

4.1 Starting points for a new analysis

1st observation: The suffixes with [ɛ] ~ Ø alternation on their left edge behave alike with respect to: a) an occurrence either [ɛ] or Ø inside them is fully predictable, b) both [ɛ] and Ø trigger the same types of palatalization (see tables 1 and 3). **Consequences:** They should have alike phonological representation in which this alternation is somehow encoded. It means that in this case both alternating [ɛ] and Ø represent the same phonological object.

2th observation: Roots with [ɛ] ~ Ø alternation behave partly like suffixes: an occurrence either [ɛ] or Ø within them is fully predictable under the same conditions stated above (see table 3). However, neither [ɛ] nor Ø alternating in roots trigger palatalization (see table 2). **Consequences:** Their phonological representation should be alike that of suffixes and simultaneously slightly different of them. Hence, alternating vowel [ɛ] (and of course Ø) represents two phonological objects with a different makeup.

3th observation: The suffix *–em* has no palatalizing effect (see table 4). **Consequences:** Vowel [ɛ] involved has the same phonological structure as an alternating [ɛ] in roots.

4th observation: While suffixes with front vowels [ɛ], [i] on the left edge palatalize preceding consonants or not, suffixes with back vowels on the left edge never do it (see tables 5, 6). **Consequences:** A palatalization is a phonological process somehow associated with a phonological makeup of front vowels.

4.2 Tools for a new analysis

4.2.1 What is Government phonology (GP)?

GP is a generative model of phonology in which cross-linguistic phonological processes, like voicing assimilation, vowel harmony, palatalization etc., are derived from the set of universal principles which can be parametrized for individual languages. From this point of view, a phonological module is parallel to a syntactic one in the language architecture.

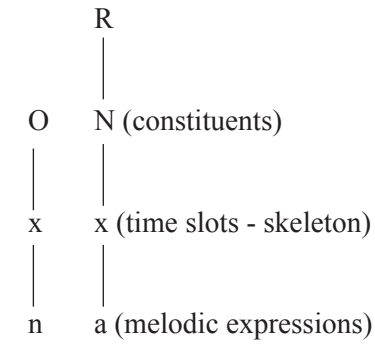
Footnote: For the core principles of this theory see especially Kaye (1990, 2000, 2001), Kaye et al. (1990), Charette (1990), Harris & Lindsey (1995). An exhaustive overwiev is provided in Scheer (2004).

4.2.2 What is a phonological structure in GP?

A phonological structure is made of three separate layers which are connected

through associative lines. There is a level of phonological positions, i.e. time slots which limit a time duration of melody (this level is called *skeleton*). These positions are dominated by *phonological constituents* (Onset, O; Nucleus, N; Rhyme, R) and *phonological (melodic) expressions* are associated to them. All three levels are illustrated under (3):

(3) Layers in phonological structure



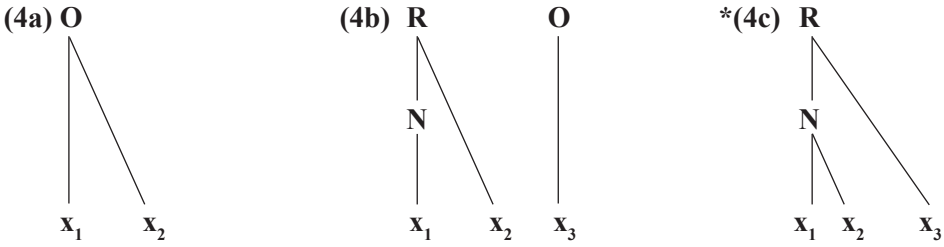
4.2.3 Why *Government* Phonology?

A government is defined as an asymmetric relation between constituents (*transconstituent g.*) and also between positions within them (*constituent g.*). Informally speaking, the government is that what holds a phonological structure together. By means of government, phonotactic constraints (for example those traditionally explained by a Sonority Sequencing Principle) and functioning of phonological processes (for instance those which concern us here: vowel–zero alternations and palatalization) can be explained.

