Lowering: the interaction of phonology and morphology in Hungarian

by

Szilárd Szentgyörgyi

József Attila University, Szeged

1998
Acknowledgements

First of all, I owe many thanks to all the linguists who helped me get here. To István Kenesei at JATE University, Szeged, my first linguistics professor, who inspired me not to stop and to go on. To Ádám Nádasdy at ELTE University, Budapest, whose wonderful classes had an indelible effect on me and made me choose phonology for my field. I must thank Cathie Ringen at UI, Iowa City, without whose commitment and careful supervision I would have never been able to achieve anything. This work is at least half hers, except for the errors, of course.

I also thank everyone at the Linguistics Department at the University of Iowa, Iowa City, especially Jerzy Rubach, Jill Beckman, Rosemary Plapp and Olga Petrova, who made my stay there unforgettable and very useful indeed.

I thank the Soros Foundation, whose financial help, grant Nr. 230/290, took a great burden oof my shoulder.

And, most importantly, I thank my parents, my family and Enikő for their patience and understanding that they gave me during my studies and work. Thank you for all this.
# Table of Contents

## Introduction

### 1. Quaternary vowel harmony in a derivational framework

1.1. The data ................................................................................................................. 2

   1.1.1. The Hungarian vowel system ................................................................. 2

   1.1.2. Suffix alternations ............................................................................... 3

      1.1.2.1. Binary alternation ....................................................................... 4

      1.1.2.2. Ternary alternation ..................................................................... 5

      1.1.2.3. Quaternary alternation ................................................................ 6

1.2 A purely phonological analysis ........................................................................... 13

   1.2.1. Backness harmony ............................................................................. 13

   1.2.2. Rounding harmony ........................................................................... 16

   1.2.3. Lowering .............................................................................................. 18

   1.2.4. The status of the rules ......................................................................... 20

1.3. A morphological analysis ................................................................................. 24

## 2. Optimality Theory: constraint hierarchies

2.1. The basic principles of Optimality Theory ....................................................... 26

2.2. Correspondence Theory and Positional Faithfulness ..................................... 30

## 3. An OT analysis of lowering

3.1. Stiebels and Wunderlich's (1998) analysis ....................................................... 43

3.2. Binary and ternary harmony .......................................................................... 46

3.3. Quaternary harmony ...................................................................................... 52

3.4. A morphological analysis ................................................................................. 62

   3.4.1. Suffixes with two underlying forms ....................................................... 62

   3.4.2. Lowering as a morphophonological constraint ..................................... 66

3.5. Conclusion ........................................................................................................ 71
4. Vowel-zero suffix alternations

4.1. The data ......................................................... 73
4.2. Consonant final stems and syllable structure ............... 76
   4.2.1. The data ....................................................... 76
   4.2.2. Stems ending in a single consonant ....................... 78
   4.2.3. Stems ending in consonant clusters ....................... 85
   4.2.4. Geminates .................................................... 89
4.3. Vowel final stems ............................................. 94
   4.3.1. The data ....................................................... 94
4.4. The accusative vs. other quaternary suffixes ............... 97
   4.4.1. Stiebels and Wunderlich's (1998) account ............... 97
   4.4.2. Unstable segments and subsegments in Zoll (1996) ...... 100
      4.4.2.1. Consonant final stems ............................... 102
      4.4.2.2. Vowel final stems .................................... 113

5. Vowel-zero root alternations

5.1. The data ......................................................... 129
5.2. Previous analyses .............................................. 132
   5.2.1. Stiebels and Wunderlich's (1998) analysis ............... 132
   5.2.2. Törkenczy's (1995) analysis ................................ 138
5.3. An analysis with subsegments .................................. 146
   5.3.1. Underlying root nodes .................................... 148
   5.3.2. Underlying subsegments .................................. 152

Conclusion

Bibliography ....................................................... 174
Introduction

Hungarian vowel harmony is one of the most well-described phenomena of its kind. However, almost all analyses concentrate on binary and ternary alternations. Quaternary alternations are either completely ignored or just superficially mentioned in the literature as another kind of vowel harmony. In the present paper my main objective is to shed some light on the peculiarities of such alternations in Hungarian suffixes and their treatment in Optimality Theory (OT) (Prince and Smolensky 1993, McCarthy and Prince 1993). In this work I assume McCarthy and Prince’s (1995) Correspondence Theory of Faithfulness. I will conclude that Hungarian quaternary vowel harmony cannot be described with purely phonological means in OT. This shows that OT is not an unrestricted theory, in which everything can easily be accounted for if the constraints are appropriately formulated.

The structure of the dissertation is the following: first I describe the Hungarian vowel system and the different kinds of alternations found in suffixes with special attention to quaternary alternations. Then I will sketch a purely phonological account of quaternary harmony in the framework of Lexical Phonology (LP). However, this phonological solution requires several assumptions concerning abstract intermediate vowels, adjustment rules, and rule ordering. Then I will give a morphological analysis of quaternary harmony in the same derivational framework. The second chapter introduces a constraint-based theory, Optimality Theory (Prince and Smolensky 1993, McCarthy and Prince 1993), and its latest version, the Correspondence Theory of Faithfulness (McCarthy and Prince 1995). Chapter 3 explores the phonology-morphology interface in
Optimality Theory first giving a short overview of the treatment of binary and ternary harmony in OT proposed by Ringen and Vago (to appear). Based on these I will argue that no purely phonological constraints can account for the phenomenon of quaternary harmony and that an analysis involving morphological features must be assumed. I will argue that as a consequence of the morphological analysis, there is no real quaternary harmony (cf. Vago, 1980) but that quaternary harmony is the result of the interaction of constraints governing binary and ternary harmony and the constraint of Lowering, which refers to the grammatical marking of a morphological class. In chapter 4 I will focus on the alternants of quaternary suffixes lacking a vowel. This treatment is based on Zoll’s (1996) distinction between segments and subsegments. Chapter 5 extends the treatment of suffix vowel-zero alternations to the same kind of alternations in roots.

1. Quaternary vowel harmony in a derivational framework

1.1. The data

1.1.1. The Hungarian vowel system

<table>
<thead>
<tr>
<th>(1)</th>
<th>Front</th>
<th>Back</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-round</td>
<td>+round</td>
</tr>
<tr>
<td></td>
<td>short</td>
<td>long</td>
</tr>
<tr>
<td>High</td>
<td>i [i]</td>
<td>í [i:]</td>
</tr>
<tr>
<td>Mid</td>
<td>é [e:]</td>
<td>ö [Ø:]</td>
</tr>
<tr>
<td>Low</td>
<td>e [ɛ]</td>
<td></td>
</tr>
</tbody>
</table>
The Hungarian vowel inventory consists of 14 vowels, 7 short-long pairs as in (1). Front
non-low unrounded vowels are considered to be neutral with respect to vowel harmony,
the rest of the vowels are considered harmonic\(^1\). The main reason for considering [e] to
be harmonic are the facts that there are no non-alternating suffixes with this vowel, as
opposed to [e:], [i], e.g. -ért and -ig\(^2\) and that there are no antiharmonic roots containing
only this vowel, but there are antiharmonic roots with the neutral vowels [e:] and [i], e.g.
[hi:d] and [t^e:l]\(^3\).

1.1.2. Suffix alternations

The literature usually divides the Hungarian vowel harmony phenomena into two
major groups: root and suffix harmony. Native Hungarian roots contain either all back or
all front vowels, although neutral vowels freely cooccur with either. Recent loan words
sometimes violate root harmony and contain both front harmonic and back harmonic
vowels, e.g. [ot:itüd] 'attitude', [röno:] 'Renault\(^4\).

Hungarian suffix vowel harmony consists of three related phenomena, binary,
ternary, and quaternary harmony, i.e. suffixes with two, three, and four surface alternants
respectively. However, only binary and ternary harmony are addressed at great length in

---

1 Ringen (1975, 1978, 1980), Hulst (1985), and Steriade (1987), among others, treat [e] as harmonic. For
empirical evidence that [e] is harmonic see Ringen and Kontra (1988).
2 There are no non-alternating suffixes with [i:] either.
3 For antiharmonic roots see 1.1.2.1. on backness harmony.
4 There are some words that vacillate between choosing front or back suffixes. These words contain a back
vowel (or vowels) followed by one or more neutral vowels: Ágnes+nak/Ágnes+nak 'proper name'DAT.
Such stems fall out of the scope of this paper. A possible analysis in OT can follow the argumentation given
for vacillating Finnish loanwords in Ringen (1998). Ringen's analysis uses different permutations of
unranked constraints to account for the actual percentages of occurrence of back and front suffixes.

3
the literature. Kornai (1987) treats all three kinds of harmony as related phenomena governed by the same rules. His approach is purely phonological, in contrast to Vago's (1980), whose rules accounting for binary and ternary harmony are phonologically conditioned as opposed to the morphologically conditioned rules of quaternary harmony. In this paper I will claim that Vago's approach provides a valuable insight to the phenomenon, i.e. that there is no real quaternary harmony in Hungarian, but that Kornai's analysis provides the relevant generalizations missed by Vago as far as the morphological classes of quaternary alternations are concerned.

The facts of Hungarian suffix vowel harmony are given below for binary, ternary, and quaternary suffixes respectively:

1.1.2.1. Binary alternation

(2) -nok/-nek Dative

<table>
<thead>
<tr>
<th>Back⁵/nok</th>
<th>Front</th>
<th>Back+Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>kor+nok</td>
<td>fej+nek 'head'</td>
<td>roди:r+nok 'eraser'</td>
</tr>
<tr>
<td>ha:z+nok 'house'</td>
<td>ke:z+nek 'hand'</td>
<td>bo:be:r+nok 'laurel'</td>
</tr>
<tr>
<td>kor+nok 'age'</td>
<td>kör+nek 'circle'</td>
<td>póli+nok 'Paul dim.'</td>
</tr>
<tr>
<td>kor+r+nok 'illness'</td>
<td>bör+nek 'skin'</td>
<td>kotfi+nok 'cart'</td>
</tr>
<tr>
<td>ju:k+nok 'hole'</td>
<td>sirt+nek 'cliff'</td>
<td>buji+nok 'panty'</td>
</tr>
<tr>
<td>ku:t+nok 'well'</td>
<td>vi:z+nek 'water'</td>
<td>put'e:r+nok 'naked'</td>
</tr>
<tr>
<td>hi:d+nok 'bridge'</td>
<td>fült+nek 'roast'</td>
<td>ho:he:r+nok 'hangman'</td>
</tr>
<tr>
<td>t'se:l+nok 'goal'</td>
<td>tü:z+nek 'fire'</td>
<td>fog'e:r+nok 'single'</td>
</tr>
</tbody>
</table>

As we can see, stems with back vowels always take back suffixes and generally stems with front vowels take front vowel suffixes as do stems with only neutral vowels,

---


⁶ Besides back vowel roots, antiharmonic roots with neutral vowels are also shown.
e.g. [keːz], [viːz], and [sirt] in the second column. However, there are about 60, so-called antiharmonic, front vowel stems in Hungarian that take back suffixes, like [hiːd] and [tʰeːl] in the first column. Polysyllabic native roots select suffixes with harmonic vowels according to the backness of the harmonic vowels of the root, *béraː+t+nők* 'friend', while loanwords select the alternant according to the backness of the last harmonic vowel of the root, *[őːtːitːːdːnek]*, *[rőːnːőːk]*. If, however, a back vowel or a sequence of back vowels is followed by a neutral vowel, the suffix will have a back vowel showing that neutral vowels are transparent to backness harmony.

1.1.2.2. Ternary alternation

(3) -hoz/-hez/-höz Allative

<table>
<thead>
<tr>
<th>a.) Back</th>
<th>b.) Front unrounded</th>
<th>c.) Front rounded</th>
<th>d.) Back+Neutral</th>
</tr>
</thead>
<tbody>
<tr>
<td>kor+höz 'arm'</td>
<td>féj+hez 'head'</td>
<td>kor+höz 'circle'</td>
<td>rődiːːr+höz 'eraser'</td>
</tr>
<tr>
<td>haːz+höz 'house'</td>
<td>keːz+hez 'hand'</td>
<td>bőːr+höz 'skin'</td>
<td>bőːbeːr+höz 'laurel'</td>
</tr>
<tr>
<td>kor+höz 'age'</td>
<td>sirt+höz 'cliff'</td>
<td>jűlt+höz 'roast'</td>
<td>poliː+höz 'Paul dim.'</td>
</tr>
<tr>
<td>koːr+höz 'illness'</td>
<td>viːz+hez 'water'</td>
<td>tűz+höz 'fire'</td>
<td>kotʃiː+höz 'cart'</td>
</tr>
<tr>
<td>juk+höz 'hole'</td>
<td></td>
<td></td>
<td>buːjiː+höz 'panty'</td>
</tr>
<tr>
<td>kuːt+höz 'well'</td>
<td></td>
<td></td>
<td>putʃːːr+höz 'naked'</td>
</tr>
<tr>
<td>hiːd+höz 'bridge'</td>
<td></td>
<td></td>
<td>hoːheːːr+höz 'hangman'</td>
</tr>
<tr>
<td>tʃeːːl+höz 'goal'</td>
<td></td>
<td></td>
<td>fotsːːr+höz 'single'</td>
</tr>
</tbody>
</table>

Ternary harmony only differs from its binary counterpart with front vowel roots.

The choice of a back or front ternary suffix is governed by the same rules or constraints.

---

7 For the behaviour of with words with back vowels followed by one or several neutral vowels see Ringen and Kontra (1988).
as in binary suffixes. Stems that take the back alternant of a binary suffix, i.e. back vowel stems, antiharmonic stems and stems with sequences of back vowels followed by a neutral vowel, take the back alternant of a ternary suffix, too (see 3.a, 3.d). Front roots fall into two groups based on the final vowel of the root: roots with a final rounded front vowel take the front rounded alternant, cf. (3.c), while roots with a final front unrounded vowel, whether harmonic or not, i.e. [i], [i:], [e:] vs. [e], take the front unrounded alternant, cf. (3.b). Disharmonic loans behave exactly the same way as native roots.

1.2.2.3. Quaternary alternation

There is a gap in the Hungarian suffix system closely connected with harmony. In Hungarian we find the following vowel alternations in alternating suffixes: ɔ/e, aː/eː, ɔː/øː, u/ü, uː/üː; ɔ/ø, ɔ/ø/ø. The front high unrounded vowels i/i do not alternate with any other vowels since they do not have back counterparts. The only pair missing is thus ɔ/ø, which only occurs in a highly unproductive derivational suffix (ügy-ügynők 'case/agent', fő-főnők 'head/boss', mér-mérnők 'measure/engineer', hír-hírnők 'message/messenger', gond-gondnok 'care/caretaker', szó-szónok 'word/orator', lát-látnok 'see/seer'). Most of these suffixed forms have already been lexicalized and thus we can claim that there is no pure ɔ/ø alternation in suffixes. This gap is filled by ternary suffixes as we will see. Ternary harmony involves the same mechanism as binary harmony

---

8 Back high unrounded vowels never appear on the surface. Vago (1980) proposes an underlying inventory with back unrounded vowels, both mid and high, but since any evaluation in OT is based on the surface form, these vowels must be prevented from appearing in any optimal candidate even if they were included in the input. Also, Kiparsky's (1972) Alternation Condition prevents us from positing abstract
intertwined with a roundness alternation. As we will see below, quaternary alternations differ from ternary harmony in that they involve the phenomenon of lowering, a result of adding quaternary suffixes to members of a morphological class, the so-called lowering stems.

(4) -ök/-ök/-eök/-ök Plural

<table>
<thead>
<tr>
<th>Back</th>
<th>Front</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>kör+ök 'arm'</td>
<td>foöl+ök 'wall'</td>
</tr>
<tr>
<td>bar+ök 'bar'</td>
<td>ha:z+ök 'house'</td>
</tr>
<tr>
<td>kor+ök 'age'</td>
<td>hold+ök 'moon'</td>
</tr>
<tr>
<td>kor+r+ök 'illness'</td>
<td>lov+ök 'horse'</td>
</tr>
<tr>
<td>rum+ök 'rum'</td>
<td>juk+ök 'hole'</td>
</tr>
<tr>
<td>bu:r+ök 'Boer'</td>
<td>ku:t+ök 'well'</td>
</tr>
<tr>
<td>hi:d+ök 'bridge'</td>
<td></td>
</tr>
</tbody>
</table>

As we can see in the upper chart containing back roots in (4), one of the differences between the ternary and quaternary suffixes is that there are two different back alternants of the plural suffix, a quaternary suffix: a mid alternant, i.e. -ök, and a low representations that are very “far” from the actual surface forms, i.e. they never appear in any surface realisation of the morpheme.

9 Note that the affiliation of the vowels of quaternary suffixes has always been unclear. They may be treated as part of the suffix, as part of the stem, or as a separate constituent, i.e. a linking vowel, between the stem and the suffix. However, the quality of the vowel must be determined by principles of vowel harmony regardless of which of the above approaches we take. In the present analysis nothing hinges upon the status of the suffix vowel.

Also, quaternary suffixes have a surface variant without a vowel after stems ending in vowels. Such cases are not considered here since no vowel harmony is involved.
alternant, i.e. -ők. A similar distinction can be drawn in the case of front alternants: we find a mid, i.e. -ők, and a low, i.e. -ünk, alternant. However, while the back alternants only differ in height, the front alternants also differ in roundness, a phenomenon already observed in ternary harmony. Hence, one would be tempted to think of quaternary suffixes as ternary ones with an extra alternant. It cannot be done that way since, oddly enough, roots can be partitioned into five classes instead of the three classes that we saw with ternary suffixes. Members of two groups out of the five, i.e. members of groups III and IV, take the same suffix, but for different reasons as I will argue\textsuperscript{10}.

Roots in Group I take the back mid alternant of quaternary suffixes. As can be seen from the data above, the same vowels, including neutral vowels as well, can be found in these roots as in stems that take the back alternant of the binary and ternary suffixes. The same is true of Group II, in which we find roots taking the back low alternant. Because of the overlap in root vowel quality in the two groups\textsuperscript{11} it seems most reasonable that roots fall into two discrete morphological classes. Although Group II contains a large number of roots\textsuperscript{12}, it is still much smaller than Group I, which also contains all recent loanwords and nonce words taking back quaternary suffixes. We also have to note that all foreign words fall into Group I when used in Hungarian discourse. Thus we can conclude that Group I is the default; hence Group II, being anomalous, must be marked in the lexicon somehow.

\textsuperscript{10} The partition of stems is based upon Kornai (1987).
\textsuperscript{11} It would be unreasonable to suppose that the choice of the suffix is governed by the consonants in the root. Also, all kinds of consonants are found in roots in both classes.
\textsuperscript{12} Cf. Kornai (1987)
Front stems are divided into three groups in the above chart although there are only two front alternants of quaternary suffixes. Of these three groups, two are unmarked and one is marked together with Group II. Roots in Groups III and V behave in the same way as they do with ternary suffixes: they select the appropriate suffix based on backness and then choose the one with the roundness value matching the last vowel of the stem: stems with final rounded vowels select \(-\text{\textael}k\), those with final unrounded vowels select \(-\text{\textael}k\). There is nothing unusual about their behaviour. However, roots in Group IV behave differently: they take front rounded ternary suffixes but front unrounded quaternary suffixes. This phenomenon can be accounted for in two ways since\(^1\) the suffix vowels [\(\text{o}\)] and [\(\text{e}\)] differ in two features, \([+/-\text{low}]\) and \([+/-\text{round}]\): we can either claim that this group is marked for taking unrounded quaternary suffixes or that, being anomalous the same way as stems in II, it is marked for taking low quaternary suffixes. Since we have already seen that Group II is marked as taking \([+\text{low}]\) quaternary suffixes\(^{13}\), it is most reasonable to propose the same kind of markedness for Group IV based on Occam's Razor.

We should note however, that there is an alternative treatment of front roots in the case of quaternary harmony. Groups III and IV can be merged into one on the basis of their quaternary suffix choice. In this case, we would have to mark this new broader group for taking the low front suffix variant. Such a solution would increase the complexity of the grammar since on the one hand more words would have to be marked in the lexicon, on the other hand there would be two different diacritic features marking stems taking low quaternary suffixes: one for front and another one for back roots. It

\(^{13}\) The lowering class cannot be marked for taking quaternary suffixes with unrounded vowels since the vowels in both the back mid and the back low variants of quaternary suffixes are rounded.
would not provide additional insights or advantages as opposed to the five-way partition in (10) either. Thus the partition in (10) is preferred by Occam's Razor again\textsuperscript{14}.

Thus we can conclude that stems in Groups II and IV, constituting a grammatically marked class of stems called "lowering stems" as opposed to the unmarked stems shown in Groups I, II, and V, behave differently when taking quaternary suffixes. For this reason this class must be marked in the lexicon.

Next consider stems with multiple suffixes, plural and accusative:

\begin{equation}
(5)
\begin{array}{lll}
\text{kör+ok+ôt 'arm'} & \text{fő+ok+ôt 'wall'} \\
\text{kor+ok+ôt 'age'} & \text{hold+ok+ôt 'moon'} \\
\text{rum+ok+ôt 'rum'} & \text{juk+ok+ôt 'hole'} \\
\text{ʒi:r+ok+ôt 'fat'} & \text{hi:d+ok+ôt 'bridge'} \\
\text{fej+ek+et 'head'} & \text{kör+ôk+et 'circle'} \\
\text{szirt+ek+et 'cliff'} & \text{sült+ek+et 'roast'} \\
\text{kojiv+sk+et 'book'} & \text{kür+t+ok+et 'horn'}
\end{array}
\end{equation}

As can be seen in (5), only two variants of the quaternary accusative suffix, both low, occur after the quaternary plural suffix, independent of whether the stem being lowering or not. This phenomenon can be explained by claiming that not only roots but also suffixes may be lowering. Note that if we analyse all the above low suffixes as a result of being attached to a lowering root, then we cannot explain why we find the low

\textsuperscript{14} Additional evidence is provided by vacillating stems like Ágnes [aːɡnɛʃ] 'Prop.name', which sometimes take front, sometimes back suffixes. This particular word vacillates with all three kinds of alternating suffixes: Ágnesnak/Ágnesek, Ágneshez/Ágneshez, Ágnesok/Ágnesek. In the binary and ternary case this stem vacillates between selecting the front or back alternant; besides, the roundness value of the ternary suffix must match that of the last vowel of the stem, hence we get -hez. The same happens with quaternary suffixes: when the stem selects the back variant, it selects for the mid back vowel showing that it is not a lowering stem. If we assume that it is not a lowering stem even if it selects the front variant, then the same mechanism of roundness adjustment takes care of the suffix vowel choice. This way we are not forced to
variants of the accusative after a non-lowering root plus plural sequence. The low quality of the accusative thus must originate in the preceding suffix. Thus based on the data in (5) we can argue that not only stems but also suffixes may belong to the marked class of lowering morphemes.

In another closely related phenomenon we can see that some suffixes block lowering:

(6) a. mogof  mogof+ot  'tall'
    b. mogof+[aːg]  mogof+[aːg]+ot  'height'

The data in (6.a) shows that [mogof] 'tall' is a lowering stem, i.e. it belongs to the marked class, i.e. Group II, and thus takes a back low quaternary suffix. However, the suffixed form [mogof+[aːg]] 'height' in (6.b) takes the back mid alternant, showing that [mogof+[aːg]] is not a lowering stem, i.e. it belongs to the unmarked class, Group I, or rather that the nominal suffix [-[aːg]/[-eːg]], which creates an abstract noun out of a noun or an adjective is a non-lowering morpheme, hence belonging to Group I. I did not include any front stems displaying similar behaviour to that in (6) because the lowering of the quaternary suffix and regular quaternary harmony, i.e. selecting the backness and roundness value of the last vowel in the stem, i.e. the eː in [-eːg], would result in the same output, i.e. a front low unrounded vowel, thus providing no argument either for or against our analysis.

claim that such stems are non-lowering, i.e. regular or unmarked, when selecting for back quaternary suffixes but they are lowering, i.e. they belong to a marked class, when selecting the front alternant.
To sum up the data presented, we can say that binary suffixes alternate in backness, ternary suffixes alternate in backness and roundness\textsuperscript{15}, and quaternary suffixes alternate in backness, roundness and height\textsuperscript{16}. Based on the above examples I conclude that morphemes belong either to the grammatically marked class of lowering morphemes or that of the unmarked non-lowering, or regular, normal morphemes as far as quaternary suffixation is concerned. Unfortunately, marking the morphemes for being lowering is not enough to ensure that quaternary suffixation yields the right results for it is not all suffix vowels that are lowered following a lowering stem, it is only quaternary ones. Thus the underlying representation of quaternary suffixes must be different from that of ternary and binary suffixes, preventing them from being lowered after lowering morphemes, a kind of grammatical marking once again. This marking may be achieved by diacritics, underspecification or rule exception features.

\textsuperscript{15} Binary suffixes like bon/ben also alternate in roundness but it has nothing to do with the quality of the stem vowels. It is just a reflex of the vowel inventory of the language.

\textsuperscript{16} Some of the binary and ternary suffixes also alternate in height, like na:l/ne:l and hoz/h\v{e}z/h\=oz but we can again claim that the height alternation follows from facts of the inventory.
1.2. A purely phonological analysis

In this section, I will sketch a possible derivational treatment of vowel harmony\(^{17}\) in the framework of lexical phonology with special focus on quaternary harmony to show that such a treatment is possible in derivational theories.

1.2.1. Backness harmony

All alternating suffixes alternate in backness: suffix vowels are usually back if the last harmonic vowel of the stem is back, but front if the last harmonic vowel of the stem is front. Antiharmonic stems like [hiːd] 'bridge' take back suffixes despite the fact that they contain neutral vowels only. I adopt Ringen's (1988) analysis of backness harmony\(^{18}\) here. Ringen (1988) claims that backness harmony is best analyzed if we assume the following underlying representations for the Hungarian vowels:

(7)

<table>
<thead>
<tr>
<th></th>
<th>i</th>
<th>e</th>
<th>õ</th>
<th>u</th>
<th>o</th>
<th>ɔ</th>
<th>ü</th>
<th>ð</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>low</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>back</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>round</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^{17}\) A derivational treatment of all kinds of harmony is given in Kornai (1987, 1994) but he assumes, as opposed to several other researchers, that segments may be specified for the same feature on at least two different tiers: the feature tier and the skeletal tier or core. My analysis will not make use of this extra machinery.

