LOCAL CONSTRAINT CONJUNCTION AND NEUTRAL VOWELS IN FINNISH HARMONY*

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Abstract

In many of the languages displaying vowel harmony, one or two vowels systematically resist the process, and seem to be skipped by harmony. These vowels have been labelled as transparent or neutral vowels in the literature. Neutral vowels pose a severe threat either to the widespread assumption that phonological feature interaction generally applies locally with regard to some level of representation or to the Optimality Theoretic assumption of parallelism. In this paper, I argue that these vowels are anything but neutral. They are particularly active in that they impose severe restrictions on their environment. This analysis saves the locality theorem as well as parallelism in Optimality Theory. The language under investigation is Finnish.

1 Introduction

A vowel is regarded as transparent to vowel harmony if it exhibits the behaviour of the Finnish high front vowel in (1c,d). The examples in (1a,b) illustrate that in most cases Finnish words contain either front vowels only or back vowels only. Affix vowels assimilate to the next stem vowel in backness. The high front vowel *i* (as well as *e*) is an exception. Preceded by a back vowel, as in (1d), the high front vowel fails to alternate with a back vowel. What makes the vowel transparent is the behaviour of

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the following affix vowel. In (1d), the vowel of the essive marker is not harmonic with its direct neighbour, the *i*, but rather with the preceding nonadjacent back vowel.

(1) Finnish vowel harmony[1]

a.	p´öytä-nä	'table'	essive
b.	póuta-na	'fine weather'	essive
c.	grötsi-nä	'porridge'	essive
d.	tsaari-na	'czar'	essive

(Ringen & Heinämäki 1999:305)

In the literature, transparent/neutral vowels, which are attested in a broad range of languages with backness or tongue root harmony, are generally conceived of as being ignored by the whole process. In the underspecification type of analysis they are bereft of the harmonically active feature, which is why they are labelled 'neutral' (see Ringen & Vago 1998 for the most recent proposal along these lines). In these and other accounts (e.g., Pulleyblank 1996), the neutral vowel is simply skipped by the harmony process. Harmony somehow permeates through the neutral vowels, which is why these vowels are labelled 'transparent'. In addition to this, the neutral vowels are 'pushed around' from their underlying feature specification to an intermediate specification, and back to their initial state, in order to be able to trigger harmony in their neighbour in the intermediate stage in accounts assuming derivational opacity in one or the other sense (Bach 1968, Vago 1976, Clements 1976, McCarthy 1984, Hualde 1989, Ní Chiosáin & Padgett 1997). In recent correspondence theoretic accounts of transparent vowels, derivational opacity is translated as additional correspondence to failed candidates (Walker 1998, 1999, Baković 2000, Baković & Wilson 2000). In Correspondence Theory (McCarthy & Prince 1995), every surface form stands in a correspondence relation with its underlying representation. To account for vowel transparency, Walker (1998, 1999) assumes an additional 'Sympathetic' (McCarthy 1999) correspondence relation of the output candidate with the failed candidate that is maximally harmonic with regard to the feature affected by vowel harmony. Baković (2000) and Baković & Wilson (2000) assume a pairwise candidate evaluation governed by a so-called targeted constraint. This pairwise candidate evaluation by each con-

[1] Thanks to Tuulikki Virta, a native speaker of Finnish, for providing the data in (1c,d).

straint cumulates as well in a comparison of the actual output with the candidate which is most harmonic with regard to vowel harmony. These two nonderivational accounts and the accounts assuming derivational opacity have in common that they all have to refer to an abstract representation mediating between input and output representation.

In this paper, I attempt to show that the assumption of two levels of representation (i.e., the input and the output) is fully sufficient as soon as we change our perspective on transparent/neutral vowels. Rather than conceiving of these vowels as transparent or neutral it is more appropriate to regard them as particularly active, as balanced. A balanced vowel is a vowel, which prefers the same state of affairs to prevail at both its sides, i.e., it is in disharmony with every neighbour or it is in harmony with every neighbour.

The paper is structured as follows. In section 2, I will examine the behaviour of transparent vowels in Finnish in more detail and show that they are not inactive in the harmony process. Furthermore, I will outline my conception of vowel balance in section 2. Section 3 is devoted to the formal analysis of balance within Correspondence Theory. Section 4 concludes.

2 Balance

To develop a notion of balance we first have to have a closer look at the patterns of vowel harmony in Finnish. As noted earlier, most Finnish words have either back vowels or front vowels only as exemplified in (2). The vowel of the essive suffix alternates in backness in accordance to the preceding stem vowel in (2a,b,c).

(2) Finnish vowel harmony

a.	p´öytä-nä	'table'	essive
b.	póuta-na	'fine weather'	essive
c.	h´ämär`ä-nä	'dusk'	essive

(Ringen & Heinämäki 1999:305)

If such an alternating suffix vowel is preceded by a transparent/neutral vowel (*i* or *e*), the suffix vowel has the backness quality of the next non-neutral vowel in the word, as shown in (3).

