Harmony that cannot be represented

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1. Introduction

In this paper, we examine some lesser known and hitherto unanalyzed phenomena about Hungarian front/back harmony (henceforward: vowel harmony), specifically the behavior of suffixes that have an alternant with a neutral vowel. We show that these suffixes behave differently with respect to harmony when they are harmonizing suffixes (they have harmonic back and front alternants) and when they are non-harmonizing (they are invariant) in that the neutral vowel alternant of a harmonizing suffix is opaque whereas the neutral vowel of a non-harmonizing suffix is transparent. We also show that even non-harmonizing neutral vowel suffixes behave in two different ways in that some of these suffixes are transparent to anti-harmony and others are opaque. We argue that this proliferation of types and the properties of these phenomena make a representational explanation, in which the source of these differences is locally encoded in the (abstract) representations of the different types of neutral vowels, problematic or even untenable. In the paper we first review the facts, then discuss the problems of a representational approach, and finally outline an optimality theoretic analysis that is based on the interaction of markedness constraints and paradigm uniformity (output-output) constraints.

2. Front/back harmony in Hungarian

The vowel inventory of Hungarian consists of seven short and seven long vowels, see (1) below.

* Some of the ideas in this paper are due to or have been developed together with László Kálmán.

(1) Vowel inventory in Hungarian

	short			long		
	back	front		back	front	
		round	non-round		round	non-round
high	u	y	i	uː	yː	iː
mid	o	ø		oː	øː	eː
(mid-)low	*a*		ɛ	aː		

It can be seen in (1) above that the system of short and long vowels is rather symmetric: each short vowel has a long counterpart, and *vice versa*. The short–long pairs have almost the same quality, except for the mid-low short vowels: the low-mid back vowel [*a*] is paired with the low vowel [aː] and, crucially, the long counterpart of the low-mid front vowel [ɛ] is the mid vowel [eː]. This latter difference in quality has an important phonological role in the behavior of neutral vowels.

Backness harmony in Hungarian takes place within the "word" domain, i.e. does not cross a compound or word boundary (Vago 1980, Siptár & Törkenczy 2000). Most suffixes have both front and back vowel allomorphs. These harmonic vowel alternations are the following:

(2) Harmonic vowel alternations in suffixes

	short		long		Examples:[1]
	back	front	back	front	
high	u	y	uː	yː	haj-unk ~ fɛj-ynk, haj-uː ~ fɛj-yː
"mid"	o	ø/ɛ[2]	oː	øː	haj-on ~ fɛj-ɛn, haj-toːl ~ fɛj-tøːl
"low"	*a*	ɛ	aː	eː	haj-nak ~ fɛj-nɛk, haj-naːl ~ fɛj-neːl

It can be seen in (1) and (2) above that all vowel qualities have a harmonic pair except the high front unrounded vowels [i iː]. The vowels [i] and [iː] do not take part in regular[3] harmonic alternations. Therefore most authors consider only *them* as neutral vowels (cf. Kiparsky & Pajusalu 2003). In the next section we will examine the concept of neutrality in more detail.

1. Glosses: *haj* 'hair', *fɛj* 'head', *-(u|y)nk* 'POSS.PL1' *-uː|yː* 'adjectival marker', *-(o|ɛ|ø)n* 'Superessive', *-t(oː| øː)l* 'Ablative', *-n(a|ɛ)k* 'Dative', *-n(aː|eː)l* 'Adessive'.

2. The choice between [ø] and [ɛ] depends on roundness harmony, which is not relevant to the issues discussed in this paper.

3. In a regular harmonic alternation, the allomorphs contain exactly the same consonants and only the vowels can differ. For the irregular harmonic alternation *-ja* ~ *-i* see the discussion below.

3. Neutral vowels

Neutrality of a vowel does not necessarily mean that the vowel does not have a harmonic alternant. There are several properties that are associated with neutral vowels cross-linguistically or language specifically. These are the following.

(3) Neutrality can mean
  i. no harmonic alternants
  ii. transparency to harmony
  iii. occurrence in mixed stems
  iv. antiharmony

In the following sections we examine in detail the properties listed in (3) in Hungarian.

3.1 Harmonic alternants and harmonizing suffixes

We have to make a distinction between the situation when a vowel does not have a harmonic counterpart in the language at all and when a vowel occurs in a non-harmonizing suffix. In Hungarian the former property is only true of the (short and long) high front unrounded vowels [i iː]: thus [i] and [iː] occur only in non-harmonizing suffixes. The latter property, however, can be true without the former being true: the long mid front unrounded vowel [eː] occurs in both harmonizing suffixes and non-harmonizing ones. This is exemplified in (4) below.

(4) Examples for harmonizing and non-harmonizing suffixes

a. non-harmonizing suffixes with [i iː] and [eː]

hɑjoː-**i**	vɑːroʃ-**i**	hɑt-**i**g	tɑn-**iː**t
ship-POSS3SG.PLUR	town-ADJ_SUFF	six-TERMINATIVE	teaching-VERBAL_SUFF
‘his/her/its ships’	‘urban’	‘until six’	‘teach’
paːl-**eː**	toːt-**eː**k	haːz-**eː**rt	laːt-**eː**k
Paul-ANAPH_POSS	Tót-ASSOC_PLUR	house-CAUSAL_FINAL	see-COND.INDEF.1SG
‘one of Paul’	‘the Tót family’	‘for a/the house’	‘I would see sg.’

b. harmonizing suffixes with [eː]

teːr-neːl	~	vɑːr-nɑːl	seːp-ʃeːg	~ ruːt-ʃɑːg
square-ADESSIVE		castle-id.	beautiful-ness	ugly-ness
‘at a/the square’		‘at a/the castle’	‘beauty’	‘ugliness’

c. harmonizing suffixes containing [eː] resulting from the lengthening of [ɛ].[4]

keːr-nɛ	~	vaːr-n*a*	kɛz-ɛ	~	haːz-*a*
ask-COND.INDEF.3SG		wait-id.	hand-POSS3SG.NOM		house-id.
keːr-neː-m	~	vaːr-naː-m	kɛz-**eː**-t	~	haːz-**aː**-t
ask-COND-DEF.1SG		wait-id.	hand-POSS3SG-ACC		house-id.

The observations mentioned above are summarized below in (5); for comparison a "well-behaved" harmonizing vowel – [ɛ] – is also given. The approximate number of suffixes is indicated for each type.

(5) Different behavior of front unrounded vowels

	[i iː]	[eː]	[ɛ]
a. occurs in harmonizing suffixes (i.e. has a harmonic counterpart)	**no**[5]	**yes** (8)	**yes** (~50)
b. occurs in non-harmonizing suffixes	**yes** (7)	**yes** (9 + 4)	**no**[6]

It can be seen in (5) above that the three vowel qualities show different behavior: high [i iː] do not have harmonic counterparts (hence only occur in non-harmonizing suffixes). By contrast, low-mid [ɛ] does not occur in non-harmonizing suffixes, but occurs in harmonizing ones. The status of [eː] is intermediate: it can occur both harmonizing and non-harmonizing suffixes.

3.2 Transparency

It is a complex issue in Hungarian whether a vowel is transparent (see Törkenczy 2011 for an overview). The main generalizations are the following. Transparency is (i) quality sensitive and (ii) quantity sensitive.

Quality sensitivity means that the higher the unrounded front vowel the more transparent it is. A single occurrence of [i iː] is always transparent and [eː] is almost always so: in the latter case there do exist vacillating cases. In the case of mid-low [ɛ] there is a great degree of variation: there are clear cases of non-transparency, mostly, however, there is vacillation (Ringen & Kontra 1989, Siptár &

4. [*a*] and [ɛ] lengthen into [aː] and [eː], respectively, before (most) suffixes by a general process (Low Vowel Lengthening, cf. Vago 1980, Siptár & Törkenczy 2000)

5. For the sake of completeness, we have to mention that [i] occurs in a single suppletive alternation which is triggered by backness harmony: e.g., *lop-ja* 'steal-DEF.3SG' ~ *lɛp-i* 'surprise-DEF.3SG', see footnote 3 above.