Then the following redundancy rules must apply to fill in the blanks:

\[(8)\]

a. \( [+\text{low}] \rightarrow [-\text{high} \quad +\text{round}] \)
b. \( [\quad] \rightarrow [+\text{round}] \)
c. \( [\quad] \rightarrow [-\text{low}] \)
d. \( [-\text{round} \quad -\text{low}] \rightarrow [-\text{back}] \)
e. \( [\quad] \rightarrow [+\text{back}] \)
f. \( [\quad] \rightarrow [+\text{high}] \)

Backness harmony spreads the feature \([-\text{back}]\) to the right:

\[(9)\]

\([-\text{back}]\)

\[
\begin{array}{c}
\text{V} \\
\text{V}
\end{array}
\]

This way, in front harmonic roots and roots with only neutral vowels, except antiharmonic roots, the underlying floating \([-\text{back}]\) feature\(^{19}\) spreads to the root vowels and the suffix vowel. Of course, the rule of backness harmony must precede the redundancy rule in (8.e):

\[(10)\] \[\text{öörömsk}\]

\[
\begin{array}{c}
\text{V} \\
\text{r} \\
\text{V} \\
\text{m+n} \\
\text{V} \\
\text{k}
\end{array}
\]

\[
\begin{array}{c}
[-\text{high}] \\
[-\text{high}] \\
[+\text{low}]
\end{array}
\]

---

\(^{19}\) Ringen assumes, after Pulleyblank (1986), that floating autosegments are linked one-by-one left-to-right by the Universal Association Convention.
Back harmonic roots contain no [-back] autosegment and neither do mixed roots. Surface back vowels receive their backness from the redundancy rule in (8.e) and so do neutral vowels following back vowels in mixed roots.

Surface back vowels receive their backness from the redundancy rule in (8.e) and so do neutral vowels following back vowels in mixed roots.

\[
(11) \text{a. [ha:znôk]} \quad \begin{array}{c}
\text{h} \quad V \quad V \quad z+n \quad V \quad k \\
\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\
\text{[+low]} \quad \text{[+low]} \quad \text{[+low]} \\
\text{[+back]} \quad \text{[+back]} \quad \text{[+back]}
\end{array}
\rightarrow 
\begin{array}{c}
\text{h} \quad V \quad V \quad z+n \quad V \quad k \\
\downarrow \\
\text{[+low]} \quad \text{[+low]} \quad \text{[+low]} \\
\text{[+back]} \quad \text{[+back]} \quad \text{[+back]}
\end{array}
\]

\[
b. \text{[rôdi:nôk]} \quad \begin{array}{c}
\text{r} \quad V \quad d \quad V \quad V \quad r+n \quad V \quad k \\
\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\
\text{[+low]} \quad \text{-round} \quad \text{[+low]} \\
\text{[+back]} \quad \text{[+back]} \quad \text{[+back]}
\end{array}
\rightarrow 
\begin{array}{c}
\text{r} \quad V \quad d \quad V \quad V \quad r+n \quad V \quad k \\
\downarrow \\
\text{[+low]} \quad \text{-round} \quad \text{[+low]} \\
\text{[+back]} \quad \text{[+back]} \quad \text{[+back]}
\end{array}
\]

Disharmonic roots contain both front and back harmonic vowels. If the last vowel is a front harmonic vowel, then everything works the same way as in front harmonic stems except that underlyingly the [-high] feature is linked to the last vowel. This way it cannot link to the other stem vowels.

\[
(12) \text{[jôfô:mêk]} \quad \begin{array}{c}
\text{f} \quad V \quad V \quad r+n \quad V \quad k \\
\downarrow \quad \downarrow \quad \downarrow \\
\text{[+low]} \quad \text{[+low]} \quad \text{[+low]} \\
\text{[+back]} \quad \text{[+back]} \quad \text{[+back]}
\end{array}
\rightarrow 
\begin{array}{c}
\text{f} \quad V \quad V \quad r+n \quad V \quad k \\
\downarrow \\
\text{[+low]} \quad \text{[+low]} \quad \text{[+low]} \\
\text{[+back]} \quad \text{[+back]} \quad \text{[+back]}
\end{array}
\]

\[20\text{ We have to assume that (8.c) applies before (8.d) to establish a feeding relationship and thus filling in the correct [-back] feature for neutral vowels.}\]
If, however, the last harmonic vowel in a disharmonic root is back, the [-back] feature can only be linked to the first vowel. We can assume that since it is underlyingly linked to a vowel, the UAC will not be applied. Thus the rule of backness harmony cannot apply within the root since it is not a derived environment\textsuperscript{21}. To prevent the rule of backness harmony from spreading [-back] to the suffix vowel Ringen (1988) refers to Archangeli and Pulleyblank's (1987) Locality Condition, according to which a rule can only apply if a specified target is adjacent to a specified trigger. Thus the rule in (7) cannot apply in a word like [rōno:nōk] for two reasons: it cannot apply within the root because of the root not constituting a derived environment, and it cannot apply to the suffix vowel because it is not adjacent to the trigger, i.e. the first vowel of the root.

We can conclude that the above rules can account for backness alternations in binary, ternary, and quaternary suffixes. Now we turn to roundness alternations.

1.2.2 Rounding harmony

Rounding harmony is only found in ternary and quaternary alternations (cf. (3) and (4)), where stems ending in front vowels select the suffix variant based on the roundness values of the stem final vowel. (This is further complicated by the phenomenon of lowering, a problem addressed in 2.3.). Roundness alternations arise as a result of spreading [-round] as shown in rule (13) below.

\textsuperscript{21} Note that in front harmonic roots the [-back] feature is not linked to the vowels. This way the UAC creates a derived environment and hence backness harmony can apply within the root.

16
This rule affects short front mid vowels, i.e. only /o/, if preceded by an unrounded vowel. This rule correctly predicts that if a ternary suffix is preceded by a root with a final front unrounded vowel, the suffix vowel will surface as front unrounded. This requires that (13) precede the redundancy rule in (8.b) and that (9) precede (13). There are stems containing front unrounded vowels followed by front rounded vowels, e.g. [dizö:z] 'diseuse'; in such roots (13) incorrectly predicts unrounding of the rounded vowel, i.e. *[dize:z]. We can avoid this problem by assuming that the Locality Condition is observed by the rule of roundness harmony as well. The application of rounding harmony is illustrated in (14) below:

For the rule in (13) to apply only to ternary and quaternary suffixes it has to be ordered with respect to the other rules as (8.a) > (8.c) > (9) > (8.d) > (8.e) > (8.f) > (13) >

---

22 Note that the rule in (13) results in a short front unrounded mid vowel, /e/. This vowel, since it never occurs on the surface, is then lowered by an adjustment rule. Another adjustment rule is needed for providing the correct surface roundness value for /e/. Also, in roots like [rodi:r] the result of backness and rounding harmony will be a suffix with a back vowel since the neutral vowel is skipped by backness harmony and thus rounding harmony cannot apply since the suffix vowel will be [+back].
(8.b). I will show the way the rules work in a derivation in section 2.4 after we have taken a look at the phenomenon of lowering in the next section.

1.2.3 Lowering

The phenomenon of lowering only occurs with quaternary suffixes as we have already seen above. Assume that lowering morphemes have a floating [+low] feature that may link up to a following vowel if that is unspecified for the feature [low]. To be able to restrict the rule of lowering to quaternary suffixes only, the representation of these suffixes must be different from the rest of the suffixes at the stage when the rule of lowering applies, so that lowering cannot apply to ternary or binary suffixes. Thus I assume that all suffixes are specified for height underlyingly except for quaternary suffixes, which are only specified as [-high], i.e. their specification for the feature [low] is missing. A rule of lowering, (15) links up a floating [+low] feature of a morpheme to a following vowel:

---

23 An account of the phenomenon of lowering can be found in Kornai (1987), Nádasdy and Siptár (1994), and Polgardi and Rebrus (1997). While Kornai’s (1987) account makes use of specification for a feature on two different tiers, Nádasdy and Siptár’s (1994) analysis cannot account for the fact that the floating [+low] of lowering quaternary suffixes like the plural cannot dock on the suffix vowel itself, yielding the incorrect result *[botok] instead of the correct [botok].

24 This assumption is reasonable given that suffixes usually do not alternate in height. The only exceptions in addition to quaternary suffixes are the suffixes containing a/e: alternations. I assume that these suffixes are underlyingly specified as [+low] and another adjustment rule turns the long front low vowel into a mid vowel.

25 I assume that all vowels are underlyingly specified for the feature [low] except for the vowels in quaternary suffixes and that the rule in (15) only applies in a feature filling fashion.
The rule\textsuperscript{26} in (15) applies to any sonorant that has the first dorsal node in a morpheme and is specified as [-high]. Since there are neither disyllabic suffixes with both vowels having four surface alternants nor disyllabic suffixes with the second vowel having four alternants, our lowering rule correctly targets only the first vowel of a quaternary suffix. In Hungarian, the only sonorant consonant having a dorsal node is [ŋ] but since it is specified as [+high], the rule will not affect it\textsuperscript{27}. Thus the rule only applies to non-high vowels.

Now I will turn to the status and ordering of the above rules and show how they interact in a derivation.

\textsuperscript{26} The lowering rule has to precede the redundancy rule in (8.b).
\textsuperscript{27} We should also note, that the velar nasal being an allophone of the alveolar nasal only occurs in pre-velar positions. This allophony is a result of a late allophone rule. If the rule of lowering precedes the nasal allophonic rule, and it does, then it could not affect the velar nasal anyway. Alternatively, if vowels have not a DORSAL node but a V-PLACE node, then the rule in (15) would target the first V-PLACE node.
1.2.4 The status of the rules

The words in (16) show how the floating [+low] features dock on the suffix vowels unspecified for [low].

(16) a. \(-L +L\)
    rum + ok + ot

    b. \(-L\)
    rum + ot

    c. \(-L +L\)
    rum + ok

    d. \(+L +L +L\)
    ha:z + ok + ot

    e. \(+L +L\)
    ha:z + ot

    f. \(+L +L +L\)
    ha:z + ok

(16a) and (16c) show that the floating [+low] feature of the plural suffix can never dock on the plural suffix itself; it can only link up to a following suffix unspecified for the feature [low], i.e. another quaternary suffix as predicted by the rule of lowering in (15).

It is clear from the above data that Lowering applies in a cyclic fashion. This is shown by the derivations in (17):

(17)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle 1 WFR</td>
<td>+L ha:z+Vk</td>
<td>+L ha:z+Vt</td>
<td>+L bob+Vk</td>
<td>+L bob+Vk</td>
<td>+L mogoj+Vt</td>
<td>+L mogoj+ja:g</td>
</tr>
<tr>
<td>Lowering</td>
<td>ha:z+ok</td>
<td>ha:z+ot</td>
<td>-</td>
<td>-</td>
<td>mogoj+ot</td>
<td>-</td>
</tr>
<tr>
<td>Cycle 2 WFR</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>bob+Vk+Vt</td>
<td>-</td>
<td>mogoj+ja:g+Vt</td>
</tr>
<tr>
<td>Lowering</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>bob+Vk+ot</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Phonetic Representation</td>
<td>[ha:zok]</td>
<td>[ha:zot]</td>
<td>[bobok]</td>
<td>[bobokot]</td>
<td>[mogojot]</td>
<td>[mogoj:a:got]</td>
</tr>
</tbody>
</table>

20
The data in (18) shows that either the same is true of backness and roundness spreading\(^{28}\), or that they are iterative\(^{29}\):

\[(18)\]

a. \(\text{bora:t}+\text{A:g+nAk} \quad \text{bora:tja:gn\text{\text{\text{\text{\text{\text{}}}n}}}k \quad \text{friend+ship+DAT}'\)

\(\text{huij\text{\text{\text{\text{\text{}}}e}}}+\text{A:g+nAk} \quad \text{huij\text{\text{\text{\text{\text{}}}e}}}gn\text{\text{\text{\text{\text{}}}n}k \quad \text{stupid+ity+DAT}'\)

b. \(\text{vo}g+dO\text{\text{\text{\text{\text{}}}j+nOn}^{30}} \quad \text{vo}gdo\text{\text{\text{\text{\text{}}}j+nOn} \quad \text{cut+into pieces+3\text{rd sg.IMP}'\)

\(\text{l\text{\text{\text{\text{\text{}}}o}k+dO\text{\text{\text{\text{\text{}}}j+nOn} \quad \text{l\text{\text{\text{\text{\text{}}}o}kdo\text{\text{\text{\text{\text{}}}j+nOn} \quad \text{push+keep+3\text{rd sg.IMP}'\)

\(\text{te:p+dO\text{\text{\text{\text{\text{}}}j+nOn} \quad \text{te:pde\text{\text{\text{\text{\text{}}}j+nOn} \quad \text{tear+into pieces+3\text{rd sg.IMP}'\)

The words in (18a) constitute the evidence for the cyclic or iterative application of backness spreading. Either the first suffix is added and then the last backness specification of the stem spreads to the suffix vowel and then the same process is performed on each consecutive cycle after the application of WFRs (if the suffix vowel is unspecified for backness) or backness spreading applies iteratively to all suffix vowels after all the suffixes are added.

(18b) contains examples that argue for the same in the case of roundness spreading. In third example in (18b) the [-round] specification of the stem vowel spreads

\(^{28}\) 'A' represents a short low vowel unspecified for backness and roundness, 'A:' represents a long low vowel unspecified for backness, and 'O' represents a short rounded mid vowel unspecified for backness.

\(^{29}\) I assume that Stray Erasure does NOT apply at the end of each cycle but only at the end of the components of grammar. Note that I do not include the rules of backness and roundness harmony here since they are not relevant to the matter discussed.

\(^{30}\) The initial [j] of the imperative suffix undergoes assimilation to a preceding strident fricative or affricate.
to the suffixes (after backness spreading applied), and it turns the suffix vowels to /e/. Then the vowels are adjusted to a low front vowel.

Thus we can conclude that lowering is cyclic and that the other two harmony rules are either cyclic or at least iterative, and that they are followed by the adjustment and default rules. As for the ordering of the harmony rules, we saw that backness spreading must precede roundness spreading. Since the rule of Lowering does not mention either of the features affected by the other two rules, and neither do the other two rules mention floating [+low] features, we cannot set up an ordering relationship between lowering and the other two rules if they are all cyclic. Of course, if lowering is cyclic and the other two are not, then lowering precedes the other harmony rules because of the ordering of the postcyclic component of grammar after the cyclic component.

Adjustment rules follow harmony rules since they adjust the output of harmony rules. The derivations in (19) show a possible ordering of the rules:\(^\text{31}\):

---

\(^{31}\) The adjustment rules determining the correct surface roundness of /ɔ/, and the surface height of /e/ in ternary and quaternary suffixes are not shown in the derivation.
To sum up, in this section I have sketched a possible analysis that does not rely on morphological classes; it treats all three kinds of harmony in a purely phonological fashion. The great disadvantages of this analysis are however, that it allows, and in fact requires intermediate abstract vowels in the course of derivation, vowels that are not found in the Hungarian vowel inventory, and that it greatly depends on adjustment-rules and rule ordering. As I have already mentioned, derivational theories also allow for a morphological treatment of the above phenomena, especially the phenomenon of lowering (cf. Vago (1980)), and thus cannot unambiguously characterize quaternary harmony either as purely phonological or morphological.

1.3. A morphological analysis

In a morphological analysis of lowering, a diacritic feature would be used instead of the floating [+low] specification of lowering morphemes. Thus, lowering morphemes would still constitute a marked class but instead of making diacritic use of a phonological feature we make phonological use of a diacritic feature. This way after the application of backness and roundness harmony, a morphophonological rule of lowering will apply making quaternary suffix vowels unspecified for the feature [low] be [+low] if preceded by a morpheme, marked with a diacritic feature, belonging to the 'lowering class' of morphemes. The rule of morphologically conditioned lowering can be formulated as given below:
Morphologically Conditioned Lowering

\[
\begin{array}{c}
\text{[+syllabic]} \\
\text{-high}
\end{array} \rightarrow [+\text{low}] / \text{[lowering morpheme]} + \_
\]

This lowering rule has to be ordered with respect to the other rules as the phonological lowering rule to have the same effect as demonstrated in (19).

Thus it seems that derivational rule-based theories allow both a phonological and a morphological treatment of the phenomenon of lowering. This, however, is not true about non-derivational constraint-based theories like Optimality Theory. In OT only a morphological solution can be plausibly proposed, which means that Optimality Theory is consequently more restricted. In the following chapter I will outline the fundamentals of Optimality Theory and in subsequent chapters I will propose an analysis of quaternary vowel harmony and its related phenomena.

2. Optimality Theory: constraint hierarchies

Optimality Theory, a non-derivational, constraint-based framework developed by Prince and Smolensky (1993) and McCarthy and Prince (1993) resolves some longstanding problems in phonology including, for instance, intermediate representations, abstract underlying representations and others. The above authors suggest that instead of rules there are violable constraints ranked in a hierarchy with respect to each other and it is
their interaction determines the output form of an input. This dissertation explores the ways opened by this new theory in the treatment of suffixes displaying quaternary vowel harmony.

2.1. The basic principles of Optimality Theory

Prince and Smolensky’s (1993) and McCarthy and Prince’s (1993) Optimality Theory eliminates rules from the grammar. Their conception of grammar consists of a Generator function, Gen, mapping input representations coming from the Lexicon onto a set of possible candidate forms which are in turn evaluated by an Evaluation function, Eval, consisting of a hierarchy of ordered violable constraints. Eval selects the „best” candidate created by Gen as shown in (2).

\[
\begin{array}{cccc}
\text{Lexicon} & \rightarrow & \text{Input} & \rightarrow \text{Generator} & \rightarrow \text{Evaluation} & \rightarrow \text{Output} \\
\end{array}
\]

where \( \text{Generator (Input)} = \{\text{candidate}_1, \text{candidate}_2, \text{candidate}_3, \ldots\} \)

\[
\text{Evaluation (\{candidate}_1, \text{candidate}_2, \text{candidate}_3,\ldots\}) = \{\text{candidate}_k\}
\]

\[
\text{Output} = \{\text{candidate}_k\}
\]

As an illustration let us consider Törkenczy’s (1995) analysis of Hungarian [h], which appears on the surface only if followed by a vowel in the same word but not anywhere else.
The two constraints that are responsible for the presence and absence of [h] are the following: one requires that segments from the input be present in the output, the other penalizes [h] in the coda.

The generator function creates a variety of input candidates from an input which will be checked by Eval for constraint violation as shown. It is important to note that the evaluation of candidates is done in a parallel fashion, i.e. there is no step-by-step derivation-like evaluation. For each violation of each constraint Eval assesses a mark, an asterisk '*'. The evaluation of the generated candidates is shown in tableaux like the one below.

---

32 Törkenczy uses the constraint PARSE instead of MAXseg, a constraint of the older version of Optimality Theory called Containment Theory. Nothing hinges upon whether we use one constraint or the other in this case.

33 Syllable boundaries are indicated with full stops in the tableaux.
From the input sequence /juhnɔk/, Gen created a number of candidates of which only three are shown in (5). Candidate (b) has an [h] in the coda of the syllable and thus violates the constraint Codacon. One violation is assessed for each [h] in a coda. This is shown by the asterisk in the column of the first constraint, Codacon. The other constraint, MAXseg is violated by the forms in (a) and (c). In (a) the coda /h/ is not preserved, in (c) neither the coda [h] nor the onset [n] of the second syllable is present in the output. This is indicated by the asterisk in the second column of candidate (a) and by the two asterisks in the second column of candidate (c). Since the form in (a) is the actual surface form of the word, it is this candidate that has to be selected as optimal. Thus it must be more important to satisfy Codacon than MAXseg, i.e. it is more important to avoid an [h] in a coda than preserving input segments in the output. This means that constraints have to be ranked with respect to each other. Constraints on the left of the tableau are considered to be ranked higher, i.e. more important by convention if separated by a solid line. Rankings can also be indicated by the symbol '>>'. In this case we could say that Codacon >> MAXseg, i.e. Codacon dominates or outranks MAXseg. In the tableau in (7) this relationship is shown by the solid line between the two constraints. Should we be unable
to decide about the relative ranking, there would be a dotted line between the columns of the constraints as in (5).

The exclamation point after the asterisks in (7) shows the fatal violation, i.e. the point where a candidate is eliminated from the „race”. Also, the shading of the cells in the tableau indicates that these cells, or rather the violations marked in these cells, are not significant in the evaluation any more. The violation of Codacon by candidate (b) makes it unnecessary for Eval to consider the shaded cell since this candidate is already eliminated by the higher ranking constraint.

Candidates (a) and (c) do not violate Codacon, but they both violate MAXseg but while (a) violates it once, (c) violates it twice. This second violation is fatal as indicated by the exclamation point after the second asterisk in candidate (c) in (7). This way candidate (a) is selected as optimal by the constraint hierarchy. Note that in this case the optimal candidate is not perfect in the sense that it violates some constraint, but this violation is forced by the higher ranking constraint. MAXseg is violated by (a) to satisfy the more important Codacon. The optimal candidate is always indicated by a symbol of a hand pointing rightwards, », as in candidate (7.a).

<table>
<thead>
<tr>
<th>Input: juhnɔk</th>
<th>Codacon</th>
<th>MAXseg</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ju.ŋɔk</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b. juh.ŋɔk</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>c. ju.ɔk</td>
<td></td>
<td>**!</td>
</tr>
</tbody>
</table>

Codacon >> MAXseg
Note that in the above tableaux I only included candidates that are relatively "similar" to the input string, i.e. there is only one difference between input and output forms. However, the Generator function supplies many output candidates for a given input. For instance, there might be a candidate [uh] created from underlying /juhnɔk/ by Gen. The "distance" between the input and output of the phonological component of grammar or, in other words, the abstractness of the underlying representation has been the subject of debates for years. In Optimality Theory, constraints have been proposed to maintain faithfulness between input and output forms. These faithfulness constraints penalize differences between the input and output forms. However they can be violated under duress, i.e. if the satisfaction of a higher ranking constraint requires so. In the tableaux above, for example, the faithfulness constraint MAXseg was violated by the optimal candidate (and also by candidate (c)) to satisfy the higher ranking Codacon. Note that faithfulness to the input is really important since candidate (c) was disfavoured because of its unfaithfulness to the input, i.e. because of the suffix-initial segment not present in the output. In the following subsection I will introduce the basic notions and principles of the theory of Faithfulness and one of its extensions, Positional Faithfulness.

2.2. Correspondence Theory and Positional Faithfulness

McCarthy and Prince (1995) give the following definition of Correspondence, the central concept of the Theory of Faithfulness:
(8) Correspondence

Given two strings $S_1$ and $S_2$, related to each other by some linguistic process, Correspondence is a function $R$ from any subset of elements of $S_1$ to $S_2$. Elements $\alpha \in S_1$ and any element $\beta \in S_2$ are correspondents of one another if $\beta$ is the image of $\alpha$ under $R$, that is $\beta = R(\alpha)$.

Note that the two strings $S_1$ and $S_2$ can both be either the input or the output string in a tableau. If $S_1$ is the input string and $S_2$ is a candidate form, then function $R$ mentioned in the definition gives a function from the input to the output. If, however, $S_1$ is a candidate string and $S_0$ is the input string, then $R$ is a function from the output to the input. We will see that both directions are relevant to phonological analysis. The third possibility as far as the strings $S_1$ and $S_2$ are concerned is that $S_1$ and $S_2$ are both the output string. In that case McCarthy and Prince (1995) talk about output-output correspondents relevant to reduplication. In such cases segments of the base and those of the reduplicant have to be in a correspondence relation.

Let us consider some hypothetical illustrations based on McCarthy and Prince (1995). I will only concentrate on input-output and output-input correspondences since these are the ones relevant to our discussion of the matters in Hungarian.
(9) Input: /s₁ t₂ a₃ u₄ n₅ k₆ o₇/³⁴

a.) s₁ t₂ a₃ u₄ n₅ k₆ o₇ This candidate is in perfect correspondence with the input string. Both I-O and O-I correspondence are perfect.

b.) s₁ t₂ a₃ h u₄ n₅ k₆ o₇ ▲ This candidate has an inserted segment to prevent hiatus in the output. I-O correspondence is perfect because all input segments have correspondents in the output, but O-I is not since the epenthetic /h/ does not correspond to any segment in the input.

c.) s₁ t₂ a₃ n₅ k₆ o₇ ▲ This form is lacking a segment from the input to prevent hiatus again. This way O-I correspondence is perfect because every segment in the output has a correspondent in the input, but I-O correspondence is not because one input segment has no correspondent in the output.

d.) s₁ t₂ a₃ u₄ k₅ k₆ o₇ ▲ In this candidate both I-O and O-I correspondence are disturbed by the input /n/ being replaced by /k/. The input [n] has no perfect correspondent in the output and neither does the first output [k] in the input.

e.) b i η g ε ▲▲▲▲▲▲ There is no correspondence between input and output at all. Such candidates are always non-optimal, i.e. this amount of violation of faithfulness constraints is fatal for the candidate.

Based on the differences between the above types of correspondence violations McCarthy and Prince (1995) distinguish between the main constraint families discussed below³⁵.

³⁴ The black triangles pointing upwards designate the position where a segment is not faithful to its correspondent in the input or output.
³⁵ I only discuss Input-Output and Output-Input constraints here. For the discussion of the Base-Reduplicant constraints the reader should refer to McCarthy and Prince (1995).
(10) MAX-IO
Domain (R) = S₁
Every segment of the input has a correspondent in the output.
(No phonological deletion)

(11) DEP
Range (R) = S₂
Every segment of the output has a correspondent in the input.
(No phonological epenthesis)

(12) IDENT(F)
If xRy and x is [γF], then y is [γF]
Correspondent segments have identical values for the feature F.

The constraint in (10) is the reformulation of Prince and Smolensky's (1993) PARSE in the framework of Correspondence Theory but it is not connected to syllabification and phonetic interpretation as PARSE was. DEP, on the other hand, corresponds to FILL in Prince and Smolensky (1993) but DEP does not require that epenthetic segments be empty root nodes without feature content. Finally, IDENT(F) requires that corresponding segments be specified for features the same way. It replaces the Fill(feature) and PARSE(feature) type of constraints proposed in the Containment type of Optimality Theory. Since for each feature there is a separate IDENT(F) constraint, i.e. IDENT(back), IDENT(low), etc, these constraints can be ranked with respect to each other and other constraints. Thus it might be possible that in a language the preservation of some features is more important than that of others, as we will see in Hungarian. Note that featural identity is transmitted through the segments to which the features are linked. For an extension of the theory to subsegments underlyingly not linked to segments, or rather root nodes, see the discussion on Zoll (1996) in chapter 3.

It is important to note that McCarthy and Prince (1995) claim that morphemes in a language can interact with phonology in different ways. Thus correspondence
constraints can be tied not only to different directions, i.e. Input-Output or Output-Input, but also to particular morphemes or morpheme classes. This can be done in two ways: either certain constraints refer to members of a morphologically marked class or certain morphemes induce reranking of the constraints, i.e. some constraints will be ranked differently whenever some kind of morpheme appears in the input. Note, however, that while the latter treatment of exceptional forms simply puts exceptionality in the lexical item, or rather the Lexicon, and does not require language specific constraints, the former does. Since one of the axioms of Optimality Theory is that constraints are universal and it is only their ranking that causes differences between languages or dialects, the former might be problematic for the theory. However, this problem is outside the scope of the present dissertation. The potential of the theory to have morphemes marked for reranking will be explored in the treatment of lowering morphemes in Hungarian in subsequent chapters.

There are some others that play an important role in correspondence relations. These are given below (McCarthy and Prince 1995).