Each of the three phonological constituents (O, N, R) creates a governing domain where a government relation between positions dominated by it is held. The constituent government is defined as: a) strictly local (i.e. only between exactly adjacent slots of skeleton), b) head-initial (i.e. a slot on the left side governs a slot on the right side). In contrast, the transconstituent government is head-final (i.e. from right to left). In (4), I give three examples to illustrate the functioning of government. In (4a), there is a branching onset where x_1 governs x_2. (4b) illustrates transconstituent government between an onset and a preceding rhymal position (i.e. traditional coda): x_3 governs x_2. In (4c), I illustrate an illicit structure where a long vowel is in a closed syllable. The reason for the illformedness is that the constituent R is a governing domain where conditions for constituent government (defined above) aren't met: x_1 could govern x_2 but not x_3 because x_3 isn't strict local to x_1. So, the position x_3 wouldn't be integrated into the structure. (This reasoning leads to the conclusion that position x_3 is dominated by another constituent than x_1 and x_2 are, i.e. by onset following the long vowel. Furthermore, from (4c) follows that lenght in GP is not treated as a feature inherent to phonological expressions, which is com-

mon in both structuralist and SPE frameworks. A difference between long and short vowels and consonants relies on their linking to time slots – long expressions are linked simultaneously to two time slots.)

(4) Constituent and transconstituent government



Let's me now illustrate how this crucial relation determines derivation of phonological structure. There are restrictions on which phonological expressions can be governors. The most important of them states that a governing expression cannot be internally less complex than a governed one, where complexity is measured by the number of elements within a given expression.
Footnote: For a different view on complexity see Scheer (2004:40-65).

Consider, for example, two vowels [u][ɔ], adjacent on the phonetic level, and the phonological structure which they could represent. From what has been just said it follows that they cannot be dominated by the same constituent. This is because [u] as high vowel is less complex than the mid vowel [ɔ]: high vowels are defined only by one element while mid vowels are considered to be merged from elements defining both high and low vowels. So, [u] cannot govern [ɔ], while the contrary relation is possible: [ɔ] can govern [u]. The situation in Czech shows that this reasoning makes good predictions: there is no [uɔ] diphtong, while diphtong [ɔu] normally exists.
Footnote: It must be pointed out that examples such as *uondaný* ‚tired out', *konstruovat* 'construct', *fluor* 'fluorine' etc. are not to be considered as exceptions from this, because in these cases both vowels in question belong to two different nuclei: [ɔ] governs a preceding nucleus occupied by [u]. In the first two cases they are separated by glottal stop [ʔ]: [uʔondanii], [konstruʔovat], in the latter, an empty onset position lies between them.

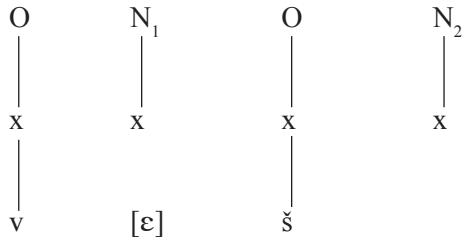
In what follows, I focus on how government controls [ɛ] ~ Ø alternation in Czech. The type of nuclei, which dominate any vowel – zero alternation site, are known as *empty nuclei*. Furthermore, empty nuclei are also all nuclear positions without any phonological content. Generally, there are two sites in the phonological structure where the empty nuclei are situated: 1. vowel – zero alternation, 2. after domain final consonants (*domain final empty nuclei*). In other words, the phonological structure of all VIs in the morphological component (each VI creates a phonological domain) ends with a nuclear constituent which is either empty (for example root √VEŠ or affixes *-k(a)* or *–ov(ý)*) or filled by some phono-

logical expression (for example affixes *–a* or *vy-*). (Arguments for the existence of domain final empty nuclei are given in Kaye 1990.)