6. It is true that [ɛ] only occurs in alternating suffixes; but it can show nonalternating behaviour in some marginally productive nonconcatenative diminutives: *maʧka* 'cat' ~ *maʧɛk* 'id.-DIMIN', *kalauz* 'conductor' ~ *kalːɛr* 'id.-DIMIN', *paːlinka* 'kind of spirit' ~ *paːlːɛs* 'id.-DIMIN'.

Törkenczy 2000; for a detailed analysis cf. Hayes & Londe 2006, Kálmán et al. 2011).

(6) Quality sensitivity of transparency

a. a single [i] or [iː] is always transparent: pɑpiːr-n(ɑ|*ɛ)k and buli-b(oː|*øː)l
b. a single [eː] may be transparent or variable: kɑreːj-n(ɑ|*ɛ)k vs. sɑteːn-b(oː|øː)l
c. a single [ɛ] may be variable or opaque:[7] fotɛl-n(ɑ|ɛ)k vs. haːrɛmb(*oː|øː)l
d. other front vowels are opaque: ʃoføːr-n(*ɑ|ɛ)k and kɑjyt-b(*oː|øː)l[8]

Quantity sensitivity manifests itself when two or more consecutive neutral vowels occur in the stem. In this case a great degree of variation and hesitation appears. The main observation is given below (Vago 1980, Ringen & Kontra 1989, Siptár & Törkenczy 2000; for a detailed analysis cf. Hayes & Londe 2006, Kálmán et al. 2011).

(7) Quantity sensitivity of transparency
a sequence of neutral vowels may be variably transparent or opaque:
hɑrɑkiri-n(ɑ|ɛ)k, klɑrineːt-t(ɑ|ɛ)l, bɑkɛlit-b(oː|øː)l vs. ɑtsɛtileːn-b(*ɑ|ɛ)n[9]

Note that on the basis of the *harmonizing property* discussed in §3.1 the mid-low vowel [ɛ] is not a neutral vowel (its behavior is clearly distinct from [i iː] and [eː]). Though there is a great degree of graduality in the behavior of front unrounded vowels, and [ɛ] is clearly the least transparent in this group, it is certain that [ɛ] *can* behave in a transparent way (as opposed to the front round vowels, see (6d)). Therefore, on the basis of *transparency*, it is neutral in that it patterns with [i iː] and [eː].

3.3 Mixed stems

The occurrence of a front vowel in harmonically mixed stems (i.e. those which contain back vowel(s) as well) can be a sign of neutrality. In some languages loanwords must strictly obey vowel harmony, but in Hungarian, recent loanwords can contain harmonically mixed vowels. In fact, any combination of vowels is permitted (cf. Siptár & Törkenczy 2000). The following data show the number of bisyllabic mixed stems sorted by the front vowel the stem contains.

7. There are a couple of stems that have transparent [ɛ], e.g. *fɑzɛk-ɑt* 'pot-ACC' (cf. *fɑzeːk* 'id-NOM').

8. Glosses: paper, party, slice, satin, arm-chair, harem, driver, cabin, *-n(ɑ|ɛ)k* 'Dative', *-b(oː|øː)l* 'Delative'

9. Glosses: harakiri-DAT, clarinet-INST, bakelite-ELA, acetylene-INE.

(8) Number of bisyllabic mixed stems

a.	frequent with [i iː]	i(ː)B	490;	Bi(ː)	414	e.g. bik*a*, k*a*viʧ
b.	frequent with [eː]	eːB	83;	Beː	103	e.g. heːj*a*, taːɲeːr
c.	frequent with [ɛ], (most are loanwords)	ɛB	223;	Bɛ	197	e.g. tɛr*a*s, h*a*vɛr
d.	rare with [ø øː y yː], (all are recent loans)	FB	6;	BF	22	e.g. pøʒoː, ʃoføːr, ny*a*ns, k*a*jyt[10]

It can be seen from (8) above that mixed stems are frequent with unrounded front vowels, and do exist (but are rare) with rounded vowels.

Thus, whether a vowel occurs in a harmonically mixed stem is not an adequate definition of neutrality for Hungarian vowels.

3.4 Antiharmony

Antiharmony means that a suffix vowel is selected from the opposite harmonic class than the triggering harmonic vowel of the stem and thus is not the normal harmonizing vowel. In Hungarian, this happens only when the stem vowel is front: that is, a back suffix vowel shows up instead of the expected front one. Antiharmony is lexically conditioned in that it only occurs after a closed set of stems: e.g. *hiːd-n(a|*ɛ)k* 'bridge-DAT', but *viːz-n(*a|ɛ)k* 'water-DAT'. The distribution of antiharmonic stems among stem-vowels is shown in (9) below.

(9) Harmonic classes of monosyllabic stems

a.	stems with [i iː]	frequent with F suffixation	e.g. *siːv-ɛn* 'heart-SUE', *his-ɛk* 'I believe'
		frequent with B suffixation	e.g. *siːv-ok* 'I suck', *hiːd-on* 'bridge-SUE'
b.	stems with [eː]	frequent with F suffixation	e.g. *teːl-ɛn* 'in winter', *feːl-ɛk* 'I am afraid'
		rare with B suffixation (2 stems)	*ʦeːl-on* 'aim-SUE', *heːj-on* 'peel-SUE'
c.	stems with [ɛ]	frequent with F suffixation	e.g. *fɛj-ɛn* 'head-SUE', *tɛs-ek* 'I put sg.'
		rare with B suff. (1 stem)[11]	*dɛreːk-on* 'waist-SUE', *dɛrɛk*-ak 'waists'

10. Glosses: (8a) bull, gravel, (8b) hawk, plate, (8c) terrace, pal, (8d) Peugeot, driver, nuance, cabin.

11. In addition, some speakers who pronounce *ʃvɛjʦ* 'Switzerland' and *ʃpɛjz* 'larder' instead of the widespread *ʃvaːjʦ* and *ʃpaːjz*, may choose the back vowelled suffix after the front stems also, e.g. %*ʃvɛjʦ-ban* 'in Switzerland', %*ʃpɛjz-ban* 'larder-INE'.

d. stems with [ø øː y yː] always with F suffixation, ***never*** with B suffixation

The above generalizations show that the occurrence of vowels in antiharmonic stems is gradual: the front unrounded vowel frequently appears in antiharmonic stems while the mid and mid-low vowels only appear in a few. An antiharmonic stem with a front rounded vowel, however, is impossible. It is important to note that monomorphemic antiharmonic stems are monosyllabic.[12] In the next section we examine mixed stems that show antiharmonic behavior, i.e. the state of affairs when the set of mixed stems and the set of antiharmonic stems overlap.

3.5 Mixed and antiharmonic stems: truncation

In Hungarian there are some morphophonological processes that can interact with the mixed and antiharmonic properties of stems. The two processes we examine both involve vowel~zero alternation: one stem-internally, the other stem-finally. Here we will refer to both of them as truncation. Examples are given in (10) below.

(10) Types of truncation

a. stem-internal: *ʃaro**k*** 'corner', cf. *ʃark-ok* 'corners', *ʃark-unk* 'our corner', *ʃark-iːt* 'polarize'
*jɛlɛ**z*** 'to sign', cf. *jɛlz-ɛk* 'I sign', *jɛlz-ynk* 'we sign', *jɛlzøː* 'signing'

b. stem-final: *kaːba* 'dazed', cf. *kaːb-ul* 'to get dazed', *kaːb-iːt* 'to daze'
fɛrdɛ 'slanting', cf. *fɛrd-yl* 'to slant (intr.)', *fɛrd-iːt* 'to slant sg.'

