Vowel Harmony

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Vowel Harmony

An Account in Terms of Government and Optimality

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For Jeroen

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26 March 1998, Amsterdam

1. Introduction

This dissertation deals with some basic theoretical problems concerning the phenomenon of vowel harmony. Harmony is a process whereby some segmental feature associates to all segments of a certain type in a specific domain. In the case of vowel harmony, all vowels in (roughly speaking) a word are required to agree with each other with respect to one of their properties. For example, in a language with palatal harmony, like Hungarian, every vowel in a word must be either front or back. This means, on the one hand, that all vowels of polysyllabic roots are either front or back and, on the other hand, that all affixes containing a vowel have two allomorphs, one with a front vowel and one with a back vowel (the choice of which depends on the root to which the affix is attached). In a language like this, roots are invariant; they control the harmonic set to which the vowels of the word belong and the affixes have to act as chameleons. This type of vowel harmony is referred to as root-controlled. In (1) I provide some examples from Hungarian:

(1)	város-ban	'in a/the city'
	falu-ban	'in a/the village'
	tömeg-ben	'in a/the crowd'
	tükör-ben	'in a/the mirror'

In other languages, however, the dominant systems (like Turkana, cf. Dimmendaal 1983), affixes may also control the harmony.

The phenomenon of vowel harmony is interesting for several reasons for any phonological theory. One of its most challenging aspects is that it looks like a process which operates non-locally, because it 'skips' (or disregards) intervening consonants. In a theory like Government Phonology (cf. Kaye, Lowenstamm &

Vergnaud 1985, 1990), or Dependency Phonology (cf. Anderson & Ewen 1987), however, there is an independently motivated level where vowels are in fact adjacent to each other. Since a vowel forms the head of the syllable that contains it, vowels in their function of syllable heads can be projected to a separate level where they can "see" each other. Consonants, on the other hand, cannot be projected in the same way, and this enables us to explain why consonant harmony of a similar sort does not exist. In a theory like this, the claim can be maintained that all phonological processes operate locally. Such a restriction constrains the number of possible grammars considerably, and this is the main reason why I chose to employ the representational theory of Government Phonology in this dissertation.

The theory of Feature Geometry (cf. Clements 1991a) can also account for the transparency of consonants, but in a different way. In Clements' theory, vowels have a richer geometrical structure than consonants, because they possess the so-called 'V-place node' that consonants lack. Vowel features can thus skip consonants, because association is local at the tier of V-place nodes. The problem with this approach is that there is no independent motivation for the additional node contained by vowels, apart from the phenomenon to be explained, namely, the transparency of consonants to long-distance spreading of vocalic features. This problem is not encountered in Government Phonology.

Apart from the basic problem of transparency of intervening consonants, research on vowel harmony involves three main areas. The first concerns the question of what types of vowel harmonies exist in the world's languages, and which feature theory can account for this typology in the best way. According to modern theories of phonology, sounds can be divided into smaller ingredients, called distinctive features. Since vowel harmony involves the agreement of vowels within a certain domain with respect to a particular property, or feature, a given feature theory predicts that there are as many possible types of harmony as there are vocalic features recognised by the theory. Feature theories thus can be tested on the basis of whether they make correct predictions about the typology of vowel harmony systems. In this dissertation (chapter 4), I will argue that the feature theory of Government Phonology can account for the possible types of harmony.

The second issue concerns the domain of vowel harmony. This domain is usually defined as the "word". One question we need to answer here is whether this domain is defined in terms of morphology or phonology (since members of compounds, for example, constitute separate harmonic spans); and if it is defined phonologically, whether it is a prosodic domain or something else. In this dissertation (chapter 5), I will argue for a phonotactic definition of the domain of harmony; more precisely, that it coincides with the 'analytic domain' to be introduced shortly below. Another question concerns the existence of disharmonic roots and disharmonic affixes. The former can be exemplified by the root *kosztüm* 'costume' in Hungarian, and the latter by the suffix *-kor* (cf. *öt-kor* 'at five o'clock', not **öt-kör*). The domain of harmony should be defined in such a way that systematic characteristics of disharmonic strings are accounted for as well.

The third research area concerns neutral vowels. These are those vowels in a given system that do not have a harmonic counterpart. Their neutrality is manifested by the fact that they can co-occur with vowels of both harmonic sets. Affixes containing neutral vowels have only one allomorph, and they do not alternate depending on what type of root they are attached to. Not all neutral vowels behave in the same way, however. On the basis of their behaviour, two main types can be distinguished. One type is called 'transparent', because harmony goes through these vowels as if they were not there. That is, if a suffix vowel follows a stem that ends in a neutral vowel, the suffix vowel will harmonise with the non-neutral vowel to the left of the transparent vowel, so to speak ignoring what is intervening. The other type is called 'opaque', because these neutral vowels stop the harmony. In these cases, the following suffix vowel harmonises with the neutral vowel itself, ignoring what is preceding in the stem. The issue of transparent vowels is connected to the problem of locality mentioned above, because it seems as if harmony had 'skipped' the transparent vowels. Van der Hulst & Smith (1986) solve this problem, and they further claim that the two types of behaviour exhibited by neutral vowels can be predicted from the segmental make-up of these vowels themselves. In this dissertation (chapter 6), I will test their theory, and show that not all the possibilities predicted by them actually occur in the world's languages. I will propose that it is possible to predict which possibilities do not occur if we take into account certain properties of the vowel systems involved.

The three issues mentioned above will be dealt with in the second half of the dissertation. To be able to offer a solution for these three problems, I had to take a position concerning some more general issues of phonological theory. This forms the first part of the dissertation. In chapter 2, I will argue that considerable advantages can be gained if the framework of Government Phonology is combined with Optimality Theory (cf. Prince & Smolensky 1993). I will show that ranking is necessary to be able to account for certain types of phenomena. Then I will argue that language variation can be expressed exclusively by ranking, and consequently the notion of parameters can be abandoned. In chapter 3, I extend the model developed in chapter 2 by certain insights of Lexical Phonology (cf. Kiparsky 1982a, b). Most importantly, I incorporate a non-derivational version of the Strict Cycle Condition into the theory. This will be utilised in chapter 5 to account for the phenomenon of disharmonicity within roots.

The aim of the present chapter is to make my basic assumptions explicit, and to give the outline of the dissertation. In section 1.1, I introduce Government Phonology and in section 1.2 Optimality Theory. In section 1.3, I present my view on the notion of 'monotonicity'. Finally, section 1.4 contains a preview of the dissertation.

1.1. Government Phonology

Government Phonology (GP) is a theory of the 'principles-and-parameters' type. In this theory, universal principles are inviolable, and language-specific properties are expressed by parameters. Contrary to classical generative phonology, there are no rules in this approach. Instead, the underlying representations change into surface representations as a result of the pressure of the principles and parameters, via the two possible operations, spreading and delinking. The emphasis is thus shifted from the investigation of rules to the investigation of principles and representations. In what follows I introduce the basic ingredients of the theory relevant for further discussions.

1.1.1. The notion of government

Let us start with phonological government, the notion that Government Phonology takes its name from. Government is defined as a binary, asymmetric relation holding between two skeletal points (cf. Kaye, Lowenstamm & Vergnaud 1990). All the examples in this section are cited from this reference, unless otherwise indicated. There are three types of government, to be discussed below: (i) constituent government, (ii) interconstituent government, and (iii) projection government. The first two types are characterised as being strictly local and strictly directional. Strict locality requires that the governor be adjacent to the governee at the level of skeletal points (the P^0 projection). Strict directionality, on the other hand, distinguishes between these two types of government: constituent government is head-initial, while interconstituent government is head-final.

The first type of government, constituent government, defines syllabic constituents. There are three types of constituents recognised by the theory, the O(nset), the N(ucleus) and the R(hyme), which are given in (2). In the following representations, head positions are underlined, and government is indicated by the arrow '→'.

(2) *Constituent government*: defines syllabic constituents

```
O          N          R
|\         |\         |\
| \        | \        N \
|  \       |  \       |  \
x → x      x → x      x → x
```

A constituent head is not required to govern another position, thus non-branching constituents are also licit. It is furthermore stipulated that the left branch of every Rhyme is the Nucleus constituent. Accordingly, the head of the Nucleus is also the head of the Rhyme.

From the strict locality and strict directionality conditions the following theorem is derived:

(3) *Binarity Theorem* (cf. Kaye, Lowenstamm & Vergnaud 1990: 199)
All syllabic constituents are maximally binary.

This is so because in a ternary constituent no position can be simultaneously adjacent to both other positions and at the same time govern them, if government can only proceed in one direction. The condition on strict locality also excludes the structure in (4), because x_1, the head, is not adjacent to x_3. In this way, branching nuclei in closed syllables are ruled out.

(4) *No superheavy rhymes*

```
*R
 |\
 N \
 |\ \
x1 x2 x3
```

For the same reason, it follows that the coda cannot branch either. Since the coda is thus not a governing domain, it is not a syllabic constituent in the sense defined above. The term 'coda' is simply used as a shorthand for 'post-nuclear rhymal position'.

The second type of government, interconstituent government, is illustrated in (5). The only difference with respect to constituent government is that here government is head-final.

(5) *Interconstituent government*: defines the coda-onset domain

```
R          O
| \        |
N  \       |
|   \      |
x    x  ←  x
```

Apart from the formal conditions on government discussed so far (i.e. strict locality and strict directionality), there are also substantive conditions on what can be a governor and what a governee. This is basically defined in terms of complexity, where a governee cannot be more complex than its governor (cf. the Complexity Condition in Harris 1990a). Since the details of syllabic constituency will not be of direct relevance for the topic of this thesis, it will suffice to say here that in general the more sonorous a segment, the lesser its complexity.

The third type of government, and the most important one for the topic of this dissertation, is projection government. It applies at the level of nuclear projection, and holds between heads of nuclear constituents. This type of government is also local (but not strictly local), in the sense that, at the relevant level of projection, the two nuclear constituents are adjacent, although other material may intervene at lower levels. Unlike the other two types, projection government is language-specific in its directionality, that is, it can be either head-initial, or head-final. This type of government is evidenced by stress, tone and harmony phenomena. Furthermore, its domain can be either binary or unbounded (cf. Kaye 1990b), as illustrated in (6). In (6a), an example of head-final binary projection government is shown, while in (6b), an example of head-initial unbounded projection government can be seen.

(6) *Government at the nuclear projection*

(a) *binary projection government*

```
     N  ←  N          P1
     |     |
O    N1  O  N2
|    |   |  |
x    x   x  x
```

(b) *unbounded projection government*

$$
\begin{array}{ccccccccc}
 & N & & & \rightarrow & & & N & P^3 \\
 & | & & & & & & | & \\
 & N & & \rightarrow & & N & & N & P^2 \\
 & | & & & & | & & | & \\
 & N & \rightarrow & N & & N & & N & P^1 \\
 & | & & | & & | & & | & \\
O & N_1 & O & N_2 & O & N_3 & O & N_4 & \\
| & | & | & | & | & | & | & | & \\
x & x & x & x & x & x & x & x &
\end{array}
$$

Under projection government, unlicensed nuclei are projected to the next higher level, P^1, where they can enter into a governing relation. In the case of unbounded government, at this projection, the governing position N_1 can only govern N_2, since this is the only position adjacent to it. The latter position, now licensed, is not projected to the next higher level. N_3, however, still unlicensed, is projected to P^2, and N_1 can now govern it. N_4 in turn gets licensed in the same way at the next projection, P^3. N_1, the governor, thus governs all of its governees in a local manner, although each one on a subsequent level of projection.

1.1.2. A special form of government: proper government

To account for cases of vowel~zero alternations, Government Phonology also recognises 'empty skeletal positions'. The distribution of such empty positions, however, has to be constrained. This is what is achieved by the device of Proper Government, a stronger form of projection government, defined in (7).

(7) *Proper Government* (Kaye 1990a: 313)

A nuclear position *A* properly governs a nuclear position *B* iff

(i) *A* governs *B* (adjacent on its projection) from right to left[1]
(ii) *A* is not properly governed
(iii) there is no intervening governing domain

[1] Proper government is standardly assumed to always apply from right to left, that is, to be head-final. However, see Rowicka (1996) for arguments for head-initial proper government.

In addition, the phonological version of the Empty Category Principle (ECP) is assumed, as given in (8).

(8) *Empty Category Principle*

An empty Nucleus is phonetically interpreted iff it is not properly governed.

The workings of proper government (indicated by the arrow '-<-'), together with the ECP, can be illustrated by the examples of vowel~zero alternation in Moroccan Arabic (cf. Kaye, Lowenstamm & Vergnaud 1990), shown in (9).

(9) *Moroccan Arabic vowel~zero alternation*

```
(a) Singular              (b) Plural

   N–<–N                       N    N –<– N
   |   |                       |    |     | \
 x x x x x                  x  x  x  x  x x x
 |   |   |                  |     |     | | /
 k   t   b                  k     t     b u

ktɨb      'I write'         kɨtbu:    'we write'
```

The stem portions of both forms only contain empty nuclei. These will not be realised phonetically as long as they are followed (properly governed) by a phonetically realised (full) nucleus appearing immediately to their right. The final nucleus of (9a), not being properly governed, will be pronounced. It then can properly govern the preceding empty nucleus, which in turn can remain silent. In (9b), the situation is different. Here, the plural marker *-u:* can properly govern the final empty nucleus of the stem, whose pronunciation now becomes unnecessary. The first empty nucleus of the stem, however, is now not properly governed, and as a result, it has to be realised phonetically. In this way, an alternating pattern of full and empty nuclei is derived.

In the causative, however, where the root-medial consonant is geminated, we find a different pattern, as shown in (10).

(10)

```
(a) Singular                      (b) Plural

     N         N                      N          N—<—N
     |         |                      |          |     | \
  x  x   x<-x  x  x               x   x   x<-x   x  x  x  x
  |       \ |     |               |        \ |      |  | /
  k         t     b               k          t      b  u
```

kittɨb 'he made x write' *kittbu:* 'we made x write'

The stem-final empty nuclei behave exactly as they did in (9). The stem-initial empty nuclei, on the other hand, cannot be properly governed in either (10a) or (10b), because there is an intervening governing domain between the potential governor and its governee, namely, the interconstituent governing domain constituted by the root-medial geminate. These stem-initial empty nuclei thus have to be pronounced, irrespective of whether they are followed by a full or a silent nucleus.

1.1.3. Element theory

Another important aspect of Government Phonology for research on vowel harmony is its feature theory. In this theory, distinctive features (the 'elements') are single-valued. That is, they are either present or absent from a particular sound. And when they are absent, they cannot be referred to. Therefore such a theory is more restrictive than a theory using binary or n-ary features (provided the number of elements is low).

Current research in Government Phonology (cf. Harris 1990, Harris & Lindsey 1995, Cobb 1997) distinguishes the three basic elements given in (11).

(11) *The set of elements*

I	'frontness'
U	'roundness'
A	'lowness'

The three basic elements can be pronounced by themselves, giving the vowels /i, u, a/. When they are combined with each other, they result in more complex vowels. Combination can happen in two ways: either all elements are equal, or one of them forms the head of the resulting expression (indicated by underlining). The elements **I** and **A**, for example, can either combine into the headless (**A.I**), giving /ɛ/, or into the headed ($\mathbf{A.\underline{I}}$), giving /e/. Headedness is thus a further property of segments.[2] Apart from the simplex and complex vowels mentioned so far, the completely empty vowel is licit as well. This vowel has no prominent properties, and is usually realised as /ɨ/, as in the Moroccan Arabic example above.

Following the traditions of autosegmental phonology, elements reside on separate tiers (or lines). The fact that in simpler vowel systems certain combinations of elements are ruled out is expressed by line fusion (cf. Kaye, Lowenstamm & Vergnaud 1985), that is, by assigning more than one element to a single line. Since on each line only one element can be linked to a given skeletal position, it follows that elements defining a fused line cannot combine with one another within one expression. In a three-vowel system thus all three elements reside on the same line, while in a five-vowel system, like (12), the element **A** has its own line, while **I** and **U** share a line.

(12) *Two lines: five-vowel system*

```
I/U  ------I-----U------------I-----U---
           |     |            |     |
 A   ------------------A------A-----A---
           |     |     |      |     |
           x     x     x      x     x
          /i/   /u/   /a/    /e/   /o/
```

As a consequence **I** and **U** cannot combine with each other, and front rounded vowels are excluded from the system.

1.1.4. Analytic vs. synthetic morphology

The last area of Government Phonology that is of interest for us concerns the interface between phonology and morphology (cf. Kaye 1995). In this theory, very little morphological information is visible to the phonology. Essentially, two types of morphological structure are distinguished: analytic and synthetic morphology. In case of analytic affixation, the affix is not part of the root's phonological domain. Thus by observing the surface form, it can be seen that it is morphologically complex. An example is provided by the word [[seep]ed] /si:pt/ in English, comprising

---

[2] This property has taken the place of a former element indicating 'ATR-ness', which in the present model is thus expressed structurally.

two analytic domains (indicated by square brackets). Empirical evidence for this analysis is provided by the fact that the cluster /pt/ is never preceded by a long vowel within a single morpheme in English.

Synthetic affixation, on the other hand, is invisible to the phonology. In these cases, the affix forms one phonological domain with the root, as in the form [kept]. Synthetically derived forms comply with the phonotactic restrictions exhibited by non-derived forms, thus there is no phonological hint of their complex morphological structure. In addition, synthetic morphology is often non-productive, and its semantics less compositional than that of analytic morphology. In sum, synthetically derived forms behave phonologically like non-derived forms do.

In this section, I have introduced the main ingredients of Government Phonology that will be assumed throughout this dissertation. In the next section, I turn to a brief introduction of the main tenets of Optimality Theory.

1.2. Optimality Theory

Optimality Theory (OT) – as developed in Prince & Smolensky (1993) – is also a non-procedural theory of phonology, where rewrite rules are replaced by constraints based on the output. Instead of transforming the underlying form, a (potentially infinite) set of candidate forms are generated by the function *Gen*. These candidate forms are then evaluated by a system of constraints (*Eval*) which select the candidate that best satisfies the constraint system as the actual output. An OT grammar thus looks like (13) (cf. McCarthy & Prince 1993a: 4).

(13) *An Optimality-Based Grammar*

> *Gen* (input$_i$) → {candidate$_1$, candidate$_2$, ...}
> *Eval* ({candidate$_1$, candidate$_2$, ...}) → candidate$_k$ (the output, given input$_i$)

The central proposal of OT is that constraints are violable and they are ranked, such that a lower-ranked constraint can be violated in the optimal output in order to satisfy some higher-ranked constraint. Universal Grammar specifies the set of constraints, but the ranking is given on a language-specific basis.

Best-satisfaction (minimal violation) is defined in a twofold manner: on the one hand, in case of a constraint conflict, the candidate which violates the *lowest-ranked* constraint is the best, and on the other hand, in case of a gradient constraint, the candidate which violates it *least* is the best. In case of a tie, all surviving candidates are tested recursively against the rest of the hierarchy. The optimal member of a candidate set is the output. Once the winner is found, the lower-ranked constraints are irrelevant. This can be illustrated by the schematic example in (14), where the basic conventions of constraint tableaux are listed as well.

(14)

Candidates	A	B	C	D
$cand_1$	*!			*
$cand_2$		*!		
$cand_3$			**!	
☞ $cand_4$			*	***

The basic conventions of OT are (cf. McCarthy & Prince 1993a: 6-7):

- Left-to-right order mirrors the dominance order of the constraints.
- A dotted line signals that the constraints in question are not ranked with respect to each other.
- Violation of a constraint is indicated by *.
- Satisfaction is indicated by a blank cell.
- The symbol ! indicates a fatal violation, the one that is responsible for a candidate's non-optimality. It highlights the point where the candidate in question loses to other more successful candidates.
- The symbol ☞ indicates the optimal candidate.
- Shading indicates the irrelevance of the constraint to the fate of the candidate. A loser's cells are shaded after the fatal confrontation, the winner's when there are no more competitors.

Candidate$_1$ and candidate$_2$ in (14) are non-optimal, because each of them violates one of the highest-ranked constraints, A and B respectively, while the other forms do not violate these constraints. Now the decision has to be made between candidate$_3$ and candidate$_4$. Both of these forms violate constraint C, but candidate$_4$ only violates it once, therefore this is the optimal candidate, that is, the output form (even though in total candidate$_4$ has the highest number of violation marks).

The candidates are supplied by *Gen*. There are three principles underlying the theory of *Gen*, as in (15). *Freedom of Analysis* ensures that there are no specific rules or repair strategies needed. *Containment* is related to monotonicity, a notion described in section 1.3. *Consistency of Exponence* is a specific hypothesis about the morphology-phonology relationship, namely that the lexical specifications of a morpheme cannot be changed by *Gen*.

(15) *Principles of Gen* (cf. McCarthy & Prince 1993a: 20)

(i) **Freedom of Analysis**. Any amount of structure may be posited.
(ii) **Containment**. No element may be literally removed from the input form. The input is thus contained in every candidate form.
(iii) **Consistency of Exponence**. No changes in the exponence of a phonologically specified morpheme are permitted.

In a recent version of Optimality Theory, Correspondence Theory (cf. McCarthy & Prince 1995), Containment has been abandoned. However, since I find monotonicity an important property of grammar, I will stick to the original formulation of OT, as defined in Prince & Smolensky (1993), and deletion and structure-changing will be forbidden accordingly. The most important consequences of this move concern the Faithfulness constraints which demand that input and output structures are maximally similar, given in (16). Note that only (16a-b) come from Prince & Smolensky (1993), whereas (16c) is my formulation, where elements refer to the distinctive features used in Government Phonology.

(16) *Faithfulness constraints*

(a) PARSE
Segments are parsed.

(b) FILL
Empty positions are prohibited.

(c) *ELEMENTS
Elements are prohibited.

In this way, the Faithfulness constraints are pure output constraints, they can be evaluated just by looking at the output, and a comparison between output and input is not required (as it is in Correspondence Theory). More precisely, whether a segment is parsed into higher order prosodic units, or whether a position in syllable structure dominates a segment can be seen by simply observing the output.

It should be noted here that when constraint ranking is applied to a representational theory such as Government Phonology, the constraint FILL acquires a slightly different interpretation from the one usual in classical OT. In GP, syllable structure is underlying, and moreover – as we have seen in the previous section –, empty positions are admitted as well. Some of these empty positions will receive phonetic interpretation in the end, but some of them will remain silent also on the surface. The constraint FILL is violated by both types of empty positions (unless the segmental material filling the empty position results from a phonological process such as spreading). However, as we will see in subsequent discussions, this will not affect the analyses in any crucial way.

Turning now to *ELEMENTS, this constraint replaces the constraint usually used in the OT-literature, *INSERT (F), given in (17), which prohibits the insertion of features (cf. Kirchner 1993, for example).

(17) *INSERT (F)
Do not insert features.

*INSERT (F) does not conform to the classical OT-proposal of only utilising pure output constraints, since it needs to compare the output with the input to be able to detect whether anything has been inserted.

*ELEMENTS, on the other hand, complies with this requirement. In a monotonic theory, where nothing can be deleted, *ELEMENTS picks out the candidates where some elements have been inserted, since all candidates have a common core of violations, reflecting lexical input. This constraint can be regarded as a parallel to the *STRUCTURE constraint, in this case prohibiting material instead of structure, and it expresses the implicit claim of unary feature theories that the less complex is the less marked. In this way, all three Faithfulness constraints used in this dissertation are true output constraints.

Finally, I depart in one crucial respect even from the classical OT-model. I do not adhere to the notion of Richness of the Base. According to this hypothesis, there are no constraints holding of the input. However, I would like to argue that if we assume the organisation of the phonological component as given in (18), then there is no reason why there could/should not be constraints referring to the input.

(18) *Organisation of the grammar*

underlying representations

↓

Lexical Phonology

↓

Postlexical Phonology

↓

phonetic forms

In such an organisation, the level of underlying representations is in no essential way different from any of the other levels (i.e. the output level of the Lexical Phonology and the output level of the Postlexical Phonology). Constraints defined with respect to the input level, thus, can be regarded as output constraints of a grammatical component whose other properties we are not interested in.

The Richness of the Base hypothesis in a sense recaptures the generalisation formulated in Kiparsky's (1985) principle of Structure Preservation, according to which processes of the Lexical Phonology cannot introduce new types of segments. In other words, constraints on underlying segment structure also hold at the output of the lexicon. However, as we will see in chapter 3, there are (sequential) generalisations (the 'word level rules') that only hold on the set of underlying representations, and not of the output of the lexicon. These generalisations cannot be expressed if one adheres to the hypothesis of Richness of the Base. Further arguments in favour of constraints on the input can be found in Archangeli & Suzuki (1997).

In this section, I have introduced the main properties of Optimality Theory, as used in this thesis. Since the notion of monotonicity has played an important role in the above discussion, and since its relevance is connected to the rejection of the Richness of the Base hypothesis, I turn to a more detailed description of this principle in the next section.

1.3. Monotonicity

The framework adopted in this dissertation makes a commitment to the principle of derivational monotonicity, defined in (19) (cf. Kálmán 1989: 21).

(19) *Derivational Monotonicity*

> A grammar is derivationally monotonic iff for any pair r_1, r_2 of representations such that r_2 can be derived from r_1 by some rule of the grammar, the information content of r_2 includes the information content of r_1.

The definition in (19) refers to rules, but the actual way of deriving the output representation from a given input representation is orthogonal to the issue of derivational monotonicity. What is important about (19) is that as a consequence of it, destructive or transformational operations such as feature changing or deletion rules are prohibited from linguistic derivations.

This principle is adhered to in several linguistic theories (such as Declarative Phonology, cf. Scobbie, Coleman & Bird (1996) and references therein). Here, I briefly review the main types of motivation for adopting this principle.

One reason is to achieve mathematical tractability and formal interpretability of grammars, which can only be accomplished if linguistic operations may not decrease the information content of a representation. Another motivation is connected to the 'abstractness' problem (cf. Kiparsky 1968). Theories adhering to derivational monotonicity claim that underlying representations can only differ from their surface realisations by the former lacking some information with respect to the latter. That is, a straightforward link is guaranteed between inputs and outputs, and abstractness is essentially equivalent to underspecification.

Since neither Government Phonology nor Optimality Theory is inherently incompatible with the principle of monotonicity, in what follows I will assume a version of these theories that adheres to this principle.

1.4. Preview

Finally, in this section, I give an outline of the dissertation. In the first part (chapters 2 and 3), I introduce the theoretical framework that I will use in discussing the three basic issues concerning vowel harmony in the second part (chapters 4, 5 and 6). In chapter 2, I motivate the proposal of combining Government Phonology, the theory of phonological representation I have chosen to use in this dissertation, with Optimality Theory, a theory of constraint interaction. I use the "principle" of Government Licensing as the basis of the discussion. This principle is in conflict with Proper Government word-internally and with the faithfulness constraint FILL word-finally. I show that an account using explicit constraint ranking is superior to a purely parametric approach. Furthermore, since ranking is shown to be necessary in any case, it would be preferable if parameters could be dispensed with altogether. I will illustrate that this is in fact possible by replacing the parameter licensing domain-final empty nuclei by a violable constraint. As a consequence, consonant-final words will end in an onset, instead of ending in an empty nucleus.

In chapter 3, I incorporate certain aspects of Lexical Phonology into the theory so far developed. I will argue that apart from the synthetic-analytic morphological distinction generally recognised in Government Phonology, there is still some derivational residue left in the theory. Some version of the lexical phonological notion of the Strict Cycle Condition needs to be retained. I will propose a violable constraint to achieve this goal which I will call the DERIVED ENVIRONMENT CONSTRAINT. Further, I will argue that to be able to evaluate this constraint in a relatively simple way, the strong version of the principle of Structure Preservation has to be adhered to. This means that lexical rules cannot create new types of segments, and rules that do create new types cannot be lexical.

In chapters 4, 5 and 6, I look at three basic issues concerning vowel harmony in the framework developed in the previous chapters: the issue of harmonic features (chapter 4), the issue of the harmonic domain (chapter 5), and the issue of neutral vowels (chapter 6). In chapter 4, I show that the element-based feature theory of Government Phonology, comprising the three elements **I**, **A** and **U** (supplemented by the property of headedness, standing for ATR), is capable of accounting for the different types of vowel harmony systems occurring in the world's languages. After exemplifying each type, I turn to the case of raising harmony in the Pasiego dialect of Spanish and show that it does not constitute a problem for the theory. That is, we do not need to refer to the absence of the element **A**, if we combine the Government Phonology analysis with Optimality Theoretic constraint ranking, where raising is the result of lack of licensing of particular configurations in governed positions. Raising is thus argued not to be a case of harmony after all.

In chapter 5, I discuss the issue of the harmonic domain, and the problems of disharmonicity. On the basis of a detailed analysis of Turkish vowel harmony, I will propose that vowel harmony applies with reference to the domain introduced in chapter 3, the 'analytic domain'. Furthermore, disharmonic roots will be analysed as a case of derived environment effects. That is, vowel harmony in Turkish is one of those processes that are blocked in a non-derived environment. Vowel harmony is thus subject to the DERIVED ENVIRONMENT CONSTRAINT, introduced in chapter 3. For the case of disharmonic suffixes, I will claim that they can only be of two types: they either behave as parts of compounds, and they fall into the category of 'compounding analytic' suffixes; or they are unproductive derivational suffixes, and they belong to the group of 'synthetic' suffixes. That is, vowel harmony only applies if 'analytic' suffixes are added to the root.

In chapter 6, I will test the neutral vowel theory proposed by Van der Hulst & Smith (1986). According to this theory, neutral vowels are expected to behave in one of two ways, depending on their segmental composition: they either possess the harmonic feature and they are transparent to harmony (since the harmonic feature is compatible with them and thus can spread through them); or they lack the harmonic feature and they are opaque (because harmony cannot skip any vowels). I will show that not all of the possibilities Van der Hulst & Smith (1986) predict actually occur, and propose a way to account for these non-occurrences on the basis of particular properties of the vowel inventories involved. I will claim that elements residing on fused lines cannot harmonise. As a consequence, **I**- and **U**-harmony are only possible in systems containing front rounded vowels. In contrast, ATR- and **A**-harmony can occur in triangular vowel systems, as well. Finally, I will discuss the role of the constraint prohibiting the combination of the property of headedness with the element **A**.

Chapter 7 provides a summary of the main findings of this study.

Part I. The framework

2. A combined theory of Government Phonology and Optimality Theory

In this chapter,[1] I propose to combine Government Phonology, a theory of phonological representation, with Optimality Theory, a theory of constraint interaction. Government Phonology (GP) is a principles-and-parameters approach, where principles are inviolable and language-specific facts are expressed by parameters (cf. Kaye, Lowenstamm & Vergnaud 1985, 1990). Some analyses, however, have been proposed which involve a conflict between different principles that is resolved on a language-particular basis (cf. Charette 1990, 1991, 1992, Cyran 1996, 1997). I use Government Licensing (GL) as an example, and I propose that such conflicts can be resolved by Optimality Theoretic (OT) ranking (cf. Prince & Smolensky 1993), rather than 'turning the principles off' in a parametric style. This not only makes the grammar simpler, but it also allows the lower-ranked constraints to have an effect in a non-conflict situation.

The project of combining GP with OT can also be of interest from a more general point of view, because both theories work with constraints, but concentrate on different aspects of the grammar. GP concentrates on the properties that all languages share with each other (that is, the inviolable principles that eventually constitute a theory of *Gen*; and the nature of the (violable) constraints, the *Con* component of the grammar). OT, on the other hand, concentrates on how languages can differ from each other (that is, on the ranking of the constraints). In an investigation that tries to combine the strong features of these theories with each other, several questions arise. For example, which of the principles of GP remain inviolable and which become violable in a combined approach, and is there any principled basis

[1] This chapter is a revised version of Polgárdi (1999a). A previous version has also appeared as Polgárdi (1996).

for such a distinction? Another question concerns parameters. Since it will be shown that ranking is necessary in any case, the question arises whether parameters are still needed as well, or whether they can all be replaced by ranking (the means expressing language variation in OT). I will show on the basis of the parameter licensing final empty nuclei that this is possible, and that this move, apart from other advantages, also simplifies the account of the behaviour of final consonants.

The chapter is built up as follows: section 2.1.1 introduces the different types of behaviour an empty nucleus can exhibit when it follows a word-internal consonant cluster, and explains how the principle of Government Licensing is meant to account for these different types. Section 2.1.2 shows that the alternation in Tangale analysed by Charette cannot be derived without violating the Projection Principle. Section 2.1.3 further shows that a purely parametric account is unsatisfactory, and proposes a solution in terms of Optimality Theoretic constraint ranking. Section 2.1.4 illustrates the typology of word-final clusters. Section 2.2 proposes to dispense with the parameter that licenses final empty nuclei, again by utilising the device of constraint ranking. Section 2.3 shows how an account without domain-final empty nuclei can handle the behaviour of final consonant clusters in a superior way to a purely parametric approach. Section 2.4 summarises the results.

2.1. Government Licensing

2.1.1. Charette (1990, 1991, 1992)

Charette (1990, 1991, 1992) discusses the problem of what happens in different languages exhibiting vowel~zero alternations when the configurations in (1) arise (where government licensing is indicated by "<<"). In these structures, the empty nucleus N_a is followed by the full nucleus N_b, thus N_a could be properly governed and as a consequence is predicted to remain silent. However, N_a at the same time follows a consonant cluster. Consonant clusters always involve a governing relation, and Charette claims that for such a relation to hold, the head of the cluster must be licensed to govern its complement by a following full nucleus. (That is, an empty nucleus is not strong enough to support such a governing relation.) N_a therefore should be audible.

(1) *Properly governable nuclei following a consonant cluster*

(a) *after a complex onset*

```
               inaudible
              N —<— N
       audible |       |
O<<<<<Na  O   Nb
|  \          |     |    |
x → x     x    x    x
|    |            |    |
A   B           C   D
```

(b) *after a coda-onset cluster*

```
                         inaudible
                       N —<— N
               audible |        |
R            O<<Na   O   Nb
|  \           |     |     |     |
x     x ← x     x    x     x
|      |     |            |     |
V    W   X           Y    Z
```

These requirements concerning N_a's audibility thus conflict with each other. Charette shows that different languages resolve this conflict in different ways. She classifies languages into three types, exemplified by French, the Billiri dialect of Tangale (a Chadic language spoken in Northern Nigeria)[2] and Polish, as illustrated in (2). Forms under (i) show that empty nuclei, represented by v^0, remain silent when they are followed by a full vowel in the next syllable (i.e. when they are properly governed), if they are only preceded by one consonant. If, however, they are preceded by more than one consonant, then these languages react differently, shown by the examples under (ii). As can be seen from these examples, French chooses to phonetically realise the empty nucleus even though it could be properly governed; Tangale – after vowel syncope, affecting short vowels followed by another vowel – deletes the second consonant from the cluster; and Polish treats empty nuclei following consonant clusters in the same way as those following single consonants – that is, it leaves them phonetically null.

[2] Note that according to the grammar of Kidda (1993), it is the Kaltungo dialect which behaves in the way illustrated in (2), whereas the Billiri dialect shows different behaviour. However, this will not affect the argumentation.

(2) *Typology of properly governable empty nuclei following a consonant cluster (Charette 1990, 1991, 1992)*

(a) *French*: phonetic realisation of empty nucleus

(i)	samv^{0}di	[samdi]	'Saturday'
(ii)	marguv^{0}ritv^0	[margərit]	'daisy'
	librv^{0}ment	[librəmã]	'freely'

(b) *Tangale*: proper government + deletion of second C

(i)	sana+do	[sando]	'her food'
(ii)	landa+zi	[lanzi]	'your (f.) dress'

(c) *Polish*: proper government of empty nucleus

(i)	kopv^{0}ra	[kopra]	'dill'
(ii)	plastv^{0}ra	[plastra]	'plaster'
	ubrv^{0}dacv^0	[ubrdac]	'imagine'

Charette (1990: 244) analyses the difference between these types of languages by the two principles in (3), standing for the two forces illustrated in (1).

(3) (a) An empty nucleus is properly governed by a head-adjacent unlicensed nucleus. (Proper Government)[3]
(b) A governing consonant must be government-licensed by an unlicensed nucleus governing it. (Government Licensing)

The principle of Government Licensing expresses the descriptive generalisation that in certain languages triconsonantal clusters are disallowed (*CCC). That is, an empty nucleus in the configuration -VCCv^{0}CV- cannot remain silent.

According to Charette's analysis then, French opts to preserve (3b), government licensing, while Tangale opts for (3a), proper government of empty nuclei. But since government licensing cannot be violated in Charette's analysis, the consonant cluster has to disappear as well. Polish is then like Tangale in opting for proper government, but in this language the parameter defining potential government licensers is set differently, namely, here

[3] The relation of proper government is defined as follows:
A properly governs B iff
(i) A governs B (adjacent on its projection) from right to left
(ii) there is no intervening governing domain
(iii) A is not properly governed

properly governed empty nuclei are government licensers as well. And consequently, government licensing is also satisfied.

There are a number of problems with this analysis. One is that it is misleading to say that Tangale opts for proper government over government licensing, whereas the phonetic forms in Tangale obey both of these principles: the nucleus remains silent, and it is not preceded by a cluster that would be in need of licensing. (However, a third constraint *is* violated, namely, the one prohibiting deletion of segments.) It would only make sense here to talk about violation of government licensing if we had a step-by-step derivation, or we employed a constraint-and-repair strategy, and we had an intermediate stage after syncope (but before consonant deletion) that we could refer to which would violate this constraint, but which would later be repaired by deleting the consonant. Since there is no such level, government licensing cannot be claimed to be violated.

The language which, in my view, does violate government licensing is, instead, Polish. I disagree that Polish is different in that here empty nuclei are government licensers too, because this amounts to saying that in Polish a governing onset must be licensed by a nucleus of any type. But this is already required of any onset, governing or not. That is, this is equivalent to saying that Polish simply lacks the Government Licensing constraint, or if it has it, it is not important enough not to violate it. However, setting a parameter within the constraint does not express this fact.

In addition, it is not clear how the Tangale alternation could be derived without violating the Projection Principle (defined below). I turn to this problem in the next section and I will argue that since the Tangale alternation cannot be derived, it does not belong to the typology given in (2).

2.1.2. Tangale and the Projection Principle

Charette (1990: 248) analyses the derivation of a form like (2bii) in Tangale as given in (4), where the surface representation in (4b) is derived from the lexical representation in (4a) (cf. also Nikiema 1989). Since the *d* in (4b) is no longer parsed into syllable structure, it remains silent.

(4) *Tangale*

(a) *lexical representation*

```
     N       O  N —<— N      proper government
     |       |  |     |
O1   R1      O2 N2 O3 N3
|    | \     |  |  |  |
x    x  x <- x  x  x  x      interconst. gov't
|    |  |    |  |  |  |
l    a  n    d  v0] z i
```

(b) *surface representation*

```
     N          N —<— N      proper government
     |          |     |
O1   N1  O2     N2 O3 N3
|    |   |      |  |  |
x    x   x   x  x  x  x
|    |   |   |  |  |  |
l    a   n   d  v0] z i
```

[lanzi]

Notice, however, that such a derivation violates the Projection Principle, given in (5), since the *n* is resyllabified from a lexical rhymal position into a surface onset, and the originally following onset is deleted, thus the coda-onset governing domain disappears. Therefore the surface form in (4b) cannot be derived from the lexical representation in (4a).

(5) *Projection Principle* (Kaye, Lowenstamm & Vergnaud 1990: 221)

> Governing relations are defined at the level of lexical representation and remain constant throughout a phonological derivation.

We could try to remedy the situation by syllabifying the *n* in an onset position lexically, as in the hypothetical lexical representation given in (6). In this case, both N_2 and O_3 would be deleted by the time we reach the surface (itself a dubious move). This means that there cannot be a governing relation between O_2 and O_3 underlyingly, since then this relation would disappear during the derivation, again in violation of the Projection Principle. Since there is no governing relation between the consonants, Government Licensing has no role to play in this derivation at all.

(6) *lexical representation (modified)*

	N		N		N		N
	$\vert$		$\vert$		$\vert$		$\vert$
O_1	N_1	O_2	N_2	O_3	N_3	O_4	N_4
$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$
x	x	x	x	x	x	x	x
$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$
l	a	n	v^0	d	v^0]	z	i

At this point, however, the question arises why, instead of (4b), we do not get (7) from (6) on the surface, that is, the usual alternating pattern of phonetically null and realised empty nuclei. (In this language, unlicensed empty nuclei surface as the vowel /u/.) A surface form like (7) would not violate any of the constraints discussed so far, and would not need to employ the additional, and powerful, mechanism of deletion.

(7) *surface representation (modified)*

	N		N		N —<—		N	proper government
	$\vert$		$\vert$		$\vert$		$\vert$	
O_1	N_1	O_2	N_2	O_3	N_3	O_4	N_4	
$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	
x	x	x	x	x	x	x	x	
$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	$\vert$	
l	a	n	v^0	d	v^0]	z	i	
			$\vert$					
			U					

*[lanudzi]

Comparing (4b) with (7) suggests that deleting a consonant (and an empty nucleus), i.e. the derivation of (4b) from (6), is still better than phonetically realising an empty nucleus, and arriving at (7). This suggestion is, however, again refuted by the parallel – though morphologically more complex – Tangale form that surfaces with exactly the pattern of (7) and has an alternating sequence of phonetically null and contentful empty nuclei, as shown in (8).