(13) ANCHOR Any element at the designated periphery of $S_1$ has a correspondent at the designated periphery of $S_2$. Let Edge $(X, \{\text{Left, Right}\})$ = the element standing at the Edge = $L, R$ of $X$
Right-Anchor: If $x = \text{Edge}(S_1, R)$ and $y = \text{Edge}(S_2, R)$ then $x R y$
Left-Anchor: If $x = \text{Edge}(S_1, L)$ and $y = \text{Edge}(S_2, L)$ then $x R y$

(14) LINEARITY $S_1$ is consistent with the precedence structure of $S_2$ and vice versa.
Let $x, y \in S_1$ and $x'$ and $y' \in S_2$. If $x R x'$ and $y R y'$, then $x < y$ iff $\neg(y' < x')$. (No metathesis)
ANCHOR as formulated in (13) captures some of the effects of the ALIGN constraint family proposed in McCarthy and Prince (1993b). It requires that segments at some edge of a category have correspondents on some edge of another category\(^{36}\). LINEARITY, on the other hand, requires that there be no metathesis; linear ordering relations must be the same in the input and the output.

Now that we have discussed the key notions of Correspondence Theory and the most important constraint families used in the framework, we turn to an extension of the theory by Beckman (1995, 1997, 1998), Positional Faithfulness. The basic assumption of positional faithfulness is that there are certain prominent or strong positions in languages where faithfulness is more strictly observed than in non-prominent or weak positions.

Many languages neutralise segments in certain positions where only segments with one value, the unmarked one, of a certain feature appear. Such positions are usually referred to as non-prominent or weak. They include codas, word final positions, pre-obstruent positions and suffixes. These contrast with onsets, word initial positions, pre-sonorant positions and roots which are strong or prominent. Two examples of neutralisation are given below from German, where only voiceless obstruents occur word finally and Hungarian where voicing is neutralised in obstruent clusters.

\(^{36}\) The ALIGN constraint family can do the same if two morphological categories are mentioned as arguments of the Align function
A straightforward way of treating the German case is positing voiced word final obstruents underlyingly and devoicing them when occurring unsuffixed. This can be done by assuming two IDENT constraints on the feature [voice]: a general one, requiring the preservation of voice in any segment, and a positional one, requiring the preservation of voice in strong positions as suggested by Beckman (1995, 1997, 1998).37

(16) IDENT(voice) Corresponding segments in the input and output have identical specifications for [voice].

(17) IDENT-Onset (voice) Corresponding segments in onset positions in the input and output have identical specifications for [voice].

Beckman (1995, 1997, 1998) claims that phenomena of positional faithfulness are the result of faithfulness constraints like the above interacting with markedness constraints.

(18) *Voiced Obstruent There are no voiced obstruents

---

If we rank the specific IDENT constraint highest and the markedness constraint between the two IDENT constraints then we get the required result for the German data as shown in the following tableaux.

**Weg 'way'**

<table>
<thead>
<tr>
<th>(19)</th>
<th>UR:</th>
<th>IDENT-Onset (voice)</th>
<th>*Voiced Obstr</th>
<th>IDENT (voice)</th>
</tr>
</thead>
<tbody>
<tr>
<td>veg</td>
<td>vek</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>veg</td>
<td>**</td>
<td>!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fek</td>
<td>*!</td>
<td>**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As we can see in tableau (19) the candidate with coda devoicing, the actual surface form, is preferred by the hierarchy. Candidate (c) violates IDENT-Onset because of the devoicing of the onset /v/ into [f] and is thus eliminated. Both candidate (a) and (b) violate *Voiced Obstruent, but while (a) violates it only once, (b) violates it twice. This is because in (a) the coda obstruent is devoiced, i.e. the one in the weak position, while in (b) both obstruents remain faithful to the input voicing value. Although candidate (a) violates IDENT(voice), the more general constraint, it does not matter because the other candidates violate higher ranking constraints. This implies then that IDENT-Onset has to dominate *Voiced Obstruent and *Voiced Obstruent has to dominate IDENT(voice). Should they be ranked in any other way, either candidate (b) or (c) would win.
The next tableau shows the same root followed by the plural suffix. In this case the candidate with all obstruents faithful to their input voice values is selected as optimal.

Wege 'way pl.'

<table>
<thead>
<tr>
<th>UR:</th>
<th>IDENT-Onset (voice)</th>
<th>*Voiced Obstr</th>
<th>IDENT (voice)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ve²ø</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ve.kø</td>
<td>*!</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. fe.kø</td>
<td><em>!</em></td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

Candidates (b) and (c) both violate IDENT-Onset because of the devoicing of the onset obstruents. Candidate (a) is absolutely faithful to the input and thus wins in spite of its violation of the markedness constraint.

Our other example is taken from Hungarian, where obstruent clusters always agree in voicing, they always share the voice specification as in the following chart.

(21) Hungarian voice assimilation

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>/rob/+/hoz/</td>
<td>[rob]</td>
<td>[rob+hоз]</td>
<td>'prisoner all.'</td>
</tr>
<tr>
<td>/ja:v/+/hoz/</td>
<td>[ja:v]</td>
<td>[ja:f+hоз]</td>
<td>'stripe all.'</td>
</tr>
<tr>
<td>/lo[p]+/ben/39</td>
<td>[lo[p]</td>
<td>[lo:b+bon]</td>
<td>'sheet iness.'</td>
</tr>
<tr>
<td>/ha:t+/ben/</td>
<td>[ha:t]</td>
<td>[ha:d+bon]</td>
<td>'back iness.'</td>
</tr>
<tr>
<td>/kost+/ben/</td>
<td>[kost]</td>
<td>[kozd+bon]</td>
<td>'food iness.'</td>
</tr>
</tbody>
</table>

38 Of course, these rankings and the transitivity of the dominance relation implies that IDENT-Onset also dominates IDENT(voice), since if A >> B and B >> C, then also A >> C.

39 The underlying form of the alternating suffix ban/ben 'inessive' contains a front vowel since whenever this morpheme is used as a root, it always has a front vowel, e.g. bennem 'I iness.', benned 'you iness.', benne 'he/she iness.'. The back vowel in the suffix in the chart is the result binary of backness vowel harmony.
To accommodate the observation that Hungarian obstruent clusters are always homogenous as far as voicing is concerned we must have a constraint requiring that obstruent clusters always share the same voice specification\(^{40}\).

(22) Share Obstruents in a cluster have the specification for [voice]. One violation is assessed for each obstruent violating the constraint.

Let us add this constraint to the ones above and see what forms they select for the Hungarian data.

\[
\begin{array}{|c|c|c|c|c|}
\hline
\text{UR: } & \text{Share} & \text{IDENT-Onset (voice)} & \text{IDENT (voice)} & \text{*Voiced Obstr} \\
\hline
\text{f}a:v & & & & \\
\hline
\text{a. } & \text{f}a:v & & & * \\
\hline
\text{b. } & \text{f}a:f & & *! & \\
\hline
\text{c. } & \text{3a:v} & *! & * & ** \\
\hline
\text{d. } & \text{3a:f} & *! & ** & * \\
\hline
\end{array}
\]

IDENT-Onset(voice), IDENT(voice) >> *Voiced Obstr

Tableau (23) shows that the IDENTITY constraints have to dominate the markedness constraint because otherwise candidate (b) would be the winner. Since Hungarian does not have word final devoicing, (a) has to be selected.

\(^{40}\) This analysis is simplified and is not entirely correct since, in fact, it is always the obstruent before a sonorant (not necessarily in an onset position) that determines the voice quality of the cluster. For an analysis of Hungarian and other voice patterns see Petrova et al (1998).
sávhoz 'stripe all.'

(24) | UR: fa:vhoz | Share | IDENT-Onset (voice) | IDENT (voice) | *Voiced Obstr |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>fa:fhoz</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>fa:vhoz</td>
<td>*!</td>
<td></td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>fa:fos</td>
<td></td>
<td></td>
<td>**!</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>fa:vhoz</td>
<td>*!</td>
<td>*</td>
<td>***</td>
<td></td>
</tr>
</tbody>
</table>

Share >> IDENT(voice), *Voiced Obstr

(24) shows the same root followed by a suffix starting with a voiceless consonant. It also tells us that Share, the constraint requiring that obstruent clusters agree in voicing, must dominate the general IDENT constraint and the markedness constraint as well to give us the right result. Thus [-voice] spreads regressively from the rightmost obstruent to the preceding one(s) in the cluster. Since candidates (b), (c) and (d) violate Share, IDENT(voice) and IDENT-Onset(voice) respectively, they are eliminated and candidate (a) is allowed to win.

kosztban 'food iness.'

(25) | UR: kostbôn | Share | IDENT-Onset (voice) | IDENT (voice) | *Voiced Obstr |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>kostbôn</td>
<td></td>
<td>**</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>kostbôn</td>
<td>*!</td>
<td></td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>c.</td>
<td>kostbôn</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>kostbôn</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

40
The form in (25) is different from the one in (24) in that it contains a root ending in a voiceless cluster followed by a voiced obstruent in the suffix. Yet, the same thing happens again: the voicing quality of the rightmost segment in the cluster, in this case [+voice] spreads to the other segments in the cluster, the hierarchy correctly selecting candidate (a) as optimal. Candidates (b) and (c) both violate Share because of the heterogenous voice quality of the obstruents in the cluster while (d) violates IDENT-Onset(voice) because of the devoicing of the onset in the cluster, i.e. the input /b/.

One last thing has to be mentioned about Optimality Theory in general. It is the fact that several different underlying representations combined with the very same constraint hierarchy may yield the same output form as shown by the following two tableaux for the Hungarian word [kost] 'food'.

<table>
<thead>
<tr>
<th>koszt 'food'</th>
</tr>
</thead>
<tbody>
<tr>
<td>(26) UR: koszt</td>
</tr>
<tr>
<td>a. kost</td>
</tr>
<tr>
<td>b. kozt</td>
</tr>
<tr>
<td>c. kozd</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>koszt 'food'</th>
</tr>
</thead>
<tbody>
<tr>
<td>(27) UR: kost</td>
</tr>
<tr>
<td>a. kost</td>
</tr>
<tr>
<td>b. kozt</td>
</tr>
<tr>
<td>c. kozd</td>
</tr>
</tbody>
</table>
Note that the constraint hierarchy selects candidate (a), [kost] as optimal in both cases. It is because the constraint hierarchy is constructed in a way to filter out all clusters not agreeing in voice even if the input contains such a cluster. But then the question might arise: which underlying representation is the „real” one? Is it the one in (26) or the one in (27)? This problem is solved by the mechanism of Lexicon Optimization proposed by Prince and Smolensky (1993). They claim that in such cases the Evaluation function compares the optimal outputs from the two tableaux and selects the one with the least and lowest ranking violations. Thus, since (26.a) violates IDENT(voice) while (26.a) does not, the latter will be selected to be the underlying form of this word by Lexicon Optimization.

3. An OT analysis of Lowering

In this section of the chapter I will consider possible OT analyses for the phenomena of vowel harmony and lowering. In 3.1 I will focus on Stiebels and Wunderlich’s (1998) account of lowering and the related phenomenon of vowel-zero alternations. Then in 3.2 I will concentrate on Ringen and Vago’s (to appear) proposal for binary and ternary harmony and will extend their account to quaternary harmony, i.e. the phenomenon of lowering.
3.1 Stiebels and Wunderlich's (1998) analysis

Here I will examine an optimality theoretic account of lowering as proposed by Stiebels and Wunderlich (1998). I will argue that their solution does not yield the actual surface forms as optimal in some cases.

Stiebels and Wunderlich (1998) claim that lowering stems have an unlinked [+low] feature that docks on quaternary suffixes but not on other ones as we saw in the derivational account of lowering in the previous section. They also claim that quaternary suffixes are different from the rest of suffixes in that they do not have an underlying mora linked to the suffix vowel. As we will see the latter assumption is correct and will also be proposed in my account in subsequent chapters however in a different form. Stiebels and Wunderlich (1998) claim that the constraints responsible for lowering and vowel zero alternations are the following:

(1) ONSET  Each syllable has a consonantal onset.

(2) X-MAX  All segments of stems and affixes in the input have a correspondent in the output.

(3) F-MAX  All features in the input have a correspondent in the output.

(4) µ-MAX  All moras in the input have a correspondent in the output.

(5) V-DEP  All vowels (root nodes with a dependent vocalic node) in the output have a correspondent in the input.
(6) C-DEP  All consonants in the output have a correspondent in the input.

(7) μ-DEP  All moras to which vocalic material is linked in the output have a correspondent in the input.

(8) IDENT-V  All features linked to a vocalic node remain unchanged.

(9) ALIGN-LEFT ([+low], suffix)  The unlinked feature [+low] at the right edge of the stem is linked to the left edge of a following suffix.

The rankings of the above constraints are given below in (10).

(10)  μ-MAX, C-DEP >> ONSET >> X-MAX >> μ-DEP >> F-MAX
     IDENT-V >> F-MAX

The constraints and their rankings do work for some candidates as shown in (11), floating features are superscripted.

házak ‘house pl.’

(11)  UR:  
      ha:z^{+L}+Vk  
      | X-MAX | μ-DEP | IDENT -V | F-MAX | V-DEP | ALIGN -L +low |
      a.  $\varnothing$ ha:zōk  | *      |       |         |       |       |            |
      b.  ha:zok  | *      |       | *!      |       |       |            |
      c.  ha:zk  | *!     |       | *       |       |       | *          |

In (11) a lowering stem is followed by a quaternary suffix. In candidate (c) the floating [+low] feature in the input does not have an output correspondent and thus the form
violates F-MAX. However it also violates X-MAX because the suffix initial vowel is not present in the output, this violation being lethal. Candidate (b) violates F-MAX for the very same reason and hence candidate (a) being optimal wins. We should also note that both candidate (b) and (c) violate ALIGN-L +low because the floating [+low] in the input is not aligned with the left edge of the suffix in the output.

<table>
<thead>
<tr>
<th>(12)</th>
<th>UR: bot+Vk</th>
<th>X-MAX</th>
<th>μ-DEP</th>
<th>IDENT</th>
<th>F-MAX</th>
<th>V-DEP</th>
<th>ALIGN -L +low</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>*botok</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>*botok</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>botk</td>
<td>*!</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tableau (12) contains a non-lowering stem followed by a quaternary suffix. Candidate (c) not containing a suffix vowel violates X-MAX and is dispreferred. Candidates (a) and (b) on the other hand both only violate μ-DEP since a mora has to be inserted to realise the suffix vowel underlingly not linked to a mora. These two candidates fare equally well on all the constraints. One constraint is problematic for the evaluation of these candidates, namely ALIGN-L +low. Since the stem underlingly does not have an unlinked, i.e. floating feature, neither form violates the alignment constraint since it only penalizes underlingly floating [+low] features not being aligned with the left edge of a following suffix. Should this constraint be formulated so that all [+low] features have to be left aligned with the left edge of the suffix, then both (a) and (c) would violate it and the

---

41 Only relevant constraints are shown in the tableaux; those not violated by the candidate are omitted.
incorrect form in (b) would be selected as optimal. Either way the constraint hierarchy is not able to select the optimal candidate unambiguously or is not able to select the actual surface form at all. Also, the alignment constraint as it is formulated is highly descriptive and is better treated as being part of morphology or the phonology-morphology interface as I will argue below.\(^{42}\)

3.2 Binary and ternary harmony

In the following I will provide a short overview of the analysis proposed by Ringen and Vago (to appear) for binary and ternary alternations. Their analysis correctly predicts the actual surface forms whether inputs are fully or partially specified. The following constraints and rankings are proposed in their analysis of binary, i.e. back-front, alternations\(^{43}\):

\[
\begin{align*}
(13) \text{Align-R} & \quad \text{No vowel intervenes between the right edge of \([	ext{back}]\) and the right edge of the word.} \\
(14) \text{IDENT-IO}^\text{harm/root} & \quad \text{Corresponding input and output harmonic vowels have identical specifications for \([\alpha\text{back}]\) (harmonic vowels are those specified as low or round)} \\
(15) \text{IDENT-IO}^\text{back} & \quad \text{Corresponding input and output segments have identical specifications for \([\alpha\text{back}]\).}
\end{align*}
\]

\(^{42}\) For other shortcomings of the analysis in Stiebels (1998) see chapter 2 and 3. 
\(^{43}\) For a detailed analysis cf. Ringen and Vago (to appear).
Every subsegment, i.e. floating class node or feature, which belongs to the root morpheme in the input must be present in the output.

Segments are specified for features.

Vowels which are [+back] and [-low] must be specified as round.

A low vowel is round iff it is short and back.

Ranking the constraints LO/R and *iA in a position not dominated by the other constraints ensures that there will be no vowels violating these inventory constraints even if such vowels are present in the input representation. The ranking of IDENT-IO_{harm/root} above ID-IO_{back} assures that changing the backness specification of harmonic root vowels is more seriously penalised than changing the same specification in a suffix vowel. Since Align-R dominates ID-IO_{back}, the preservation of the backness specification of a suffix vowel is less important than the alignment of the feature [back], i.e. right alignment of [back] is preferred over the preservation of suffix backness specifications. Ranking IDENT-IO_{harm/root} above Align-R makes back vowel + neutral vowel sequences in roots possible. Were the ranking the reverse, roots with a back vowel followed by a neutral vowel, as in [pɔpiːt] 'paper', would surface with aligned backness features, i.e. one backness specification would spread over the other one yielding incorrect surface
representations like *[pɔpɪ:r]. The ranking MAX_{subseg/root} >> Spec is made necessary by antiharmonic roots like *hid containing neutral (front) vowels but taking back suffixes, i.e. *hid+nak. This way the root vowel loses its underlying [-back] specification while the floating [+back ] root feature docks on the suffix vowel giving an aligned output as shown in (22). Ranking Align-R above MAX_{subseg} ensures that suffix backness specifications will change even if there is a floating back feature on the suffix, i.e. preferring alignment to the realisation of floating suffix features.

The tableaux in (21) and (22) show how the above constraints and their ranking select the correct output candidate for backness harmony (the irrelevant constraints are left out, floating features are superscripted):

háznak 'house dat.'

(21) | UR: | LO/R | IDENT-IO_{harm/root} | Align-R | Spec | ID-IO_{back} |
---|-----|------|----------------------|--------|------|-------------|
| ha:z+nèk | a. ha:znak | *! | | | |
| | b. ha:znèk | | *! | | |
| | c. ha:znòk | | | * | |
| | d. he:znèk | | *! | | |
| | e. ha:znAk | | *! | * | * |
hidnäk 'bridge dat.'

<table>
<thead>
<tr>
<th></th>
<th>UR:</th>
<th>*iA</th>
<th>Align-R</th>
<th>MAX_{subseg/root}</th>
<th>MAX_{subseg}</th>
<th>Spec</th>
<th>ID-IO_{back}</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>hLi:dnôk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b.</td>
<td>hi:dnôk</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>hi:dnôk</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>d.</td>
<td>hi:dnôk</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>e.</td>
<td>hi:dnôk</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

As we can see above, the backness specification of root vowels is never different from the input in the optimal candidate, and the rightmost backness feature of the stem always spreads rightwards to the suffix to satisfy the alignment constraint.

For the treatment of roundness alternations the following constraints are proposed by Ringen and Vago (to appear):

(23) Short ε

Short non-high unrounded front vowels are low

(24) No Gap

Gapped configurations are prohibited: * A B C
(where B is a possible anchor for F)

(25) Link [ROUND]

[ROUND] may be linked to a short (monomoraic) mid front suffix vowel only if it is linked to a preceding vowel.

(26) ID-IO_{round}

Corresponding input and output segments have identical specifications for [ROUND]

(27) *üö

Front rounded vowels are prohibited

49
Since Link [ROUND] is ranked above ID-IO\textsubscript{round}, the underlyingly rounded ternary suffix must be unrounded after roots ending in an unrounded vowel. Unrounding of suffix vowels is also preferred over gapped configurations where a rounded vowel followed by an unrounded vowel in the root would take a suffix with a rounded vowel as in the allative of \textit{körthöz} ‘side dish’. However, the alignment of \textit{[back]} is preferred so much that it is more important than avoiding gapped configurations. In roots with a back vowel + neutral vowel sequence a gapped structure is preferred with a backness specification linked to the first root vowel and the suffix vowel leaving the second root vowel unspecified for backness.

In tableaux (29) and (30) I demonstrate the way the above constraints and their ranking select the correct output candidate\textsuperscript{44} for a root with a front unrounded vowel and another one with a back and a neutral vowel:

\textsuperscript{44} Only candidates with aligned backness specifications are shown, irrelevant constraints are omitted. For the complete analysis see Ringen and Vago (to appear).
készhez ‘hand all.’

\[
\begin{array}{|c|c|c|c|c|c|}
\hline
\text{UR:} & \text{Short \varepsilon} & \text{No Gap} & \text{Link} & \text{ID-IO}_{\text{back}} & \text{ID-IO}_{\text{round}} & *\ddot{\text{u}}\ddot{\text{o}} \\
\hline
\text{ke:z+hoz} & & & & & & \\
\hline
\text{a. ke:z+hez} & *! & & & * & * & \\
\hline
\text{b. \ddot{\text{c}} ke:z+h\ddot{\text{e}}z} & & * & & * & * & \\
\hline
\text{c. ke:z+höz} & & *! & & * & * & \\
\hline
\text{d. kö:z+höz} & & & & * & * & *!* \\
\hline
\end{array}
\]

radírhoz ‘eraser all.’

\[
\begin{array}{|c|c|c|c|c|c|}
\hline
\text{UR:} & \text{Short \varepsilon} & \text{Align-R} & \text{No Gap} & \text{ID-IO}_{\text{back}} & \text{ID-IO}_{\text{round}} & *\ddot{\text{u}}\ddot{\text{o}} \\
\hline
\text{rodi:r+hoz} & & & & & & \\
\hline
\text{a. rodi:r+hez} & *! & \text{**} & * & * & * & \\
\hline
\text{b. \ddot{\text{c}} rodi:r+h\ddot{\text{e}}z} & & & * & * & * & \\
\hline
\text{c. rodi:r+höz} & & \text{!*} & & * & * & * \\
\hline
\text{d. rodi:r+höz} & & \text{!*} & & * & * & * \\
\hline
\end{array}
\]

The roundness quality of root vowels is never changed as indicated in both (29) and (30).

In (29) there is a violation of ID-\text{IO}_{\text{round}} both in (b) and (d) and the deciding factor between the two candidates is the markedness constraint *\ddot{\text{u}}\ddot{\text{o}} penalizing front rounded vowels. Candidate (a) is eliminated because it contains a short front non-high vowel which is not low, thus violating Short \varepsilon. The same is true of candidate (a) in (30). In (30) candidates (c) and (d) violate Align-R since there are two intervening vowel between anchor of the [+back] specification of the first root vowel and the right edge of the prosodic word. Thus candidate (b) is selected as optimal in spite of the fact that it violates No Gap.
In my analysis of quaternary harmony I assume Ringen and Vago’s (to appear) analysis of binary and ternary harmony. I will show that regardless of what kind of constraints and rankings we propose, it is impossible to account for the phenomenon of lowering without referring to the morphological classes shown in table (4) in chapter 1.

3.3. Quaternary harmony

In this section, I outline an analysis of quaternary harmony based on Ringen and Vago’s (to appear) above analysis of binary and ternary harmony. I will argue however, that any kind of purely phonological analysis of quaternary harmony is unsatisfactory in OT. I will show that multiple suffixes present a problem unresolvable in phonological terms, i.e. the marked stem classes cannot be marked with a floating low feature. Thus I will claim that the exceptional classes are marked with a diacritic feature that triggers the lowering of the following suffix.

As we saw in table (4) in chapter 1, there are two groups of stems that trigger lowering of a following quaternary suffix. This lowering would be most straightforwardly accounted for by positing a floating [+low] feature on these stems as was done in the phonological derivational analysis. This feature then could dock on the quaternary suffixes making them [+low]. Since there would be no such [+low] feature on the members of the unmarked stem classes, quaternary suffixes would surface as mid following such stems.

\[45\] Capital I stands for a high unrounded vowel unspecified for backness.
To follow the above train of thought, we have to settle the problem of underlying representations of suffixes. Since it is reasonable to assume that quaternary harmony is in fact ternary harmony combined with lowering, Ringen and Vago's (to appear) constraints must be able to take care of the backness and roundness alternations, or at least those arising from the ternary harmony part. Thus the underlying representation of quaternary suffixes must be similar to that of ternary ones, but the floating [+low] feature of the members of the marked root classes should not turn ternary suffixes into quaternary ones, which would happen if we let the floating [+low] link up to a ternary suffix vowel. Thus the underlying form of quaternary suffixes must be different from that of ternary ones. I propose an underlying representation of quaternary suffixes which is specified as [-high] and [+round]46, just like in ternary suffixes, but unspecified for the feature [low], i.e. the only difference between ternary and quaternary suffixes lies in the specification for the feature [low]. This way the floating [+low] feature can only dock on vowels that are unspecified for the feature [low]. Since ternary, binary, and nonalternating suffixes are fully specified, this feature cannot link up to these suffixes.

The constraints that are necessary to account for the behaviour of the five different types of stems are the following:

(31) \( \text{MAX}_{\text{subseg}} \)

Every subsegment which is part of the input must be present in the output.

---

46 Since quaternary suffixes never act as roots, we cannot decide about their underlying backness specification. However, this does not matter as Ringen and Vago (to appear) prove that the backness value of the suffix primarily depends on the root vowels.
MAX\textsubscript{subseg} proposed by and Zoll (1996) and also used by Ringen and Vago (to appear), forces candidates to preserve their floating feature specifications as we could see above. This way floating [low] features present in the input must be present in the output to satisfy the constraint\textsuperscript{47} in (31). This is shown in the following tableau in (32).

<table>
<thead>
<tr>
<th>lyukak 'hole pl.'</th>
<th>MAX\textsubscript{subseg}</th>
</tr>
</thead>
<tbody>
<tr>
<td>-L [+L] [+L]</td>
<td></td>
</tr>
<tr>
<td>UR: juk + Ok</td>
<td></td>
</tr>
<tr>
<td>a. ✁ juk + ok</td>
<td>*</td>
</tr>
<tr>
<td>b. juk + ok</td>
<td>**!</td>
</tr>
<tr>
<td>c. ✁ jok + ok</td>
<td>*</td>
</tr>
<tr>
<td>d. ✁ jok + ok</td>
<td>*</td>
</tr>
<tr>
<td>e. juk + Ok</td>
<td>**!</td>
</tr>
</tbody>
</table>

The tableau in (32) shows that the MAX\textsubscript{subseg} constraint can eliminate some of the candidates, but it is unable to select the winning candidate unambiguously, showing that we need another constraint to do that work. The difference between the winning candidates in (32) lies in the fact that the [low] specification of the root is changed in (c) and (d) but not in (a), the actual surface form. Candidate (c) and (d) can be filtered out by a constraint of the IDENTITY family (McCarthy and Prince, 1995):

\footnote{For a floating feature to be present in the output it must be linked to a segment. Cf. Zoll (1996), Ringen}
(33) IDENT-IO<sub>low</sub> Corresponding segments in the input and output have identical specifications for the feature [low].\(^{48}\)

The results of adding IDENT-IO to the constraint set is shown in (34):\(^{49}\)

\[
\begin{array}{|c|c|c|}
\hline
\text{lyukak 'hole pl.'} & \text{MAX}_{\text{subseg}} & \text{IDENT-IO}_{\text{low}} \\
\hline
\text{a. } -L +L \quad \text{a. } juk + ok \\
\text{b. } +L -L \quad \text{b. } juk + ok \\
\text{c. } jok + ok \\
\text{d. } -L +L \quad \text{d. } jok + ok \\
\text{e. } juk + Ok \\
\hline
\end{array}
\]

As shown in (34), candidate (a) is properly selected as the winning candidate. Note however, that there is no evidence for the ranking of these two constraints. Winning candidates will never violate either of the constraints; thus there are no cases of constraint conflict.