What happens if a mixed NB-type of stem undergoes truncation? This can be seen in (11) below with the stable (i.e. not truncated) stem vowels [i] and [eː].

(11) Truncation of mixed stems

a. stem-internal: *pis**o**k* 'dirt', cf. *pisk-oʃ* 'dirty', *pisk-unk* 'our dirt', *pisk-iːt* 'to dirt sg.'
*ʦeːlo**z*** 'to aiming', cf. *ʦeːlz-ok* 'I aim', *ʦeːlz-unk* 'we aim', *ʦeːlz-oː* 'aiming'

b. stem-final: *tist**a*** 'clean', cf. *tist-ul* 'to get clean', *tist-ogat* 'to cleanse', *tist-iːt* 'to clean'
*beːn**a*** 'lame', cf. *beːn-ul* 'to get lame', *beːn-iːt* 'to lame'

12. Except one example, the bisyllabic *dɛreːk/dɛrɛk-* 'waist', see (9c).

It can be seen in (11) above that the **harmonic class of the bound** (truncated) **stem is the same as that of the original** (non-truncated) **stem**. E.g. the allomorph *pisok* 'dirt' is a back stem because of the last back vowel (cf. *pisok-nak* 'dirt-DAT' etc.) so the allomorph *pisk-* of the same stem will be a back stem as well: e.g. *pisk-ok* 'dirt-PLUR', *pisk-ol* 'to make dirty' etc. Similarly, *tista* 'clean' is a back stem (cf. *tista-ʃaːg* 'cleanliness', *tistaː-nak* 'clean-DAT' etc.) thus *tist-* will also be back: e.g. *tist-ul* 'to get cleaned', *tist-ogat* 'to cleanse' etc. In the case of these bound stems the situation is exactly the same as in anti-harmony (cf. §3.4): the bound stems contain only front vowels – [i iː] or [eː] – but the suffix has a back vowel. (12) below shows the number of such antiharmonic truncating stems:

(12) Antiharmonic truncating stems sorted by the neutral vowel:

a. [i iː] – **frequent** *tist*(*a*) 'clean', *ʃim*(*a*) 'smooth', *tit*(*o*)k 'secret' *kiːn*(*o*)*z* 'to torture'
b. [eː] – **rare** (3 stems) *beːn*(*a*) 'lame', *neːm*(*a*) 'mute', *ʦeːl*(*o*)*z* 'to aim'
c. [ɛ] – **does not occur** in antiharmonic truncating stems
d. front round vowels **do not occur** in antiharmonic truncating stems

(12) shows that there is a hierarchy of "antiharmonic vowels" in antiharmonic truncating bound stems; this is a modified version of (9), which shows the antiharmonic free stems.

Note that the verb-forming suffix *-iːt* never harmonizes, but creates a new stem by truncation which can contain more than one neutral vowel. These stems (as the original non-truncated ones) will be back, thus new antiharmonic stems will be created, e.g. *piskiːt-ok* 'I make sg. dirty', *tistiːt-ok* 'I clean sg.', *beːniːt-ok* 'I make sy. lame' (cf. (11)). Thus these antiharmonic stems are polysyllabic as opposed to monomorphemic antiharmonic stems, which are typically monosyllabic (cf. (9)).

3.6 Summary of neutral vowels

(13) below sums up the properties discussed above, i.e. the potential signs of neutrality cross-linguistically and specifically in Hungarian.[13] Plus signs indicate that a property holds, brackets indicate rare examples. The rows (properties) and columns (front vowels) are ordered in a way that indicates a hierarchy of vowels decreasing in neutrality (and naturally, the properties are ordered such that each property is true of more of the vowels than the previous one).

13. Antiharmony is a language specific property associated with neutrality in Hungarian (e.g. Törkenczy 2011).

(13) Properties associated with neutral vowels

		unrounded			round
		high	high-mid		mid-low
		[i iː]	[eː]	[ɛ]	[ø øː y yː]
ia.	no harmonic alternants:	+	–	–	–
iiib.	occurrence in truncating mixed stems:[14]	+	(+)	–	–
ib.	occurrence in non-harmonizing suffixes:	+	+	–	–
iv.	can induce antiharmony:[15]	+	(+)	(+)	–
ii.	transparency to harmony:[16]	+	+	(+)	–
iiia.	occurrence in mixed stems:[17]	+	+	+	(+)

It can be seen in (13) above that the potential criteria of neutrality do not provide uniform results. It is only the high vowels [i iː] which do not have harmonic alternants, cf. (13ia). Only the high and high-mid vowels [i iː] and [eː] satisfy two criteria: they occur in truncating mixed stems and non-harmonizing suffixes, cf. (13iiib) and (13ib). All the three unrounded front vowels (including the mid-low [ɛ]) satisfy further two properties: they occur in antiharmonic stems and can show transparent behavior, cf. (13iv) and (13ii). And finally, all front vowels can appear in mixed stems. To sum up, defining which vowel is neutral and which is not can not be achieved properly on the basis of **all** the above properties as tests, because the different properties are associated with different sets of vowels. Rather we consider the **neutrality of vowels as a gradual concept** based on the properties in (13). In this sense (front) vowels are ordered in a hierarchy by their neutral behavior: in Hungarian this ordering is the following (see also Hayes & Londe 2006).[18]

(14) Neutrality hierarchy of front vowels

[i iː] ≫ [eː] ≫ [ɛ] ≫ [ø øː y yː]

14. With [eː] only 3 stems exist, cf. (12b).

15. With [eː] only 2 stems exist, cf. (9b); with [ɛ] only 1 stem exists, cf. (9c).

16. With [ɛ] total transparency is rare, hesitation is common, cf. (6c).

17. With [ø øː y yː] rare, only in recent loans, cf. (8d).

18. While the gradience *in transparency* has been noted in the literature by several authors, it is typically not built into the analyses, which nevertheless make a categorical distinction between neutral and non- neutral vowels (Vago 1980, Kontra & Ringen 1986, Ringen & Kontra 1989, Siptár & Törkenczy 2000). Hayes & Londe 2006 is a notable exception.

4. Violation of neutral behavior

4.1 Two types of truncation

As we mentioned above, truncation can have an effect on harmonic properties. In addition to the truncating process discussed in §3.5 above, there is another type of truncation which is frequent in diminutives/hypochoristics. This type of truncation can delete not only vowels, but a longer sequence of segments (including consonants), and is triggered by a suffix *-i*[19] resulting in a bi-syllabic stem ending in *-i*.[20] This is exemplified in (14) below.

(14) Truncated forms with the suffix $-i_{\text{DIMIN}}$[21]

a.	from names:	ʃaːrɑ ~ ʃaːr-i	aːgnɛʃ ~ aːg-i	iʃtvaːn ~ iʃt-i
b.	from common nouns:	mɑmɑ ~ mɑm-i	fɑɟlɑlt ~ fɑɟ-i	byntɛteːʃ ~ bynt-i
c.	from adjectives:	butɑ ~ but-i	ʧinoʃ ~ ʧin-i	rɛndɛʃ ~ rɛnd-i
d.	from verb:	mutɑ(ʒd) ~ mut-i	tɑpogɑt ~ tɑp-i-z	ʧiklandoz ~ ʧik-i-z[22]

It can be seen in (14) above that the diminutive suffix *-i* can occur after nominal stems (proper names, common names, adjectives) and verbal stems. Suffixation with *-i* results in the same category as the base.[23] For our purposes, it is the harmonic behavior of the suffixed forms with $-i_{\text{DIMIN}}$ that are relevant: in particular how the suffix behaves with respect to transparency and antiharmony. Some diminutive forms in (14) above are suitable for testing such behavior: e.g. *ʃaːra ~ ʃaːr-i*, *ʧinoʃ ~ ʧin-i*. In the following, two kinds of truncation will be compared: one involves the verb forming suffix *-iːt*, the other the diminutive *-i*. (15) below shows different types of stems that undergo truncation according to harmonic type: a truncating stem can be FF, BB, NF or NB type (where N stands for the non-low

19. Not only the diminutive *-i* can truncate stems in this way, there are other (rarer) types of diminutives which also do so, e.g. *sɛndviʧ* 'sandwich' ~ *sɛnd-oː* 'id-DIMIN' and *føldrajz* 'geography' ~ *fø-ʦi* 'id-DIMIN', *maːria* 'Mary' ~ *mar-a, mar-ʧa* 'id.-DIMIN', *apa* 'father' ~ *ap-u(ʃ)* 'daddy'. For other types see also footnote 6.