Let's take the root √VEŠ 'louse' as an example. Its phonological structure is outlined in (5). N_1 is an empty nucleus with alternating [ɛ], N_2 is a domain final empty nucleus without any phonological expression. We can see that these two types of empty nuclei differ in the representation assigned to them in the morphological component.

Footnote: In early models of GP, these two types of empty nuclei were represented in the same way, i.e. without any phonological content. Vowels alternating with zero were assumed to be inserted in the course of the derivation, i.e. they were treated as epenthetic vowels. The new analysis, in which alternating vowels are represented in the morphological component already, has several advantages over the epenthetic one. Especially, the alternation on the left edge of suffixes, which concerns us here, can be explained more adequately in this new frame. Recall, that the palatalization before these suffixes is independent from phonetic realization of their first nucleus – it takes place before both [ɛ] and Ø. If we assume [ɛ] to be present in the phonological structure already, not to be inserted later, we can explain why not only the vowel [ɛ] but also zero can palatalize the preceding consonat. It is because this front vowel is included in the structure in both cases. Another persuasive arguments for this non-epenthetic approach to this alternation are provided in Scheer (2004:87-93).

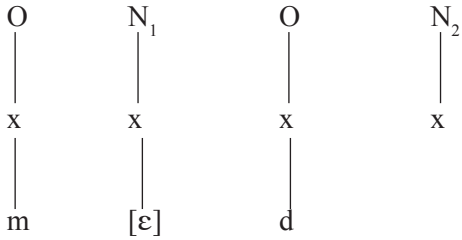
(5) Empty nuclei – phonological representation of √VEŠ



Footnote: For the sake of simplicity, I will not sketch the rhyme constituent above the nucleus if there is no other position than N dominated by it.

Whether a particular phonological expression involved in the empty nucleus is phonetically interpreted (in our case as [ɛ]) or not, depends on whether it is connected to a coresponding time slot in the skeleton. The unconnected expressions are phonetically uninterpretable (they are realized as silence), the expressions associated to the time slot are interpreted in the same way as expressions in non-empty nuclei. In (6), I give the phonological representation of the root √MED 'honey'. N_1 is a nucleus with non-alternating [ɛ], N_2 is a domain final empty nucleus. Comparing (5) and (6), the only difference in the phonological representation of both roots consists in the connection or disconnection of [ɛ] to the skeletal position dominated by N_1.

(6) Phonological representation of √MED

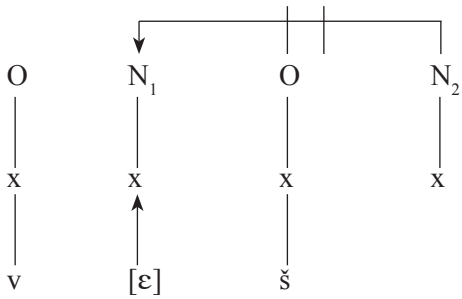


Whether a given phonological expression in the empty nucleus will be connected to the time slot depends on features of the following nucleus, namely whether this nucleus is able to *properly govern* it. Informally speaking, *proper government* is a stronger version of transconstituent goverment between two successive nuclei.

Footnote: Kaye et al. (1990) assume that all empty sites in the phonological structutre are subject to the *Empty Category Principle*, known from generative syntax. We can paraphrase this principle as follows: An empty nucleus is allowed to be phonetically empty iff it is properly governed.

As far as the domain final empty nuclei are concerned, they are not proper governors. From this it follows that any empty nucleus preceding them isn't properly governed, hence it must be phonetically realized. Consider the root √VEŠ once again. The structure under (5) doesn't represent only a bare root, i.e. morphologically simplex unit, but also the output of the derivation of its nominative singular form. This is because the morpheme [NomSg] in the context of this root takes no phonological form (so called zero morpheme). So, the derivation of nominative singular form can be described as follows. N_2 and N_1 are both constituents. Because N_2 is a domain final empty nucleus, it cannot be a proper governor of N_1. Hence, N_1 cannot remain phonetically empty and [ɛ] must be connected to the skeleton.

