Vowel harmony in Turkish and Hungarian*

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1 Introduction

In this paper I apply the approach to vowel harmony developed in van der Hulst (2011b, to appear, ms a.) to Turkish and Hungarian. In section 2 I briefly introduce the model, while sections 3 and 4 deal with Turkish and Hungarian, respectively. In section 5 I offer some conclusions.

2 The RcvP Model

2.1 Gestures, Elements and Headedness

In RcvP[1] each vowel segment has a tripartite structure consisting of the Laryngeal, Manner and Place gesture, as in (1). Within each gesture, we find precisely two elements.

* This paper reflects the result of work in progress in which I explore the application of a model for vowel harmony that is in development to two languages, Turkish and Hungarian. I regard the analyses presented here as first explorations of some of the complexities that these languages offer. I gladly contribute this paper to this collection which honors my colleague and friend Glyne Piggott. I am very lucky for having had the opportunity to directly work with Glyne and profit from his sharp and encouraging style of thinking. I look forward to many more of his insightful contributions to the field of phonology and beyond.

[1] RcvP stands for 'Radical CV Phonology', a dependency-based approach that is developed in van der Hulst (1995, 2005, 2011b; mss. a, b, c). This section presents a simplified version of the model and is almost identical to section 3 in van der Hulst (2011b), where the model is applied to vowel harmony in Yoruba. I need to include this brief introductory section here in order to give the reader the necessary background for assessing the analyses offered in this paper.

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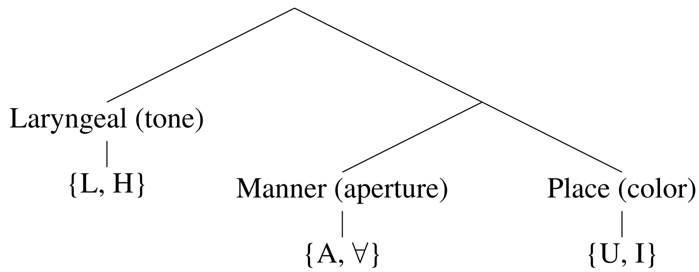
(1)



The six elements in (1) can in fact be replaced by just two, viz. |C| and |V|, as in (2) (hence the name Radical cv Phonology).

(2)

	Element names	RcvP coding
Manner	A ∀	V C
Place	U I	V C
Laryngeal	L H	V C

This reduction is possible because each gesture contains exactly two elements. This allows us to say that the element labels |A|, |U| and |L|, because they occur under different gestures, are paradigmatically speaking in complementary distribution, and so can be reduced to one and the same element, viz. |V|. The same holds for |∀|, |I| and |H|, which can be reduced to |C|. Complementary distribution is a familiar criterion used to reduce allophones to phonemes (where allophones are in complementary distribution in a syntagmatic sense). However, the same criterion can be applied to elements, provided that the elements that we reduce to |C| or |V| have something in common. In RcvP, the claim is that in each gesture, |A|, |U| and |L| represent vowel- or rhyme-oriented choices, and so reduce to |V|, while |∀|, |I| and |H| represent consonant- or onset-oriented choices, and so reduce to |C|. However, for practical purposes, I will normally use the element labels |A, U, L,∀, I, H| so as to avoid cumbersome expressions such as '|Place: V|'(instead of '|A|').

Gestures may contain a single element or a combination of elements. In the latter case, the elements enter into a head-dependency relation, such that one element is the head and the other the dependent. Headedness will be graphically indicated by underlining.

Following Kaye, Lowenstamm and Vergnaud (1985), I assume that an element in dependent position corresponds to a single phonetic attribute while an element in head position (without an accompanying dependent) denotes a complete segment – an idea that is also implicit in Dependency Phonology (Anderson and Ewen 1987). For example, in isolation the head element |U| denotes back rounded /u/, while dependent |U| denotes labiality (i.e., rounding), as in /y/[2]. If the element |U| occurs with a dependent |I|, the result is a 'fronted /u/', i.e. a kind of 'central'rounded vowel. I will return to the interpretation of such structures shortly.

[2] For ease of exposition I refer to phonemic entities (hence the use of slant lines), although it is important to bear in mind that IPA symbols represent approximate phonetic values. A notation such as /u/ is shorthand for the corresponding elemental structure, which represents a cognitive phonological entity that plays a contrastive role in a particular language.

The idea of having different (but related) phonetic interpretations for elements is referred to as the ‘dual interpretation’of elements (cf. van der Hulst 1988a). Consider for example (3):

(3) *The dual interpretation of A and* ∀[3]

	Head	Dependent
A	/a/	‘low (or retracted)’
∀	/i/	‘high (or rather ATR; cf. below)’

Combinations of |A| and |∀| denote intermediate aperture degrees and correspond to intermediate central vowels, as in (4):

(4)

A	$\underline{\text{A}}$∀	$\underline{\forall}$ A	∀	
/a/	/ɜ/	/ə/	/ɨ/	(central)
/ʌ/	/ɤ/	/ɯ/		(back unrounded)

In the case of a three-way distinction in aperture, there is a choice of IPA symbols provided we make the (not uncommon) assumption that languages never employ a phonological contrast between central and back unrounded vowels.

All vowels considered so far are ‘manner-only’or ‘colorless’vowels. Let us therefore now consider the ‘color’elements, viz. |U| and |I|. These have the dual interpretations in (5):

(5) *Interpretation of U and I*

	Head	Dependent
U	/u/	‘round’
I	/i/	‘front’

Adopting (for convenience) the ‘autosegmental line-notation’that was proposed in Kaye, Lowenstamm and Vergnaud (1985), in which headedness is indicated by underlining, yields the following representations for the four front unrounded vowels:

(6)

/æ/	/ɛ/	/e/	/i/
	∀	$\underline{\forall}$	∀
A	$\underline{\text{A}}$	A	
I	I	I	I[4]

The next question that must be addressed concerns the interpretation of combinations of |U| and |I|. Consider (7), where |U| and |I| are combined with the aperture element |∀|:

(7)

/u/	/ʉ/	/y/	/i/
∀	∀	∀	∀
$\underline{\text{U}}$	$\underline{\text{U}}$	$\underline{\text{U}}$	
	I	$\underline{\text{I}}$	$\underline{\text{I}}$

[3] Here I use articulatory labels for the phonetic interpretation of elements. Elements are also associated with an acoustic interpretation.

Both Anderson and Ewen (1987) and Kaye, Lowenstamm and Vergnaud (1985) stipulate that there is no difference between |UI| and |UI|, which both yield a rounded front vowel. However, I assume that these combinations in fact denote two distinct vowels, which are sometimes referred to as 'out-rounded' /y/, i.e. a rounded front vowel, and 'in-rounded'/ʉ/, a fronted back-round vowel. These vowels are sometimes contrastive, for example in Swedish.

Cross-classifying aperture and color, and allowing for both colorless and mannerless vowels, yields 25 different monophthong vowels, given in (8):

(8)

	I	**I̲U**	**Colorless**	**U̲I**	**U**
∀	i	y	ɨ ∼ ɯ	ʉ	u
Mannerless	ɪ	ʏ	ə (∼ schwa)		ʊ
∀̲ **A**	e	ø	ɘ ∼ ɤ ∼ ɐ	ɵ	o
A̲ ∀	ɛ	œ	ɜ ∼ ʌ	ɞ	ɔ
A	æ	ɶ	a ∼ ɑ		ɒ

Each language selects a subset of these vowels by imposing combinatorial constraints, which will be exemplified below for the Yoruba system.