20. The monosyllabic truncated stem must end in a consonant. There are further constraints on this type truncation (e.g. how many final consonants the truncated stem contains, cf. van de Weijer 1989), but the process is somewhat idiosyncratic.

21. Monosyllabic stems are not truncated, e.g. *ʃyn* 'hedgehog' ~ *ʃyn-i* 'id.-DIMIN', *paːl* 'Paul' ~ *pal-i* 'id.- DIMIN'.

22. Glosses: Sarah, Agnes, Stephen, mother, ice-cream, penalty, dumb, cute, neat, show me!, to paw, to tickle.

23. In the case of verbal stems, a verbal marker *-z* has to be added after the suffix *-i*, cf. (14d).

front unrounded vowels: [i iː] and [eː], F stands for all other front vowels and B stands for back vowels).

(15) Harmonic types of truncating stems

free stem + suffix	trunc.stem + *iːt* + suff.	free stem + suffix	trunc.stem + i_{DIMIN} + suff.
a. harmonic non-neutral front:			
FF + F	F + N + F	ydɛ-ʃeːg	yd-iːt-hɛt; fɛrɛnc-nɛk fɛr-i-nɛk
b. Harmonic back:			
BB + B	B + N + B	ʃaːrgɑ-ʃaːg	ʃaːrg-iːt-hɑt; ʃaːraː-nɑk ʃaːr-i-nɑk
c. harmonic neutral (front):			
NF + F	N + N + F	beːkɛ-ʃːeːg	beːk-iːt-hɛt eːdɛʃ-nɛk eːd-i-nɛk
d. antiharmonic neutral (back):			
NB + B	N + N + **B** vs **F**	beːnɑ-ʃaːg	beːn-iːt-hɑt eːvaː-nɑk eːv-i-nɛk
		tistɑ-ʃaːg	tist-iːt-hɑt; tibor-nɑk tib-i-nɛk[24]

It can be seen in (15) above that the two kinds of truncated forms behave similarly if the first vowel of the stem is harmonic front (15a, c) or back (15b). In the case of mixed stems (when the first vowel is neutral, the second is back (NB) their behavior is different, cf. (15d). As we saw earlier in §3.5, if an antiharmonic truncating stem is followed by the truncating suffix *-iːt,* the resulting stem will contain only neutral vowels (N + N), and it requires the back alternant of a harmonic suffix (N + N + B), e.g. *ritka* 'rare' ~ *ritk-iːt-hat* 'rare-VERBAL-MODAL' *neːma* 'mute' ~ *neːm-iːt-hat* 'mute-VERBAL-MODAL' (for further forms cf. (15d)). By contrast, if the truncating suffix is the diminutive *-i*, the resulting N + N-type stems will take front suffixes, e.g. *liza* 'Liza' ~ *liz-i-nɛk* 'id.-DIMIN-DAT', *ribants* 'slut' ~ *rib-i-vɛl* 'id.-DIMIN-INST', *iʃkola* 'school' ~ *iʃ-i-bɛn* 'id.-DIMIN-INE'. Whether this difference in the harmonic behavior of truncation processes is related to other morphological differences is an important question. In the next section we examine whether this contrast can be dealt with by proposing different (underlying) representations of the neutral vowels [i iː] and [eː].

4.2 Problems of a representational approach

If the divergent harmonic properties of truncated stems are explained by a difference in the representation of the relevant morphemes (stems and/or affixes),

24. Glosses: fresh-ness, freshen-MODAL, Francis-DAT, Francis-DIMIN-DAT, yellow-ness, make yellow-MODAL, Sarah-DAT, Sarah-DIMIN-DAT, peaceful-ness, to placate-MODAL, sweet-DAT, sweet- DIMIN-DAT, lame-ness, make lame-MODAL, Eve-DAT, Eve-DIMIN-DAT, clean-ness, make clean- MODAL, Tibor (name)-DAT, id.-DIMIN-DAT.

several hypotheses lend themselves. One could claim that the stems – more precisely the (phonetically identical) neutral vowels of the relevant stems – are different in the underlying representation.

Vago (1980) suggests that antiharmony is a result of there being two types of underlying high (and high-mid) unrounded vowels in Hungarian: a front and a back one (the high ones come in short and long versions, but that difference is irrelevant in vowel harmony). The front–back contrast of unrounded vowels is neutralized in a context-free manner after vowel harmony has taken place. That is, *viːz-nɛk* 'water-DAT' has an underlyingly front vowel, hence the front variant of the suffix is selected, but *hiːd-nak* 'bridge-DAT' is underlyingly /huːd + nak/. Thus harmony is perfectly regular, the latter stem is only apparently antiharmonic after the neutralization of /i/ and /u/ has taken place.

In such a framework, different stem vowels will be posited in the first syllables of *ʃima* 'smooth' and *ʃimon* 'Simon'. The first stem is supposed to contain the back high unrounded vowel underlyingly. It is therefore an all-back harmonic stem: /ʃuma/. After the addition of a truncating suffix (and the truncation of the final vowel of the root) the resulting stem will be mixed, but since the suffix vowel is transparent, back harmony is expected: /ʃum + iːt + hat/ → *ʃim-iːt-hat* 'smooth-VERBAL-MODAL'. The name *ʃimon,* on the other hand, is lexically different: in its first syllable it contains the front vowel underlyingly, and is thus a mixed harmonic stem. If its final vowel is truncated, the resulting stem will contain a single front vowel that triggers front harmony: *ʃim-i-nɛk* 'Simon-DIMIN-DAT'.

There are several problems with this explanation. It uses a theoretically deprecated mechanism, absolute neutralization. This "explanation" is clearly circular: the only reason for positing the abstract high back unrounded vowel in the relevant stems is to explain their harmonic behavior (they have no "independent motivation"). Furthermore, we fail to account for the generalization that the stems before the suffix *-iːt* always contain the "back" vowel, while the stems before the diminutive *-i* always contain the "front" vowel and thus we implicitly imply (falsely) that it can be the other way around. Furthermore, if the same stem /ʃuma/, which allegedly contains a back vowel in its first syllable, gets truncated by the verbal diminutive suffix *-iz*:[25] *ʃim-iz* 'to caress-DIMIN', then the resulting stem will govern front harmony: *ʃim-iz-hɛt* 'caress-DIMIN-MODAL'. This is unexpected, since the stem vowel is supposed to be back, and the *i* of the suffix is expected to be transparent, cf. (6a), as in the case of *ʃim-iːt-hat* 'to smooth-MODAL'.

25. It is not clear whether this suffix is a separate suffix, or simply the combination of the nominal/adjectival diminutive *-i* and the verb-forming *-z* suffixes.

One could suppose that besides the stem vowels, the suffix vowels are also different underlyingly. Given the contrast between *ʃim-iːt-hat* 'smoothen-MODAL' and *ʃim-iz-hɛt* 'caress-DIMIN-MODAL', which arguably have the same underlyingly back stem vowel, we must assume that the vowel of *-iːt* is transparent, while that of *-i* is opaque. This yields a back suffix vowel after the former and a front one after the latter suffix, which is borne out by the data. However, it is suspicious that we never find this allegedly opaque front /i/ in stems: recall, a stem with a back vowel followed by /i/ always governs back harmony. Furthermore, words like *ʃaːr-i-nak* 'Sarah-DIMIN-DAT' show that even the diminutive *-i* cannot be opaque, since after a back vowel it always behaves as a transparent vowel. It could still be suggested that the vowel of *-iːt* is antiharmonic to explain the back suffix in *ʃim-iːt-hat,* but such a hypothesis is refuted by words like *beːk-iːt-hɛt* 'pacify-MODAL' where the final suffix shows up in its front alternant.