---

\(^{48}\) I assume that filling in a binary feature does not constitute an IDENT-IO violation as assumed by Orgun (1995). In any other case IDENT-IO is violated.

\(^{49}\) I will exclude the constraints governing backness and roundness alternations whenever they do not play a role in selecting the optimal candidate.
Now recall that it is not only roots that may have a floating [+low] feature but also suffixes. If we posit such a floating [+low] feature on the plural suffix (cf. evidence in (5)), then our constraints, which work for non-lowering suffixes, will select a wrong candidate as shown in (35) for a non-lowering root:

<table>
<thead>
<tr>
<th>rumok ‘rum pl.’</th>
<th>MAX_{subseg}</th>
<th>IDENT-IO_{low}</th>
</tr>
</thead>
<tbody>
<tr>
<td>UR:rum+ Ok</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. rum + Ok</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>b. rum + ok</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>c. rôm + ok</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. rôm + ok</td>
<td></td>
<td>*!</td>
</tr>
</tbody>
</table>

As we can see, candidate (c) satisfies both constraints and wins although the correct form has a back mid suffix vowel, i.e. either (a) or (b) should be preferred.

We can try to amend the situation in many different ways. In the following part of this section I will show that none of the constraints of the known constraint families work. Although it is impossible to prove that no constraint can solve the problem presented by quaternary suffixes, I will argue that no natural constraint, or at least not one

---

50 Candidate (b) is preferred by the constraint SPEC, which requires segments to be specified for binary features, not shown in the tableau.
of the kinds attested in other harmony systems can be successfully applied and that it is the theory itself that forces us towards a morphological analysis.

We can propose alignment constraints that might seem to be able to account for some of the forms but not for all:

(36) Align –L

<table>
<thead>
<tr>
<th>karok ‘arm pl.’</th>
<th>Align –L</th>
<th>MAXsubseg</th>
<th>IDENT-IO_Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>+L +1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UR: kør + Ok</td>
<td>Align –L</td>
<td>MAX subseg</td>
<td>IDENT-IO_Low</td>
</tr>
<tr>
<td>a. kør + Ok</td>
<td>+L</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>b. kør + ok</td>
<td>+L</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>c. @ kør + ok</td>
<td>+L +L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. kør + ok</td>
<td>+L -L</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

Candidate (c) in (37) vacuously satisfying the alignment constraint wins over all the other candidates, among them the correct one, candidate (d).

Another possible approach would be to refer to the other MAX constraint proposed by Ringen and Vago (to appear) and Zoll (1996), called MAXsubseg/root that penalizes cases when an input floating root feature does not have an output correspondent as we could see above. This move seems to be reasonable since it is
always the floating feature of the root that docks on the suffix and not that of the suffix itself.

A positional faithfulness approach could not solve the problems presented above either. In the theory of positional faithfulness (Beckman, 1995, 1997, 1998) there are two identity constraints with markedness constraints intervening between them: IDENT IO-(strong position) \(\gg\) Markedness \(\gg\) IDENTITY IO. This ranking forces faithfulness in strong positions but not in others, where a strong position can be in roots, in stressed syllables, root initially, in onsets, in long vowels, etc. Unfortunately, we cannot find a group of strong positions where the output is always faithful to the input (as opposed to weak positions). The only clear case is that root features are never changed. This might suggest that a positional faithfulness solution could work but if we look further, we will see that we must be able to differentiate between different suffixes: it is always a suffix occurring after a lowering morpheme that is lowered regardless whether the preceding morpheme is a root or a suffix. This is shown in the following tableaux.
Candidate (38.c) violates only the constraint penalizing the non-realisation of an underlying floating feature and thus wins. Note that in candidate (c) the floating root feature is realised by being linked to the suffix vowel. However, there is another possibility for the same output form to be gained, namely realising the floating suffix feature and omitting the floating root feature. In that case still candidate (c) would be the winner since there would only be an extra violation of MAXsubseg/root for candidate (c) and thus the decision between candidates (a), (b) and (c) would be passed on to MAXsubseg. This constraint would still favour (c) since only one floating feature is omitted whereas in (a) and (b) two features are deleted.

Note that a phonetically identical candidate is possible containing the underlyingly floating [+low] suffix feature linked to the suffix vowel. In that case the floating root feature would not be realised in the output and thus the candidate would violate MAXsubseg/root, a fatal violation as compared to the MAXsubseg violation of candidate (c).
Unfortunately the same constraints cannot account for forms where we have a non-lowering root followed by a lowering suffix as in (39):

<table>
<thead>
<tr>
<th>(39)</th>
<th>karok 'arm pl.'</th>
<th>+L</th>
<th>IDENT-I0_{low}</th>
<th>MAX_{subseg/root}</th>
<th>MAX_{subseg}</th>
</tr>
</thead>
<tbody>
<tr>
<td>UR:kɔɾ+ ɔk</td>
<td>+L</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>a. kɔɾ + ɔk</td>
<td>+L</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
</tr>
<tr>
<td>b. kɔɾ + ɔk</td>
<td>+L</td>
<td>+L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. kɔɾ + ɔk</td>
<td>+L</td>
<td>-L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. kɔɾ + ɔk</td>
<td>+L</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
</tr>
</tbody>
</table>

Other constraints do not work either, like the constraint SPREAD [+low] or SPREAD [-low]. The problem with such constraints is that in Hungarian root vowels of any height can be followed by suffix vowels of any height, as we saw in the examples in tables (2), (3), and (4) in chapter 1. Thus positing either of the SPREAD[low] constraints relatively high will definitely result in optimal candidates different from the actual surface forms as shown with SPREAD [+low] in tableau (40):

---

52 Note that there is no real difference between the SPREAD constraint and the ALIGN [low] constraints. Both are violated if the feature referred to does not span to the edge of the domain.
Since AGREE constraints basically do the same as SPREAD constraints, they do not show us a way out either.

In this section I have argued that we cannot account for quaternary suffix alternations in terms of phonological constraints\(^{53}\) independent of what kinds of constraints we might propose\(^{54}\). Thus I conclude that any OT analysis of quaternary harmony in Hungarian must refer to the two morphological classes of lowering and non-lowering or regular morphemes.

\(^{53}\) Since in the OT analysis of quaternary harmony presented above nothing hinges upon the analysis of ternary and binary harmony, one cannot argue that an OT account of quaternary harmony is made impossible by the assumed analysis of the other alternating suffixes.

\(^{54}\) Of course, one could propose a constraint LINK-LOW-RIGHT, saying that floating [+low] features of the input must be linked to a following morpheme in the output, similar to the way done by Stiebels and Wunderlich, but such a constraint would not provide any insight into, and/or generalization about the grammar of the language. Note that this is exactly what rule application in the derivational analysis does in the case of the cyclic Lowering rule.
3.4. A morphological analysis

Recall that there are two kinds of morpheme: members of the marked class select for a quaternary suffix with a low vowel while those of the unmarked class do not. Although one surface variant of the quaternary suffixes selected by members of the unmarked class also contains a low vowel, it is easy to see that the low vowel is a result of not licensing [+round] on the suffix vowel after a [-round] stem vowel, cf. (3) and (4). This may be done in several different ways: I will address two in what follows.

3.4.1 Suffixes with two underlying forms

We can claim that quaternary suffixes have two underlying forms: one with a low vowel (the one found in binary alternations) and another with a vowel specified as mid and round (the one found in ternary suffixes), an instance of suppletion. Thus we could claim that morphemes belonging to the class of so-called "lowering" morphemes select for a binary version of the given "quaternary" suffix with a low vowel whereas morphemes from the unmarked class select for the ternary version with a mid vowel. This way "quaternary" suffixes would be marked, as we expected, since they would have two different underlying representations and would differ from all other suffixes. One would expect then that there would be five surface variants altogether but since one surface variant of the binary version is identical to a variant of the ternary version of the suffix, we end up with four different alternants. The morpheme classes and an example of the two versions of the "quaternary" suffix are shown in (61)
This way no extra constraints would be necessary to account for the so-called quaternary alternations: everything would be taken care of by the constraints proposed by Ringen and Vago (to appear). The stems would select for the appropriate version of the “quaternary” suffix according to their being either marked or unmarked for lowering in the lexicon. Then GEN would generate all the possible output candidates which in turn would be evaluated by EVAL. This is shown in (62):

(62)\[sültek 'roast pl.'\]

\[\text{Input: } R -L +L\]

\[\text{LEXICON: } \text{fült} + Ak\]

\[(\text{lowering})\]
<table>
<thead>
<tr>
<th></th>
<th>*tA</th>
<th>Short e</th>
<th>LO/R</th>
<th>ID-IOharm/root</th>
<th>Align-R</th>
<th>MAX$_{subseg}$/root</th>
<th>MAX$_{subseg}$ Spec</th>
<th>No Gap</th>
<th>Link [Round]</th>
<th>ID-IOback</th>
<th>ID-IOround</th>
<th>åö</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
<td><img src="image3" alt="Diagram" /></td>
<td><img src="image4" alt="Diagram" /></td>
<td><img src="image5" alt="Diagram" /></td>
<td><img src="image6" alt="Diagram" /></td>
<td><img src="image7" alt="Diagram" /></td>
<td><img src="image8" alt="Diagram" /></td>
<td><img src="image9" alt="Diagram" /></td>
<td><img src="image10" alt="Diagram" /></td>
<td><img src="image11" alt="Diagram" /></td>
<td><img src="image12" alt="Diagram" /></td>
</tr>
<tr>
<td>b.</td>
<td><img src="image13" alt="Diagram" /></td>
<td><img src="image14" alt="Diagram" /></td>
<td><img src="image15" alt="Diagram" /></td>
<td><img src="image16" alt="Diagram" /></td>
<td><img src="image17" alt="Diagram" /></td>
<td><img src="image18" alt="Diagram" /></td>
<td><img src="image19" alt="Diagram" /></td>
<td><img src="image20" alt="Diagram" /></td>
<td><img src="image21" alt="Diagram" /></td>
<td><img src="image22" alt="Diagram" /></td>
<td><img src="image23" alt="Diagram" /></td>
<td><img src="image24" alt="Diagram" /></td>
</tr>
<tr>
<td>c.</td>
<td><img src="image25" alt="Diagram" /></td>
<td><img src="image26" alt="Diagram" /></td>
<td><img src="image27" alt="Diagram" /></td>
<td><img src="image28" alt="Diagram" /></td>
<td><img src="image29" alt="Diagram" /></td>
<td><img src="image30" alt="Diagram" /></td>
<td><img src="image31" alt="Diagram" /></td>
<td><img src="image32" alt="Diagram" /></td>
<td><img src="image33" alt="Diagram" /></td>
<td><img src="image34" alt="Diagram" /></td>
<td><img src="image35" alt="Diagram" /></td>
<td><img src="image36" alt="Diagram" /></td>
</tr>
<tr>
<td>d.</td>
<td><img src="image37" alt="Diagram" /></td>
<td><img src="image38" alt="Diagram" /></td>
<td><img src="image39" alt="Diagram" /></td>
<td><img src="image40" alt="Diagram" /></td>
<td><img src="image41" alt="Diagram" /></td>
<td><img src="image42" alt="Diagram" /></td>
<td><img src="image43" alt="Diagram" /></td>
<td><img src="image44" alt="Diagram" /></td>
<td><img src="image45" alt="Diagram" /></td>
<td><img src="image46" alt="Diagram" /></td>
<td><img src="image47" alt="Diagram" /></td>
<td><img src="image48" alt="Diagram" /></td>
</tr>
<tr>
<td>e.</td>
<td><img src="image49" alt="Diagram" /></td>
<td><img src="image50" alt="Diagram" /></td>
<td><img src="image51" alt="Diagram" /></td>
<td><img src="image52" alt="Diagram" /></td>
<td><img src="image53" alt="Diagram" /></td>
<td><img src="image54" alt="Diagram" /></td>
<td><img src="image55" alt="Diagram" /></td>
<td><img src="image56" alt="Diagram" /></td>
<td><img src="image57" alt="Diagram" /></td>
<td><img src="image58" alt="Diagram" /></td>
<td><img src="image59" alt="Diagram" /></td>
<td><img src="image60" alt="Diagram" /></td>
</tr>
<tr>
<td>f.</td>
<td><img src="image61" alt="Diagram" /></td>
<td><img src="image62" alt="Diagram" /></td>
<td><img src="image63" alt="Diagram" /></td>
<td><img src="image64" alt="Diagram" /></td>
<td><img src="image65" alt="Diagram" /></td>
<td><img src="image66" alt="Diagram" /></td>
<td><img src="image67" alt="Diagram" /></td>
<td><img src="image68" alt="Diagram" /></td>
<td><img src="image69" alt="Diagram" /></td>
<td><img src="image70" alt="Diagram" /></td>
<td><img src="image71" alt="Diagram" /></td>
<td><img src="image72" alt="Diagram" /></td>
</tr>
<tr>
<td>g.</td>
<td><img src="image73" alt="Diagram" /></td>
<td><img src="image74" alt="Diagram" /></td>
<td><img src="image75" alt="Diagram" /></td>
<td><img src="image76" alt="Diagram" /></td>
<td><img src="image77" alt="Diagram" /></td>
<td><img src="image78" alt="Diagram" /></td>
<td><img src="image79" alt="Diagram" /></td>
<td><img src="image80" alt="Diagram" /></td>
<td><img src="image81" alt="Diagram" /></td>
<td><img src="image82" alt="Diagram" /></td>
<td><img src="image83" alt="Diagram" /></td>
<td><img src="image84" alt="Diagram" /></td>
</tr>
</tbody>
</table>
As we can see in the tableau in (62), the constraint hierarchy will select the actual surface form as optimal if the underlying form of the quaternary suffix is properly selected by the root in the lexicon.

However, one might have objections to the suppletion analysis. In the case of suppletion one would expect possibly very different underlying forms appearing in different environments. Interestingly, this is not what we find in Hungarian. On the one hand there is a principled difference between the “two underlying forms” of quaternary suffixes, namely one UR would always have a mid vowel while the other one would always have a low vowel, a strange coincidence. On the other hand these “different underlying forms” would occur in exactly the same position, i.e. following lowering morphemes, another odd coincidence. Thus this regular difference between the two possible underlying representations of quaternary suffixes and the regularity in their appearance, i.e. mid vowel version after normal stems, low vowel version after lowering stems, strongly suggests that these are not cases of suppletion. For this reason we have to consider other morphological treatments of the phenomenon.

In the next subsection I will consider a different morphological approach to the problem, in which quaternary suffixes have only one underlying representation and a morphologically conditioned constraint is utilised to distinguish between quaternary suffixes after lowering and non-lowering stems.
3.4.2 Lowering as a morphophonological constraint

To avoid the necessity of having two underlying representations in the lexicon for quaternary suffixes, I propose an approach different from the above. In this case, quaternary suffixes have only one underlying representation, just like the rest of the suffixes, and their alternating vowels are specified as [-high] and [+round] underlyingly but unspecified for the feature [low]. They will gain their backness specifications from the stem they attach to just like all the alternating suffixes. The selection of the proper value of backness is done by the constraints proposed in Ringen and Vago (to appear). The same happens to roundness specifications: the constraints in Ringen and Vago (to appear) can take care of that, too. Furthermore, I propose a constraint that forces lowering morphemes to have a [+low] quaternary suffix. This analysis will also make use of the IDENT$_{Low}$ constraint as in (53). The constraint of Lowering is formulated as in (63):

(63) Lowering
(ALIGN right lowering morpheme, left [+low])

The right edge of a lowering morpheme is aligned with the left edge of [+low] in a subsequent suffix.

The constraint as formulated in (63) makes reference to the morphologically marked class of lowering morphemes this way being a morphophonological interface
constraint. The following tableaux show the way Lowering and other constraints interact to yield the correct surface forms:

<table>
<thead>
<tr>
<th>TÜZEK ‘fire pl.’</th>
<th>IDENT_{low}</th>
<th>Lowering</th>
<th>IDENT_{round}</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. tüzêk</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b. tüzök</td>
<td></td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>c. tüzêk^{58}</td>
<td></td>
<td>!</td>
<td>*</td>
</tr>
</tbody>
</table>

Lowering >> IDENT_{round}

Tableau (64) shows that Lowering has to dominate IDENT_{round}. Should they be ranked the opposite way, candidate (b) would be the winning candidate against the actual surface form, candidate (a).

<table>
<thead>
<tr>
<th>KUTAK ‘well pl.’</th>
<th>IDENT_{low}</th>
<th>Lowering</th>
<th>IDENT_{round}</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. kutêk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. kutok</td>
<td></td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>c. kutak</td>
<td></td>
<td></td>
<td>!</td>
</tr>
</tbody>
</table>

Note that a possible candidate lacking the suffix vowel completely is not considered in the following tableaux in this chapter. Such candidates would always violate the constraints of the MAX constraint family penalizing deletion of segmental or subsegmental material (cf. Zoll (1996) and Ringen and Vago (to appear)). Chapter 4 discusses candidates without suffix vowels in detail and it also attempts to explain why the behaviour of the accusative is different in this respect from that of other quaternary suffixes.

Lowering morphemes are indicated with a subscripted capital ‘L’.

This candidate also violates the constraint LO/R proposed by Ringen and Vago (to appear). LO/R requires low back short vowels to be [+round] and all other low vowels to be [-round].
As we can see in tableau (65), the quaternary suffix must be low following a lowering stem, like [kuː:t] 'well'. Candidates (a) and (b) only differ in their satisfying or violating Lowering. Candidate (a) does not violate any of the constraints and thus wins.

Tableau (66) shows a lowering root followed by a non-lowering suffix and a quaternary suffix:

magasságot 'height acc.'

<table>
<thead>
<tr>
<th>(66)</th>
<th>UR: mőgő+ja:g+Ot</th>
<th>IDENT\textsubscript{Low}</th>
<th>Lowering</th>
<th>IDENT\textsubscript{round}</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>mőgő+ja:g+ot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>mőgő+ja:g+ot</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>mőgő+ja:g+at</td>
<td></td>
<td></td>
<td>*!</td>
</tr>
</tbody>
</table>

Notice that candidate (b) does not violate Lowering because the vowel in the second suffix is lowered although the suffix is not attached to a lowering morpheme. Our constraint hierarchy cannot unambiguously select the optimal candidate. This example thus indicates the need for another pair of constraints:

(67) *o Do not be a short back mid vowel
(68) *o Do not be a short back low vowel

If we rank (68) above (67), then short back mid vowels will be preferred to short back low vowels by the grammar. This is exactly what we need for our analysis\textsuperscript{60} and this

---

\textsuperscript{59} Note that the behaviour of the suffix vowel in the accusative suffix /-Ot/ is different from that of other quaternary suffix vowels. The vowel of the accusative can be dropped if it follows a non-lowering stem
constraint is also supported by the fact that low back rounded vowels are typologically much rarer than their mid counterparts. (69) shows the results of adding the two markedness constraints to the constraint hierarchy:

<table>
<thead>
<tr>
<th>magasságot 'height acc.'</th>
<th>UR: mőgőj+[a:ɡ]+Vt</th>
<th>IDENT&lt;sub&gt;Low&lt;/sub&gt;</th>
<th>Lowering</th>
<th>IDENT&lt;sub&gt;Round&lt;/sub&gt;</th>
<th>*ɛ</th>
<th>*o</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. † mőɡo]+a:ɡ+ot</td>
<td></td>
<td>*️⃣</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. mőɡo]+a:ɡ+ɔt</td>
<td></td>
<td>***!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. mőɡo]+a:ɡ+at</td>
<td></td>
<td>*!</td>
<td></td>
<td>*️⃣</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*ɛ >> *o

Since the markedness constraints are ranked below Lowering and the rest of the constraints, adding them does not influence the selection of the optimal candidates in the previous tableaux.

The tableau in (70) shows the way the constraint hierarchy selects the actual surface form if a lowering stem is followed by a non-quaternary suffix like the allative, i.e. that no suffix vowels, except for the ones in quaternary suffixes, may be lowered, a result of ranking IDENT<sub>Low</sub> above Lowering:<ref>

which ends in l, r, j, n, f, s, z, ŋ or ŋ, i.e. after coronal fricatives and coronal sonorants, clearly an interaction with some constraints on the possible codas in the language.

Note that Polgárdi and Rebrus (1998) argue that [ɔ] is the default vowel in Hungarian.

It is because all suffixes except quaternary ones are assumed to be specified for the feature [low]; hence lowering of the vowel in a non-quaternary suffix would violate the IDENTITY<sub>Low</sub> constraint.
As we can see, candidate (b) violates both IDENT\textsubscript{Low} and *_sheet. Thus we can conclude that the constraint ranking only allows the lowering of quaternary suffix vowels but not others. We also saw that if a quaternary suffix is attached to a non-lowering morpheme, the quaternary suffix vowel will be mid and not low, an effect of the ranking of the markedness constraints.

In this section I outlined two different approaches implementing the morphological marking of lowering morphemes. I conclude that the approach with the Lowering constraint is to be preferred because on the one hand it selects the actual surface forms in every case, and on the other hand, it does not involve positing two different underlying representations for every quaternary suffix. Instead, quaternary suffixes only differ from the rest of the suffixes in that they are not specified for the feature [low] underlyingly.

The typological consequences of the Lowering constraint depend on whether we consider it part of UG, i.e. a universal constraint, or a language specific constraint. The
original party line of OT claims that all constraints are part of the universal grammar and languages only differ in the rankings of the constraints. If we follow this train of thought, we can still claim that this constraint is very low ranked in other languages and hence completely ineffective. It would be very strange however, if a constraint is really used by only one language in the sense that it actually selects between candidates, i.e. the decision between candidates is passed on to this constraint. Since I know of no other language that displays a similar phenomenon and thus would make use of a similar constraint, I am tempted to say that Lowering is a language specific and not universal constraint. This constraint and its ranking with respect to other constraints are learned by language learners and not part of UG. This might present a problem for OT but one might argue that while purely phonological constraints are universal, present in the grammatical constraint hierarchy in every language, morphological constraints that are necessary to treat exceptional forms do not belong to this universal set of constraints but are language specific.

3.5. Conclusion

I have argued that there is no real quaternary harmony in Hungarian; instead, there is binary and ternary harmony intertwined with the interaction of morphological marking of a class of morhemes, i.e. lowering morphemes, and a Lowering constraint. In the case of so-called "quaternary harmony" there is one underlying form for each morpheme, which surfaces as a ternary suffix after non-lowering stems and as binary after lowering
stems. Thus "quaternary harmony" is governed by the interaction of the constraints of Lowering, IDENT\textsubscript{Low}, *o, *e, and the constraints governing binary and ternary harmony.

As a consequence of our being forced to a morphological analysis by the theory itself, we can argue that Optimality Theory is not an omnipotent "device" as claimed by some opponents of the framework. Indeed, it is much more restricted in a sense than derivational theories since it does not allow for two different solutions to the same phenomenon. As I demonstrated, and as also demonstrated in Kornai (1987) and Nádasdy and Siptár (1994), it is possible to give a purely phonological account of all three kinds of suffix alternations in a derivational theory. I also noted that a morphological analysis is also allowed in derivational theories (cf. Vago, 1980). Thus the phenomenon of quaternary suffix alternations in Hungarian can be treated as a morphologically or phonologically triggered alternation in derivational theories.

Thus Hungarian quaternary suffix vowel harmony seems to be one of the cases where Optimality Theory and an OT analysis is more restricted than a derivational one, a strong argument in favour of OT, particularly because the phonological derivational account requires a great number of assumptions concerning abstract intermediate vowels, adjustment rules, and rule ordering.

In the following chapters I will explore the consequences of the analysis of lowering presented above. In chapter 4. I will consider the variants of quaternary suffixes lacking a vowel.
4. Vowel-zero suffix alternations

As we saw in chapter 1, suffixes that participate in quaternary vowel harmony have five surface realisations altogether: four with different vowels and one without the so-called linking vowel. In this chapter I will reconsider the facts of quaternary vowel harmony in the light of data from these vowel-zero alternations. The theoretical framework will be provided by Zoll’s (1996) treatment of subsegments Törkenczy’s (1994) analysis of Hungarian codas and Padgett’s (1995) and Lombardi’s (1995b) analyses of place in codas.

4.1. The data

In the following table we find a comparison of the behaviour of the suffix vowel in different suffixes. The accusative is treated separately while the plural and the possessive represent two subgroups of the rest of quaternary suffixes.62

---

62 There are some consonant final lowering roots, all liquid final, that take the plural with a (low) suffix vowel, but are followed by the accusative without a vowel. These are oldal ‘side’ oldalt, oldalak, szökőár ‘tidal wave’ szökőárt szökőárak, raktár ‘warehouse’ raktárt, raktárak. Such roots are exceptional and must be marked in the Lexicon either for taking the accusative without a vowel or for constraint reranking.
From the point of view of the stems, the table in (1) can be summed up as follows:

lowering stems ending in consonants are always followed by a linking vowel in
quaternary suffixes as shown by the accusative, the plural and the possessive. There is no linking vowel after normal stems ending in a vowel as shown by row 2. Non-lowering stems ending in a consonant and lowering stems ending in a vowel however behave in a complex way. The vowel in the accusative suffix is sometimes dropped after non-lowering stems ending in a consonant although that does not happen to the plural or the possessive. Something similar happens to lowering stems ending in a vowel: the vowel is dropped in the accusative but not in the plural suffix. Note however, that the vowel is dropped in the possessive as well. Summing up from the point of view of the suffixes we can say that in the plural and all other quaternary suffixes except the accusative, there is always a vowel if the stem ends in a consonant. Quaternary suffixes, except the accusative and the possessive type, have a vowel after vowel final lowering stems but not after vowel final normal stems. The accusative is realised with a vowel after lowering stems ending in consonants and some normal stems ending in consonants but never after vowel final stems, except for one example, \[\text{hût/hû́t} \] \[\text{[hûːt]/[hûːɛt]} \] 'faithful'.