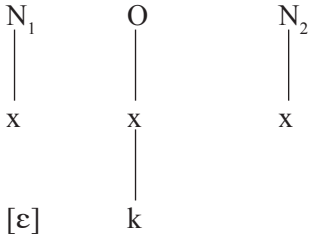
(7) Derivation of form *veš* [NomSg]



Similarly, non-final empty nuclei are not proper governors regardless of their phonetic content. From this it follows that all successive empty nuclei inside the structure must be phonetically realised. Consider the example of diminutive form

of the root in question, which is derived by suffix *–k(a)*: *veška*. We have already seen that before this suffix [ɛ] always alternates with zero. Now we are ready to explain why. This is because the phonological structure of this suffix begins with an empty nucleus with [ɛ] melody. So, we can posit the following phonological representation of it. It consists of these three constituents: the empty nucleus with [ɛ] expression, the onset to which consonant [k] is linked and the empty domain final nucleus.

(8) Phonological representation of the suffix *–k(a)*

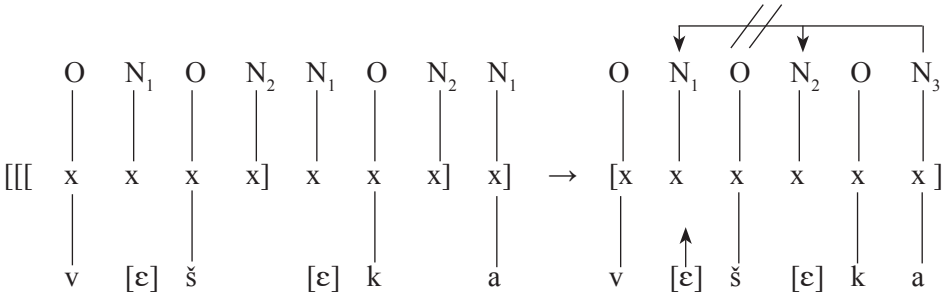


Let me now focus on how the derivation of the two following diminutive forms runs: nominative singular *veška* and genitive plural *vešek*. The structure of the former consists of three morphological units: [[[veš]k]a]. The structure of the latter also consists of three units [[[veš]k]Ø] but the last one, the ending for [GenPl], has no phonological structure. In (9a), the derivation of the phonological structure of nominative singular form is presented. There are three VIs, each of them with its own phonological representation in the morphological component. (Each of them realizes a piece of morphosyntactic structure inside the word.) These items are merged together, creating a new phonological domain, where the empty nuclei at the end of the root and the diminutive suffix are unified with the nuclei at the beginning of the following morpheme. In this new phonological domain, the final nucleus N_3 isn't empty (it is occupied by ending [a]), hence it can properly govern the preceding empty nucleus N_2. N_2 can thus be phonetically empty. N_2 as an empty nucleus isn't a proper governor and for that reason the [ɛ] in the preceding empty nucleus N_1 must be connected to the skeleton. The result of this derivation receives the expected phonetic form: [vɛʃka].

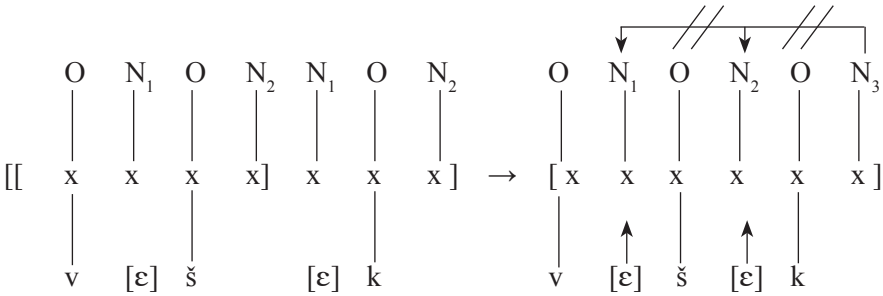
In (9b), the derivation of the phonological structure of genitive plural form is presented. There are three VIs, but only two of them with their own phonological representation. As before, they merge together and create a new phonological domain, where the empty nucleus at the end of the root is unified with the nucleus at the beginning of the following diminutive suffix. In this new phonological domain, the final nucleus N_3 is empty. Hence, it cannot properly govern the preceding empty nucleus N_2. Therefore, N_2 must be phonetically realized as [ɛ]. N_2 as an empty nucleus isn't a proper governor and for that reason the [ɛ] in the preceding empty nucleus N_1 must be connected to the skeleton. The result of this derivation will also receive the right phonetic form: [vɛʃɛk]. The behaviour of N_2