(3) Finnish neutral vowels in medial position

a.	näke-vät	'see-3pl'	b.	tunte-vat	'feel-3pl'
	grötsi-nä	'porridge-essive'		tsaari-na	'car-essive'

However, the neutral vowels are not literally neutral. If a root has no other vowel, suffixes surface as front, as shown in (4). If the 'neutral' vowels were really neutral, i.e., if they were no active triggers of harmony we would expect that the vowels of alternating suffixes would surface with their underlying backness specification in this context. This means that at least some suffixes should surface with a back vowel when attached to a root containing only a neutral vowel. This is not the case, which shows us that the 'neutral' vowels are active triggers of harmony.

(4) Finnish transparent vowels

a.	vélje-llä	'brother'	adess.
b.	tié-llä	'road'	adess.

(Ringen & Heinämäki 1999:305f)

The behaviour of the Finnish transparent vowels can be schematised as in (5i). The scheme in (5) also shows the difference to opaque vowels, as can be found in Turkish for instance. If a transparent (front) vowel is preceded by a front vowel, the following vowel is a front vowel as well. Harmony on the left side of the vowel is accompanied by harmony to the right side of the vowel. If disharmony is the prevailing state between the transparent vowel and a preceding back vowel, disharmony can be found to the right side of the vowel as well. It is always followed by a back vowel in this configuration. In sum, the same state of affairs, either harmony or disharmony, can be found on both sides of the transparent vowel. From this perspective the vowel is not transparent, but rather balanced. An imbalanced configuration is the one in which the medial vowel is harmonic with the vowel to its left and disharmonic with the vowel to its right or the other way round, as indicated in (5iib). Such a pattern can be found in Turkish rounding harmony, where non-initial low vowels are never rounded. If preceded by a rounded vowel, such a non-initial low unrounded vowel initiates a new harmonic domain by imposing unrounding on the following vowels (see Lewis 1967, Clements & Sezer 1982, Kirchner 1993, Kaun 1994, 1995, and others).

(5) Vowels and their neighbours

i. Balance (transparency)

a. harmony	b. disharmony
$V \leftrightarrow V_B \leftrightarrow V$	$V \not\leftrightarrow V_B \not\leftrightarrow V$
$[\alpha F]$ $[\alpha F]$ $[\alpha F]$	$[\alpha F]$ $[-\alpha F]$ $[\alpha F]$

ii. Imbalance (opacity)

a. harmony	b. disharmony
$V \leftrightarrow V_i \leftrightarrow V$	$V \not\leftrightarrow V_i \leftrightarrow V$
$[\alpha F]$ $[\alpha F]$ $[\alpha F]$	$[\alpha F]$ $[-\alpha F]$ $[-\alpha F]$

Balanced vowels are either harmonic to all their direct neighbours or disharmonic to all their direct neighbours, never harmonic to one neighbouring vowel and disharmonic to the other.

One question is why the two balanced vowels *i* and *e* do not simply change their backness specification in accordance with the harmony requirement when preceded by a back vowel, resulting in *ɯ* and *ɤ*, respectively. The back unrounded vowels *ɯ* and *ɤ* are absent from the Finnish vowel inventory, and the grammar does not tolerate a re-pairing of the nonlow front vowels with back vowels differing in roundness or height. The Finnish vowel inventory is given in (6). The form of presentation chosen in (6) underlines the particularity of the vowels *i* and *e* in the Finnish system. While every back vowel has a variant which differs only in the backness specification, this generalisation does not hold in the opposite direction. Not every front vowel has a potential back counterpart. There is no phonemic contrast between a front unrounded non-low vowel and a back unrounded non-low vowel. This disturbs the balance of the system in the backness dimension which is observed with all other vowels. Thus, the two balanced vowels *i* and *e* render the whole vowel system imbalanced.

(6) The Finnish vowel system

	front		back	
	unrounded	rounded	unrounded	rounded
high	i	y		u
mid	e	ö		o
low	ä		a	

From this angle, the balanced behaviour of the vowels *i* and *e* can be seen as a marking or compensation strategy triggered by the imbalance they cause in another dimension of the phonology, the vowel inventory. The Turkish unrounded low vowels, which interrupt the harmony process, in contrast, do not cause an imbalance to the vowel system. Rounded low vowels are quite frequent in Turkish, though not in non-initial syllables.

In the next section, I will turn to the formalisation of the above observation in Correspondence Theoretic terms.

3 A correspondence theoretic implementation of balance

I will take the basic architecture of Optimality Theory for granted here and refer the interested reader to Prince & Smolensky (1993), or for more up-to-date introductions to Archangeli & Langendoen (1997) as well as Kager (1999).

McCarthy & Prince (1995) propose a range of faithfulness constraints that govern the relation between input representations and output representations to make sure that they are as close to each other as possible. The most ignored but nonetheless relevant faithfulness constraint family to be considered in the analysis of vowel harmony is the IO-Identity constraint family, given in (7).

(7) The IDENT(F) Constraint Family McCarthy & Prince (1995:264)

Let α be a segment in S_1 and β be any correspondent of α in S_2.

If α is [γF] then β is [γF].

(Correspondent segments are identical in feature F.)

Featural IO-Identity constraints demand that the input and the output have the same specifications of the features present in the input. The constraint broadly ignored under backness harmony is the special IO-Identity instantiation on backness given in (8).