(8) *Alternating pattern of full and empty nuclei*

	N		N		N	—<—	N	proper government
	|		|		|		|	
O_1	N_1	O_2	N_2	O_3	N_3	O_4	N_4	
|	|	|	|	|	|	|	|	
x	x	x	x	x	x	x	x	
|	|	|	|	|	|	|	|	
d	o	b	v^0]	n	v^0]	g	o	
			|					
			U					

[dobungo] 'called me'

The only way, therefore, to derive (4b), instead of (7), is by not positing the empty N_2 to begin with – that is, by leaving the underlying representation of [lanzi] as (4a), as one containing an underlying coda-onset cluster.[4] However, as we have seen above, in that case there is no way to derive the change between (4a) and (4b) without violating the Projection Principle. Therefore I would like to argue that the consonant~zero alternation in Tangale should not be analysed as phonologically conditioned, but as a case of allomorphy, similar to for example Closed Syllable Shortening in English in pairs like *keep~kept* (cf. Kaye 1990a, Harris 1994a). Deriving the English alternation would also violate the Projection Principle, and the forms resulting from the alleged derivation pattern together with underived forms of the language, just as they do in Tangale.

Consequently, the relevant forms in Tangale do not constitute a minimal pair with the French and Polish examples given in (2), and therefore the Tangale alternation does not directly figure in the typology to be discussed here. Thus from now on I will concentrate on the French-type and Polish-type languages. In fact,

[4] Note that the issue of morphological complexity is not relevant here, because Proper Government only applies within analytic domains, and not across them. Thus all the relevant suffixes in Tangale must be synthetic (i.e. they must form one phonological domain with the stem), and the boundary symbols in all the above examples can only refer to morphological boundaries, and not to phonological ones. (For a detailed discussion of the distinction between analytic and synthetic morphology, see chapter 3.)

Moreover, according to Kidda (1993), the pattern in (8) is in fact the default in monomophemic cases as well, and consonant deletion only occurs in the case of tautomorphemic geminates, and homorganic nasal/liquid + stop clusters. This also points in the direction of an analysis that recognises a governing relation between the consonants in the latter type of cases.

I am going to argue that it is Polish that violates government licensing, instead of Tangale.

2.1.3. French vs. Polish and Optimality Theory

It seems thus that there are only two types of languages when it comes to the behaviour of properly governable nuclei following a consonant cluster. There is French, which satisfies government licensing by (3b), and Polish, which violates it in order to satisfy proper government of empty nuclei. These two possibilities can be illustrated as in (9a-b).

(9) (a) *French*

```
      N          N     N     N
      |          |     |     |
O1    R1      O2<<N2   O3    N3    O4    N4   gov't licensing
|     |  \     |   |   |     |     |     |
x     x   x <- x   x   x     x     x     x    interconst. gov't
|     |   |    |   |   |     |     |     |
m     a   r    g   v0  r     i     t     v0
```

[margərit]

(b) *Polish*

```
      N          N  —<—  N           N    proper gov't
      |          |       |           |
O1    R1      O2   N2   O3    N3    O4    N4
|     |  \     |   |    |     |     |     |
x     x   x <- x   x    x     x     x     x    interconst. gov't
|     |   |    |   |    |     |     |     |
v     a   r    x   v0   l     a     k     v0
```

[varxlak] *warchlak* 'boarlet'[5]

In (9a), the full vowel under N_3 is not allowed to properly govern the empty N_2 so that this ungoverned nucleus can government license O_2. Since the empty N_2 is not properly governed, it receives phonetic content. The problem here is that there is no explicit means in the standard GP approach to express the fact that the principle of Government Licensing overrides the principle of Proper Government in case of a conflict, as in (9a).

[5] This example was provided by Grażyna Rowicka.

This is where principle ranking can provide a solution.

This ranking, however, is not universal, that is, it can be reversed, as evidenced by Polish, represented in (9b). Here the empty N_2 *is* properly governed by the full vowel in N_3. N_2 therefore remains silent, and it is thus not capable of giving the required license for O_2 to govern. That is, here it is Proper Government that overrides Government Licensing.

Notice that O_2 in (9b), though not licensed, still governs the preceding rhymal complement. This is a legitimate state of affairs, if constraints are violable. This situation can be compared to driving a car without a license. Such a driver breaks a rule, but he is not deprived of his ability to drive. This is what happens in Polish. In French, however, the requirement for having a license is so strong that it is impossible to violate it. Then the only way out is to break some other rule.

On the other hand, in a "repair" situation (as in Tangale) the given constraint is satisfied vacuously in an OT-style analysis. For instance if there is no governing relation, then there is no need for a license to govern.[6] In a derivational approach, the implication is reversed, and if there is no license, then no governing relation is possible. However, as we have seen in the Polish example in (9b), this requirement is too strong, which shows that constraints can in fact be violated.

The contrast between (9a) and (9b) thus demonstrates that we have a genuine constraint conflict here, resolved in different ways in different languages. These facts call for an Optimality Theoretic analysis in terms of constraint ranking. The two (violable)

---

[6] Another example of such a situation is described in Cyran (1996). In Munster Irish, we find lengthening of a vowel before a (virtual) geminate, when this geminate is word-final, such as in /bɑːr/ 'top NOM SG' vs. /bɑrə/ 'top NOM PL' (the geminate is virtual, since it behaves as a cluster phonologically, but it is short on the surface). Since geminates involve proper government, this relation needs to be licensed by a following full vowel (Proper Government Licensing (PGL)). If there is no vowel following, no proper government is possible, and the position is filled in by spreading from the preceding vowel (i.e. we get compensatory lengthening). Since in the latter configuration, there is no longer a geminate (not even a virtual one), there is no proper governing relation to be licensed either, and PGL is satisfied vacuously (*pace* Cyran, who – similarly to Charette – claims that PGL is violated here). That is, potential violations of PGL are always repaired by compensatory lengthening in Irish. This case is in a way parallel to the Tangale example, the difference being that syllable structure is underlying and thus any attempted repair will violate the Projection Principle, whereas relations of Proper Government are added during the derivation (as in (9b) for example), and thus repair simply means failing to add such a relation (although at the same time adding something else).

constraints are given in (10).

(10) (a) PROPER GOVERNMENT (PG)
An ungoverned nucleus properly governs a preceding empty nucleus.

(b) GOVERNMENT LICENSING (GL)
A governing onset must be licensed by a nucleus which is not properly governed.

PROPER GOVERNMENT says that if there is a configuration containing an empty nucleus followed by a full nucleus, then the full nucleus has to properly govern the empty one, whereas GOVERNMENT LICENSING says that a consonant cluster must be followed by a full nucleus.

The constraint PROPER GOVERNMENT works in conjunction with an inviolable principle, given in (11), the Empty Category Principle, or the Principle of P-Licensing (cf. Kaye, Lowenstamm & Vergnaud 1990 and Kaye 1990a, although in both of these articles the principle is formulated as a conditional instead of the biconditional given here).[7]

(11) *Empty Category Principle (ECP)*
An empty nucleus is phonetically interpreted iff it is not properly governed.

This principle is violated if (a) an empty nucleus remains silent even though it is not properly governed, or if (b) it is properly governed, but it is phonetically interpreted. Note that this principle governs phonetic interpretation. What is relevant for phonology is therefore not whether the empty nucleus is audible or not, but whether it is properly governed or not. And the principle is formulated as a biconditional (instead of the general conditional allowing an empty nucleus to remain silent, if it is properly governed), because otherwise finding an audible empty nucleus on the surface would not say anything about its phonological status as to whether it is properly governed or not.[8]

[7] Note that the formulation in (11) only refers to the basic type of licensing of empty nuclei, viz. proper government. Domain-final licensing will be discussed in the next section, while the other types, magic licensing and interonset licensing, will be disregarded in the present discussion.

[8] This issue is more complicated than presented above. In Polish, we find examples of sequences of empty nuclei without phonetic content (cf. Gussmann 1997), violating condition (a) of the ECP. On the other hand, in Mohawk, certain empty nuclei surface even though they are properly governed, violating condition (b) (cf. Rowicka (1999b)). However, these nuclei

The constraint PROPER GOVERNMENT is standardly not a separate constraint of GP, but it is supposed to fall out from the ECP. However, I think that it is necessary to formulate it separately, since the two constraints perform different functions. The ECP tells us something about the governee, whereas PROPER GOVERNMENT refers to the governor. Moreover, it seems that the ECP is inviolable, while – as we have seen – PROPER GOVERNMENT is violated in French.

The two possible systems resulting from the two different rankings of the constraints in (10) are given in (12) and (13). In the following tableaux, I will use the symbol of the phonetic realisation of the empty nucleus in the given language as a shorthand for ungoverned empty nuclei.

(12) *French – empty N realised after C cluster*

margv⁰ritv⁰	GL	PG
☞ margərit		*
margrit	*!	

(13) *Polish – no "illicit" filling of empty nuclei*

varxv⁰lakv⁰	PG	GL
varxelak	*!	
☞ varxlak		*

In the first candidates (represented as in (9a)), PROPER GOVERNMENT is violated, since N_2 is not properly governed by N_3. As a result, N_2 can government license O_2. And the ECP will ensure that N_2 receives phonetic interpretation. In the second candidates (represented as in (9b)), on the other hand, proper government applies, thus by the ECP N_2 remains silent, and GOVERNMENT LICENSING is violated accordingly. As we have seen, French chooses to preserve GOVERNMENT LICENSING, while Polish opts for PROPER GOVERNMENT. That PROPER GOVERNMENT is not 'turned off' in French is evidenced by the fact that following single consonants (that is, in the absence of a conflict), proper government does apply, and the empty nucleus remains silent, as in the example of [samdi], given in (14).

are still invisible for stress, supporting the claim that what matters for phonology is the presence of the governing relation, and not audibility per se.

(14) *empty N remains silent after a single C*

samv^{0}di	GL	PG
samədi		*!
☞ samdi		

Since this example does not involve a consonant cluster, GOVERNMENT LICENSING does not come into play. It is thus the next constraint that decides, PROPER GOVERNMENT.[9,10]

In summary, in this section, I have shown that it is necessary to supplement Government Phonology with constraint ranking in order to be able to account for cases where principles (or rather constraints) are in conflict with each other. The question I turn to in the following sections is whether parameters are still needed as well, or whether they can be replaced by ranking. Such a hypothesis is of course impossible to prove for every case. However, since licensing of empty nuclei is one of the key issues of Government Phonology, and since licensing of domain-final empty nuclei is done on a parametric basis, this phenomenon seems to be a good case to test this hypothesis. Moreover, the set of data involved (viz. domain-final consonant clusters) is complementary to that discussed in the first part of this chapter.

2.1.4. Domain-final consonant clusters

As far as the behaviour of domain-final empty nuclei is concerned when they follow a consonant cluster, Polish and French behave in the same way, so we should look at some other languages as well. Example (15) illustrates the different types given by Charette.

[9] In fact, in sequences of two consecutive empty nuclei, either nucleus can remain silent, and a word like *devenir* 'to become' can be pronounced either as [dəvnir] or as [dvənir] (cf. Charette 1991), with the second form violating PROPER GOVERNMENT, without any obvious reason. Although such forms as yet await further explanation, the fact that they are considered more marked than the ones with the first nucleus interpreted indicates that the constraint PROPER GOVERNMENT still manifests itself here.

[10] Cyran (1996) also proposes (for Irish) to *rank* Government Licensing above Proper Government instead of turning Proper Government off completely. However, he still follows Charette (1990, 1992) in claiming that the conflict only arises as a result of particular licensing properties of word-internal nuclei, and he furthermore suggests that this ranking is universal, claims I have been arguing against in this chapter.

(15) *Word-final consonant clusters (Charette 1992: 280)*

(a) *French*: domain-final consonant clusters allowed

carte	[kart]	'card'
table	[tabl]	'table'
castre	[kastr]	'castrate'

(b) *Ixil*: epenthesis after domain-final clusters[11]

ok		'enter'
q'ospu	*q'osp	'stick'

(c) *Korean*: one of the consonants is deleted

hulk	[hul]/[huk]	'earth'

(d) *English*: only coda-onset clusters permitted

card
guilt
*catr

In French domain-final empty nuclei are government licensers, and words may end both in a coda-onset cluster and in a complex onset. In the Nebaj dialect of Ixil (cf. Ayres 1991) and Korean (cf. Sohn 1994) they are not government licensers, thus an *u* is inserted after morpheme-final consonant clusters in Ixil, whereas in Korean, one of the consonants of a word-final cluster is deleted. And finally in English, domain-final empty nuclei government license directly, but not indirectly, and words may end in a coda-onset cluster, but not in a complex onset.

Charette analyses these facts by setting the parameter of potential government licensers differently in these languages: i.e. final empty nuclei are either government licensers (as in French and English), or they are not (as in Ixil and Korean); and if they are, then they either government license both directly and indirectly (as in French), or only directly (as in English). Direct and indirect licensing are illustrated in (16).

[11] Note that the example of Ixil (a Malay language spoken in Guatemala) replaces the original example of Wolof given by Charette. According to Ka (1994), epenthesis actually occurs between the two final consonants in Wolof, unless the cluster is a geminate (in which case epenthesis occurs after the cluster).

(16) (a) *direct licensing* (b) *indirect licensing*

```
R       O<<N            O<<<<<N
|  \    |   |           |  \    |
x   x <- x   x          x -> x   x
```

Direct licensing means that the nucleus is strictly adjacent to the preceding onset head, whereas in the case of indirect licensing the onset head is separated from the nucleus by its complement position.

One problem with this analysis is that Korean, just like Tangale, cannot be derived without violating the Projection Principle (by breaking up a lexical non-nuclear governing domain). The alternation in Korean thus must be a case of allomorphic alternation as well.[12] The word-final typology in my analysis therefore also has one fewer member than the one in Charette's analysis. In addition, I have reservations about positing domain-final empty nuclei. I will discuss the problems and the solution, which replaces the domain-final parameter by constraint ranking, in the next section.

2.2. Domain-final empty nuclei

As argued by Kaye (1990a), word-final consonants behave differently from word-internal codas in several respects; e.g. they do not trigger Closed Syllable Shortening (as in the example *reduce~reduction* in English), they are usually extrametrical with respect to stress assignment, etc. In fact, they can be argued to pattern together with word-internal onsets. To account for this fact, Kaye proposes the principle of Coda Licensing, given in (17).

(17) *Coda Licensing Principle* (Kaye 1990a: 311)
Post-nuclear rhymal positions must be licensed by a following onset.

This principle requires that a coda always be followed by an onset. Onsets in turn must be followed by a nucleus, as a consequence of

[12] Unless Korean is analysed as a strict CV language in the sense of Lowenstamm (1996), where every cluster is broken up by an empty nucleus. In fact, there is evidence for this, because word-internally there are practically no restrictions on what type of clusters can occur. In such an analysis, deletion does not violate the Projection Principle. However, since there are no governing relations, government licensing has no role to play in the derivation either.

the principle of Onset Licensing, given in (18) (cf. Harris 1992).

(18) *Onset Licensing Principle* (Harris 1992: 380)
An onset head position must be licensed by a nuclear position.

Consonant-final words therefore end in an onset followed by an empty nucleus. Since such empty nuclei cannot be properly governed, the only way to make sure they remain silent is to add the extra clause in (19) to the ECP, which parametrically licenses domain-final empty nuclei.

(19) *ECP Domain-final Parameter* (Harris 1992: 381)
A domain-final empty nuclear position is licensed: YES/NO

Thus languages that have this parameter switched on allow words to end in a consonant (or rather in an empty nucleus), while languages having this parameter in the 'off' setting oblige their words to end in a full vowel.

One problem with such final empty nuclei is that they need to be deleted when they come to precede an empty onset as a result of suffixation. This operation, introduced under the name Reduction by Gussmann & Kaye (1993), is defined as (20a) and illustrated in (20b).

(20) (a) *Reduction* (Gussmann & Kaye 1993: 433)
A sequence of an empty nucleus followed by an onset lacking a skeletal position is removed from any phonological representation in which it occurs.

(b) *Polish: pesek* 'dog (diminutive)'

O_1	N_1	O_2	N_2	O_3	N_3	O_4	N_4		O_1	N_1	O_2	N_3	O_4	N_4
|	|	|	|		|	|	|		|	|	|	|	|	|
x	x	x	x		x	x	x	→	x	x	x	x	x	x
|	|	|				|			|	|	|		|	
p	e	s				k			p	e	s		k	

Reduction has often been used in the GP literature, without mentioning the fact that it strictly speaking violates the Projection Principle. This can be seen in (20b), where the governing domains contracted by the pairs O_2 and N_2 and O_3 and N_3 disappear, and a new governing domain is created between O_2 and N_3.[13] (N_3 in (20)

[13] Note that the suffix-initial empty onset in (20) is not only empty, but it also lacks a skeletal position. The only reason I see for this move is to attempt

surfaces, because the final empty nucleus cannot properly govern it.)

An additional problem is encountered in languages such as Turkish (cf. Lees 1961, Lewis 1967, for example), where unlicensed empty nuclei surface phonetically as the vowel /ɨ/, spelled *ı*. Turkish also allows words to end in a consonant and thus seems to license final empty nuclei. These facts are illustrated in (21a), an example exhibiting vowel~zero alternation. Therefore the vowel /ɨ/ should never appear in domain-final position, a prediction which turns out to be false, as shown in (21b).[14] The question thus remains how to account for the difference between the behaviour of the domain-final nuclei in (21a) and (21b), i.e. final empty nuclei that always remain silent and final empty nuclei that are always pronounced.[15]

(21) *Turkish (*Lees 1961, Lewis 1967)

(a)	$qarv^0nv^0$	→	qarɨn	'belly NOM SG'
	$qarv^0nv^0$+a	→	qarna	'belly DAT SG'

(b)	kapɨ	'door NOM SG'
	karɨ	'wife NOM SG'
	acɨ	'grief NOM SG'

In order to avoid these problems, I propose to turn the principle of Onset Licensing into a violable constraint called

to avoid the violation of the Projection Principle. That is, if governing relations are established between skeletal points, then there is no such underlying relation between O_3 and N_3. However, the governing relation between O_2 and N_2 is still present, and it still has to be deleted during the derivation. But even if this move was successful, such a derivation would still violate the more general principle of Monotonicity, according to which nothing can be deleted.

[14] Kaye (1990a) argues that the possessive suffix *-ı* in Turkish is in fact *-v⁰nv⁰* underlyingly, where the *n* is not realised phonetically for some reason when no other suffixes follow it. This, however, does not solve the problem completely, because there are many lexical words (and suffixes, other than the possessive) in Turkish ending in the ominous *ı*, where there is no evidence of a following latent consonant.

[15] In the rest of this chapter, I will disregard the domain-internal alternating empty nuclei, illustrated in (21a), because their account does not directly affect the argumentation here. In chapter 5, I will propose that these should be marked (diacritically) for being deletable if followed by a full nucleus. In what follows I will only concentrate on the two types of empty nuclei found in domain-final position.

NUCLEUS, which requires that every onset be followed by a nucleus, given in (22), and in this way remove the extra clause from the ECP.

(22) NUCLEUS
An onset is licensed by a following nucleus.

A language with underlying consonant-final morphemes has then the three possibilities listed in (23) for the surfacing of such forms. (Square brackets indicate morpheme boundaries.) Note that (23) is not a tableau, it is rather a summary of three tableaux, where each row represents a possible language. The examples mentioned will be discussed in more detail below.

(23) *Syllable typology – domain-final position*

N O | | x x] | | α β	PARSE	FILL	NUCLEUS
a. *Samoan* N | x x] | | α<β>	*		
b. *Zulu* N O N | | | x x x] | | α β		*	
c. *English* N O | | x x] | | α β			*

Notice that the underlying representation of these morphemes satisfies Coda Licensing and ends in an onset. Each possible surface representation, however, violates one of the universal (faithfulness) constraints defined in (24) (cf. Prince & Smolensky 1993).

(24) (a) PARSE
Segments are parsed.

(b) FILL
Empty positions are prohibited.[16]

Depending on which of the constraints is lower-ranked than the others, we get two types of languages. In one type, words can end in a consonant, like in English, illustrated in (25). In the following tables, the representations in (23) are abbreviated by indicating nuclear positions as 'V' and onset positions as 'C'. Underparsing is indicated by angled brackets, and epenthesis (i.e. the addition of an empty nuclear position) by the '◊' sign.

(25) *English*: final consonants allowed

/VC/	PARSE	FILL	NUCLEUS
V<C>	*!		
VC◊		*!	
☞ VC			*

Here NUCLEUS is ranked below the faithfulness constraints and therefore consonant-final morphemes have to surface identical to their underlying representation.[17]

[16] This constraint is slightly different from the one usually bearing this name in OT, since it is also violated by empty positions that actually remain silent as a consequence of being properly governed by a following full nucleus. Thus for instance the examples in (12) and (13) all violate FILL, containing underlying empty nuclei. But since every relevant candidate has the same number of violations, this constraint is irrelevant for the decision between the candidates.

[17] Here the question might arise whether Coda Licensing could not be turned into a violable constraint as well. Apart from the arguments listed at the beginning of this section, there is a further argument in favour of the inviolable status of Coda Licensing which comes from syllable typology. Given the two parameters of 'branching rhymes' and 'domain-final empty nuclei' (DFEN), the following four types of languages are predicted (cf. Kaye 1990a: 324):

	branching rhyme	
DFEN	yes	no
yes	CV(C).CV(C)	CV.CV(C)
no	CV(C).CV	CV.CV

For the CV(C).CV type to exist, Coda Licensing must be inviolable. If it was a violable constraint, it still should be unviolated (i.e. highly ranked) in this type of languages. But the only way to repair an offending underlying form

In the other type of languages, words have to end in a vowel. This can be achieved in two ways: either by deletion of the word-final consonant, as in Samoan in (26), that is by ranking Parse below the other two constraints; or by inserting an epenthetic vowel, as in Zulu in (27), that is, by lowest-ranking of Fill.

(26) *Samoan*: deletion

/VC/	Nucleus	Fill	Parse
☞ V<C>			*
VC◊		*!	
VC	*!		

(27) *Zulu*: epenthesis

/VC/	Parse	Nucleus	Fill
V<C>	*!		
☞ VC◊			*
VC		*!	

Notice that here the ranking itself establishes the difference between these two languages, whereas in a parametric approach, the extra clause of the ECP only says that domain-final empty nuclei are disallowed, and we need an extra parameter to distinguish between the two types of repair employed by Samoan versus Zulu, namely, deletion versus epenthesis.

Thus under the present approach, languages differ in whether words have to end in a nucleus or not – instead of differing in whether they allow a final empty nucleus or not. Consequently the extra clause of the ECP can be dispensed with (and empty nuclei can only remain silent if they are properly governed). This is why the winning candidate in (27) has a final vowel which is realised: a final empty nucleus can *never* be licensed.

In this way the problems mentioned above are avoided. In languages like Turkish, words ending in the vowel /ɨ/ (as in (21b)) can be distinguished from words ending in a consonant, as in (28).

which ends in a coda without violating the Projection Principle is to add an epenthetic onset *and* an epenthetic nucleus to the end of such forms. I do not know of any such languages. However, finding an answer to this query is an empirical issue.

(28) *Turkish*

(a) consonant-final words

O	N	O
|	|	|
x	x	x
|	|	|
k	a	p

kap 'mantle'

(b) *ı*-final words

O	N	O	N
|	|	|	|
x	x	x	x
|	|	|	
k	a	p	

kapı 'door'

That is, while consonant-final words indeed end in an onset, *ı*-final words can now end in an empty nucleus underlyingly which consequently will have to receive phonetic interpretation, since it is always unlicensed (in the same way the final empty nucleus is unlicensed in the winning candidate of (27)).

Turning now to the other problem, deletion of final empty nuclei (as in (20b)) is no longer necessary, since they are not there in the first place, and *pesek* is represented as in (29).

(29) *Polish*

O	N	O		N	O
|	|	|		|	|
x	x	x	+	x	x
|	|	|			|
p	e	s			k

pesek

As can be seen here, the suffix-initial onset without a skeletal position (O_3 in (20b)) is also missing from this representation. In my view, no convincing evidence has ever been provided for the presence of these initial empty onsets. I will rather analyse such cases as a violation of the ONSET constraint, given in (30). In other words, this constraint requires that every nucleus is preceded by an onset.

(30) ONSET (Prince & Smolensky 1993: 16)
Every syllable has an onset.

As can be seen, NUCLEUS constitutes a perfect parallel to the constraint ONSET. That is, the NUCLEUS and ONSET constraints together express the requirement that onsets and nuclei should form an alternating pattern with each other. However, as we have seen, both constraints can be violated under certain circumstances, namely, at the edges of domains. To preserve the generalisation that domain-internally the alternating pattern is undisturbed, we therefore need a further, stronger constraint enforcing this effect. I propose to express this by the inviolable representational principle (which is part of *Gen*), given in (31).

(31) *Alternation Principle*
Within an analytic domain, sequences of consecutive constituents of the same type are prohibited.

This principle is parallel to the rhythmic principle requiring the alternation of stressed and unstressed syllables within a string. (The notion of analytic domains will be discussed in detail in chapter 3.) One of the effects of this principle is to preserve domain-internal empty nuclei in languages with word-final consonants (i.e. where NUCLEUS is ranked below FILL). Another is to separate nuclei in hiatus by an empty onset.

At this point, one might ask whether adding the Alternation Principle does not result in duplicating the information already expressed by the combination of the NUCLEUS and ONSET constraints in the grammar. However, the Alternation Principle is more specific than the sum of the other two constraints, since the former is restricted to domain-internal position. That is, this case can be regarded as an application of the Elsewhere Condition, whereby a more specific statement overrules a more general one.[18]

Notice also that now the addition of empty nuclei becomes necessary in certain configurations, for example, when a synthetic suffix starting with a consonant follows a consonant-final root, as in (29). But if we regard the Projection Principle as a monotonicity requirement (which allows addition, but forbids deletion of structure), then this will cause no problems.

Furthermore, by making the principle of Onset Licensing violable, the more general Licensing Principle (cf. Kaye 1990a), given in (32a) becomes violable as well. The most important aspect of this principle, namely, that every analytic domain must have a head, however, can be retained under a modified version of the Licensing Principle, given in (32b).

[18] In the classical OT-literature, the generalisation that word edges like to coincide with syllable edges (but that they do not always do), is usually accounted for by a member of the ALIGN family, expressed by two constraints, one referring to the left, the other to the right edge (cf. McCarthy & Prince 1993b). This (extra type of) constraint becomes superfluous here.

(32) (a) *Licensing Principle* (Kaye 1990a: 306)
All phonological positions save one must be licensed within an analytic domain. The unlicensed position is the head of this domain.

(b) *Licensing Principle (new version)*
Every analytic domain must have a head, i.e. a nucleus.

This principle then becomes a reformulation of the Culminativity Condition of Hayes (1995), which requires that every word has a stressable element to bear main stress. (It is enough to use ‘nucleus’ in this principle, since in the absence of a proper governor, a sole nucleus will always receive phonetic interpretation – although certain languages might impose extra restrictions on possible domain heads.)[19]

In summary, in this section I have shown that it is possible, and also preferable, to replace the parameter of domain-final licensing of empty nuclei by a violable constraint NUCLEUS. In the next section, I return to the story of government licensing, that is, to the case where words do not end in a single consonant, but rather in a consonant cluster, and show how these can also be accounted for in a non-parametric way (contrary to Charette’s analysis).

2.3. Domain-final consonant clusters continued

The behaviour of the word-final consonant clusters in (15) can now be handled in an analysis parallel to that of single final consonants; except that underparsing as in (15c) (/hulk/ giving [huk] or [hul]) is not legitimate in the case of consonant clusters, because the disappearance of a non-nuclear governing domain constitutes a violation of the Projection Principle. Therefore the constraint PARSE will not figure in the following discussion.

Let us start with French, illustrated in (33).

[19] There is another issue here, that of catalexis (cf. Kiparsky 1991), which deserves attention. This phenomenon fitted very well in an account with final empty nuclei, where these nuclei could become “visible” in languages that had previously been analysed by means of a final dummy syllable. However, since the ECP might prove to be violable independently (cf. sequences of phonetically null empty nuclei in Polish, Gussmann 1997), it could be suggested that catalexis be the result of some higher-ranked constraint as well. This issue requires further consideration.

(33) *French – word-final consonant clusters allowed*

/tabl/	FILL	GL	NUCLEUS	PG
☞ tabl		*	*	
tabl◊	*!			

As we have seen in (12), in French GOVERNMENT LICENSING (GL) is ranked above PROPER GOVERNMENT (PG). And since there are word-final consonants in this language, we know that NUCLEUS is ranked below PARSE and FILL, as in (25). The existence of word-final consonant clusters shows that GOVERNMENT LICENSING is not inviolable either. Since no epenthesis occurs in these cases, this provides evidence that GOVERNMENT LICENSING, like NUCLEUS, is ranked below FILL.

As can be seen from this example, the ranking of GOVERNMENT LICENSING with respect to FILL is independent of its ranking with respect to PROPER GOVERNMENT, in the same way as in Charette's analysis. That is, the behaviour of final clusters is independent of the behaviour of internal ones.

Ixil, as shown in (34), chooses to preserve GOVERNMENT LICENSING word-finally, by employing epenthesis; that is, through lower ranking of FILL.

(34) *Ixil – epenthesis after word-final consonant clusters*

/q'osp/	GL	FILL	NUCLEUS
q'osp	*!		*
☞ q'osp◊		*	

Now let us turn to English. English looks like a case in between French and Ixil, since it allows word-final consonant clusters of the coda-onset type, but not of the complex onset type. If we look at words like *cycle*, *fibre* or *centre* more closely, we see that English treats these in the same way as Ixil, at least if we analyse syllabic sonorants as word-final complex onsets followed by an empty nucleus (i.e. as a violation of FILL).

I suggest analysing this language by adding a more specific GOVERNMENT LICENSING constraint, GL(O_1,O_2), requiring licensing of the head of a branching onset. Something that might provide support for such an analysis is the fact that, in general, complex onsets are subject to stricter phonotactic restrictions, and are therefore also more likely to require more licensing than coda-onset clusters. By Panini's theorem, Prince & Smolensky's (1993) version of the Elsewhere Condition, if there are two constraints, one of which is a more specific version of the other, then the more specific constraint can have an effect only if it is ranked higher than the more general one. When, on the other hand, the general constraint is ranked above the specific one, the effect of the latter is concealed. In this way we account for the fact that there is no language that requires more licensing for coda-onset clusters than for complex onsets.

The analysis of English is given in (35).

(35) *English – epenthesis after word-final complex onsets*

/gilt, saikl/	$GL(O_1,O_2)$	FILL	GL	NUCLEUS
☞ gilt			*	*
gilt◊		*!		
saikl	*!		*	*
☞ saikl◊		*		

Since FILL is sandwiched in between $GL(O_1,O_2)$ and GL, violating it will be fatal in the case of a coda-onset cluster, but optimal in the case of a complex onset.

The French dialect spoken in Saint-Etienne, mentioned by Charette (1992), provides interesting extra evidence for the two GOVERNMENT LICENSING constraints. But in this case the two are ranked differently with respect to another constraint. It is PROPER GOVERNMENT which is sandwiched in between; that is, this dialect represents a case in between standard French and Polish. The facts are illustrated in (36).

(36) *Saint-Etienne French – empty N realised after complex onsets*

	$GL(O_1,O_2)$	PG	GL
parvənir		*!	
☞ parvnir			*
librmã	*!		*
☞ librəmã		*	

Depending on the behaviour of word-final clusters, FILL will be either ranked below, in between or above the GOVERNMENT LICENSING constraints. In summary, in this analysis, the ranking between FILL and GOVERNMENT LICENSING establishes the difference between all cases.

2.4. Predictions and summary

Now let us see how many possible (relevantly distinctive) permutations the constraints introduced in this chapter give. The permutations are given in (37).

(37) Total number of permutations: medial x final: 3x5=15

- medial contexts: 3
  - – GL >> PG (e.g. French)
  - – PG >> GL (e.g. Polish)
  - – GL(O_1,O_2) >> PG >> GL (e.g. Saint-Etienne French)
- word-final contexts: 5
  - – PARSE, FILL >> NUCLEUS:
    - – FILL >> GL (e.g. French or Polish)
    - – GL >> FILL (e.g. Ixil)
    - – GL(O_1,O_2) >> FILL >> GL (e.g. English)
  - – NUCLEUS >> PARSE (e.g. Samoan)
  - – NUCLEUS >> FILL (e.g. Zulu)

In medial contexts, different rankings between PROPER GOVERNMENT and GOVERNMENT LICENSING result in three different grammars. In word-final contexts, GOVERNMENT LICENSING can only come into play if NUCLEUS can be violated (and thus word-final consonants are allowed). In this case, we have to look at the rankings between GOVERNMENT LICENSING and the faithfulness constraint FILL. Either GOVERNMENT LICENSING is lowest-ranked, or FILL is in this position, or FILL is sandwiched in between the two halves of GOVERNMENT LICENSING. This leaves us with three possibilities. This, together with the two cases where NUCLEUS is unviolated, gives five. The total number of permutations, combining both contexts, is 3x5=15. The empirical testing of these predictions awaits further research.

As a matter of fact, the parametric approach does not fare any better, because in Charette's formulation direct and indirect licensing are two separate parameters, predicting four possibilities word-internally, in contrast to the present approach where GL and GL(O_1,O_2) predict only three (thus the total number of permutations is 20 instead of 15). That is, according to the theory advocated here, we cannot have indirect licensing without first allowing for direct licensing. This connection can be expressed in a parametric approach as well, but only by sacrificing one of the basic claims, namely, that parameters are independent of each other. (Word-finally, the two approaches do not make different predictions.)

However, as we have seen, an analysis employing ranking has certain advantages over a parametric one. One such advantage is that it can account for cases of constraint conflict in an elegant way, a state of affairs that as yet has not received a principled solution in a parametric approach (where the only possibility is to turn constraints off completely, as they cannot be made violable).

Another advantage of a ranking approach is that it expresses the connections between former parameters in a more explicit way. For example, in the case of Zulu, the ranking of FILL below NUCLEUS expresses both the fact that NUCLEUS cannot be violated and the means to rescue the situation, namely epenthesis. In contrast, in a parametric approach, the parameter licensing domain-final empty nuclei only says whether they are licensed or not in a given language, and we need a separate parameter to distinguish between Zulu and Samoan, that is, between epenthesis and deletion.

Finally, as I have shown, by turning the Principle of Onset Licensing into a violable constraint, the controversial stipulation of phonetically always null final empty nuclei can be dispensed with. Moreover, all the parameters mentioned in this chapter can be expressed by different rankings of violable constraints, which are needed anyway (among them Proper Government and Government Licensing). The principles that still seem to prove inviolable on the basis of this study are the Projection Principle (basically a monotonicity requirement), the (modified version of the) Licensing Principle, Coda Licensing and the ECP. Further study will have to tell whether they are all really principles, or whether some of them can be violated under the pressure of other constraints.

3. The phonology-morphology interface

In this chapter,[1] I will be concerned with the relationship between phonology and morphology, the nature of the lexicon, and the status of derivation within the theory adopted here. As opposed to the Lexical Phonology model of Kiparsky (1982a,b), where phonological rules are assigned to different lexical strata, I will basically follow the view advocated by Kaye & Vergnaud (1990), and Kaye (1995), where the only phonologically available morphological information concerns the analytic-synthetic distinction of domains.

There is one significant point where I depart from this model. As far as phonological derivations are concerned, Kaye (1995) assumes the minimality hypothesis given in (1) (cf. also Koutsoudas 1976).

(1) *Minimality Hypothesis* (Kaye 1995: 291)
Processes apply whenever the conditions that trigger them are satisfied.

This means that processes are 'blind' to the history and the future of the derivation they are involved in. I will claim that the minimality hypothesis is too restrictive, and that derivations cannot be totally blind to their history. More precisely, to be able to account for "derived environment effects", we need to retain some version of the lexical phonological notion of the Strict Cycle Condition (SCC). This is not only a problem from a Government Phonological view, but also from the viewpoint of Optimality Theory, since in this theory it is claimed as well that there is nothing left which would correspond to the old notion of derivation. To be able to formulate the non-derivational version of

[1] An earlier version of section 3.3 can be found in Polgárdi (1998).

the SCC in a relatively simple way, I will adhere to the strong version of Structure Preservation advocated in Kiparsky (1985), claiming that lexical rules cannot create new types of segments.

This chapter is built up as follows: section 3.1 introduces the analytic-synthetic distinction. Section 3.2 gives the typology of phonological rules applying in the lexicon. Section 3.3 discusses the problem of derived environment effects: after introducing Kiparsky's (1973) basic generalisation that he formulates in the Revised Alternation Condition (RAC) (section 3.3.1), I illustrate the workings of this condition on a pair of vowel harmony systems, one involving neutralising harmony (Korop), while the other involving allophonic harmony (Zulu) (section 3.3.2). In section 3.3.3, I propose a way to incorporate the generalisation expressed by the RAC in an OT-type grammar. I will show that to be able to do this, the strong version of the Principle of Structure Preservation (cf. Kiparsky 1985) needs to be adhered to. In section 3.3.4, I argue that the alleged counterexamples to this principle are not lexical rules after all. In section 3.3.5, I show that the non-derivational version of the RAC, the DERIVED ENVIRONMENT CONSTRAINT, belongs to the family of Faithfulness constraints. In section 3.3.6, I argue against the claim that the application of phonological rules can also make an environment derived. Finally, section 3.4 summarizes the results.

3.1. Analytic vs. synthetic morphology

According to Kaye (1995), morphological structure can have two sorts of effect on phonology: little or none. The first type is called analytic morphology, the second synthetic (or non-analytic) morphology.

The "little" effect which analytic morphology has on phonology is to define the domains of phonological processing. In other words, "analytic morphology is phonologically parsable" (p. 305). The morphological complexity of analytically derived words is apparent from observing phonological characteristics of the string. For example, phonotactic regularities respected by non-derived forms can be violated by analytically complex forms, as in the example given in (2).

(2) [[[sɪks]θ]s] 'six ORD PL'

The "cluster" *-ksθs* could never be legitimate within a single analytic domain, since it violates phonotactic restrictions on underived forms of the language. The fact that this form is grammatical informs us that it must be morphologically complex. That is, the presence of such clusters provides us with a parsing cue (i.e. that there is more than one domain involved). This type of complexity is schematically represented as (3a) and (3b), giving analytic suffixation and analytic prefixation, respectively. The other type of analytic morphology, which could be dubbed 'compounding', is represented as (3c).

(3) *Analytic morphology* (Kaye 1995)

a.	[[A]B]	$\varphi(concat(\varphi(A),B))$	suffixation
b.	[A[B]]	$\varphi(concat(A,\varphi(B)))$	prefixation
c.	[[A][B]]	$\varphi(concat(\varphi(A),\varphi(B)))$	compounding

The middle column in (3) gives the exact definitions of the expressions in the left-hand column. Here, *concat* is a function taking two strings as arguments and returning the concatenation of these strings as a result, whereas φ is a function taking one string as its argument and applying phonology to this argument. Note that (3c) can be instantiated in three ways: as a lexical compound, or as a form comprising a root plus a 'non-cohering' suffix or prefix.[2]

According to Kaye (1995), the second possibility, (3b), is empirically unattested. Prefixed forms are instead claimed to have the structure given in (3c). This asymmetry between prefixes and suffixes is widely documented in the literature (cf. Booij 1985a, b, Nespor & Vogel 1986, among others), where prefixes are claimed not to incorporate into the prosodic word, but rather to adjoin to it, evidenced by lack of 'resyllabification' of prefix-final consonants into vowel-initial stems. Apart from this empirical motivation, there is also a theory-internal reason for Kaye (1995) to reject (3b) as a possible structure. The final empty nucleus of phonetically consonant-final prefixes could not be licensed in such a structure, because Proper Government does not operate across analytic domain boundaries. On the other hand, if prefixed forms have the structure in (3c), the prefix-final empty nucleus is licensed by virtue of it being domain-final.

A compound analysis of prefixes, however, encounters some problems. One such problem concerns 'subminimal' prefixes like

[2] Cf. Booij (1985a,b), for example, for the distinction between 'cohering' vs. 'non-cohering' affixation. According to this classification, cohering affixes form one phonological word together with the stem they attach to, whereas non-cohering affixes form phonological words of their own. Here the distinction is made in terms of analytic domains, instead of phonological words, although the two often coincide.

be- and *ge-* in Dutch that only contain a schwa-syllable, illustrated in (4).

(4) *Subminimal prefixes in Dutch* (Booij 1985a)

be#aamd	'assent PART'
ge#aard	'earth PART'

Such syllables could never form independent words, since they do not contain at least one full vowel. Thus they cannot form an analytic domain of their own either (and be represented as [[be][aamd]] and [[ge][aard]]), since then they would violate a phonotactic restriction of the language. But they cannot form an unanalysable unit with the stem either (and be represented as [beaamd] and [geaard]), since they retain their schwa before vowel-initial stems, a configuration forbidden morpheme-internally.

A more extreme version of this problem can be illustrated by Polish, where prefixes can consist of a single consonant. Some examples of single and double prefixation are given in (5a) (the data come from Rowicka 1999a[3]). ('Ø' in (5b) indicates a silent empty nucleus.)

(5) *Monoconsonantal prefixes in Polish*

(a)	z#ńeść	'to bear'
	w#z#ńeść	'to raise'

(b) [[wØ][zØ][ńeść]]

Such prefixes cannot be included in an unanalysable domain with the root, as evidenced by the doubly prefixed forms where no yer surfaces between the two prefixes, i.e. *[wEzØńeść], which would be expected on the basis of examples like [przedØdźEń]~[przedEdØńu] 'the day before NOM SG ~ LOC SG' with a regular alternating pattern of realised and silent empty nuclei. Independent motivation is provided by lack of Palatal Assimilation across prefix boundaries (i.e. *[źńeść]), a process that does apply inside roots, as in the form [bliźńe] 'scar LOC SG'.