in derivates in (9a) and (9b) shows that the empty nuclei aren't proper governors in Czech, regardless of their phonetic status.

(9a) Derivation of diminutive form *veška* [NomSg]



(9b) Derivation of diminutive form *vešek* [GenPl]



The analysis of [ɛ] ~ Ø alternation, I have just presented, enables us to explain why the suffixes *-k-, -c-, -b-, -n-* behave as they behave. The alternation [ɛ] ~ Ø on their left edge is fully predictable from the phonological structure they have in the morphological component. It consists of these three constituents: the empty nucleus with [ɛ] expression, the onset to which the consonant (*b, k, c, n*) is linked, and the empty domain final nucleus. In contrast, consider the phonological structure of the suffix *-em* for [InstrSg], beginning with non-alternating [ɛ]. It is also formed by three constituents but the first one is not an empty but full nucleus with [ɛ] expression.

In the following section, I turn my attention to the difference between palatalizing and non-palatalizing [ɛ].

4.2.4 What is a phonological expression?

Phonological expressions linked to positions are phonetically interpretable melodies. While traditional phonemes are defined as unique bundles of unordered, phonologically relevant (i.e. distinctive) features, a phonological expression is assumed to have an internal structure. Its structure is made of hierarchically organized phonological elements ("building blocks of melody").

4.2.5 Element Theory

Elements involved in phonological expressions have the status of privative phonological primes. In that they differ from classical distinctive features which are assumed to be binary – an element is either present in a given expression or not, it has no +/- values. Furthermore, the set of elements (or at least some of them, defining a place of articulation, how we will see further) is assumed to be common to both vocalic and consonantal expressions – their phonetic interpretation depends on what constituent (onset/rhyme or nucleus) immediately dominates them. In contrast, distinctive features are construed as peculiar to vowels or to consonants (of course with a grey area of sonorants). So, none of vocalic phonemes is defined by, for example, a place feature [+coronal], and vice versa, none of consonants is defined as, for example, [-high].

To illustrate a difference between a phoneme and a phonological expression, consider, for instance, the vowel [i]. In phoneme-based models (i.e. both structuralist models and generative models of the SPE format) it is defined as a sound realizing the phoneme /i/ which is specified as a bundle of distinctive features, commonly {[+syllabic], [+high], [-back]}. In the model presented here, [i] is the phonetic interpretation of the phonological expression which consists of just one element {I} and which is dominated by nucleus constituent. The same element linked to a position dominated by onset will receive the phonetic interpretation [j]. (Elements and their status will be discussed in detail.) From this it follows that the elements alone are phonetically interpretable which doesn't hold for distinctive features. For example, a feature [-back] must be combined with other features to be phonetically interpreted.

As far as the number and a character of elements are concerned, several models exist. For example, in the earliest one (Harris 1990), ten elements have been posited. Nowadays, there is a strong tendency to reduce their inventory (their number varying from 5 to 8, depending on a given model). The reason for such a reduction is to avoid overgeneration of phonological expressions.

Footnote: For alternative models see Harris & Lindsey (1995), Kaye (2001), Scheer (2004).

However, these elements, regardless of their number we are working with, could be divided into two groups: place of articulation elements and manner of articulation elements.

There are three place elements: U, I, A, which are involved in both vowels and consonants (i.e. phonological expression dominated by nucleus and by onset/rhyme). Their phonetic interpretation is shown in table 7 below.