2.2 THE VOWEL HARMONY RELATION

In a unary system, it is impossible to say that vowel harmony is the result of 'needy', i.e. underspecified, vowels (cf. Nevins 2010), since there is no underspecification to express this 'neediness'. Nevertheless, the idea of 'neediness' is similar in spirit to the Government Phonology approach, where 'emptiness', or more specifically empty nuclei, require licensing (cf. Kaye, Lowenstamm and Vergnaud 1990). In van der Hulst (2011b), I suggest that a vowel that undergoes vowel harmony possesses the harmonizing element as a *variable element*, i.e. an element which can be present only if it is licensed by an adjacent non-variable, i.e. licensed, occurrence of that same element. Thus, alternating vowels contain the harmonic element as a 'variable'; variable elements will be represented between parentheses[5]. Segmental structures that contain a variable element will be called morphophonemes. For example in Finnish, all vowels that are front (in stems) or can be front (in suffixes) are represented as *morphophonemes*:

(9)	/u/ ∼ /y/	{U (I̲) }
	/o/ ∼ /ø/	{AU (I̲)}
	/a/ ∼ /æ/	{A (I̲) }

Variable elements represent the neutralization of the contrast between presence and absence of an element. In a binary feature system, absence of contrast would be expressed by saying that the harmonic feature is not specified, but in the current model it is expressed in terms of a variable element '(X)'which means 'X or nothing'. It must be borne in mind that the so-called zero that is used in underspecification also refers to a disjunction namely '+ or –'.

[5] I will refine this notion in our discussion of ATR-harmony in Yoruba.

While a complete theory of licensing remains to be developed (see van der Hulst ms.b), van der Hulst (2011b) proposes two types of licensing[6]:

(10) a. *Positional licensing*
An element X is licensed in position P (where P is the first/last syllable in domain D, where D is a Word or Stem/Root)
b. *Lateral licensing*
A variable element (X) is licensed by an adjacent occurrence of X

The crucial aspect of positional licensing is that position P licenses the presence of element E which implies that in this position we can find a contrast between the presence of E and its absence. In all other positions, no contrast is allowed which means that in those positions we always find (E).

If positional licensing rules alone, we find that a potential contrast is neutralized in the non-privileged position. If lateral licensing is active, we get the effect that the non-privileged positions agree with the privileged position for the element E. In other words, the fact of vowel harmony is expressed in terms of lateral licensing.

It might be asked why I use the notion of variable element and lateral licensing. The motivation for using the variable notation, rather than saying that vowels in non-privileged positions simply lack the element E, comes from disharmonic roots and non-alternating affix vowels. With the variable notation we can distinguish vowels that alternate from vowels that do not alternate either by always having E or never having E. Thus we can make a three-way distinction:

(11) a. (E) b. E c.
X X X

a = alternating vowel element must be licensed to get interpreted
b = invariant E
c = invariant non-E

A disharmonic root with (for example) a front vowel preceding a back vowel (e.g., ü - o) would have the positionally licensed I-element associated to the front vowel and there would be no variable element on the back vowel. This can be illustrated with the Hungarian disharmonic root *büro* ‘desk’(Hungarian has palatal harmony, i.e. harmony for the element |I|):

[6] In van der Hulst (2011b) positional licensing refers to ‘a variable element (X)’. Here I simplify that to ‘an element X’. Also, here I assume that the directionality of lateral licensing does not need to be stated. Any variable element is licensed by either a preceding or following licensed instance of the same element; see van der Hulst (ms. b) for further discussion of this point.

(12) a.

			A
	I		
	U		U
b	ü	r	o

b.

	A				
				I	
	U			U	
k	o	sz	t	ü	m

The second example illustrates an invariable occurrence of the element |I| in non-initial position. We could say that in this case the element |I| is 'lexically licensed', which essentially means that its occurrence is irregular, just like büro is irregular in lacking the variable (I) in non-initial position.

Affixes can also have disharmonic vowels. A suffix that is invariably back would have option (11c), whereas a suffix that is invariably front would have option (11b). Regular alternating suffixes would have option (11a). If we were to adopt a spreading (or copy) model, using unary elements, we cannot distinguish between (a) and (c).

Now, whereas vowels in harmonic affixes de facto alternate (which is adequately expressed by supplying its vowels with the variable element, i.e. the neutralization option), vowels in stems do not (in so-called stem or root-controlled systems). It might be said that we could therefore assume that all vowels are marked with this element as invariable. However, there is interesting evidence (provided in Harrison and Kaun 2001) that non-initial vowels in, for example, Turkish and Finnish are not invariably specified with the harmonic value. This evidence is based on certain language games. I refer to van der Hulst (ms. b) for discussion.

Another question that arises is whether vowels that contain the harmonic element predictably (such as /i/ and /e/ in Finnish which always contain the element |I|, or /i/ and /u/ in Yoruba which contain the ATR-element predictably) must have this element lexically (invariably in the privileged position and variably in other positions) or rather acquire it by a redundancy rule. In line with my discussion in van der Hulst (2011b), but contrary to van der Hulst (to appear) where I consider the alternative of full specification, I will suggest here that predictable elements remain unspecified except when their presence is licensed. This licensing happens in two circumstances. Firstly, as shown in (13b), the neutral vowel /i/ in Hungarian will be followed by a front suffix when preceded by a front vowel that is when its 'latent'element |I| is laterally licensed, but not when preceded by a back vowel (see 13a):

(13) a.

			∀				∀		
	A								
							(I)		
p	a	p	i:	r	–	b	o:	l	‘of paper’

b.

∀		∀				∀		
A								
I	>	$\boxed{\text{I}}$		>		(I)		
ü	v	e	g	–	b	ö	l	‘of glass’

Secondly, when a root only contains neutral vowels, the neutral vowel in the first syllable will be positionally licensed and thus be present[7]:

(14) *“front /i/”*

	∀					
					A	
	I		>		(I)	
v	i:	z	–	n	e	k

Thus, neutral vowels act as licensors when preceded by a front vowel or when they are the only vowel(s) in the stem. This raises the question how this element is interpreted if it is not laterally or positionally licensed, for example in the (second syllable in the) form /papi:r/. At the phonemic level every Hungarian vowel that has the element |∀| must have either |I| or |U|. I will argue in section 4 that predictable elements are added in order to satisfy the constraints that hold for the phonemic level, the output of the lexical phonology, i.e. at the phonemic level where all segmental structure must be wellformed, i.e. in accordance with the constraints. This implies that lexical representations can deviate from phonemic structures, but only, as I will argue, in terms of forming *substructures* of phonemic structures.

3 TURKISH

In this section I will first offer an analysis of vowel harmony and disharmony in Turkic languages. I start the discussion with a detailed analysis of standard Turkish. The most recent extensive treatment is offered in Clements and Sezer (1982) and Kabak (2011), from which this section takes much of its examples. The formal description that I offer, however, assumes a rather different conception regarding the nature of phonological primes than these authors do.

[7] Hungarian has about 60 stems which are exceptional in taking a back vowel in the suffix; see section 5 for an analysis of Hungarian.

3.1 THE BASIC FACTS

It is not difficult to formulate the general vowel harmony requirements that hold for Turkish. The statement appears again and again in elementary textbooks and numerous studies. Turkish has 8 contrastive vowels:

(15)

	[front]		[back]	
	[non-round]	[round]	[non-round]	[round]
[high]	i	y	ɨ	u
[low]	e	ø	a	o

Any of the eight Turkish short vowels may appear in the first syllable of a word. Any following vowel must agree with the preceding vowel in frontness. As a result, *all vowels* in a regular stem agree in frontness. This is traditionally called *palatal harmony*. For example:

(16) *Examples of palatal harmony*

hyviyet	'identity'	kɨmɨltɨ	'movement'
kysyly	'annoyed'	oyuncak	'plaything'
netice	'result'	sogukça	'ice cold'

In addition, a non-initial high vowel agrees with the preceding high or non-high vowel in roundness. This is apparent in the form *oyuncak* 'plaything': the high /u/ is rounded just like the initial /o/, but the /a/ is not rounded as it is low. This process is called *labial harmony*.

Because the roundness of initial vowels does not extend to low vowels in subsequent syllables, the vowels /o/ and /ø/ may not occur *as a result of vowel harmony* in any syllable except the first. I shall refer to this constraint on as the Ònon-initial /o-ö/ prohibitionÓ. Below I will discuss the nature of this constraint. I summarize the three harmony requirements of Turkish in (17):

(17) *Generalizations*

a. All vowels in a regular stem agree in frontness
b. Any high vowel agrees with the immediately preceding vowel in roundness
c. The vowels /o/ and /ø/ can only occur in stem-initial syllables.

Following Haiman (1972), I would like to discuss an explanation as to why constraint (17c) should be part of the grammar of Turkish. Suppose for a moment that Turkish only had palatal harmony, i.e. (17a). In that case, in non-initial syllables a four-way contrast would exist[8]:

(18) a.