Gussmann & Kaye (1993) propose to analyse such prefixed forms with the structure in (5b). Such a representation, however, is problematic, because the prefixal analytic domains violate the Licensing Principle (cf. section 2.2), lacking a domain head. (This

[3] See the same reference for the behaviour of prefixes preceding roots that contain a yer in the initial syllable.

problem has also been acknowledged by Cyran & Gussmann 1999.)

Another problem can be illustrated by vowel harmony, a process that normally does not apply across compound boundaries. If prefixes always formed a compound phonotactically, vowel harmony should never be able to apply to them. This prediction is not borne out, as illustrated by the cases of Korop and Zulu in section 3.3.2, for example.

Therefore it seems reasonable to assume that the structure in (3b) is a viable one, contrary to the claim made in Kaye (1995), and the ad hoc stipulation prohibiting it can be dispensed with. All the cases discussed above can now be analysed with this structure, as in (6), and the problems can be avoided, at the same time retaining the insight that these prefixes do not form an unanalysable unit with the root.[4]

(6) *Analytic prefixation in Dutch and Polish*

[ge[aard]]
[w[z[ńeść]]]

In fact, in light of the proposal presented in chapter 2, the theory internal argument against such a structure disappears, since consonant-final prefixes do not have to end in an empty nucleus that would be in need of licensing (that is, such prefixes end in an onset).

The asymmetry between prefixes and suffixes concerning syllabification, on the other hand, can be accounted for on independent grounds, using the notion of 'Syllable Integrity', as proposed by Van Oostendorp (1994), given in (7).

(7) *Syllable Integrity*
A syllable can only incorporate segments on the first cycle of its existence.

This means that a vowel-initial suffix B in the structure [[...A]B] can include the stem-final consonant in its initial syllable, because the stem-final consonant is already present at the first cycle of B's existence. The first syllable of a vowel-initial stem A in

[4] The Dutch example has been analysed as involving an 'appendix to the phonological word' by Booij (1985a), while the Polish example has been analysed as involving a 'prosodic proclitic' by Rowicka (1999a). These analyses express the insight that such prefixes behave differently from lexical compounds, but because they stick to making reference to the prosodic hierarchy (instead of recognising a parallel phonotactic one), they have to extend that hierarchy in different ways.

a structure [B[A...]], on the other hand, cannot be repaired in the same way by incorporating a prefix-final consonant, because the prefix B is not yet present at the first cycle of A's existence. And by the time the prefix is added in the next cycle, the syllable structure of A can no longer be changed.

In fact, the only consistent type of evidence for a "compounding" structure of prefixation comes from syllabification. Other processes, like vowel harmony, distinguish between groups of analytic and compounding prefixes in the same way as they distinguish between groups of suffixes (this issue will be discussed in more detail in chapter 5). Syllabification being accounted for in the way illustrated above, suffixes and prefixes can now be categorised in a parallel fashion as far as phonotactic domain boundaries are concerned.

As we have seen in (3), in the case of analytic morphology, the integrity of the internal domains is preserved. That is, the stem is pronounced in the same way as it would be if it was standing on its own (abstracting away from the results of across-the-board processes). This is not the case in all sorts of morphology. Synthetic (or non-analytic) morphology does not leave the stem unaffected. Level 1 suffixes in English, for example, shift the stress of the stem they are attached to, as in the pair *démon~demónic*. In effect, synthetically derived forms become indistinguishable from non-derived forms. That is, synthetic morphology is invisible to the phonology. Morphologically complex forms form one domain phonologically, as given in (8).

(8) *Synthetic morphology* (Kaye 1995: 309)

[A B] φ(concat(A,B))

The boundary separating synthetic suffixes from the stem does not block phonological processes in the same way as an analytic suffix boundary can. This is the second type of interaction mentioned above, namely, no interaction. Synthetic forms are thus "not phonologically parsable" (Kaye 1995: 310). Their morphological complexity is hidden on the surface. They share their phonological properties with underived forms (respecting, for example, the same phonotactic restrictions).

Kaye furthermore assumes that forms "derived" synthetically are not derived at all, but they are all listed as separate lexical items in the lexicon. (A similar suggestion, though not as general, was made by Orešnik 1979.) The apparent regularities among these forms are no more than historical relics. Thus Velar Softening, for instance, is not an active rule of English. Forms related by it are listed separately in the lexicon, and the regularity is at best represented as a non-derivational one, that is, as a case of allomorphy.

Kaye further claims that there is a correlation between regular and analytic versus irregular and synthetic morphology (cf. also Kiparsky 1982a on this point). In his view, "irregularity is a strategy to render such forms unparsable" (Kaye 1995: 310). There are two ways to handle morphologically complex forms, by computation and by lookup. Irregular forms involve the second option. Irregularity is an arbitrary lexical property – although to some extent it is correlated with compositionality (i.e. the less compositional the meaning, the more irregular the form). And if we assume that lookup is more efficient as far as access is concerned than computation, then it does not come as a surprise that irregular forms should be relatively frequent to exploit this efficiency. That is, it is the frequent forms that are irregular, their irregularity being preserved through their frequent usage. I disagree with claiming total correspondence between irregularity and syntheticity and will argue in chapter 5 that what looks like irregular morphology is sometimes a case of compounding affixation, where a certain process does not apply, because it is restricted to single analytic domains.

In summary, "morphologically related forms which resemble each other phonologically are not necessarily derived from a common source" (Kaye 1995: 313). Instead, they are assumed to be physically proximate in the psychological lexicon. Kaye furthermore demonstrates through a series of examples that making use of the analytic-synthetic distinction frees us from the need for rule ordering or for reference to different levels of phonological structure, and thus enables us to stick to the minimality hypothesis about phonological derivation, given in (1).[5] Phonological events thus are claimed to have no notion of the past or the future of a derivation, they take place if their conditions are satisfied, and otherwise they do not.

The main difference thus between this approach and the Lexical Phonology model of Kiparsky is that in Lexical Phonology, phonology interacts with morphology directly, the two being interleaved with each other; whereas here the morphological

[5] In fact, as has been shown by Rebrus *et al* (1996), the synthetic-analytic distinction is not refined enough to account for all the morphological classes apparent in Hungarian, where the dividing line between synthetic vs. analytic suffixes seems to be placed differently for different phonological processes. In other words, more than one level/degree of syntheticity seem to be necessary to distinguish. In this dissertation, I will disregard these complications.

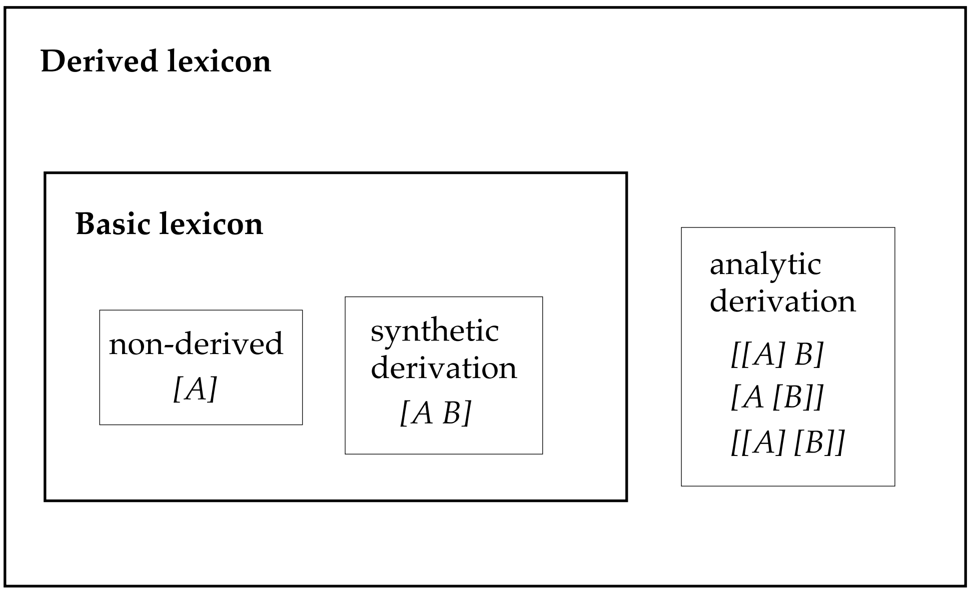
boundaries are "phonologised", the only morphological information available is the analytic domain boundaries. In fact, the synthetic-analytic-compounding distinction to all intents and purposes is equivalent to the '+'-'#'-'##' distinction in SPE, where the '+'-boundaries were invisible to phonological processing.

There have been other attempts to propose an alternative to the Lexical Phonology approach which are, however, different from the one advocated here. One is the 'cohering'–'non-cohering' distinction of Booij (1985a,b). However, this theory does not replace, but rather supplements the cyclic-noncyclic distinction. Moreover, since it does not include the category of analytic affixes, reference to morphological domains in these cases is still necessary (e.g. for the Main Stress Rule, or the *g*-Deletion Rule in *ŋg*-clusters in English).

The other relevant approach in this respect is Inkelas's (1989, 1993) model of Prosodic Lexical Phonology. This theory is, however, more general (among other differences) than the one proposed here, since phenomena like 'extrametricality' are also accounted for in terms of the 'p-constituents', the string minus the extrametrical material constituting such a constituent, whereas in a Kaye-type approach extrametrical constituents still form one analytic domain with the rest of the string preceding them.

To conclude this section, the representation of the structure of the lexicon is given in (9).

(9) *Structure of the lexicon*



The 'basic lexicon' contains all non-derived items and lexical items involving synthetic morphology. Items in the latter set are not considered derived either. "Rules" applying to this basic lexicon are thus regarded as redundancy rules. Forms involving analytic morphology, on the other hand, are derived, and they undergo active phonological processing.

3.2. Typology of phonological rules

To be able to evaluate the minimality hypothesis, we have to look at all the possible types of (lexical) rules proposed so far in the literature. Note that 'rule' in the following discussion is meant as an informal term referring to 'regularity', whether such regularities are expressed statically or by derivation, and by actual rules or by constraints. (10) gives an overview of the basic types. In each case, (ii) gives examples that undergo the rule, and (iii) examples that do not.

(10) *Rule types*

(a) rules "applying" to synthetically "derived" forms: "Level 1 / morpholexical rules"[6]

- *Trisyllabic Laxing (and Vowel Shift)* (Harris 1994a: 21)

(i) V → [lax] / __ σ σ #	
(ii) van+ity	/vænıti/
(iii) salient	/seylıənt/
teeter#ing	/ti:tərıŋ/

- *Velar Softening* (Harris 1994a: 21)

(i) k/g → s/dʒ / __ [–low, –back, +voc]	
(ii) electric+ity	/ılɛktrısıti/
(iii) king	/kıŋ/
panick#ing	/pænıkıŋ/

[6] Note that traditionally these rules are also regarded as 'derived environment rules'. However, since they only apply before synthetic suffixes, they are not considered as dynamic processes in the model adopted here. The term 'derived environment rules' is thus here restricted to processes triggered by analytic morphology.

(b) rules "applying" to basic lexical items: "word level rules"

- *Belfast Dentalization* (Harris 1989: 40)

(i)
```
                                σ
                               / | \
t, d, n, l  →  [dental]  /__  (ə) r
```

(ii) spider /spayd̪ər/
element+ary /ɛləmɛn̪t̪əri/
(iii) wide#r /waydər/

- *English Cluster Simplification* (Borowsky 1993: 202)

(i) n → Ø / m __ #
(ii) damn /dæm/
damn#ing /dæmɪŋ/
(iii) damn+ation /dæmneyʃən/

(c) rules only applying to analytically derived forms: "derived environment rules"

- *Finnish Assibilation* (Kiparsky 1973a: 2)

(i) t → s / __ i
(ii) tilat#i /tilasi/ 'ordered'
vete /vesi/ 'water NOM SG'
(iii) koti /koti/ 'home'

- *Hungarian Vowel Harmony*

(i) V → [αback] / [αback] __
(ii) por#ban /porbɔn/ 'dust INESS'
szép#ság[7] /se:pʃe:g/ 'beauty'
(iii) kosztüm /kostym/ 'costume'
Fer+kó /fɛrko:/ 'name DIM'

[7] This form is not the actual spelling of this word. The suffix vowel is given in its "underlying" representation, i.e. before harmony has applied to it.

(d) rules applying across-the-board: "postcyclic rules"

- *Dutch Syllable Final Devoicing* (Booij 1995)

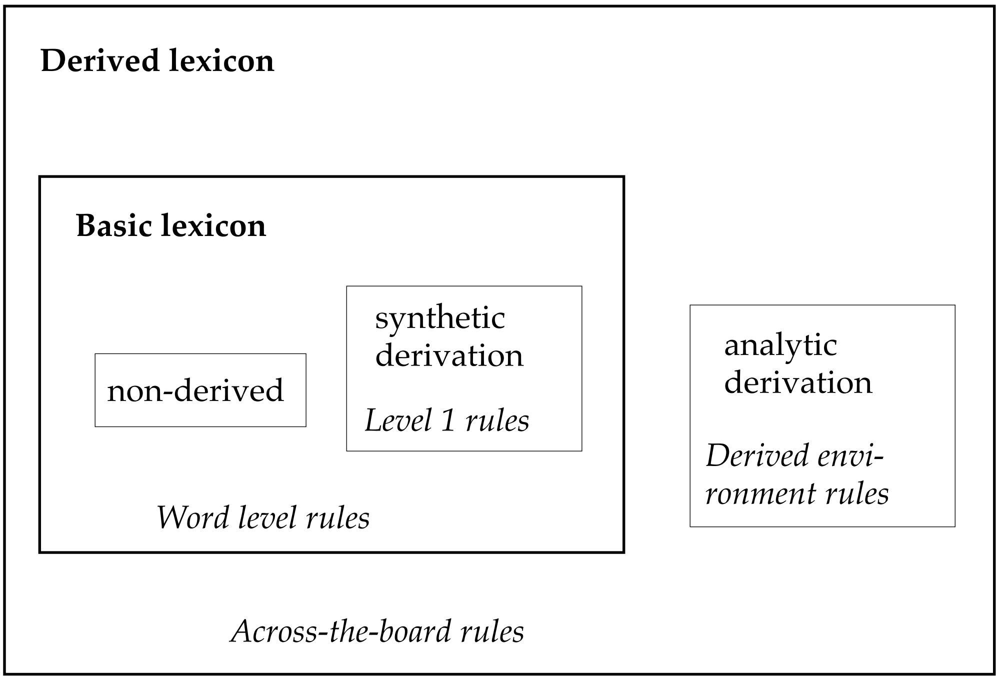
    (i) [obs] → [–voice] / __ $]_\sigma$
    (ii) absoluut /apsolyt/ 'absolute(ly)'
    vreed#zaam /vretsam/ 'peaceful'
    hoed#ster /hutstər/ 'shepherdess'

- *Vata Vowel Harmony* (Kaye 1981, 1982)

    (i) V → [ATR] % $\underset{\text{V}}{\text{[ATR]}}$ __
    (ii) ɛfli /efli/ 'albino'
    nu#lɔ /nulo/ 'understand PASS'
    novo#yɛ /novoye/ 'bee SG'

These types of rules are located in the lexicon sketched in (9) as in (11).

(11) *Rule types in the lexicon*



As can be seen in (11), each rule type in (10) corresponds to a box in (9), except for the innermost box, the one containing the set of non-derived forms. This is as it is expected, since as claimed in

Kiparsky (1982a) and Kaye (1995), synthetically derived forms conform to the phonotactic restrictions exhibited by non-derived lexical items. This means, in other words, that there are no phonotactic restrictions holding only of non-derived forms to the exclusion of synthetically derived items.[8, 9]

Moreover, the rules in (10a-b), those applying to forms in the basic lexicon, are not considered rules in this model. They all have the status of redundancy rules, expressing non-derivational regularities within the lexicon. Rules of the (10d) type, the across-the-board rules, do not threaten the minimality hypothesis either, since they apply whenever their conditions are satisfied.[10]

Rules of the (10c) type, however, are problematic for such a restrictive view of derivation. They have been dubbed global rules of the "looking back" type (cf. Kiparsky 1973a), because they are aware of the history of their derivation. These rules only apply to an input if the relevant environment has arisen during the derivation, but not if it was already present underlyingly. Before discussing this issue in detail in the next section, first let me mention globality of the "looking forward" (or "peeking") type, first discussed by Kisseberth (1970).

Globality of this sort involves "rule conspiracies", where apparently independent rules "conspire" to achieve a common goal in the output. An example of such a conspiracy is provided by Yawelmani Yokuts, where the consonant deletion and vowel epenthesis processes in (12) conspire to arrive at a maximally CV(C) syllable structure. (Here, '+' stands for morpheme boundaries in general.)

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[8] The best-known candidate for being a counterexample for this claim is the case of constraints against homorganic consonants within Semitic roots (cf. Greenberg 1950). Paradis & Prunet (1993), however, show that these constraints are only historical remnants of once existing constraints that used to hold across morpheme-boundaries which now play no active role in the grammar (e.g. loan-words are not adapted and speakers have no intuitions about them). These regularities are thus even more opaque than those expressed by the word level rules in (11). (The opacity of word level rules will be further discussed in section 3.3.4.)

[9] It is true that affixes can exhibit further restrictions, not adhered to by roots. This distinction still needs to be incorporated into the model proposed here.

[10] It is not obvious at first sight whether across-the-board rules should be regarded as applying in the lexicon or in the smallest domain of the postlexical component (a problem also discussed by Booij & Rubach 1987). At this point I simply assume that the type of rules illustrated in (10d) are lexical. But see more on this in section 3.3.4.

(12) *Yawelmani Yokuts* – “rule conspiracy” (Kisseberth 1970: 293-7)

C → ø / CC + __	e.g.	hall+hatin+i:n → hallatini:n ‘lift up DESID FUT’	
C → ø / C + __ C	e.g.	gitin+hnil+a+w → gitinnilaw ‘hold under the arm PASS LOC’	
ø → V / C __ C {#, C}	e.g.	di:yl+t → di:ylit ‘guard PASS AOR’	
		ʔilk+hin → ʔilikhin ‘sing AOR’	

One of the basic motivations for Optimality Theory was precisely to find a solution for the problem of such “rule conspiracies”. Derivational constraints of this type do not fit into the organisation of a rule-based theory, but they constitute the prototypical case a constraint-based theory is designed to account for.

For the problem of the first type of global rules, the “looking back”, or “derived environment” rules, however, OT is of little help and, in fact, the combined theory here faces the same kind of difficulty as rule-based theories do with conspiracies, namely, to be able to express this generalisation the theory needs to be extended in a substantial way to also include constraints which have the power of comparing the output form with the input.[11] In the following section I will outline the problem and the solution I propose.

3.3. Derived environment effects

3.3.1. Kiparsky (1973a)

As was first noted by Kiparsky (1973a), there is a set of phonological rules – the “backward looking global rules” – that are sensitive to the derivational history of their inputs, that is, they apply to inputs of a certain type but not of another. Some examples were already provided in (10c). Some additional examples are given in (13). Here again, in each case, (ii) gives

[11] In fact, there is a third type of global rule, the “transderivational constraints” of Burzio (1994), which express an identity relation between one output form and another output form of which the first one is a substring. These could be called “looking sideways” rules, and they pose a problem similar to the one discussed here.

examples that undergo the rule, and (iii) examples that do not.

(13) *Rules that do not apply in non-derived environments*

(a) *Sanskrit ruki-Rule* (Kiparsky 1973a: 5-8)

(i) s → ṣ / i, u, r, k __			
(ii) /agni#su/	→	agniṣu	'fire DAT PL'
/já#ghas#anti/	→	jákṣati	'eat 3PL'
(iii) /kusuma/	→	kusuma	'flower'

(b) *Korean Palatalization* (Iverson 1993: 263)

(i) t, t^h → tʃ, $tʃ^h$ / __ i, y			
(ii) /hæ tot#i/	→	hæ dodʒi	'sunrise NOM'
/pat^h#i/	→	$patʃ^hi$	'field NOM'
(iii) /mati/	→	madi	'knot'
/t^hi/	→	t^hi	'dust'

The basic generalisation that emerges from these patterns is that these rules apply to an input, if the relevant environment has arisen during the derivation, either via morphology or phonology; and they do not apply if the relevant environment was already present in the underlying representation of the morpheme.

There are, however, other rules that *can* apply in the forbidden environments, and which are thus exceptionless. Some examples are given in (14).

(14) *Rules that do apply in non-derived environments*
(a) allophonic rules: Aspiration in English
(b) structure building rules: Stress Assignment in Hungarian

The difference between these rules is that the group of examples in (13) consists of neutralisation rules, whereas the group in (14) does not include neutralisation rules. Kiparsky (1973a) argues that the only type of global rules involving "looking back" in the derivation is the one in (13). Thus this type of 'globality' can be expressed as a general condition on phonological rules as in (15):

(15) *The Revised Alternation Condition (RAC)* (Kiparsky 1973a :9)
Neutralisation processes only apply in derived environments.[12]

[12] This generalisation was reformulated as the Strict Cycle Condition (SCC) by Mascaró (1976). The differences between these formulations need

Informally speaking, the functional point behind this condition is to preserve a potential underlying contrast in the environment of an otherwise neutralising rule, such as Assibilation in Finnish (in this case, to preserve the contrast of *t* vs. *s* in the environment of *i*, as in *koti* 'home' vs. *lasi* 'glass'). And the prohibition is limited to non-derived environments, because it is only in these cases that the contrast would get lost altogether from the whole lexicon, whereas as long as such a rule applies in a derived environment, there will always be alternations to enable us to recover the underlying contrast. Thus the RAC serves to preclude synchronically irrecoverable phonological mergers, in this way limiting the abstractness of phonological representations.

On the other hand, we do not want to restrict allophonic rules in the same way, because then we would predict the existence of segments whose distribution is restricted to derived environments. That is, we would predict that there should exist rules like the English Aspiration Rule, but which only create the aspirated allophones in derived environments. Since this prediction is not borne out and allophonic rules always apply across-the-board, the RAC is rightly restricted to neutralising processes.

The question now is how the RAC can be put to work, that is, by what mechanism neutralisation rules are blocked from applying in non-derived environments. Looking at specific cases might shed more light on this issue. In the next section, still in an informal fashion, I will compare two systems of vowel harmony which only differ in one respect, namely that in one of them the rule is neutralising, while in the other it is allophonic.

3.3.2. The RAC at work: neutralising vs. allophonic vowel harmony

Korop (a Benue-Congo language spoken in Cameroon) has a seven-vowel system as in (16), where vowels above the line are ATR, while those below are not (cf. Kastelein 1994).

(16) *Korop Vowel System*

[ATR] i u
e o
———
ɛ ɔ
a

not concern us here. See also Hermans (1994) for a different formulation of the SCC.

In this language, we find ATR-harmony,[13] as in (17), by which *ɛ* and *ɔ* become *e* and *o* respectively, when followed by an ATR-vowel (*i*, *e*, *o* or *u*). The non-ATR *a* behaves as opaque, that is, it stops harmony.

(17) *Korop Vowel Harmony* (Kastelein 1994: 19-21)

(a) V → [ATR] / __ [ATR]
V

(b)	/ɛ#desiŋ/	→	edesiŋ	'knife'
	/dɛ#nɔ:mi/	→	dɛnɔ:mi	'is nice'
	/kɛ#bini/	→	kebini	'charcoal'
	/ɔ#kɛbɛ/	→	ɔkɛbɛ	'box'
	/ɔ#nato:n/	→	ɔnato:n	'woman'
(c)	/kɔ#ɲɔni/	→	kɔɲɔni	'saliva'
	/ɛ#wo:ka/	→	ewo:ka	'buffalo'
	/bɛ#tena/	→	betena	'3PL-PAST-show'

(17b) shows that vowel harmony applies between roots and prefixes, whereas it does not apply within roots, as shown in (17c). The last example in (17b) illustrates the opaque behaviour of the vowel *a*.

When we want to apply the Vowel Harmony Rule to a form like /kɛ#bini/, the third form in (17b), we first have to check whether it is neutralising, that is, whether the output of the rule could also be a possible underlying representation. For this, we have to search for patterns in the underlying representations, and check whether the particular output fits into any of these patterns. In this case, this means searching for the pattern *e...i*. This pattern we find among the underlying representations, as, for example, in *desiŋ*, the first form in (17b), and thus the rule is neutralising.

This means that we further have to check whether the environment is derived, and /kɛ#bini/ is, since there is an analytic domain boundary between /kɛ/ and /bini/. Thus the rule can apply, even though it is neutralising.[14] However, if we were

[13] Whether the harmony in Korop and Zulu should indeed be analysed as involving the ATR-dimension is orthogonal to the issue discussed here. The only thing that is important is that the two systems only differ from each other in the character of the harmony as neutralising or allophonic.

[14] One could ask the question at this point whether harmony still counts as neutralising within prefixes, if the language does not have disharmonic

looking at a form like /kɔ#ɲɔni/, the first one in (17c), we would find the relevant part of this form /ɲɔni/ within a single analytic domain, which in turn would prevent us from applying the Vowel Harmony Rule in this non-derived environment.

Now let us compare this case with a non-neutralising rule of vowel harmony. A case in point is Zulu (a Southeastern Bantu language spoken in Zululand Natal) which has an underlying five-vowel system as in (18) (cf. Harris 1987, Doke 1969).

(18) *Zulu Vowel System* (Harris 1987, Doke 1969)

[ATR]	i	u
	ɛ	ɔ
	a	

Mid vowels in this language have two possible realisations, half-close *e*/*o* and half-open *ɛ*/*ɔ*, depending on the following vowel. The first variant occurs when a high vowel (*i*/*u*) follows, and the second variant occurs otherwise. This system thus can be analysed as one involving allophonic ATR-harmony, as shown in (19), triggered by the ATR-feature of the high vowels and targeting the mid vowels. The low vowel *a* is opaque to harmony.

(19) *Zulu Vowel Harmony* (Harris 1987: 269)

(a) $V \rightarrow [ATR] \;/\; \_\_ \underset{V}{[ATR]}$

(b)	/phɛk#a/	→	phɛka	'cook (VB)'
	/um#phɛk#i/	→	umpheki	'cook (N)'
	/ɓɔn#a/	→	ɓɔna	'see'
	/ɓɔn#is#a/	→	ɓonisa	'show'
	/nɔ#tʃʔa:ni/	→	nɔtʃʔa:ni	'and grass'

---

prefixes bearing the feature ATR themselves, i.e. if ATR is not distinctive among prefixes. The existence of disharmonic affixes, however, is orthogonal to the issue of whether harmony is neutralising in the given language or not. If there are no disharmonic affixes, then one could say that harmony in affixes is non-neutralising. As an effect, harmony could apply in an unrestricted way – a result we get anyway, because processes can only be blocked in a non-derived environment. However, if there *are* disharmonic affixes, harmony still always applies to affixes, that is, to the harmonic affixes, whereas it is blocked from applying within stems. And this is what the RAC is meant to account for. (How to prevent harmony from applying to disharmonic affixes, on the other hand, will be the subject of chapter 5.) Moreover, with other types of assimilations, the issue does not arise.

(c)	/izi#ncɛku/	→	izinceku	'chiefs'
	/ama#gɛja/	→	amagɛja	'hoes'
	/izi#yɔni/	→	iziyoni	'birds'
	/izi#nyɔka/	→	izinyɔka	'snakes'

The non-neutralising nature of the harmony is also evidenced by the fact that it applies both in derived environments (19b) and morpheme-internally (19c). And we know that *ɛ* and *ɔ* are the underlying mid vowels, because in final syllables, the ones triggering harmony, only these vowels appear (e.g. *i:thɔ:lɛ* 'male calf' and *u:khɛ:zɔ* 'spoon'), whereas *e*/*o* do not. Again, the last example in (19b) shows the opaque behaviour of *a*.

Here, to know whether the harmony rule can apply to (the relevant part of) a form like the first one in (19c), /izi#ncɛku/, we have to check whether the would-be output [nceku] fits into any underlying pattern. The answer is negative, since no underlying form contains the segment *e*, and thus the rule is non-neutralising. Thus no further checking is necessary, and the rule can apply whether in a derived environment or not.

At this point it becomes interesting to consider the so far neglected behaviour of the vowel *a* in both systems (exemplified by the last examples in (17b) and (19b) respectively). When we apply the test of corresponding underlying patterns, we get a negative answer in both cases. This means that there is no contrast to neutralise in the [low] region, which further implies that harmony should not be blocked in either language. But in fact it *is* blocked in both languages. I think the opaque behaviour of *a* can be accounted for in exactly the same way in the two languages. That is, both languages have a prohibition against the feature combination *[ATR, low] in their grammar which is inviolable. And this prohibition will block harmony, regardless of whether it is of the neutralising or of the non-neutralising nature. (I will come back to this prohibition in more detail in section 6.3.3.)

To summarise, before we can apply a certain rule to a specific form, we have to check the conditions in (20).

(20)

If potential output ≠ underlying pattern (non-neutralising rule), then
    apply the rule (unless prohibited by an independent cooccurrence restriction)
    else
        if input = lexical item (non-derived environment), then
            do not apply the rule
        else
            apply the rule

3.3.3. Derived environment effects and Optimality Theory

The Revised Alternation Condition in (15) restricts neutralisation rules to derived environments. However, as we have seen in (10d), there are neutralisation rules such as vowel harmony in Vata that apply across the board. If neutralisation rules were not allowed to apply in non-derived environments, such regularities would have to be expressed by separate Morpheme Structure Conditions, which would lead to the "duplication problem" (cf. Kenstowicz & Kisseberth 1977: 136-45), namely, that a generalisation expressed by a rule would also have to be stated in the lexicon. In a theory like OT, however, constraints are violable. Since the RAC seems to be violable, as evidenced in (10d), it makes a good candidate for an OT-type constraint.

The generalisation in (15) thus reduces to the fact that certain neutralisation rules are blocked in a non-derived environment, while others are not. In an OT-type grammar, this could be expressed by a constraint such as (21).

(21) DERIVED ENVIRONMENT CONSTRAINT (first version)
No neutralisation of contrasts is allowed within a single analytic domain.

To put it in another way, only the addition of nondistinctive information is allowed in a non-derived environment. The constraint in (21), in fact, only deals with morphologically derived environments. I will return to the issue of phonologically derived environments in section 3.3.6.

This constraint thus requires an intervening analytic domain boundary between trigger and target for a particular neutralisation process to apply. DEC will be ranked *above* constraints forcing changes that are blocked in a non-derived environment (like the Finnish Assibilation "rule"), and *below* constraints that force changes across the board (like the Vata Vowel Harmony "rule"). This is illustrated in (22a-b).

(22) (a) *Finnish Assibilation*

tilat#i, koti	DEC	ASSIB
[[tilat]i]		*!
☞ [[tilas]i]		
☞ [koti]		*
[kosi]	*!	

(b) *Vata Vowel Harmony*

nu#lɔ, ɛfli	HARMONY	DEC
[[nu]lɔ]	*!	
☞ [[nu]lo]		
[ɛfli]	*!	
☞ [efli]		*

In (22a), in the first example, assibilation goes through, since the environment is derived, and DEC is satisfied in both candidates. In the second example, however, both candidates violate one of the constraints. Thus ranking becomes relevant here, and it blocks assibilation in a non-derived context. In (22b), on the other hand, the constraint forcing harmony is ranked higher, and by virtue of that it wins, even in a non-derived environment. This is illustrated by adaptation of loan-words containing a disharmonic sequence in the source language (in Baule in this case, cf. Kaye 1981). That is, in a given language, DEC is ranked between the two groups of constraints triggering the two types of neutralisation processes, the derived environment processes and the across-the-board processes. Note that constraints forcing allophonic changes are immune to the constraint defined in (21), and such changes are thus allowed everywhere if their conditions are satisfied.

Notice, however, that the constraint in (21) is very different from the constraints generally found in OT which is defined as a theory of output constraints. But the DEC in (21) cannot be evaluated by only inspecting the output. As we have seen in the preceding section, such an evaluation involves extensive comparisons between the output and the set of underlying forms to determine whether the change has been a neutralising one. Thus the DEC is not an ordinary output constraint. It in fact has to look at the 'derivation', something also prohibited by the

Minimality Hypothesis in (1).

Nevertheless, it seems to be possible to considerably simplify the evaluation of the constraint in (21), namely, to reduce the set of comparisons between the output and the set of underlying forms to simple comparison between input and output. This can be achieved by reformulating the DEC as in (23), and by accounting for the fact that this constraint is only relevant for neutralisation processes on independent grounds.

(23) DERIVED ENVIRONMENT CONSTRAINT (DEC) (final version)
No changes are allowed within a single analytic domain.

Since this constraint makes crucial reference to analytic domains, it cannot play any role in the postlexical phonology, where morphological structure is totally inaccessible, and constituents are instead defined on a purely prosodic basis. If allophonic rules can be argued to be postlexical, then nothing else needs to be said and the simpler version of the DEC is sufficient to account for the phenomenon of derived environment effects. And, in fact, this is precisely what Kiparsky (1985) claims to be the case in his formulation of the Structure Preservation Principle, which holds of the entire lexicon. This principle is given in (24).

(24) *Structure Preservation Principle* (Kiparsky 1985: 89)
Marking conditions expressing generalisations concerning underlying segments also apply to derived lexical representations.

This means that lexical rules do not introduce types of segments that do not occur in the underlying segment inventory of the language.

This claim has often been challenged in the literature by the set of 'word level or postcyclic rules' (cf. Mohanan & Mohanan 1984, Booij & Rubach 1987, Harris 1987, 1989, Borowsky 1993 among others, and Booij 1994 for an overview of the issue). If Structure Preservation is meant to hold inviolably over the whole lexicon, then it has to be shown that these alleged counterexamples are not lexical rules after all. It is impossible to prove this for each case within the scope of a study like this, but in the next section I shall indicate on the basis of some well-known examples that such a claim seems indeed tenable.[15]

[15] Note that the formulation in (23) will not work for lenition-type processes, such as Velar Drop in Turkish (cf. Inkelas & Orgun 1995) which is blocked in a non-derived environment. During this process, velars are deleted in intervocalic positions, as in the example *[[bebek]i]* 'baby 3 POSS',

3.3.4. Word level rules

As will be shown, the set of rules categorised as 'word level' or 'postcyclic' rules in the literature is in fact a heterogeneous group which can be subdivided into four distinct sets. The first two apply across the board, that is, to the output of the derived lexicon; but I will argue that only one of these sets, namely the set of neutralising rules, is truly lexical, while the set of allophonic across-the-board rules applies postlexically instead. The second two apply exceptionlessly as well, but not at the same level as the previous two. The latter rules are restricted to apply only *within* lexical items, that is, they are confined to the output of the basic lexicon. These are the 'word level rules' in Borowsky's (1993) terminology, a term I have adopted (cf. the diagram in (11)).

Let us start the discussion by looking at the set of across-the-board rules. Some examples of neutralising across-the-board rules were given in (10d).These used to be called postcyclic in order not to be blocked by the Strict Cycle Condition. Such a distinction is no longer necessary. Since the DEC (the descendant of the SCC) is violable, the distinction among neutralisation rules as to whether they apply in non-derived environments or not is accounted for by their ranking with respect to the DEC.

The second group of postcyclic rules, the set of allophonic across-the-board rules, is however problematic, if we want to maintain the claim that every lexical rule is structure preserving. Here I will argue that there is no convincing evidence against treating these rules as postlexical.

One example where an allophonic across-the-board rule has been claimed to be lexical involves the Zulu vowel harmony rule from section 3.3.2, in the analysis of Harris (1987). Apart from the context illustrated in (19), the half-close *e* and *o* also appear whenever a mid long vowel is created, or when a mid vowel occurs before a syllabic *m̩*. Harris' (1987: 270-1) derivations are shown in (25) and (26). The harmony rule (analysed by Harris as

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pronounced /bebei/. Since in a constraint-based account, there is no obvious way to establish a relation between the trigger and the target of a process like this, the 'change' referred to in the DEC will still happen *within* one analytic domain (thus violating the DEC), even though the trigger is provided by the outer domain. (This problem was also recognised by Hermans & van Oosterdorp 1995, who built it into the formulation of their version of a non-derivational SCC that it only applies to assimilation processes.) Vowel harmony processes, however, the topic of this thesis, are not affected by this problem, because in these cases there is always an obvious (governing) relation established between trigger and target. Thus I leave finding a solution for this problem for further research.

[–low] Spread) is crucially ordered before IPCD (Intervocalic Prefixal Consonant Deletion) and NPVD (Nasal Prefix Vowel Deletion) respectively, which in turn are claimed to be lexical rules, since they refer to morphological information, namely they only apply in prefixes, and not in stems. Thus the harmony rule has to be lexical as well, even though it is allophonic.

(25) Zulu long *e* and *o*

	na-ili-khanda	na-ulu-laza
Coalescence	nɛlikhanda	nɔlulaza
[–low] Spread	nelikhanda	nolulaza
IPCD	neikhanda	noulaza
Assimilation	neekhanda	noolaza
	ne:khanda	no:laza
	'with the head'	'with the cream'

(26) Zulu *e* and *o* before syllabic *m̩*

	na-umu-hlaɓa	
Coalescence	nɔmuhlaɓa	
[–low] Spread	nomuhlaɓa	
NPVD	nomhlaɓa	
	nom̩hlaɓa	'with the earth'

These data, however, can be analysed differently (as in Cobb 1997, for example). In her analysis, *e* and *o* are headed, whereas *ɛ* and *ɔ* are headless vowels. Now the fact that only *e* and *o* are found in long vowels will follow from a constraint prohibiting headless expressions from appearing in the governor position of a branching constituent (cf. also the Cold Headedness Constraint of Lowenstamm 1986). The syllabic nasals, on the other hand, can be analysed with a 'floating' or 'unparsed' *u* following them, making explicit deletion unnecessary in these cases.[16]

Since the ordering with respect to the deletion rules provided the only argument for the lexical status of the harmony rule, we can now safely assume that it applies postlexically instead. There

[16] In fact, syllabic *n*'s also trigger raising, and they can be analysed with a floating *i* following them, whereas the fact that the syllabic velar nasals do not trigger the process is explained, because those are derived from an original *na* sequence, resulting in a floating *a*.

are in fact additional arguments supporting the postlexical status of the harmony rule, apart from it being allophonic. One argument comes from the fact that its domain of application is variable (cf. Cobb 1997). For some speakers it applies locally, whereas for other speakers it applies in an unbounded fashion. Moreover, as claimed by Harris (1987), in the other groups of the language family, Venda and Tsonga, the harmony process also applies postlexically. (The harmony rule in the related language Sesotho, also treated as lexical by Harris 1987, can be argued to apply postlexically instead along the same lines as was done for Zulu above.) Southeastern Bantu harmony thus does not provide convincing evidence for relaxing the principle of Structure Preservation in the lexicon.

Now let us turn to the other group of alleged lexical rules that create segments not present underlyingly, namely the allophonic word level rules in Borowsky's (1993) terminology (cf. Harris 1989 for the first discussion of the status of these rules in Lexical Phonology). This group can be illustrated by the German alternation of 'Ich-laut' and 'Ach-laut', a phenomenon that has again been the topic of discussion recently (cf. Hall 1989, Macfarland & Pierrehumbert 1991 and Iverson & Salmons 1992, among others). Here the controversy arises because the sounds /ç/ and /x/ are in complementary distribution, shown in (27a), whereby the velar fricative occurs after back vowels, while the palatal fricative occurs elsewhere; but this complementarity is opaque on the surface, and we find (near) minimal pairs, as in (27b).

(27) German *ç~x* alternation (Hall 1989: 2-5)

(a)	ich	/ɪç/	'I'
	sicher	/zɪçər/	'sure'
	Buch	/buːx/	'book'
	Sprache	/ʃpraːxə/	'language'
(b)	Kuchen	/kuːxən/	'cake'
	tauch#en	/taoxən/	'to dive'
	pfauch#en	/pᶠaoxən/	'to hiss'
	Kuh#chen	/kuːçən/	'little cow'
	Tau#chen	/taoçən/	'little rope'
	Pfau#chen	/pᶠaoçən/	'little peacock'

The rule governing this alternation has to be lexical, because it only applies to monomorphemic forms and forms derived by Level 1 affixation. Consequently, it is claimed to provide a counterexample for the principle of Structure Preservation.

Note, however, that this rule only affects the 'basic' lexicon. This means that in the model advocated here this "rule" is not considered active, but is merely a static generalisation over the lexicon, and the forms in (27) are represented with the "allophones" *ç* and *x* specified underlyingly. Active phonology starts in the 'derived' lexicon, and it is there that Structure Preservation holds. That is, Structure Preservation means that the *output* of the derived lexicon does not contain new types of units compared to the *input* of the derived lexicon. In other words, Structure Preservation is defined with respect to the input of the derived lexicon, which at the same time is the output of the basic lexicon. That is, 'word-level rules' such as this one are not in the scope of Structure Preservation, because they "apply" in the basic lexicon, their "output" is part of the input on which Structure Preservation is defined.

The complementary distribution mentioned above is also only present at the output of the basic lexicon. At the output of the derived lexicon, however, there is no complementary distribution, since there we find minimal pairs like *Kuchen* /ku:xən/ vs. *Kuh#chen* /ku:çən/. Thus if there is any rule at all, it has to apply before the forms exit the basic lexicon. However, according to the theory adopted here, we do not see what happens inside the basic lexicon, we only see the result, and we can only make static generalisations about it. That is, in what we see, the "allophones" are already specified.

In other words, complementary distribution is a necessary, but not a sufficient condition for deriving sounds from the same phoneme. When this complementary distribution becomes opaque on the surface, underlying specification of the distinction becomes justified. Since the "output" of the basic lexicon is the first level which is input to derivation, Structure Preservation is defined with respect to this basic lexicon. 'Word level rules' thus can never be a challenge to this principle by definition.