There are several questions to be addressed here. The first one concerns where and why the accusative suffix vowel is dropped following a normal, non-lowering stem. The second one is the problem of vacillation of the presence-absence of the accusative suffix vowel after lowering stems ending in a vowel, as in \[\text{hû́t}] vs \[\text{hû́ɛt}]. And probably the most important question is that of the difference between the accusative, the

64 The original stem \[\text{hibo} \] also undergoes low vowel lengthening, which applies to the two low vowels of the Hungarian vowel system, \(\varepsilon \) and \(\varepsilon \), stem finally before any suffix.
possessive and other quaternary suffixes. Why does the accusative, or rather the vowel in the accusative (and to a certain extent in the possessive) behave in a way different from that of the rest of quaternary suffixes? What is the reason for the relative instability of the vowel in the accusative (and the possessive)? Based on the above data the vowel in the accusative might seem to be an epenthetic vowel but the one in the rest of quaternary suffixes does not. If it were true that the vowel in the accusative only appears for reasons of syllable well-formedness then we could treat it as epenthetic, i.e. not being present in the underlying representation of the suffix while the vowel in the rest of quaternary suffixes would be underlyingly present. I will explore these possibilities in the following sections.

4.2. Consonant final stems and syllable structure

4.2.1. The data

Let us first examine stems ending in a sequence of a vowel followed by a single consonant. Column 1 shows examples of non-lowering stems followed by the accusative. Column 3 shows similar lowering stems. The middle column contains examples of monomorphemic forms ending in a $-VCt$ sequence for the sake of comparison.
<table>
<thead>
<tr>
<th>Non-lowering + Acc.</th>
<th>Monomorphemic Ct</th>
<th>Lowering + Acc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>lop+ot 'sheet'</td>
<td>rstcpt 'recipe'</td>
<td>la:b+ot 'foot'</td>
</tr>
<tr>
<td>ba:b+ot 'puppet'</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>lom+ot 'lumber'</td>
<td>terempt 'create'</td>
<td>korom+ot 'my arm'</td>
</tr>
<tr>
<td>gro:f+ot 'count'</td>
<td>sof 'gravy'</td>
<td>-</td>
</tr>
<tr>
<td>ta:v+ot 'distance'</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>hot+ot 'six'</td>
<td>ot: 'there'</td>
<td>ha:t+ot 'back'</td>
</tr>
<tr>
<td>pod+ot 'bench'</td>
<td>-</td>
<td>vod+ot 'game'</td>
</tr>
<tr>
<td>sa:s+t 'Saxon'</td>
<td>kost 'food'</td>
<td>-</td>
</tr>
<tr>
<td>holmōz+t 'set'</td>
<td>-</td>
<td>ma:z+ot 'glaze'</td>
</tr>
<tr>
<td>pa:t+ot 'brine'</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>tēlfon+t 'telephone'</td>
<td>pa:nt 'band'</td>
<td>-</td>
</tr>
<tr>
<td>ba:l+t 'ball'</td>
<td>bolt 'shop'</td>
<td>fobl+ot 'wall'</td>
</tr>
<tr>
<td>ta:je:r+t 'plate'</td>
<td>fürt 'bunch'</td>
<td>var+ot 'fortress'</td>
</tr>
<tr>
<td>ma:j+t 'other'</td>
<td>moft 'now'</td>
<td>hoj+ot 'stomach'</td>
</tr>
<tr>
<td>ru:ʒ+t 'lipstick'</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>botf+ot 'bear cub'</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>dʒordʒ+ot 'George'</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>romoc+ot 'trash'</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>fɔj+ot 'frost'</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>la:j+t 'girl'</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>baj+t 'charm'</td>
<td>höjt 'drive'</td>
<td>-</td>
</tr>
<tr>
<td>ra:k+ot 'crab'</td>
<td>økt 'nude figure'</td>
<td>-</td>
</tr>
<tr>
<td>rɔg+ot 'suffix'</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>dox+ot 'mustiness'</td>
<td>jɔxt 'yacht'</td>
<td>-</td>
</tr>
</tbody>
</table>
As it can be seen in table (2), all lowering stems take the accusative with the low vowel. There are no cases of lowering stems followed by a single [-t] without a suffix vowel. However, there is a large number of non-lowering stems ending in -VC which take the accusative without a suffix vowel. It seems that non-lowering stems ending in [s], [z], [ʃ], [ʒ], [l], [r], [j], [n], [ŋ], i.e. in coronal fricatives and coronal sonorants drop the vowel of the accusative suffix. In analyzing this and other related phenomena I will follow Törkenczy’s (1994) analysis of Hungarian codas outlined below and will attempt to „optimize” it, i.e. apply it in the framework of OT.

4.2.2. Stems ending in a single consonant

Törkenczy (1994) claims that codas in Hungarian can be empty, non-branching and branching. Here I will focus primarily on non-branching and branching codas. Empty codas, i.e. stems ending in a vowel will be dealt with in subsequent sections. The well-formedness conditions proposed by Törkenczy and relevant to the problems discussed here are the following:

(3) *Fricative+Fricative

(4) (a) *Stop+Stop,
(b) *Affricate+Affricate,
(c) *Affricate+Stop,
(d) *Stop + Affricate

(5) (a) *Fricative + Affricate,
(b) *Affricate + Fricative

(6) *Fricative + Stop except if both coronal

(7) *Nasal + Stop only if homorganic or /pt/, /pd/

In the following I will sketch an analysis of the possible coda clusters of Hungarian in Optimality Theory along the lines of Padgett (1995). Since coda clusters usually include almost exclusively coronals as the final segment, Padgett (1995) assumes that this markedness of Place is due to a universally ranked family of markedness constraints.

(8) *Dorsal No dorsal segments.

(9) *Labial No labial segments.

(10) *Coronal No coronal segments.

(11) *Dorsal, *Labial >> *Coronal

The ranking of *Dorsal and *Labial above *Coronal reflects the fact that coronal segments are less marked and hence, being the "cheapest" place of articulation, function as the default place for consonants.

---

65 A precise and thorough analysis of Hungarian coda clusters is out of the scope of this paper. For discussions on Hungarian codas see Törkenczy (1994) and Siptár and Törkenczy (1998).
Candidate (c) in tableau (12) violates MAXseg because of the unparsed suffix consonant and is thus eliminated. Candidates (a) and (b) do not violate MAXseg or the higher ranking markedness constraint on place. For this reason, the decision is passed down to the lowest ranked markedness constraint, *Coronal. Candidate (a) contains two coronal features while (b) contains three. Hence (a) is preferred by the hierarchy.

We can argue that in order to capture the generalisation that affricates never occur in branching codas the following two constraints have to be utilised.

(13) NoComplex    No complex codas.

(14) *Affricate    No affricates.

66 We can assume that the accusative does not have a vowel underlyingly since the vowel only occurs if the stem final consonant and the -t would form an illegitimate coda cluster and after consonant final lowering stems. This shows that the vowel is epenthetic. For details see the section 4.3. *Vowel final stems* of the present chapter.

67 Note that this candidate also violates DEPseg.
However, since affricates and branching codas occur (separately), it is best if we conjoin the two constraints and use them as one block of constraints in the tableaux as suggested by Smolensky (1995).

(15) Local conjunction (Smolensky 1995)

"The local conjunction of $C_1$ and $C_2$ in domain $D$, $C_1$ & $C_2$, is violated when there is some domain of type $D$ in which both $C_1$ and $C_2$ are violated."

A candidate violates a pair of conjoined constraints if and only if it violates both constraints. NoComplex&*Affricate is then a conjunctive constraint that rules out affricates in a branching coda. The conjoined constraint is violated only by a segment which is both an affricate AND in a branching coda. This is equal to the markedness constraint “No affricate in complex coda”.

<table>
<thead>
<tr>
<th>Bécset 'Vienna acc.'</th>
</tr>
</thead>
<tbody>
<tr>
<td>(16) UR: be:tf+t</td>
</tr>
<tr>
<td>MAXseg</td>
</tr>
<tr>
<td>No Complex &amp; *Aff</td>
</tr>
<tr>
<td>*Cor</td>
</tr>
<tr>
<td>a. be:tf</td>
</tr>
<tr>
<td>!</td>
</tr>
<tr>
<td>*</td>
</tr>
<tr>
<td>*</td>
</tr>
<tr>
<td>b. be:tf</td>
</tr>
<tr>
<td>*</td>
</tr>
<tr>
<td>*</td>
</tr>
<tr>
<td>*</td>
</tr>
<tr>
<td>c. be:tf</td>
</tr>
<tr>
<td>!</td>
</tr>
<tr>
<td>*</td>
</tr>
<tr>
<td>*</td>
</tr>
<tr>
<td>MAXseg, NoComplex&amp;*Affricate =&gt; *Cor</td>
</tr>
</tbody>
</table>

Candidate (16.c) has an unparsed segment and violates MAXseg. Candidate (a) on the other hand violates NoComplex&*Affricate as it contains an affricate in a branching coda. Since candidate (b) does not violate either of these constraints and all candidates violate *Labial, candidate (b) is allowed to win.

The observation that Nasal+stop clusters can only occur if the members of the cluster are homorganic or if the nasal is palatal [p] and the stop is alveolar [t] or [d] can be captured if we assume that there is a constraint requiring that nasals be homorganic with an immediately following stop as suggested by Padgett (1995).

(17) Nasal Place Assimilation
In every sequence NC, every place linked to C is linked to N, and vice versa.

rémet 'ghost acc.'

(18) | UR:   | MAXseg | NPA | *Dor | *Lab | *Cor |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>re:m+t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. re:mt</td>
<td></td>
<td>!</td>
<td>*</td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>b. &lt;re:.m sé</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>c. re:m</td>
<td></td>
<td>!</td>
<td>*</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

MAXseg >> *Cor
Candidate (18.a) has an NC cluster in which the Place node is not multiply linked and thus violates NPA. Candidate (c) violates MAXseg because of the unparsed consonant. This way candidate (b), the actual surface form, wins again.

(19) * Identical Manner nodes cannot be multiply linked in a coda\(^{69}\).

\[
\begin{array}{|c|c|c|c|c|}
\hline
& \text{UR:} & \text{MAX} & *\text{Identical} & *\text{Dor} & *\text{Lab} & *\text{Cor} \\
\hline
\text{bok} + \text{t} & & & & & & \\
\hline
\text{a. } \text{bōkot} & & * & * & * & * \\
\hline
\text{b. } \text{bōkt} & & *! & * & * & * \\
\hline
\text{c. } \text{bok} & & *! & * & * \\
\hline
\end{array}
\]

In (20) candidate (b) violates *Identical because two coda segments share the same Manner node. Note that this output form is possible with separate Manner nodes but that would violate the Obligatory Contour Principle McCarthy (1986), which prohibits adjacent identical elements at the melodic level. Candidate (c) has an underlying segment unparsed and thus violates MAXseg. Hence candidate (a) wins.

---

\(^{69}\) Note that this constraint does not only refer to affricate+affricate, fricative+fricative and stop+stop clusters in codas, but also to liquid+liquid and nasal+nasal clusters. The prediction then is that in Hungarian there are no instances of segments with identical manner nodes in codas and this prediction is born out. There are only a few exceptions, e.g. gehören 'girl', fürj 'quail', füjl 'file'.

83
To cover the generalisation in (6), there has to be a constraint prohibiting non-coronal Fricative+Stop coda clusters, cases when at least one of the two segments is not coronal\textsuperscript{70}.

(21) Share (Place) Fricative+Obstruent sequences share the Place node in codas.

\begin{tabular}{|l|c|c|c|c|}
\hline
\textit{UR: jaːv+t} & \text{MAX seg} & \text{Share} & \text{*Dor} & \text{*Lab} & \text{*Cor} \\
\hline
a. \textit{ʃaː.vot} & & * & ** & & \\
\hline
b. \textit{ʃaːvt\textsuperscript{71}} & ! & * & ** & & \\
\hline
c. \textit{ʃaːv} & ! & * & * & & \\
\hline
\end{tabular}

In tableau (22), candidate (c) violates MAXseg because of the unparsed suffix segment while candidate (b) contains a coda fricative+stop cluster with two separate Place nodes. This way (b) violates Share (Place), which requires that there be only one Place node in a fricative+stop coda cluster. Candidate (a) does not violate the higher ranking constraints and thus wins.

\textsuperscript{70} Note again, that there are monomorphemic stems violating this constraint, e.g. baszk [bɔsk] 'Basque'. I assume that there is a higher ranking constraint IDENTITY(Place) which forces the preservation of these coda clusters. The important fact is there cannot be coda clusters created by suffixation that violate this constraint. It is cheaper to insert a vowel than change the Place feature of the consonants.

\textsuperscript{71} Note that this form is also ruled impossible by a constraint requiring that obstruent clusters share their voice specification.
4.2.3. Stems ending in consonant clusters

Let us turn our attention to words ending in -VCC sequences\(^{72}\). Some such words can still take the accusative without the linking vowel though they always take other quaternary suffixes with the vowel, of course. Table (23) shows examples of the occurring CC+t clusters:

\[
\begin{array}{ll}
\text{(23)} & \text{pe:nd}^2+t \quad \text{‘money’} \\
\text{ens}^t & \text{‘U.N.’} \\
\text{brilia:n}^t & \text{‘brilliant’} \\
\text{kons}^t & \text{‘concern’} \\
\text{görl}^t & \text{‘girl’} \\
\text{fe:dervejs}^t & \text{‘talcum powder’} \\
\text{pøj3}^t & \text{‘shield’} \\
\text{komba:jn}^t & \text{‘combine harvester’} \\
\end{array}
\]

Note that there are only two types of forms that violate the constraints discussed so far: the one with the coda affricate, i.e. \text{pe:nd}^t \(^{73}\) ‘money acc.’, and the one with a coda liquid cluster, i.e. \text{gör}l ‘girl acc.’. However, the rest of the cluster final words behave exactly the same way as words ending in single consonants do as indicated in tableau (24) with one of the stems.

\(^{72}\) There are no roots ending in more than two consonants that can take the accusative suffix without a suffix vowel.

\(^{73}\) Note that this form, similarly to /pøj3+t/ undergoes voice assimilation and the voiced segment becomes voiceless.
Candidate (24.c) violates MAXseg because the suffix consonant is not present in the output. Candidates (a) and (b) fare equally well on the higher ranking constraints. They both violate Labial once because of the word initial labial stop. However, while (b) only violates *Coronal once since it has three consonants linked to one common Place node, (a) violates it twice because of the two separate Place nodes for [jɔ] and [t]. This way candidate (b) is allowed to win.

Let us now take a look at the forms that seem to violate some of the constraints governing syllable well-formedness. Let us first consider the word containing a coda affricate in a branching coda.

---

74 We have to note again that a candidate phonetically identical with (b) is possible with two or three Place nodes for the cluster. However, that would violate *Coronal more times than (b) and it would also violate the OCP.
The stem in the input in (25) ends in a nasal+affricate cluster violating the constraint penalizing affricates in branching codas. Thus the most faithful candidate in (b), which only differs from the input in the voicing of the affricate, violates NoComplex&*Affricate. Candidate (c) violates MAXseg because of the unparsed suffix consonant. This way candidate (a) incorrectly wins. The actual surface form is (b). One might be tempted to say that the analysis is incorrect, but we have to note that this is just one pronunciation variant of this word. Let us consider the other possible variant in (26).

Note that in the forms of this word where the word final affricate is adjacent to the suffix –t, the affricate assimilates in voicing to the stop and becomes [t^87].
In candidate (c) the suffix consonant remains unparsed; hence this form violates MAXseg. Candidates (a) and (b) only violate the place markedness constraints. Both of them violate *Labial once, but while (a) violates *Coronal twice, (b) violates it only once. This allows (b), the actual surface form, to win. There is another factor that argues that the actual surface form in (25), i.e. candidate (b) is a marked one: other nasal+affricate final (non-lowering) stems take the accusative with a vowel, e.g. koncot [kont⁶ot] 'bone acc.', láncot [la:nt⁶ot] 'chain acc.', Kunczot [kunt³ot] 'id. acc.'. One of these stems is shown in tableau (27) with the accusative.

<table>
<thead>
<tr>
<th>(27)</th>
<th>UR: konct³⁺t</th>
<th>MAXseg</th>
<th>No Complex &amp; *Aff</th>
<th>*Dor</th>
<th>*Lab</th>
<th>*Cor</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>kont³t</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>kon.t³⁰t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>c.</td>
<td>kont³</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Based on the above arguments it can be claimed that pénzt [pent³t] 'money acc.' is an exceptional form. We can argue that it is marked for constraint reranking, i.e. this form requires the partial ranking NoComplex&*Affricate >> *Coronal to be reversed into *Coronal >> NoComplex&*Affricate. Then the actual surface form will be selected as optimal in (25).
Although the constraint hierarchy does not select the actual surface form as optimal, this very form does not present a real problem for the theory since there is only a very limited number of words, about three, in the language (and some of their suffixed forms) that end in liquid coda clusters. These forms then would be marked as exceptional similarly to the input in (25). In this case one we can argue that these forms are marked for reranking *Identical and *Coronal so that *Coronal would have to dominate *Identical for these words. Then the actual candidate (a) would be selected as optimal by the hierarchy.

4.2.4 Geminates

In the previous subsections the discussion have not covered cases where sequence of the suffix consonant and the word final consonant would result in a geminate. Let us now turn our attention to geminates in Hungarian as discussed in Törkenczy (1994).
True geminates, i.e. one consonantal melodic material linked to two timing units or X-slots on the skeleton, can occur only intervocally or postvocally at the end of a phonological phrase as suggested by the data.

(29)  a. lottó [lot:o:] 'lottery'  b. mappa [mɔpː] 'folder'
     e. hattal [hotːol] 'six instr.'  f. képpel [keːpːel] 'picture instr.'

(30)  a. ott [otː] 'there'  b. passz [pɔːsː] 'pass'
     c. varr [vɔːrː] 'sew'  d. hall [holː] 'hear'
     e. maradt [mɔrɔtː] 'stayed 3rd sg.'  e. húzz [huːzː] 'pull 2nd sg. imp. subj.'

Both in (29) and (30), the examples in (a)-(d) are monomorphemic, while examples (e) and (f) are plurimorphemic and contain a geminate the first part of which belongs to the stem while the second part belongs to the suffix.

The case exemplified in (29) is not problematic since the first part of the geminate always belongs to the coda of the first syllable while the second one belongs to the onset of the following one. This way ill-formed codas, i.e. ones that do not observe the constraints above, never appear.

The examples in (30) on the other hand might be problematic because the geminates occur word finally and thus they have to be syllabified into the last syllable of
the word. Törkenczy (1994) claims that whenever there is a word final geminate, its first part is syllabified in the coda while the second part will belong to the appendix of the syllable. This applies to all instances of word final geminates in monomorphemic words, i.e. when the two parts of the geminate belong to the same morpheme.

Let us see what our constraints that govern coda well-formedness predict for monomorphemic forms in like the ones in (30.a)-(d).

In (31) I assume that the representation of the geminate in the UR of the word is a consonantal root node linked to two X-slots on the skeleton. This is because Lexicon Optimization prefers this form to two underlyingly separate root nodes. The optimal candidate created from the latter UR would violate the OCP while the actual surface form (31.b), which is not unambiguously selected as optimal in this tableau, does not. Candidate

<table>
<thead>
<tr>
<th>(31)</th>
<th>UR: ot:</th>
<th>MAX seg</th>
<th>*Identical</th>
<th>*Dor</th>
<th>*Lab</th>
<th>*Cor</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>ot</td>
<td>!</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b.</td>
<td>ot</td>
<td>!</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>ost</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>d.</td>
<td>otot</td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>**!</td>
</tr>
</tbody>
</table>

In (31) I assume that the representation of the geminate in the UR of the word is a consonant root node linked to two X-slots on the skeleton. This is because Lexicon Optimization prefers this form to two underlyingly separate root nodes. The optimal candidate created from the latter UR would violate the OCP while the actual surface form (31.b), which is not unambiguously selected as optimal in this tableau, does not. Candidate

---

76 Note that when words are inserted into a sentence, the second part of the word final geminate might be resyllabified into the onset of the first syllable of the following word.

77 Geminate consonants are indicated with a colon after the consonant symbol. Fake geminates, i.e. two adjacent identical root nodes are represented by a double consonant symbol.
(31.a) violates MAXseg because of the deleted X-slot on the skeleton\textsuperscript{78}. Candidates (a), (b) and (c) all violate the markedness constraint against coronal segments, but while (b) and (c) violate it only once, (d) violates it twice and is thus eliminated. To be able to select the optimal unambiguously, another constraint has to be utilised.

(32) IDENTITY (Manner) \textendash\ Input and output segments have identical manner features\textsuperscript{79}.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|}
\hline
UR: & MAX & IDENT & *Dor & *Lab & *Cor \\
& ot: & seg & (Manner) & & & \\
\hline
a. & ot & *! & & & * \\
\hline
b. & \textasciitilde & ot: & & * & \\
\hline
c. & ost\textsuperscript{80} & *! & & * & \\
\hline
d. & o.tot & & & **! & \\
\hline
\end{tabular}
\caption{Tableau (33) shows the effect of adding IDENTITY(Manner) to the constraint hierarchy. Candidate (c) violates IDENT(Manner) because one part of the geminate stop appears as a fricative in the output. This way candidate (b) is correctly allowed to win.}
\end{table}

\textsuperscript{78} I assume that MAXseg is violated both by deleting root nodes and X-slots.

\textsuperscript{79} See footnote 11 about the similar high ranking IDENTITY(Place) constraint that requires that input and output segments have identical specifications for Place features.

\textsuperscript{80} This candidate also violates DEPseg since there is a root node in the output which does not have an input correspondent.
Tableau (34) shows a t-final root followed by the accusative. In the input the two t’s are two separate segments with separate root nodes and features. Candidate (a) violates MAXseg because an input root node, i.e. one of two the identical root nodes of the t’s, does not appear in the output. Candidate (e) violates the same constraint because one of the two t’s remains completely unparsed, i.e. neither the timing slot nor the root node with the linked features appears in the output. Candidate (d) violates IDENTITY(Manner) since an underlying stop corresponds to a surface fricative. Candidate (b) with the fake word final geminate violates the OCP and hence is eliminated. This way candidate (c), the actual surface form, is selected as optimal.

It has to be noted here that this analysis predicts that in Hungarian it is not possible to have a stem final consonant followed by an identical consonant of a subsequent suffix if this cluster is word final. However, there are two cases when that happens. One is the past tense marker -t, the other is the imperative suffix -j. The forms maradt [mɔɾatː] 'stayed 3rd sg.' and vajj [vaːjː] 'scoop 2nd imp. indef.' contradict forms
like hatot [hɔtot] 'six acc.' above. Note that the past tense form never occurs without a vowel following an underlying word final /t/, e.g. látott [la:tot:] 'saw 3rd sg. indef.' and not *[la:t:], kötött [kötőt:] 'knitted 3rd sg. indef.' and not *[köt:]. In maradt, the stem final consonant is /d/ underlyingly and it is realised as [t] because of constraints requiring that obstruent clusters agree in voicing.

These phenomena are not within the scope of this dissertation. Let us just note that these forms are exceptional. We can assume that these suffixes require different rankings of the constraints to yield the correct surface form, i.e. they are marked for constraint reranking.

Summing up the behaviour of the accusative after C-final stems, it seems that the vowel in this suffix acts as if it were epenthetic. The second part of the epenthetic vowel problem is addressed below in the section about V-final stems.

4.3. Vowel final stems

4.3.1. The data

Let us now focus on stems ending in vowels. The behaviour of the plural, possessive and accusative suffixes will be very different from that after consonant-final stems. Table (35) contains examples of normal and lowering stems ending in a vowel followed by the vowel initial plural, accusative, 1st person singular possessive and terminative:
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal stem ending in V</td>
<td>kopu+k</td>
<td>'gate'</td>
<td>kopu+t</td>
<td>kopu+m</td>
<td>kopu+ig</td>
</tr>
<tr>
<td>fô:+k</td>
<td>'head'</td>
<td>fô:+t</td>
<td>fô:+m</td>
<td>fô:+ig</td>
<td></td>
</tr>
<tr>
<td>ji:+k</td>
<td>'ski'</td>
<td>ji:+t</td>
<td>ji:+m</td>
<td>ji:+ig</td>
<td></td>
</tr>
<tr>
<td>fo:+k</td>
<td>'salt'</td>
<td>fo:+t</td>
<td>fo:+m</td>
<td>fo:+ig</td>
<td></td>
</tr>
<tr>
<td>ūprū:+k</td>
<td>'broom'</td>
<td>ūprū:+t</td>
<td>ūprū:+m</td>
<td>ūprū:+ig</td>
<td></td>
</tr>
<tr>
<td>hiba:+k</td>
<td>'mistake'</td>
<td>hiba:+t</td>
<td>hiba:+m</td>
<td>hiba:+ig</td>
<td></td>
</tr>
<tr>
<td>Lowering stem ending in V</td>
<td>sorñū:+ɛk</td>
<td>'terrible'</td>
<td>sorñū:+t</td>
<td>sorñū:+m</td>
<td>sorñū:+ig</td>
</tr>
<tr>
<td>somoru:+ok</td>
<td>'sad'</td>
<td>somoru:+t</td>
<td>somoru:+m</td>
<td>somoru:+ig</td>
<td></td>
</tr>
<tr>
<td>va:roşi:+ok</td>
<td>'urban'</td>
<td>va:roşi+t</td>
<td>va:roşi+m</td>
<td>va:roşi+ig</td>
<td></td>
</tr>
<tr>
<td>ūrtö:+(ɛ)k</td>
<td>'offensive'</td>
<td>ūrtö:t</td>
<td>ūrtö:m</td>
<td>ūrtö:+ig</td>
<td></td>
</tr>
<tr>
<td>ba:nto:+(ɔ)k</td>
<td>'insulting'</td>
<td>ba:nto:+t</td>
<td>ba:nto:+m</td>
<td>ba:nto:+ig</td>
<td></td>
</tr>
<tr>
<td>hū:+ɛk</td>
<td>'faithful'</td>
<td>hū:+(ɛ)t</td>
<td>hū:+m</td>
<td>hū:+ig</td>
<td></td>
</tr>
</tbody>
</table>

Normal stems ending in a vowel always have the plural, the accusative, the possessive and, of course, all other quaternary suffixes, without the suffix vowel. The first three vowel-final lowering stems exhibit a different behaviour: they take the plural with the vowel but the accusative and the possessive without the vowel. It shows again that the vowel of the accusative is quite unstable as compared to that of the plural. The phenomenon is strange, however, since one would expect the quaternary suffix vowel to surface after lowering morphemes even in the accusative and the possessive but it does not. The only exception to this generalization is the very last example, hū [hū:] 'faithful', in which the vowel may surface in the accusative as well, the word vacillating between
taking the accusative with or without the vowel. This example, together with the other vacillating items sértő [Je:rtö:] 'offensive' and bántó [ba:nto:] 'insulting' will be treated as exceptional forms of some kind.