	[-back]		[+back]	
	[-round]	[+round]	[-round]	[+round]
[+high]	i	y	ɨ	u
[-high]	e	ø	a	o

[8] When I use traditional binary features I do this to refer to 'phonetic properties'. These features have no status in Element Theory.

b. *non-initial syllables (palatal harmony, phase I)*

	[-round]	[+round]
[+high]	I (i/ɨ)	U (y/u)
[-high]	A (e/a)	U, A (ø/o)

c. *non-initial syllables (palatal harmony, phase II)*

	[-round]	[+round]
[+high]	I (i/ɨ)	U (y/u)
[-high]	A (e/a)	

Constraint: |U, A| is blocked from non-initial syllables

d. *non-initial syllables (after adding labial harmony)*

	[-round]	[+round]
[+high]	I (i/ɨ)	
[-high]	A (e/a)	

Constraint: |U, A| is blocked from non-initial syllables

In (18b), the capital letters represent elements. If we now add constraint (17c) to the grammar, this set is reduced to that of I, U and A, which can be identified as the typical minimal, unmarked vowel system. As Haiman (1972) shows, in languages like Russian and Greek we see that in unstressed syllables only the vowels /a/, /i/ and /u/ occur, whereas in stressed syllables a richer set occurs. By eliminating |U,A| from non-initial syllables, Turkish achieves an unmarked three-way distinction in non-initial syllables, as shown in (18c).

It would seem then that Russian, Greek and Turkish are united in limiting the position in which vowels are maximally contrastive to one: the stressed position in Russian and Greek, the initial position in Turkish, both 'privileged'positions. Palatal harmony causes there to be two variants for the three unmarked vowels, as shown in (18c).

Now, once rounding harmony is present in the grammar, the contrast in non-initial syllables is reduced to A and I (18d), but due to the constraint introduced earlier in (18c), rounding harmony cannot cause low round vowels. With labial harmony present, the motivation for (17c) is no longer transparent, but apparently this did not immediately cause this constraint to disappear. As a result, from the view point of Turkish-cum-labial harmony, the constraint is an arbitrary statement. I infer from this that the constraint must have been added to the grammar *before* labial harmony because the presence of (17c) can be understood if this condition became part of the Turkish grammar before rounding harmony.

Thus we see that a *restriction* on labial harmony finds motivation in the original palatal system when labial harmony was not yet around. As a result we do not find non-initial /o/ and /P/ (in roots or suffixes) even where these vowel 'could'result from labial harmony.

There are other possible explanations for the fact that low vowels refuse to harmonize in rounding, such as the idea that rounding is more marked for low vowels than for high vowels (see Kaun 2004) but I find Haiman's account very insightful.

Unrestricted or *fully symmetrical* harmony systems can be described in a number of ways, and it would be difficult to choose between different descriptions if one is not otherwise predisposed toward a particular framework. It is often the case that restrictions on or exceptions to a particular harmonic pattern, causing various patterns of asymmetry, shed more light on its nature than the regular instances. In the next section, I will show how it is possible to integrate the disharmonic stems into an analysis of synchronic harmony[9].To achieve this goal, I first review which stem vowel combinations are regular, which are disharmonic but do occur, and which are disharmonic and categorically ruled out, i.e. are not attested. Then, I will offer an account within the present framework. As it will turn out, the statement as to which vowels can occur in disharmonic roots and which cannot, can be reduced to a rather simple formula. I will take this as evidence that our account deals with vowel harmony in a promising way.

3.2 ROOT DISHARMONY

All descriptions of palatal and labial harmony in Turkish acknowledge that there is a host of exceptions to both processes, as well as to the non-initial /o-ø/ prohibition. I shall illustrate these below. As Clements and Sezer (1982) (henceforth: CS) point out in great detail, within stems many exceptional patterns to vowel harmony arise. In particular, vowels from the set /i e a o u/ may combine quite freely. However, patterns which include the vowels /y øɨ/ are much more limited. CS argue that they are absent except for the occurrence of a number of stems combining /i/ and /y/ (in violation of labial harmony). Kabak (2011) disagrees with CS and points to disharmonic roots that involve /y øɨ/. Having noted his observations, I still assume that the relative rarity of such vowels in disharmonic roots has a systematic basis. CS do not offer an explanation for the rarity of these vowels in disharmonic roots, but decide on the basis of the exceptions that harmony is no longer active in roots. I shall argue against this view and suggest that the disjunction in the vowel set can be understood if I assume that vowel harmony is governed by unary elements that either regularly 'extend'over the word domain, or, irregularly, are linked to specific vowel positions.

First, I summarize the co-occurrence patterns of vowels. In the table below, an empty box indicates that the pattern /...V1...V2.../ is regular (and attested). A mark in a box indicates that the pattern is disharmonic with respect to either palatal (P) and/or labial (L) harmony. The symbol C is given when the pattern would violate the constraint against non-initial low round vowels. However, as was pointed out above, disharmonic roots involving the vowels /i e a o u/ may still occur. Irregular pattern that thus occur are marked with bold. The row of vowels stands for the first syllable, while the column represents non-initial syllables.

[9] See van der Hulst and van de Weijer (1997) on which this discussion is based.

(19)

$\sigma 1 \backslash \sigma 2$	i	y	ɨ	u	e	ø	a	o
i		**L**	P	**P L**		C	P	**P C**
ɨ	**L**		P L	P		C	P	P C
ɨ	P	P L		L	P	P C		C
u	**P L**	P	L		**P**	P C		**C**
e		L	P	**P L**		C	P	**P C**
ø	L		P L	P		C	P	P C
a	P	P L		**L**	**P**	P C		**C**
o	**P L**	P	L		**P**	P C		**C**

L = disharmonic due to labial harmony
P = disharmonic due to palatal harmony
C = illegal due to the "non-initial /o-ö/ prohibition"
Bold = attested as an exception

On the basis of the exceptions, CS conclude that within stems neither palatal nor labial harmony holds in Turkish. I fail to see that we should draw that conclusion. Synchronic harmony on suffix vowels is independently needed. The stems which conform to the harmonic pattern can therefore simply get a 'free ride'on the harmony rules. This simplifies their underlying representation considerably[10].

3.2.1 FORMAL PRELIMINARIES

Under the approach presented in section 2 the vowel inventory of Turkish is represented as follows:

(20)

/i/	/e/	/y/	/ø/	/ɨ/	/a/	/u/	/o/
∀		∀		∀		∀	
	A		A		A		A
I	I	(I̲)	(I̲)			U	U
		U	U				

The vowel /ɨ/ is analyzed as merely |∀|, although below I will suggest that this vowel seems to behave as a |IU̲| combination (i.e. /ɯ/) in stems (see the table in 8).

A simple situation of harmony can be represented as follows:

(21)

∀ - A	A - ∀	A - A	∀ - ∀
I > (I̲)	I > (I̲)	I > (I̲)	I > (I̲)
U > (U)	U > (U)	U > (U)	U > (U)

The elements |I| and |U| are licensed in the first syllable and variable elsewhere. Recall that a variable element is licensed if preceded by a licensed instance of that element.

[10]Within stems epenthetic vowels also harmonize although this may have to be analyzed as an independent harmony system (see Kabak 2011).

3.2.2 HARMONY AND DISHARMONY

If we take bisyllabic stems as representative, we need to consider four combinations:

(22) ∀ - A   A - ∀   A - A   ∀ - ∀

We can cross-classify these stem types with the four possible combinations of harmonic elements:

(23)
a. No harmonic element
b. I harmonic element only
c. U harmonic element only
d. I and U harmonic elements

I shall discuss the combinations of intrinsic properties and harmonic properties in turn.