(8) IO-IDENT(bk): Correspondent segments in the input and in the output have identical backness specifications.

Finnish displays stem-controlled vowel harmony (as opposed to the dominant-recessive type of harmony; see van der Hulst & van de Weijer 1995, Baković 2000 on this distinction). As observed by Beckman (1995, 1997, 1998) this type of harmony is predominantly shaped by the vowel in the first syllable. A strategy to maintain harmony in the disharmonic Finnish data in (3) would have been to change the first vowel in the word accordingly, yielding words with front vowels only in case a balanced vowel is found in word-medial position. However, this is not the case, which can be attributed to the role of the positional faithfulness constraint on material in the first syllable as proposed by Beckman (1995, 1997, 1998).

(9) Positional Faithfulness

IO-IDENTσ1: Correspondent segments in the input and in the first syllable of the output have identical feature specifications.

The third ingredient of a harmony grammar is the reason for harmony. In most analyses of vowel harmony, the harmonic pattern is attributed to one or more alignment constraints, aligning feature spans with morphological or phonological edges (Smolensky 1993, Kirchner 1993, Pulleyblank 1996, Ringen & Vago 1998, Ringen & Heinämäki 1999 and many others). Beckman (1995, 1997, 1998) proposes that at least Shona height harmony is triggered by simple markedness constraints. Various valid arguments against both proposals have been gathered in Krämer (1998, 2001b), and Baković (2000). Following both the latter authors I adopt the view that harmony and any other kind of assimilation is the effect of an agreement constraint or syntagmatic identity constraint, as given for backness in (10).

(10) Harmony constraint Syntagmatic Identity (Krämer, 2001a,b)

S-IDENT(bk): Adjacent syllables have identical backness specifications.

Constraints on surface structure are ranked in a language-specific dominance hierarchy in optimality-theoretic grammars. In the particular case of Finnish backness harmony, the harmony constraint S-IDENT(bk) has to rank higher than the general identity constraint IO-IDENT(bk). The result is harmony. The immunity of the vowel in the first syllable is captured by a ranking of the positional faithfulness constraint IO-IDENTσ1 above the harmony constraint. The resulting grammar is shown in (11).

(11) Finnish basic harmony ranking

IO-IDENTσ1 >> S-IDENT(bk) >> IO-IDENT(bk)

In tableau (12), a form containing only potentially harmonic vowels is evaluated. For the sake of illustration I assumed the underlying form /póutä-nä/ for the surface form *póutana*, even though the underlying specification of the last two vowels as front is quite unlikely. The affix vowel, however, could at least be front underlyingly, since it surfaces both as front and as back, dependent on the context, which this grammar predicts.

(12) Unimpeded harmony tableau

/póutä-nä/	IO-IDENTσ1	S-IDENT(bk)	IO-IDENT(bk)
a. pöytänä	*!		**
b. póutänä		*!	
☞ c. póutana			**

The highly ranked positional faithfulness constraint is violated by the first candidate which has only front vowels. This form deviates in the backness specification of the first vowel from its underlying form, which violates the topmost constraint. This renders candidate (a) suboptimal, since there are forms which do not violate this constraint. The choice among the remaining two candidates is passed down to the next constraint in the hierarchy. Candidate (b) has a disharmonic pair of syllabically adjacent vowels, which violates the harmony constraint S-IDENT(bk). The last candidate satisfies the harmony constraint, even though it does this on the cost of IO-faithfulness with regard to the backness specification of most of its vowels. The latter violations are irrelevant, because candidate (c) is the only remaining form, and therefore judged as optimal.

3.1 Composing the Balance grammar

With this basic harmony grammar, we can turn to the analysis of balanced vowels. The first issue to be clarified is why they do not alternate with their back counterparts. Following Ringen & Heinämäki (1999), I assume this to be due to an inventory structure constraint, which bans the two back nonlow unrounded vowels from surfacing in Finnish.

(13) a. *ALIEN: *[ɯ, ɤ] or *[-lo, -rd, +bck]. 'No high back unrounded vowels, please!'

b. *[i, e] or *[-lo, -rd, -bk]. 'No high front unrounded vowels, please!'

Additional faithfulness constraints on height and roundness militate against all forms which have altered the height or roundness specification of the balanced vowels in order to perform optimally on the harmony constraint. The fate of a hypothetical underlying back unrounded non-low vowel is illustrated in tableau (14). The vowel surfaces as *i* under the assumed grammar. If such vowels never surface and do not have other indirect influence on surface forms, they can be assumed to be absent from the Finnish lexicon.[2]

(14) The fate of potential underlying back high unrounded vowels in Finnish

/ɯ/	*ALIEN	IO-IDENT(hi)	IO-IDENT(rd)	IO-IDENT(bk)
a. ɯ	*!			
b. a		*!		
c. u			*!	
☞ d. i				*

Now we know why the balanced vowels in Finnish do not alternate, but we do not know what makes them balanced. To account for this we have to take another constraint into consideration. One advantage of the formalisation of assimilation as

2 If they were historically ever present in Finnish, they have been erased synchronically by this grammar at some stage.

correspondence, is that dissimilatory or OCP effects (OCP = Obligatory Contour Principle, Leben 1973, Goldsmith 1976, McCarthy 1986) can be modelled simply as surface epiphenomena of the negation of the assimilation constraint.[3] The negated version of the harmony constraint in (15) demands that syllabically adjacent vowels have different backness specifications. Backness dissimilation is observed in a variety of languages such as Ainu (Itô 1986, Dettmer 1989, Krämer 1998, 1999) or Yucatec Mayan (Krämer 1998, 1999, 2001b).