Table 7 Place-of-articulation elements

element	nuclear constituent	non-nuclear constituent
U	roundness	labiality, velarity
I	frontness	palatality
A	lowness	coronality

In what follows, I discuss these three elements with respect to the vocalic and consonantal inventory of Czech. The element U will be present in back vowels [u, ɔ], labials [p, b, f, v, m] and velars [k, g, x] and in the glottal fricative [ɦ]. The element I will be involved in front vowels [i, ɛ], alveolars [s, z, t͡s], postalveolars [ʃ, ʒ, t͡ʃ], sonorants [r, l, n], and, of course, in palatals [c, ɟ, ɲ]. The element A will characterize the low vowel [a] and also mid vowels [ɛ, ɔ]. As far as a presence of the element A in consonants is concerned, it is widely assumed to be a common part of all types of coronals, i.e. dentals [t, d], alveolars [s, z, t͡s], postalveolars [ʃ, ʒ, t͡ʃ], sonorants [r, l, n] and palatals [c, ɟ, ɲ]. (But see Scheer (2004) for an alternative interpretation of A in consonants.)

Let's now turn our attention to the manner elements which are summarized in table 8.

Table 8 Manner-of-articulation elements

element	nuclear position	non-nuclear position
H	high tone	voicelessness
L	nasality, low tone	nasality
h		noise
ʔ		occlusion

The above table shows a striking asymmetry: the first two elements, H and L, are interpreted in both nuclear and non-nuclear position, while others, h and ʔ, are interpretable only in non-nuclear positions. As far as Czech is concerned, this asymmetry disappears: because the vowels in Czech don't differ with respect to their tones (and there are no nasal vowels here), the elements H and L don't contribute to the phonological makeup of vowels in Czech. This means that all four manner elements will be involved just in consonants.

The element H characterizes all voiceless obstruents: [p, f, t, s, ʃ, t͡s, t͡ʃ, c, k, x]. The element L defines nasals [m, n, ɲ]. h divides consonants into two groups: its presence defines obstruents, i.e. all stops, affricates and fricatives, its absence defines sonorants. Finally, the element ʔ characterizes stops (affricates [t͡s,t͡ʃ] included) and also laterals.

Footnote: The elements h and ʔ are defined in Harris & Lindsey (1995:70) as follows: "The elemental pattern associated with ʔ may be described as *edge* or *stop*. In signal terms, it manifests itself as an abrupt and sustained drop in overall amplitude. This effect is achieved by a non-continuant articulatory gesture of the type that characterizes oral and nasal stops and laterals. [...] The elemental pattern of h may be identified as 'noise', manifested in the speech signal as aperiodic energy. The articulatory execution of this effect involves a narrowed stricture which produces turbulent airflow."

Table 9 Elements in the phonological inventory of Czech

element	vowels	consonants
U	[u, ɔ]	[p, b, f, v, m, k, g, x, ɦ]
I	[i, ɛ]	[j, s, z, ʃ, ʒ, t͡s, t͡ʃ, r, l, n, c, ɟ, ɲ]
A	[a, ɛ, ɔ]	[t, d, s, z, ʃ, ʒ, t͡s, t͡ʃ, r, l, n, c, ɟ, ɲ]

H		[p, f, k, x, s, ʃ, t͡s, t͡ʃ, c]
L		[m, n, ɲ]
h		[p, b, f, v, k, g, x, ɦ, s, z, ʃ, ʒ, t͡s, t͡ʃ]
ʔ		[p, b, k, g, t, d, t͡s, t͡ʃ, c, ɟ, ɲ, m, n, l]

From what has been said up to now, it might seem that the elements are rather phonetic than phonological primes. What we actually expect from the phonological prime? The answer is rather simple: to be phonologically active, i.e. to participate in phonological processes. In other words, the spreading of some element from one expression to another provides evidence that this element takes presence in both of them. From this point of view the palatalization is defined as a phonological process in which the element I is active. Strictly speaking, the I element spreads from the phonological expression dominated by nucleus to the preceding one, dominated by onset/rhyme. What is important is that this element is interpreted in the both expressions simultaneously, i.e. it contributes to phonetic realization of both these expressions.