No harmonic element

If no harmonic element is present the regular patterns surface as follows:

(24)	∀ - A	A - ∀	A - A	∀ - ∀
	/ɨ a/	/a ɨ/	/a a/	/ɨ ɨ/
	gɨrtlak ‘throat’	altɨ ‘six’	kara ‘black’	kɨsɨm ‘part’
	hɨtta ‘province’	yalɨ ‘villa’	tavşan ‘rabbit’	sɨnɨr ‘border’
	kɨyak ‘excellent’	kadɨ ‘judge’	hasta ‘sick’	sɨgɨr ‘sick’

I harmonic element only

We now move to the stems which contain one harmonic element. First, let us consider regular cases with the I-harmonic element. This harmonic element associates to all vowels in the stem:

(25)	∀ - A	A - ∀	A - A	∀ - ∀
	I > (I)	I > (I)	I > (I)	I > (I)
	/i e/	/e i/	/e e/	/i i/
	ince ‘thin’	degis ‘change’	kere ‘time’	kişi ‘person’
	igne ‘needle’	yedi ‘seven’	gebe ‘pregnant’	gibi ‘like’
	diçer ‘other’	aski ‘cold’	tepe ‘hill’	inci ‘pearl’

Stems with the I-harmonic element can be disharmonic in two ways. A non-initial syllable either misses the variable element (26) or it has the element ‘lexically licensed’(27):

(26)	∀ - A	A - ∀	A - A	∀ - ∀
	I	I	I	I
	/i a/	*/e ɨ/	/e a/	*/i ɨ/
	siyah ‘black’	—	elma ‘apple’	—
	inan ‘believe’		beyan ‘declaration’	
	idrak ‘perception’		mezat ‘auction’	

(27)	∀ - A	A - ∀	A - A	∀ - ∀
	I	I	I	I
	*/i e/	/a i/	/a e/	*/ɨ i/
	—	tatil ‘vacation’	haber ‘news’	—
		dani ‘also’	kardes ‘brother’	
		hangi ‘which’	anne ‘mother’	

We see that all patterns are possible exceptions, except those which would produce a bare |∀| in a root that contains the element |I|. It would seem that bare |∀| acts as a ‘black hole’that must attract the element |I|, if present.

U harmonic element only

Let us turn to stems containing the U-harmonic element:

(28)	∀ - A	A - ∀	A - A	∀ - ∀
	U > (*U)	U > (U)	U > (*U)	U > (U)
	/u a/	/o u/	/o a/	/u u/
	tuhaf ‘strange’	soguk ‘cold’	boga ‘bull’	kuru ‘dry’
	bugday ‘wheat’	yorgun ‘tired’	oda ‘room’	ugur ‘fortune’
	muhak ‘new moon’	oku ‘read’	dogar ‘is born’	nutuk ‘speech’

Non-initial |U| cannot be licensed by a preceding licensed |U| due to constraint (17c). Thus, in the two cases in the box, even though the U-element is licensed it is nonetheless prevented by a sequential constraint. However, it must be noted that the pattern /o-o/ *does* occur, which would require a lexical association of U to both V-positions. /u-o/ is not reported in CS:

(29)	A - A	
	U U	
	/o o/	
	horoz	‘rooster’
	moloz	‘debris’
	lodos	‘southwest wind’

In addition, exceptional patterns can arise due to lexical association of |U| to either of the two V-positions:

(30)	∀ - A	A - ∀	A - A	∀ - ∀
	U	U	U	U
	/u a/	*/o ɨ/	/o a/	*/u ɨ/

Examples of lexically associated |U| in the first syllable with |A| in the next syllable produce the same result as regular cases because |U| does not associate to |A| due to (17c).

(31)	∀ - A	A - ∀	A - A	∀ - ∀
	U	U	U	U
	/ɨ a/	/a u/	?/a o/	*/ɨ u/
	—	marzul ‘lettuce’	(see 17c)	—
		arzu ‘desire’		
		yakut ‘emerald’		

As in the case of the |I| element, we note that disharmonic patterns which would result in a bare ∀ position are ill-formed. This, however, does not account for the absence of /a – o/, which again is due to (17c). Since irregular non-initial /o/ occurs with other vowels preceding it (i.e. /e o/), one would expect that exceptions involving /a o/ should not be ‘too bad’.

We conclude the following: that in the presence of |I| and/or |U|, bare ∀ is not permitted in a root.

<u>I and U harmonic elements</u>

With respect to the combined presence of both harmonic elements, we also start with the regular pattern:

(32)	∀ - A	A - ∀	A - A	∀ - ∀
	I > (I)	I > (I)	I > (I)	I > (I)
	U > (*U)	U > (U)	U > (*U)	U > (U)
	/y e/	/ø y/	/ø e/	/y y/
	dymen ‘wheel’	søgyt ‘willow’	øyle ‘thus’	ytyn ‘iron’
	dygme ‘button’	gönyl ‘heart’	gönder ‘send’	yzyim ‘grape’
	myspet ‘proven’	døvys ‘fight’	køpek ‘dog’	‡ynky ‘because’

Analogous to the above, we can imagine a number of patterns with lexical associations. For example, |I| can be missing in non-initial position or |U| can be invariable in non-initial position (as in 33), or the other way around (as in 34):

(33)	∀ - A	A - ∀	A - A	∀ - ∀
	I	I	I	I
	U	U	U	U
	/i o/	/e u/	/e o/	/i u/
	pilot ‘pilot’	mevzu ‘topic’	petrol ‘petrol’	billur ‘crystal’(rare)
	cinko ‘zinc’	memur ‘official’	peron ‘platform’	
	sifon ‘toilet flush’	mebus ‘MP’	metot ‘method’	

(34)	∀ - A	A - ∀	A - A	∀ - ∀
	I	I	I	I
	U	U	U	U
	/u e/	/o i/	/o e/	/u i/
	lutfen ‘please’	bobin ‘spool’	otel ‘hotel’	muzip ‘mischievous’
	suret ‘manner’	polis ‘police’	rozet ‘collar pin’	kulis ‘stage wing’
	kudret ‘power’	torik ‘blue fish’	model ‘model’	muhit ‘neighbour-hood’

All these patterns are reported by CS as possible exceptions.

All other disharmonic patterns will involve either the presence of both harmonic elements on one of the V-positions, or the presence of one harmonic element on a single V-position with the other on both; twenty of such patterns are logically possible and of these only two cases occur that we have not seen before:

(35)	∀ -	A	A -	∀	A -	A	∀ -	∀
	I		I		I		I	
	U > (*U)		U > (U)		U > (*U)		U > (U)	
	*/y	a/	*/ø	u/	*/ø	a/	*/y	u/

(36)	∀ -	A	A -	∀	A -	A	∀ -	∀
		I		I		I		I
	U > (*U)		U > (U)		U > (*U)		U > (U)	
	/u	e/	*/o	y/	/o	e/	*/u	y/
	(see 21)				(see 21)			

(37)	∀ -	A	A -	∀	A -	A	∀ -	∀
	I		I		I		I	
	U		U		U		U	
	*/y	a/	*/ö	ɨ/	*/ø	a/	*/y	ɨ/

(38)	∀ -	A	A -	∀	A -	A	∀ -	∀
		I		I		I		I
		U		U		U		U
	*/ɨ	ö/	*/a	y/	*/a	ø/	*/ɨ	y/

(39)	∀ -	A	A -	∀	A -	A	∀ -	∀
	I >	(I)	I >	(I)	I >	(I)	I >	(I)
	U		U		U		U	
	?*/y	e/	*/ø	i/	*/ø	e/	/y	i/
	—		—		—		ymit ‘hope’	
	(see below)						mymbit ‘fertile’	
							ymmi ‘illiterate’	

(40)	∀ -	A	A -	∀	A -	A	∀ -	∀
	I >	(I)	I >	(I)	I >	(I)	I >	(I)
		U		U	U			U
	*/i	ø/	?*/e	y/	*/e	ø/	/i	y/
	—		—		—		tifys ‘typhus’	
			(see below)				virys ‘virus’	
							bitym ‘bitumen’	

It would seem desirable to find one generalization that rules out the marked vowels from disharmonic patterns (except the combination of /y/ and /i/). Somehow, we need to appeal to the fact that the five vowels /i u e o a/ represents the most common 5-vowel system. The simplest solution would be to show that /ɨ øy/ have something in common which is excluded to be 'concentrated'in a single position.