Thus, we are forced to conclude that no combination of the standard ways of distinguishing the unrounded high (or high-mid) front vowels in the stems and the suffixes is able to predict the patterns observed. We could claim that the vowel of the diminutive *-i* is transparent (*ʃim-i-nɛk*), unless it is added to a stem containing an underlying back high (or high-mid) unrounded vowel (*ʃim-iz-ɛk*), in which case it is opaque. This, however, is begging the question: such a claim is blatantly untenable and *ad hoc*.

4.3 Transparency of harmonizing and non-harmonizing vowels

We have seen in the previous sections that two kinds of neutral vowel suffixes can be distinguished on the basis of their harmonic properties: one of them is completely transparent, the other is "semi-transparent", i.e. transparent after back vowels, but opaque for antiharmonic neutral stem vowels. In this section we want to point out another difference between suffixes with neutral vowels: there is a special situation when harmonizing and non-harmonizing neutral vowel suffixes behave differently: non-harmonizing suffixes are transparent and harmonizing suffixes are opaque. This phenomenon is observable only when the stem the suffix is attached to is harmonically vacillating (Bɛ or BNN type), and the front allomorph of the harmonizing suffix attached contains a neutral vowel. If these BN(N) stems get an N-type suffix (which yields a BN(N) + N stem) two kinds of behavior can be observed depending on the harmonic class of the suffixed forms: if the N-suffix does not have a harmonic counterpart, then the suffixed form also vacillates (16ii), if it does, it is obligatorily front (16i). The following data show this behavior with three pairs of suffixes.

(16) Harmonic behavior of harmonizing and non-harmonizing suffixes after hesitating stems

a. *-ʃ(eː|aː)g* vs. *-eːk* b. *-j(eː|aː)* vs. *-eː* c. $-(i|ja)_{\text{VERB}}$ vs. $-i_{\text{ADJ}}$

i. only front suffix after harmonizing neutral vowel suffixes

Bɛ + N/B	BNN + F/B	BNN + N/B
hɑvɛr-ʃ(eː|aː)g	kolibri-j(ɛ|ɑ)	mɑrtini-z-(i|ːɑ)
Bɛ + N + **F**	BNN + N + **F**	BNN + N + **F**
hɑvɛr-ʃeːg-b(**ɛ**|*ɑ)n	kolibri-jeː-v(**ɛ**|*ɑ)l	mɑrtini-z-i-t(**ɛ**|*o)k

ii. both front and back suffix after non-harmonizing neutral vowel suffixes

Bɛ + N	BNN + N	BNN + N
hɑvɛr-eːk	kolibri-eː	mɑrtinik-i
Bɛ + N + **F/B**	BNN + N + **F/B**	BNN + N + **F/B**
hɑvɛr-eːk-b(**ɛ**|**ɑ**)n	kolibri-eː-v(**ɛ**|**ɑ**)l	mɑrtinik-i-h(**ɛ**|**o**)z

iii. both front and back suffix after monomorphemic neutral vowelled stems

BɛN + **F/B**	BNN + **F/B**
sutɛreːn-b(**ɛ**|**ɑ**)n	horribilis-(**ɛ**|**ɑ**)k[26]

It can be seen in (16) above that the contrast in behavior obtains independently of whether the harmonizing suffix "really" has (regular) neutral vowelled alternants (e.g. *-ʃɑːg* ~ *-ʃeːg* see (16a)), the neutral vowel is the result of a lengthening process (e.g. *-jɑː-* ~ *-jeː-*, cf. (16b), see footnote 4), or the neutral vowel suffix alternant is involved in a suppletive/irregular alternation which is triggered by the harmony (*-i-* ~ *-jɑː-*, cf. (16c)). This last case is crucially important: if we tried to explain the contrast between harmonizing and non-harmonizing neutral vowel suffixes with a representational difference between the suffix vowels (e.g. if we posited different representations for harmonizing [eː] and non-harmonizing [eː]), we would fail with *-i-* ~ *-jɑː-*, because in this non-phonological alternation there is no (phonological) connection between the two alternants, i.e. according to standard assumptions the allomorph *-i* is phonologically "unaware" that there is another allomorph *-jɑː-*.

The next pair of sentences shows that in the case of two possessive suffixes (harmonising POSS3SG *-jeː-* ~ *-jɑː-* and non-harmonising ANAPHORIC_POSS *-eː*) there is a minimal pair of word forms which strikingly demonstrate the harmonic differences discussed. Note that in the anaphoric possessive form *kolibri-eː* there is compulsory hiatus filling with the glide [j], which makes the form

26. Glosses: (i) friend-ship(-INE), humming bird-POSS3SG(-INST), to spill Martini on-DEF (-2PL), (ii) pal- ASSOC_PLUR (-INE), humming bird-ANAPHORIC_POSS(-INST), Martin-ique-ADJ_SUFF(-LAT), (iii) basement-INE, horrible-PLUR.

phonetically identical to the 3sg possessive form of the same stem suffixed with -*jeː*-. This is exemplified in (17) below.

(17) A minimal pair
   a. Kidobtuk a galamb ketrecét a [kolibrijeːvɛl / kolibrijeːvɑl] együtt.
   'we threw the pigeon's pen out together **with that of the hummingbird**'
   b. Kidobtuk a galambját a [kolibrijeːvɛl / *kolibrijeːvɑl] együtt.
   'we threw his/her pigeon out together **with his/her hummingbird**'

In the next section we summarize the harmonic and morphological characteristics of the different types of neutral vowel suffixes.

4.4 Types of neutral vowel suffixes

In order to account for the antiharmonic, transparent, opaque and semitransparent behavior we have to distinguish four types of neutral vowels. This is shown in (18) below.

(18) Four different [i]'s?
   i. the antiharmonic [i] of *hiːd* 'bridge', or *ɲit* 'to open'
   ii. the front/opaque [i] of *viːz* 'water', *his* 'believe', or -i_{VERB}
   iii. the transparent [i] of -*iːt*, or -i_{ADJ} (and in other non-harmonizing suffixes)
   iv. the semitransparent [i] of -i_{DIMIN}, (transparent after back, but opaque after "underlyingly" back (but phonetically front) vowels)

Let us examine the harmonic and morphological behavior of these four suffix classes. There are two populous classes (neutral vowel suffixes with and without harmonic alternants) which show different behavior according to transparency (cf. §4.3), and there are two single suffixes which show transparent and semitransparent behavior in truncated forms (cf. §4.1).

(19) Properties of suffixes with neutral vowels

	-i_{VERB} *-jeː-* and others with harm. alternants	*-ʃeːg* etc.	-i_{DIMIN}	*-iːt*	i_{ADJ} *-eː -eːk* etc. and others without harm. alt.
harmonizing properties:					
i.	no harmonic alternants:	+	−	+	+
ii.	transparency after B:[27]	+	−	+	+

27. *martiniz-**i**-t(*o|**ɛ**)k* 'Martini(verb)-DEF-2PL' vs. *ʃaːr-i-n(**a**|*ɛ)k* 'Sarah-DIMIN-DAT', *ʃaːrg-**iː**t-h(**a**|*ɛ)t* 'yellow-VERBAL-MODAL, *martinik-**i**-n(**a**|**ɛ**)k* 'Martinique-ADJ_SUFF-DAT'.

iii.	transp. after "antiharmonic" F:[28]	+	n.a.	–	+
other morphological properties:					
iv.	truncating:[29]	–	–	+	+
v.	productive:	+ or –	+ or –	(+)[30]	–[31]
vi.	denominal (not deverbal):	+ or –	+ or –	+ or –	+

It can be seen in (19) above that on the basis of harmonic behavior there are three distinct neutral vowel suffix classes: (a) the non-transparent suffixes with harmonic alternants, (b) the transparent suffixes with harmonic alternants, and (c) the diminutive *-i*, which is "semitransparent" (and does not have a harmonic alternant). In the next section we propose a non-representational analysis for the problem of their complex behavior.