(15) OCP *S-IDENT(bk) (Krämer, 2001a,b): Adjacent syllables do not have identical specifications for backness.

The observation regarding balanced vowels is that they may violate the OCP constraint in (15) when they are harmonic with both their neighbouring vowels as in (3a), or they may violate the harmony constraint in (10) when they are disharmonic with both their neighbours, as in (3b), but they are not allowed to violate both constraints at the same time. Violation of both constraints in the same instance is incurred by a vowel if it is disharmonic with one neighbour (e.g., that to the left) and harmonic with the other neighbour (e.g. the one to the right).

(16) Harmony and the OCP

			S-IDENT(bk)	*S-IDENT(bk)
a.	transparent	tunte-vat	**	
b.	opaque	*tunte-vät	*	*
c.	harmonic	näke-vät		**
tunte-vat 'feel-3pl', *näke-vät* 'see-3pl'				

A simple addition of this constraint to the Finnish grammar would not solve the problem. It would have to be ranked rather low in the hierarchy anyway to prevent an overall pattern of backness dissimilation. However, what is to be excluded is the candidate showing the opaque pattern[4] in tableau (16), which violates both con-

[3] For a different implementation of the OCP in Optimality Theory see Alderete (1997). For a view similar to that adhered to here see Plag (1998).

[4] To put it correctly, the word-medial vowel behaves like an *opaque vowel*, which renders the form *phonologically transparent*, while the word-medial vowel in the candidate labelled as 'transparent' in

straints. The solution to the dilemma is that both constraints join forces in the grammar's attempt to mark the exceptional status of the vowels which cause asymmetry in the system. Constraints can be combined to complex or macro-constraints (Crowhurst & Hewitt 1997) by local constraint conjunction as proposed by Prince & Smolensky (1993), Smolensky (1993, 1995), Lubowicz (1998), Itô & Mester (1998) and others.

(17) Local Conjunction of Constraints (LCC) (Itô & Mester 1998:10)

a. Definition

Local conjunction is an operation on the constraint set forming composite constraints: Let C_1 and C_2 be members of the constraint set CON. Then their local conjunction $C_1 \&_l C_2$ is also a member of CON.

b. Interpretation

The local conjunction $C_1 \&_l C_2$ is violated if and only if both $*C_1$ and $*C_2$ are violated in some domain δ.

c. Ranking (universal)

$C_1 \&_l C_2 >> C_1$

$C_1 \&_l C_2 >> C_2$

A local conjunction of two (or more) constraints is violated whenever a candidate violates both participating constraints within the designated domain, which is usually conceived of as the segment or a similar domain. Lubowicz (1998) proposes that local conjunctions are restricted to the smallest possible domain, i.e., to the smallest domain which is affected by both constraints. I will not enter the discussion here, whether segments do exist or not and on which tier of representation exactly vowel harmony applies, however, the local constraint conjunction relevant for balanced vowels must be restricted somehow to the articulatory span covered by the balanced vowel. For the sake of simplicity I will denote the local domain of the conjunction as that of the syllable, which was also indicated as the relevant argument referred to by the harmony constraint as well as the OCP constraint.

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the above tableau behaves like a *transparent vowel*, which renders the whole form *phonologically opaque* in serialist terminology.

(18) Local Conjunction BALANCE(bk): S-IDENT&$_\sigma$*S-IDENT

> 'Adjacent syllables have identical backness specifications, OR adjacent syllables do not have identical backness specifications.' Local domain: The syllable.[5]

A local conjunction of the OCP and the harmony constraint only would result in an unattested dissimilation pattern. If a balanced vowel is situated in the second syllable of a word (V_2 in 19), preceded by a back vowel (V_1 in 19), and followed by two potentially harmonic vowels, the last vowel in the word (V_4 in 19) should surface as a front vowel. This prevents a violation of the local conjunction by the penultimate vowel (V_3 in 19), which would otherwise be disharmonic with its neighbour to the left and harmonic with its neighbour to the right.

(19) * CV_1[+bk] CV_2[-bk] CV_3[+bk] CV_4[-bk]

Since this is an unattested pattern, the local conjunction must be further restricted in order to apply only to balanced vowels. This can be achieved in two ways. Either the local domain to which the conjunction refers is the non-low front feature span, or the markedness constraint violated by balanced vowels has to be added to the conjunction.

(20) Local Conjunction BALANCE(bk) revised: *[-lo, -rd, -bk]&$_\sigma$S-IDENT&$_\sigma$*S-IDENT

> 'Do not articulate nonlow unrounded front vowels, OR adjacent syllables have identical backness specifications, OR adjacent syllables do not have identical backness specifications.' Local domain: The syllable.