Goldsmith (1990, 304ff.) also argues for an analysis in which the fact that the vowels /i e a o u/ combine freely is not an arbitrary stipulation. He points out that this is a favored five-vowel system. His analysis of the five vowels does not make use of the feature [±front] (or [±back]). Hence, stems containing these vowels do not violate a rule governing palatal harmony, i.e. agreement for the feature [front]. Whenever stems contain /y ø ɨ/, specification of this feature is required (i.e. [+front] for /y ø/, and [-front] for /ɨ/). Thus only 'disharmonic'roots (in the traditional sense) containing any of the three vowels are truly disharmonic in Goldsmith's feature system. This is a clever solution, cast in a binary-feature approach.

Given the representation of Turkish vowels in (20), the reasons for not allowing /ɨ/ and /øy/ must be different. We could say that the vowel that has just |∀| functions as an 'attractor': if a harmonic element is present, it cannot remain colorless. On the other hand for the vowels /ø y/ both harmonic elements are present and in this case, apparently, it is not possible to 'restrain' the harmonic elements, i.e. vowels with two harmonic elements functions are 'projectors'.

This suggests that combinations of /e/ and /y/ should also be acceptable, since here at least the |I| harmonic element is not restrained to a single position. Indeed, Polgárdi (1998) observes that disharmonic patterns involving /e/ and /y/ are quite common (like /i/ and /y/) and states a generalization, which I here formulate as follows:

(41) |I| and |U| can only be associated to a single position if the combination is harmonic for |I|

However, this seems to allow all combination in (39) and (40), so we would have to add: if both positions share |∀|:

(42) |I| and |U| can only be associated to a single position if the combination is harmonic for |I| and |∀|

But note that this then excludes combinations of /e/ and /y/ which Polgárdi (1989) claims are not so bad. Aside from this problem, the absence of /ɨ/ in disharmonic domains needs a separate statement:

(43) In the presence of I and/or U, bare ∀ is not permitted

However, there may be a way to achieve Goldsmith's generalization if we represent the vowel /ɨ/ differently, namely as a combination of |I| and |U| (which would be /ɯ/ according to the table in 8):

(44)

/i/	/e/	/y/	/ø/	/ɨ/	/a/	/ɯ/	/o/
∀		∀		∀		∀	
	A		A		A		A
I	I	$\underline{\text{I}}$	$\underline{\text{I}}$	I		U	U
		U	U	$\underline{\text{U}}$			

This would not extend to suffixes, however, where the representation with variable |I| and |U| is required; see below.

With the representation |∀ I <u>U</u>| for the vowel /ɨ/, the basic statement concerning disharmonic roots is that the combination |I U| cannot be restricted to a single position:

(45) IU combinations are not allowed if one or both are not harmonic, unless both I and ∀ are harmonic

Note that this also excludes combinations of /e/ and /y/ as permissible under the unless-clause.

Note that this statement suggests an asymmetry among the two color elements since the harmonic |IU| combination is not allowed if both |U| and |∀| are harmonic. We will later see whether this can be seen as part of a larger generalization regarding an asymmetry between the elements |I| and |U|.

We have now dealt with disharmonic roots internally. The next question is how roots of this sort behave with respect to suffixes.

3.3 SUFFIXES

3.3.1 THE REGULAR CASES

Most suffixes undergo regular harmony. High suffix vowels undergo both palatal and labial harmony. Consider the following set of representative examples:

(46)

	nom.sg	poss.	abl.	nom.pl.	poss./acc.pl.
‘room’	oda	odasɨ	odadan	odalar	odalarɨ
‘end’	son	sonu	sondan	sonlar	sonlarɨ
‘pipe’	boru	borusu	borudan	borular	borularɨ
‘village’	køy	køyu	køydan	køyler	køylarɨ
‘worm’	kurt	kurdu	kurttan	kurtlar	kurtlarɨ
‘fox’	tilki	tilkisi	tilkiden	tilkiler	tilkileri
‘cow’	inek	inei	inekten	inekler	inekleri
‘river’	dere	deresi	dereden	dereler	dereleri
‘horse’	at	atɨ	attan	atlar	atlarɨ
‘taste’	tat	tadɨ	tattan	tatlar	tatlarɨ
‘girl’	kɨz	kɨzɨ	kɨzdan	kɨzlar	kɨzlarɨ
‘container’	kap	kabi	kaptan	kaplar	kaplarɨ
‘iron’	yty	ytysy	ytyden	ytyler	ytyleri

The fact that low suffix vowels do not undergo labial harmony follows from the constraint on non-initial /o-ø/, which I already assumed for stem-initial harmony. The fact that after low vowels only non-round vowels can appear, shows us that licensing in Turkish (and, I would submit: universally) is local, i.e. involves vowel positions in adjacent syllables. Consider the underlying representation of *pullarɨn* ‘stamp nom.pl.’:

(47)
```
U        (U)       (U)
p∀l  -   lAr   -   ∀n    →   [pul - lar - ɨn]
```

The U harmonic element cannot license the variable element for the low vowel because of the non-initial /o-ö/ prohibition (17c). As a result, the variable element in the second suffix cannot be licensed either.

3.3.2 DERIVED ENVIRONMENT EFFECTS?

In other models that use unary primes and in which harmony is seen as 'spreading' a potential problem arises when it comes to disharmonic roots. If a front vowel occurs in the stem-final syllable it will spread to suffix vowel, whereas it cannot do that if it is associated to the stem- initial vowel:

(48) *mezar-lar 'auction' and hotel-ler 'hotels'*

a. m A z A t] l A r
   I

b. h A t A l] l A r
   I ⟶

To prevent a lexically associated |I| from spreading to the other vowel(s) of the stem, while allowing it to go to the suffix vowel if it occurs in the stem-final syllable van der Hulst and Smith (1986) and Polgárdi (1998) appeal to the notion derived environment. Kiparsky (1973) has shown that phonological rules may be prevented from applying within morphemes if their effect is neutralizing. It is assumed that lexically associated elements are subject to this principle, whereas floating elements are not because associating the latter does not eliminate a potential lexical contrast assuming that a floating element is not distinct from a lexically associated element. Non- association is a form of underspecification and underspecified representations cannot be taken to be distinct from representations that differ only in adding association lines.

In the model developed here, no appeal to a derived environment condition is necessary because the two cases in (48) would have vowels *without* the variable element. This being so, there is no licensing 'action' in the first form:

(49) *mezar-lar 'auction' and hotel-ler 'hotels'*

a. m A z A t] l A r
   I (I)

b. h A t A l] l A r
   I >(I)

This leaves open whether derived environment condition may be motivated for other cases.

3.4 IRREGULAR SUFFIXES

CS discuss a number of exceptional suffixes[11]:

[11]Haiman (1972) also mentions the disharmonic diminutive *–os*. In various publications Kardestuncer argues that the suffixes which fail to undergo harmony do not really qualify as suffixes. For example, in Kardestuncer (1983) the point is made that /-iyor/ is not a suffix but a compound component, i.e. a stem. It also appears that the suffixes that are exceptional to vowel harmony also have exceptional stress. However, this does not explain that suffixes can be partially

(50) a. gel-iyor-um 'I am coming'
koş-uyor-um 'I am running'
gyl-yyor-um 'I am laughing'
bak-ɨyor-um 'I am looking'

b.

yc	'three'	yc-gen-ler	'triangles'
altɨ	'six'	altɨ-gen-ler	'hexagonals'
sekiz	'eight'	seki-gen-ler	'octagonals'
cok	'many'	cok-gen-ler	'polygonals'

c. arab-istan-ɨ 'Arabia'
ermeni-stan-ɨ 'Armenia'
mool-istan-ɨ 'Mongolia'
tyrk-istan-ɨ 'Turkestan'

d. gid-edur-sun 'let him keep coming'
kos-edur-sun 'let him keep running'
gyl-edur-sun 'let him keep laughing'
bak-edur-sun 'let him keep looking'

In two other suffixes, an invariant /a:/ occurs preceding an invariant front vowel:

(51) -a:ne : denominal, adjective-forming
-va:ri : denominal, adverb-forming

We can represent these suffixes as follows[12]:

(52)

/∀yAr /	/gAn/	/∀stAn/	/Ad∀r/	/A:nA/	/vA:r∀/
(U)U	I	I (I)		I	I
(I)	(U)	(U)	(U)U	(U)(U)	(U)(U)

In the third case, (*-istan*), a derived environment condition can not prevent rounding coming from the stem. This is a problem for a spreading model, whereas in the present approach this is explained by the absence of variable (U). There is, in addition, the suffix /*-gil*/, with a front non- alternating vowel, which raises the same issue.