5. Optimality

As we pointed out in §4.2 and §4.4, the standard representational tools seem to be insufficient for explaining antiharmonic and transparency differences between the suffixation processes discussed in the previous sections. This raises the possibility of using a type of explanation other than local encoding of phonological behavior in the underlying representation of segments. In the framework of Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1995) it is possible to posit constraints that govern the harmonic behavior of vowel sequences and these constraints can be sensitive to the morphological make-up of words. In the next sections we propose a possible way to explain the truncation problem (§5.1) and the transparency problem (§5.2).

28. *ʃi:m-**i**-n(*a|ɛ)k* 'Simon-DIMIN-DAT' vs. *ʃim-**i**:t-h(**a**|*ɛ)t* 'flatten-VERBAL-INDEF.1SG, *hid-**i**-(**a**|ɛ)k* 'bridge-ADJ_SUFF-PLUR'.

29. Diminutive suffixation can truncate a string of segments of any length in order to create a monosyllabic base for the suffix *-i* to attach to it, *-i:t*-suffixation truncates at most one stem-final vowel.

30. Although *-i* DIMIN can be attached to a great number of nouns, even newly created/borrowed ones (and is productive in this sense), it cannot combine with some nouns, e.g. *astal* 'table', **ast-i* 'table-DIMIN' (compare *ɛstɛr* 'Esther', *ɛst-i* 'Esther DIMIN'); *bana:n 'banana', *ban-i* 'banana DIMIN' (compare *narantʃ* 'orange', *nar-i* 'orange DIMIN'); *nɛvɛt-e:ʃ* 'laughter', **nɛv-i* laughter DIMIN' (compare *tyntɛt-e:ʃ* 'demonstration', *tynt-i* 'demonstration DIMIN'). The details are not clearly understood, hence the symbol '(+)'.

31. *-i:t* is not productive as a truncating suffix, but is productive in combination with adjective forming *-(V)ʃ*, *ku:l* 'cool', *ku:l-oʃ-i:t* 'make cool' (compare **ku:l-i:t*)

5.1 Paradigm uniformity

Let us recapitulate the facts of truncation: forms in (11) and (15b) show that if a BB-type stem is truncated by a neutral (N) vowelled suffix, the resulting B + N-type stem will have a back harmonic property, i.e. takes back suffixes: B + N + B (e.g. *ʃaːrg-iːt-hat* and *ʃaːr-i-nak*). The harmonic properties of these B + N stems are exactly the same as other (monomorphemic) BN stems, because of the total transparency of N: the suffixed forms will be BN + B (see (6b)). We can formulate a constraint which penalizes those sequences that do not conform to the regular (i.e. the most frequent) harmonic restrictions in the language. We will call this constraint Global-Harmony.[32]

The forms containing the truncated stems mentioned above obey another important generalization: their harmonic class is identical to the harmonic class of their (untruncated) base, i.e. *ʃaːrga* and *ʃaːrg-iːt* both govern back harmony, and so do *ʃaːra* and *ʃaːr-i*. This generalization is based on a comparison between two output forms: it assumes identity between the harmonic class of a suffixed form and that of its base. Output-output constraints of this kind are well-known in the OT-literature (cf. Benua 1995, 1997/2000 among others), and since two forms in the same paradigm are compared,[33] this expresses **paradigm uniformity**. We will use the following definition for the parametrized harmonic uniformity constraint Harmonic-Uni(*m1– m2*), where *m1* and *m2* are morphological categories.

(20) Harmonic uniformity
Harmonic-Uni(*m1–m2*): the harmonic classes of forms belonging to morphological categories *m1* and *m2* are identical.

In our case one of the categories is the unsuffixed stem and the other is a specific suffixed form of the same stem (i.e. a member of the stem's paradigm with a specific suffix). Thus, the relevant version of the constraint is Harmonic-Uni(stem–*SUFFIX*),[34] where *SUFFIX* takes on "values" such as MODAL, DIMINUTIVE, etc.

32. GLOBAL-HARMONY is meant as an informal "cover" constraint that penalises "disharmonic" (F...B, B...F) combinations. Actually, this constraint may well be a family of markedness constraints regulating the agreement of vowel sequences in some property and may even interact with one another (cf. Kiparsky & Pajusalu 2003). This difference, however, is not relevant here.

33. We accept a broad interpretation of "paradigm": it is a set of words that share the same morpheme (e.g. Steriade 2000, Kenstowicz 2005, Rebrus & Törkenczy 2005; thus it is not restricted to inflected forms.

34. The stem is not necessary a free stem such as ʃaːrga, it can be a bound stem occurring in forms with harmonizing truncating suffixes, like *-(u|y)l,* e.g. *ʃaːrg-ul* (cf. (10b) and (11b)).

The analysis of the relevant forms is the following. (21) and (22) below show that candidate forms suffixed with *-iːt-* and *-i*$_{\text{DIMIN}}$ obey Global-Harmony and Harmonic-Uni(stem–*SUFFIX*) if they are followed by a back alternant of a harmonic suffix, but violate both constraints if they are followed by front suffix alternants. (For the sake of clarity, we show the reason for the violation in parentheses next to the violation mark in the tableaux below.)

(21) The transparent behavior of suffix *-iːt* (BN-stems)

/ʃaːrgɑ/ + /iːt/ + /h(ɑ|ɛ)t/ 'yellow-VERBAL-MODAL'	Harmonic-Uni (stem–VERBAL)	Global-Harmony
☞ ʃaːrg-iːt-hɑt		
ʃaːrg-iːt-hɛt	* (ʃaːrgɑ + B, ʃaːrg-ul)	* (BN + B)

(22) The transparent behavior of suffix *-i*$_{\text{DIMIN}}$ (BN-stems)

/ʃaːrɑ/ + /i/ + /n(ɑ|ɛ)k/ 'Sarah-DIMIN-DAT'	Global-Harmony	Harmonic-Uni (stem–DIMIN)
☞ ʃaːr-i-nɑk		
ʃaːr-i-nɛk	* (BN + B)	* (ʃaːrɑ + B)

In the case of antiharmonic truncating stems (NB), however, the effect of the two truncating suffixes is different. The verb-forming suffix *-iːt* creates new antiharmonic stems containing more than one neutral vowel, belonging to the back harmonic class (N + N + B): *ʃim-iːt-hat*. In the case of diminutive *-i*, however, the resulting N + N stems will be "regular" front (N + N + F) in spite of the fact that the original stem is mixed NB and induces back harmony (NB + B). The analysis is based on the observation that in the case of mixed truncating stems these suffixation types violate Global-Harmony and Harmonic-Uni constraints in a different way: the antiharmonic verbal forms observe harmonic uniformity between the stem and the forms suffixed with the verbal suffix *-iːt* (e.g. *ʃima-ʃaːg*, *ʃimaː-nak*, *ʃim-ul* etc. and *ʃim-iːt-hat*), but violate the global harmonic constraint, because stems containing only front vowels "regularly" induce front harmony, i.e. the productive scheme is: NN + F. The diminutive forms, on the other hand, obey global harmony (NN + F), but violate harmonic uniformity between their stem and the forms suffixed with *-i*, e.g. *ʃimon-nak* vs. *ʃim-i-nɛk* or *ʃimogat-hat* vs. *ʃim-i-z-hɛt*. This is expressed by the differential ranking of Harmonic-Uni with respect to

Global-Harmony in these two cases. This can be seen in the OT-tableaux (23) and (24) below:

(23) The transparent behavior of suffix *-i:t* (NN-stems)

/ʃimɑ/ + /i:t/ + /h(ɑ|ɛ)t/ 'flatten-VERBAL-MODAL'	Harmonic-Uni (stem–VERBAL)	Global-Harmony
☞ ʃim-i:t-hɑt		* (NN + F)
ʃim-i:t-hɛt	* (ʃimɑ + B, ʃim-ul)	

(24) The opaque behavior of suffix *-i_{DIMIN}* (NN-stems)

/ʃimon/ + /i/ + /n(ɑ|ɛ)k/ 'Simon-DIMIN-DAT'	Global-Harmony	Harmonic-Uni (stem–DIMIN)
ʃim-i-nɑk	* (NN + F)	
☞ ʃim-i-nɛk		* (ʃimon + B)

It can be seen from the analysis above that the raking assumed selects the well-formed candidates as optimal. The ranking has to be the following.