Footnote: For example Gussmann (undat.) defines this process as follows: "A following vowel licenses the I element in the preceding onset which can thus be realised phonetically."

This reasoning leads us to the following preliminary conclusions:

1. The vowels that trigger palatalization must include the element I in their internal structure.
2. The consonants which are outputs of palatalization must also include the element I.

(The presence of I in the front vowels and the palatalized consonants has been already predicted, see the second line in table 9 above.)

First, let's look at the internal structure of the mid front vowel [ɛ] which is merged from two elements I and A. I claim that the difference between palatalizing and non-palatalizing [ɛ] doesn't follow from the number and quality of elements within these expressions but from their mutual configuration inside them.

It has already been mentioned that phonological expressions are ordered combinations of phonological primes. Each of these expressions is defined as a pair of a head and an operator. The head position can be occupied by maximally one element (so, in some cases, the head can remain empty). The operator position can be occupied by any number of elements (and can also be empty). The elements in the operator position form an unordered set. Furthermore, every element can occur only once per each phonological expression. The schema of phonological expression is outlined in (10). In (10a), I show an illicit structure, where the element I occurs twice – simultaneously in the head and the operator.

(10) Internal structure of phonological expression (10a) Illicit structure

({set of operators} <u>head</u>) *({A,I} <u>I</u>)

We are now ready to posit that the variable behaviour of front vowels with respect to the preceding consonant depends on whether the palatal element I is in the operator or head position. I thus propose that he vowel [ɛ] in Czech realizes two different phonological expressions: I-headed ({A}I) or headless ({I,A}).
Footnote: The same analysis of the mid vowel [ɛ] in Polish is proposed in Gussmann (undat.).

What is the connection between these two vocalic expressions (both interpreted as [ɛ]) and the preceding consonant? First, consider the internal structure of consonants undergoing the palatalization before alternating [ɛ]. It is widely assumed that velars contain an empty head position and labials are U-headed. In this respect, consider also the internal structure of postalveolars which are outputs of palatalization. The internal structure of both of them is represented in table 10.

Table 10 Internal structure of velars and postalveolars

velars headless U as operator		postalveolars I-headed A as operator	
k	{h,ʔ,H,U}	t͡ʃ	{h,ʔ,H,A}I
g	{h,ʔ,U}	ʒ	{h,A}I
x	{h,H,U}	ʃ	{h,H,A}I
ɦ	{h,U}	ʒ	{h,A}I

Comparing the two columns in the table, it is obvious that there is the close relationship between the inputs and outputs of the palatalization before alternating [ɛ]. Generally, the difference between velars on the one side and postalveolars on the other side relies on the place-of-articulation elements. We can see that U and I never combine within one phonological expression: in a given expression there is either U or I. Furthermore, in table 9 above, where all expressions with their elemental content are listed, we can see that mutual exclusivity of U and I holds for all expressions. None of the expressions is simultaneously listed in the first two lines. Such restrictions on combinations of elements within phonological expressions are called *licensing constraints*.
Footnote: For a general discussion of the role of these constraints see Kaye (2001). It must be pointed out that these restrictions are defined as language-specific. So, while in Czech I and U don't merge within one expression, in Turkish, for example, where front rounded vowels exist, they do. See Charette & Göksel (1996), where the constraints for Turkish vowels are developed.

By this constraint we can explain why the spreading of the palatal element I into velars goes hand in hand with the delinking of the velar element U.