3.5 THE DIRECTIONALITY OF LICENSING

Another problem for the derived environment approach is that the harmonic element of a disharmonic suffix cannot license a variable element in the stem. The fact that licensing cannot go from suffix to root can be demonstrated with the following example:

---

disharmonic such as /-Iyor/ and /-Adur/.

[12]Recall that all non-initial vowels have both color elements as variable unless they are disharmonic in which case they lack it or have it invariably.

(53)

al	tɨ	-gen	-ler
	∀		
A		A	A
	(I)/<	I	>(I)
	(U)		(U)

In this example, the variable (I) in the plural suffix is licensed. Crucially, the (I) on the final vowel of the stem does not get licensed by the I-element of –gen. It could be said that what prevents licensing from a suffix toward the final stem vowel is that the direction of licensing is rightward[13] or that licensing is 'root-controlled'. This latter approach would stipulate that roots cannot harmonize to affixes. Note, though, that 'root' here cannot mean 'simplex root', but rather 'base' since a vowel in affix A cannot harmonize with the vowel of an affix B that is added to a base containing A:

(54) */i/ does not turn into /ɨ/*

[[[root] affix A] affix B]

← X ———

-va:ri -…a…

Hence a better term would be 'base-control'.

That licensing cannot go from suffix to root can be demonstrated with the following example:

(55)

al	tɨ	-gen	-ler
	∀		
A		A	A
	(I)/<	I	>(I)
	(U)		(U)

In this example the variable (I) in the plural suffix is licensed. Crucially, the (I) on the final vowel of the stem does not get licensed by the I-element of *–gen*.

One reason for being suspicious of stipulating directionality is that in Turkish prefixes do not integrate with stem like suffixes do; in that sense, prefixes behave like independent words, just like members of compounds. I suspect that the deeper notion here is that vowel harmony in Turkish (and many other cases) reflects base control which I here formulate as follows:

(56) *Base control*

Only base elements can be licensors

In so-called dominant-recessive harmony systems, base control does not apply. See van der Hulst (ms. a) for further discussion of such systems. In such systems all morphemes contain the harmonic

[13] Anderson (1980) argues that labial harmony in Turkish is *directional*, (i.e. left-to-right) given that the sequence /u a/ is regular, whereas the sequence /a u/ is exceptional (even though such exceptions do exist). This only follows if labial harmony is rightward directional. I would agree that this is the case for *root-internal* harmony and this is reflected in the fact that I take the first syllable to be the privileged syllable.

element as variable except for some (which can be roots or affixes) which thus cause all variable elements to be licensed.

3.6 CONSONANTS AND HARMONY

3.6.1 THE PALATAL LATERAL

Roots ending in the palatal lateral take front suffixes irrespective of the preceding vowel:

(57)	goʎ - y	'goal ACC'	kol - u	'arm ACC'
	usuʎ - sʎz	'without a system	jorul - du - k	'we were tired'

However, if the palatal lateral occurs in the middle of a stem it does not enforce the next vowel to be front (Kabak 2011):

(58)	ysʎub - u	'style-ACC'	
	ma:ʎum - dy	'known PAST	(ma:ʎum-du is also possible)

We must also note that the palatal approximant /j/ does not cause a following suffix to be front. This suggests that the |I| element of the palatal lateral has a different structural status than the |I| element of /j/. I propose the following analysis. Let there be a redundancy rule which stipulates that a root ending in a palatal lateral has a floating |I| element at the end of the root which can act as a licensor:

(59)			]I	>	(I)
	U	(U)			(U)
	u	suʎ			-sʎz

This analysis explains why root internal laterals do not cause front vowels to their right, if we assume that floating elements must occur at an edge.

3.6.2 FRONT SUFFIXES AFTER NON-PALATAL CONSONANTS

CS observe front suffixes after a number of stems ending in velars:

(60)	'explosion'	infiʎak	infiʎa:ki
	'alliance'	ittifak	ittifa:ki
	'fasting'	imsak	imsa:ki
	'real estate'	emʎak	emʎaki

CS also note that some velars sometimes require suffix vowels to be back. They suggest that the examples in (60) end in a velar that is 'palatalized'. This palatalization is deleted when the velar consonants are word-final. But Kabak observes that front suffixes may also show up after other roots that do not end in palatal laterals or velars:

(61)	saat-i	'watch/clock'
	harf-te	'on the letter'

Also, Kabak (2011) suggests that the unexpected backness is specific to suffixes and thus not a regular property of roots:

(62)	tasdik - ɨ	'confirmation POSS 3sg'
	but:	
	tasdik - ler	'confirmation PLl'
	tasdik - siz	'confirmation DER'

It is not clear whether the unexpected behavior of suffixes after roots that do not end in a palatal lateral is really due to a property of the root final consonant or an arbitrary property of the roots involved. (In parallel to the analysis for the palatal lateral,) I suggest that 'fronting roots' are provided with a floating |I| element[14]:

(63)	A	A	[I]	>	(I)	
	saat				i	(instead of saatɨ)

Clearly, the various cases of overapplication of palatal harmony require further research.

3.7 LABIAL ATTRACTION

In the literature on vowel harmony, special status is sometimes assigned to the occurring pattern /a CL u/, in which CL is a labial consonant. The unexpected rounding of the non-initial high vowel is attributed to the preceding labial consonant. However, CS show that the pattern /a - u/ also frequently occurs when the consonant is non-labial, while on the other hand the pattern /a CL ɨ/ can also easily be found:

(64)	a.	marul	'lettuce'
		fatura	'invoice'
		yakut	'emerald'
	b.	sabɨr	'patience'
		kapɨ	'door'
		kamɨs	'reed'

We must also note that the pattern is not productive in suffixation:

(65) kitap - ɨn 'of a/the book' (not: kitap – un)

Kabak (2011) concludes that 'labial attraction'does not form part of the synchronic phonology of Turkish.

[14]The suggestion has been made in Kabak (2011) that the roots in question fail to trigger harmony and that frontness is the default value. That suggestion is difficult to implement in the element approach since the prediction is that if roots fail to induce harmony, we get the suffix vowel without the harmonic element, not with the harmonic element.

3.8 CONCLUSIONS

The case of Turkish is revealing with respect to various important issues. Firstly, we learn that low vowels in non-initial syllables fail to receive labiality and act opaque. This suggests that vowels that are incompatible with the harmonic element must act opaque. This fact is accounted for given our use of unary elements and the claim that licensing is local.

Secondly, we learn that non-harmonic vowels in disharmonic roots cannot contain a combination of the elements |I| and |U|, which motivates the representation |IU| for /ɨ/ in stems.

Thirdly, I concluded that licensing is base-controlled which means that invariable elements of disharmonic affixes cannot license into the stem that these affixes have been attached to.

4 HUNGARIAN

We now come to a second case which is also much discussed in the literature. In this chapter I analyze palatal harmony in Hungarian, which, as will see, also has a limited amount of labial harmony.

4.1 THE BASIC FACTS

Hungarian has the following vowel system:

(66)

	[–back]		[+back]	
	[–round]	[+round]	[–round]	[+round]
[+high, –low]	i(:)	y(:)		u(:)
[–high, –low]	e:	ø(:)		o(:)
[–high, +low]	ɛ		a:	ɔ

All high and mid round vowels occur short and long, but, as indicated, in case of non-high non-round front vowels and in the case of low (back) vowels, there is a quality difference between the long and the short vowel. In the former case, the difference is mainly one of height, whereas in the latter case the difference involves lip rounding. Only the difference between /e:/ and ɛappears to have consequences for how the vowel harmony system works.