(25) Ranking of harmonic uniformity and harmony constraints
Harmonic-Uni (stem–VERBAL) ≫ Global-Harmony ≫ Harmonic-Uni (stem–DIMIN)

The question why harmonic uniformity for diminutive forms ranks lower than the other two constraints leads us to consider the general properties of paradigm uniformity. This analysis based on affix-specific ranking (cf. Raffelsiefen 2004) is *ad hoc* if it does not relate this difference to any other difference between the two suffixes. If we examine the two kinds of suffixation we find that there are significant morphological differences between them (cf. (19)). The differences are (a) in the "scope" of truncation, (b) in the productivity and the selection of the stem-category. As mentioned above, truncation by *-i:t* deletes only one vowel in stem-final position. By contrast, diminutive truncation can delete a whole sequence of segments (vowels and consonants) at the end of the stem. This can have an effect on harmonic properties if the deleted sequence contains more than one vowel, and they are in different harmonic classes, e.g. *andrɛa* 'name' ~ *and-i* 'id.-DIMIN', *cigarɛtta* 'cigarettes' ~ *cig-i* 'id.-DIMIN'. Truncating suffixation by *-i:t* occurs with a closed class of mostly adjectival stems, i.e., it is not productive. Diminutive

truncation, on the other hand, can be regarded as productive (though the exact conditions of its applicability have not been fully explored). We leave the relationship between these properties and the ranking described above for further research.[35]

5.2 Sequencing constraint

Harmonic-Uni (stem–*SUFFIX*) plays an important role in vacillating cases, as well. If we have a BN-type stem and a suffix with a neutral vowel, the suffixed stem will be BN + N. According to regular vowel harmony (encoded in the Global-Harmony constraint), we expect variation to occur in this case: both BN + N + B, and BN + N + F should be possible if a harmonic suffix is added (cf. quantity sensitivity for BNN stems in discussed in (7)). These BN + N stems, however, require back harmony, i.e. BN + N + B, and *BN + N + F is not allowed: e.g. *madrid-i-*(*a*|*ɛ)*k* 'Madrid-ADJ-PLUR', *papi*ː*r-e*ː*-n*(*a*|*ɛ)*k* 'paper-ANP-DAT' – compare the behavior of monomorphemic *alibi-v*(*a*|*ɛ)*l* 'alibi-DAT', *praline*ː*-n*(*a*|*ɛ)*k* 'praliné-DAT'. First, let us examine a (non-vacillating) BN stem, like *madrid* 'Madrid', suffixed with a neutral vowelled suffix, like the adjectival marker -i_{ADJ}. The resulting stem is BNN and Global-Harmony permits both BNN + B and BNN + F forms: *madrid-i-hoz* or **madrid-i-hɛz* 'to one from M'. The latter form, however, is ungrammatical, because of the Harmonic-Uni(stem–ADJECTIVAL) constraint: since the unsuffixed stem *madrid* can only get back harmonic suffixes (e.g. *madrid-hoz* and not **madrid-hɛz*), the suffixed form with front harmonic suffix violates the harmonic uniformity constraint. This is shown in (26) below.

(26) The transparent behavior of non-harmonizing -i_{ADJ} (back stems)

/madrid/ + /i/ + /h(o|ɛ)z/ 'Madrid-ADJ-ADESSIVE'	Harmonic-Uni (stem–ADJECTIVAL)	Global-Harmony
☞ madrid-i-hoz	($^{\text{OK}}$ madrid + B)	($^{\text{OK}}$ BNN + B)
madrid-i-hɛz	* (madrid + B)	($^{\text{OK}}$ BNN + F)

35. One of our anonymous reviewers suggests that this could be achieved if we assumed a stratal organisation of phonology and assigned the two morphological operations to different levels. This may be a possible approach to the problem, but in close-up it turns out to be more complicated than expected since the domains of Hungarian phonological processes do not seem to fit neatly into the level 1–level 2 distinction (or its equivalent) that is usually assumed, cf. Rebrus et al. 1996, Törkenczy 2011.

Because of the role of the paradigm uniformity constraint Harmonic-Uni, variation is only possible if the unsuffixed stem is a vacillating one. A vacillating BNN stem such as *martinik* 'Martinique' can receive both back or front harmonic suffixes (e.g. *martinik-hoz* or *martinik-hɛz*) in conformity with Global-Harmony. When -i_{ADJ} attaches to such a stem, the resulting stem (*martinik-i*) may receive both the front and the back alternants of a harmonic suffix since harmonic uniformity is not violated violated: therefore both *martinik-i-hoz* and *martinik-i-hɛz* are well-formed, as is shown in (27) below, where none of the relevant constraints are violated.

(27) The transparent behavior of non-harmonizing -i_{ADJ} (vacillating stems)

/martinik/ + /i/ + /h(o|ɛ)z/ 'Martinique-adj-adessive'	Harmonic-Uni (stem–adjectival)	Global-Harmony
☞ martinik-i-hoz	(OK martinik + B)	(OK BNNN + B)
☞ martinik-i-hɛz	(OK martinik + F)	(OK BNNN + F)

If such a vacillating stem receives a harmonizing suffix whose front alternant happens to have a neutral vowel (e.g. -i_{VERB} which is the front alternant of the 3sg present definite suffix *-i ~ -ja*), the result should be the same (given the constraints and the constraint ranking above): the stem suffixed with the neutral-vowelled allomorph potentially should be able to receive back and front suffixes, as well: **martiniz-i-tok* or *martiniz-i-tɛk*. This is because Global-Harmony and Harmonic-Uni are not violated. Back suffixation, however, is ungrammatical in this case, which cannot be explained by the analysis above. Since this fact cannot be explained by positing a special representation for the harmonizing suffix vowel -i_{VERB} (cf. §4.4), we have to find another solution.

As is well-known, morphemes can have an effect on the choice of neighboring alternants, i.e. they can select their phonological or other properties. This frequently happens in the case of the stem–suffix relationship: the stem can select between suffix alternants. Selection can also take place between two affixes: typically the first suffix can select the phonological or morphological properties of the second suffix. We formulate a new type of constraint to express this relationship. This constraint is based on allomorph sequencing: it constrains which harmonic allomorph can follow a specific allomorph. The constraint Harmonic Sequencing is violated if two consecutive harmonic allomorphs occur such that this allomorph sequence is not found in the language. In our case a harmonizing allomorph is typically not followed by another allomorph whose harmonic class is the opposite: e.g. the following harmonic sequences do not occur because of

the global harmony restrictions: *...+B+F,*...+F+B. If a non-harmonizing (hence N-type) suffix is followed a harmonizing one, both possibilities are allowed: +N + F/B, see examples in (26) and (27). If the neutral vowel is harmonizing (i.e. the suffix alternates according to harmony), the global harmony would permit both cases, but harmonic sequencing is violated by the back variant, because harmonizing N + B sequences never occur: i.e. *-i* + *-tok* is violates Harmonic Sequencing. (So does *-jaː* + *-tɛk*, as well.) This can be seen in (28) below.