This completes the Finnish grammar of balance. The complete ranking is shown in (21).

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5 Note that in the 'prose' formulation both requirements are connected by 'or'. This mirrors the fact that the conjunction is satisfied already if at least one of the two conjoints is satisfied. Logically, the local conjunction is a constraint disjunction. See Crowhurst & Hewitt (1997) for a discussion of the logical aspects of constraint coordination.

(21) Finnish ranking:

*ALIEN, IO-IDENTσ1, IO-IDENT(hi,lo,rd) >> BALANCE(bk) >> S-IDENT(bk) >> IO-IDENT(bk) >> *S-IDENT(bk), *[-lo, -rd, -bk]

We can now proceed to evaluate the crucial forms and see how the candidate displaying opaque vowel behaviour is excluded.

(22) Balance tableaux

/tunte-vät/	*ALIEN	IO-IDσ1	IO-ID (hi,lo,rd)	BALANCE	S-ID(bk)	IO-ID(bk)
a. tuntɤvat	*!					**
b. tüntevät		*!				*
c. tuntevät				*!	*	
☞ d. tuntevat					**	*

In tableau (22), the candidate which has changed the balanced vowel to its potential back unrounded counterpart violates the undominated inventory constraint *ALIEN, which militates against exactly this vowel. All potential candidates have been excluded from consideration which achieve optimised performance on the harmony constraint while respecting the markerdness constraint *ALIEN by re-pairing the balanced vowel with a vowel of different height or roundness. They would be ruled out by the high ranking faithfulness constraints on these features.

However, the candidate with an initial vowel harmonised to the following balanced vowel is sub-optimal in comparison to the candidates (c) and (d) by violation of the faithfulness constraint on the first syllable. In choosing between the last two remaining candidates, the one with an opaque vowel (c) and the one with a balanced vowel, the BALANCE conjunction becomes crucial. The word-medial vowel in candidate (c) is disharmonic with the neighbouring vowel to its left, which violates the harmony constraint S-IDENT(bk). In addition, it incurs a violation mark on the OCP constraint *S-IDENT(bk) for its harmonic relation with the neighbouring vowel to the right. Together with the violation of the markedness constraint *[-lo, -rd, -bk] both violations add up to a violation of the local conjunction of all three constraints. The word-medial vowel in candidate (d) violates the markedness constraint as well. It fares even worse on the harmony constraint by being disharmonic with both its neighbours. The additional violation of the harmony constraint renders the OCP constraint satisfied, because the vowel disagrees with both neighbours in satisfaction of *S-IDENT(bk). Satisfying one of the conjoined constraints is fully sufficient to perform acceptably on the entire local conjunction. Thus, the candidate (d) with the transparent vowel pattern outperforms the candidate with the opaque vowel pattern (candidate c).

Tableau (23) below illustrates the evaluation of a balanced vowel preceded by a front vowel, which is unproblematic since maximal harmony with regard to backness is easily achieved by such a form.

(23) A balanced vowel in a front environment

/grötsi-nä/	*ALIEN	IO-IDσ1	IO-ID (hi,lo,rd)	BALANCE	S-ID(bk)	IO-ID(bk)
☞ a. grötsinä						
b. grötsina				*!	*	*
c. grötsɯnä	*!				**	*
d. grotsɯna	*!	*				***

(24) Harmony without balanced vowels reconsidered

/póutä-nä/	*ALIEN	IO-IDσ1	IO-ID (hi,lo,rd)	BALANCE	S-ID(bk)	IO-ID(bk)
a. pöytänä		*!				**
b. póutänä					*!	
c. póutäna					*!*	*
☞ d. póutana						**

Tableau (24) shows that the added balance constraint has no impact on the choice of the optimal form with inputs lacking a balanced vowel. In tableau (24), candidate (c) which best satisfies the (irrelevant) OCP constraint as well as the local conjunction on BALANCE is judged as sub-optimal because of its bad performance on the harmony constraint in comparison with candidate (d). The local conjunction of BALANCE is trivially satisfied by all candidates, since none of them contains a front nonlow unrounded vowel, which satisfies the markedness constraint against these vowels.

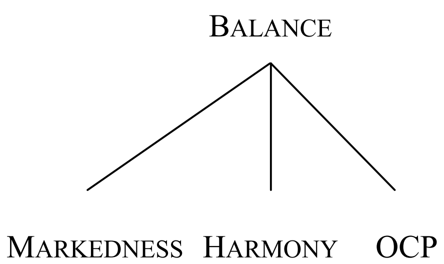
This completes the analysis of balance in Finnish. However, with regard to the given analysis two crucial questions still have to be discussed. If it is allowed to conjoin more than two constraints, what is the internal structure of such a complex constraint? Would a hierarchical structure imply the existence of a less complex partial conjunction in the grammar? If so, we would expect an effect of this intermediate conjunction in Finnish or a related language. The other issue still to be raised is which pattern the analysis predicts in case we have a chain of several balanced vowels preceded by a back vowel in a word. I will discuss both aspects in turn.