Let us first list the harmonic pairs (abstracting from length):

(67)

Harmonic pairs	Neutral
/y/ - /u/	/i/, /e:/, /ɛ/
/ø/ - /o/	
/a:/ - /e:/	
/ɔ/ - /ɛ/	

/i/ (long and short) is clearly neutral. Since /i/ is front and frontness (i.e. |I|) is the harmonic element, we expect it to be transparent, and this will turn out to be the case, except in the case of a sequence of /i/'s. The status of /e/ and /ɛ/ is ambiguous, in particular that of /ɛ/. First of all we note that in suffixes /e:/ forms the harmonic counterpart of /a:/, and /ɛ/ that of /ɔ/:

(68) öröm - nek ‘joy’ (dat.) varos - nak ‘city’ (dat.)
öröm - ne:l ‘joy’ (ad.) varos - na:l ‘city’ (ad.)

These suffixes are specified as {|A(I)|}. Thus, these pairs ‘behave’ as the pair /a/ - /æ/ in Finnish. In stems, however, /e:/ occurs both with front and back vowels, and, if preceded by back vowels, a following suffix turns up as back. It is ‘transparent’ as shown in (70a):

(69) a. ta:nye:r - nak ‘plate’
ka:ve: - nak ‘coffee’
b. radi:r - nak ‘eraser’
taxi - nak ‘taxi’

The same behavior is displayed by /i/, as shown in (70b).

The vowel /ɛ/ in a similar context triggers allows both suffix variants; this is called vacillation:

(70) A:gnes - nek/nak
szalamender - nek/nak

Ringen and Kontra (1989) and Kontra, Ringen and Stemberger (1991) have tested individual words with either /e:/ or /ɛ/ in the final syllable and there is a certain amount of unpredictability. For example, in some cases (like *okto:ber* and a few others) it is claimed that only *-nak* can occur.

Before proceeding to a formal analysis, let us set up the vowel system in terms of elements. There are two major challenges. The first involves the mid front unrounded vowels (long /e:/ and short /ɛ/) and here there are two issues.

Firstly, both vowels form the harmonic counterpart to the low vowel /a/, (phonetically [ɔ]) or /a:/. We have seen that /e:/ forms the harmonic counterpart of /a:/ and as such it will end up with a representation lacking |∀|:

(71)

∀	∀			
A	A		A	
I	(I)	>	(I)	
ö	röm	-	ne:l	‘joy’ (ad.)

(72)

∀	∀			
A	A		A	
I	(I)	>	(I)	
ö	röm	-	nek	‘joy’ (dat.)

From this one might infer that the representation of long /e:/ and short /ɛ/ does not contain the element |∀|, but, both being mid vowels that seems wrong. Rather it would seem that /e:/ is high mid, whereas /ɛ/ is low mid:

(73)

/e:/	/ɛ/
$\underline{\forall}$	∀
A	$\underline{\text{A}}$
(I)	I

We could remedy this as follows. We can adopt a rule that will insert the element |∀| for any segment that has color. This would in fact be a constraint (see 85 below), so we must assume that the result of harmony is 'adjusted' by inserting |I| (the constraint functions as what would be called a 'linking rule' in SPE). I will assume that all structures must be in conformity with the constraint at the output level of the lexical phonology:

(74) |I| → |∀|

We do not have to postulate headedness for the A+∀ combination. We could in fact assume that the headedness is 'spelled' out at the phonemic level depending on the length of the vowel:

(75) If long: |∀| is the head, else |A| is the head

The second issue that we need to address has to do with how /e:/ and ɛbehave within the stem. The vowel ɛis ambiguous. When occurring in stems with a preceding back vowel it can be either predictable (acting transparently, as a non-licenser) or disharmonic (acting as a licenser):

(76)

a.		∀			
	A	A		A	
		I	>\	(I)	
	Ag	nɛs	+	nak	
b.		∀			
	A	A		A	
		I	>	(I)	
	Ag	nɛs	+	nek	

I propose to represent this vacillating behavior by postulating two different representations. When ɛacts 'transparently' this is the result of leaving out the predictable |I| element as in (78a). When this vowel causes the suffix to be front, its |I| element is not predictable because we omit the |∀| element (which makes this representation identical to the result of a fronted /a/ in suffixes):

(77)

a.		∀		
	A	A		A
				(I)
	Ag	nɛs	+	nak
b.	A	A		A
		I	>	(I)
	Ag	nɛs	+	nek

Both representations will be made complete at the phonemic level so that they conform to the constraints (see 85 below).

It is important to note that the /e:/ and ɛvariant of alternating vowels in suffixes are not transparent. Thus, if an alternating suffix follows a vacillating stem such as Agnes, the front variety of the suffix must be followed by front varieties of suffixes (see 79a). But if a vacillating stem is followed by a suffix with a non-alternating neutral vowel an alternating suffix following can still have two varieties (see 79b):

(78) a. Agnes – je: - nek/*nak
Agnes – ja: - *nek/nak
'that of Agnes – DAT'
b. Agnes - e: - nek/nak
'his/her Agnes – DAT'

The -je:/-ja: suffix is alternating and both forms can be found for this stem, whereas the –e: suffix is invariantly front. The point to note is that the choice between –je: and –ja: determines the frontness of the vowel in the alternating dative suffix. But adding the non-alternating neutral vowel /e:/ allows the vacillation to apply to the dative suffix. Thus –je behaves as harmonic, whereas /e:/ is 'transparent'. In our account the two /e:/ have different representations:

(79)	a.	/–je:/	b.	/e:/
				∀
		A		A
		I		I

Recall that the representation in (80a) will be repaired by adding the element |∀|. Long /e:/ does not display vacillating behavior. This vowel, like both long and short /i/ acts transparently when preceded by a back vowel:

(80) a. *Transparent /e:/*

ta:n	ye:r	-nak	'plate'
ka:	ve:	-nak	'coffee'
	∀		
A	A	A	
		(I)	

b. *Transparent /i(:)/*

ra	di:r	-nak	'eraser'
tax	i	-nak	'taxi'
	∀		
A		A	
		(I)	

The |I| element of /e:/ and /i(:)/ cannot act as a licensor because, being predictable, it is omitted. Not only stems with ɛin the final syllable may be vacillating. In addition, stems ending in more than one neutral vowel (even if preceded by a back vowel) have a strong tendency to select a front suffix vowel:

(81)

	a	na	li:	zis	-	nɛk / -nak
		as	pi	rin	-	nɛk / -nak
			∀	∀		
	A	A				A
				?	>	(I)

How can we account for the fact that a sequence of two /i/s somehow allows one or both of the /i/s to act as a licensor. Now given that /i/ vowels are minimally specified, we might compare this situation to the prohibition on sequences of so-called empty-vowels, which, as argued in Government Phonology, are ruled out by requiring that such vowels must be licensed by a non- empty vowel. It is perhaps not a coincidence that a bare |∀| comes as close to being an empty vowel as possible. Therefore[15] it is reasonable to suggest that one of the bare vowels must be licensed by the other one which requires the licensor to be fully specified:

(82)

	…	li:		zis	-	nɛk	
		[∀	<	∀]			
	A	A				A	
				I	>	(I)	

Concluding, the vowel system at the phonemic level can be fully specified as follows.

(83)

	/i(:)/	/y(:)/	/u(:)/	/e(:)/	/ø(:)/	/o(:)/	/a(:)/
	∀	∀	∀	∀	$\underline{\forall}$	$\underline{\forall}$	
				A	A	A	A
	$\underline{\text{I}}$	$\underline{\text{I}}$		$\underline{\text{I}}$	$\underline{\text{I}}$		
		U	U		U	U	

(84) *Constraints*

a. Aperture: ¬ Ø
$\forall \rightarrow \underline{\forall}$

b. Color: I → $\underline{\text{I}}$

c. Cross-gestural:
(i) ¬ $\underline{\text{A}} \rightarrow \forall$
(ii) ∀ & ↔ (I v U)

For the vowel /i(:)/ and /e(:)/, the element |I| is predictable in accordance with (85cii): if a vowel with the element |∀| does not have |U| is must have |I|.

I assume that the rounding of short /a/ is ‘phonetic’, as is the headedness of front mid unrounded vowels which depends on length. This means that the special quality of short /a/ (as [ɔ]) and short ‘/e/’ (as [ɛ]) are both seen as allophonic and thus not specified at the phonemic level.

[15]As Beata Moskal reminded me.