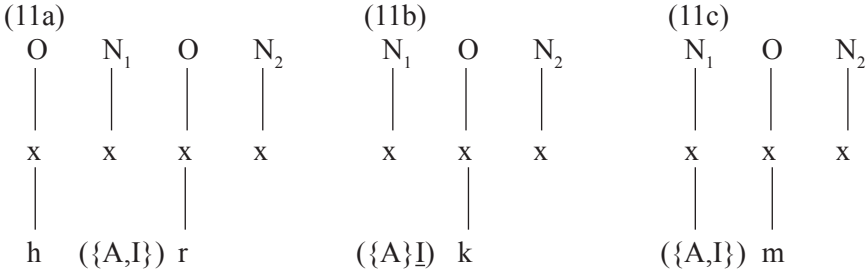
Comparing further the elemental structure shown in table 10, another licensing constraint for consonants must be posited: I as head in non-nuclear expressions licenses the element A in operator.
Footnote: It is obvious that velar voiced occlusive [g] behaves peculiar in that the spreading of I into it causes its shift from occlusive to fricative, i.e. the delinking of the occlusive element ʔ. I have no plausible explanation its peculiar behaviour.

Before describing how palatalization of velars into postalveolars works, recall the two distinct internal structures that have been already proposed for [ɛ]: ({A}I) or ({I,A}). If postalveolars (as outputs of the palatalization before [ɛ]) are I-headed, we can then conclude that [ɛ] from which the element I spreads into this head position is also I-headed. Subsequently, the phonological constraint that forces the palatalization of the consonant can be formulated as follows: I-headed nucleus requires an I-headed onset.

Footnote: Such restrictions on the internal structures of onset-nucleus pairs are sometimes summarized under the term *alignment*. In other words, some of the elements in successive onset and nucleus must be aligned. In our case, we have to do with *I-head alignment*. For functioning of I-alignment in Polish see Gussmann (undat.).

Having suggested that there are two distinct phonological expressions realized by one sound, [ɛ], let us focus on the difference between the palatalizing and non-palatalizing suffixes. Root final velars undergo palatalization when they are followed by the suffixes *-k, -c-, -b-, -n-* because of the internal structure these suffixes have. Or more acurately, because of the internal structure of [ɛ] that is present in the empty nucleus these suffixes begin with: the alternating [ɛ] on their left edge is represented as I-headed: ({A}I). In contrast, the alternating [ɛ] in roots (for some examples of them see table 2 above) will be represented as headless, with the I element in operator: ({A,I}). The same internal structure has also the non-alternating and non-palatalizing [ɛ] in the suffix *–em*.

Under (11), I summarize the phonological representation of three morphological units: the root √HR ‘play’ containing alternating, non-palatalizing [ɛ] (11a), the suffix *–ek* containing alternating, palatalizing [ɛ] (11b), and finally the suffix *–em* containing non-alternating, non-palatalizing [ɛ] (11c).



4. Conclusion

The main aim of this paper was to demonstrate that the alternations which are traditionally treated as paradigmatic, namely [ɛ] ~ Ø alternation and the palatalization preceding it, can be reduced to syntagmatic alternations. I demonstrated that alternations in question arise as a result of regular phonological processes that operate on the phonological representations of morphological units.

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FONOLOGICKÁ FORMA V MORFOLOGICKÉM KOMPONENTU: PŘÍPAD SUFIXŮ OBSAHUJÍCÍCH NA LEVÉM OKRAJI [ę]

V tomto článku se zabývám fonologickou reprezentací sufixů *-k-, -c-, -b-, -n-*. Tyto sufixy mají analogické fonologické chování: a) na jejich levém okraji alternuje [ɛ] ~ Ø, b) palatalizují předcházející veláru a *h*. V českých gramatikách jsou jak palatalizace, tak i alternace [ɛ] ~ Ø tradičně interpretovány jako paradigmatické alternace. Ve své studii ukazuji, že fonologické chování těchto sufixů popsané v a), b) není arbitrární vlastností každého z nich, ale že je plně odvoditelné z jejich analogické fonologické struktury, která je reprezentována v morfologickém komponentu. Fonologickou strukturu těchto sufixů analyzuji v rámci generativní fonologické teorie, tzv. *Government Pphonology*.

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