3.2 Decomposing the Balance constraint

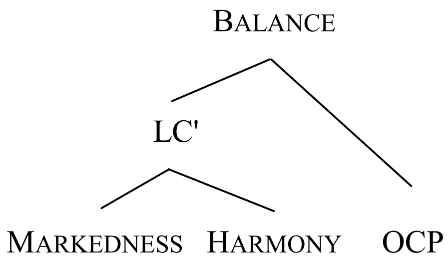
The macro-constraint of BALANCE, as formulated in (20), consists of three simplex constraints. For such a complex constraint four possibilities of internal structure exist. The complex constraint can either have no internal structure viz. a hierarchically flat structure, which means that all three constraints are conjoined simultaneously (25a), or the constraint coordination is hierarchical. In the latter case, either the markedness constraint *[-lo, -rd, -bk] and the harmony constraint S-IDENT(bk) are conjoined to an intermediate Local conjunction LC' (25b), which is then coordinated with the OCP constraint *S-IDENT(bk), or the harmony constraint and the OCP constraint form an interim LC', which is conjoined with the markedness constraint (25c), or markedness and OCP constitute the partial LC' which is conjoined with the harmony constraint (25d). If one of the structures in (25b-d) is the correct analysis of the BALANCE conjunction, we would expect one of the LC' combinations to be present in the grammar and eventually show an effect in some environment.

(25) Possibilities of multiple constraint conjunction

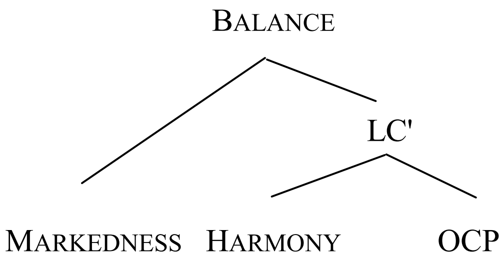
a.



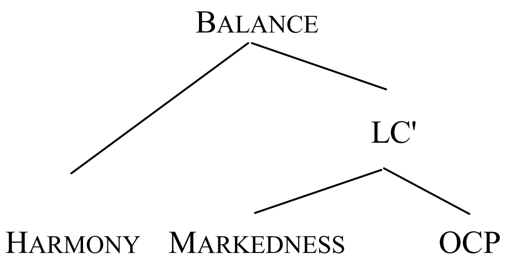
b.



c.



d.



Let us first figure out what could be the possible effects of the potential partial LC's. The LC' assumed in (25b) would have no effect at all, since it only enforces harmony of non-low front unrounded vowels with their neighbours. According to the universal ranking theorem of Itô & Mester (1998), the partial LC would have to be ranked below the complete tripartite LC of BALANCE, since with regard to its members it is a proper subset of the members of BALANCE. Therefore we can disregard this possibility.

The LC' in structure (25c), however, should have an effect on surface forms. The local conjunction of the harmony constraint with the OCP constraint should be ranked higher than the harmony constraint and below the BALANCE conjunction. In this position, it triggers dissimilation of a word-final suffix vowel to the preceding suffix vowel, in case this penultimate suffix vowel is preceded by a balanced vowel, which in turn is preceded by a back vowel. The configuration is schematised in (26).

(26) The effect of LC' (25c)

	/CV - V^BC -VC- VC/ | | [+bk] [-bk]	BALANCE	*S-ID(bk)&$_l$ S-ID(bk)	S-ID(bk)	*S-ID(bk)
a. opaque	V -V^B -V -V | | | | [+bk] [-bk] [-bk] [-bk]	*!		*	**
b. balanced	V -V^B -V -V | | | | [+bk] [-bk] [+bk] [+bk]		*!	**	*
☞ c. unattested	V -V^B -V -V | | | | [+bk] [-bk] [+bk] [-bk]			***	

In tableau (26), *V* indicates a vowel or syllable peak and superscript ^{B} indicates the balanced vowel. Consonants are left out of consideration since they have no influence on the outcome at all. In this evaluation, the balanced candidate (b) is outperformed by another candidate (c) for its poor performance on the intermediate LC' *S-ID(bk)&$_l$S-ID(bk). The penultimate vowel in (b) is disharmonic with its preceding neighbour, which violates S-IDENT(bk). On the other side this penultimate vowel is harmonic with the following vowel, violating the OCP constraint *S-IDENT(bk). Both violations, incurred by the same vowel, add up to a violation of the local conjunction of the affected constraints. The alternative candidate (c) avoids this violation. In satisfaction of *S-IDENT(bk), the penultimate vowel is disharmonic with both its neighbours in this form. However, this is an unattested pattern. Therefore, this LC' is not an appropriate choice for the deconstruction of the BALANCE constraint as well.

Let us now consider the last possibility, a local conjunction of the markedness constraint with the OCP constraint. As before, the conjunction has to be ranked somewhere below the BALANCE constraint in the dominance hierarchy of constraints. However, it can be ranked lower or higher than the simplex harmony constraint. Ranked below the harmony constraint, the LC' (25d) is neutralised. This LC' demands dissimilation of balanced vowels and their neighbour, regardless of how many neighbours there are in a form. If the constraint favouring harmonic neighbourhood for all vowels is ranked higher, the LC' shows no surface effect at all. In the scenario where the LC' is ranked above the general harmony constraint, it favours candidates which show disharmonic backness patterns of the balanced vowels with their neighbour. In particular, a form comprising only one balanced vowel plus a potentially harmonic suffix vowel should show such a dissimilation effect: The suffix vowel should turn out as a back vowel. This is not the case in Finnish.