4.2 ANTI-HARMONIC NEUTRAL VOWEL ROOTS: THE PROBLEM OF UNDERAPPLICATION

Neutral vowel roots, i.e. having only neutral vowels, select front suffix vowels, with the exception of a small group of 60 roots (almost all of which are monosyllabic), which take back suffixes. The difference between both types of roots can be represented as follows[16]:

(85) a. *"front /i/"*

∀		
		A
I	>	(I)
vi:z	-	nek

b. *"back /i/"*

∀		
		A
		(I)
hi:d	-	nak

Regular neutral vowel roots can license (I) in suffixes because the first vowel of such roots is in a licensed position, which means that its |I| element is licensed and thus present[17]. The irregularity of the anti-harmonic roots lies in the fact that the expected |I| element is not present even though this predictable element occurs in a licensed position. This, I must conclude, implies that the presence of a predictable element in a vowel where this element is positionally licensed can be a lexical choice.

It could be said that we have essentially 'replicated' the 'abstract' approach to antiharmonic roots and to 'transparent' vowels. The question is whether allowing lexical representations to be in disagreement with the phonemic constraints is 'bad'. I suggest that it is harmless as long as the lexical structures are substructures of the fully specified phonemic structures. Deviant structures are allowed if we assume that lexical representations are not governed by 'morpheme structure conditions'. However, the resulting 'freedom of the base' is curtailed by requiring that the relationship from lexical to phonemic level has to be 'monotonic' which means that elements can be added but not deleted. That puts a limit on abstractness. For example, as suggested in van der Hulst (2011???), it would prevent us from specifying low vowels as 'ATR' (i.e. with the element |∀|) if they do not surface as ATR.

In conclusion, underapplication results from *absence* of the harmonic element. Recall that in the analysis of Turkish we have seen that some roots with back vowels take front suffixes. Here we were dealing with overapplication, which was represented in terms of the *presence* of a floating element. In this connection we need to ask whether such floating elements need to be 'deleted' after they have performed their licensing duty, or when such licensing is not required because there is no suffix. Deletion, of course, has just been ruled out, so I will assume that these floating elements

[16]There also antiharmonic roots with /e:/ which means that we also have to have two representations for this vowel. (There is only one antiharmonic example with /E/; cf. Kontra 2011, footnote 13).

[17]Recall that we already postulated the |I|-less varieties of /i/ and /e/ in roots where these vowels are preceded by back vowels (see 81).

remain in the representation, but fail to be phonetically interpreted because they are not linked to a syllabic position.

4.3 DISHARMONIC ROOTS

As in Turkish, we find disharmonic roots:

(86) sofförr - nek
bü:ro - nak

As expected, it is the last vowel of the disharmonic roots which determines the quality of the suffix vowel. There is no evidence that front rounded vowels ever act transparently, as in Finnish (see Campbell 1980).

(87)

sof	fö:r	-	nek			bü:	ro	-	nak
∀	∀					∀	∀		
A	A		A				A		A
U	U					U	U		
	I	>	(I)			I			(I)

The element |I| in the second example cannot license across /o/.

4.4 NON-HARMONIC SUFFIXES

Here we may distinguish suffixes containing neutral vowels, and suffixes containing invariant non-neutral vowels, or both[18]:

(88) *Suffixes*

a. -i, -ig, -ni, -int, ke:nt, -e:rt, -ne:
b. -kor, -us, -u, -ko:, -a
c. -i:roz, -ista, -izmus, fika:l, -i:kus

We expect that category (89a) if followed by another suffix will act as transparent, whereas category (89b) and (89c) ought to stop the harmonic process. Examples of transparency of a suffix belonging to class (89a) are:

(89)

	poss	plur		
tükr	e	i	hez	'to his mirrors'
ablak	a	i	haz	'to the windows'

Disharmonic suffixes in groups (89b) will be represented as lacking the variable element. Finally, the /i/s in groups (89c) will lack their predictable |I| element and have no variable element in the vowel in their second syllable.

[18]Note that there are no suffixes with short /E/.

4.5 LABIAL HARMONY

Hungarian has a limited amount of apparent rounding harmony affecting suffixes which have short εas on of their alternants. There are three types of suffixes with mid short vowels[19]:

(90) a. ε - a (i.e. nek/nak)
b. ε - y - o (i.e. hez/ höz/hoz)
c. ε - a - ø - o (i.e.ek/ak/ök/ok)

I have already adopted the representation {|A|} for two-way alternators (like –nak/-nek). Let us ask what the representation of a three-way alternator might be. The distribution of the three alternants is as follows:

(91) *3-way alternators*
a. ε after harmonic i, e
b. ø after y, ø
c. o after u, o, a and anti-harmonic i, e

The first case, (92a), refers to the occurrence of the suffix vowels after active neutral vowel roots (such as vi:z in 86a). Thus, this concerns /i/'s and /e/'s that cause fronting. In the case of three- way alternators, we cannot see the round variants as the result of spreading of |U| because we find the /o/ variant after stem-final /a/. I propose that three-way alternators are specified as {|A,∀, (I), (U)|} so that we can derive the variants as follows:

(92)		
	ε after harmonic i,e	licensing of (I): {|A, ∀, I, (U)|}
	ø after ü, ö	licensing of (I) and (U): {|A, ∀, I, U|}
	o after u, o	licensing of (U): {|A, ∀, (I), U|}
	o after a and anti-harmonic i, e	U by default: {|A, ∀, (I), U|}

Note that the default rule in the suffix system supplies |U|, while the default rule for stems supplies |I|. This may be a stem – suffix difference or be due to the fact that |U| is the default in the presence of the element |A|[20].

Let us now turn to the 4-way alternators. The basic issue here is that a certain class of stems, called 'lowering stems' in Vago (ms), treat ternary suffixes as binary suffixes. (These stems also have other phonological properties that distinguish them from regular stems.) Lowering stems are a closed class of stems that cause the low vowels /a/ or ε(the choice being dependent on whether or not the stem has a spreading I element) to appear in the initial vowels of 4-way alternators such as:

[19]Note that suffixes that alternate just between /o/ and /ø/ do not exist (cf. Polgárdi and Rebrus 1998).

[20]Polgárdi and Rebrus (1998) also suggest that the element |U| is a property of the suffix to begin with, but as invariant, which entails an analysis in which |U| must be deleted in case the suffix shows up with the vowel ε(i.e. after a and anti-harmonic i,e).

(93)	Plural	-Vk
	Accusative	-Vt
	1st person poss.	-Vm
	A derivational suffix	-Vs

All of these start with a 'linking vowel' that appears when the stem ends in a consonant. If the linking vowel appears after a regular (non-lowering stem), it alternates three-ways just like suffixes that have three alternants only.

Kontra (1991) suggests that lowering stems impose the element |A| onto the linking vowel. Following the spirit of this idea and implementing it within the current model, we could say that the linking vowel is 'empty'and that lowering stems come with the floating combination {|A (I)|}. We then need a rule which spells out the empty vowel as the combination {|A, ∀, (I), (U)|} after non-lowering stems.

4.6 CONCLUSION

In this section, I have provided an analysis of Hungarian vowel harmony patterns. Firstly, alternating suffixes with /a ∼ e/ point to the need to have a rule adding the element |∀| to the fronted variant. Secondly, it has been concluded that anti-harmonic roots can most naturally be represented as lacking the element |I| (which mimics the old abstract analysis). Thirdly, a representational proposal for ternary suffixes points to |U| as the default element for suffix vowels (or vowels specified with the element |A|).

5 GENERAL CONCLUSIONS

The analyses proposed here are still 'sketchy', but I believe that the model proposed in section 2 offers a very strict guideline for how to analyze both the general and the specific aspects of vowel harmony systems. It has been assumed that lexical representations can be minimally specified and that omitted predictable elements will be added at the end of the lexical derivation where the representation must be fully specified phonemically. This allows a degree of abstractness given that predictable elements can, but need not occur in specified in privileged positions so that both harmonic and anti-harmonic neutral vowel roots can be represented in Hungarian. Many details need to be worked out and no doubt problems will emerge. However, it has been shown that there is no need for binary features such as [±back] and [±round], or, more specifically, that [+back] and [–round] are not needed in the analysis of palatal and labial systems. The model also makes the correct prediction regarding the behavior of neutral vowels as either opaque or transparent, supporting the claims in van der Hulst and Smith (1986).

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