This claim receives interesting independent motivation from a finding of Mohanan & Mohanan (1984), whose analysis of Malayalam nasal assimilation was in fact meant to demonstrate that Structure Preservation is sometimes violated in the lexicon. I will illustrate their point on the basis of their analysis of Palatalisation. Palatal consonants in Malayalam only occur following a front vowel (where /a/ counts as front). These palatals alternate with velars in other contexts, illustrated in (28) (cf. Mohanan & Mohanan 1984: 586-8).

(28) *Palatalisation in Malayalam*

(a)	mik'acca	'excellent'
	meeg'ham	'cloud'
(b)	awar-kkə	'they DAT'
	puucca-k'k'ə	'cat DAT'
	piɭar-kk-	'split CAUS'
	mara-k'k'-	'cover CAUS'
	wiɭar-kk-	'pale VERBAL'
	wira-k'k'-	'tremble VERBAL'
(c)	kuʈʈi-kaɭ	'child PL'
	puucca-kaɭ	'cat PL'
(d)	kuʈʈi-kaɭi	'childish game'
	puucca-kuʈʈi	'kitten'

Palatalisation applies in monomorphemic forms (28a) (although there are exceptions), and before certain suffixes (28b), but not before others (28c), and not between members of compounds (28d). That is, it is a lexical process which is, at the same time, allophonic.

However, exactly for the reason that it only applies in monomorphemic forms and before certain suffixes, Palatalisation can be argued to only apply in the 'basic lexicon' (i.e. to non-derived and to synthetically "derived" items). It is thus a word level rule of the type discussed above in the German example. Its result, the palatal consonants, therefore, will be part of the input to phonological derivation in any case. Thus this "rule" does not violate the principle of Structure Preservation. The other rules discussed by Mohanan & Mohanan, the ones more specifically referring to nasals, can be argued to belong to the same category on similar grounds.

Mohanan & Mohanan furthermore claim that the 'underlying alphabet' of a language can differ from its 'lexical alphabet', and that it is the latter which contributes to speakers' judgements of sameness and distinctness. Their 'lexical alphabet' in this model corresponds to the inventory at the output of the 'basic lexicon', and their claim thus provides further motivation for defining Structure Preservation with respect to this level of representation.

In fact, "rules" of this type could be called the "postlexical" phonology of the basic lexicon, while neutralising "rules" of the same category, like Cluster Simplification in English (given in (10b)), could be regarded as their "lexical" counterparts, similarly to the lexical-postlexical distinction made for across-the-board rules above. That is, at the output of both the basic and the derived lexicon, there are two types of rules applying in an unrestricted manner: one type referring to a morphological domain, while the other referring to a prosodic domain. In this sense, the basic lexicon has a complete grammar of its own contained within (rather than ordered before) the grammar of the derived lexicon.

In summary, it seems possible to maintain the claim that Structure Preservation as defined on the basic lexicon also holds true for the derived lexicon, and allophonic rules are either confined to the postlexical level or to the word level. Therefore the DERIVED ENVIRONMENT CONSTRAINT can retain its simpler formulation as given in (23).

There is one issue that remains, the one raised briefly in footnote 10 above. If allophonic across-the-board processes apply in the postlexical component, what provides evidence that neutralising processes of the same type are really lexical, and not postlexical in the same way? (And the same question arises for the word level.) That is, how do we know whether the domain of an across-the-board process is the analytic domain (which means that it is lexical) or the prosodic word (which means that it is postlexical), if these two types of domains generally coincide? This issue is relevant, because if all across-the-board processes were indeed postlexical, then the DEC would never be violated in the lexicon and all lexical rules would be derived environment rules. That is, the DEC would then be a principle (as it is for Kiparsky), rather than being a violable constraint. Although at this moment I do not see any watertight way to decide this issue, in chapter 5 I will show that to be able to account for the fact that certain types of disharmonic roots are impossible in Turkish, the DEC has to be a violable constraint.

3.3.5. DEC and Faithfulness

If we thus still regard the DEC as a constraint, repeated in (29) for convenience, it will still be an extension of the theory in that it has to compare input with output to be able to detect a change (although it is not as complicated to evaluate as the version in

(21)).

(29) DERIVED ENVIRONMENT CONSTRAINT (DEC) (=(23))
No changes are allowed within a single analytic domain.

The DEC is thus not a simple output constraint. It seems, however, that such an extension of the theory is unavoidable.[17]

On closer inspection, the DEC turns out to be a member of the family of Faithfulness constraints, but now on a higher level than the segment, roughly on the level of the morpheme. The Faithfulness constraints as defined in section 1.2, however, do not need to compare the input with the output during the evaluation procedure. This can be seen in (30).

(30) (a) PARSE
Segments are parsed.

(b) FILL
Empty positions are prohibited.

(c) *ELEMENTS
Elements are prohibited.

Whether a segment is parsed into higher order prosodic units, or whether a position in syllable structure dominates a segment can be seen by simply observing the output. Similarly, *ELEMENTS picks out the candidates where some elements have been inserted without comparison, because all candidates have a common core of violations, reflecting lexical input.

It seems thus that the Faithfulness constraints up to the level of the segment can do without input-output comparison. However, as demonstrated above with the example of the DERIVED ENVIRONMENT CONSTRAINT, such comparisons cannot be excluded altogether from the grammar.

[17] Note that deriving the RAC (or its equivalents) from contrastive underspecification (suggested by Kiparsky 1993) is not possible without ending up in circularity, as is also shown by Iverson (1993). In the case of Assibilation in Finnish, for example, the rule would be blocked from applying in forms like /koti/ by specifying the /t/ as [–continuant] underlyingly. But it is exactly the cases that do not undergo the rule, which are so specified. That is, the generalisation is missed here that underlying specification of [–continuant] does not appear just anywhere, but precisely in the environments which fall under the category 'non-derived'. Thus it seems that the RAC cannot be dispensed with after all.

3.3.6. Phonologically derived environments

The DERIVED ENVIRONMENT CONSTRAINT as stated in (23) only considers derivation in terms of analytic domains, which is roughly equivalent to morphological derivation. But in the literature it has been suggested that for a derived environment rule to apply it is enough if another phonological rule applies earlier to the otherwise morphologically underived form (see the examples in (10c) and (13a), from Kiparsky 1973a). (10cii) shows that the Finnish Assibilation Rule which turns a *t* into an *s* before an *i* is fed by a Raising Rule which raises word-final *e* to *i*. In (13aii), the Sanskrit *ruki*-Rule applies morpheme-internally if Vowel Deletion creates its environment. Let us see whether we need some extra mechanism to be able to express this second way of creating a derived environment.

In Kiparsky's terms, rules like Raising in Finnish or Vowel Deletion in Sanskrit cannot be derived environment rules, because they apply monomorphemically (unless there are some further rules creating their environment that apply even earlier in the derivation). Thus, under Kiparsky's analysis, these rules cannot be neutralising. But in fact they are.[18] Consequently, it is not clear how these rules can apply at all, and thus – contrary to Kiparsky's claim – they cannot be the trigger for the following derived environment rules.

In fact, there is evidence that these "trigger rules" are no longer synchronically active (cf. Kiparsky 1973b and Skousen 1975). For example, in Finnish there are numerous examples ending in *e* that do not undergo the Raising rule. Thus the results of these rules, together with the results of the rules triggered by them, have to be encoded as allomorphic alternations in the underlying representation. For the Finnish data this means that forms with final alternating *e*/*i* will be represented as two separate allomorphs of the same stem. Alternating forms of the *vesi~vetenä* type will also be the product of an allomorphy rule choosing *vesi* when no suffixes are added, and *vete* otherwise. (In other – morphologically derived – environments, however, the Assibilation rule still applies.) The Sanskrit example exactly

[18] The third example Kiparsky mentions, from Estonian, is of exactly the same type. Here consonant gradation, which deletes the lax unvoiced stops /b, d, g/ in certain cases, creates the environment of a vowel lowering rule, which lowers a high vowel immediately preceding another vowel. Vowel lowering does not apply to sequences that are already present in the underlying representation. The gradation rule, however, is again neutralising.

parallels this.

The only further examples of phonologically created derived environments that I have been able to find in the literature come from Rubach (1984). Here, Lower in Polish (the process responsible for the surfacing of yers) and *r*-Lowering (another rule affecting yers) create the environment for the Labio-Velar Glide Insertion rule that inserts a *y* in between a non-coronal segment and an *e*. However, vowel~zero alternations such as the ones involving yers in Polish are analysed differently in the framework adopted here. Since the actual surfacing of the vowel is part of phonetic interpretation, and only the conditions under which this happens are phonological (cf. proper government), the process of Labio-Velar Glide Insertion has to be accounted for differently. The other example involves Iotation in Polish triggered by *y*-Insertion applying before a sequence of vowels the second of which is lax. This latter rule, however, is hardly a natural phonological rule (especially since afterwards the first vowel has to be deleted). Thus Iotation will have to be analysed differently, as well.

It seems thus that so far no convincing evidence has been found in favour of the claim that phonological rules can also make an environment derived. Until such evidence becomes available, it is thus sufficient to limit our attention to morphological derivation, and the DEC in (23) need not be supplemented with any additional device (such as an extra clause saying "if the relevant environment was already present in the input").

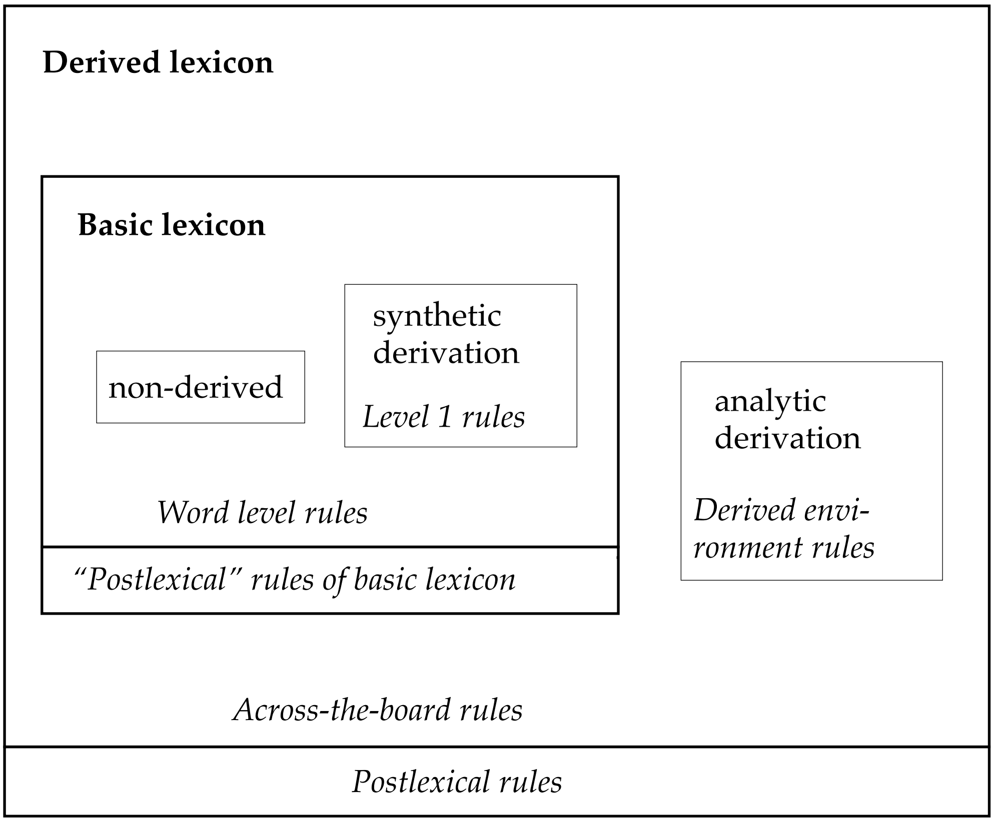
3.4. Summary

In summary, in my view the structure of the lexicon can be represented as in (31). The 'basic lexicon' contains all non-derived items and lexical items involving synthetic morphology. Items in the latter set are not considered as derived either. Rules "applying" to this basic lexicon are thus regarded as redundancy rules, applying only to synthetically derived forms or to the whole basic lexicon.

Forms involving analytic morphology, on the other hand, are derived dynamically and they undergo active phonological processing. Such processes always respect the principle of Structure Preservation, defined on the basic lexicon. They can either show derived environment effects and not apply to the basic lexicon, only to analytically derived forms; or they can apply across the board, to the whole derived lexicon. This depends on how the constraints forcing them are ranked with respect to the

DEC given in (23). This constraint retains some version of the Strict Cycle Condition, extending minimally the model proposed in Kaye (1995), where processes are claimed to apply whenever their conditions are satisfied. But this constraint is simpler than its previous formulations, since it does not need to be restricted to either cyclic or neutralising rules. And because it is violable, the cyclic-postcyclic distinction of Lexical Phonology can be dispensed with as well.

(31) *Structure of the lexicon*



The only level distinction that remains concerns the lexical-postlexical division. Postlexical rules also apply across the board, but they do not have access to morphological information, their domain is specified in terms of prosodic structure instead. These rules can be variable, optional and gradient. They never have exceptions. They might be allophonic. And they might apply across word boundaries. That is, they are not subject to any of the constraints restricting lexical rules.

Part II. Vowel harmony

4. Harmonic features

In this chapter I consider the main types of vowel harmony and the issue of how to represent these types in the framework introduced here. Since vowel harmony involves the agreement of vowels within a certain domain with respect to a particular property, or feature, we expect to find as many types of harmony as there are vocalic features. For a theory of vowel harmony, therefore, the choice of feature theory is of crucial importance. In this dissertation, I adopt an element-based theory of phonological primes (cf. Kaye, Lowenstamm & Vergnaud 1985, Harris & Lindsey 1995), with the three basic elements **I**, **A** and **U**, supplemented with the property of headedness. (For other theories using privative features, see Anderson & Ewen 1987 on Dependency Phonology, Schane 1984 on Particle Phonology.)

After introducing element theory, in the first half of the chapter I exemplify each type of harmony predicted by the theory. In the second half of the chapter, I turn to a discussion of Pasiego raising harmony, a type which is not predicted to occur, given the set of elements as listed above (where there is no unique element standing for the feature [high] which could spread in this case). I will show that raising in Pasiego is not a counterexample to the theory, because it behaves differently from harmonies expressed by the usual means of spreading. I will propose an analysis which combines insights from Government Phonology and Optimality Theory, in which raising is a result of lack of licensing of particular configurations in governed positions.

4.1. Element theory

One of the basic issues which feature theories are concerned with is whether phonological primes are unary or binary; that is, whether the two terms of a phonological opposition are equivalent, in the sense that they both play an active role in the phonology, or not (cf. Harris & Lindsey 1995). (For an overview of the binary-unary issue, see Den Dikken & van der Hulst 1988). If they are equivalent, then the opposition is equipollent, and the prime has two values, plus and minus. If they are not, then the opposition is privative, and the prime is either present or absent from a particular segment. All other things being equal, a privative model has weaker generative capacity than a model based on equipollence and is thus preferable.

In particular, in an equipollent approach, vowel harmony can affect both values of a given feature, predicting two different types of harmonies, whereas in a privative approach, only one type of spreading is possible, since there is nothing corresponding to the opposite value of the feature in question that spreading could have access to. The difference between spreading the minus and the plus value of a binary feature is not always easily detectable. One good test case is provided by languages with 'dominant harmony'. In such languages, both roots and affixes can bear the harmonic feature. Thus both roots and affixes are divided into two subgroups, the dominant group (bearing the harmonic feature), and the recessive group (lacking the harmonic feature). An important characteristic of dominant morphemes is that they never alternate. That is, they clearly show which value of a binary feature is active in the given language.

However, there are also harmony systems where only roots can bear the harmonic feature, and the harmony is therefore called 'root-controlled'. In this type of languages, the difference between the binary and the unary approach can still manifest itself, namely, if there are neutral vowels in the systems (vowels without a harmonic counterpart). As will be discussed in chapter 6, in a unary approach the behaviour of neutral vowels can be predicted on the basis of their segmental make-up (more precisely, on the basis of whether they contain the harmonic feature or not). It is, however, not possible to make such a prediction in a binary approach, where we do not know a priori which value of the binary feature is active in harmony (i.e. whether the given neutral vowel has or lacks that particular value). Another difference in predictions between the two approaches will be discussed in section 4.3.4.

According to the privative approach, then, phonological oppositions are universally asymmetric, where only one term of each distinction is capable of phonological activity, whereas the other term is doomed to be phonologically inert. This type of asymmetry has also been expressed by underspecification theories (cf. Archangeli 1984, Archangeli & Pulleyblank 1994), where only the marked value of an opposition is specified underlyingly. The other (unmarked) value is thus inaccessible to phonological processing, and is only filled in at the end of the derivation by a universal default rule. However, the universal markedness conventions can be overruled in individual grammars (referred to as 'markedness reversal'), and in these cases, it is the unmarked value which is specified lexically. That is, underspecification theory still predicts the existence of twice as many harmony systems as unary feature theory. In addition, the markedness conventions constitute an independent part of the theory, whereas in a privative model, markedness relations are built directly into phonological representations. A privative approach thus can be viewed as a more radical version of underspecification theory, where one value of each prime is inherently underspecified (cf. Archangeli 1988).

The element-based theory of primes is a privative approach. In addition, it complies with the "autonomous interpretation hypothesis" (cf. Harris & Lindsey 1995: 46-50), namely, that elements are the minimal units both of phonological contrasts and of phonetic interpretation. This means that phonological representations are directly interpretable at every level, that is, they are not underspecified in the sense that they would need redundancy rules to fill in missing values to be phonetically interpretable. Thus there is no linguistically significant level of phonetic representation either. Phonology is purely generative in function, defining the grammaticality of phonological structures. Phonological representations are uniformly cognitive, with no provisions made for articulation or perception.

In (1), the set of elements currently in use in the GP literature is given (cf. Cobb 1997). (For an earlier version of the theory, utilising more than these five elements, see Harris 1990a, Harris & Lindsey 1995.)

(1) *The set of elements*

I	'frontness'
U	'roundness'
A	'lowness'
H	'high tone/aspiration'
L	'low tone/voicing/nasality'

All elements are involved in the representation of both vowels and consonants, but here I will only concentrate on their vocalic use. The tonal elements, **H** and **L**, will not figure in further discussions. The three basic elements, **I**, **U** and **A**, can form segments by themselves (when they are realised as the three corner vowels of the vowel triangle /i, u, a/), or they can combine with each other to form complex expressions.

A further property of segments is whether they contain a head or not (indicated by underlining the head element). This property of headedness has taken the place of a further element that used to indicate 'ATRness'. In the present model, then, this property is expressed structurally: headed expressions are 'ATR', while headless ones are 'non-ATR'. Note that this notion of headedness is different from that used in Dependency Phonology, where headedness stands for preponderance of a particular element within an expression (that is, the expression ($\mathbf{I}.\underline{\mathbf{A}}$) is more **A**-like, and is pronounced /æ/ or /ɛ/, while the expression ($\mathbf{A}.\underline{\mathbf{I}}$) is more **I**-like and is pronounced /e/). The notion of headedness used here, on the other hand, has a constant phonetic interpretation, as explained above.

These points are illustrated in (2), by the example of a nine-vowel system, where mid vowels result from the combination of two elements, and headedness stands for ATR. (Note that in my view, headedness can also be totally absent from a given system, if the ATR-dimension in that particular language is inert.)

(2) *Representation of a nine-vowel system*

headed expressions		*headless expressions*	
i = ($\underline{\mathbf{I}}$)	u = ($\underline{\mathbf{U}}$)	ɪ = (**I**)	ʊ = (**U**)
e = ($\mathbf{A}.\underline{\mathbf{I}}$)	o = ($\mathbf{A}.\underline{\mathbf{U}}$)	ɛ = (**A.I**)	ɔ = (**A.U**)
		a = (**A**)	

In addition, the completely empty vowel is also licit which is realised as the high back unrounded /ɨ/. This means that a further element is dismissed from the original proposal of Kaye, Lowenstamm & Vergnaud (1985), namely, the 'cold vowel', or v^0. However, this element was defective in several respects. Most importantly, it did not characterise a natural class as all the other elements do, and it did not take part in phonological processes, such as spreading. (For a detailed discussion of the reasons for abandonment of the cold vowel, see Cobb 1997.)

In a model like this, vowel harmony can involve any of the listed elements, by requiring that every vowel in a given domain has or lacks a particular element. In the next section, I will show that this is indeed the case, and that we can find cases of **I**-, **U**- and **A**-harmony. In addition, agreement between vowels can involve headedness as well, giving rise to ATR-harmony. In this dissertation, I will not discuss nasal harmony, which often affects not only vowels, but rather strings of adjacent sonorant segments (cf. Piggott 1988), nor minor types of vowel harmony, such as retroflex harmony.

4.2. Types of vowel harmony

4.2.1. I-harmony

I-harmony can be illustrated by the case of Finnish (cf. Hakulinen 1961). The vowel inventory is given in (3).

(3) *Finnish vowel system*

i	ü	u	$\mathbf{\underline{I}}$	$\mathbf{I.\underline{U}}$	$\mathbf{\underline{U}}$
e	ö	o	$\mathbf{A.\underline{I}}$	$\mathbf{AI.\underline{U}}$	$\mathbf{A.\underline{U}}$
ä		a	$\mathbf{A.I}$		$\mathbf{A}$

Harmony is shown in (4).

(4) *Finnish vowel harmony* (Hakulinen 1961: 73, 139, 161)

(a)	tää-ltä	'here ABL'
	kala-lta	'fish ABL'
(b)	jäätü-nüt	'freeze ACT PAST PART'
	hakku-nut	'drown ACT PAST PART'
(c)	vie-köön	'take IMP SG 3'
	tuo-koon	'bring IMP SG 3'

Apart from the neutral vowels, *i* and *e*, front and back vowels do not co-occur within a word. (A detailed discussion of neutral vowel behaviour is postponed until chapter 6.) In other words, once an **I** element is present, it has all the nuclear positions in the word in its domain. This can be seen through the examples of suffix alternations in (4a-c). A front vowel stem is followed by a front vowel suffix, while a back vowel stem by a back vowel suffix.

I-harmony can be represented as in (5). Vowel harmony, under this view, is a manifestation of unbounded projection government, applying at the level of nuclear projection (cf. Kaye 1990b). In (5), unlicensed nuclei are projected to the next higher level, where they can enter into a governing relation. N_1, the initial nucleus is a potential governor, since it possesses the harmonic element **I**. At the P^1-projection, N_1 governs N_2, which is manifested by spreading the element **I** to the N_2 position (indicated by '>>>' and a dot). Since the N_2-position is now licensed, it is not projected to the next higher level. N_3, on the other hand, is projected to P^2, and N_1 can now govern it. N_3 thus becomes licensed by spreading the element **I** into it.

(5) ***I**-harmony*

```
          N       →      N                P2
          |              |
          N   →    N     N                P1
          |        |     |
      O   N1    O  N2 O  N3 O
      |   | \   |  |  |  |  |
      x   x   x x  x  x  x  x
      |   |  /  |  |  |  |  |
      j   | /   t  |  n  |  t
          |/       |     |
  - - - - -I >>>>>>>•>>>> • - - - - - - -
  - - - - -| - - - - - - -U - - - -U - - - - - - -
  - - - - -A - - - - - - - - - - - - - - - - - - - -
```

jäätünüt 'freeze ACT PAST PART'

Under this view, harmony does not proceed step-by-step from one nucleus to the next (a sort of iterative, or cyclic application). Rather, the harmonic element spreads from a single governor all through the domain, but still in a local manner. That is, the insight is retained that one and the same position cannot play both the role of governee and governor at the same time.

Notice that it makes no difference whether harmony is regarded as spreading (the traditional view), or as interpretation (cf. Harris 1994a). According to the first view, harmony is expressed by multiple association of a given element; while according to the second view, harmony is the result of extending the domain of a particular element and interpreting this element in every position that falls into its domain. In this dissertation, I will adopt the traditional view.

Notice that (5) above only gives the representation of harmony, but does not tell us anything about why there is harmony in one language, and why there is not in another. This is accounted for by constraint ranking. The two relevant constraints are given in (6).

(6)

- HARMONY
  If there is an element α associated to one nuclear position, it must have all the positions on the nuclear projection in its domain (via government).

- *MULTIPLE (α)
  No multiply associated elements.

The constraint expressing harmony is not specified for direction. I assume that the direction of spreading falls out from the site of specification and the domain of harmony.[1,2] The domain of harmony is generally the analytic domain. This issue will be discussed in detail in chapter 5.

The constraint HARMONY will be ranked above the instance of *MULTIPLE (α) that specifies the element that is harmonic in the given language, and below the instances that are not harmonic. Note that *MULTIPLE (α), together with the PARSE constraint, expresses the fact that the ideal autosegmental relation is one-to-one. That is, an element has to be associated to at least one anchor, and to not more than one anchor.

Let us see how these constraints work in the case of Finnish, as given in (7). The '**v**'-symbols in the table stand for the 'cold vowel' in terms of Kaye, Lowenstamm & Vergnaud (1985), representing the absence of an element on a particular autosegmental tier. The cold vowel has no status in the theory advocated here, and is simply used for expository purposes. (Vowel length is not represented in this table.)

---

[1] This is straightforward in root-controlled systems (where only roots can contain the harmonic feature), and in dominant systems (where affixes can also bear the harmonic feature) with bidirectional harmony. In dominant systems with unidirectional harmony (such as Pulaar, to be discussed in section 4.2.4), the position bearing the harmonic feature will at the same time define the right (or left) edge of the harmonic domain.

[2] Note also that there are no floating features in the theory advocated here. In fact, floating features could never get associated in this theory. In a language with disharmonic roots, harmony will be argued to be blocked inside roots by the higher-ranked DERIVED ENVIRONMENT CONSTRAINT (see chapter 5). This ranking would prevent the association of floating features as well. In a language with across-the-board harmony, on the other hand, if the harmonic feature is floating, it is not associated to any segment in the underlying inventory. Thus the principle of Structure Preservation precludes association of this feature in the lexical phonology. Floating features thus could only be used for allophonic (that is, postlexical) processes of harmony.

(7) ***I**-Harmony in Finnish*

j V t V n V t **I v v** **v U U** **A v v**	*MULT(**A**)	*MULT(**U**)	HARMONY	*MULT(**I**)
a. j V t V n V t **I**>>•>>• **v U U** **A v v** ☞ *jäätünüt*			**	*
b. j V t V n V t **I**>>• **v** **v U U** **A v v** *jäätünut*			***!	*
c. j V t V n V t **I v v** **v U U** **A v v** *jäätunut*			***!	
d. j V t V n V t **I v v** **v U U** **A**>>•>>• *jäätonot*	*!		**	
e. j V t V n V t **I**>>•>>• **v U U** **A**>>•>>• *jäätönöt*	*!		*	*

The candidates in (7d-e) are the worst candidates, because they violate the highest-ranked *MULTIPLE (**A**), by harmonising the element **A** (even though candidate (7e) correctly harmonises the element **I**). Candidates (7b-c) come next by not harmonising **I** or only harmonising it partially. Finally, (7a) is the optimal candidate, by harmonising **I**, but no other element.

Now let us turn to **U**-harmony.

4.2.2. U-harmony

An example of **U**-harmony is provided by Kirghiz, a Turkic language, spoken in the Kirghiz Republic, in China and in Afghanistan (cf. Hebert & Poppe 1963, Kaun 1995). The vowel system is given in (8). Here again, v^0 is simply used for expository purposes, representing a vowel lacking any elements.

(8) *Kirghiz vowel system*

i	ü	ı	u	**I**	**I.U**	v^0	**U**
e	ö	a	o	**A.I**	**AI.U**	**A**	**A.U**

Notice that in this system all vowels are represented as headless. This is because, in my view, the property of headedness can be totally absent from a particular system, if ATR is not distinctive in the language.

Vowel harmony is shown in (9).

(9) *Kirghiz vowel harmony* (Hebert & Poppe 1963: 7-11)

(a)	bir-intʃi	'first'
	tört-üntʃü	'fourth'
	altı-ntʃı	'sixth'
	toguz-untʃu	'ninth'
(b)	et-ten	'meat ABL'
	üy-dön	'house ABL'
	alma-dan	'apple ABL'
	tokoy-don	'forest ABL'
(c)	ata-sın-da	'father POSS LOC'
	ene-sin-de	'mother POSS LOC'
	köz-ün-dö	'eye POSS LOC'
	tuz-un-da	'salt POSS LOC'

Note that apart from **U**-harmony, **I**-harmony is active in the language as well. (9a) illustrates the effect of harmony on a high vowel suffix, (9b) on a low vowel suffix, and (9c) in multiple suffixation. Vowels within a word thus have to agree as far as their specification for **I** and **U** is concerned. (There is one restriction on harmony to be noted here. **U**-harmony does not apply in sequences of a high vowel followed by a low vowel, as illustrated by the last example in (9c).)

U-harmony can be represented as in (10).

(10) ***U**-harmony*

```
             N          →          N             P3
             |                     |
             N     →       N       N             P2
             |             |       |
             N  →  N       N       N             P1
             |     |       |       |
          O  N1 O  N2 O  R3    O   N4
          |  |  |  |  |  | \   |   |
          x  x  x  x  x  x  x  x   x
          |  |  |  |  |  |  |  |   |
          t  |  g  |  z  |  n  tʃ  |
             |     |     |         |
     - - - - U >>>>•>>>>>•>>>>>>>>•- - -
     - - - - A - - - - - - - - - - - - - - - - - - -
```

toguzuntʃu 'ninth'

N_1 again is the governor, since it possesses the harmonic element **U**. It governs N_2 on the P^1-projection, N_3 on the P^2-projection, and N_4 on the P^3-projection, and as a consequence we find unbounded **U**-spreading. As can also be seen in (10), rhyme nodes do not interfere with projection government, and the head of R_3 simply gets projected as any other nuclei do (which are of course also dominated by a rhyme node that is left out here for ease of exposition).

The constraint tableau accounting for harmony in Kirghiz is given in (11). In this language, HARMONY is ranked above *MULTIPLE (**U**) and *MULTIPLE (**I**), causing **U**- and **I**-harmony, while *MULTIPLE (**A**) is ranked above HARMONY to prevent **A**-harmony from applying. The example in (11) only illustrates **U**-harmony, since the underlying form is not specified for **I**.

As in the previous tableau, candidates in (11d-e) fare the worst, since they violate the highest-ranked constraint, *MULTIPLE (**A**). The candidate in (11c) is out, because it does not harmonise **U** at all, while (11b) is out, because it only harmonises **U** partially. Thus (11a) is the winning candidate, by harmonising **U**, but not **A**.

(11) ***U**-Harmony in Kirghiz*

t V g V z V n tʃ V **U** **v** **v** **v** **A** **v** **v** **v**	*MULT(**A**)	HARMONY	*MULT(**U**)	*MULT(**I**)
a. t V g V z V n tʃ V **U**>>•>>•>>>• **A** **v** **v** **v** ☞ *toguzuntʃu*		*	*	
b. t V g V z V n tʃ V **U**>>•>>• **v** **A** **v** **v** **v** *toguzuntʃı*		*!*	*	
c. t V g V z V n tʃ V **U** **v** **v** **v** **A** **v** **v** **v** *togızıntʃı*		*!*		
d. t V g V z V n tʃ V **U** **v** **v** **v** **A**>>•>>•>>>• *togazantʃa*	*!	*		
e. t V g V z V n tʃ V **U**>>•>>•>>>• **A**>>•>>•>>>• *togozontʃo*	*!		*	

Finally, let us look at harmonic spreading involving the third element, **A**.

4.2.3. A-harmony

A-harmony is found in many Bantu languages. The vowel system of Runyakore (cf. Clements 1991b) is given in (12).

(12) *Runyakore vowel system*

i		u		**<u>I</u>**		**<u>U</u>**
e		o		**A.<u>I</u>**		**A.<u>U</u>**
	a				**A**	

The workings of **A**-harmony are shown in (13), whereby non-low vowels within a word have to agree for their specification for the element **A**. That is, they either all have to be high, or all mid.

(13) *Runyakore vowel harmony* (Clements 1991b: 38)

(a) hik-ir-a 'reach APPL'
kub-ir-a 'fold APPL'
gamb-ir-a 'say APPL'

(b) reet-er-a 'bring APPL'
kor-er-a 'work APPL'

A-harmony can be represented as in (14).

(14) ***A**-harmony*

```
          N  →  N                      P1
          |     |
       O  N1 O  N2 O  N3
       |  |  |  |  |  |
       x  x  x  x  x  x
       |  |  |  |  |  |
       k  |  r  |  r  |
          |     |     |
- - - - -U- - - - -I- - - - -|- - -
- - - - -A >>>>•- - - - A- - -
```

korera 'work APPL'

N_1, a non-low vowel possessing the harmonic element **A**, acts as governor, and it spreads its **A** element to the adjacent non-low vowel, N_2. The neutrality of the vowel /a/ will be discussed in chapter 6 (section 6.2.2).

The relevant constraint tableau is given in (15).

(15) ***A**-Harmony in Runyakore*

k V r V r V **U** **I** **v** **A** **v** **A**	HARMONY	*MULT(**A**)
a. ☞ k V r V r V **U** **I** **v** **A**>>• **A** *korera*	**	*
b. k V r V r V **U** **I** **v** **A** **v** **A** *korira*	***!	

The constraint HARMONY in this language is ranked above

*MULTIPLE (**A**), causing **A**-spreading, as in the winning candidate in (15a). *MULTIPLE (**I**) and *MULTIPLE (**U**) are not included in the table, because **I**- and **U**-harmony are excluded from this language for independent reasons, as will be argued in chapter 6 (see section 6.3.2). (That is, the *Generator* will simply not create candidates violating those constraints.) Thus *MULTIPLE (**A**) could in fact be replaced by the general constraint *MULTIPLE (α).

So far I have looked at harmony represented by the spreading of a particular element. In the next section, I turn to the remaining type of harmony, involving the property of ATRness.

4.2.4. ATR-harmony

Since in the theory advocated here, the property of ATRness is not expressed by a particular element, but by the presence of headedness in a certain expression, ATR-harmony will also be different from the usual representation of harmony as spreading. Namely, ATR-harmony is now viewed as 'head alignment' or 'head agreement'. That is, vowels within a particular domain have to agree with each other in whether they all possess a head or whether they all lack one. The discussion below is based on Walker (1995) and Cobb (1997). 'Head agreement' as a type of harmony has been proposed before, although not specifically for the case of ATR-harmony (cf. Demirdache 1988, Lowenstamm & Prunet 1988).

I will illustrate this device on the basis of ATR-harmony in Pulaar, a Niger-Congo language of the West Atlantic branch spoken in Mauritania (cf. Archangeli & Pulleyblank 1994). The Pulaar vowel system consists of seven vowels, given in (16), where /e/ and /o/ only occur preceding high vowels.

(16) *Pulaar vowel system*

i		u	$\underline{\mathbf{I}}$		$\underline{\mathbf{U}}$
e		o	**A.**$\underline{\mathbf{I}}$		**A.**$\underline{\mathbf{U}}$
ɛ		ɔ	**A.I**		**A.U**
	a			**A**	

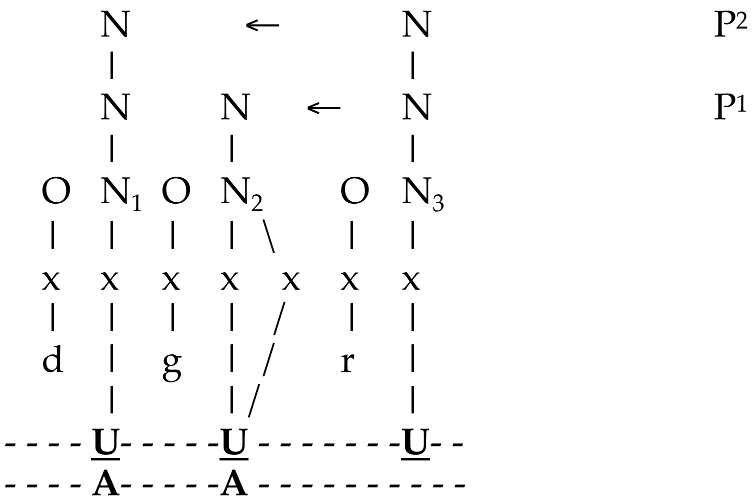
ATR-harmony operates from right to left, triggered by high vowels (the only vowels specified as headed lexically). Some examples are given in (17). The opaque behaviour of /a/, shown in (17d), will be discussed in chapter 6 (section 6.2.1).

(17) *Pulaar vowel harmony* (Archangeli & Pulleyblank 1994: 135-6)

(a)	peec-i	'crack PL'
	pɛɛc-ɔn	'crack DIM PL'
(b)	dog-oo-ru	'runner SG'
	ⁿdɔg-ɔ-w-ɔn	'runner DIM PL'
(c)	duk-oo-ji	'dispute PL'
	duk-ɔ-y-ɔn	'dispute DIM PL'
(d)	nɔdd-aa-li	'call'
	ᵑgɔr-aa-gu	'courage'

Thus in Pulaar, headed expressions define the righthand border of a harmonic domain which extends on the left to the beginning of the word. A nucleus occupied by a headed expression 'head-governs' nuclei on its left, which then have to become headed themselves. This mechanism is illustrated in (18).

(18) *ATR-harmony as head agreement*



dogooru 'runner SG'

Head-government is the same type of unbounded projection government as discussed above for the spreading-harmony cases, except that this time it is not an element which becomes shared by all the nuclei, but the property of headedness.

The relevant constraint tableau is given in (19).

(19) *ATR-Harmony in Pulaar*

d V g V r V **U** **U** $\underline{\mathbf{U}}$ **A** **A** **v**	*MULT(**A**)	HARMONY	*MULT(h)
a. d V g V r V $\underline{\mathbf{U}}$ $\underline{\mathbf{U}}$ $\underline{\mathbf{U}}$ **A** **A** **v** ☞ *dogooru*		**	*
b. d V g V r V **U** **U** $\underline{\mathbf{U}}$ **A** **A** **v** *dɔgɔɔru*		***!	

Since HARMONY is ranked above *MULTIPLE (h), candidate (19a) wins over candidate (19b). *MULTIPLE (**I**) and *MULTIPLE (**U**) are left out of the table for the same reason as they were in (15) above. (Length again is not indicated in the table.)

Note that the constraints HARMONY and *MULTIPLE (α), as defined in (6), do not apply to ATR-harmony, because headedness is not an element. Even though it is an additional property of segments, it is not simply added to the segment as a whole, but specifically to a particular element within the segment. Thus the constraints in (6) have to be reformulated to apply to this type of harmony as well. This could be done by replacing 'element' with 'segmental property' and 'multiple association' with 'sharing', as given in (20).

(20)

- HARMONY

    If there is a property α associated to one nuclear position, it must have all the positions on the nuclear projection in its domain (via government).

- *MULTIPLE (α)

    No shared properties.

In this case, it might in fact be favourable to regard spreading as interpretation (as in Harris 1994a), to be able to unify the two types of harmonies. Since this issue will not be of crucial importance for further discussions, I leave the decision for further research.

In summary, in this section I have shown that vowel harmony can involve all three vocalic elements, **I**, **U** and **A**, as well as the additional property of headedness. In the next section, I will look at a case that poses a potential problem for the theory as introduced so far.

4.3. The problem of Pasiego: raising harmony

In an **A**,**I**,**U**-type system supplemented with headedness, like the one advocated here, only the four types of harmony discussed in section 4.2 are predicted to occur. The Pasiego dialect of Spanish challenges this prediction, since it involves vowel harmony of the bidirectional type; namely, both raising of mid vowels before high vowels and lowering of high vowels before mid ones (although the existence of lowering is controversial). The vowel /a/ does not trigger lowering, neither does it undergo raising. Furthermore, it is transparent to the process.

Lowering can easily be accommodated in the unary feature system adopted here, by spreading the element **A**. Raising, however, is more problematic. Harris (1990b) proposes an analysis where raising is analysed as "reduction harmony", namely as delinking of a dependent element **A** in unstressed positions, unless there is an **A** in the governing, stressed, position to license it. The problem with this analysis is that the condition on delinking refers to the absence of the element **A**, a possibility which is crucially denied by unary feature theorists, since it in effect reintroduces the negative value of binary features into the theory.[3]

In this section, I will argue that this problem can be solved by combining the Government Phonology approach of Harris with that of Optimality Theory (cf. Prince & Smolensky 1993). Since this latter theory is non-procedural, the only thing that has to be stated is constraints on the output. More precisely, the constraint requiring the combination of elements in a governed position to be licensed by a governing **A** (LICENSE (COMB)) has to be ranked above PARSE (**A**). Thus there is no need to define when a certain process has to apply, and the reference to the absence of elements can be dispensed with. The other harmony process, lowering, will be accounted for using the by now familiar HARMONY constraint.

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[3] In fact, as has been shown by Ingleby *et al* (1996), strict privativeness of GP cannot be maintained as far as the *representation* of natural classes (of consonants) is concerned, and reference to the *absence* of certain elements has to be allowed – at least given the number of elements and their possible combinations proposed at the moment. Given this fact, it would be favourable if at least phonological *processes* could be restricted to only refer to the *presence* of elements in the representation. An analysis such as Harris (1990b) undermines even this weaker claim.

4.3.1. The data

Let me start with introducing the facts. The Pasiego dialect of Spanish, spoken in Santander, has a nine-vowel system illustrated in (21) (all the examples in this section come from Penny 1969). In final unstressed syllables, however, only the vowels *u*, *e*, *a* and the lax *ʊ* can appear.