However, Kiparsky (2000) compares Finnish with Uyghur, Ostyak, Seto, and Vepsian. He reports exactly this pattern for Uyghur, a Turkic language. In word-medial position, Uyghur balanced vowels behave exactly like those in Finnish. Found in isolation, these vowels trigger dissimilation in the following suffix vowel. This is the pattern favoured by the local conjunction of markedness and OCP. In Enarve Vepsian, another Finno-Ugric language, the balanced vowels are not balanced at all, they are completely insensitive to the feature specification of the preceding vowel and trigger dissimilation in the following vowel in all environments. From these facts I conclude that if any decomposition of the BALANCE constraint is to be assumed the LC' in (25d) is present in the grammar, and therefore the whole structure in (25d) is the right internal analysis of the BALANCE constraint.

(27) i. Uyghur

a.	yaz-ğu-či-lar	'writers'	
	kör-gü- či-lär	'watchers'	
b.	tizil-maq	'lining up'	
	dil-ğa	'to heart'	(Kiparsky 2000)

ii. Enarve Vepsian (Kiparsky 2000):

— Backness harmony like Finnish;

— 'Neutral' vowels always disagree in backness with the following vowel.

The constraints determining the output of the harmony grammars in the three languages are given in (28). Most strikingly, Enarve Vepsian has no BALANCE conjunction. However, Vepsian has the interim conjunction of the markedness constraint *[-lo, -rd, -bk] with the dissimilation constraint *S-IDENT(bk) which causes dissimilation between the balanced vowels and the following potential target of harmony.

Uyghur has both conjunctions ranked high enough to show an effect, while in Finnish, the interim conjunction is located below the harmony constraint, and is thus ineffective, if it is present at all.

(28) Cross-linguistic rankings and conjunctions

Finnish:	BALANCE >> S-IDENT(bk) >> *[-lo, -rd, -bk]&*S-IDENT(bk)
Uyghur:	BALANCE >> *[-lo, -rd, -bk]&*S-IDENT(bk) >> S-IDENT(bk)
Enarve Vepsian:	*[-lo, -rd, -bk]&*S-IDENT(bk) >> S-IDENT(bk)

I will not go into the details of the analyses of Uyghur and Vepsian here. In the next section, I turn my attention to Finnish words containing more than one balanced vowel preceded by a back vowel.

3.3 Macro-balance: chains of balanced vowels

The data concerning disharmonic loanwords in Finnish are quite incoherent with respect to disharmonic words containing more than one balanced vowel in a chain. Campbell (1980) gives a set of examples where a chain of balanced vowels is preceded by a back vowel. In these data, the following nonbalanced suffix vowel agrees in backness with the adjacent balanced vowel. This speaks in favour of an analysis in which the syllable is the relevant domain of the (dis-)harmony constraints as well as of the local conjunction. The last balanced vowel/syllable is preceded by a front (balanced) vowel, and, thus, has to be harmonic with the following vowel as well.

(29) Finnish sequences of balanced vowels

*a*djektiivej*ä*	'adjectives (partitive pl.)'
p*a*rtikkel-eist*ä*	'particles (elative pl.)'

(Campbell 1980:252)

This picture is contradicted by Kiparsky's (2000) data. According to Kiparsky (2000), it does not matter how many balanced vowels are connected to an uninterrupted chain, the following potential target vowel goes conform with the backness specification of the next nonbalanced vowel somewhere in the word.

(30) Finnish neutral vowels between trigger and target

a.	ui-da	'to swim'	b.	*u*i-ske-nt-ele-mi-se-ni-k*o*	'my swimming around?'
	syö-dä	'to eat'		s*yö*-ske-nt-ele-mi-se-ni-k*ö*	'my constant eating?'
	teh-dä	'to do'		tee-ske-nt-ele-mi-se-ni-kö	'my pretending?'

(Kiparsky 2000: 2)

This suggests an analysis where the whole chain of balanced vowels is interpreted as one entity covering several syllables.

The foot, as the relevant domain to which harmony constraints refer, must be excluded on the grounds of the Finnish stress pattern. Finnish has invariable word-initial stress, and secondary stress is found on the third syllable in the word. Footing is trochaic in Finnish, going from left to right (Ringen & Heinämäki 1999, Karvonen 2000). However, in words such as these in (30), there are at least two feet intervening between the foot in which the triggering vowel is parsed and the foot containing the target vowel. Thus, such an analysis would not conform to the locality restriction incorporated into the harmony constraint (interacting elements, whether syllables or feet, must be adjacent; see the definition in 10).

Therefore, the relevant argument of the constraints in question must be defined over the maximally homorganic articulatory feature span. The same holds for the domain of the local conjunction. This view is supported by the findings of Ringen & Heinämäki's (1999) survey of alternation in such words. They found out that the number of instances where a back suffix is attached to such roots approaches 100%. However, there is a small residue of forms where alternation of the suffix vowel between its front and back variant is found. To me this shows that Finnish speakers are not 100% sure as well whether they have to regard sequences of neutral vowels as one entity (on an articulatory basis) or as several entities (on a prosodic basis).