From the above we can conclude that the behaviour of the vowel in the accusative suffix is clearly epenthetic since it only appears if otherwise the concatenation of the stem and the accusative -t would result in an ill-formed syllable. The possessive and similar suffixes are two-faced: after consonant final stems they behave like the plural while after vowel final ones they behave like the accusative. Such suffixes always have a vowel after consonant final stems but not after vowel final ones. We also saw that the rest of quaternary suffixes exemplified by the plural behave in a way different from both the accusative and real vowel initial suffixes like the terminative as far as vowel zero alternations are concerned. For these reasons it seems reasonable to assume that the three kinds of suffixes have vowels reperesented in different ways underlingly and that this is the cause of the different surface behaviour. Since the accusative has an epenthetic vowel, it is not part of the underlying representation of the suffix but is inserted. The quality of the vowel is determined by the constraints governing vowel harmony but we have to assume that epenthetic vowels are mid if not required otherwise by constraints like Lowering\textsuperscript{81}. Suffix vowels like in the terminative on the other hand clearly appear

\textsuperscript{81} Most stems with unstable vowels have mid vowels but there are some with unstable vowels that are not mid but high, as in baj(u)sza [bojus] 'moustache', becsz(u)l [beztul] 'estimate', õrt(õ)z [o:r:z] 'guard, protect', or low, as in aj(a)k [ojok] 'lip', kaz(a)l [kozol] 'stack', vac(a)k [vorok] 'stuff, gadget'. I will assume that
after all kinds of stems and are thus represented underlyingly as full vowels with a root node and all their features. Quaternary suffixes like the plural and the possessive form an intermediate class between the above two. Hence their underlying representation should be somewhere 'between' those of the others, i.e. these suffixes should have 'part' of the vowel underlyingly but not 'the whole'. This can be done in two ways. Either we claim that these suffixes have only a root node underlyingly with only some but not all or no features linked to it or the other way round, i.e. they have floating features without a root node. For reasons discussed below the latter solution will be preferred over the former. However, the possessive and other suffixes alike have to be distinguished from the plural and similar suffixes. This will be the result of being lexically marked for constraint reranking as we will see at the end of this chapter.

4.4. The accusative vs other quaternary suffixes

4.4.1. Stiebels and Wunderlich's (1998) account

Before we start our discussion of how to account for the above mentioned differences between the accusative and the rest of quaternary suffixes in Hungarian, let us consider Stiebels and Wunderlich's (1998) account already mentioned in chapter 3. Their constraint hierarchy is repeated here for convenience.

the vowel in these words is normally mid and that the forms mentioned here are exceptional and should be treated separately. See chapter 3 for a detailed analysis of vowel-zero root alternations.
These constraints in this ranking cannot account for the behaviour of the accusative after vowel final lowering stems and after consonant final stems, the last consonant of which can form a legitimate coda with the accusative /-t/. Also, this hierarchy cannot account for the absence of the vowel in the possessive suffix (and similar suffixes) after vowel final lowering stems. These problems are demonstrated in the following tableaux.

The actual surface form in (a) unluckily violates X-MAX because of the unparsed vowel segment in the suffix and is eliminated. The other two candidates both violate the constraint penalizing the insertion of moras. Decision is thus passed down to the alignment constraint which favours the form with the [low] feature left-aligned with the suffix.

---

82 For the exact formulation of Stiebels's (1998) constraints see chapter 3.
The stem in (38) is a non-lowering stem. Since the word final /z/ can form a branching coda with the accusative /t/\textsuperscript{84}. However, Stiebels and WUnderlich's (1998) constraint hierarchy forces the underlying suffix vowel to be realised again, this way preferring either candidate (b) or (c). Also note that the hierarchy will not select the optimal candidate unambiguously in this case. Since the root is not lowering, the alignment constraint will not be able to decide between (b) and (c).

Although the hierarchy can select the optimal candidate unambiguously in tableau (39), it is not the actual surface form. That, in candidate (a), is eliminated because of the

\textsuperscript{83} Since the highest ranking constraints, i.e. $\mu$-MAX, C-DEP and ONSET are never violated in the tableaux I omit them.

\textsuperscript{84} Note that because of regressive voice assimilation the root final /z/ will surface as [s]. This change is not shown in the tableau.
unparsed suffix vowel again. The decision between the remaining two candidates is made by the alignment constraint: it selects the candidate with the low suffix vowel.

Thus we could see that Stiebels and Wunderlich's system does not give the correct prediction for suffixes behaving differently from the plural, like the possessive and the accusative for instance. For this reason, let us turn to another approach to unstable segments and subsegments discussed in the following subsection.

4.4.2. Unstable segments and subsegments in Zoll (1996)

Generative phonology has traditionally differentiated segments from subsegments. The solutions proposed to account for the behaviour of latent segments included extrametricality, defective root nodes, segments lacking timing units and lexically marked optionally non-syllabifying segments\textsuperscript{85}. Instead of these analyses Zoll (1996) claims that full segments and latent segments must be distinguished as in (40)\textsuperscript{86}.

\begin{tabular}{l|l|l}
\textbf{Surface:} & \textbf{Full segments} & \textbf{Latent segments and dependent features} \\
\hline
\multicolumn{2}{l|}{Root} & \\
\textbf{Underlying:} & features & features \\
\end{tabular}

\textsuperscript{85} The proposals were made for the treatment of subsegments among others by Clements and Keyser (1983); Szpyra (1992); Hyman (1985), Kenstowicz and Rubach (1987), Rubach (1993); Archangeli (1991) respectively. For a comparative analysis see Zoll (1996).

\textsuperscript{86} Chart from Zoll (1996).
Zoll claims that subsegmental behaviour and patterns must follow from the options encoded in grammars and not from automatic consequences of the representations in (40). Thus it is the interaction of the constraints in the hierarchies themselves that are responsible for the emerging patterns. The most important constraints, proposed by McCarthy and Prince (1995) and Zoll (1996), necessary for the description of segmental and subsegmental behaviour are shown below.

(41) **MAX(segment)** Every segment in the input has a correspondent in the output.

(42) **MAX(subsegment)** Every subsegment in the input has a correspondent in the output.

These constraints penalize the deletion of underlying segments and subsegments, i.e. features and feature class nodes not linked to a root node underlyingly.

We have seen above that Hungarian suffix vowels display three kinds of behaviour. Either they are present after every kind of stem without respect to the segmental and subsegmental make-up of the stem, like the terminative -ig, or they are epenthetic, i.e. underlyingly not present, like the vowel of the accusative suffix, or they are present after consonant final normal stems and after any lowering stem, just like the vowel of the plural (and some other quaternary suffixes). Because of this intermediary behaviour of the plural suffix vowel, we can assume that it does not have a root node underlyingly but
it consists of a floating rootless class node of Place with dependent features. The difference between the three types of suffixes are shown in (43)\textsuperscript{87}.

(43) \[
\begin{array}{ccc}
\mu & \mu \\
\text{a. } \text{Rt} & \text{Rt} & \text{b. } \text{Rt} & \text{c. } \text{Rt} \\
/\text{i}/ & /\text{g}/ & \text{Place }/\text{k}/ & /\text{t}/ \\
\text{'terminative'} & \text{'plural'} & \text{'accusative'}
\end{array}
\]

4.4.2.1 Consonant final stems

As we have seen above the vowel in the accusative suffix is probably epenthetic: it breaks up illegitimate consonant clusters if its necessary. If the situation were so simple, we could just propose the following constraints to govern the surface distribution of the suffix vowel besides Lowering repeated here for convenience.

(44) Lowering The right edge of a lowering morpheme is aligned with the left edge of [+low] in a subsequent suffix.

Lowering is a necessary constraint as shown in chapter 1 since it selects the optimal candidate with a low vowel after lowering morphemes.

\textsuperscript{87} Symbols between slants represent the feature trees of segments while boldface Place stands for a floating Place node not linked to a root node.
vadat 'game acc.'

(45) | UR: va:dₜ +t | Lowering |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>va:d+ọt</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>vọdọt</td>
<td>*!</td>
</tr>
<tr>
<td>c.</td>
<td>vọdọt⁸⁸</td>
<td>*!</td>
</tr>
</tbody>
</table>

In (45) a lowering morpheme is followed by the accusative. Lowering forces the suffix to appear with a low vowel. Candidates (b) and (c) do not have low vowel in the suffix and thus violate Lowering. This way candidate (a) wins. After non-lowering morphemes it is the vowel markedness constraints that decide on the optimal candidate as shown in chapter 1 repeated here for convenience.

mást 'other acc.'

(46) | UR: ma:j+t | Lowering |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>ma:jt</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>ma:jọt</td>
<td>*!</td>
</tr>
<tr>
<td>c.</td>
<td>ma:jọt</td>
<td>*</td>
</tr>
</tbody>
</table>

Candidate (46.b) violates the higher ranking markedness constraint while (c) violates the lower ranking one. Since candidate (a) does not violate any of the constraints, it wins.

⁸⁸ This candidate has to undergo voice assimilation.
Note that on the basis of these examples we cannot set up any ordering relations between the constraints.

bókot 'compliment'

<table>
<thead>
<tr>
<th></th>
<th>UR:</th>
<th>Lowering</th>
<th>*o</th>
<th>*o</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>bo:kot</td>
<td></td>
<td></td>
<td>**!</td>
</tr>
<tr>
<td>b.</td>
<td>⊗ bo:kt</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>bo:kot</td>
<td></td>
<td>*!</td>
<td>**</td>
</tr>
</tbody>
</table>

In (47) we find a non-lowering stem followed by the accusative. Unfortunately, the constraints select candidate (b) over the actual surface form, candidate (a). Candidate (b) should not be preferred since it contains an illegitimate coda clusters that can never arise as the result of morpheme concatenation. This shows the need for another constraint, or rather a group of constraints that penalize ill-formed syllables.

(48) Syll Syllables are well formed\textsuperscript{89}.

\textsuperscript{89} This constraint is actually the collection of the constraints presented in the previous subsection based on Törkenczy's (1994) analysis and some others not discussed in this paper.
Tableau (49) shows the result of adding Syll to the constraint hierarchy. Since candidates (b) and (c) violate higher ranking constraints, the double violation of the lowest ranking *o is not fatal for candidate (a) and it wins. The tableau also shows that Syll has to dominate *o. Should the ranking be the reverse, candidate (b) would be selected as optimal. Although there is nothing in the tableau explicitly requiring that Syll be ranked highest, it is ranked undominated because morpheme concatenation will never create clusters violating syllable well-formedness constraints. The addition of Syll to the hierarchy does not influence the selection of the optimal candidate after lowering morphemes as shown in (50) where the accusative is preceded by a lowering morphemes ending in a consonant which could form a branching coda with the accusative.
The constraint primarily responsible for the selection of the optimal output is Lowering as it can be seen in tableau (50).

Since in many cases a vowel segment is inserted before the accusative -t, the universal constraint penalizing epenthesis has to be ranked relatively low. As Zoll (1996) claims, there are two constraints that interact to result in different patterns of segmental and subsegmental behaviour, MAX(segment) and MAX(subsegment) repeated here for convenience.

(51) DEP(segment) Segments in the output have a correspondent in the input. (No epenthesis)

(52) MAX(segment) Segments in the input have a correspondent in the output. (No deletion of segments)

(53) MAX(subsegment) Subsegments in the input, i.e. floating features or feature class nodes not linked to a root node, must have a correspondent in the output. (No deletion of subsegments)
hasat 'stomach acc.'

<table>
<thead>
<tr>
<th>(54)</th>
<th>UR:</th>
<th>Syll</th>
<th>Lowering</th>
<th>MAXseg</th>
<th>MAX subseg</th>
<th>DEPseg</th>
<th>*ɔ</th>
<th>*0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>hɔʃ +t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>hɔʃot</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>hɔʃot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>hɔʃt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>hɔʃ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lowering, MAXseg >> DEPseg

The DEPseg constraint is violated by candidates (a) and (b) in tableau (54) because of the inserted vowel in the suffix. To select (a) as optimal DEPseg has to be ranked lower than Lowering. Should they be ranked any other way, candidate (d) would be chosen as optimal. Candidate (d) violates MAXseg once because of the deleted suffix consonant. This allows (a) to win if MAXseg dominates DEPseg. If the reverse were true, candidate (d) would be the winner once again. As for the relative ranking of MAXseg and MAXsubseg, there is no evidence in the above forms.

Finally, let us take a look at stems ending in consonant clusters.

briliánst 'brilient (N) acc.'

<table>
<thead>
<tr>
<th>(55)</th>
<th>UR:</th>
<th>Syll</th>
<th>Lowering</th>
<th>MAXseg</th>
<th>MAX subseg</th>
<th>DEPseg</th>
<th>*ɔ</th>
<th>*0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>brilia:nʃ+t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>brilia:nʃt</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>brilia:nʃot</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>brilia:nʃot</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

107
The stem in (55) ends in a cluster which can be a possible syllable final sequence together with the [t] of the accusative. For this reason candidate (a) does not violate Syll. Both candidate (b) and (c) violate DEPseg since they both contain an epenthetic vowel not present in the input. Since candidate (a) does not violate any of the constraints, it wins.

\[
\text{narancsot 'orange acc.'}
\]

\[
\begin{array}{|c|c|c|c|c|c|c|c|}
\hline
\text{UR:} & \text{Syll} & \text{Lowering} & \text{MAXseg} & \text{MAX subseg} & \text{DEPseg} & \text{*} & \text{o} \\
norontj+t & & & & & & & \\
\hline
a. norontjot & & & & & \ast & & \\
\hline
b. norontjot & & & & & \ast & \ast! & \ast \\
\hline
c. norontjt & \ast! & & & & & & \\
\hline
\end{array}
\]

\[\ast o >> \ast o\]

In (56) the stem final cluster [ntj] is a legitimate coda but it does not form a possible syllable final sequence with the accusative, i.e. [-ntjt] is not possible because it violates Syll\(^90\). Candidates (a) and (b) on the other hand fare equally well on the higher ranking constraints. Thus the decision between these two candidates is passed on to the markedness constraints, *ο and *ο. Candidate (b) violates the higher ranking markedness constraint and thus allows candidate (a) to win.

---

\(^90\) The cluster [ntf] violates the component of Syll penalizing Affricates in syllable final clusters, i.e. *Aff-Coda. Note that affricates are allowed in branching codas but with sonorants only. Hence narancs [norontf] 'orange' has a well-formed coda.
The stem in (58) is identical to that in (55). The only difference is that in (55) the word is a noun while that in (58) is an adjective. In Hungarian there are many words that can act both as an adjective and as a noun. Moreover, there are suffixes that can derive either a noun or an adjective from a word. In such cases nouns are always normal stems while the derived adjectives usually belong to the morphologically marked class of lowering morphemes as shown in (57).

(57) a.) ház+as 'married (N)'    ház+as+ok 'married pl. (N)'
[ha:zɔʃ]                   [ha:zɔʃok]

b.) ház+as 'owner of a house (Adj)' ház+as+ak 'owners of a house (Adj)'
[ha:zɔʃ]                   [ha:zɔʃok]

All the forms in (57) are derived from the word ház [haːz] 'house', a lowering morpheme. The form in (57.a) is a noun, the suffix -as being a normal stem shown by the mid vowel in the plural suffix. The same suffix creates an adjective in (57.b). The suffix -as in this case is a lowering morpheme as indicated by the low vowel in the plural suffix. The very same is true of words like briliáns: as a noun it is a normal morpheme, but as an adjective it is lowering.

---

91 The fact that ház is a lowering morpheme is also shown by the vowel in the suffix in (57), házas [haːzɔs]. The very same suffix has a mid vowel after non-lowering stems like tánc [taːntʃ] 'dance', as in táncos [taːntʃos] 'dancer'.
briliánsat 'brilliant (Adj) acc.'

Candidates (b) and (c) both violate Lowering since a lowering morpheme is not followed by a low vowel. Thus EVAL selects candidate (a) as optimal.

Our constraint hierarchy works for all kinds of consonant final stem + accusative sequences. Let us now take a look at consonant final stem + plural sequences, the plural being representative of the rest of quaternary suffixes as we have seen above.

vadak 'game pl.'

Tableau (59) shows an input lowering stem followed by the plural suffix. Candidate (b) violates Syll because [dk] is not a possible coda cluster and is thus eliminated. Candidate

---

92 Capital 'O' stands for the floating feature matrix [-high, ROUND] unspecified for the [low] and [back].
(c) differs from the winning candidate only in that it has a mid suffix vowel instead of the optimal low vowel. The violation of Lowering excludes this candidate. Finally, candidate (d) violates MAXseg and MAXsubseg since the whole suffix, i.e. the floating feature matrix and the anchored segment, remain unparsed in the output. Note that this candidate does not violate Lowering because there is no suffix following the lowering morpheme and Lowering is only concerned with suffixes following lowering morphemes. This way candidate (a) is selected as optimal.

Tableau (60) shows a stem whose final consonant+k could form a legitimate coda.

<table>
<thead>
<tr>
<th>UR:</th>
<th>Syll</th>
<th>Lowering</th>
<th>MAXseg</th>
<th>MAXsubseg</th>
<th>DEPseg</th>
<th>*o</th>
<th>*</th>
</tr>
</thead>
<tbody>
<tr>
<td>rovósₐl. +Ok</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. rovósok</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td>***</td>
<td></td>
</tr>
<tr>
<td>b. rovósk</td>
<td>!</td>
<td></td>
<td>*</td>
<td></td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. rovosō</td>
<td>!</td>
<td></td>
<td>*</td>
<td></td>
<td>***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. rovosok</td>
<td>!</td>
<td></td>
<td>*</td>
<td></td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>e. rovos</td>
<td>!</td>
<td></td>
<td>*</td>
<td></td>
<td>**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As we can see the actual surface form is selected as optimal again. Candidate (a) only violates the vowel markedness constraint, *ɔ. Candidate (b) on the other hand violates Lowering just like candidate (d). Thus both candidates are eliminated. Candidate (e) is excluded for the same reason as (59.d): underlying segments and subsegments are deleted.
and it is penalized by MAXseg and MAXsubseg respectively. The same happens in candidate (c) but only the anchored segment is deleted there. It does not violate Lowering because the lowering morpheme is followed by a low vowel in the subsequent suffix although the suffix consonant has been deleted.

Now let us take a look at non-lowering morphemes followed by the plural.

\[\text{párok 'pair pl.'}\]

(61) \[
\begin{array}{|c|c|c|c|c|c|c|}
\hline
\text{UR:} & \text{Syll} & \text{Lowering} & \text{MAXseg} & \text{MAXsubseg} & \text{DEPseg} & \text{*o} & \text{*o} \\
\text{pa:r+Ok} & \text{a. \_ \_ \_ \_ \_} \text{pa:rok} & & & * & & * \\
\text{b. \_ \_ \_ \_ \_} \text{pa:rok} & & & * & & *! \\
\text{c. \_ \_ \_ \_ \_} \text{pa:rk} & & *! & & & \text{!} \\
\text{d. \_ \_ \_ \_ \_} \text{pa:r} & & *! & & & \text{!} \\
\hline
\end{array}
\]

In (61) pár+Ok is a non-lowering stem followed by the quaternary plural. Candidate (c) violates MAXsubseg because of the unparsed floating feature matrix while (d) violates both MAXseg and MAXsubseg since neither the segment nor the subsegments of the suffix is realised in the output; thus they are out of the competition. Note that (c) does not violate Syll because [rk] is a possible coda in the language as exemplified by words like park [pôrk] 'park'. The first two candidates fare equally well on Syll, Lowering, MAXseg, MAXsubseg and DEPseg. The decision is passed on to the markedness constraints where the less marked [o] is selected for the suffix vowel and thus (a) wins.
The word in (62) is also a non-lowering stem but this time the word final consonant cannot form a legitimate coda with the suffix consonant. This is shown by the Syll violation in candidate (c). Candidate (d) has an unparsed segment and unparsed subsegments and is thus got rid of. Candidates (a) and (b) behave exactly like those in (61): (a) wins since it only violates the lowest ranked markedness constraint. The constraint hierarchy yields the very same results with non-lowering stems ending in consonant clusters.

4.4.2.2 Vowel final stems

In this subsection I will consider vowel final stems both lowering and non-lowering followed by the accusative and the plural. Let us first take a look at a vowel final non-lowering stem followed by the accusative.
Candidate (d) in (63) violates MAXseg because of the deletion of the suffix consonant and is thus eliminated. Candidates (b) and (c) on the other have violations of DEPseg since they contain output segments that do not have an input correspondent, namely the suffix vowel [o] and [ɔ] respectively. This allows candidate (a) to be selected as optimal.

Tableau (64) containing the same stem as (63) followed by the plural suffix shows the need for another constraint, Onset.
(65) Onset Syllables have onsets.

kapuk 'gate pl.'

<table>
<thead>
<tr>
<th>(66)</th>
<th>UR:</th>
<th>Syll</th>
<th>Lowering</th>
<th>MAX seg</th>
<th>Ons</th>
<th>MAX subseg</th>
<th>DEP seg</th>
<th>*ο</th>
<th>*ό</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>kɔpuk</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>kɔpuɔk</td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td>**!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>kɔpuɔk</td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td>kɔpuɔ</td>
<td></td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>kɔpu</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MAXseg, Onset >> MAXsubseg

Tableau (66) shows the result of adding the constraint in (65) to the constraint hierarchy. The constraint penalizing onsetless syllables is violated by candidates (b), (c) and (d). The last two candidates on the other hand violate MAXseg because of the suffix consonant not being present in the output forms. Since candidate (a) does not violate any of the higher ranking constraints, i.e. it only violates MAXsubseg and *ο, it wins. We should note however that it wins on condition that both MAXseg and Onset dominate MAXsubseg. And it is at this very point that we apply Zoll’s (1996) differentiation between subsegments and segments. Candidates (d) and (e) violate the higher ranking MAXseg while candidate (a) violates the lower ranking MAXsubseg. Thus, as predicted by Zoll’s taxonomy of segments and subsegments, it is “cheaper” leave a subsegment unparsed than doing the same with a segment. Segments cannot be unparsed but subsegments can under duress. If we claimed that quaternary suffixes contained vowel.
features linked to a root node underlyingly, then candidate (a) in (66) would violate MAXseg and not MAXsubseg and candidate (c) would be selected as optimal instead of the actual surface form in (a).

<table>
<thead>
<tr>
<th>(67)</th>
<th>UR: somoru: l +Ok</th>
<th>Syll</th>
<th>Lowering</th>
<th>MAXseg</th>
<th>Ons</th>
<th>MAXsubseg</th>
<th>DEPseg</th>
<th>*o</th>
<th>*o</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. somoru:ɔk</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. somoru:ok</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. somoru:k</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. somoru:ɔ</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. somoru:</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lowering, MAXseg >> Onset

The tableau in (67) shows a vowel final lowering stem followed by the plural suffix. Candidates (b) and (c) are eliminated by Lowering because they do not have a suffix with a low vowel. The last two candidates are excluded by MAXseg since the suffix consonant remains unparsed in both. This allows candidate (a) to win since it only violates MAXsubseg, which is ranked lower than the constraints violated by the rest of the candidates.
The input in (68) contains the same stem as (67) but this time followed by the accusative. The candidate that is selected by the constraint hierarchy is not the actual surface form used in the language. Since the accusative suffix does not contain a vowel underlyingly, recall that the vowel is clearly an epenthetic segment, the lack of the vowel is not penalized by either MAXseg or MAXsubseg. Also, since the stem ends in a vowel, no illegitimate coda clusters will arise from the concatenation of the morphemes. Lowering on the other hand is violated by the forms in (a) and (c) as the suffix does not have a low vowel following a lowering morpheme. Thus Lowering rules out these two candidates, the actual form, (a), being one of them. Candidates (d) and (e) are eliminated because of their violation of MAXseg, the result of unparsing the suffix consonant.

Tableau (69) shows that the same happens to such roots when followed by the possessive suffix.
Unfortunately, if we tried to change some rankings then in some of the previous tableaux a wrong candidate would be selected as optimal. For instance, we could try to reverse the ordering of Onset and the Lowering-MAXseg block of rules. That would result in selecting the correct candidates in (68) and (69), but at the same time would yield the selection of incorrect candidates for vowel final lowering stems followed by the plural and similar suffixes.

For this reason it might seem reasonable to claim that suffixes like the accusative and the possessive are marked in the Lexicon and require a different ranking of some of the constraints. If we proposed a constraint reranking that would not interfere with the selection of the optimal candidate in the previous tableaux, then this problem could be eliminated. Also, note that on the basis of the behaviour of quaternary suffixes after consonant final stems and vowel final non-lowering stems one might expect that they will behave the same way after vowel-final lowering stems as well. That is, one might expect that these suffixes only behave differently after non-lowering stems. Unfortunately
that is not the case. Thus let us take a look at the consequences of reranking some of the constraints.

As we have noted above, the forms in tableaux (68) and (69) require that the constraint penalizing onsetless syllables, i.e. Onset, dominate Lowering and MAXseg. Tableaux (70) and (71) show the effects of such a reranking for both the accusative and the possessive type of suffixes.

\[
\text{szomorút 'sad acc.'}
\]

\[
\begin{array}{|c|c|c|c|c|c|c|c|c|}
\hline
\text{UR:} & \text{Syll} & \text{Ons} & \text{MAX seg} & \text{Lowering} & \text{MAX subseg} & \text{DEP seg} & \text{*o} & \text{*o} \\
\hline
\text{somoru:\text{L} +t} & \text{somoru:\text{t}} & *! & * & * & * & * & * & ** \\
\hline
\text{somoru:öt} & *! & & & & & & ** \\
\hline
\text{somoru:ot} & *! & & & & * & * & * & *** \\
\hline
\text{somoru:ő} & *! & * & & & & * & * & ** \\
\hline
\text{somoru:} & *! & & & & & & & ** \\
\hline
\end{array}
\]

MAXseg, Onset >> Lowering

Candidate (b), (c) and (d) in tableau (70) all violate Onset because of the hiatus between the stem final and the suffix initial vowel and are thus eliminated. Candidate (e) violates MAXseg because of the unparsed suffix consonant, the violation being fatal. This allows candidate (a) to win in spite of its Lowering violation. Note that both MAXseg and Onset must dominate Lowering. Should either of them be ranked below Lowering, an incorrect
candidate would be chosen as optimal. Note that in the tableaux above we only had a partial ranking of the constraints since MAXseg and Lowering have not been crucially ranked with respect to each other. Tableaux (70) and (71) constitute evidence for the relative ranking of these two constraints. Note that this will not interfere with the selection of the optimal candidates in any of the tableaux above.

The candidates in tableau (71) behave the same way as those in tableau (70). Here the same root is shown with the possessive suffix.

\begin{table}
\begin{tabular}{|c|c|c|c|c|c|c|c|}
\hline
(71) & UR: & Syll & Ons & MAX seg & Lowering & MAX subseg & DEP seg & *\(o\) & *\(o\) \\
\hline
a. & somoru:m & - & - & * & * & * & ** \\
\hline
b. & somoru:om & *! & - & - & * & * & ** \\
\hline
c. & somoru:om & *! & - & - & * & * & ** \\
\hline
d. & somoru:o & *! & * & - & * & * & ** \\
\hline
e. & somoru: & *! & * & - & * & * & ** \\
\hline
\end{tabular}
\end{table}

Let us now consider non-lowering vowel final roots again and see whether the established reranking causes any changes in the selection of the candidates.
kaput 'gate acc.'