(21) (a) *Pasiego vowel system*

	ATR		non-ATR	
high	i	u	ɪ	ʊ
mid	e	o		ɔ
low	a		ä	

(b) *Representation*

high	**<u>I</u>**	**<u>U</u>**	**I**	**U**
mid	**A.<u>I</u>**	**A.<u>U</u>**		**A.U**
low	**<u>A</u>**		**A**	

Pasiego exhibits two sorts of harmony, both of which take the phonological word as their domain, which is defined as the morphological word plus any proclitics. (The proclitics thus act like analytic prefixes for the process of harmony.) ATR-harmony is morphologically conditioned, it is triggered by the masculine singular count suffix -*ʊ* in word-final position. The vowel *e* is transparent to this process. At the moment I do not have an analysis of this process, but since its formalisation is of no direct relevance for the topic of this section, I leave this issue open for further research.[4]

The other harmony process involves height. Pretonic non-low vowels have to agree in height with the tonic vowel (the final unstressed vowel is invisible to this process). Low vowels are neutral; they can cooccur with both sets of vowels, that is, they neither trigger, nor undergo the harmony. Moreover, they are transparent to the process. These regularities are supported both by distributional facts and by alternations. The examples in (22)

[4] Analysing this process as ATR-harmony causes problems. One such problem is that it implies the representation of /a/ as (**<u>A</u>**), cf. (21b); whereas in chapter 6 it will be argued that the element **A** cannot bear headship. Another problem concerns the fact that it is the minus value of ATR that seems to spread here. However, this process is also special in that it is only triggered by one specific suffix.

show distributional evidence.

(22) *Height harmony: distributional evidence*

(a)	bindiθír	'to bless'
	litʃúga	'lettuce'
	kʊntíntʊ	'happy'
	mɪnʊ́dʊ	'small'
(b)	sosprésa	'surprise'
	kolór	'colour'
(c)	abidúl	'birch tree'
	kalór	'heat'
	okalitál	'eucalyptus grove'
	bɔrrä́tʃʊ	'drunk'

In (22a), pretonic vowels are high, whereas in (22b) they are mid, in agreement with the tonic vowel in each case. The forms in (22c) show that *a* (whether ATR or not) can cooccur with either type of vowel, and in fact with both, as evidenced by the third example in (22c), *okalitál* 'eucalyptus grove'.

Alternations can be illustrated by verbal paradigms and nominal proclitics, as in (23) and (24).

(23) *Height harmony: alternations in verbal paradigms*

	'drink'	'feel'	'leave'	
(a)	bibí:s	sintí:s	salís	2PL PRES IND
(b)	bebémus	sentémus	salémus	1PL PRES IND
(c)	bebámus	sintáis	salgámus	1/2/1PL PRES SUB

(24) *Height harmony: alternations in nominal proclitics*

	'the'		'my/me'	
(a)	ɪl mädírʊ	'the log'	ɪl mɪ kʊ́dʊ	'my elbow'
(b)	el kwéru	'the leather (mass)'	me lo kompró	'he bought it for me'
(c)	el ganáu	'the cattle'	ɪl mɪ ermä́nʊ	'my brother'

Here again the examples in (a) show alternants with high vowels, while those in (b) show alternants with mid vowels. The underlying vowel surfaces when the tonic vowel is *a*, as illustrated in (c). (24a) furthermore shows the transparency of *a*.

Height harmony is not totally exceptionless. As Penny (1969) observes, however, such exceptions almost exclusively fall into one type, namely, where a mid tonic vowel is preceded by a high pretonic vowel. Apart from a few monomorphemic cases, a handful of nominal derivational suffixes containing a stressed mid vowel behave disharmonically, in addition to the 1SG and 1PL future suffixes *-ré* and *-rémus*. Some examples are given in (25). (25a) contains some monomorphemic cases, (25b) the derivational suffixes and (25c) the future suffix.

(25) *Disharmony*

(a)	dinéru	'money'
	usté	'you'
	mirólus	'cross-eyed'
	urón	'ferret'
(b)	batidéra	'hoe'
	libréta	'notebook'
	istirón	'thin person'
	iskarpidór	'comb'
	pisarósus	'penitent PL'
(c)	sintiré	'feel 1SG FUT'
	iskupiré	'spit 1SG FUT'

The opposite pattern, where a mid pretonic vowel is followed by a high tonic vowel only occurs in less than a dozen monomorphemic cases in a list containing more than 6000 items, so for the present purposes these can safely be ignored.

4.3.2. Raising as reduction harmony

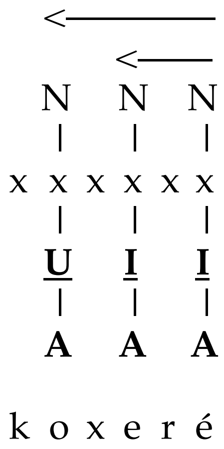
As illustrated in (22), (23) and (24), Pasiego height harmony thus involves both lowering and raising. Consequently, it has drawn the attention of several scholars, especially since the advent of underspecification theory which claims that only one value of every feature is active phonologically. The system of Pasiego seems to challenge this claim. McCarthy (1984), in an autosegmental framework, analyses these facts by a feature-changing rule, spreading both values of the feature [high]. Vago (1988), however, argues that there is no solid evidence for a lowering rule. Thus the remaining raising harmony can be analysed as a feature-filling rule spreading [+high] (and [–high] is filled in by default in all other contexts).

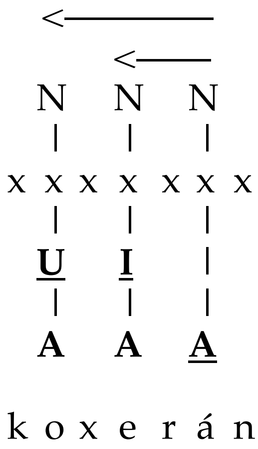
This, however, still poses a problem for element-based feature theories which only recognise the element **A** as a primitive in the height dimension. There is thus no equivalent of [+high] which could spread in Pasiego. This is the problem Harris (1990b) (recapitulated in Harris & Lindsey 1995) proposes to solve by analysing raising as decomposition, or reduction. His proposal is summarised in (26) and illustrated in (27), quoted from Harris (1990b).

(26) *Harris 1990b*

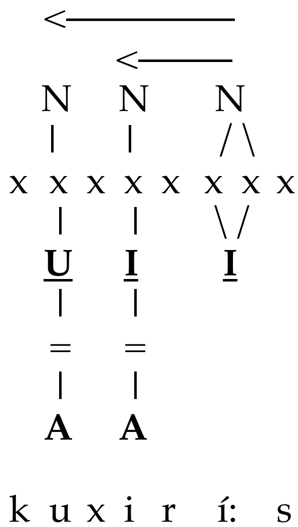
An operator **A** in a governed position must be licensed by an **A** in the governing position; otherwise, it delinks.

(27) (a) *koxeré* ‘take 1SG FUT’ (b) *koxerán* ‘take 3PL FUT’





(c) *kuxirí:s* ‘take 2PL FUT’



In (27a-b), the dependent **A**’s of the root vowels, *o* and *e*, are licensed by an element **A** in the governing position. As can be seen here, it is irrelevant whether this governing **A** is a head or a dependent. In (27c), on the other hand, there is no element **A** in the governing position, thus the **A**’s in governed positions have to delink.

The transparency of low vowels is accounted for as in (28). The vowel of the proclitic undergoes raising, because its dependent **A** is not licensed by an **A** in the governing position, irrespective of whether there is an intervening **A** in another governed position.

(28) *Il mAdÍrU*

```
<—————————
      <———
N     N   N
|     |   |
x x x x x x x x
|     |   |  |
I     |   I  U
|     |
=     |
|     |
A     A

ɪ lm ä  d í r ʊ
```

The representation in (28) does not directly correspond to the one given in Harris (1990b). There, non-ATR vowels are not represented as headless, thus the non-ATR vowel /ä/ in (28) is headed in Harris' analysis. However, if we update his analysis with the new developments, we encounter a problem. Since the example in (28) is a non-ATR word, all the vowels are represented as headless. According to the formulation of harmony in (26) the dependent **A** of the second vowel should thus delink too, which it does not. I will return to this problem in section 4.3.4.

Harris furthermore argues that the underlying reason for this process lies in the Complexity Condition, given in (29), whereby a governed segment cannot be more complex than the segment governing it.

(29) *Complexity Condition* (Harris 1990a: 274)
Let α and β be segments occupying the positions A and B respectively. Then, if A governs B, β must be no more complex than α.

This statement, however, is again problematic. It is true that high vowels, comprising only the element **I** or **U**, are not strong enough to license a complex expression in a governed position. A sole **A**, however, when in a governing position (as in (27b)), is perfectly capable of such licensing. Thus this licensing seems to have more to do with the element **A** itself than with complexity requirements.

There is in fact a more fundamental problem with this analysis, namely, that the condition on delinking in (26) refers to the absence of the element **A**. This possibility is crucially ruled out by unary feature theories, because what it does is reintroduce the negative value of binary features into the theory. Delinking in the context of the absence of the very same element is indistinguishable from spreading the minus value of the corresponding binary feature. This problem remains even if raising harmony is viewed as a matter of interpretation and not of delinking; it is only pushed a step further, into phonetic interpretation. Under this view, it still needs to be defined when an **A** in a governed position is not meant to be interpreted, that is, when it is not licensed. And this happens if *there is no* **A** in the governing position. Reference to the absence of an element is therefore still required. In what follows, I propose a reanalysis of the Pasiego data which solves this problem.

But first I argue that there is both raising and lowering harmony in Pasiego, contrary to what Vago (1988) and Harris (1990b) have claimed.

4.3.3. Both raising and lowering

Vago's arguments against lowering are based on the conjugation paradigm. One argument comes from the future suffixes *-ré* and *-rémus*, which do not trigger lowering, as shown in (30a). Another argument is based on the present indicative *-émus*, which triggers lowering with some verbs, but not with others, as can be seen in (30b), and lowering is sometimes optional. In addition, there are the nominal derivational suffixes, illustrated in (25b), which also fail to trigger lowering.

(30)	(a)	sintiré	'feel 1SG FUT'
		sintirémus	'feel 1PL FUT'
	(b)	sentémus	'feel 1PL PRES IND'
		iskupémus	'spit 1PL PRES IND'

However, there is also the case of proclitics, illustrated in (24), which undergo both raising, as in *ɪl mädírʊ* 'my elbow' from underlying *el* and lowering, as in *me lo kompró* 'he bought it for me' from underlying *mi*. If there is no **A**-spreading, it is not clear how we can account for these cases. And the fact that this spreading has exceptions does not make the process non-existent. There are many harmony systems with both disharmonic roots and disharmonic suffixes (like Turkish or Hungarian, to mention just two). The fact that – contrary to lowering – raising does not have exceptions only provides an additional argument for treating the two processes separately – something one is forced to do anyway in a theory based on unary features.

Therefore I maintain the claim that in Pasiego both raising and lowering exist, but while raising is exceptionless and can thus apply across the board, lowering has exceptions, and must be prevented from applying in certain environments. (How this should be achieved exactly will be the topic of chapter 5, using Turkish as an example, and will not be dealt with further here.) Having established that there is both raising and lowering in Pasiego, let me turn to the analysis of these processes which solves the problem encountered by Harris' account.

4.3.4. A combined GP-OT account

The solution is based on the licensing idea developed in Harris (1990b), but is cast in an Optimality Theoretic framework, which makes the reference to the absence of the element **A** dispensable.

The basic generalisation about Pasiego seems to be that the combination of elements in a single position needs to be supported by an **A** element in another position. This can be achieved in two ways, summarised in (31).

(31) **A**-support for combination of elements

(a) governed position: underparsing
(b) governing position: spreading

If the combination occurs in a governed position, and there is no element **A** in the governing position to support this combination, then **A** will remain unparsed. If on the other hand, the combination occurs in the governing position, and there is no element **A** in the governed positions to support it, then the **A** spreads to the governed positions to achieve this support.

To express (31a), underparsing, we need the two constraints in (32), ranked in the given order (indicated by '»').

(32) *Underparsing*

- LICENSE (COMB)
  The combination of elements in a governed position is licensed by a governing **A**. »

• PARSE (**A**)
The element **A** present in a representation is parsed.

Looking at the constraint LICENSE (COMB), the question might immediately arise whether *any* element can license *any* combination. Or is it the case that a combination involving element **X** must be licensed by an occurrence of the same **X** in the governing position, giving more the impression of "harmony"? I have decided on the above formulation for the following reason.

In Government Phonology, inventories are defined through tier conflation (discussed in more detail in chapter 6). That is, if a language does not allow for complex expressions, then all elements share the same line (and we get the three corner vowels /i, u, a/). In a more complex system, **A** can combine with either **I** or **U**, giving /e/ and /o/. Thus **I** and **U** are still occupying the same line, while **A** has one for itself. Finally, in the most complex systems, all elements have their own lines, and /ü/ and /ö/ are possible as well.

Parallel to this, one could say that even in languages where the combinations are allowed, that is, where the lines are not fused, such combinations can still be restricted to certain conditions. And this is what LICENSING constraints of the type given in (32) express. Thus we expect the arguments of such LICENSING constraints to correspond to the arguments of constraints defining inventories. Namely, we expect to find LICENSE (COMBINATION), corresponding to the fusion of all three lines, and LICENSE (**I**, **U**), corresponding to the fusion of the **I**- and **U**-lines only. (A constraint of the second type will be discussed later on in this chapter, and another example will be given in chapter 5, section 5.3.1.)

In the case at hand, however, "combination" in LICENSE (COMB) can only mean fusing **A** with either **I** or **U**, since the combination of these elements with each other is ruled out independently by fusing the **I**- and **U**-lines in Pasiego.

(27a) and (27c) then can be accounted for as (33a) and (33b) respectively. In (33a), LICENSE (COMB) is satisfied, since there is an element **A** in the governing position. Thus it is the constraint PARSE (**A**) which decides in favour of the first candidate. In (33b), however, each candidate violates one of the constraints. Thus ranking becomes relevant here, and by virtue of it the second candidate wins over the first one. That is, it is more important that if there is a combination of elements, it should be licensed, than to remain faithful to the input.

(33) (a) *koxeré*

k **U** x **I** r **Í** **A** **A** **A**	LICENSE (COMB)	PARSE (**A**)
k **U** x **I** r **Í** **A** **A** **A** ☞ *koxeré*		
k **U** x **I** r **Í** <**A**><**A**>**A** *kuxiré*		*!*

(b) *kuxirí:s*

k **U** x **I** r **Í**: s **A** **A**	LICENSE (COMB)	PARSE (**A**)
k **U** x **I** r **Í**: s **A** **A** *koxerí:s*	*!*	
k **U** x **I** r **Í**: s <**A**> <**A**> ☞ *kuxirí:s*		**

The transparency of the low vowels follows in the same way it did in Harris' approach, except that the present analysis does not encounter the problem with non-ATR words, because LICENSE (COMB) is not defined over "a dependent **A**", but over "the combination of elements".

In this analysis, no processes are defined; it is only the well-formedness of the output which is assessed through the constraints. This means that changes affecting the input are not triggered by anything, but occur spontaneously in the *Generator*. Afterwards the forms are checked against the constraints, and the best one is chosen as the output. Since there is no need to define *when* a particular change occurs, no reference needs to be made to the absence of elements, as it was necessary in (26).[5]

Turning now to the other half of the generalisation, that in (31b), i.e. spreading, we need the two constraints in (34) to express it. (The domain of harmony is defined as the prosodic word, including any proclitics, but excluding post-tonic unstressed vowels.)

[5] In fact, after drawing up this analysis, I obtained a handout of Harris (1994b), where he proposes an analysis along the same lines for a raising harmony process in another language, Kera – although overlooking the fundamental problem with his previous analysis of Pasiego.

(34) *Spreading*

- HARMONY (COMB)
  If there is a combination of elements in the governing position, then **A** must have all the positions on the nuclear projection in its domain (via government).

- *MULTIPLE (α)
  No multiply associated elements.

The constraint HARMONY (COMB) differs from harmony constraints in other languages in that it is not simply the presence of an element α in the governing position that triggers spreading. This happens only if there is a combination of elements in this position. That is, this constraint is more specific than harmony constraints normally are.

A form like *sentémus* in (23b) is thus derived as in (35).

(35) *sentémus*

s **I** n t **Í** m **U** s A	PARSE (**A**)	HARMONY (COMB)	*MULTIPLE (**A**)
s **I** n t **Í** m **U** s **A** *sintémus*		*!	
s **I** n t **Í** m **U** s <**A**> *sintímus*	*!		
s **I** n t **Í** m **U** s •<< **A** ☞ *sentémus*			*

Since HARMONY (COMB) is ranked above *MULTIPLE (**A**), it is better to spread **A**, as in the last candidate, than to leave the form unaffected, as in the first one. The second candidate illustrates that underparsing in this case is no remedy, since PARSE (**A**) is ranked just as high as HARMONY (COMB). Note that *MULTIPLE (**I**) and *MULTIPLE (**U**) have been left out of the table for the same reason as in (15).

Transparency of the low vowels to **A**-spreading follows automatically, if we follow Van der Hulst & Smith's (1986) classification of neutral vowels. According to them, neutral vowels bearing the harmonic feature behave transparently, because the harmonic feature is compatible with them and can spread through them; while neutral vowels lacking the harmonic feature are opaque to harmony, because the harmonic feature is incompatible with them and is thus blocked from spreading further due to the condition on locality. Low vowels in Pasiego are thus predicted to act transparently to **A**-spreading, since they themselves contain the element **A**, as illustrated in the schematic example in (36).

(36)
```
[N     N     N]PrWd
 |     |     |
 I     |     I
 •<< A<<<A
```

Notice that the generalisation in (31) is expressed by two separate constraints, namely LICENSE (COMB) and HARMONY (COMB), and it cannot be unified into one single constraint. This is so because LICENSE (COMB) makes crucial reference to only one position in the domain, the governing position, whereas HARMONY (COMB) refers to all the positions. Thus the two conditionals cannot be combined into a single biconditional.

Despite this difference, licensing – just like spreading – is unbounded, as we have seen in (33). This might make one wonder whether we do not end up having twice as many possible harmony systems as we had before – thus getting back to the problem of increasing the power of the system to that of a binary feature theory. One question we need to consider is whether the other elements figure in similar licensing constraints, or whether this phenomenon is specific to the element **A**.

As it turns out, there is at least some evidence for **U** behaving in the same way. In Polgárdi & Rebrus (1998), we argue that contrary to previous claims, there is no labial harmony in Hungarian. Labial harmony has been proposed to account for the behaviour of ternary suffixes (i.e. suffixes with three allomorphs), illustrated in (37).

(37) *Ternary suffixes in Hungarian*

bab-hoz	'to the bean'
fej-hez	'to the head'
füst-höz	'to the smoke'

However, ternary alternation is restricted to suffixes containing the short mid vowels *o/e/ö*. At the same time, the binary alternation *o~ö* is curiously missing from suffixes. In our view, these two facts are connected. In fact, we derive the phenomenon of "labial harmony" from the absence of suffixes with the short *o~ö* alternation. The surfacing of *e* instead of *ö* in words like *fejhez* is the result of the requirement, given in (38), that the combination of the elements **I** and **U** in a governed position needs to be licensed by a governing **U**.

(38) LICENSE (**I**, **U**)
The combination of **I** and **U** in a governed position is licensed by a governing **U**.

If such licensing is not available, the element **U** remains unparsed (expressed by the lower-ranked PARSE (**U**) constraint). (The fact that the vowel *ü* is not decomposed in the same way follows from an independent restriction prohibiting switching of headship.) Our analysis closely parallels the analysis of Pasiego raising I presented here. This fact of Hungarian is even more curious in light of the general claim that harmony systems referring to the minus value of the feature [round] are totally absent from the world's languages.

But is raising in Pasiego really like harmony processes traditionally expressed by spreading? I would like to claim that it is not. Apart from the difference I have mentioned above, another basic difference between the two processes is that while in the case of spreading we have the extension of the domain of one and the same element, in the case of licensing we have different instances of a particular element interacting with each other. In connection to this, in spreading harmony, it is one position in a given domain that determines the properties of the rest of the positions, while in licensing "harmony", the result is an interplay of the properties of both the governing and the governed positions. This is best evidenced by those words in Pasiego that have the vowel *a* in the stressed position, since here the underlying properties of both types of positions manifest themselves on the surface.

In fact, I think that the phenomenon in Pasiego looks like harmony only because there is also a separate process of lowering, that is, spreading of the element **A**. If this was not the case, and only the process of raising existed, the only pattern that would be prohibited would be that of mid vowels followed by high ones. And this would not look like harmony at all, since a high-mid pattern would still be legitimate. What makes it look like harmony is that the high-mid pattern is ruled out as well.

This difference between spreading harmony and licensing "harmony", however, can only be expressed in a unary approach. In a binary approach, raising "harmony" would be analysed as the spreading of the feature value [+high] (or [–**A**]). Forms containing high pretonic vowels followed by a mid tonic vowel then would have to be analysed as disharmonic. In such an analysis, however, it remains unexplained why *all* allegedly disharmonic forms contain the high-mid pattern, and none the opposite mid-high pattern. Such asymmetries are generally not found in languages with disharmonic roots. In a unary approach, on the other hand, this asymmetry is expected. Licensing is different from speading, in that it only checks what is in the governing position, if a particular configuration occurs in the governed positions. If such a configuration is not present, nothing happens. (That is, the high-mid pattern in this particular case is not regarded as disharmonic in any sense.) In the case of harmony as spreading, however, the harmonic feature is generally only specified in the governing position, apart from the case of disharmonic forms (in which case there are generally no restrictions on the site of specification).

I claim thus that this theory is not equivalent to one that uses binary features. That is, we still do not predict systems with [–round] harmony, for example. On the other hand, the combined mechanism of licensing and spreading employed in Pasiego can be extended to 'bidirectional' assimilation processes of the local type, such as voice assimilation in Hungarian or Polish, where both values of the feature [voice] seem to spread. Such processes have also always constituted a problem for unary feature theories. In fact, in these cases it is possible to unify spreading and licensing in a single constraint, because the domain is bipositional, and thus both constraints have only to refer to one other position. The elaboration of this proposal, however, is beyond the scope of this thesis.

4.4. Summary

In this chapter, I have shown that an element-based feature theory comprising the three vocalic elements **A**, **I** and **U**, supplemented with the property of headedness, is sufficient to characterise the types of harmony systems occurring in the world's languages. So-called raising harmony, as the one encountered in Pasiego, can be argued not to be a case of harmony after all, but rather to result from lack of licensing of the presence of certain elements in certain positions.

Other harmony systems have been used as evidence in favour of a binary feature system. A strong case suggesting the need for [–ATR]-harmony, that of Yoruba, will be reanalysed as **A**-harmony in chapter 6 (cf. section 6.2.2). For an element-based reanalysis of Irish consonant-vowel interactions that provide a strong argument for the feature [+back] (cf. Ní Chiosáin 1992), see Cyran (1997).

5. The harmonic domain: an account of disharmony

In this chapter I investigate the domain with respect to which harmony processes apply.[1] Vowel harmony is usually claimed to hold within the "word". However, the relevant notion of word need not coincide with a grammatical word. A case in point is compounds which are single words syntactically, yet in many cases constitute two harmonic spans of vowel harmony. This independence of compound constituents shows up in a variety of phonological phenomena including both stress and segmental processes, and in these cases it is usually said that the members of a compound form separate prosodic words (Nespor & Vogel 1986). This is why the typical domain of vowel harmony is generally considered to be the prosodic word.

This proposal is, however, not completely satisfactory. Processes that make reference to prosodic categories are usually fully automatic, and often allophonic and variable (and can thus be regarded as postlexical). Vowel harmony, on the other hand, is generally non-allophonic (but neutralising) and non-variable (but obligatory). Furthermore, it allows for exceptions, both in the form of disharmonic roots and disharmonic affixes. The domain of harmony thus has to be defined in a way that such disharmonic sequences are accounted for.

In this chapter, on the basis of a detailed analysis of Turkish vowel harmony and disharmony, I propose that vowel harmony applies with reference to the domain introduced in chapter 3, the 'analytic domain', which is the "phonologised" version of morphological structure referred to more directly in classical Lexical Phonology. As a consequence, vowel harmony processes can be subject to the DERIVED ENVIRONMENT CONSTRAINT (DEC) (cf. section 3.3.3), the non-derivational version of the Strict Cycle

[1] For a previous version of this chapter, see Polgárdi (1999b).

Condition, which blocks processes in a non-derived environment, i.e. within an analytic domain. I claim that in Turkish this is indeed the case, thus there is no active harmony inside roots (cf. also Clements & Sezer 1982). This explains the existence of disharmonic roots.

For the case of disharmonic suffixes, I claim that they can only fall into one of the following two categories: (i) they either behave as parts of compounds, or (ii) they are unproductive derivational suffixes. For the first class, it is reasonable to assume with Van der Hulst & Smith (1986) that they come with a pre-specified domain boundary from the lexicon, that is, that they belong to the category of 'compounding analytic' suffixes, introduced in chapter 3. For the second class I propose that such suffixes belong to the 'synthetic' morphology of the language, i.e. they form one unit phonologically with the root they attach to. This means that such root + suffix combinations behave as non-derived forms. That is, vowel harmony is prevented from applying to them. Harmony can thus only apply if 'analytic' suffixes are added to the root.

5.1. Turkish vowel harmony

Let us start with the basic facts of vowel harmony in Turkish. Turkish has an eight-vowel system, with every possible combination of the three elements **I**, **A** and **U**, including the completely empty vowel; the same system thus as Kirghiz, from section 4.2.2. The inventory can be seen in (1) (cf. Van der Hulst & van de Weijer 1991 for essentially the same representations involving the three unary features LOW, FRONT and ROUND).

(1) *Turkish vowel system*

i	ü	ı	u	**I**	**I.U**	v^0	**U**
e	ö	a	o	**A.I**	**AI.U**	**A**	**A.U**

Note that – contrary to the proposal of Charette & Göksel 1996 – the notion of headedness need not be utilised here.[2]

There are two kinds of vowel harmony active in the language: (i) **I**-harmony, which requires that all vowels in a word either have

[2] There is no empirical evidence for headedness in Turkish. The ATR-distinction is not phonologically active. Transparent vowels might also provide evidence for headedness, as we will see in chapter 6. However, in Turkish, there are no transparent vowels. And postulating headedness, as was done in Charette & Göksel (1996), causes additional problems, because it necessitates switching of headship during harmony, a move that violates the principle of Monotonicity.

or lack the element **I**, and (ii) a restricted version of **U**-harmony, which requires that non-low vowels agree with the preceding vowel in having or lacking the element **U**. The examples of suffix alternations in (2) illustrate these points (all the examples in this section are cited from Clements & Sezer 1982, unless otherwise indicated).

(2) *Turkish vowel harmony*

NOM SG	GEN SG	NOM PL	GEN PL	
ip	ip-in	ip-ler	ip-ler-in	'rope'
kız	kız-ın	kız-lar	kız-lar-ın	'girl'
yüz	yüz-ün	yüz-ler	yüz-ler-in	'face'
pul	pul-un	pul-lar	pul-lar-ın	'stamp'
el	el-in	el-ler	el-ler-in	'hand'
sap	sap-ın	sap-lar	sap-lar-ın	'stalk'
köy	köy-ün	köy-ler	köy-ler-in	'village'
son	son-un	son-lar	son-lar-ın	'end'

Here the genitive suffix /-ın/ shows both the effects of **I**- and **U**-harmony. The plural suffix /-lar/, on the other hand, which contains a low vowel, only undergoes **I**-harmony.

Vowels alternating with zero, which are always high, usually also undergo the two harmony rules, as can be seen in (3).

(3) *Vowel~zero alternation*

NOM SG	GEN SG	
koyun	koyn-un	'bosom'
fikir	fikr-in	'idea'
hüküm	hükm-ün	'judgement'
kısım	kısm-ın	'part'
sabır	sabr-ın	'patience'
metin	metn-in	'text'

In roots, however, vowel harmony is no longer very active. That is, there are many disharmonic roots. There is no agreement in the literature as to which of the possible disharmonic roots actually occur, but there is agreement that this set is restricted. Clements & Sezer (1982) claim that it is only the vowels of a typical 5-vowel system, /i, e, a, o, u/, that are allowed to occur in disharmonic roots. Some examples are given in (4).

(4) *Disharmonic roots*

a/i	takvim	'calendar'	fiat	'price'
a/e	haber	'news'	hesap	'bank account'
o/i	polis	'police'	pilot	'pilot'
o/e	otel	'hotel'	metot	'method'
i/u	billur	'crystal'	muhit	'neighbourhood'
u/e	kudret	'power'	mebus	'member of parliament'

That is – with the exception of /i...ü/ and /ü...i/ sequences (like *düzine* 'dozen' and *virüs* 'virus') which do occur regularly –, the most marked vowels of the system, /ü, ö, ı/ are rare in disharmonic roots.[3] And when they appear, they are unstable and they tend to regularise, as the examples in (5) show.

(5) *Regularisation*

ü~i	komünist	~	kominist	'communist'
ö~e	mersörize	~	merserize	'mercerized'
ü~u	püro	~	puro	'cigar'
u~ü	nüzul	~	nüzül	'paralysis'
	kupür	~	küpür	'denomination, clipping'
i~ü	bisküvit	~	büsküvüt	'biscuit'

As can be seen from the examples in (5), this regularisation can happen in several ways: it can involve the spreading of **I** or **U**, or the deletion of the same elements.

Besides disharmonic roots, there are also disharmonic suffixes, and for these the same generalisation holds, that is, the marked vowels are excluded from them. Some examples are given in (6) (the examples with -*ane* come from Lewis 1967: 66).

[3] In fact, later in this chapter I will arrive at a slightly different generalisation, based on further literature and my own field work; namely, that disharmony for rounding is acceptable as long as the form is harmonic for palatality.

(6) *Disharmonic suffixes*

/ıyor/	PROGR	/gen/	N-FORMING
gel-iyor-um	'I am coming'	sekiz-gen-ler	'octagonals'
koš-uyor-um	'I am running'	čok-gen-ler	'polygonals'
gül-üyor-um	'I am laughing'	üč-gen-ler	'triangles'
bak-ıyor-um	'I am looking'	altı-gen-ler	'hexagonals'
/istan/	N-FORMING	/ane/	ADV-FORMING
ermen-istan-ı	'Armenia'	mest-ane	'drunkenly'
mool-istan-ı	'Mongolia'	dost-ane	'friendly'
türk-istan-ı	'Turkestan'	bilgiç-ane	'in a know-all fashion'
arab-istan-ı	'Arabia'		

5.2. Analysis of harmony

First let us consider root-suffix harmony. To account for spreading I use the constraints proposed in section 4.2.1, repeated in (7) for convenience. The sign '»' indicates the ranking between these constraints. The domain of harmony is the analytic domain.

(7)

- HARMONY
  If there is an element α associated to one nuclear position, it must have all the positions on the nuclear projection in its domain (via government). »
- *MULTIPLE (α)
  No multiply associated elements.

Since HARMONY is ranked above *MULTIPLE (**I**) and *MULTIPLE (**U**), there is **I**- and **U**-harmony in Turkish. The fact that there is no **A**-harmony is expressed by ranking *MULTIPLE (**A**) above HARMONY, thus preventing the spreading of the **A** element.

Let us see how these constraints work on an example such as (8), where a low front rounded root vowel is followed by a high vowel suffix.

(8) *Harmony in high vowel suffixes*

k V y + V n **A** **v** **I** **v** **U** **v**	*MULT(**A**)	HARMONY	*MULT(**I**)	*MULT(**U**)
a. k V y + V n **A** **v** **I** >>> • **U** >>>• ☞ *köyün*		*	*	*
b. k V y + V n **A** **v** **I** >>> • **U** **v** *köyin*		**!	*	
c. k V y + V n **A** **v** **I** **v** **U** >>>• *köyun*		**!		*
d. k V y + V n **A** **v** **I** **v** **U** **v** *köyın*		**!*		
e. k V y + V n **A** >>>• **I** >>>• **U** >>>• *köyön*	*!		*	*

The candidate *köyön* in (8e) is the worst candidate, because it violates the highest-ranked *MULTIPLE (**A**). Candidates (8b-d), *köyin*, *köyun* and *köyın* come next, violating the HARMONY constraint twice or three times. The optimal output is (8a) *köyün*, where **I** and **U** are harmonised, but **A** is not.

So far I have accounted for the behaviour of high vowels. But low vowels do not harmonise for rounding. In fact, there is a general prohibition in Turkish noted in the literature against non-initial *o* and *ö*. This can be expressed by the constraint in (9).

(9) LICENSE (**A**, **U**)

The combination of the elements **A** and **U** is only licensed in initial position.

LICENSE (**A**, **U**), when ranked above HARMONY, will block Rounding Harmony to low vowels, as illustrated in (10).

(10) *Blocking of Rounding Harmony in low vowel suffixes*

s **A** n + l **A** r **v** **v** **U** **v**	LICENSE (**A**, **U**)	HARMONY	*MULTIPLE (**U**)
a. s **A** n + l **A** r **v** **v** **U** **v** ☞ *sonlar*		*	
b. s **A** n + l **A** r **v** **v** **U**>>>>• *sonlor*	*!		*

Note that when a high vowel suffix follows a low vowel suffix, Rounding Harmony will not affect the high vowel suffix either, as in the example *son-lar-ın* 'end GEN PL' in (2). That is, low vowels are opaque to Rounding Harmony. This is so because there is an inviolable principle requiring phonological processes to operate locally (cf. the Locality Condition of Van der Hulst & Smith 1986, Archangeli & Pulleyblank 1994). This means that the *Generator* will not be able to create a non-local association illustrated in (11).

(11) *Opacity of low vowels with respect to Rounding Harmony*

*s **A** n + l **A** r + **v** n
| |
U >>>>>>>>>•

5.3. Analysis of disharmony

5.3.1. Disharmonic roots

So far I have only discussed harmonic alternations in suffixes. But the majority of Turkish roots seem to harmonise too. Is this the result of a dynamic process? On the basis of the great number of disharmonic roots, illustrated in (4) above, I claim (together with Clements & Sezer 1982, among others) that Turkish no longer has active harmony in roots.

I propose to analyse this as a case of blocking in non-derived environments (cf. Bennink 1992 for a similar proposal). As discussed in chapter 3, in Lexical Phonology, this type of cases were accounted for by the *Revised Alternation Condition (RAC)* of Kiparsky (1973a), or by its later reformulations in the *Strict Cycle Condition (SCC)* (cf. Mascaró 1976, among others). The former restricted neutralising rules to only apply in derived environments, and the latter did the same with respect to cyclic rules.

In a non-derivational approach such as OT, there are no rules, and restrictions on rules such as the SCC have to be expressed differently. In chapter 3 (section 3.3.3), the constraint in (12) is proposed to achieve this goal.

(12) DERIVED ENVIRONMENT CONSTRAINT (DEC)
No changes are allowed within a single analytic domain.

If DEC is ranked above a constraint that requires certain changes (such as HARMONY), then the changes forced by the latter will only be carried out in derived environments. If the latter constraint is ranked above DEC, it will be in force everywhere, both in non-derived and in derived environments. Thus the change (in this case, harmonic spreading) occurs across the board.[4] In other words, DEC belongs to the family of Faithfulness constraints, restricting the relation between inputs and outputs.

As explained in chapter 3, DEC is more general than the RAC or the SCC, because it does not need to be restricted to neutralising or cyclic rules. Briefly, the restriction to neutralising changes falls out of an independent property of lexical processes, namely, that they are structure preserving (cf. Kiparsky 1985). Since DEC refers to analytic domains, lexical processes are the only ones it can be relevant to, because these domains are no longer visible at the postlexical level. And because lexical changes are always structure preserving (i.e. neutralising), this fact does not need to be specified separately in the constraint itself.

Returning to Turkish, this language exhibits many disharmonic roots, thus no active harmony operates within roots. Consequently, the HARMONY constraint has to be ranked below DEC. The interaction of the above constraints is illustrated in (13).

[4] Such languages might still exhibit a few exceptions. At the moment, I do not know how to account for such cases.

(13) *Disharmonic roots*

h **A** s **A** p **I** **v** **v** **v**	DEC	HARMONY	*MULTIPLE (**I**)
a. h **A** s **A** p **I** **v** **v** **v** ☞ *hesap*		*	
b. h **A** s **A** p **I**>>• **v** **v** *hesep*	*!		*

Thus the disharmonic *hesap* in (13a) wins over the harmonic *hesep* in (13b) to save a violation of the higher-ranked DEC.[5]

Since LICENSE (**A**, **U**) is ranked below DEC in the same way as HARMONY, we find exceptional *o*'s and *ö*'s in non-initial positions. That is, violations of these two constraints are not repaired in a non-derived environment. Notice that the analysis of harmony in suffixes, illustrated in (8) and (10), remains unaffected by DEC, because the addition of analytic suffixes always creates a derived environment, and therefore in those cases DEC is always satisfied. A consequence of this approach is that seemingly harmonic roots will now have to be represented with the harmonic feature multiply associated already lexically.

But this is not yet the whole story. As we have seen in (4) and (5) above, not every combination of disharmonic vowels is possible in Turkish. There is no complete agreement in the literature as to which are exactly the possible combinations. (See, for example, Clements & Sezer 1982, Van der Hulst & van de Weijer 1991, Van de Weijer 1992, Bennink 1992, 1994.) In this chapter, on the basis of the literature, supplemented with my own field work, I adopt the (slightly simplified) view that the generalisations in (14) hold of disharmonic roots.

[5] Note that in this theory the ranking of DEC with respect to HARMONY in itself establishes the difference between languages where harmony is a derived environment process and languages where it applies across-the-board. In a theory utilising the (inviolable) RAC or SCC, an additional distinction is needed between languages where the harmonic feature is always floating (across-the-board harmony), and languages where words can contain the harmonic feature either floating, or associated (harmony as a derived environment process).

(14) *Generalisations*

(a) *ı* does not occur disharmonically
(b) *ü* and *ö* do not occur with back vowels

In an OT-type grammar, we can express these generalisations by ranking some further constraints above DEC, ensuring in this way that for forms containing these vowels it will always be more optimal to undergo harmony than to stay unaffected. More specifically, we need to rank the three constraints given in (15) above DEC.

(15)

- *ELEMENTS
  Elements are prohibited. »

- FILL
  Empty positions are prohibited.

- LICENSE (**I**, **U**)
  The combination of **I** and **U** in a single position is only licensed by multiple association of **I**.

LICENSE (**I**, **U**) is a direct translation of the generalisation in (14b). Put in another way, this amounts to saying that palatal harmony is in some sense stronger than labial harmony. Although this is in fact a tendency across languages, it should be built into the grammar in a more principled way. At the moment, however, I cannot provide a more principled solution. This constraint is a member of a family of constraints expressing conditions on possible feature combinations (for examples from other languages see Chapter 4 on Pasiego, and Polgárdi & Rebrus (1998) on Hungarian).

To see the effects of these constraints let us consider the table in (16). *ELEMENTS needs to be highest-ranked, since violations of FILL are never repaired by insertion of elements, only by spreading. PARSE (demanding elements to be phonetically realised) also needs to fall into this category, because monosyllabic words with front rounded vowels, *ö* and *ü* are possible (cf. for example *yüz* and *köy* in (2) above). Since PARSE is never violated, I have not included it in the table, to save space.

(16) *Regularisation of impossible disharmonic roots*

v ... **v** **I** **v** **U** **v**	*ELEMENTS	LIC(**I**, **U**)	FILL	DEC	HARMONY	*MULT(**I**/**U**)
a. **v** ... **v** **I**>>>• **U**>>>• *ü ... ü*	**			**!		**
b. **v** ... **v** **I**>>>• **U** **v** ☞ *ü ... i*	**			*	*	*
c. **v** ... **v** **I** **v** **U**>>>• *ü ... u*	**	*!		*	*	*
d. **v** ... **v** **I** **v** **U** **v** *ü ... ı*	**	*!	*!		**	
e. **v** ... **A** **I** **v** **U** **v** *ü ... a*	***!	*		*	***	

An underlying form like (16) violates both FILL and LICENSE (**I**, **U**), since *ı* has no elements, whereas *ü* has both **I** and **U**. This can be seen in the candidate in (16d), where the underlying form is unaffected. Since FILL and LICENSE (**I**, **U**) are ranked above DEC, violation of the latter is more optimal. (16c) shows that spreading of **U** is not enough, because the form still fatally violates LICENSE (**I**, **U**). The form in (16a), on the other hand, which is parsed harmonically, incurs an extra violation of DEC, and is thus also out. Therefore (16b), where only **I** is harmonised, comes out as optimal, even though it violates the HARMONY constraint. Finally, (16e) demonstrates that inserting an element, although saves a FILL violation, results in violating an even higher-ranked constraint, namely *ELEMENTS. Notice here that this system can only predict one of the patterns of regularisation illustrated in (5), namely spreading of **I**.

As we have seen in (16), *ı* can never appear in a word together with vowels possessing either of the elements **I** or **U**. As a matter of fact, it can only appear together with *a* or itself. To account for this, we have to rank both *ELEMENTS and *MULTIPLE (**A**) above FILL, as illustrated in (17). That is, it is worse to insert an element, or to spread **A**, than to leave the position empty.

(17) *kapı* 'door'

k **v** p **v** **A** **v** **v** **v**	*MULTIPLE (**A**)	*ELEMENTS	FILL
a. k **v** p **v** **A** **v** **v** **v** ☞ *kapı*		*	*
b. k **v** p **v** **A** **v** **v** **I** *kapi*		**!	
c. k **v** p **v** **A** >>• **v** **v** *kapa*	*!	*	

Finally, let us turn to the behaviour of vowels that alternate with zero, illustrated in (3). These can be analysed in two ways: they are either epenthesized, or they are deleted. Here I will argue for a deletion analysis. One argument for this comes from vowel harmony itself. Although in most cases, as we have seen in (3), alternating vowels harmonise with the vowel preceding them, this is not always the case. Some examples of such disharmonic alternating vowels are given in (18) (cf. Kardestuncer 1982: 109).