Additionally, Ringen & Heinämäki (1999) found out that in loanwords, other front vowels show a tendency to join the balanced behaviour as well. This tendency can be captured if the markedness constraint involved in the BALANCE conjunction is eventually reduced by some speakers to affect only the feature dimensions height and backness, but not roundness.

Ringen & Heinämäki (1999) crucially base their OT analysis of these data on the formalisation of harmony as a featural instantiation of the alignment constraint family and on the assumption that balanced vowels are underspecified in the output of the phonology. The latter introduces a second step of derivation through the backdoor, because the filling in of the appropriate backness feature for the balanced or 'neutral' vowels still has to be provided in another component of grammar or the phonetics. It is doubtful whether the phonetics component would insert frontness for the front rounded vowels in loanwords which have adapted to the behaviour of balanced vowels. Secondly, the analysis of harmony as alignment has to be rejected on external grounds (see Krämer 1998, 2001a,b, Baković 2000, and others), thus, the Finnish alternation data still wait for a detailed analysis. What they show us for the moment, however, is that in vocalic feature interaction, the segment plays a quite subordinate role, if any at all. This is in sharp contrast to the proposal in Ní Chiosáin & Padgett (1997), where all featural interaction is assumed to take place strictly locally on the segmental level. To account for transparency/balance data, they have to assume an intermediate abstract level of representation where all balanced vowels are back when preceded by a back vowel, just as Ringen & Heinämäki have to.

However, their approach gives no hint as to why other front vowels should behave like the balanced vowels as well, and why these other vowels should be reset to their front specification in the phonetic component, since a front rounded vowel like *y* can hardly be reset from its back variant to its front counterpart on the grounds of markedness considerations.

Both accounts lack an explanation of the fact that not all languages with vowels which do not display the whole range of phonemic contrast display transparency/balance as well. Such a segmental analysis can neither give any insight to why alternation in potentially harmonic suffixes attached to chains of balanced vowels, preceded by back vowels, takes place at all.

4 Conclusion

This paper was devoted to the discussion of vowel transparency in vowel harmony. The central topic was the proposal to analyse vowel transparency/neutrality not as such but rather as vowel balance. In particular, balanced vowels are those vowels which have to have the same relationship (i.e., either harmony or disharmony) with the vowel to their right as with the vowel to their left side.

Formally such an analysis is possible only if we conceive of harmony as a featural correspondence relation among vowels or syllable peaks. This analysis has a range of consequences regarding central theoretical issues such as the notion of locality in phonology, the question whether underspecification is necessary (or desirable) in the output of the phonology, as well as the discussion on serialist opposed to parallel treatments of phonological opacity.

If vowel transparency is seen as balance, the segment cannot be the relevant category on which featural interaction must be assumed to take place. As discussed in section 3.3, the relevant argument of the harmony constraint, the disharmony constraint, and consequently that of the local conjunction must either be prosodically motivated, i.e., the syllable, or articulatorily grounded, i.e., a maximally homorganic articulatory span. Balanced behaviour of segments would have almost no consequences at all if we consider vowels and consonants to have distinct sets of features, and it would result in an incredible wealth of assimilation and dissimilation among segments if both types of segment shared the same set of features; whichever choice is made on that topic, the theory of balance would not work for the analysis of transparent vowels if we considered the pattern to take place on the segment level of representation.

Furthermore, the balance analysis allows us to dispense with surface underspecification of the respective vowels. The emerging picture even strengthens the opposite view that the balanced vowels are crucially specified for the harmonic feature. This is preferable since a subsequent phonetic interpretation of underspecified backness values in high vowels could also lead to the articulation of centralised high vowels instead of front ones. This must be prevented since we cannot assume a phonetic component to be sensitive to phonological peculiarities like the ban on vowels which are not part of the phonemic system. If the phonetics were that elaborated and phonology-sensitive, it would constitute a second level of grammatical derivation. Since OT broadly denies the existence of more than two levels of representation (the input and the output), a post-grammatical phonetic component has to be 'deaf' with regard to grammatical issues.

Thirdly, within the proposed analysis no need arises to assume any kind of phonological opacity in connection with balanced vowels. Neither cumulative nor sympathetic evaluation has to be assumed in case the transparent vowels are regarded as balanced. In short, the balance grammar exploits a minimum of representations, since no reference to intermediate levels or failed candidates has to be made. Furthermore, the balance grammar displays a minimum of complexity since no other than strictly parallelist one-step candidate evaluation is necessary. Correspondence relations of the surface form do not have to be extended to failed candidates, nor have particular constraints to be targeted in a cumulative evaluation.

The only additional device of constraint interaction which is crucial here is that of constraint coordination. This is a kind of constraint interaction which is inherent to the basic architecture of Optimality Theory. Even this device is explored to a minimum degree, since the number of conjoined constraints is kept rather low, and the same conjunction can be assumed to be active cross-linguistically as a marking strategy for those vowels which cause an imbalance in the vowel inventory.

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