(28) The opaque behavior of harmonizing $-i_{\text{VERB}}$ (vacillating stems)

/martiniz/ + {i,ja} + /t(o|ɛ)k/ 'martini(verb)-def-2pl'	Harmonic Sequencing	Harmonic-Uni (stem–definite)	Global-Harmony
martiniz-i-tok	* ($-i_{\text{VERB}}$ + F)[36]	($^{\text{OK}}$ martini(z) + B)	($^{\text{OK}}$ BNNN + B)
☞ martiniz-i-tɛk	($^{\text{OK}}$ $-i_{\text{VERB}}$ + F)	($^{\text{OK}}$ martini(z) + F)	($^{\text{OK}}$ BNNN + F)
☞ martinizː-aː-tok	($^{\text{OK}}$ $-jaː_{\text{VERB}}$ + B)	($^{\text{OK}}$ martini(z) + B)	($^{\text{OK}}$ ...B + B)
martinizː-aː-tɛk	* ($-jaː_{\text{VERB}}$ + B)	($^{\text{OK}}$ martini(z) + F)	* (...B + B)

Exactly the same happens with stems suffixed by the non-harmonizing *-eː-* and the harmonizing *-jeː-*, too. This can bee seen in (29) and (30) below.

(29) Transparent behavior of non-harmonizing *-eː* (hesitating stems)

/kolibri/ + /eː/ + /v(a|ɛ)l/ 'humming bird-ANP-INST'	Harmonic Sequencing	Harmonic-Uni (stem–ANP)	Global-Harmony
☞ kolibri-eː-val	($^{\text{OK}}$ eː + B)	($^{\text{OK}}$ kolibri + B)	($^{\text{OK}}$ BNNN + B)
☞ kolibri-eː-vɛl	($^{\text{OK}}$ eː + F)	($^{\text{OK}}$ kolibri + F)	($^{\text{OK}}$ BNNN + F)

36. Because the back vowelled allomorph *-tok* occurs only after the allomorph *-jaː-* (which is the back version of the suffix $-i_{VERB}$), e.g. *lop-jaː-tok*.

(30) The opaque behavior of harmonizing *-jeː-* (hesitating stems)

/kolibri/ + /j(a|ɛ)/ + /v(a|ɛ)l/ 'humming bird-POSS 3SG-INST'	HARMONIC SEQUENCING	HARMONIC-UNI (stem–POSS 3SG)	GLOBAL-HARMONY
kolibri-jeː-vɑl	* (jeː$_{POSS}$ + F)[37]	(^{OK} kolibri + B)	(^{OK} BNNN + B)
☞ kolibri-jeː-vɛl	(^{OK} -jeː$_{POSS}$ + F)	(^{OK} kolibri + F)	(^{OK} BNNN + F)
☞ kolibri-jaː-vɑl	(^{OK} -jaː$_{POSS}$ + B)	(^{OK} kolibri + B)	(^{OK} ...B + B)
kolibri-jaː-vɛl	* (jaː$_{POSS}$ + B)	(^{OK} kolibri + F)	* (...B + B)

Conclusion

The aim of this paper was partly to offer some fresh data for the discussion of vowel harmony in Hungarian. It appears to be impossible to give an insightful analysis for these data in terms of a representational theory: the neutral vowel [i] has to be simultaneously analysed as transparent and antiharmonic in the verbal suffix *-iːt,* and transparent and opaque in the diminutive suffix *-i(z).* In other suffixes the front unrounded vowel [eː] behaves as transparent if the suffix does not have a back-vowelled alternant (e.g. the associative plural *-eːk*), but as opaque if it does (e.g. *-ʃeːg* '-ness', cf. allomorph *-ʃaːg*). We offer a possible solution in terms of paradigm uniformity.

References

Benua, Laura. 1995. "Identity Effects in Morphological Truncation". *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory* ed. by Jill Beckman, Laura Walsh Dickey & Suzanne Urbanczyk, 77–136. Amherst, GLSA.

Benua, Laura. 1997/2000. Transderivational identity. PhD diss., UMass. Amherst. http://scholarworks.umass.edu/dissertations/AAI9809307. [Published by Garland in 2000 as Phonological relations between words].

Hayes, Bruce & Zsuzsa Cziráky Londe (2006). "Stochastic phonological knowledge: The case of Hungarian vowel harmony". *Phonology* 23.59–104.

37. Because the back vowelled allomorph *-val* occurs only after the allomorph *-jaː-* (which is the back version of the suffix *-jeː-*), e.g. *lap-jaː-val.*

Kálmán, László, Péter Rebrus, Péter Szigetvári & Miklós Törkenczy. 2011. Harmony that cannot be represented. 10th International Conference on the Structure of Hungarian (ICSH10), Lund, Sweden, 25–28 August 2011. (http://www.nytud.hu/icsh10/index.html).

Kenstowicz, Michael. 2005. "Paradigmatic uniformity and contrast". *Paradigms in phonological theory* ed. by Laura J. Downing, Tracy A. Hall & Renate Raffelsiefen, 145–169. Oxford: Oxford University Press.

Kiparsky, Paul & Karl Pajusalu. 2003. "Towards a Typology of Disharmony". *The Linguistic Review* 20.217–241

Kontra, Miklós & Catherine Ringen, 1986. "Hungarian vowel harmony: The evidence from loanwords". *Ural-Altaic Yearbook* 58.1–14.

McCarthy, JohnAlan Prince. 1995. "Faithfulness and Reduplicative Identity". *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory* ed. by Jill Beckman, Suzanne Urbanczyk & Laura Walsh Dickey, 249–384. Amherst, GLSA.

Prince, Alan & Paul Smolensky. 1993/2004. Optimality theory: Constraint interaction in generative grammar. Manuscript. Rutgers University, New Brunswick, and University of Colorado, Boulder (Published by Oxford: Blackwell, 2004).

Raffelsiefen, Renate. 2004. "Absolute ill-formedness and other morphophonological effects". *Phonology* 21.91–142.

Rebrus, Péter & Miklós Törkenczy (2005). "Uniformity and contrast in the Hungarian verbal paradigm". *Paradigms in phonological theory* ed. by Laura J. Downing, Tracy A. Hall & Renate Raffelsiefen, 263–295. Oxford: Oxford University Press.

Rebrus, Péter, Péter Siptár, Péter Szigetvári & Miklós Törkenczy. 1996. Hungarian morphology does not meet GP. 8th International Phonology Meeting, Vienna, 1–3 November 1996. http://www.univie.ac.at/linguistics/gp/hung1101.gif.

Ringen, Catherine & Miklós Kontra. 1989. "Hungarian neutral vowels". *Lingua* 78.181–191.

Siptár, Péter & Miklós Törkenczy. 2000. *The phonology of Hungarian*. Oxford: Oxford University Press.

Steriade, Donca. 2000. "Paradigm uniformity and the phonetics-phonology boundary". *Papers in Laboratory Phonology* 5 ed. by Michael Broe & Janet Pierrehumbert, 313–334. Cambridge: Cambridge University Press.

Törkenczy, Miklós. 2011. "Hungarian Vowel Harmony". *The Blackwell companion to phonology* 5 ed. by Marc van Oostendorp, Colin J. Ewen, Elizabeth Hume & Keren Rice, 2963–2990. Malden, MA & Oxford: Wiley-Blackwell.

Vago, Robert M. 1980. *The sound pattern of Hungarian*. Washington: Georgetown.

van de Weijer, Jeroen. 1989. "The Formation of Diminutive Names in Hungarian". *Acta Linguistica Hungarica* 39.353–371.