<table>
<thead>
<tr>
<th>(72)</th>
<th>UR:</th>
<th>Syll</th>
<th>Ons</th>
<th>MAX seg</th>
<th>MAX subseg</th>
<th>DEP seg</th>
<th>*∅</th>
<th>*o</th>
</tr>
</thead>
<tbody>
<tr>
<td>kōpu+t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>kōput</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>∗</td>
</tr>
<tr>
<td>b.</td>
<td>kōput</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>∗</td>
</tr>
<tr>
<td>c.</td>
<td>kōput</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>∗</td>
</tr>
<tr>
<td>d.</td>
<td>kōpu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>∗</td>
</tr>
</tbody>
</table>

Tableau (72) shows that the actual surface form is selected as optimal with the reranked constraints for the accusative suffix not containing a vowel underlyingly. Candidates (b) and (c) both violate Onset because of the lacking onset consonant. Candidate (d) violates MAXseg since the input suffix consonant does not have an output correspondent. This way candidate (a) is correctly allowed to win.

kapum 'gate 1st sing poss.'

<table>
<thead>
<tr>
<th>(73)</th>
<th>UR:</th>
<th>Syll</th>
<th>Ons</th>
<th>MAX seg</th>
<th>MAX subseg</th>
<th>DEP seg</th>
<th>*∅</th>
<th>*o</th>
</tr>
</thead>
<tbody>
<tr>
<td>kōpu+Om</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td>kōpum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>∗</td>
</tr>
<tr>
<td>b.</td>
<td>kōpum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>∗</td>
</tr>
<tr>
<td>c.</td>
<td>kōpum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>∗</td>
</tr>
<tr>
<td>d.</td>
<td>kōpu</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>∗</td>
</tr>
</tbody>
</table>

Tableau (73) contains the same root followed by the possessive containing a floating Place node. Candidates (b) and (c) are penalized by Onset again. In candidate (d) the
suffix consonant does not appear on the surface, obviously a MAXseg violation. Thus, (a) wins again.

Note that the reranking of the constraints does not influence the selection of the optimal candidate in consonant final stems, lowering or non-lowering, since the concatenation of such stems and quaternary suffixes will never result in hiatus. Thus we can conclude that the above constraints with the accusative and possessive types of suffixes being marked for reranking can account for the vowel-zero alternations in quaternary suffixes.

One problem that we also have to address shortly is the behaviour of the root hű 'faithful'. This is a lowering stem shown by the fact that the plural form of the word is hűek. However, there is vacillation in the accusative. It may appear with or without a (low) suffix vowel, i.e. hűt/hűet. Our constraint hierarchy with the mechanism of reranking predicts that the form without the suffix vowel is selected as optimal.

hűt/hűet 'faithful acc.'
Just as in the tableaux above, the first candidate is selected as optimal because of the penalized hiatus in candidates (b) and (c) and the unparsed suffix consonant in candidate (d). Since this vacillation is not a "widespread" phenomenon in such stems, we can treat it as a lexically marked property of this stem. For those speakers who use the form with the suffix vowel, this form is marked for reranking, or rather the lack of reranking, and thus surfaces with a low vowel. Note that this might be the result of homophony since there is another word $\textit{hűt}$ 'refrigerate 3rd sg.'. The possibility of the form with the suffix vowel might be the result of avoiding homophony.

We also have to mention another type of exceptional behaviour shown in chart (35) of this chapter. Namely, there are some vacillating stems, vowel final adjectives, that may take the plural suffix with or without the vowel, e.g. $\textit{sértő(e)k}$ 'offensive', $\textit{bántó(a)k}$ 'insulting'. Whenever the vowel is present it is always low. For this reason it is clear that these stems can either be lowering or non-lowering. In the former case they take the suffix with a low vowel while in the latter there is no vowel in the suffix at all. Consonant final vacillating stems like $\textit{tányér}$ 'plate' behave in similar ways; if the stem is lowering, then the plural and accusative are realised as $\textit{tányérak}$, $\textit{tányérát}$. If, however, it is a non-lowering stem, then the respective forms are $\textit{tányérok}$, $\textit{tányért}$. The vacillation is shown in tableaux (75) and (76) for one of the vowel final adjectives.
bántók 'offensive pl.'

(75) | UR: ba:nto:+Ok | Syll | MAX seg | Lowering | Ons | MAX subseg | DEP seg | *<sub>c</sub> | *<sub)o</sub>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. &quot;&lt;sup&gt;ε&lt;/sup&gt;&quot; ba:nto:k</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ba:nto:ok</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. ba:nto:ok</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>d. ba:nto:</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In (75) bántó 'offensive' is a vowel final normal, non-lowering stem and thus appears with the plural suffix lacking a vowel. Candidate (d) is eliminated since it has a MAXseg violation arising from the unparsed suffix consonant. Candidates (b) and (c) violate Onset because the last syllable in these forms is onsetless. This way candidate (a) is selected as optimal.

bántóak 'offensive pl.'

(76) | UR: ba:nto:±Ok | Syll | MAX seg | Lowering | Ons | MAX subseg | DEP seg | *<sub>c</sub> | *<sub)o</sub>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. &quot;&lt;sup&gt;ε&lt;/sup&gt;&quot; ba:nto:ok</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ba:nto:ok</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>c. ba:nto:k</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. ba:nto:</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Tableau (76) is different from (75) in that the same stem is a lowering morpheme here. For this reason it has to be followed by a low suffix vowel, i.e. the right edge of the lowering morpheme has to be aligned with the left edge of [+low] in the suffix.
Candidate (d) violates MAXseg for the same reasons as in (75) and hence (a), the candidate with the low suffix vowel, is allowed to win.

We have to note that these stems would have the accusative with the same shape, i.e. without a vowel, whether they are lowering or not, i.e. the accusative would be bánatót and sértőt and not *bántóat and *sértőet. It is because the accusative (and the possessive as well) takes a different ranking of the constraints. These suffixes never occur with a vowel after a vowel final stem. Onset is ranked too low to have an effect in those cases.

Finally let us consider suffixes with non-alternating vowels and see whether the constraint hierarchy makes the right predictions.

\[
\begin{array}{|c|c|c|c|c|c|}
\hline
\text{UR: kapu+ig} & \text{Syll} & \text{MAX seg} & \text{Lowering} & \text{Ons} & \text{MAX subseg} & \text{DEP seg} \\
\hline
a. \not{\text{kőpuig}} & \text{*} & \text{seg} & \text{**} & \text{**} & \text{**} & \text{**} \\
\hline
b. \text{kőpuig} & \text{!*} & \text{seg} & \text{**} & \text{**} & \text{**} & \text{**} \\
\hline
c. \text{kőpig} & \text{!*} & \text{seg} & \text{**} & \text{**} & \text{**} & \text{**} \\
\hline
d. \text{kőpu} & \text{!*!*} & \text{seg} & \text{**} & \text{**} & \text{**} & \text{**} \\
\hline
\end{array}
\]

In tableau (77) a non-lowering vowel final stem is followed by the non-alternating terminative suffix. The candidates in (b), (c) and (d) violate MAXseg (note that there is no reranking in this case!) and are thus eliminated allowing (a) to win.
The constraint hierarchy selects the actual surface form as optimal for a lowering vowel final stem followed by the causal-final suffix. Another constraint from chapter 3 is shown here, IDENT(low) dominating Lowering. Candidates (b) and (c) have fatal violations of MAXseg, while (d) violates IDENT(low) because of the height change in the suffix vowel. This way the correct candidate wins again.

As another consequence of the theory of subsegments and the treatment outlined above, we can argue that other Hungarian suffixes that behave similarly to the accusative and the possessive in that there is no suffix vowel after vowel final stems are also marked for constraint reranking the same way as the accusative and the possessive. These suffixes include the 1st pl. possessive unk/ünk, and the superessive on/ön/en.

The vowels in these suffixes appear after consonant final stems but remain unparsed after vowel final ones.
Tableau (79) shows what happens if the constraints are not reranked. Candidates (a) and (c) violate MAXseg because of the unparsed suffix segment(s) and incorrectly allow (b) to win. The actual surface form in (a) can be properly selected as optimal if we assume that this suffix belongs to the same marked suffix class as the accusative and requires the ranking Onset >> MAXseg >> Lowering. This is shown in tableau (80).

To sum up, we saw that there are three types of quaternary suffixes. The accusative constitutes a type of its own. It does not have an underlying vowel and it is marked for constraint reranking, Onset>>MAXseg>>Lowering. The possessive type of
suffixes underlyingly have a floating Place node and are also marked for constraint reranking. The plural type of suffixes also have an underlying floating Place node but they are not lexically marked for reranking. This is indicated in the following chart.

93 Capital 'U' indicates a high rounded vowel unspecified for backness.
94 Note that the capital 'O' in quaternary suffixes stands for a floating Place node containing [ROUND, -high] while the same symbol in /-On/ represents a vowel (with an underlying root node) unspecified for the feature [back].
5. Vowel-zero root alternations

In the previous chapters I have tried to shed some light on the behaviour of quaternary suffixes after lowering and non-lowering, and consonant final and vowel final stems. Chapter 4 dealt with vowel-zero alternations in quaternary suffixes and concluded that all quaternary suffixes except the accusative have a floating rootless Place node underlyingly and that the accusative does nto have an underlying vowel at all. This treatment may have consequences in the treatment of vowel-zero root alternations as well. The present chapter is an outline of a possible treatment of such alternations with the help of Zoll’s (1996) approach to the difference between segments and subsegments95.

5.1. The data

Some roots in Hungarian have two forms, a longer and a shorter one. The shorter one ends in a two-member consonant cluster and is lacking a vowel present in the longer one breaking up the cluster. Some examples are given in (1) the taxonomy and examples taken from Törkenczy (1992, 1994) and Nádasdy and Siptár (1994)

(1) Liquid final

<table>
<thead>
<tr>
<th>Word</th>
<th>Traditional</th>
<th>Reformatted</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>bokor</td>
<td>[bokor]</td>
<td>[bokr]</td>
<td>'bush'</td>
</tr>
<tr>
<td>lepel</td>
<td>[lepēl]</td>
<td>[lepēl]</td>
<td>'veil'</td>
</tr>
<tr>
<td>töröl</td>
<td>[törōl]</td>
<td>[tōrēl]</td>
<td>'wipe'</td>
</tr>
<tr>
<td>bagoly</td>
<td>[bōgoj]</td>
<td>[bōgj]</td>
<td>'owl'</td>
</tr>
<tr>
<td>bátor</td>
<td>[baːtor]</td>
<td>[baːtr]</td>
<td>'brave'</td>
</tr>
<tr>
<td>becsül</td>
<td>[betsul]</td>
<td>[betsl]</td>
<td>'estimate'</td>
</tr>
<tr>
<td>kazal</td>
<td>[kōzl]</td>
<td>[kōzl]</td>
<td>'stack'</td>
</tr>
</tbody>
</table>

(2) Nasal final

<table>
<thead>
<tr>
<th>Word</th>
<th>Traditional</th>
<th>Reformatted</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>izom</td>
<td>[izom]</td>
<td>[izm]</td>
<td>'muscle'</td>
</tr>
<tr>
<td>takony</td>
<td>[tokonj]</td>
<td>[toknj]</td>
<td>'snot'</td>
</tr>
<tr>
<td>álom</td>
<td>[aːjom]</td>
<td>[aːjm]</td>
<td>'dream'</td>
</tr>
<tr>
<td>torony</td>
<td>[tornj]</td>
<td>[tornj]</td>
<td>'tower'</td>
</tr>
<tr>
<td>majom</td>
<td>[majom]</td>
<td>[majm]</td>
<td>'monkey'</td>
</tr>
</tbody>
</table>

(3) Obstruent final

<table>
<thead>
<tr>
<th>Word</th>
<th>Traditional</th>
<th>Reformatted</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>tűcsök</td>
<td>[tūtʃɵk]</td>
<td>[tūtʃk]</td>
<td>'cricket'</td>
</tr>
<tr>
<td>piszok</td>
<td>[pisok]</td>
<td>[pisk]</td>
<td>'dirt'</td>
</tr>
<tr>
<td>tülök</td>
<td>[tʃɵlk]</td>
<td>[tʃljk]</td>
<td>'horn'</td>
</tr>
<tr>
<td>dolog</td>
<td>[dolog]</td>
<td>[dolg]</td>
<td>'thing'</td>
</tr>
<tr>
<td>szerez</td>
<td>[ʃɛɾez]</td>
<td>[ʃɛrz]</td>
<td>'get'</td>
</tr>
<tr>
<td>bajusz</td>
<td>[bɔjus]</td>
<td>[bɔjs]</td>
<td>'moustache'</td>
</tr>
<tr>
<td>őriz</td>
<td>[őːriz]</td>
<td>[őːrz]</td>
<td>'guard'</td>
</tr>
<tr>
<td>ajak</td>
<td>[aʃok]</td>
<td>[aʃk]</td>
<td>'lip'</td>
</tr>
<tr>
<td>vacak</td>
<td>[vɔɾʃok]</td>
<td>[vɔɾʃk]</td>
<td>'gadget'</td>
</tr>
</tbody>
</table>
It is obvious from the tables above that the vowel alternating with zero is always short and in the majority of cases a mid vowel. However there are some exceptional forms where this vowel is either high or low as in the forms under the lines in (1) and (3). Such forms will be treated as exceptional and will either have slightly different underlying representations form the rest of such stems or will be marked with a lexical exception feature. The analysis of these stems is postponed until the end of the chapter.

As for the analysis of such stem alternations, we have two possible alternatives: either we analyse the phenomenon as a case of vowel deletion or as vowel epenthesis. In the first case there should be a rule or constraint that requires that vowels are deleted in the second syllable of stems before certain suffixes\footnote{The question of what kind of suffixes induce this alternation will be discussed below.} but not before others. However, this analysis will surely run into problems since not all roots have such vowel-zero alternation in their second syllables. Although this approach would correctly predict that the concatenation of /bokor/ 'bush’ and /-Ok/ 'plural’ will yield [bokrok] lacking the second root vowel, it will incorrectly predict that the sequence /Jo:gor/ 'brother in law’ + /Ok/ 'plural’ will surface as *[Jo:grok] instead of the actual [Jo:gorok], the reason for this simply being that not all disyllabic roots have a vowel alternating with zero in the second syllable. Such an analysis would be forced to use lexical diacritic features to make thousands of forms exempt from this rule or constraint.
The other analysis seems much more promising. If we assume that the form lacking the vowel constitutes the underlying representation of these words then there have to be some principles requiring the insertion of an epenthetic vowel in certain contexts.

5.2. Previous analyses

5.2.1 Stiebels and Wunderlich’s (1998) analysis

Stiebels and Wunderlich’s (1998) analysis has already been mentioned in chapter 1 when discussing the behaviour of lowering stems and the phonological vs morphophonological account of the phenomenon in OT. Stiebels and Wunderlich (1998) claim that suffixes where the suffix vowel alternates with zero have an unmoraic vowel underlingly. Their representation of the plural and the illative is given in (4).

(4)

As it can be seen the difference lies in the illative having moraic structure while the plural, and thus other suffixes with vowel-zero alternations, lacks such structure. Stiebels

132
and Wunderlich (1998) argue that this underlying representation and their constraints select the correct candidates for all forms. My claim is that their representations are correct as far as the illative is concerned but not for quaternary, and other vowel-zero alternating suffixes. My proposal for the underlying representation of quaternary suffixes either posits floating feature Place nodes, as in the plural suffix, or no vowel at all, as in the accusative, as opposed to Stiebels and Wunderlich, who posit underlying root nodes without feature content and moraic structure. Stiebels and Wunderlich’s (1998) representations of vowel-zero alternating stems are given in (5).

\[
\begin{array}{ll}
\text{a. base stem} & \text{b. cracked stem} \\
\mu & \mu \\
\text{C V C V C} & \text{C V C C} \\
\text{b o k o r} & \text{b o k r}
\end{array}
\]

Their constraints and the necessary rankings are repeated below for convenience.

(6) ONSET  Each syllable has a consonantal onset.

(7) X-MAX  All segments of stems and affixes in the input have a correspondent in the output.

(8) F-MAX  All features in the input have a correspondent in the output.

(9) \(\mu\)-MAX  All moras in the input have a correspondent in the output.

10) V-DEP  All vowels (root nodes with a dependent vocalic node) in the output have a correspondent in the input.

(11) C-DEP  All consonants in the output have a correspondent in the input.
(12) $\mu$-DEP
All moras to which vocalic material is linked in the output have a correspondent in the input.

(13) IDENT-V
All features linked to a vocalic node remain unchanged.

(14) ALIGN-LEFT ([+low], suffix)
The unlinked feature [+low] at the right edge of the stem is linked to the left edge of a following suffix.

(15) $\mu$-MAX, C-DEP >> ONSET >> X-MAX >> $\mu$-DEP >> F-MAX
IDENT-V >> F-MAX

This constraint hierarchy will select the actual surface form as optimal in some but not all cases as demonstrated in the following tableaus for both non-lowering and lowering stems that display vowel-zero alternations.\(^97\)

\begin{center}
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
bokrok 'bush pl.' & UR: bok$V^\mu_r +V_k$ & ONSET & X-MAX & $\mu$-DEP & IDENT-V & F-MAX & V-DEP \\
\hline
a. bokrok & \cellcolor{gray!50} & \cellcolor{gray!50} & \cellcolor{gray!50} & \cellcolor{gray!50} & \cellcolor{gray!50} & \cellcolor{gray!50} & \cellcolor{gray!50} \\
\hline
b. bokork & \textbf{$!!$} & \textbf{??} & \textbf{??} & \textbf{??} & \textbf{??} & \textbf{??} & \textbf{??} \\
\hline
c. bokorok & \textbf{$!!$} & \textbf{??} & \textbf{??} & \textbf{??} & \textbf{??} & \textbf{??} & \textbf{??} \\
\hline
\end{tabular}
\end{center}

In (16), a non-lowering morpheme is followed by the plural suffix, the stem being a vowel-zero alternating one. Stiebels claims that cracked stems are selected in the lexicon if certain types of suffixes follow the stem. In candidate (a) the cracked stem is followed

\(^{97}\) Only relevant constraints are shown. Also, note that capital V here stands for an underlyingly unspecified vowel root node not linked to a mora. The unlinked moras of the cracked variant of stems are superscripted. An underlined capital V refers to an underlyingly unspecified vowel linked to a mora.
by the suffix containing a vowel while in (b) and (c) the base stem can be found. It is followed by the suffix containing a vowel in (c) and without a suffix vowel in (c). Candidate (b) violates X-MAX since a segment, in this case a vowel root node, remains unparsed in the output. Candidate (c) on the other hand violates the constraint penalizing the addition of moras for the suffix vowel is not linked to a mora underlyingly but it is on the surface. This way candidate (a), the actual surface form of the word is allowed to win.

Tableau (17) shows a form where the selection of the optimal candidate cannot be performed unambiguously.

bokorba 'bush ill.'

<table>
<thead>
<tr>
<th>(17)</th>
<th>UR: bokVfr +bA98</th>
<th>μ-MAX</th>
<th>ONSET</th>
<th>X-MAX</th>
<th>μ-DEP</th>
<th>IDENT -V</th>
<th>F-MAX</th>
<th>V-DEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>bokorbɔ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>bokrobo</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>bokrbo</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In this case the suffix is the illative, containing a low vowel underlyingly linked to a mora, i.e. being different from that of the plural. μ-MAX is violated by candidate (c) because an underlying mora is unparsed. the same way a root vowel is unparsed in (c) and hence this form also violates X-MAX. Candidates (a) and (b) do not violate any of the constraints since all the underlying segments, features and moras appear on the
surface, all syllables have onsets and no moras or extra vowels are inserted. One might argue that candidate (a) will be preferred by a linearity constraint penalizing metathesis of segments as in candidate (b). Linearity is formulated as in (18) by McCarthy and Prince (1995).

(18) Linearity  $S_1$ is consistent with the precedence structure of $S_2$ and vice versa.
Let $x, y \in S_1$ and $x', y' \in S_2$. If $xRx'$ and $yRy'$, then $x < y$ iff $\neg(y' < x')$. (No metathesis)

Adding such a universal constraint to the hierarchy anywhere would result in eliminating candidate (b) and thus allowing (a) to unambiguously win.

Let us now take a look at lowering stems displaying vowel-zero alternations. Such forms are shown with and without suffixes in tableaux (19) and (20) respectively.

<table>
<thead>
<tr>
<th>(19)</th>
<th>UR: farkak 'tail pl.'</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>forkok $^{h_1} +$Vk</td>
</tr>
<tr>
<td></td>
<td>$\mu$-MAX</td>
</tr>
<tr>
<td></td>
<td>ONSET</td>
</tr>
<tr>
<td></td>
<td>$X$-MAX</td>
</tr>
<tr>
<td></td>
<td>$\mu$-DEP</td>
</tr>
<tr>
<td></td>
<td>IDENT</td>
</tr>
<tr>
<td></td>
<td>$F$-MAX</td>
</tr>
<tr>
<td></td>
<td>$V$-DEP</td>
</tr>
<tr>
<td>a.</td>
<td>forkok</td>
</tr>
<tr>
<td>b.</td>
<td>forkok</td>
</tr>
<tr>
<td>c.</td>
<td>forkok</td>
</tr>
<tr>
<td>d.</td>
<td>forkok</td>
</tr>
<tr>
<td>e.</td>
<td>forkok</td>
</tr>
<tr>
<td>f.</td>
<td>forkok</td>
</tr>
</tbody>
</table>

98 Capital ‘A’ stands for a low vowel unspecified for backness.

136
The three highest ranking constraints are not violated by any of the candidates in (19) since no moras and segments are deleted and all syllables have an onset. In candidates (c), (d), (e) and (f) a mora is added to enable the suffix vowel to be realised. The unlinked mora of the cracked stem is of no use here since these candidates do not have the cracked stem, i.e. the stem is realised with both vowels. this eliminates all these forms. The constraint to decide between candidates (a) and (b) is F-MAX because the floating [+low] feature remains unparsed in (b) the suffix vowel being mid. this way candidate (a), the actual surface form wins.

| farok 'tail' |
|---|---|---|---|---|---|---|---|
| UR: for\_vk^{L,L} | \(\mu\)-MAX | ONSET | X-MAX | \(\mu\)-DEP | IDENT -V | F-MAX | V-DEP |
| a. forok | | | * | | | !! | |
| b. forok | | | | | |  | |
| c. fork | *! | * | | | |  | |
| d. forko | | | | | | *! | |
| e. forko | | | | | |  | |

In (20) we find the same stem shown bare without any suffixes. In this case candidate (c) violates \(\mu\)-MAX because of the unparsed mora of the cracked stem and is thus eliminated. Candidates (a) and (d) violate F-MAX since the floating [+low] of the lowering stem is not realised in the output the suffix vowel or the second vowel being mid. Candidates (b) and (e) contain a low vowel in the second syllable of the base stem.
or after the stem this way enabling the underlyingly floating [+low] to be realised. Even if we included the abovementioned Linearity constraint, it would not do any good since neither (b) nor (e) is the actual surface form, that being (a). Candidate (b) would not even violate Linearity and would win. Thus we could conclude that Stiebels and Wunderlich’s (1998) analysis cannot account for lowering stems displaying vowel-zero alternations.

5.2.2 Törkenczy’s (1995) analysis

Törkenczy (1995) also analyzes vowel-zero stem alternations but with a different approach. He assumes that there are two classes of suffixes in Hungarian corresponding to non-analytic and analytic structures in Government Phonology (GP), or root level and word level morphology. Non-analytic suffixes when attached to the root act as part of the stem while analytic suffixes do not. This is shown in (21) where the symbols {,} are used to indicate stem edges

(21) a. \{bokrot\} \{bokro\} \{bokrostu\}
    'bush'+'acc.' 'pl' 'assoc.'

b. \{bokor\}ban\{bokor\}hoz\{bokor\}nak
    'iness.' 'all.' 'dat.'

99 For another analyses of vowel-zero alternations in GP using the analytic-non-analytic distinction see Polgárdi and Rebrus (1998) and Rebrus and Törkenczy (1998)
Törkenczy assumes that such alternations are due to the differences in the underlying representations of the morphemes involved and the intercation of alignment and faithfulness constraints. As for the underlying representations, he claims that plural and quaternary suffixes behaving the same way have an underlying vowel linked to a root node while the rest of quaternary suffixes, like the accusative, for instance, do not. The vowel in these morphemes is always epenthetic appearing to satisfy high ranking constraints. Thus in the underlying representations the only difference between Törkenczy's (1995) and my proposal is that Törkenczy's vowel in the plural has a root node, while the one in my analysis has a floating Place node without a root node. Törkencz's constraints responsible for the selection of optimal candidates are the given below.

(22) ALIGN-STEM Align (Stem, Right, Syllable, Edge) For the right edge of every stem there is some syllable edge that is aligned with it.

(23) SYLLSTR Syllables are well formed\textsuperscript{100}.

(24) MAX-SEG\textsuperscript{101} Segments in the input have a correspondent in the output.

(25) DEP-SEG Segments in the output have a correspondent in the input.

The constraint hierarchy selects the correct output for vowel zero alternating stems as shown in the following tableaux.

\textsuperscript{100} Törkenczy (1995) does not give an exact formulation of this constraint but it basically requires that syllables are well-formed.

\textsuperscript{101} Törkenczy (1995) uses PARSE and FILL instead of the correspondence theoretic equivalents. Nothing hinges on whether we use one or the other here.
bokor 'bush'

In (26), a bare epenthetic stem is shown. Candidates (b) and (c) violate SYLLSTR since the first one contains an illegitimate coda cluster while the second one contains a short mid rounded vowel in word final position, which is impossible in Hungarian. Hence candidate (a) wins despite its violation of DEP-SEG by the epenthesized vowel.

bokrok 'bush pl.'

In tableau (27) the same root is followed by the plural forming a stem together as shown by the braces. None of the candidates violate the higher ranking constraint but while (b) and (c) violate DEP-SEG once and twice respectively, candidate (a), the actual surface form, does not and hence wins.

---

102 In the output candidates I will only indicate right stem edges because only these are important for the analysis.
The input in tableau is the vowel epenthesizing stem used above followed by the inessive, an analytical suffix with a boundary visible to phonology. Two of the candidates, (b) and (c), are filtered out by SYLLSTR because they contain impossible coda or onset clusters respectively. Three of the candidates, (c), (d) and (e) violate the stem alignment constraint since the right edge of the stem is not aligned with a syllable edge. Candidate (f) on the other hand only violates MAX-SEG because of the unparsed stem final consonant, but this violation is fatal as the optimal candidate in (a) only violates the lowest ranking DEP-SEG constraint.

Since these constraints are not special in the sense that other forms of Hungarian comply with them in most cases, let us consider words stems of other kinds that are relevant for the account developed in this work. I will examine vowel final stems,

103 Capital ‘V’ here stands for a vowel unspecified for backness and roundness.
lowering and non-lowering below to see whether Törkenczy’s (1995) above hierarchy can account for the vowel-zero alternations in suffixes following such stems.