(18) *Disharmonic alternating vowels*

NOM SG	ACC SG	
vakit	vakt-i	'time'
akis	aks-i	'opposite'
zulüm	zulm-ü	'oppression'

Since following suffixes harmonise with the alternating vowel, the quality of the latter cannot be derived. This means that certain underlying high vowels have to be marked in the lexicon for undergoing deletion under specific circumstances, namely, when they are followed by another vowel in the next syllable. This can be analysed using the Government Phonological tool of Proper Government, whose exact mechanism need not concern us here (but see chapter 2 for further details). Roots containing alternating vowels thus behave like any other type of root: some of them are harmonic, while some of them are not; the only difference being that in this type of root one of the (high) vowels is marked for deletion.[6]

In summary, we need the ranking of constraints in (19) to derive the Turkish facts discussed above.

(19) *Constraint hierarchy of Turkish*

```
PARSE      *ELEMENTS      *MULTIPLE (A)
     \          |          /
      LICENSE (I, U), FILL
                |
               DEC
                |
         LICENSE (A, U)
                |
             HARMONY
                |
  *MULTIPLE (I), *MULTIPLE (U)
```

The top row is occupied by the inviolable constraints, and each step down the constraints can be violated only if in this way the form avoids a violation higher up in the hierarchy. Here it can also be seen that the HARMONY constraint accounting for the regular cases is relatively low-ranked. It is outranked by DEC which accounts for the exceptional forms, that is, the disharmonic roots, and this in turn is outranked by LICENSE (**I**, **U**) and FILL, which are responsible for the exceptions-to-exceptions, that is, the impossible disharmonic roots.

5.3.2. Disharmonic suffixes

So far I have only dealt with one form of disharmonicity, namely, disharmonic roots. But as we have seen in (6) above, Turkish also has disharmonic suffixes. This is in fact quite common for languages with vowel harmony. The analysis of disharmonic roots, as it stands, does not account for this phenomenon, since the addition of analytic suffixes always creates a derived environment, where the constraint DEC has nothing to say.

The two important properties of disharmonic suffixes are that, on the one hand, they block harmony (this is why they are called

[6] There is another type of "epenthesis" in Turkish, whereby in colloquial pronunciation initial clusters are broken up by a high vowel, as in *prens* (careful form) vs. *pirens* (colloquial form) 'prince'. The majority of these vowels are harmonic. Since these vowels do not alternate in the same way as those given in (18), they can be analysed in a parallel way to the case of regularisation given in (16).

disharmonic), but on the other hand, they also never spread back to the stem. The two problematic cases can be illustrated as in (20).

(20) *Disharmonic suffixes*

(a) block harmony

```
* F
  |
  V  +  V
```

e.g. *din+das* (**din+des*) 'co-religionist'

(b) do not spread back to the stem

```
*       F
        |
  V  +  V
```

e.g. *çok+gen* (**çök+gen*) 'polygonal'

If we use unary features, then in (20a) we have to prevent the harmonic feature from spreading to the disharmonic suffix, while in (20b) we have to prevent it from spreading from the suffix back to the root. It was for these cases that Van der Hulst & Smith (1986) proposed that such disharmonic suffixes come with a prespecified domain boundary from the lexicon. Such a boundary would save us from both undesirable situations.

Making a survey of disharmonic suffixes in Turkish through Lees (1961), Lewis (1967) and Kardestuncer (1982, 1983) suggests that for one group of disharmonic suffixes, a prespecified domain boundary is not unjustified. This group can be exemplified by *-ıyor*, from (6), and *-ken* 'copulative gerund' (but there are more than a dozen additional examples). All these suffixes share the exceptional property that they are enclitic (or preaccenting), that is, they cannot bear the regular final main stress of the word. This is illustrated in (21a). (21b) shows that compounds have the same stress pattern, namely, stress falls on the last syllable of the first member of the compound.

(21) (a) *preaccenting suffixes*

yazárken	'while writing'
gelíyor	'he is coming'

(b) *compound stress*

hanímeli	'honeysuckle'	(*hanım* 'lady' + *el* 'hand' + *i*)
toplúigne	'pin'	(*toplu* 'knobbed' + *igne* 'needle')

Furthermore, in Lewis (1967), *-ıyor* is described as coming from an independent verb originally, while *-ken* can still be used either as an independent word or as a suffix. A compound structure for these suffixes thus seems justified, as illustrated in (22).

(22) *Compounding suffixes*

[[yorgun][ken]]	'be tired copulative gerund'
[[[gel]i][yor]]	'he is coming'

Interestingly, in Hungarian too, there are about half a dozen relatively new suffixes, with one exception all disyllabic, that show a similar behaviour. This group can be exemplified by *-féle* 'sort of' and *-kor* 'at (time)', as in (23a). These suffixes do not undergo vowel harmony. In addition, they exceptionally do not trigger lengthening of morpheme final low vowels preceding them, shown in (23b), providing further evidence for a compound structure.

(23) *Hungarian compounding suffixes*

(a)	[[más][féle]]	'of another type'	
	[[hét][kor]]	'at seven (o'clock)'	
(b)	ruhaféle	'type of clothes'	(vs. *ruhá-t* 'clothes ACC')
	órakor	'at the hour'	(vs. *órá-t* 'hour ACC')

However, not all disharmonic suffixes show characteristics of a compounding behaviour. For these latter suffixes, positing a prespecified domain boundary is thus ad hoc. But as it turns out, this remaining group of suffixes shares some other common property, namely that all of them are non-productive derivational suffixes. In Turkish, they can be exemplified by the noun-forming *-istan* and the adverb-forming *-ane* from (6), while in Hungarian by the diminutive suffixes *-kó* and *-us*, shown in (24).

(24) *Non-productive derivational suffixes in Hungarian*

Ferkó	'Ferenc DIM'
Melus	'Melinda DIM'

There has been a suggestion in Orešnik (1979), on the basis of evidence from Icelandic, that the definition of 'derived forms' in the Revised Alternation Condition should be modified "so that segment strings crucially containing a *derivational* morpheme boundary are not considered derived if present in the underlying representation" (p. 230). This means that processes prohibited from monomorphemic environments would not apply to forms that have only undergone derivational morphology, that is, they would only be allowed in inflectionally derived environments. It seems reasonable to include derivational affixes in the lexical items, since they have idiosyncratic properties like changing the meaning of the root in a not completely predictable way; being able to combine with certain roots, but not with others, etc.

Still, as it stands, Orešnik's proposal is too general. It is true that all of the relevant suffixes in Turkish (and Hungarian) are derivational and, in addition, non-productive. But it is not the case that every non-productive derivational suffix is disharmonic. There are quite a few such suffixes both in Hungarian and in Turkish that behave harmonically. So how are we to interpret Orešnik's suggestion in order not to block harmony in these cases?

A solution is offered in Kaye's (1995) proposal, reviewed in chapter 3, where he divides morphology into the three categories, given in (25), on the basis of how they define the domains of phonological processing.

(25) *Types of morphology* (Kaye 1995)

(i) non-analytic (or synthetic): [A B]
(ii) dependent analytic (or analytic): [[A] B]
(iii) independent analytic (or compounding): [[A] [B]]

For the third group, compounding morphology, where both the root and the affix forms an analytic domain of its own, we have seen examples above. The distinction that is of relevance here is between the first two groups, that of synthetic and analytic morphology. The basic difference between these two is that synthetic affixes form one phonological domain with the root they attach to, thus forming an unanalysable unit phonologically; whereas analytically derived forms clearly show their morphological complexity, thus preserving the integrity of the inner phonological domain just comprising the root. As discussed in chapter 3, the distinction between synthetic and analytic morphology corresponds to that between Level 1 and Level 2 morphology in classical Lexical Phonology (cf. Kiparsky 1982b, Borowsky 1993). But in Lexical Phonology the interaction with morphology is more direct, while here the morphological boundaries are "phonologised".

I propose to analyse the second class of disharmonic suffixes as synthetic, illustrated in (26a). Forms derived by these suffixes form one phonological domain together with the root, and they behave phonologically like non-derived forms; that is, harmony is prevented from applying to them by the DEC constraint. Analytic suffixes, shown in (26b), on the other hand, will behave regularly and will undergo vowel harmony.

(26) (a) *synthetic suffixation*

[türkistan]
[mestane]

(b) *analytic suffixation*

[[yüz]ün]
[[son]lar]

Unfortunately, there is no independent defining property of suffixes analysed as synthetic here. That is, neither the inflectional vs. derivational nor the productive vs. non-productive distinction is of any help in these cases. Moreover, there is another problem with this distinction, addressed in Rebrus *et al* (1996) with respect to Hungarian, which is applicable here as well. The synthetic-analytic distinction is not refined enough to account for all the morphological classes apparent in Turkish, where the dividing line between synthetic vs. analytic suffixes seems to be placed differently for different phonological processes. Or in other words, more than one level/degree of syntheticity seem to be necessary to distinguish. I leave this issue open for further research.

In summary, there are two types of disharmonic suffixes, one of which behaves like compounding affixes (cf. (22)), while the other belongs to synthetic affixation (cf. (26a)), falling in effect into the same category as disharmonic roots. This means that to account for disharmonic suffixes we do not need to posit ad hoc domain boundaries.

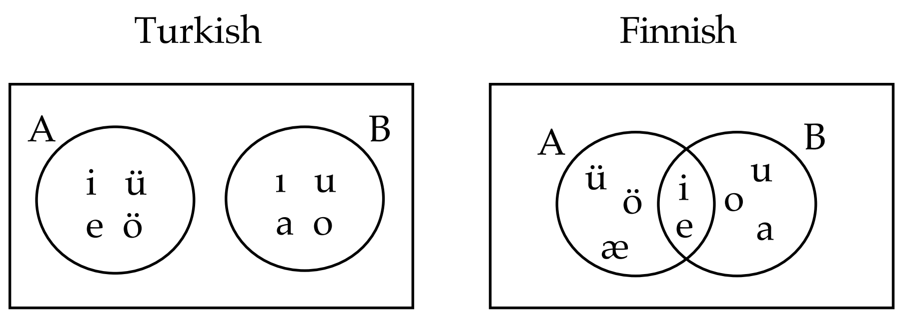
5.4. Conclusion

In this chapter, on the basis of a detailed analysis of Turkish vowel harmony and disharmony, I have proposed that vowel harmony processes apply with respect to the analytic domain defined in chapter 3. Harmonic alternations in analytic suffixes were accounted for by the HARMONY constraint. Disharmonicity within roots results from the higher ranking DERIVED ENVIRONMENT CONSTRAINT, a non-derivational version of Kiparsky's Revised Alternation Condition. Restrictions on possible types of disharmonicity follow from even higher-ranked constraints. Finally, disharmonic suffixes come in two types, compounding and synthetic, which are distinguished from harmonically regular analytic suffixes in terms of the (independently motivated) phonological domains they form with respect to the stem.

6. Neutral vowels

In the simplest type of vowel harmony systems, the vowels fall into two distinct sets, where each vowel has its harmonic counterpart in the other set, and only vowels belonging to the same set co-occur. Often, however, the situation is more complex and the two sets intersect, resulting in a system where segments at the intersection have no harmonic counterpart. These two situations are illustrated in (1), by Turkish and Finnish, respectively.

(1)



Both languages exhibit palatal harmony, where only front or back vowels (Set A vs. Set B) cooccur. In Turkish, these two sets are distinct, whereas in Finnish they intersect. In the vowels at the intersection (*i* and *e* in this particular example), a (potential) distinction is neutralised. Therefore they have been traditionally referred to as neutral vowels. Their neutrality is typically manifested by the fact that they co-occur with vowels of both harmonic sets. This also means that suffixes containing neutral vowels are invariant and only have one allomorph, contrary to the general chameleon-like character of suffixes in vowel harmony.[1]

However, such neutral vowels can behave in two very different ways. One of the two types has been called 'transparent', because harmony behaves as if these vowels were simply not there. That is, if for example a suffix vowel follows a stem that ends in a neutral vowel, the suffix vowel will harmonise with the non-neutral vowel to the left of the transparent vowel, so to speak ignoring what is intervening. This type of behaviour is illustrated in (2a). The other type of neutral vowel has been called 'opaque', because in this case a following suffix vowel harmonises with the neutral vowel itself, ignoring what is preceding in the stem. That is, an opaque neutral vowel starts a harmonic domain of its own, in this way breaking up the harmonic unity of the word. This is shown in (2b).

(2) (a) *transparency*: Hungarian /i/ (palatal harmony)

radír-nak	'eraser DAT'
rövid-nek	'short DAT'

(b) *opacity*: Akan /a/ (ATR harmony)

o-bisa-ɪ	'he/she asked (it)'
ɔ-kæri-i	'he/she weighed (it)'

In this chapter, I will further develop the theory put forward by Van der Hulst & Smith (1986), who propose that the behaviour of neutral vowels as transparent or opaque can be predicted from the segmental make-up of these vowels themselves. I will show that not all of the possibilities they predict actually occur, and propose a way to account for these non-occurrences on the basis of particular properties of the vowel inventories involved.

I will start by presenting the neutral vowel theory of Van der Hulst & Smith (1986) in section 6.1, according to which neutral

[1] Neutral vowels discussed in this chapter belong to the class of 'absolutely neutral' vowels (in the terminology of Van der Hulst & van de Weijer (1995); the distinction itself was already present in Van der Hulst & Smith (1986)), in the sense that they are always neutral, their neutrality resulting from the position they occupy within the vowel system. Apart from this type, Van der Hulst & van de Weijer (1995) distinguish two other types: the case of 'contextual neutralisation', where vowels are invariant only in certain positions of the word (e.g. the prohibition on low rounded vowels in non-initial positions in Turkish); and 'lexical neutralisation' (i.e. the case of disharmonic roots and disharmonic suffixes). The latter type has been discussed extensively in chapter 5, while the former has been mentioned in passing.

vowels possessing the harmonic feature are transparent, whereas neutral vowels lacking the harmonic feature are opaque. In section 6.2, I test their predictions on the four types of harmony systems discussed in chapter 4, and show that cases of expected opacity are conspicuously missing from **I**- and **U**-harmony systems. In section 6.3.1, I introduce the constraints governing the representation of vowel inventories, and in section 6.3.2, I propose an account for the above mentioned gap in terms of one of the inventory constraints. I will claim that elements residing on fused lines cannot harmonise. In section 6.3.3, I discuss the different types of behaviour that the low vowel /a/ can exhibit in ATR-harmony systems, and show that this behaviour is a consequence of an inviolable constraint prohibiting the combination of headedness with the element **A**.

6.1. Van der Hulst & Smith (1986)

Here I will only present the basic idea proposed by Van der Hulst & Smith (1986), the one that persisted through several publications over the years (cf. Van der Hulst & Smith 1987, 1988a, Van der Hulst 1988, 1989, etc.), and ignore the technicalities of the 1986 solution which originate from the framework they use (the classical autosegmental approach), and which will not be of relevance to what I will be concerned with here.

In the literature on vowel harmony, the general practice is to simply list the neutral vowels found in a given vowel harmony system. Contrary to this practice, Van der Hulst & Smith propose that the behaviour of neutral vowels as either transparent or opaque can be predicted from general principles, rather than be stipulated on a case-by-case basis. Neutral vowels belong to one of the two vowel sets defined by harmony. That is, they themselves either possess the harmonic feature or they lack it. Van der Hulst & Smith submit that neutral vowels of the former type will always be transparent, while those of the latter type will always be opaque. Let us see on the basis of some schematic examples why this should be so.

There are two relevant situations. One is when the stem in which the neutral vowel occurs has the harmonic feature, the other is when it lacks the harmonic feature. Let us first consider stems possessing the harmonic feature, as in (3). In the following informal representations, ‘F’ stands for the harmonic feature. Harmonising vowels are indicated by ‘V’. Neutral vowels with the harmonic feature are also indicated by ‘F’, while neutral vowels without the harmonic feature are indicated by ‘¬F’.

(3) *Stems possessing the harmonic feature F*

(a) *neutral vowel with the harmonic feature (F)*

```
F                                F>>>>•>>>>>>•
|                                |    |      |
V    F   +   V        →          V    F  +   V
```

(b) *neutral vowel without the harmonic feature (¬F)*

```
F                                F
|                                |
V    ¬F  +   V        →          V    ¬F +   V
```

(3a) shows that if the neutral vowel possesses the harmonic feature, then the harmonic feature of the preceding stem vowel can associate to the neutral vowel (since they are compatible), and spread further to the suffix vowel. Such neutral vowels are therefore predicted to be transparent. In (3b), however, the harmonic feature cannot associate to the neutral vowel, because they are incompatible. And since every phonological operation must be local (a universally inviolable principle), spreading cannot proceed to the suffix vowel, because then the neutral vowel would have to be skipped, and as a result a gapped configuration, shown in (4), would arise.

(4) *Locality violation: gapped configuration*

```
*     F
    /   \
  V   V   V
```

Harmony is therefore blocked in these cases, and this type of neutral vowels are predicted to be opaque.

Note that in the original proposal, incompatibility was defined by feature cooccurrence restrictions. In the theoretical framework used here, headedness is an additional property of segments. Thus restrictions on headedness also play a role in defining incompatibility, as we will see in the following sections.

Now let us turn to stems that lack the harmonic feature, as in (5).

(5) *Stems lacking the harmonic feature F*

(a) *neutral vowel with the harmonic feature (F)*

V F + V → V F + V

(b) *neutral vowel without the harmonic feature (¬F)*

V ¬F + V → V ¬F + V

As can be seen in (5), in this situation nothing happens. The interesting case involves (5a), where although the neutral vowel possesses the harmonic feature, this does not spread to the suffix vowel. In fact, it was precisely this case that motivated the term 'transparent' for this type of neutral vowels, since in a theory with binary features, the opposite value of the harmonic feature must spread from the first stem vowel to the suffix vowel, skipping the intervening neutral vowel. In the analysis presented here, no such skipping is necessary (or even allowed), but now we have to account for the non-spreading behaviour of the neutral vowel.

For this case Van der Hulst & Smith propose that neutral vowels do not spread their harmonic feature, because this feature is predictable and is thus underspecified at the time when harmony applies. In the theory advocated here, however, this type of underspecification does not exist and we have to find some other way to handle these cases. One possibility is to propose that elements that have the status of head behave differently from elements playing the role of operator. Operators can spread, while heads cannot, or only under special circumstances (cf. Demirdache 1988, Van der Hulst 1988). Such a distinction is supported by general properties of heads, as discussed in Coleman (1992), for example. Transparent vowels will then have the harmonic feature as the head of their expression, while harmonising vowels will have this element in an operator position. Note that this solution will obviously not work in the case of ATR-harmony, where it is headedness itself that "spreads". At the moment, I do not have a solution for this problem.[2]

In summary, then, neutral vowels possessing the harmonic feature act transparently, while neutral vowels lacking the harmonic feature are opaque. In subsequent publications, however, Van der Hulst & Smith discuss some cases where neutral vowels expected to act transparently are in fact opaque, and vice

[2] I will come back below to the special behaviour of **A**-harmony systems (cf. section 6.2.2.).

versa (cf. Van der Hulst & Smith 1987, 1988a, Van der Hulst 1988). Still, these unexpected cases are not completely random. Two further generalisations can be made.

Neutral vowels lacking the harmonic feature can behave as 'idiosyncratically transparent', if they can be argued to be completely empty, or unspecified. That is, it is claimed that in special cases a completely empty vowel can remain invisible for harmony, as if it was not present in the string. This invisibility is illustrated by parentheses in (6).

(6) *neutral vowel without the harmonic feature (¬F): idiosyncratically transparent, if empty*

$$\begin{array}{ccccccccc}
F & & & & & F & \multicolumn{3}{c}{>>>>>>>>>>>} & \bullet \\
| & & & & & | & & & | \\
V & \neg F & + & V & \rightarrow & V & (\neg F) & + & V
\end{array}$$

On the other hand, a neutral vowel possessing the harmonic feature can behave as 'idiosyncratically opaque', if the harmony is 'parasitic' on the presence of an element the vowel in question lacks. In this case, harmony is again blocked by the locality requirement, this time not because of feature incompatibility, but because the neutral vowel, the potential target, is not specified in the required way. This is illustrated in (7), with the example of a neutral vowel that does have F, but lacks G, the property F-harmony is parasitic on.

(7) *neutral vowel with the harmonic feature (F): idiosyncratically opaque, if F-harmony is parasitic on G*

$$\begin{array}{ccccccccc}
F & & & & & F & & & \\
| & & & & & | & & & \\
G & F & + & G & \rightarrow & G & F & + & G
\end{array}$$

In total, therefore, there are four possible ways in which a neutral vowel can behave, as summarised in the table given in (8).

(8) *typology of neutral vowels*

neutral vowel	expected	unexpected
with harmonic feature	transparent	opaque
without harmonic feature	opaque	transparent

In the next section, I will test whether all these four types occur for all possible harmony systems (ATR-, **A**-, **I**- and **U**-harmony).

6.2. Testing the theory

6.2.1. ATR-harmony

In ATR-harmony systems, the ATR-distinction is often neutralised in the [high] and [low] regions. That is, high vowels are often non-contrastively ATR, resulting in a seven- or eight-vowel system; while the low vowel is often non-contrastively non-ATR, resulting in a nine-vowel system. Such high neutral vowels are predicted to be transparent (since they bear the agent of harmony), whereas the low neutral vowel is predicted to be opaque (since it lacks the harmonic property). These predictions are indeed borne out. The first case can be illustrated by Wolof, and the second by Akan.

Wolof (a language belonging to the West Atlantic subgroup of the Niger-Congo family, spoken in Senegal and Gambia, cf. Archangeli & Pulleyblank 1994, Ka 1994) has an eight-vowel system, illustrated in (9), where the vowels above the line are ATR (i.e. headed), and those below it are non-ATR (i.e. headless). I will come back to the representation of /ə/ as v^0 in section 6.3.3.

(9) *Wolof vowel system*

i		u	$\mathbf{\underline{I}}$		$\mathbf{\underline{U}}$
e		o	$\mathbf{A.\underline{I}}$		$\mathbf{A.\underline{U}}$
	ə			v^0	
ɛ		ɔ	**A.I**		**A.U**
	a			**A**	

Within a word, non-high vowels agree for ATR, or headedness, as shown in (10).

(10) *Wolof ATR-harmony* (Ka 1994: 15-6)

(a)	suul-əl	'bury for'	v^0~**A**
	wax-al	'speak for'	
(b)	door-e	'hit with'	$\mathbf{A.\underline{I}}$~**A.I**
	xɔɔl-ɛ	'look with'	
(c)	bəgg-oon	'wanted'	$\mathbf{A.\underline{U}}$~**A.U**
	rɛɛr-ɔɔn	'had dinner'	

The forms in (11) show the transparent behaviour of high vowels (cf. Archangeli & Pulleyblank 1994: 231).

(11) *Wolof high vowels: expected transparency*

(a)	tərijileen	'go sleep!'
	mɔytulɛɛn	'avoid!'
(b)	seenuwoon	'tried to spot'
	xɔlliwɔɔn	'peeled'
(c)	yobbujinə	'he went to bring'
	yɛbbijina	'he went to unload'

This is as it is expected, since these neutral vowels possess the harmonic "feature", viz. headedness, that is, it is compatible with them and can "spread" through them.[3,4]

The next question is whether high neutral vowels ever show idiosyncratically opaque behaviour in an ATR-harmony system, that is, whether there are cases of parasitic ATR-harmony. I have not found any such cases. Although this might be a coincidence, there is a possible rationale behind this absence. If we look at the representation of an eight-vowel system as in (9), the only element the high vowels lack, and that ATR-harmony could be made parasitic on to achieve opacity of the high vowels, is the element **A**. However, as we will see in section 6.3.3, the element **A** and headedness in fact repel each other. This then might well be the very reason why cases of ATR-harmony being parasitic on the presence of the element **A** are missing. And this then explains the absence of idiosyncratic opacity in ATR-systems.

Now let us turn to the case of expected opacity, illustrated by Akan (spoken in Ghana, cf. Stewart 1967, 1983, Clements 1981). Akan has a nine-vowel system, as shown in (12).

---

[3] Note that when the high vowels occur in initial position, they induce harmony in vowels following them (e.g. *gis-e*, and not **gis-ɛ*). This is not an isolated phenomenon, the same happens for example in Hungarian. The reason probably has to do with the fact that in these cases the neutral vowel occurs in a governing position. However, a full account of this problem will not be provided in this dissertation.

[4] Archangeli & Pulleyblank (1994) analyse Wolof as exhibiting [–ATR] harmony. To be able to account for the transparency of high vowels, which they call "contextual neutrality", without having to skip these high vowels, thus violating the Locality Condition, they propose a context-sensitive rule of F-element insertion. [–ATR] is inserted (on a non-high vowel) when the targeted vowel follows a [–ATR] specification. Introducing this powerful mechanism is ad hoc and, moreover, unnecessary, in light of the analysis of Wolof vowel harmony as a case of ATR-harmony, as proposed above.

(12) *Akan vowel system*

ATR		non-ATR		
i	u	ɪ		ʊ
e	o	ɛ		ɔ
			a	
$\underline{\mathbf{I}}$	$\underline{\mathbf{U}}$	**I**		**U**
$\mathbf{A.}\underline{\mathbf{I}}$	$\mathbf{A.}\underline{\mathbf{U}}$	**A.I**		**A.U**
			A	

The root-controlled ATR-alternations involving non-low vowels are illustrated in (13).

(13) *Akan ATR-harmony* (Clements 1981: 118)

(a)	e-bu-o	'nest'
	ɛ-bʊ-ɔ	'stone'
	o-kusi-e	'rat'
	ɔ-kɔdɪ-ɛ	'eagle'
(b)	o-fiti-i	'he/she pierced (it)'
	ɔ-cɪrɛ-ɪ	'he/she showed (it)'
	o-be-tu-i	'he/she came and dug (it)'
	ɔ-bɛ-tʊ-ɪ	'he/she came and threw (it)'

In (14), the opacity of the low vowel is illustrated.[5]

(14) *Akan low vowel: expected opacity* (Clements 1981: 119-20)

(a)	pɪræko	'pig'
	fuñanɪ	'to search'
(b)	o-bisa-ɪ	'he/she asked (it)'
	ɔ-kæri-i	'he/she weighed (it)'

[5] Here *æ* stands for a fronted and raised version of /a/. This raising is the result of a separate process that affects all the vowels when they precede an advanced vowel (cf. Clements 1981, Kiparsky 1985, Archangeli & Pulleyblank 1994). This process is local and gradient, it is thus postlexical or maybe even phonetic. It is certainly independent of the lexical ATR-harmony under discussion in this chapter, so its effect will be ignored here.

This opacity is expected, since the element **A** is incompatible with headedness, which then cannot proceed further due to the principle of Locality on phonological processes.

The question whether the reverse (unexpected) situation occurs as well, that is, whether a neutral low vowel ever behaves transparently in an ATR-harmony system, is answered negatively this time, too.[6] Such a case of idiosyncratic transparency would require, according to the theory presented here, that the vowel /a/ is (exceptionally) represented as totally empty. The reason for the non-appearance of such a situation might be that the vowel /a/ is the "best" vowel, the one containing the most vocalic element **A** (expressed by assigning positive charm to this element in early versions of Government Phonology, cf. Kaye, Lowenstamm & Vergnaud 1985). Intuitively it is clear that such a "real" vowel would resist being represented as totally void of any melodic content, even if only exceptionally. The exact formal expression of this resistance, however, will have to wait for further research.

In this section, I have shown that in ATR-harmony systems the predictions made by Van der Hulst & Smith as to the expected behaviour of neutral vowels as transparent or opaque are borne out. High neutral vowels are transparent, since they possess the property of headedness, the agent of harmony, while a low neutral vowel is opaque, because it is incompatible with this property. However, cases of idiosyncratic opacity and transparency do not seem to occur. Both these latter facts have been related to the involvement of the element **A**.

In the next section, I turn to the behaviour of neutral vowels in **A**-harmony.

6.2.2. A-harmony

In **A**-harmony systems, it is seven-vowel systems that are of interest if one is looking for neutral vowels. Such a system is represented in (15).

(15)

i		u	$\underline{\mathbf{I}}$		$\underline{\mathbf{U}}$
e		o	$\mathbf{A}.\underline{\mathbf{I}}$		$\mathbf{A}.\underline{\mathbf{U}}$
ɛ		ɔ	**A.I**		**A.U**
	a			**A**	

[6] The only apparent counterexample, Kinande, will be dealt with later on in this chapter (cf. section 6.3.3.).

Here, **A**-spreading can affect /i/and /u/, turning them into an /e/ and /o/ respectively. The other three vowels then have no harmonic counterparts, and thus are neutral. They are all predicted to be transparent, since all of them contain the harmonic feature, **A**. No such systems are known to me.

However, a seven-vowel system has another possible analysis, the one given in (16).

(16)

i	u	$\underline{\mathbf{I}}$	$\underline{\mathbf{U}}$
e/ɪ	o/ʊ	**I**	**U**
ɛ	ɔ	**A.I**	**A.U**
a		**A**	

The expressions (**I**) and (**U**) are strictly speaking the phonological analysis of the sounds /ɪ/ and /ʊ/, respectively. But since one of the defining properties of a seven-vowel system is precisely the fact that the *e*/ɪ and *o*/*ʊ* distinctions are neutralised, the resulting vowels can have the phonological identity of either (**A.**$\underline{\mathbf{I}}$) and (**A.**$\underline{\mathbf{U}}$), or (**I**) and (**U**).

In a system such as (16), **A**-harmony will affect (**I**) and (**U**), turning them into (**A.I**) and (**A.U**) respectively. (**A**) is predicted to be transparent, while ($\underline{\mathbf{I}}$) and ($\underline{\mathbf{U}}$) to be opaque. This system can be illustrated by Yoruba (a Niger-Congo language, spoken in Nigeria), previously analysed as a case of [–ATR]-harmony by Archangeli & Pulleyblank (1989, 1994). All the examples mentioned come from these references. The analysis presented here is in crucial respects very similar to the analysis of Yoruba harmony proposed in Van der Hulst (1988).

The facts of Yoruba vowel harmony are shown in (17). I omit tones from the following examples.

(17) *Yoruba vowel harmony*

(a)	[mid]-[mid]	ebe	'heap for yams'
		ɔbɛ	'soup'
(b)	[mid]-[low]	ate	'hat'
		asɔ	'cloth'
		ɛpa	'groundnut'
		* epa	

As can be seen in (17a), mid vowel sequences must agree in height, while (17b) shows that although a low vowel can be followed by both types of mid vowels, it can only be preceded by a lower mid vowel. This can be analysed as leftward spreading of **A** from the vowels /a, ɛ, ɔ/ to the vowels /e, o/.

The examples in (18) show the behaviour of high vowels.

(18) *Yoruba high vowels: expected opacity*

(a)	[mid]-[high]	ile	'house'
		itɔ	'saliva'
		oju	'eye'
		ɛwu	'clothing'
		ɛburu	'shortcut'
(b)	[mid]-[high]-[low]	yoruba	'Yoruba'
		* yɔruba	
	[mid]-[high]-[mid]	odidɛ	'Grey Parrot'
		* ɔdidɛ	

Forms in (18a) demonstrate that high vowels can co-occur with both types of mid vowels in any order, that is, they behave as neutral. Forms in (18b) show that they block the spreading of **A**. This is as it is expected, since the high vowels (**I**) and (**U**) are incompatible with **A**, because the expressions (**A.I**) and (**A.U**) do not exist in this system, and they cannot be created without violating Structure Preservation. And they cannot be skipped either. The fact that there is no change in the quality of the mid vowels preceding the high vowels in (18a) follows as well, since the high vowels do not possess any property that would be actively harmonising in this language.

This analysis exactly parallels that of Archangeli & Pulleyblank, in that it groups together the three triggering vowels, /a, ɛ, ɔ/. The difference is that under their analysis, the feature these three vowels share to the exclusion of the others is [–ATR] (i.e. we get the representation of the vowel system as in (15)), and thus what is marked in the system is that it is this marked feature value that spreads. In the present analysis, the defining property of these vowels is their possession of the element **A**, and what is marked in the system is that the vowels resulting from the neutralisation of the *e/ɪ* and *o/ʊ* distinctions are the high vowels (phonologically), and not the mid ones.[7]

Let us now look at the behaviour of the low vowel /a/. This vowel is predicted to be transparent, since it does not have a harmonic counterpart, and it possesses the harmonic feature, the element **A**. However, this prediction is not borne out, as demonstrated in (19), through the behaviour of the Agentive/ Instrumental prefix *o/ɔ*.

(19) *Yoruba low vowel: unexpected opacity*

ɔ-bayejɛ	'sower of discord'
ɔ-daju	'callous person'
ɔ-laju	'civilized person'
ɔ-yaju	'impertinent X'

Mid vowels always have to surface in their lower mid variant when they precede a low vowel, that is, /a/ is opaque rather than transparent.

This type of behaviour of the low neutral vowel in **A**-harmony systems is, in fact, not specific to Yoruba. It is rather the rule than the exception. I would like to suggest that the reason for this behaviour lies in the fact that the element **A** does not like to be the head of an expression (as will be discussed in detail later in this chapter, cf. section 6.3.3.). Recall that the non-spreading character of transparent neutral vowels is explained by assigning head status to the harmonic feature in these vowels. The vowel /a/ is therefore predicted to behave differently from transparent vowels in other types of harmony systems, where the harmonic feature does not exhibit such resistance to headship as is the case with the element **A**.[8]

[7] To be able to account for the distribution of the element **A** within lexical items, namely, that apart from the data in (18b), the following [mid]-[high]-[mid] combination is also ruled out: **ɛsuro*, while the [low] vowel /a/ can occur in initial position in all three combinations (e.g. *abiya* 'armpit', *akurɔ* 'a type of farmland' and *aburo* 'younger sibling'), we still have to assume something parallel to Archangeli & Pulleyblank's analysis. That is, in the underlying representation, **A** is a morpheme level feature, and it is not specified in the low vowel either. This morpheme level specification must first associate to the rightmost available target (anything not containing a head **I**/**U**), and then all empty /a/'s are assigned the element **A** by default. At the moment I do not see a non-derivational way to express these distributional patterns, but finding a solution to this problem does not affect the argumentation presented in the text.

[8] As we have seen in chapter 4, in the case of Pasiego **A**-harmony, the

Now let us turn to a different type of idiosyncratic opacity from the one discussed above, the behaviour of /a/ in the Bantu languages, illustrated by the case of Chichewa (cf. Harris & Moto 1989). This language has a canonical five-vowel system that can be analysed as in (20).

(20) *Chichewa vowel system*

i	u		**<u>I</u>**	**<u>U</u>**
e	o		**A.<u>I</u>**	**A.<u>U</u>**
a			**A**	

The examples in (21) illustrate the workings of **A**-harmony in Chichewa, whereby within a span of non-low vowels, all have to be either high or mid. The forms in (21a) show this in polysyllabic roots, while those in (21b) by alternating suffixes.

(21) *Chichewa vowel harmony* (Harris & Moto 1989: 6)

(a)	pitiliz-a	'continue'
	uzir-a	'blow cool'
	fotokoz-a	'explain'
	kolez-a	'blow on fire'
(b)	pind-its-a	'bend CAUS'
	konz-ets-a	'correct CAUS'
	put-il-a	'provoke APPL'
	lemb-el-a	'write APPL'

In (22), the neutrality of /a/ can be seen (cf. Harris & Moto 1989: 6-7).

(22) *Chichewa low vowel: idiosyncratic opacity*

(a)	chiŋgamir-a	'welcome'
	luŋgam-a	'be straightforward'
	pendam-a	'slant'
	polam-a	'bend face-down'

vowel /a/ in that system was transparent. But this transparency had a different reason, namely, harmony in Pasiego is only triggered by complex expressions, thus /a/ comprising only one element does not trigger it. And in fact this is the only case of **A**-harmony I have come across so far where the low vowel behaves in a transparent way.

(b) bal-its-a 'give birth CAUS'
kaŋgaz-il-a 'hurry up APPL'

(c) konz-an-its-a 'correct RECIPR CAUS'
lemb-an-its-a 'write RECIPR CAUS'

(22a) shows that /a/ freely co-occurs with both high and mid vowels within roots, (22b) that roots with /a/ select high vowel suffixes, and (22c) that suffixes containing /a/ stop the spreading of **A**.

That is, /a/ is a blocker, a non-undergoer and a non-spreader. In other words, it is totally inert to harmony. This is a different type of opacity from the one we have seen in Yoruba, where the vowel /a/ did spread its element **A**. Since in this system /a/ does not initiate its own domain, but is totally immune to harmony, it makes sense to analyse this process as a case of parasitic harmony. Namely, the spreading of **A** is parasitic to the presence of an element on the **I**/**U** line. Since the low vowel /a/ does not contain either of these elements, this vowel will neither trigger, nor undergo harmony, and consequently it will also block the spreading of **A** through itself, due to Locality.

Harris & Moto (1989) argue that analysing the Chichewa system as a case of parasitic harmony is problematic, since it predicts that any harmony process is potentially conditioned by any feature. This is true, but since the number of primes is only three, the number of actual possibilities is not very high. And since **I** and **U** often occupy the same line, as in the case under discussion, parasitic harmony might be restricted to being parasitic to the presence of elements on a particular line, instead of being parasitic to the presence of specific elements. This issue needs further investigation.

In this section, I have shown that high vowels in **A**-harmony behave opaquely, as expected according to Van der Hulst & Smith (1986), since they lack the harmonic feature. The low vowel /a/, however, instead of being transparent, is either opaque, as in Yoruba, or it is totally inert, as in Chichewa. The first is explained by the special property of the element **A** of repelling headship. And the second is analysed as a case of idiosyncratic opacity due to the parasitic character of harmony. I have not found any cases where either of the high vowels is idiosyncratically transparent. At the moment I do not have an explanation for this absence.

6.2.3. I- and U-harmony

In **I**-harmony, transparency usually arises when the back non-rounded vowels are missing from the system. This can be illustrated by the case of Hungarian. The vowel system is given in (23) (cf. Polgárdi & Rebrus (1998)).[9]

(23) *Hungarian vowel system*

i ü	u	**<u>I</u>**	**I.<u>U</u>**		**<u>U</u>**
e ö	o	**A.<u>I</u>**	**AI.<u>U</u>**		**A.<u>U</u>**
a				**A**	

The effect of **I**-harmony on suffixes is shown in (24).

(24) *Hungarian vowel harmony*

(a) fog-unk 'tooth POSS 1SG'
bőr-ünk 'skin POSS 1SG'

(b) lúd-nak 'goose DAT'
tök-nek 'pumpkin DAT'

(c) kalap-ból 'hat ELAT'
kürt-ből 'horn ELAT'

The vowels *i*, *í* and *é* are neutral, and they behave transparently, as illustrated in (25). That is, suffixes following them harmonise with the vowel in the preceding syllable.[10]

(25) *Hungarian front unrounded vowels: expected transparency*

(a) papír-nak 'paper DAT'
rövid-nek 'short DAT'

fazék-nak 'pot DAT'
tündér-nek 'fairy DAT'

---

[9] In fact, (**A.<u>I</u>**) is only the representation of the long vowel *é*. Its short counterpart, *e* [ɛ] is represented as a headless vowel, (**A.I**). The behaviour of the latter vowel is vacillating between neutral and harmonic. I will not deal with this issue in detail here.

[10] The long vowel *é* also appears in alternating suffixes, such as the adessive *-nál/-nél*, but the important point here is that *i*, *í* and *é* are the only vowels that occur in non-alternating suffixes (apart from a few lexical exceptions).

(b)	buda-i-tól	‘buda ADJ FORMING ABL’
	pest-i-től	‘pest ADJ FORMING ABL’
	János-ék-tól	‘János & his company ABL’
	Ödön-ék-től	‘Ödön & his company ABL’

Opacity for **I**-harmony is predicted in systems where it is the front rounded vowels that are absent. Such a system is illustrated in (26). Here the alternating pairs would be *i~ɨ* and *e~a*, whereas *u* and *o* are predicted to be opaque.

(26) *Expected opacity: no front rounded vowels*

i	ɨ	u	**I**	v^0	**U**
e		o	**A.I**		**A.U**
	a			**A**	

In fact, the same system should manifest opacity for **U**-harmony as well. There the alternating pairs would be *ɨ~u* and *a~o*, whereas *i* and *e* are predicted to be opaque.

However, both types of systems are missing from the world’s languages. I would like to claim that this is not an accident. The vowel system illustrated in (26) is one where the elements **I** and **U** cannot combine with each other (i.e. where there are no front rounded vowels). This is represented in Government Phonology by fusing the **I**- and **U**-lines.

I propose that this is precisely the reason for the non-existence of harmony in systems like the one illustrated in (26). Namely, since the elements **I** and **U** share the same line, they are “in each other’s way”, so to speak, as far as spreading is concerned, and this makes harmony involving these elements impossible in this type of systems. In more general terms, this means that the vowel inventory of a given language limits what type of harmony can exist in that language. I will elaborate this proposal in the next section.

But first let me turn to the case of expected transparency in **U**-harmony systems. This could be represented as in (27).

(27) *Expected transparency in **U**-harmony*

i	ü	u	$\underline{\mathbf{I}}$	$\mathbf{U.}\underline{\mathbf{I}}$	$\underline{\mathbf{U}}$
e	ö	o	$\mathbf{A.}\underline{\mathbf{I}}$	$\mathbf{AU.}\underline{\mathbf{I}}$	$\mathbf{A.}\underline{\mathbf{U}}$
	a			**A**	

Here the alternating pairs would be *i~ü*, *e~ö* and maybe *a~o*, whereas *u* (and possibly *o*, if it does not alternate with *a*) would be transparent. In fact, I have not found any such systems. However, I suspect that this is only an accident.

If, on the other hand, this is a systematic gap, the reason might lie in the representation of front rounded vowels. As it stands now, front rounded vowels have two possible representations: they can be headed either by **I**, or by **U** (and no language seems to make a contrastive use of this distinction).[11] If, however, front rounded vowels are universally **U**-headed, the absence of systems such as (27) is explained, because the alternations *i~ü* and *e~ö* would involve switching of headship which is ruled out by the principle of Monotonicity. This issue clearly requires further consideration.

In this section, we have seen that from the predicted possibilities for transparency and opacity within **I**- and **U**-harmony systems only the transparency cases in **I**-harmony are actually attested. This fact will be made to follow from properties of the vowel inventories of the given languages in the next section. Finally, it should be noted that I have not found any cases of idiosyncratic transparency of back rounded vowels, or idiosyncratic opacity of front unrounded vowels in systems of the type illustrated in (23). These would be cases where either of the back rounded vowels is totally empty, and/or where **I**-harmony is parasitic on the presence of the element/line **U** in triggers and targets. There seems to be no reason to exclude these possibilities a priori.

There is one case of unexpected transparency in an **I**-harmony system that still needs to be mentioned here, namely, that of Eastern Cheremis (cf. Sebeok & Ingemann 1961). The vowel system is given in (28).

(28) *Eastern Cheremis vowel system*

i	ü		u	**<u>I</u>**	**I.<u>U</u>**		**<u>U</u>**
e	ö	ə	o	**A.<u>I</u>**	**AI.<u>U</u>**	**A**	**A.<u>U</u>**
		a				**<u>A</u>**	

In this language, word-final /e/ assimilates for **I** and **U** to a preceding vowel (giving /o/ and /ö/), illustrated in (29a). /ə/ is transparent for this process, as shown in (29b) (cf. Sebeok & Ingemann 1961: 10-12).

[11] Unless the "in-rounding" vs. "out-rounding" distinction among Swedish high front rounded vowels (cf. Clements 1991a) is to be analysed as a difference in headedness.

(29) *Eastern Cheremis vowel harmony*

(a) kit-ʃe 'his hand'
boz-ʃo 'his wagon'
üp-ʃö 'his hair'

(b) surtəʃ-ko 'to the house'
surtəʃ-kə-ʒo 'to his house'

These facts can be analysed by postulating underlying schwas word-finally and applying **I**- and/or **U**-spreading to them, giving *e*, *o* or *ö*. This can be seen as a response to a prohibition on word-final schwas. The transparency of non-final schwas is still problematic, but note that these spreading processes are not cases of general harmony, since they do not affect any of the other vowels. They rather serve as repair strategies to save the situation from a violation of the word-final restriction. This is also shown by the fact that the allomorph with /e/ appears after back vowel stems as well, as in *ʃuʒar-ʒe* 'his sister', where there could not have been any spreading of the element **I**. Note also that schwa cannot be analysed as totally empty underlyingly, because then we would get high vowels finally, and not mid ones. I leave this issue open for further research.

This concludes the investigation of the validity of predictions made by Van der Hulst & Smith (1986). I summarise the results in the tables given in (30a-d). The final column indicates the explanation I have provided for why certain cases do not exist. Cells with a question mark, on the other hand, represent cases that I have not found any examples of, but where I think this absence is accidental.

(30)

(a)

expected transparency	the neutral vowel possesses the harmonic feature (as head)		
ATR	/i/=(<u>**I**</u>), /u/=(<u>**U**</u>)	Wolof	
A	/a/=(<u>**A**</u>)	—	*<u>**A**</u>
I	/i/=(<u>**I**</u>), /e/=(**A.<u>I</u>**)	Hungarian	
U	/u/=(<u>**U**</u>), /o/=(**A.<u>U</u>**)	?	

(b)

expected opacity	the neutral vowel is incompatible with the harmonic feature		
ATR	/a/=(**A**)	Akan	
A	/i/=(**<u>I</u>**), /u/=(**<u>U</u>**)	Yoruba	
I	/u/=(**U**), /o/=(**A.U**)	—	line fusion
U	/i/=(**I**), /e/=(**A.I**)	—	line fusion

(c)

unexpected transparency	the neutral vowel is empty		
ATR	/a/=( )	—	*empty
A	/i/=( ) or /u/=( )	?	
I	/u/=( ) or /o/=( )	?	
U	/i/=( ) or /e/=( )	Khalkha M.	

(d)

unexpected opacity	the harmony is parasitic		
ATR	/i/=(**<u>I</u>**), /u/=(**<u>U</u>**)	—	***<u>A</u>**
A	/a/=(**A**)	Chichewa	
I	/i/=(**I**) or /e/=(**A.I**)	?	
U	/u/=(**U**) or /o/=(**A.U**)	Khalkha M.	

The examples from Khalkha Mongolian, where /i/ is unexpectedly transparent, while /u/ is unexpectedly opaque to **U**-harmony, will be discussed in section 6.3.2.

In the next section, I discuss the representation of vowel inventories, and show how the constraints involved can account for the gaps in the predictions pointed out above.

6.3. Vowel inventories and vowel harmony

6.3.1. The representation of vowel inventories

Vowel inventories can be characterised in different ways. One way is to simply list their members. Another, more interesting, way is to try and find some regularities concerning the occurring vs. non-occurring segments, and express these by constraints. In the latter case, the inventory is not simply listed, but can be derived from the given constraints and the set of primes the theory provides us with. The advantage of the second approach is that, since these constraints are part of the phonology of the language, they can be referred to during phonological derivation. (Note that Structure Preservation demands that these constraints are not violated in the lexicon, although they can be violated at the postlexical level.)

The inventory constraints thus express cooccurrence restrictions on the set of phonological primes. Every combination that is not excluded by these constraints is permitted in the given language. In my view, there are three types of constraints defining inventories. These are given in (31).

(31) *Inventory constraints*

(a) line fusion
(b) empty vowel: YES/NO
(c) restrictions on headedness

(31a), line fusion, is proposed by Kaye, Lowenstamm & Vergnaud (1985) as a means of defining impossible element combinations. According to their proposal, elements are normally found on separate lines (similar to autosegmental tiers). In such a situation, every combination of the set of elements is possible, since each line can contain an element linked to a given skeletal position. However, in systems where two lines are fused, we find two elements residing on the same line. Since on each line only one element can be linked to a given skeletal position, it follows that the two elements defining the fused line cannot combine with each other within one expression. One common situation of such line fusion is the conflation of the **I**- and **U**-lines, in this way excluding the existence of front rounded vowels in such systems. If all three lines are fused, then none of the elements can combine with one another and every expression will be simplex (resulting in a three- or four-vowel system, depending on whether the empty vowel is allowed).

Another way of looking at (31a) is to call it 'line fission' (cf. Harris 1994c). Now the markedness of a particular system can be defined by the number of lines present. That is, in the most unmarked vowel system, there is only one line, resulting in three possible vowels, as shown in (32).

(32) *Only one line: three-vowel system*

```
A/I/U - - - - - I - - - - - U - - - - - A - - -
                |           |           |
                x           x           x
               /i/         /u/         /a/
```

In a more marked system, **A** can occupy its own line, giving this element the opportunity to combine with **I** or **U**, resulting in five possible combinations, given in (33).

(33) *Two lines: five-vowel system*

```
I/U  - - - - -  I - - - - - U - - - - - - - - - - - - I- - - - -U - - -
                |           |                         |          |
 A   - - - - - - - - - - - - - - - - - - A - - - - - A - - - - A - - -
                |           |            |            |          |
                x           x            x            x          x
               /i/         /u/          /a/          /e/        /o/
```

And finally, in the most marked system, each element resides on its own line, which gives seven possibilities, as illustrated in (34).

(34) *Three lines: seven-vowel system*

```
I  - - - - I - - - - - - - - - - - - - - - - - - -I - - - - - - - - - - - - - I - - - - -I - -
           |                                      |                           |          |
A  - - - - - - - - - - - - - - - - - - A - - - - -A - - - - -A- - - - - - - - - - - - A - -
           |                           |          |          |                |          |
U  - - - - - - - - - - - -U- - - - - - - - - - - - - - - - - -U- - - - - - -U - - - - U - -
           |             |             |          |          |                |          |
           x             x             x          x          x                x          x
          /i/           /u/           /a/        /e/        /o/              /y/        /ø/
```

The second parameter along which vowel systems can differ is given in (31b), namely, whether the vowel possessing no elements at all is accepted in the system. This vowel is, in other words, the phonetic realisation of an unlicensed empty nucleus. It does not have any distinctive properties, and it surfaces as the high back unrounded /ɨ/. Together with the possibilities defined by (31a), this parameter derives four-, six- and eight-vowel systems, respectively.

The third parameter concerns headedness. The property of headedness can be completely missing from a particular system, such as the ones discussed so far. And if it is present, it can be restricted in several ways. (Restrictions similar to the ones discussed here have also been proposed under the name 'licensing constraints' in Charette & Göksel 1996 and Cobb 1997.) One of these restrictions, referred to on several occasions earlier in this chapter, is so strong that it does not seem to be violated in any language. This constraint is given in (35).

(35) *$\underline{\mathbf{A}}$

The element **A** cannot be the head of an expression.

This constraint will be qualified later on in this section, and will only refer to situations where headedness is interpreted as ATR (and not where headedness stands for preponderance of a particular element within a certain expression).

When there are no extra constraints on headedness, a five-vowel system such as (33) is extended into a nine-vowel system, shown in (36).

(36) *Two lines + *$\underline{\mathbf{A}}$: nine-vowel system*

I/U	$\underline{\mathbf{I}}$	**I**	$\underline{\mathbf{U}}$	**U**		$\underline{\mathbf{I}}$	**I**	$\underline{\mathbf{U}}$	**U**
A					**A**	**A**	**A**	**A**	**A**
	x	x	x	x	x	x	x	x	x
	/i/	/ɪ/	/u/	/ʊ/	/a/	/e/	/ɛ/	/o/	/ɔ/

Another common restriction involves the elements **I** and **U** when they constitute an expression on their own. This constraint is given in (37).

(37) $\underline{\mathbf{\mathit{I}}}$/$\underline{\mathbf{\mathit{U}}}$

A sole **I**/**U** element must be headed.

This results in a seven-vowel system, identical to (36), but lacking the high non-ATR vowels, /ɪ/ and /ʊ/.

In a system with front rounded vowels, there can also be restrictions on the headedness of these vowels, as we have seen during the discussion of (23) and (27) above.

In summary, setting the three parameters in (31) defines the vowel inventory of a given language. The constraints resulting from the particular choices made will hold during the whole lexical phonology, as follows from the principle of Structure Preservation (defined in chapter 3, section 3.3.3). This is essential for the neutral vowel theory proposed by Van der Hulst & Smith (1986) that is being developed here, since it is the absence of certain expressions that makes other vowels neutral, and it is the properties of these latter vowels that determine their behaviour as transparent or opaque.

Let us turn now to the issue of how a particular vowel inventory determines what type(s) of vowel harmony the language in question can exhibit.

6.3.2. How the inventory determines harmony

In this section I would like to claim that from the three parameters in (31), it is (31a), line fusion, that restricts the type of harmony available in a language in the most profound way. I propose that elements residing on fused lines cannot harmonise. This idea, in fact, can be regarded as a reformulation of the original autosegmental proposal according to which only features specified on separate autosegmental tiers can exhibit long-distance spreading, whereas features specified in the segmental core can only be involved in local assimilation (cf. Goldsmith 1976).

If we look at languages with the **I**- and **U**-lines fused, we can see that they have a 'triangular' vowel system (containing 5, 7 or 9 vowels, disregarding for the moment the issue of the presence/absence of the empty vowel). The maximal nine-vowel system is shown in (38).

(38) *Nine-vowel system*

i								u
	ɪ						ʊ	
		e				o		
			ɛ		ɔ			
				a				

In systems of the triangular type, **I**- and **U**-harmony are not possible, since these elements reside on the same line, thus they are in each other's way as far as spreading is concerned. Therefore, in these systems the only possible harmony types include **A**-harmony (since **A** occupies a separate line), and ATR-harmony (provided that headedness is distinctive in the given language). In sections 6.2.1 and 6.2.2 we have seen some examples of this type of languages. The parameter settings of (31b) and (31c) will then further define the set of neutral vowels and their behaviour as transparent or opaque. (I will come back to this in more detail in the next section.) There is thus an important difference between parameters (31b-c) and (31a) in that restrictions expressed by the former only result in neutral (i.e. non-alternating) vowels, whereas restrictions expressed by the latter make certain types of harmony completely impossible in the given systems as a whole.

In systems where all lines are separate, on the other hand, every type of vowel harmony is possible, because now every element has its own line and can thus freely spread along it. Since **I**- and **U**-harmony can only occur in this type of systems, neutral vowels in these harmony types will always be transparent, as we have seen in section 6.2.3.

The fact that **I**-harmony can only occur in fully-fledged vowel systems might also explain why palatal harmony can sometimes develop into ATR-harmony, as happened in the East Mongolian dialects for example (cf. Svantesson 1985). In these dialects, as a result of backing, front rounded vowels disappeared (and /u/ changed into /ʊ/), as shown in (39a), the example of the Khalkha Mongolian dialect.

(39) *Classical Mongolian* *Khalkha Mongolian*

(a)	i	ü		u	i			u
								ʊ
	e	ö	a	o	e			ɵ
							a	ɔ

(b) ü~u, ö~o, e~a u~ʊ, ɵ~ɔ, e~a

However, the harmonising vowel pairs remained the same (as given in (39b)); but the harmonic feature **I** was replaced by headedness. Under the present proposal, this development is expected. Once the **I**- and **U**-lines become fused, **I**-harmony is no longer possible. ATR-harmony, on the other hand, is still available, and it is preferable to keep the process of harmony, because given the restructuring of the vowel system, the harmonising pairs remain the same as they were in **I**-harmony.

The whole picture, however, is more complex than this. That is, we do in fact find cases of **I**- and **U**-harmony in systems that lack front rounded vowels. For these I hypothesise that this is only possible in systems where the other colour element is inert, and thus can remain unspecified. I will illustrate these cases with Yawelmani, Khalkha Mongolian and Chamorro.

The (underlying) vowel system of Yawelmani Yokuts (an American Indian language of California) is given in (40) (cf. Newman 1944, and for representations very similar to mine Van der Hulst 1988).

(40) *Yawelmani vowel system*

i		u	v^0	**U**
		o		**A.U**
	a		**A**	

Representing /i/ as empty gains independent motivation from vowel~zero alternation (cf. Kaye 1990a, Rowicka 1996 for a

Government Phonology account and Kuroda 1967, among others, for an epenthetic analysis).

Vowel harmony, illustrated in (41), involves spreading of **U** between vowels that agree for their specification of **A** (they either both lack it, or they both have it).

(41) *Yawelmani vowel harmony* (Kenstowicz 1994: 108)

Aorist	Participative	
xil-hin	xil-xa	'tangle'
dub-hun	dub-xa	'lead by hand'
xat-hin	xat-xa	'eat'
bok-hin	bok-xo	'find'

Since **I** is completely missing from the system, it cannot "get in the way" of **U**-spreading. There are only two lines, but they are each specified by a single element, **A** and **U**, respectively.

A more complex system with **U**-harmony, but no front rounded vowels, can be found in Khalkha Mongolian (cf. Svantesson 1985). The vowel system is given in (42).

(42) *Khalkha Mongolian vowel system*

i		u	$\underline{\mathbf{I}}$		$\underline{\mathbf{U}}$
		ʊ			**U**
e		ɵ	**A.**$\underline{\mathbf{I}}$		**A.**$\underline{\mathbf{U}}$
	a	ɔ		**A**	**A.U**

ATR- and **U**-harmony are illustrated in (43) (cf. Svantesson 1985: 302, 319).

(43) *Khalkha Mongolian vowel harmony*

(a)	gʊrv-ʊ:l	'three COLL NUM'
	dɵrv-u:l	'four COLL NUM'
(b)	jav-la:	'go NARR PAST'
	uz-le:	'see NARR PAST'
	ɔr-lɔ:	'enter NARR PAST'
	ɵg-lɵ:	'give NARR PAST'

(c) adʒil-a:r 'work INSTR'
mɔri-ɔ:r 'horse INSTR'
cɵcgi:-gɵ:r 'cream INSTR'

(d) ɔr-ʊ:l-a:d 'enter CAUS PERF'
tɵr-u:l-e:d 'be born CAUS PERF'

(43a) shows only ATR-harmony, (43b) shows both. In (43c), the transparency of /i/ is demonstrated to both harmonies, while (43d) illustrates that high rounded vowels block **U**-spreading.

In fact, it is possible to argue that the element **I** is not active in this system. /i/ then is represented as completely empty, and it acquires **I** in phonetic implementation. /e/ is the ATR version of /a/, that is, an expression (**A**) in an ATR word acquires an element **I** to avoid violation of the constraint given in (35), *<u>**A**</u>, (see more on this in the next section).[12] In this way the transparency of /i/ to **U**-harmony is explained: this is a case of 'idiosyncratic transparency', where a totally empty vowel can be invisible to a particular harmony process. (Note that the same vowel is not invisible to ATR-harmony. Instead, it is transparent to it, as expected.)

The 'idiosyncratic opacity' of high rounded vowels to **U**-harmony, on the other hand, can be explained by the parasitic character of this harmony (cf. also Van der Hulst & Smith 1987). **U**-spreading is only triggered by and it only targets vowels containing the element **A** (the vowels below the line in (42)).[13] That is, the vowel of a suffix such as the narrative past tense in (43b) is represented as the expression (**A**) underlyingly. It then acquires headedness and/or the element **U** from a preceding vowel, and we get a four-way alternation.

Finally, let us turn to Chamorro (spoken in the Marianas Islands, cf. Topping 1968, 1973), where it is the element **U** which is totally inert. The vowel system is given in (44) (cf. also Van der Hulst 1988).

[12] In fact, in the other Inner Mongolian dialects, this vowel has become a /ə/, another possible realisation of an ATR /a/.

[13] Rounding harmony in the Tungusic languages (cf. Kaun 1995, Li 1996) is minimally different from the pattern found here in that there all high vowels are opaque to **U**-spreading. That is, the front high vowels are not skipped unexpectedly as they are in Mongolian.

(44) *Chamorro vowel system*

i	u	<u>**I**</u>	v^{0}
e	o	**A.<u>I</u>**	**A**
æ	a	**I.<u>A</u>**	<u>**A**</u>

(45) shows the fronting of stem-initial vowels when they are preceded by a grammatical particle containing the element **I**.

(45) *Chamorro vowel harmony* (Topping 1968: 69)

gúmaʔ	'house'	i gímaʔ	'the house'
nána	'mother'	si nǽna	'Mother'
fógon	'stove'	ni fégon	'the stove'
óksoʔ	'hill'	gi éksoʔ	'at the hill'
túŋoʔ	'to know'	in tíŋoʔ	'we (excl.) know'
túŋoʔ	'to know'	en tíŋoʔ	'you (pl.) know'
góde	'to tie'	g-in-éde	'thing tied'
húloʔ	'up'	sæn-híloʔ	'in the direction up'
lágu	'north'	sæn-lǽgu	'towards north'
ótdot	'ant'	mí-etdot	'lots of ants'

A simple and completely symmetrical vowel system can be represented as in (44), with just two elements, since the rationale behind using three elements is to express the triangular character of the vowel system, which is not the case here. (Especially once we know that the system originally contained only four vowels, /i, u, æ, a/, and the mid vowels only developed as a consequence of the appearance of many Spanish loan-words.)

But a representation such as (44) violates the constraint given in (35), that the element **A** cannot occupy the head position within an expression. Notice, however, that headedness here has a different interpretation from what we have seen so far in this chapter. Headedness has indicated 'ATR', whereas here it means enhancing a particular element within an expression. There is no reason why in this second interpretation headedness should not be able to combine with the element **A**.[14] (For a similar proposal to

[14] Another example of a system where headedness stands for enhancing a particular property is provided by Korean (cf. Kim 1968) which possesses more than one central vowel. These vowels undergo fronting and backing in the vicinity of front and back vowels respectively. The changes and the representations are shown below:

replace [tenseness] by 'enhancement', at the same time keeping it separate from the [±ATR] distinction, see Smith & van der Hulst 1990.)[15] For a discussion concerning the interpretation as 'ATR', see the next section.

That is, here again there are only two lines, but each is occupied by a single element, **A** and **I**, respectively. **I**-harmony thus can proceed uninterrupted.

In this section, we have seen how the parameter in (31a), line fusion, determines what type of harmony can occur in a given vowel system. In particular, the fusion of the **I**- and **U**-lines prevents harmony involving these elements from triangular vowel systems. The only possibility for **I**- and **U**-harmony to occur in systems lacking front rounded vowels is provided by systems where the non-harmonising colour element is completely inert, and can thus remain unspecified.

In fact, I have found one counterexample to this statement, namely, the case of Romanian (cf. Steriade 1986, Agard 1958). The vowel system is given in (46).

(46) *Romanian vowel system*

i	ɨ	u	**<u>I</u>**	v^0	**<u>U</u>**
e	ʌ	o	**A.<u>I</u>**	**A**	**A.<u>U</u>**
	a			**<u>A</u>**	

In Romanian, the non-low central vowels are fronted when they precede a front vowel, as illustrated in (47a); that is, /ɨ/ alternates with /i/, while /ʌ/ with /e/. Intervening /u, o, a/, on the other hand, block fronting, as shown in (47b).

(47) *Romanian vowel harmony* (Steriade 1986)

(a) tɨnʌr-u 'young MASC SG'
tiner-i 'young MASC PL'

sʌmɨnt-ʌ 'seed FEM SG'
semint-e 'seed FEM PL'

---

i	←	ɨ	→	u	**I**	v^0	**U**
e	←	ə	→	o	**A.I**	**A**	**A.U**
æ	←	a			**I.<u>A</u>**	**<u>A</u>**	

[15] The fact that two different interpretations of headship seem to be necessary might indicate that ATR should not be represented in terms of headedness after all. I leave this issue open for further research.

(b) sʌrut-i 'kiss 2 SG'
sʌrat-e 'salted FEM PL'

This might mean that **I**- and **U**-harmony are only impossible in truly triangular systems, and the appearance of central vowels facilitates these types of harmony.[16] Such systems, however, are special anyway, since they require the presence of a headed **A**. Or maybe this process is not a real case of harmony after all, but it is rather a means of getting rid of the marked central vowels (similar to the case of Eastern Cheremis discussed in (29) above). Note also that the process does not apply on a full scale, only to a specific class of stems. Since this is the only case of this type of **I**-harmony I know of, further research is necessary to decide the issue.

In the next section, I will look at how the other two parameters in (31) influence the behaviour of vowels in harmony. More specifically, I will examine more closely the behaviour of the vowel /a/ in ATR-harmony systems.

6.3.3. A and headedness, or the behaviour of /a/ in ATR-harmony

In this section, I will look at the different effects the constraint in (35) can have in systems of ATR-harmony with different vowel inventories. This constraint says that the element **A** cannot occupy the head position within an expression, and it seems to hold universally across languages. In other words, this constraint says that **A** and headship are in complementary distribution. This type of facts are generally expressed by line fusion in Government Phonology. However, in this case we cannot resort to this particular device for two reasons. One reason is that headedness does not occupy an independent line, because it is not an independent property of segments, it is rather always specific to a particular element within the segment. The other reason is that the complementary distribution between headedness and the element **A** is not perfect. It is true that the element **A** cannot be the head itself, but it is not true that an expression cannot contain both a head and the element **A**. This is a consequence of the triangular representation of vowels, where **A** is not an absolute value expressing lowness, but where the precise degree of height is calculated on the basis of the interaction of **A** with the elements

[16] In fact, this solution can be extended to harmony in three-vowel systems (such as those discussed by Van der Hulst & Smith 1985). Since such systems only possess one line, harmony should be impossible. However, the alternating vowel in each case is analysed as underlyingly empty, that is, as a central vowel, extending again the triangular system.

defining the other extremes of the vowel triangle, **I** and **U**. In such a representational system, the constraint in (35) has to be formulated separately, as given above.

Be that as it may, the constraint in (35) is inviolable. However, not all languages obey it in exactly the same way. More precisely, there are three different ways in which languages avoid a violation of the constraint in (35) (cf. also Goad 1993 on this issue). One of these we have seen in the discussion of Akan above, where the low vowel /a/ is opaque to ATR-harmony. The representation of the vowel system and the facts of opacity are repeated here for convenience under (48) and (49), respectively. Since the element **A** cannot become headed, it blocks further propagation of headedness due to Locality.

(48) *Akan: nine-vowel system*

ATR		non-ATR		
i	u	ɪ		ʊ
e	o	ɛ		ɔ
			a	
<u>I</u>	**<u>U</u>**	**I**		**U**
A.<u>I</u>	**A.<u>U</u>**	**A.I**		**A.U**
			A	

(49) *Akan low vowel: opacity*

(a)	pɪræko	'pig'
	fuñanɪ	'to search'
(b)	o-bisa-ɪ	'he/she asked (it)'
	ɔ-kæri-i	'he/she weighed (it)'

However, another reaction to the same situation is possible, as well. Igbirra (a Kwa language of the Niger-Congo group, spoken in Kabba Province, Nigeria, cf. Ladefoged 1964, 1971), and Maasai (a Nilo-Saharan language, spoken in southern Kenya and northern Tanzania, cf. Tucker & Mpaayei 1955, Levergood 1984), with the same vowel system as is shown in (48), do harmonise the vowel /a/. But they do it at the cost of neutralising the distinction between the ATR counterparts of /ɛ/ and /a/ into the vowel /e/ in Igbirra and those of /ɔ/ and /a/ into the vowel /o/ in

Maasai.[17] These alternations are illustrated in (50a-b) (where tones are omitted) (cf. Ladefoged 1971: 78, Tucker & Mpaayei 1955: 56, 79-80).

(50) (a) *Igbirra low vowel: raising and fronting*

ma-zɪ	'I am in pain'
me-zi	'I expect'
ma-tɔ	'I pick'
me-to	'I arrange'

(b) *Maasai low vowel: raising and backing*

aa-ipot-i-to-i	'I am being called'
aa-rɪk-ɪ-ta-ɪ	'I am being nauseated'
a-ta-pe-to	'I smeared it'
a-tɛ-pɛ-ta	'I kept close to it'

The third possibility can be exemplified by Diola-Fogny (belonging to the Western Atlantic Branch of the Niger-Congo family, spoken in the Basse-Casamance region of Senegal, cf. Sapir 1965), which possesses a central vowel, resulting in a ten-vowel system, shown in (51).

(51) *Diola-Fogny: ten-vowel system*

ATR		non-ATR	
i	u	ɪ	ʊ
e	o	ɛ	ɔ
ə		a	
<u>I</u>	**<u>U</u>**	**I**	**U**
A.<u>I</u>	**A.<u>U</u>**	**A.I**	**A.U**
v^0		**A**	

Here /a/ is harmonic as well, but this time it alternates with /ə/, as illustrated in (52) by the dominant suffix *-ul* 'towards the speaker' (cf. Sapir 1965: 12).

[17] In Maasai, the low vowel only undergoes raising as a result of rightward harmony, whereas in leftward harmony it behaves as opaque. Here I only discuss the case of raising.

(52) *Diola-Fogny low vowel: raising*

nɪ-baj-ɛn-ʊ	'I caused you to have'
ni-bəj-ul-u	'I have for you'

These different types of behaviour can be expressed by different rankings of four constraints. The reaction of Akan is in a sense the simplest one. If **A** cannot combine with headedness, and it cannot be skipped either, then it has to stop harmony, unless something else happens to the expression (**A**). This can be formulated in other words by saying that the Faithfulness constraints ***I**, ***U** and FILL are ranked above the constraint requiring harmony. That is, nothing is done to get around the inviolable constraint expressed in (35). Rather, harmony is blocked, and opacity arises.

This can be expressed in a tabular form as in (53). The inviolable (35), ***A̲**, is left out of the tables below, because it is assumed to be part of *Gen* (that is, a vowel headed by the element **A** simply never arises). The same holds for the Locality constraint. The relevant vowel is underlined in each candidate for ease of exposition.

(53) *Akan*

ɔ-bisa-ɪ	***I**	***U**	FILL	HARMONY
☞ o-bisa̲-ɪ				*
o-bisə̲-i			*!	
o-bise̲-i	*!			
o-biso̲-i		*!		

The second candidate in (53) violates FILL, since it contains the empty vowel. (Note also that in this and the following tableaux, candidates violating FILL always violate PARSE (**A**) as well, but I do not indicate these violations here.) The third candidate violates ***I**, because an extra **I** element has been inserted to give (**A.I̲**), where this latter element can bear the property of headedness without violating any constraints. In the fourth candidate, an element **U** has been inserted to achieve the same purpose, resulting in a violation of ***U**. Since these constraints are ranked above HARMONY, the candidate exhibiting opacity will be optimal.

Notice that given the present formulation of HARMONY, we would expect that the candidate showing opacity is not harmonised at all, since it violates HARMONY in any case, and in this way it also incurs some *MULTIPLE (α) violations. However, if HARMONY is evaluated as a gradient constraint, incurring a violation by each non-harmonised nucleus in the domain, then this problem does not arise, and at the same time nothing changes in the previous analyses.

High ranking of FILL means that the empty vowel is dispreferred. In fact, in Akan, the empty vowel is disallowed completely. This has been expressed by the parameter given in (31b) above. It might turn out that the ranking of FILL alone can account for this fact, and that in this way the parameter in (31b) becomes superfluous.

In Igbirra and Maasai, the ranking is different. The empty vowel is ruled out here as well (through high ranking of FILL). But in these languages harmony must still go through, although at the cost of inserting an element, and by this neutralising a potential contrast. Thus the ranking of HARMONY and *I or *U respectively is reversed, and in this way the third candidate becomes optimal in (54) and the fourth in (55).

(54) *Igbirra*

ma-zi	HARMONY	***U**	FILL	***I**
ma̱-zi	*!			
mə̱-zi			*!	
☞ me̱-zi				*
mo̱-zi		*!		

(55) *Maasai*

-ipot-i-ta-i	***I**	HARMONY	FILL	***U**
-ipot-i-ta̱-i		*!		
-ipot-i-tə̱-i			*!	
-ipot-i-te̱-i	*			
☞ -ipot-i-to̱-i				*!

Finally, when the empty vowel is allowed, as in Diola-Fogny, we get the ranking in (56), and harmony can proceed without having to insert anything, or neutralising any contrasts. Of course, now – as a result of low ranking of FILL – the empty vowel surfaces.

(56) *Diola-Fogny*

nɪ-baj-ul-ʊ	***I**	***U**	HARMONY	FILL
nɪ-ba̱j-ul-u			*!	
☞ ni-bə̱j-ul-u				*
ni-be̱j-ul-u	*!			
ni-bo̱j-ul-u		*!		

The representation of the winning candidate of (56) is given in (57).

(57) */ə/ as the ATR counterpart of /a/*

```
I/U  - - - I - - - - - - - -U- - - U - - -
           |              |     |
 A   - - - - - - -<A>- - - - - - - - - - -
           |      |       |     |
        x  x  x   x  x    x  x  x
        n  i  b   ə  j    u  l  u
```

Headedness cannot be assigned to an expression containing a single **A**. But if this **A** element is unparsed, the expression becomes empty and thus can be skipped, turning this case into one of 'idiosyncratic transparency'.

In fact, a fourth type of behaviour of the low vowel /a/ has been identified as well. In Kinande (cf. Schlindwein 1987, Archangeli & Pulleyblank 1994: 210), the low vowel is transparent to ATR-harmony, as illustrated in (58a) (where tones are again omitted).

(58) *Kinande low vowel: transparent*

(a)	tu-ka-ki-li:m-a	'we exterminate it'
	tʊ-ka-kɪ-lɪ:m-a	'we cultivate it'
	tu-ka-ki-hu:k-a	'we cook it'
	tʊ-ka-mʊ-hʊ:m-a	'we beat him'
(b)	ɔ-mu-kə:li	'woman'
	ɛ-ki-tsə:li	'pea'

However, it is argued in the literature (cf. Archangeli & Pulleyblank 1994) that this transparency is only apparent. Under this analysis, Kinande behaves exactly like Diola-Fogny, with the difference that the ATR version of /a/ only manifests itself as [ə] in certain environments (i.e. when lengthened and bearing a low tone, shown in (58b)), and in all other environments the distinction is neutralised phonetically into [a].

To summarise, in this section I have discussed the four different ways in which languages can react to the inviolable constraint given in (35) which prohibits assigning headedness to the element **A**. If the empty vowel is absent from the system, /a/ can either be opaque (thus violating HARMONY), or it can acquire the element **I** or the element **U**, and as a result alternate with /e/ or with /o/ (violating *I or *U). If on the other hand the empty vowel is allowed, then /a/ may alternate with /ə/ (and violate the FILL constraint).[18]

6.4. Conclusion

In summary, in this chapter I have tested the theory proposed by Van der Hulst & Smith (1986). According to this theory, neutral vowels are expected to behave in one of two ways: they either possess the harmonic feature and they are transparent to harmony, or they lack the harmonic feature and they are opaque. There are two further possibilities. Neutral vowels can be exceptionally transparent even though they do not have the harmonic feature, if they can be argued to be completely empty. On the other hand, they can show exceptional opaque behaviour even if they do have the harmonic feature, if the harmony is parasitic on a property they do not have.

The most striking gap in the predictions made by this proposal is the absence of cases of expected opacity in **I**- and **U**-harmony systems. I have proposed to account for this gap by referring to certain properties of the vowel inventories involved. I have claimed that elements residing on fused lines cannot harmonise. As a consequence, **I**- and **U**-harmony are only possible in systems containing front rounded vowels (or in systems where either **I** or **U** is totally inert). In contrast, ATR- and **A**-harmony can occur in triangular vowel systems, as well. The other two parameters constraining inventories (the one involving the existence of the empty vowel, and the other referring to headedness) have a more local effect, defining the set of neutral vowels, and not preventing harmony in general.

The absence of expected transparency cases in **A**-harmony, on the other hand, follows from the inviolable constraint prohibiting the combination of headedness with the element **A**. This constraint also governs the behaviour of the low vowel /a/ in ATR-harmony systems. The four possible reactions to avoid violation of this

[18] Languages with more than one central vowel *and* ATR-harmony might constitute a problem, since as we have seen in (46), such complex systems require the presence of a headed **A**. I only know of one system of this complexity, Kpokolo (discussed by Kaye, Lowenstamm & Vergnaud 1985). However, it might be possible to argue that here all the central vowels are in fact derived from the peripheral ones (by unrounding and raising), and thus they are not underlying. More information is needed about the facts of the language to determine whether such a proposal is feasible.

constraint were discussed in the last section. Notice, however, that I have not motivated why this constraint should be so strong (it even holds in the postlexical phonology, as was illustrated by the case of Zulu in chapter 3 (section 3.3.2.)). The explanation for this question has to wait for further research.

7. Summary

In this dissertation, I have examined the phenomenon of vowel harmony in a framework combining insights from Government Phonology, Optimality Theory and Lexical Phonology. Vowel harmony is interesting, because it involves several aspects of phonological theory. It is a segmental process, but it operates in a seemingly non-local manner, thus it applies with respect to some type of constituent structure. I have looked at the following three basic issues concerning vowel harmony: (i) how can an element-based feature theory, comprising the three elements **I**, **A** and **U** (supplemented by the property of headedness) account for all the different types of vowel harmonies? (chapter 4); (ii) what is the domain of vowel harmony, and how is disharmonicity handled in the proposed model? (chapter 5); (iii) is the theory of neutral vowels proposed in Van der Hulst & Smith (1986) adequate, and if not, how should it be modified to match with the facts? (chapter 6).

In the first part of the thesis, chapters 2 and 3, I introduced and motivated the general framework that I used in subsequent discussions on issues of vowel harmony. In chapter 2, I showed through the example of government licensing that the device of constraint ranking is necessary to be able to account for certain types of phenomena. In this particular case, a properly governable empty nucleus behaves differently in different languages when it follows a consonant cluster. In some languages, such as French, it receives phonetic interpretation despite the fact that it *could* be properly governed, because the need to government license the preceding consonant cluster is more pressing than the need to obey proper government (and we get *margərit* and not **margrit*). In other languages, however, such as Polish, it is proper government that is satisfied, the empty nucleus thus remains silent, and government licensing is violated accordingly (and the correct form is *varxlak* instead of **varxelak*).

Further I argued that since ranking is necessary in any case, it would be favourable if parameters could be dispensed with altogether. I have shown that this is indeed possible by replacing the parameter that licenses domain-final empty nuclei by a violable constraint called NUCLEUS, which requires that every onset is followed by a nucleus. In this approach, then, consonant final words in fact end in an onset (by this violating the NUCLEUS constraint), and not in a parametrically licensed empty nucleus.

In chapter 3, I added some elements of Lexical Phonology to the theory developed in chapter 2. First I introduced the analytic-synthetic distinction in affixation. Then I argued that processes cannot be totally 'blind' to the history of the derivation they are involved in. More precisely, processes of the lexical phonology can show 'derived environment effects', that is, they can be restricted to only apply in a derived environment. This means that we have to retain some version of the Strict Cycle Condition. I formulated a non-derivational version of this condition in the form of a violable constraint and called it DERIVED ENVIRONMENT CONSTRAINT. This constraint prohibits changes within a single analytic domain. To avoid having to refer to 'neutralising' changes, which would have complicated the evaluation procedure of this constraint considerably, I have argued that in fact all lexical processes are neutralising. This means that the principle of Structure Preservation is fully adhered to in the lexicon. I showed on the basis of some representative examples that processes which are not structure preserving can be argued not to be lexical on independent grounds. They are either 'word level' rules (in the sense of Borowsky 1993), or they are postlexical.

After this general introduction, the second part, comprising chapters 4, 5 and 6, deals with the phenomenon of vowel harmony. In chapter 4, I looked at the issue of harmonic features. Given a particular theory of (vocalic) features, we expect as many types of vowel harmony as there are features allowed for by the theory. In an element-based feature theory, such as Government Phonology, where there are only three elements, **I**, **A** and **U**, supplemented by the property of headedness, this means that we expect four types of vowel harmony. In the first part of the chapter, I gave an example of each type.

In a theory like this, there is no primitive corresponding to the feature [high], thus we do not expect to find cases of raising harmony. In the second part of the chapter, I discussed the case of Pasiego Spanish that has been argued to exhibit exactly this type of harmony. I argued that it is possible to analyse the process in Pasiego without referring to the absence of the element **A** in a framework that combines the insights of Optimality Theory with those of Government Phonology. I proposed a constraint that requires that the combination of elements in a governed position is licensed by a governing **A** (LICENSE (COMB)). This constraint is ranked above PARSE (**A**). Thus the element **A** will always be deleted from a complex expression, if it is not supported by an **A** in the governing position without having to state this negative condition as the trigger of the process. Moreover, raising is not regarded as the same type of harmony as spreading harmonies, since only sequences of mid vowels followed by high vowels are ruled out by it, and complete uniformity is not required in sequences of non-low vowels.

In chapter 5, I investigated the issue of the harmonic domain, and how disharmonic roots and affixes should be handled in the adopted framework. On the basis of a detailed analysis of Turkish vowel harmony, I proposed that harmony applies with reference to the domain introduced in chapter 3, the 'analytic domain'. Furthermore, I argued that vowel harmony is no longer active in Turkish roots, and this is why there are so many disharmonic roots in the language. In other words, vowel harmony is one of those lexical processes that can exhibit derived environment effects. This can be expressed by ranking the DERIVED ENVIRONMENT CONSTRAINT, introduced in chapter 3, above the HARMONY constraint responsible for spreading. Restrictions on possible types of disharmonicity follow from even higher ranked constraints.

For disharmonic suffixes I claimed that they can be of one of the following two types: (i) they either behave as parts of compounds, in this way falling into the category of 'compounding analytic' suffixes; or (ii) they are unproductive derivational suffixes, belonging to the category of 'synthetic' suffixes. The first type of suffixes do not undergo harmony, because they form an analytic domain of their own. The second type of suffixes, on the other hand, form one unit phonologically with the stem they attach to, and harmony does not apply to them for the same reason why it does not apply in non-derived roots. This means that harmony only applies if analytic suffixes are added to the root.

In chapter 6, I tested the predictions which the theory proposed by Van der Hulst & Smith (1986) makes concerning the typology of neutral vowels. According to this theory, neutral vowels are expected to behave in one of two ways on the basis of the segmental make-up of these vowels: (i) they either possess the harmonic feature (as the head of their expression) and they are transparent to harmony, or (ii) they lack the harmonic feature and they are opaque. There are two further possibilities. Neutral vowels can be exceptionally transparent even though they do not have the harmonic feature, if they can be argued to be completely empty. On the other hand, they can show exceptional opaque behaviour even if they do have the harmonic feature, if the harmony is parasitic on a property they do not have.

I showed in chapter 6 that not all of these possibilities occur in all types of harmony systems. I proposed to account for the non-existent cases on the basis of particular properties of the vowel systems in question. More precisely, I claimed that harmony cannot involve those elements that reside on a fused line. This recaptures the original autosegmental idea that only features specified on separate autosegmental tiers can exhibit long-distance dependencies. As a consequence, **I**- and **U**-harmony are only possible in vowel systems that contain front rounded vowels; whereas **A**- and ATR-harmony can occur in triangular systems, as well. Finally, I discussed the role of an apparently very powerful constraint that prohibits the combination of the element **A** with the property of headedness. In **A**-harmony, this prevents the vowel /a/ from acting as transparent, whereas in ATR-harmony it predicts that the vowel /a/ will be opaque (unless there is some repair strategy involved).

In summary, the combination of a theory of representations with a theory of constraint interactions and with a theory of phonological derivations can handle several phenomena in a satisfactory way that cannot be accounted for in either theory when they stand on their own. Since these theories cover different empirical domains, it never has been claimed that they are inherently incompatible. However, it has not been suggested either that they *should* be combined.

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Samenvatting (Summary in Dutch)

Dit proefschrift behandelt enkele elementaire theoretische problemen rond het fenomeen klinkerharmonie in een kader dat inzichten uit Government Phonology, Optimaliteitstheorie en Lexicale Fonologie combineert. Klinkerharmonie is een proces waarbij alle klinkers met elkaar moeten overeenstemmen in een van hun eigenschappen in (onnauwkeurig gezegd) een woord. In een taal met palatale harmonie, zoals het Hongaars, moet bijvoorbeeld elke klinker in een woord ofwel 'voor', ofwel 'achter' zijn. Enerzijds betekent dit dat de klinkers in meerlettergrepige wortels allemaal voor- of allemaal achterklinkers moeten zijn; anderzijds moeten alle affixen met een klinker twee allomorfen hebben, één met een voorklinker, en één met een achterklinker; de keuze tussen deze twee is afhankelijk van de wortel waar het affix aan gehecht wordt (bijv. *város-ba̲n* 'in [een] stad' vs. *tömeg-be̲n* 'in [een] menigte'). Dat wil zeggen dat de klinkers met elkaar harmoniseren.

Dit verschijnsel is om verschillende redenen interessant voor elke fonologische theorie. Een van de spannendste aspecten is dat het om een niet-lokaal proces lijkt te gaan, dat tussenliggende medeklinkers 'overslaat' (of negeert). In een theorie zoals Government Phonology (zie Kaye, Lowenstamm en Vergnaud 1985, 1990) is er echter een onafhankelijk gemotiveerd niveau waarop klinkers wel degelijk aan elkaar adjacent zijn. Aangezien een klinker het hoofd vormt van de syllabe waarin hij staat, wordt hij geprojecteerd naar een niveau waarop hij door andere klinkers 'gezien' kan worden. Medeklinkers worden niet op deze manier geprojecteerd en zo kunnen we begrijpen waarom een soortgelijke vorm van medeklinkerharmonie niet bestaat. Deze theorie staat ons daarom toe de bewering te handhaven dat alle fonologische processen strikt lokaal opereren. De hoeveelheid mogelijke grammatica's wordt op deze manier aanzienlijk beperkt; dit is de voornaamste reden waarom ik besloten heb in dit proefschrift de representationele theorie van Government Phonology te gebruiken.

Behalve dit elementaire probleem bestrijkt het klinkerharmonieonderzoek drie hoofdgebieden. Het eerste betreft de vraag welke soorten klinkerharmonie er bestaan in talen van de wereld, en welke kenmerktheorie deze typologie het best kan verantwoorden. Volgens moderne fonologische theorieën kunnen klanken worden opgedeeld in kleinere eenheden, die distinctieve kenmerken worden genoemd. Omdat klinkerharmonie betrekking heeft op de overeenkomst tussen klinkers in een bijzondere eigenschap, of kenmerk, voorspelt elke theorie over kenmerken dat er evenveel soorten klinkerharmonie zijn als er klinkerkenmerken bestaan binnen de theorie. Kenmerktheorieën kunnen zo worden getest aan de hand van de voorspellingen die zij doen over de typologie van klinkerharmonieën. In dit proefschrift beargumenteer ik dat de kenmerktheorie van Government Phonology een goede verklaring biedt voor de mogelijke soorten harmonie.

De tweede kwestie betreft het domein van klinkerharmonie. Dit domein wordt gewoonlijk gedefinieerd als het "woord". Eén vraag die we hier moeten beantwoorden is of dit domein in morfologische of fonologische termen gedefinieerd wordt (omdat bijvoorbeeld de samenstellende delen van een compositum aparte *harmonic spans* vormen); en, zo het fonologisch gedefinieerd wordt, of het een prosodisch domein is of iets anders. In dit proefschrift geef ik argumenten voor een fonotactische definitie van het harmoniedomein; preciezer gezegd, voor de stelling dat het overeenkomt met het zogenaamde analytische domein. Nog een vraag betreft het bestaan van disharmonische wortels en disharmonische affixen. Een voorbeeld van de eerste is de Hongaarse wortel *kosztüm,* en een voorbeeld van de laatste het achtervoegsel *-kor* (bijv. *öt-kor* 'om vijf uur' en niet **öt-kör*). Het domein voor harmonie moet op een dusdanige manier gedefinieerd worden dat ook systematische karakteristieke eigenschappen van disharmonische zeeksen worden verklaard.

Het derde onderzoeksterrein betreft de zogenaamde neutrale klinkers. Dit zijn klinkers die geen harmonische tegenhanger hebben in een systeem. Hun neutraliteit manifesteert zich in het feit dat ze met klinkers uit beide harmonische verzamelingen kunnen voorkomen. Affixen die neutrale klinkers bevatten hebben slechts één allomorf, en alterneren niet naar gelang het soort wortel waar ze aan gehecht worden. Niet alle neutrale klinkers gedragen zich echter op dezelfde wijze. Op basis van hun gedrag kunnen er twee hoofdsoorten worden onderscheiden. Eén soort is 'transparant' omdat harmonie door deze klinkers heengaat, alsof ze er niet waren. Dat wil zeggen: als een klinker in een achtervoegsel een stam volgt die eindigt op een neutrale klinker, harmoniseert de klinker in het achtervoegsel met de niet-neutrale klinker links van de transparante klinker, als het ware het tussenliggende materiaal negerend. Het andere soort wordt 'opaak' genoemd, omdat deze klinkers de harmonie stoppen. In deze gevallen harmoniseert de klinker in het achtervoegsel met de neutrale klinker zélf, voorbijgaand aan wat er in de stam voorafgaat. De kwestie van transparante klinkers houdt verband met het hierboven genoemde lokaliteitsprobleem, omdat het erop lijkt dat harmonie de transparante klinkers 'overslaat'. Van der Hulst en Smith (1986) lossen dit probleem op, en beweren voorts dat de twee soorten van door neutrale klinkers tentoongespreid gedrag kunnen worden voorspeld uit de segmentele inhoud van de klinkers zelf. In deze dissertatie test ik hun theorie en toon dat niet alle mogelijkheden die ze voorspelt ook daadwerkelijk voorkomen in talen van de wereld. Ik stel voor dat we kunnen voorspellen welke eigenschappen niet voorkomen als we enkele eigenschappen van de betrokken klinkersystemen in de beschouwing betrekken.

Om een oplossing te kunnen bieden voor deze drie problemen moest ik mijn positie bepalen aangaande enkele algemenere kwesties binnen de fonologische theorie. Dit vormt het eerste deel van dit proefschrift. In hoofdstuk 2 stel ik er aanzienlijke voordelen behaald kunnen worden als het theoretisch kader van Government Phonology gecombineerd wordt met Optimaliteitstheorie (zie Prince and Smolensky 1993). Ik laat zien dat rangschikking van constraints nodig is om bepaalde soorten verschijnselen te verklaren. Ik gebruik als voorbeeld het 'principe' *government licensing*, dat woordintern in conflict is met het 'principe' van *proper government*. Sommige talen lossen dit conflict op ten gunste van het ene principe, terwijl andere talen het oplossen ten gunste van het andere. Als we aannemen dat rangschikking van principes (of liever constraints) noodzakelijk is, kunnen we nog een paar positieve veranderingen aanbrengen in de theorie. Ik beargumenteer namelijk dat taalvariatie nu uitsluitend in termen van rangschikking beschreven kan worden, en dat het begrip parameters bijgevolg kan worden afgeschaft. Ik illustreer dit door de parameter die domeinfinale lege nuclei toestaat te vervangen door een schendbare constraint. Als een gevolg daarvan eindigen consonantfinale woorden nu in een onset in plaats van in een lege nucleus.

De theorie die in hoofdstuk 2 ontwikkeld wordt is echter nog steeds niet rijk genoeg om bepaalde soorten problemen op te lossen. Processen binnen de lexicale fonologie kunnen namelijk zogenaamde ‘derived environment effects’ vertonen. Dit betekent dat ze zo kunnen worden beperkt dat ze alleen in een afgeleide context toegepast kunnen worden, maar niet binnen monomorfemische vormen. Dat wil zeggen dat we een versie van het begrip Strikte Cyclusconditie uit de Lexicale Fonologie moeten behouden. Ik formuleer een niet-derivationele versie van deze conditie in de vorm van een schendbare constraint en noem dit de DERIVED ENVIRONMENT CONSTRAINT. Deze constraint verbiedt veranderingen binnen een enkel analytisch domein. Om niet naar ‘neutraliserende’ veranderingen te hoeven verwijzen, die de evaluatieprocedure aanzienlijk zou compliceren, beargumenteer ik dat alle lexicale processen in feite neutraliserend zijn. Dit betekent dat het structuurbehoudendheidsprincipe in het lexicon volledig gehoorzaamd wordt. Ik laat aan de hand van enkele representatieve voorbeelden zien dat op onafhankelijke gronden kan worden aangetoond dat niet-structuurbehoudende processen niet lexicaal zijn. De regels bevinden zich ofwel ‘op woordniveau’ (in de zin van Borowsky 1993), of ze zijn postlexicaal.

Na deze algemene inleiding behandelt het tweede deel, dat de hoofdstukken 4, 5 en 6 omvat, het verschijnsel klinkerharmonie. In hoofdstuk 4 bekijk ik de kwestie van harmonische kenmerken. Gegeven een bepaalde theorie over (klinker-)kenmerken, verwachten we evenveel soorten klinkerharmonie als er kenmerken zijn in de theorie. In een kenmerktheorie die gebaseerd is op elementen zoals Government Phonology, waarin er slechts drie elementen zijn, **I**, **A**, **U**, aangevuld met de eigenschap hoofdigheid, betekent dit dat we vier soorten klinkerharmonie verwachten. In het eerste deel van het hoofdstuk geef ik een voorbeeld van elk type.

In een theorie als deze is er geen primitieve die correspondeert met het kenmerk [hoog], zodat we geen gevallen van hoogteharmonie verwachten. In het tweede deel van dit hoofdstuk bepreek ik het geval van het dialect van het Spaans uit Pasiego, waarover beweerd is dat het precies dit soort harmonie tentoonspreidt. Ik stel dat het mogelijk is om het proces in het dialect van Pasiego te analyseren zonder te verwijzen naar de afwezigheid van het element **A** in een theoretisch kader dat de inzichten van de Optimaliteitstheorie combineert met die van Government Phonology. Ik stel een constraint voor, die eist dat de combinatie van elementen in een geregeerde positie gelicensed wordt door een regerende **A**. Deze constraint is hoger gerangschikt dan PARSE (**A**). Zo wordt het element **A** altijd uit een complexe expressie verwijderd als het niet ondersteund wordt door een **A** in de regerende positie, zonder dat de negatieve conditie als de trigger van het proces hoeft te worden gespecificeerd. Daarenboven wordt verhoging niet gezien als hetzelfde soort harmonie als spreidingsharmonieën, aangezien alleen rijen middenklinkers gevolgd door hoge klinkers erdoor worden uitgebannen, en totale uniformiteit niet vereist wordt in rijen niet-lage klinkers.

In hoofdstuk 5 onderzoek ik de kwestie van het harmonisch domein, en hoe disharmonische wortels en affixen behandeld moeten worden in het aangenomen theoretisch kader. Op basis van een gedetailleerde analyse van Turkse klinkerharmonie, stel ik voor dat harmonie wordt toegepast onder verwijzing naar het domein dat in hoofdstuk 3 is ingevoerd, het zogenaamde 'analytische domein'. Voorts stel ik dat klinkerharmonie niet langer actief is in Turkse wortels en dat dit de reden is waarom er zoveel disharmonische wortels zijn in de taal. Klinkerharmonie is met andere woorden een van de lexicale processen die effecten van een afgeleide context vertonen. Dit kan worden uitgedrukt door de DERIVED ENVIRONMENT CONSTRAINT, die in hoofdstuk 3 is ingevoerd, te rangschikken boven de constraint HARMONY, die verantwoordelijk is voor spreiding.

Voor disharmonische suffixen beweer ik dat ze in de volgende twee soorten kunnen worden onderverdeeld: (i) ofwel ze gedragen zich als onderdelen van composita, en vallen op deze manier in de categorie van 'samenstellende analytische' suffixen; of (ii) ze zijn niet-productieve, derivationele suffixen, die tot de categorie van 'synthetische' suffixen behoren. Suffixen van de eerste soort ondergaan geen harmonie omdat ze eigen analytische domeinen vormen. Suffixen van de tweede soort vormen anderzijds fonologisch een eenheid met de stam waaraan ze gehecht worden; harmonie is niet op hen van toepassing om dezelfde reden waarom het niet van toepassing is in niet-afgeleide wortels. Dit betekent dat harmonie alleen wordt toegepast als er analytische suffixen aan de wortel worden toegevoegd.

In hoofdstuk 6 test ik de voorspellingen die de door Van der Hulst en Smith (1986) voorgestelde theorie maakt over de typologie van neutrale klinkers. Deze theorie voorspelt dat neutrale klinkers zich op één van twee manieren gedragen, afhankelijk van de segmentele inhoud van deze klinkers: (i) ofwel ze bezitten het harmonische kenmerk en zijn dus transparant voor harmonie (omdat het harmonische kenmerk compatibel met ze is en dus door ze heen kan spreiden); of (ii) ze bezitten het harmonische kenmerk niet en zijn opaak (omdat harmonie geen klinkers kan overslaan).

Ik laat zien dat deze mogelijkheden niet allebei voorkomen in harmoniesystemen. Ik stel voor om het niet-bestaan van sommige gevallen te verklaren op grond van de bijzondere eigenschappen van de desbetreffende klinkersystemen. Preciezer gezegd beweer ik dat harmonie geen betrekking kan hebben op elementen die op een samengevoegde lijn staan. Dit brengt nieuw leven in het oude autosegmentele idee dat alleen kenmerken lange afstandsafhankelijkheden kunnen vertonen, die op verschillende autosegmentele tiers gespecificeerd staan. Bijgevolg zijn **I**- en **U**-harmonie alleen mogelijk in klinkersystemen die geronde voorklinkers bevatten; terwijl **A**- en ATR-harmonie ook in een driehoekig systeem kunnen voorkomen. Tenslotte bespreek ik de rol van een kennelijk zeer krachtige constraint die de combinatie van het element **A** met de hoofdigheidseigenschap verbiedt.

De combinatie van een theorie over representaties met een theorie over interactie tussen constraints en met een theorie over fonologische derivaties kan, samenvattend, meerdere verschijnselen op een bevredigende manier verklaren, die niet in elk van deze theorieën op zich kunnen worden opgelost. Aangezien deze theorieën verschillende empirische domeinen afdekken, is nooit beweerd dat ze inherent incompatibel waren. Er is echter ook nooit eerder gesuggereeerd dat ze gecombineerd *moeten* worden.

Összefoglalás
(Summary in Hungarian)

A disszertáció a magánhangzó-harmónia jelensége által felvetett alapvető elméleti problémákat tárgyalja egy olyan elméleti keretben, amely a kormányzás-fonológia, az optimalitáselmélet és a lexikális fonológia bizonyos elemeit egyesíti. Magánhangzó-harmónián azt értjük, ha egy bizonyos tartományon belül (ami általában egybeesik a szóval), minden magánhangzó megegyezik egymással valamely tulajdonsága alapján. A magyarban például ún. elölségi harmóniát találunk. Ez azt jelenti, hogy egy szón belül vagy csak elölképzett, vagy csak hátulképzett magánhangzók jelenhetnek meg. Ez a megszorítás kétféleképpen nyilvánul meg. Egyrészt egy-egy tövön belül csak az egyik fajta magánhangzót találjuk. Másrészt a magánhangzót tartalmazó toldalékoknak két alakjuk van, és hogy ezek közül melyik jelenik meg, attól függ, hogy milyen típusú tőhöz illesztjük a toldalékot (pl. *város-ba̱n*, de *tömeg-be̱n*). Tehát a magánhangzók harmonizálnak egymással.

Ez a jelenség több szempontból is érdekes bármely fonológiai elmélet számára. Legproblematikusabb aspektusa az, hogy olyan folyamatnak tűnik, amely nem lokálisan működik, hiszen "átugorja" (vagy más szóval, figyelmen kívül hagyja) a mássalhangzókat. Vannak azonban olyan fonológiai elméletek mint például a kormányzás-fonológia (l. Kaye-Lowenstamm-Vergnaud 1985, 1990), amelyek megkülönböztetnek egy olyan (függetlenül motivált) szintet, ahol a magánhangzók szomszédosak egymással. Mivel a magánhangzók egyben az őket tartalmazó szótagok fejei, ezen funkciójukban kivetíthetők egy olyan szintre, ahol már "látják egymást". A mássalhangzók ezzel szemben nem nézhetnek ugyanígy át a magánhangzók fölött, és így megmagyarázhatjuk, hogy hasonló típusú mássalhangzó-harmónia miért nem létezik. Egy ilyen jellegű elméletben fenntartható az az állítás, hogy minden fonológiai folyamat lokálisan működik. Ez a megkötés jelentősen megszorítja a lehetséges nyelvtanok számát, és ezért ebben a disszertációban a kormányzás-fonológia reprezentációs keretét vettem alapul.

Ezen az alapvető problémán túl a magánhangzó-harmónia kutatása három fő területet foglal magába. Az első azt a kérdést illeti, hogy milyen típusú magánhangzó-harmóniák léteznek a világ nyelveiben, és hogy milyen jegyelmélet tud erről a tipológiáról legjobban számot adni. A fonológia modern elméletei szerint a hangok kisebb összetevőkre bonthatók. Ezek az ún. megkülönböztető jegyek. Mivel a magánhangzó-harmónia során a magánhangzók bizonyos tulajdonságuk (vagyis megkülönböztető jegyük) szempontjából egyeznek meg egymással, egy adott jegyelmélet azt jósolja, hogy annyiféle harmónia létezik, ahány megkülönböztető jegyet az elmélet elfogad. A jegyelméleteket tehát tesztelni lehet annak alapján, hogy jól jósolják-e meg a lehetséges harmóniatípusokat. Ebben a disszertációban amellett érvelek, hogy a kormányzás-fonológia jegyelmélete helyesen fedi le a lehetséges típusú harmóniákat.

A második kérdés a magánhangzó-harmónia tartományára vonatkozik. Ezt általában a “szó”-ként definiálják. Itt egyrészt arra kell választ adnunk, hogy ez a “szó”-tartomány morfológiailag vagy fonológiailag meghatározott (hiszen például az összetett szavak részei külön tartományt alkotnak a harmónia szempontjából); és ha fonológiailag, akkor prozodikusan vagy valahogy másképp. Ebben a disszertációban egy fonotaktikai definíció mellett érvelek, pontosabban amellett, hogy a magánhangzó-harmónia tartománya az ún. analitikus tartomány. Másrészt meg kell magyaráznunk a diszharmonikus tövek és a diszharmonikus toldalékok létét. Az előbbire példa a *kosztüm* tő, míg az utóbbira a *-kor* toldalék (l. *öt-kor*, és nem **öt-kör*). A magánhangzó-harmónia tartományát úgy kell meghatározni, hogy a diszharmonikus hangsorok szisztematikus tulajdonságait ne veszítsük szem elől.

A harmadik kutatási terület az ún. semleges magánhangzókat érinti. Ezek azon magánhangzók egy adott rendszerben, melyeknek nincsen harmonikus párjuk. Semlegességüket az mutatja, hogy a harmonikus magánhangzók mindkét csoportjával együtt megjelenhetnek. A semleges magánhangzókat tartalmazó toldalékoknak csak egy alakjuk van, és nem váltakoznak attól függően, hogy milyen tőhöz illesztjük őket. Azonban a semleges magánhangzók se mind egyformák. Viselkedésük alapján két típust különböztethetünk meg. Az egyik típust “átlátszó”-nak hívják, mert ezeken a magánhangzókon átmegy a harmónia, mintha ott sem lennének. Ilyen például a magyar *i*, ahol az *i* után következő magánhangzó minőségét az *i*-t megelőző magánhangzó határozza meg (l. *radír-nak*, de *rövid-nek*). A másik típus "átlátszatlan", mert megállítja a harmóniát, és a semleges magánhangzót követő magánhangzó minősége mindig a semleges magánhangzóétól függ. Az "átlátszó" magánhangzók problémája kapcsolódik a fentebb említett lokalitási problémához, mert úgy tűnik, mintha a harmónia "átugorná" az "átlátszó" magánhangzókat. Van der Hulst és Smith (1986) megoldja ezt a problémát. Ezenkívül azt állítják, hogy a semleges magánhangzók kétféle viselkedése megjósolható az adott magánhangzók felépítéséből. Ebben a disszertációban az ő elméletüket tesztelem, és megmutatom, hogy nem minden általuk megjósolt lehetőség jelenik meg a világ nyelveiben. Javaslatom szerint azonban a nyelvek magánhangzó-készlete alapján megjósolható, hogy mely lehetőségek nem jelenhetnek meg.

Ahhoz, hogy a magánhangzó-harmónia fentebb említett három alapproblémáját megoldhassam, néhány általánosabb fonológiai kérdésben is állást kellett foglalnom. Ezt tartalmazza a disszertáció első része. A második fejezetben amellett érvelek, hogy a kormányzás-fonológia és az optimalitáselmélet (l. Prince-Smolensky 1993) kombinálása több szempontból is előnyös. Megmutatom, hogy a kormányzás-fonológia bizonyos jelenségekről nem tud számot adni, ha a megszorítások megsérthetetlenek és nem rangsorolhatók. Példaként a kormányzás-jogosítás "elvét" hozom fel, ami szóbelseji helyzetben konfliktusban áll a szoros kormányzás "elvével". Ezt a konfliktust egyes nyelvek az egyik elv javára, míg mások a másik elv javára oldják fel. Ha elfogadjuk, hogy a megszorítások rangsorolására szükség van, ez további előnyös változtatásokra ad lehetőséget az elmélet felépítésében. Mégpedig, érvelésem szerint, ebben az esetben megszabadulhatunk az eddig szükséges paraméterektől, és minden nyelvspecifikus variációt a rangsorolás segítségével fejezhetünk ki. Ezt a tartományvégi üres magokat jogosító paraméter példáján illusztrálom, melyet egy megsérthető megszorítással helyettesítek. Ennek eredményeképpen a mássalhangzóra végződő szavak most szótagkezdetre végződnek, míg eddig egy üres mag állt ebben a helyzetben.

A második fejezetben kifejlesztett elmélet azonban még mindig nem elég gazdag bizonyos típusú problémák megoldására. A lexikális fonológia folyamatai mutathatnak ún. "levezetett környezeti jelenségeket". Ez azt jelenti, hogy bizonyos lexikális folyamatok csak levezetett környezetben mehetnek végbe, monomorfemikus környezetben viszont nem. Ennek megfelelően a Szigorú Ciklus Elvének valamilyen verzióját bele kell építeni az elméletbe. Ezen elv nem-derivációs változatát LEVEZETETT KÖRNYEZETI MEGSZORÍTÁS-nak (LKM) neveztem el, és megsérthetőként fogalmaztam meg. Ez a megszorítás megtilt mindenféle változtatást egy adott analitikus tartományon belül. Azért, hogy elkerülhessük a neutralizáló változásokra való utalást, ami sokkal bonyolultabbá tenné a megszorítás kiértékelését, amellett érvelek, hogy valójában minden lexikális folyamat neutralizáló. Vagyis a Struktúraőrzés Elve az egész lexikonban érvényben van. Néhány reprezentatív példa alapján amellett érvelek, hogy azokról a folyamatokról, amelyek látszólag megsértik a Struktúraőrzés Elvét, független érvek alapján bemutatható, hogy nem tartoznak a lexikális folyamatok közé, hanem vagy ún. szószintű szabályok (Borowsky 1993 terminológiáját követve), vagy posztlexikálisak.

Ezután az általános bevezető után a disszertáció második része, a negyedik, ötödik és hatodik fejezet, a magánhangzó-harmónia jelenségét tárgyalja. A negyedik fejezet a harmonikus jegyek problémájával foglalkozik. Egy adott jegyelmélet annyiféle magánhangzó-harmónia létezését jósolja, ahány (magánhangzós) jegyet az elmélet elfogad. Egy olyan elmélet szerint tehát, mint a kormányzás-fonológia, amely három elemet különböztet meg, az **A**-t, az **I**-t és az **U**-t, kiegészítve a fejség tulajdonságával, négyféle magánhangzó-harmónia létezésére számítunk. A fejezet első részében minden típusból bemutatok egy-egy példát.

Egy ilyen elméletben a [felső] jegynek nincs megfelelője, tehát azt várnánk, hogy zártabbá-válási harmónia nem létezik. A fejezet második részében a spanyol nyelv pasiego dialektusát vizsgálom meg, amelyről azt állítják, hogy pontosan ilyen típusú harmóniát tartalmaz. Én azonban amellett érvelek, hogy megsérthető megszorítások segítségével ez a jelenség is kifejezhető anélkül, hogy az **A** elem hiányára kéne utalnunk. Javaslatom szerint az a megszorítás, amely azt követeli meg, hogy kormányzott pozícióban az elemek kombinációját egy kormányzó **A** elem jogosítsa a PARSE (**A**) megszorítás fölé van rendelve. Ha tehát a kormányzó pozíció nem tartalmaz **A** elemet, akkor a kormányzott pozícióban álló összetett kifejezés elveszti **A** elemét anélkül, hogy az **A** elem hiányára a folyamat kiváltójaként utalni kellene. Másrészt megmutatom, hogy ez a jelenség különbözik a hagyományosan harmóniának tekintett jelenségektől, mert ebben a nyelvben csak azok a magánhangzósorok vannak kizárva, ahol a felső nyelvállású magánhangzó követi a középső nyelvállásút, míg az ezzel ellentétes sorrendűek megengedettek.

Az ötödik fejezet a harmónia tartományával foglalkozik és azzal a kérdéssel, hogy az itt elfogadott elmélet hogyan birkózik meg a diszharmonikus tövek és toldalékok problémájával. A török magánhangzó-harmónia részletes elemzése alapján azt javaslom, hogy a magánhangzó-harmónia tartománya a harmadik fejezetben bevezetett ún. analitikus tartomány. Ezenkívül amellett érvelek, hogy ebben a nyelvben a töveken belül a harmónia már nem aktív folyamat, és ezért találunk olyan sok diszharmonikus tövet. Más szóval, a törökben a magánhangzó-harmónia azok közé a lexikális folyamatok közé tartozik, amelyek levezetetlen környezetben nem mennek végbe. Ezt úgy lehet kifejezni, hogy a harmadik fejezetben bevezetett LEVEZETETT KÖRNYEZETI MEGSZORÍTÁS-t a magánhangzó-harmóniát kiváltó HARMÓNIA megszorítás fölé rendezzük.

A diszharmonikus toldalékokról kimutatom, hogy kétfélék lehetnek: vagy úgy viselkednek, mintha egy összetett szót alkotnának a tővel, vagy pedig nem-produktív derivációs toldalékok és ezért az ún. szintetikus toldalékok kategóriájába sorolhatjuk őket. Az első típusra azért nem alkalmazódik a harmónia, mert ezek a toldalékok külön analitikus tartományt alkotnak, ugyanúgy, mint az összetett szavak részei. A szintetikus típusra pedig azért nem alkalmazódik, mert ezek osztatlan analitikus tartományt alkotnak a tővel, és a fenti érvelés szerint egy analitikus tartományon belül a törökben nem működik a harmónia. Ez azt jelenti, hogy a harmónia csak akkor megy végbe, ha analitikus toldalékokat illesztünk a tőhöz.

A hatodik fejezetben Van der Hulst és Smith (1986) elméletét vizsgálom. E szerint az elmélet szerint a semleges magánhangzók kétféleképpen viselkedhetnek attól függően, hogy milyen elemekből épülnek fel. Ha tartalmazzák a harmonikus jegyet, akkor átlátszóak, mert ilyenkor a harmonikus jegy összefér velük és ezért átterjedhet rajtuk. Ha viszont nem tartalmazzák a harmonikus jegyet, akkor átlátszatlanok, mert a harmonikus jegy nem kapcsolódhat hozzájuk, a harmónia pedig nem ugorhat át egyetlen magánhangzót sem.

Megmutatom, hogy nem mind a két fajta semleges magánhangzó jelenik meg mind a négy fajta harmónia-rendszerben. Javaslatom szerint a nemlétező esetekre az adott magánhangzó-rendszerek alapján lehet magyarázatot találni. Pontosabban szólva azt állítom, hogy összeolvadt tengelyeken elhelyezkedő elemek nem vehetnek részt harmóniában. Ezt a javaslatot úgy is tekinthetjük mint ami annak az autoszegmentális ötletnek az újrafogalmazása, hogy csak külön autoszegmentális tengelyen elhelyezkedő jegyek vehetnek részt hosszútávú függőségi viszonyokban. Ennek következtében **I**- és **U**-harmónia csak olyan magánhangzó-rendszerekben lehetséges, amelyekben vannak elölképzett kerekített hangok. **A**-harmónia és fejrendezés ezzel szemben a háromszög alakú magánhangzó-rendszerekben is megjelenhet. Végül pedig annak a nagyon erős megszorításnak a szerepéről beszélek, amely megtiltja, hogy az **A** elem a fej szerepét töltse be egy szegmentumon belül.

Összefoglalva, ha egy reprezentációs elméletet kombinálunk egyfelől a megszorítások rangsorolásának elméletével, másfelől a fonológiai levezetések elméletével, akkor több olyan jelenséget is kielégítő módon tudunk elemezni, amelyről ezen elméletek külön-külön nem tudnak számot adni. Mivel ezek az elméletek különböző empirikus tartományokat fednek le, senki sem állította, hogy eleve összeférhetetlenek lennének egymással. Eddig azonban azt sem javasolta senki, hogy össze *kellene* őket párosítani.

Summary in English

This dissertation deals with some basic theoretical problems concerning the phenomenon of vowel harmony in a framework combining insights from Government Phonology, Optimality Theory and Lexical Phonology. Vowel harmony is a process whereby all vowels in (roughly speaking) a word are required to agree with each other with respect to one of their properties. For example, in a language with palatal harmony, like Hungarian, every vowel in a word is either front or back. On the one hand, this means that all vowels of polysyllabic roots are either front or back. On the other hand, all affixes containing a vowel have two allomorphs, one with a front vowel and one with a back vowel, the choice of which depends on the root to which the affix is attached (e.g. *város-ba̲n* ‘in a/the city’ vs. *tömeg-be̲n* ‘in a/the crowd’). That is, the vowels harmonise with one another.

This phenomenon is interesting for several reasons for any phonological theory. One of its most challenging aspects is that it looks like a process which operates non-locally, because it ‘skips’ (or disregards) intervening consonants. In a theory like Government Phonology (cf. Kaye, Lowenstamm & Vergnaud 1985, 1990), however, there is an independently motivated level where vowels are in fact adjacent to each other. Since a vowel forms the head of the syllable that contains it, vowels in their function of syllable heads can be projected to a separate level where they can “see” each other. Consonants, on the other hand, cannot be projected in the same way, and this enables us to explain why consonant harmony of a similar sort does not exist. In a theory like this, the claim can be maintained that all phonological processes operate locally. Such a restriction constrains the number of possible grammars considerably, and this is the main reason why I chose to employ the representational theory of Government Phonology in this dissertation.

Apart from this basic problem, research on vowel harmony involves three main areas. The first concerns the question of what types of vowel harmonies exist in the world's languages, and which feature theory can account for this typology in the best way. According to modern theories of phonology, sounds can be divided into smaller ingredients, called distinctive features. Since vowel harmony involves the agreement of vowels within a certain domain with respect to a particular property, or feature, a given feature theory predicts that there are as many possible types of harmony as there are vocalic features recognised by the theory. Feature theories thus can be tested on the basis of whether they make correct predictions about the typology of vowel harmony systems. In this dissertation, I argue that the feature theory of Government Phonology can account for the possible types of harmony.

The second issue concerns the domain of vowel harmony. This domain is usually defined as the "word". One question we need to answer here is whether this domain is defined in terms of morphology or phonology (since members of compounds, for example, constitute separate harmonic spans); and if it is defined phonologically, whether it is a prosodic domain or something else. In this dissertation, I argue for a phonotactic definition of the domain of harmony; more precisely, that it coincides with the analytic domain. Another question concerns the existence of disharmonic roots and disharmonic affixes. The former can be exemplified by the root *kosztüm* 'costume' in Hungarian, and the latter by the suffix *-kor* (cf. *öt-kor* 'at five o'clock', not **öt-kör*). The domain of harmony should be defined in such a way that systematic characteristics of disharmonic strings are accounted for as well.

The third research area concerns neutral vowels. These are those vowels in a given system that do not have a harmonic counterpart. Their neutrality is manifested by the fact that they can co-occur with vowels of both harmonic sets. Affixes containing neutral vowels have only one allomorph, and they do not alternate depending on what type of root they are attached to. Not all neutral vowels behave in the same way, however. On the basis of their behaviour, two main types can be distinguished. One type is called 'transparent', because harmony goes through these vowels as if they were not there. That is, if a suffix vowel follows a stem that ends in a neutral vowel, the suffix vowel will harmonise with the non-neutral vowel to the left of the transparent vowel, so to speak ignoring what is intervening. The other type is called 'opaque', because these neutral vowels stop the harmony. In these cases, the following suffix vowel harmonises with the neutral vowel itself, ignoring what is preceding in the stem. The issue of transparent vowels is connected to the problem of locality mentioned above, because it seems as if harmony had ‘skipped’ the transparent vowels. Van der Hulst & Smith (1986) solve this problem, and they further claim that the two types of behaviour exhibited by neutral vowels can be predicted from the segmental make-up of these vowels themselves. In this dissertation, I test their theory, and show that not all the possibilities predicted by it actually occur in the world’s languages. I propose that it is possible to predict which possibilities do not occur if we take into account certain properties of the vowel systems involved.

To be able to offer a solution for these three problems, I had to take a position concerning some more general issues of phonological theory. This forms the first part of the dissertation. In chapter 2, I argue that considerable advantages can be gained if the framework of Government Phonology is combined with Optimality Theory (cf. Prince & Smolensky 1993). I show that ranking is necessary to be able to account for certain types of phenomena. I use the “principle” of government licensing as an example, which is in conflict with the “principle” of proper government word-internally. Certain languages resolve this conflict in favour of one of the principles, while other languages resolve it in favour of the other. If we accept that ranking of principles (or rather constraints) is necessary, this makes it possible to carry out some further positive changes in the theory. I argue that language variation can now be expressed exclusively by ranking, and consequently the notion of parameters can be abandoned. I illustrate this by replacing the parameter that licenses domain-final empty nuclei by a violable constraint. As a consequence, consonant final words now end in an onset, instead of ending in an empty nucleus.

The theory developed in chapter 2, however, is still not rich enough to solve certain types of problems. Processes of the lexical phonology can show ‘derived environment effects’. This means that they can be restricted to apply only in a derived environment, but not within monomorphemic forms. That is, we need to retain some version of the Lexical Phonological notion of the Strict Cycle Condition. I formulate a non-derivational version of this condition in the form of a violable constraint and call it DERIVED ENVIRONMENT CONSTRAINT. This constraint prohibits changes within a single analytic domain. To avoid having to refer to ‘neutralising’ changes, which would complicate the evaluation procedure of this constraint considerably, I argue that in fact all lexical processes are neutralising. This means that the principle of Structure Preservation is fully adhered to in the lexicon. I show on the basis of some representative examples that processes which are not structure preserving can be argued not to be lexical on independent grounds. They are either 'word level' rules (in the sense of Borowsky 1993), or they are postlexical.

After this general introduction, the second part, comprising chapters 4, 5 and 6, deals with the phenomenon of vowel harmony. In chapter 4, I look at the issue of harmonic features. Given a particular theory of (vocalic) features, we expect as many types of vowel harmony as there are features allowed for by the theory. In an element-based feature theory, such as Government Phonology, where there are only three elements, **I**, **A** and **U**, supplemented by the property of headedness, this means that we expect four types of vowel harmony. In the first part of the chapter, I give an example of each type.

In a theory like this, there is no primitive corresponding to the feature [high], thus we do not expect to find cases of raising harmony. In the second part of the chapter, I discuss the case of Pasiego Spanish that has been argued to exhibit exactly this type of harmony. I argue that it is possible to analyse the process in Pasiego without referring to the absence of the element **A** in a framework that combines the insights of Optimality Theory with those of Government Phonology. I propose a constraint that requires that the combination of elements in a governed position is licensed by a governing **A**. This constraint is ranked above PARSE (**A**). Thus the element **A** will always be deleted from a complex expression, if it is not supported by an **A** in the governing position without having to state this negative condition as the trigger of the process. Moreover, raising is not regarded as the same type of harmony as spreading harmonies, since only sequences of mid vowels followed by high vowels are ruled out by it, and complete uniformity is not required in sequences of non-low vowels.

In chapter 5, I investigate the issue of the harmonic domain, and how disharmonic roots and affixes should be handled in the adopted framework. On the basis of a detailed analysis of Turkish vowel harmony, I propose that harmony applies with reference to the domain introduced in chapter 3, the 'analytic domain'. Furthermore, I argue that vowel harmony is no longer active in Turkish roots, and this is why there are so many disharmonic roots in the language. In other words, vowel harmony is one of those lexical processes that can exhibit derived environment effects. This can be expressed by ranking the DERIVED ENVIRONMENT CONSTRAINT, introduced in chapter 3, above the HARMONY constraint responsible for spreading.

For disharmonic suffixes I claim that they can be of one of the following two types: (i) they either behave as parts of compounds, in this way falling into the category of 'compounding analytic' suffixes; or (ii) they are unproductive derivational suffixes, belonging to the category of 'synthetic' suffixes. The first type of suffixes do not undergo harmony, because they form an analytic domain of their own. The second type of suffixes, on the other hand, form one unit phonologically with the stem they attach to, and harmony does not apply to them for the same reason why it does not apply in non-derived roots. This means that harmony only applies if analytic suffixes are added to the root.

In chapter 6, I test the predictions which the theory proposed by Van der Hulst & Smith (1986) makes concerning the typology of neutral vowels. According to this theory, neutral vowels are expected to behave in one of two ways on the basis of the segmental make-up of these vowels: (i) they either possess the harmonic feature and they are transparent to harmony (since the harmonic feature is compatible with them and thus can spread through them); or (ii) they lack the harmonic feature and they are opaque (because harmony cannot skip any vowels).

I show that not both of these possibilities occur in all types of harmony systems. I propose to account for the non-existent cases on the basis of particular properties of the vowel systems in question. More precisely, I claim that harmony cannot involve those elements that reside on a fused line. This recaptures the original autosegmental idea that only features specified on separate autosegmental tiers can exhibit long-distance dependencies. As a consequence, **I**- and **U**-harmony are only possible in vowel systems that contain front rounded vowels; whereas **A**- and ATR-harmony can occur in triangular systems, as well. Finally, I discuss the role of an apparently very powerful constraint that prohibits the combination of the element **A** with the property of headedness.

In summary, the combination of a theory of representations with a theory of constraint interactions and with a theory of phonological derivations can handle several phenomena in a satisfactory way that cannot be accounted for in either theory when they stand on their own. Since these theories cover different empirical domains, it never has been claimed that they are inherently incompatible. However, it has not been suggested either that they *should* be combined.

Curriculum Vitae

Krisztina Polgárdi was born on 12 March 1968, in Győr, Hungary. She finished secondary school in Arany János Gimnázium, Budapest, in 1986. She received a Master's degree in English and General Linguistics in 1991 at Eötvös Loránd University, Budapest. From September 1991 she had a PhD-scholarship at the Hungarian Academy of Sciences. In 1992 she spent six months in Amsterdam with a Tempus-scholarship, at the Institute of Logic, Language and Information. From 1 January 1993 until 1 June 1998 she has been working on a project on vowel harmony at the Holland Institute of Generative Linguistics (HIL) at Leiden University (first as an *assistent-in-opleiding*, and later as an *onderzoeker-in-opleiding*). This dissertation is the result of that research. As part of her training at HIL, she spent five months at University College London / School of Oriental and African Studies in 1996.

Stellingen

behorende bij het proefschrift

Vowel Harmony

An Account in Terms of Government and Optimality

van

KRISZTINA POLGÁRDI

I.
Government Phonology is compatible with Optimality Theory.
(this dissertation)

II.
There are no parametrically licensed final empty nuclei.
(this dissertation)

III.
Derived environment effects form (part of) the derivational residue in OT. (this dissertation)

IV.
Raising in Pasiego does not require reference to the absence of **A**.
(this dissertation)

V.
The domain of vowel harmony is the analytic domain.
(this dissertation)

VI.
Elements on fused lines do not harmonise. (this dissertation)

VII.
It is bad enough that reference to inaccessible manuscripts is a well-established practice in linguistics. At least reference to non-existent manuscripts should not be accepted.

VIII.
The recent fashion of having secret meetings of the size of a conference only widens the gap between the in-crowd and the rest of the linguistic community. It does not serve any scientific interest.

IX.
Finding a real problem is at least as interesting as finding a solution for that problem. It is a pity that the two are far from being equally appreciated in linguistics.

X.
The eastern border of Europe is defined by the Ural Mountains.