Tableau (29) shows a non-lowering vowel final stem folowed by the accusative, which does not contain a vowel underlyingly. The actual surface form is selected by the constraint hierarchy since candidates (b) and (c) both violate DEP-SEG because of the epenthesized suffix vowel. Candidate (a) does not violate any of the constraints and wins.

104 Syllable boundaries are indicated with ‘.’ full stops.
The stem in (29) is shown here again but followed by the plural suffix. In this case, candidate (a), the real surface form, violates MAX-SEG because of the unrealised suffix vowel. This way a candidate with a parsed suffix vowel will win. The quality of the suffix vowel must be determined by other constraints not discussed in Törkenczy (1995). Whatever suffix vowel there is, the candidate will not be the actual form because that does not have a suffix vowel. However, if we add a constraint like Lowering discussed in the previous chapters, or any other constraint that does the same job, the hierarchy will select the actual form as shown in (31) if Lowering dominates MAX-SEG.

<table>
<thead>
<tr>
<th>(31)</th>
<th>UR: {kɔpuVk}</th>
<th>SYLL</th>
<th>ALIGN-STEM</th>
<th>Lowering</th>
<th>MAX</th>
<th>DEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>kɔ.puk}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>kɔ.pu.ok}</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>kɔ.pu.ok}</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Since Lowering only penalizes cases when a lowering morpheme is followed by a non-low vowel and when there is now vowel in the subsequent suffix, it will not have any effect on non-lowering stems with or without suffixes. Let us now consider vowel final lowering stems.
In (32), the candidates with an inserted vowel, in (b) and (c), violate DEP-SEG and allow the actual candidate (a) to win. However the same lowering stem behaves differently if followed by the plural as noted in the previous chapter.

Instead of the correct form with a low suffix vowel, the candidate without a vowel in the plural suffix is preferred by the hierarchy. this can be amended if we consider the Lowering constraint again. Candidates (b) and (c) do not have a lowe suffix vowel and thus violate Lowering. Since Lowering dominates MAX-SEG in tableau (31), because of

---

105 Lowering stems are indicated with a superscripted capital ‘L’.

---
the transitivity of the dominance relation it also has to dominate DEP-SEG. Thus candidate (a) would be selected as optimal in tableau (33).

Unfortunately, this analysis runs into a problem with the form in (32) repeated below with the added Lowering constraint.

szomorú ’sad acc.’

(34)  
<table>
<thead>
<tr>
<th>UR: {somoru: ́t}</th>
<th>SYLL</th>
<th>ALIGN-STEM</th>
<th>Lowering</th>
<th>MAX</th>
<th>DEP</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. so.mo.ru:t}</td>
<td></td>
<td></td>
<td>!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. ⊗ so.mo.ru:.Ot}</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. so.mo.ru:.ot}</td>
<td></td>
<td></td>
<td>!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The forms without a low suffix vowel, i.e those in (a) and (c), both violate Lowering and are thus eliminated. The winning candidate, (b), only violates DEP-SEG because of the epenthetic vowel in the suffix, a violation which is not fatal because of the higher ranking Lowering. However, the actual surface form is the one in (a). For (a) to win, either we have to get rid of Lowering or have a higher ranking constraint penalizing candidate (b). If we exclude Lowering from the constraint hierarchy, we lose the ability to account for the behaviour of all Lowering stems, a whole class of morphemes. If, on the other hand, we posit a higher ranking constraint that disfavours (b), the same constraint would eliminate the same kind of candidate with the plural suffix, which is the correct one. It
seems then that there is a basic difference between the plural and the accusative types of quaternary suffixes. Thus the same conclusion can be reached here as in chapter 2.

Let us now turn to the analysis outlined in chapter 2. In what follows I will explore for zero-vowel alternations in roots the consequences of that analysis making use of the distinction between faithfulness constraints referring to segments and subsegments as proposed by Zoll (1996).

5.3. An analysis with subsegments

In chapter 4, after examining the different behaviour of the plural and the accusative I proposed different underlying representations for such suffixes. Suffixes that behave like the plural have vowel Place nodes without a root node underlyingly as opposed to the accusative and the similar suffixes that do not have a vowel in the underlying representation. Other suffixes that do not display vowel-zero alternations have vowels linked to a root node. This difference is exploited by the constraint pair MAXseg and MAXsubseg requiring the presence of underlying segments and floating features or feature nodes in output candidates respectively. The constraint hierarchy discussed in chapter 3 and 4 is repeated here for convenience.

(35) Syll>>MAXseg>>Lowering>>Onset>>MAXsubseg>>DEPseg>>*ceans>*
We also noted that if an accusative-type suffix is used, a sub-ranking has to be changed because of the marked status of such morphemes; i.e. because of the relative insignificance of the fact whether a preceding morpheme is lowering or not.

Before we see what the hierarchy predicts in the case of vowel-zero alternating stems, we have to address the question of the underlying representation of the unstable vowel in these roots. As the vowel does not only appear for reasons of syllable well-formedness, we cannot claim that the vowel is epenthetic. This is shown by triplets such as török [török] 'Turkish' – far(o)k [för(o)k] 'tail' – park [pørk] 'park', where the first word has a stable vowel that is never deleted, the second one has an unstable vowel deleted if followed by vowel-zero alternating suffixes and the last one does not have a vowel between the members of the word final cluster at all showing that it is a possible cluster in the language. For this reason the unstable vowel must be present underlyingly in some form. It is either present as a full vowel or as a root node without some of the vowel features or as a feature node without a root node. The first representation cannot be correct since then all vowels in the second syllables of words will be deleted by the mechanism or a large number of lexical entries must be marked as exceptional. Let us now see whether the second or the third representation will work with the above hierarchy.
5.3.1 Underlying root nodes

Let us assume that roots with vowel-zero alternations contain a root node underlyingly, but that this is a moraic root node not linked to vowel features, an empty moraic root node. The representation of the root *bokor* 'bush' is given in (36).106

\[
\begin{array}{cccc}
\text{Rt} & \text{Rt} & \text{Rt} & \text{Rt} \\
\text{/b/} & \text{/o/} & \text{/k/} & \text{/r/} \\
\end{array}
\]

Let us now see how the constraint hierarchy selects the optimal candidates.107

\[
\begin{array}{ccccccc}
\text{UR: Syll} & \text{MAX} & \text{Lowering} & \text{MAX} & \text{DEP} & \text{*a} & \text{*o} \\
\text{bokor} & \text{seg} & \text{seg} & \text{seg} & \text{seg} & \text{seg} & \text{seg} \\
\hline
\text{a.} & \text{boker} & & & & & \\
\text{b.} & \text{bok} & *! & & & & \\
\text{c.} & \text{bokr} & *! & & & & \\
\text{d.} & \text{bokro} & *! & & & & \\
\text{e.} & \text{bokro} & & & & *! & \\
\text{f.} & \text{bokor} & & & & *! & \\
\end{array}
\]

106 Segments between slant lines stand for the feature tree of the segments.
107 The Onset constraint is not shown in the tableaux because it is never a decisive factor for this kind of stems.
Tableau (37) shows a bare vowel-zero alternating root. Candidates (c) and (d) violate Syll because (c) contains an illegitimate coda and (d) contains a word final short mid rounded vowel which is not allowed in Hungarian. Candidate (b) violates MAXseg twice since the empty root node and the word final consonant are both deleted. Note that from this point of view a root node unspecified for features counts as a normal segment. Candidates (e) and (f) are eliminated because of their violation of the higher ranking vowel markedness constraint. Although candidate (a) violates *o twice, it is allowed to win because a double violation of the lowest ranking constraint is better than even a single violation of any higher ranking constraint. Also note that candidates (d) and (e) violate the constraint of Linearity, formulated in (18) of this chapter, because of the metathesized vowel consonant sequence.

Tableaux (38) and (39) show the same stem followed by the plural and the accusative respectively as representatives of their types of suffixes.

108 The symbol ‘•’ refers to a moraic root node unspecified for vowel features.
In tableau (38) an incorrect candidate wins over the actual surface form, [bokrok]. Candidates (a), (d), (e) and (f) all violate MAXseg at least once (candidate (f) actually violates it three times) because of the unparsed root node in the root. Candidate (b) is eliminated by its violation of MAXsubseg since the floating Place node of the plural is deleted from the output. This way, incorrectly, candidate (c) is allowed to win. We should note however that the form in (c) is not an impossible form in Hungarian. A proper name like *Bokor would behave exactly like shown in tableau (38) if used in the plural, i.e. it would be *Bokorok.

---

109 Capital ‘O’ stands for an underlyingly floating Place node if not noted otherwise.
In (39) an incorrect candidate is selected as optimal once again. Candidates (a), (d), (e) and (f) violate MAXseg for the same reason as in (38). Note that in candidate (e) the \([o]\) vowel can either be coindexed with the underlyingly empty root node or not. In the first case it does not violate MAXseg but violates Linearity which is relatively high ranked in Hungarian because segments are normally not metathesized\(^{110}\). In the second case, the surface \([o]\) vowel is not coindexed with the empty root node in the input and thus the deletion of the root node violates MAXseg as shown above. Candidate (d) violates Syll because of the resulting impossible coda cluster. Candidate (b) is preferred over (c), as opposed to (38), because (c) violates DEPseg. The difference between candidates (b) and (c) in (38) and (39) is that in the former tableau one candidate violates DEPseg because

\(^{110}\) There is a small number of vowel-zero alternating stems in which we have metathesis of two consonants but never a vowel and a consonant. Such stems, like \(\text{teh(e)r} [\text{teh}^r]\) ‘weight’ or \(\text{peh(e)ly} [\text{pehej}]\) ‘fluff’, where the unstable vowel is shon in parenthesis, have alternative variants as in \(\text{terhet} [\text{terhet}]\) ‘weight acc.’ and \(\text{pehyhet} [\text{pehjhet}]\) ‘fluff acc.’. Should the consonants not be metathesized, the \([h]\) would be in a coda position in the latter two forms because of the deletion of the unstable vowel. In Hungarian a glottal fricative cannot occur in a coda. If we rank this constraint higher than Linearity, we get the right result.
of the insertion of a root node in the suffix, the other violating MAXsubseg because of the deletion of the floating Place node in the suffix. In (38) there is no floating Place node in the suffix and thus neither candidate violates MAXsubseg allowing (b) to win. Note again, that although candidate (b) is an impossible form of the input, it is a possible output if the input is the proper name Bokor mentioned above, the accusative being Bokort.

Thus we can conclude that the assumption that unstable root vowels are underlyingly empty root nodes gives us wrong predictions when fed to the feature hierarchy developed in the previous chapters. For this reason we turn our attention to the other possibility of the underlying representation of unstable vowels, the approach already applied to the plural-type of suffixes, i.e. subsegments.

5.3.2 Underlying subsegments

The other possible way to represent the unstable vowel in vowel-zero alternating roots is to posit a subsegment, a Place node underlyingly not linked to a root node. This Place node will be linked to an epenthesized root node if made necessary by higher ranking constraints but will remain uninterpreted, i.e. deleted if not. The representation of such a root is given below.
This way the representation of vowel-zero alternating segments is made uniform since we assumed the same kind of underlying structure for suffix vowels alternating with zero. Thus vowels behaving the same way are treated the same way by the theory. Whether or not these Place nodes appear on the surface linked to an inserted root node should follow from the constraint hierarchy. Also note that the claim that the underlyingly floating Place node contains the dependent features [-high, -low ROUND] predicts that there will be no cases of front rounded vowels in the first syllable followed by front unrounded vowels in the second. This prediction is in fact borne out. Whenever such roots have a front rounded vowel in the first syllable, the second (unstable) vowel is always also rounded, as in tulök 'horn' for instance, while if it is unrounded the unstable mid vowel is always unrounded, as in lepel 'veil', since a front mid rounded vowel following an unrounded vowel would result in the violation of the constraint Link [ROUND] discussed in chapter 1. This means that there are no forms like the hypothetical nonexistent nonce words tük(e)r or tök(e)r. There are some exceptional forms where a front unrounded vowel is followed by a front rounded vowel, but in such cases the rounded

---

111 Symbols between slanting lines stand for the feature trees of the segments; boldface Place stands for a floating Place node with the dependent feature specifications [-high, -low, ROUND]

112 Of course, I propose this kind of underlying representation only for suffix vowels that are clearly NOT epenthetic, i.e. the accusative and similar suffixes are not represented this way underlyingly. For details see chapter 2.
vowel is always high, i.e. the root belongs to the marked class of vowel-zero alternating stems containing high or low unstable vowels. The Link [ROUND] constraint is not sensitive to high vowels, so it will not penalize such co-occurrences.

Let us now consider the behaviour of unstable vowels in bare roots and suffixed forms as shown in the following tableaux.

<table>
<thead>
<tr>
<th>(41)</th>
<th>UR: bokOr</th>
<th>Syll seg</th>
<th>Lowering</th>
<th>MAX subseg</th>
<th>DEP seg</th>
<th>*₀</th>
<th>*₀</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>bokor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>b.</td>
<td>bok</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>bokr</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>d.</td>
<td>bokro</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>e.</td>
<td>bokro</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*!</td>
</tr>
<tr>
<td>f.</td>
<td>bokOr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Tableau (41) shows a bare unstable vowel stem. Of the generated candidates, the ones in (c) and (d) are eliminated by Eval since they both violate the high ranking Syll constraint for one contains an impossible coda cluster while the other has a short mid rounded vowel word finally, a prohibited structure in the language. Candidate (b) violates MAXseg and MAX subseg because of the unparsed root consonant and Place node respectively. Candidates (a), (e) and (f) all violate DEPseg for a root node has to be inserted to support the underlyingly floating root node. For this reason the decision is
passed on to the markedness constraints which favour candidate (a) as it contains only back mid vowels as opposed to the back low vowels in the other two forms.

<table>
<thead>
<tr>
<th>(42)</th>
<th>UR: barom 'cattle'</th>
<th>Syll seg</th>
<th>MAX Lowering</th>
<th>MAX subseg</th>
<th>DEP seg</th>
<th>*ₗ</th>
<th>*₀</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. børOm</td>
<td>børōm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. bør</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. børm</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. børmo</td>
<td>bórmo</td>
<td>*!</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. bórmo</td>
<td>bórōm</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>f. bórōm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

The form in (42) is another root with an unstable vowel. The difference between the lexical items in (41) and (42) is that the consonant cluster resulting from the deletion of the floating Place node does not form a possible branching coda in (41) but it does in (42). However, as we can see it does not make a difference in the selection of the optimal candidates. The candidate with the parsed Place node is selected as optimal again. this time candidate (c) is not eliminated by Syll because of the well-formed coda cluster but by MAXsubseg since the underlying unlinked Place node remains unparsed in the output.

In the following tableau I examine a root with an exceptional unstable vowel since this vowel is not mid as it is in normal cases but high. In such stems the floating
Places node dominates the features [+high, -low, ROUND]. The backness value of the vowel will be filled in by the value of the other root vowel\textsuperscript{113}.

\begin{center}
\begin{tabular}{|c|c|c|c|c|c|c|c|}
\hline
 & UR: & Syll & MAX & Lowering & MAX & DEP & *o \\
 & bajUs & & seg & & subseg & seg &  \\
\hline
a. & bojus & & & & & * & *  \\
\hline
b. & boj & & *! & & * &  \\
\hline
c. & bojs & & & & *! &  \\
\hline
d. & bojsu & & & & * &  \\
\hline
e. & bojos & & & * & * & *!  \\
\hline
f. & bojos & & & * & **! &  \\
\hline
\end{tabular}
\end{center}

In this tableau the actual surface form cannot be unambiguously selected as optimal. Candidate (b) violates MAXseg since the word final consonant has been deleted. Candidate (c) is eliminated because of its violation of MAXsubseg as a result of the unrealised underlying Place node. The rest of the candidates violate DEPseg, i.e. the Place node is supported by an inserted root node. Candidate (f) violates *o twice as opposed two (e) and (a)'s one violation. Candidate (a) and (d) win because (e) also violates *o. Note that (e) and (f) also violate an identity constraint for the feature [high]

\textsuperscript{113} In roots with a low unstable vowel the floating Place node, of course, dominates the features [-high, +low]. Note that there are only two unstable roots listed by Törkenczy (1992) in which the backness values of the two vowels of the root are not identical: \textipa{pizzy(o)k} \textipa{[pizok]} ‘dirt’ and \textipa{in(o)g} \textipa{[inog]} ‘sways’. We can assume that in these words the Place node also dominates the feature [+back]. However, there are no real disharmonic words, like sofor \textipa{[fo:fo:r]} ‘chauffeur’, with unstable vowels, not a coincidence but an expected consequence of the theory and the representation of unstable vowels.
which can never be violated in Hungarian. As we have already seen all other vowel features can alternate in certain cases except for [high]. For this reason, IDENTITY\textsubscript{high} has to be ranked high in the hierarchy. Note that candidate (a) can be correctly selected as optimal if we assume that there is a constraint penalizing word final short u’s. Since there are words ending in a short [u], e.g. kapu [k\textipa{u} pu] ‘gate’, this constraint must be ranked low.

The next tableau shows a bare lowering root with an unstable vowel and the actual form is selected as optimal by the hierarchy.

<table>
<thead>
<tr>
<th></th>
<th>Syll</th>
<th>MAX</th>
<th>Lowering</th>
<th>MAX</th>
<th>DEP</th>
<th>*ο</th>
<th>*ο</th>
</tr>
</thead>
<tbody>
<tr>
<td>UR: forOk\textsuperscript{l}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. forok</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. for</td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. fork</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>d. forko</td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>e. fork</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>d. forok</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>**</td>
</tr>
</tbody>
</table>

Candidate (d) is eliminated in (44) because it violates the highest ranking Syll constraint. Candidate (b) on the other hand violates the MAX constraints since the word final consonant and the floating vowel Place node are not parsed in the output. Candidate (c)
violates MAXsubseg but this violation is enough to eliminate it since the optimal candidate does not violate this constraint. Candidates (a), (e) and (f) all violate DEPseg to be able to parse the floating Place node and thus to avoid the violation of MAXsubseg. Finally, the decision between (a), (e) and (f) is passed down to the markedness constraints: (e) and (f) violate *∅ twice while (a) violates it only once and thus wins.

Now that we have seen that the constraint hierarchy selects the actual surface forms as optimal for all kinds of roots with unstable vowels, let us take a look at the suffixed forms of these roots.

<table>
<thead>
<tr>
<th></th>
<th>Syll</th>
<th>MAX seg</th>
<th>MAX subseg</th>
<th>DEP seg</th>
<th>*∅</th>
<th>∅</th>
</tr>
</thead>
<tbody>
<tr>
<td>bokOr+t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.  bokrot</td>
<td>*</td>
<td>∅</td>
<td>∅</td>
<td>*∅</td>
<td>**</td>
<td>∅</td>
</tr>
<tr>
<td>b.  bokort</td>
<td>*</td>
<td>∅</td>
<td>∅</td>
<td>*∅</td>
<td>**</td>
<td>∅</td>
</tr>
<tr>
<td>c.  bokorot</td>
<td>∅</td>
<td>∅</td>
<td>*∅</td>
<td>*∅</td>
<td>***</td>
<td>∅</td>
</tr>
<tr>
<td>d.  bokrt</td>
<td>*</td>
<td>∅</td>
<td>*∅</td>
<td>*∅</td>
<td>*</td>
<td>∅</td>
</tr>
<tr>
<td>e.  bokrot</td>
<td>*</td>
<td>∅</td>
<td>*∅</td>
<td>*∅</td>
<td>*</td>
<td>∅</td>
</tr>
<tr>
<td>f.  bok</td>
<td>*</td>
<td>*∅</td>
<td>*∅</td>
<td>*∅</td>
<td>*</td>
<td>∅</td>
</tr>
</tbody>
</table>

The same hierarchy cannot properly select the optimal candidate when the root is followed by a suffix like the accusative. Candidate (d) violates Syll because of the ill-formed coda cluster and is eliminated. Candidate (f) has two unparsed segments and an
unparsed subsegment, so it is excluded for violating MAXseg. The rest of the forms all violate DEPseg. Since the candidate in (c) violates it twice as opposed to the one violation of the other three candidates, this second violation is fatal. Candidate (e) has a violation of *∅ and is hence also eliminated. Candidate (a) and (b) thus fare equally well on the hierarchy and neither of them can be selected as optimal alone. This shows the need for another constraint penalizing complex codas, repeated here from chapter 4 for convenience115.

(46) *No Complex No complex codas.

Tableau (47) shows the same word as in (45) with the added NoComplex constraint.

bokrot 'bush acc.'

\[
\begin{array}{|c|c|c|c|c|c|c|}
\hline
\text{UR:} & \text{Syll} & \text{MAX seg} & \text{MAX subseg} & \text{No Complex} & \text{DEP seg} & *∅ & *∅ \\
\text{bokOr+t} & \text{bokrot} & & & * & ** \\
a. & & & & & & & \\
b. & & & & *! & * & ** \\
c. & & & & & & * & **! \\
d. & & & & *! & * & * \\
e. & & & & & & * & *! \\
f. & & & & *! & * & * \\
\hline
\end{array}
\]

114 Lowering is not shown in the tableau because it is not relevant for non-lowering stems.
115 Note that the coda cluster in (45.b) is well formed it can be found in monomorphemic words, e.g. part [port] 'shore', and also in plurimorphemic ones, e.g. pdr̩+t [pa:rt] 'pair acc.'
As it can be seen, NoComplex eliminates the unwanted candidate in (b) and correctly allows candidate (a) to win. The rest of the candidates are excluded as in (45). Since in the previous tableaux the optimal candidates do not have complex codas, the insertion and ranking of the new constraint will not influence the selection of the right candidates.

Tableau (48) shows the lowering root *farok* followed by the same suffix. Candidates (e) and (f) are out of the race for they both violate the highest ranking syllable well-formedness constraint because of the stop cluster in the coda. The candidates in which the lowering morpheme is not followed by a low suffix vowel, i.e. candidates (b), (d), (e) and (f), all violate Lowering and are thus eliminated. The remaining candidates, (a) and (c) fare equally well on the highest ranking constraints, Syll, Lowering, MAXseg, MAXsubseg and NoComplex. However, while (a) only violates DEPseg once, (c)
violates it twice. The second violation is thus fatal for (b) and allows (a) to correctly win\textsuperscript{116}.

It seems then that our hierarchy amended the above way selects the actual surface forms for bare roots with unstable vowels and also when such roots are followed by suffixes like the accusative. Let us now focus on the same kind of roots followed by the plural suffix, being representative of its kind. Tableau (49) shows the non-lowering root \textit{bokor} followed by the plural. Unfortunately, the wrong candidate is selected as optimal in this case.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline
 & Syll & MAX seg & MAX subseg & No Complex & DEP seg & \(\text{*C}\) & \(\text{*O}\) \\
\hline
\textit{bokOr+Ok} & & & & & & & \\
\hline
a. bokrok & & \text{*!} & & & & & \\
\hline
b. bokork & & \text{*!} & \text{*} & \text{*} & \text{**} & & \\
\hline
c. \textasteriskcentered bokorok & & & \text{**} & \text{**} & & & \\
\hline
d. bokrk & \text{*!} & \text{**} & \text{*} & & \text{**} & & \\
\hline
e. bok\textasteriskcenteredrok & & \text{*!} & & \text{*} & \text{*} & \text{*} & \\
\hline
f. bok & \text{*!*} & \text{**} & & & & & \\
\hline
\end{tabular}
\caption{bokrok 'bush pl.'}
\end{table}

Candidate (d) is excluded from the race since it has an ill-formed coda cluster. Candidate (f) has unparsed segments and thus violates MAX seg, this violation being fatal.

\textsuperscript{116} Note that the ranking of the constraints Lowering and MAXseg has to be MAXseg \textgreater\textgreater Lowering if the input contains an accusative type of suffix. This change however does not influence the selection of the
Candidates (a), (b) and (e) all violate MAXsubseg as they have one of the two underlying floating Place nodes unparsed. Since candidate (c) has both subsegments realised in the output, it is incorrectly allowed to win. This tableau shows the necessity of having another constraint penalizing forms like candidate (b) but not forms like (a). The key to understanding the behaviour of the floating Place nodes seems to lie in forms containing more than one underlyingly unlinked subsegments. Before the formulation of such a constraint, let us take a look at which subsegments are realised if the input has several ones.

<table>
<thead>
<tr>
<th>(50) UR</th>
<th>Surface forms</th>
<th>Incorrect forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bokO₁r</td>
<td>bok₀₁₀r</td>
<td></td>
</tr>
<tr>
<td>b. bokO₁r+t</td>
<td>bok₀₁₀ᵗ</td>
<td>*bok₀₁₀r₀₂k</td>
</tr>
<tr>
<td>c. bokO₁r+O₂k</td>
<td>bok₀₁₂₀k</td>
<td>*bok₀₁₀r₀₂kat</td>
</tr>
<tr>
<td>d. bokO₁r+O₂₉+t</td>
<td>bok₀₁₂₀kᵗ</td>
<td>*bok₀₁₂ᵣ₀₂ᵗ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*bok₀₁₂ᵣ₀₂₉ᵗ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>*bok₀₁₂ᵣ₀₂₉kt</td>
</tr>
</tbody>
</table>

As table (50) shows, whenever there is just one underlying subsegment as in (a) and (b), it is always realised in the output. If there are two subsegments underlyingly as in (c) and (d) at least one is always realised. In (c) only one of the the subsegments is realised and optimal candidate in the tableaux.
thus it occupies the nucleus of the last syllable of the word. In (d) both subsegments are parsed. Note that the last three of the incorrect forms all have one subsegment unparsed and violate the syllable well-formedness constraint. Thus in this case syllable well-formedness requires that both subsegments be present in the output. Also note that the first incorrect form in (d) differs from the actual surface form in that the output correspondents of the input subsegments are not aligned to the right edge of the prosodic word. This suggests that an alignment constraint requiring that output correspondents of input subsegments be right aligned with the prosodic word might be at work here.

(51) ALIGN(subseg, PrWd, R)  Output correspondents of input subsegments are aligned with the right edge of the prosodic word\textsuperscript{118}.

Let us now see whether the constraint hierarchy with this new constraint is able to select the actual surface forms as optimal for all kinds of inputs with unstable segments. I will consider lowering and non-lowering roots with unstable vowels followed by one or more quaternary suffixes. Then I will also examine whether the hierarchy still selects the optimal outputs for other roots correctly.

\textsuperscript{117} Subscripted numbers show the correspondence relations of vowels, coindexed vowels are considered to be corresponding ones. If a vowel has two indices, e.g. 1,2, then it does not matter which vowel it corresponds to.

\textsuperscript{118} The right edge here means the rightmost syllable. Violation is counted by syllables. Also note that the constraint is not violated if some underlying subsegment is not present in the output. The only thing this alignment constraint penalizes is output correspondents of input subsegments not aligned to the right of the prosodic word.
Tableau (52) shows the bare root *bokor* underlyingly containing an unstable vowel, i.e. a floating Place node not linked to a root node. Candidates (c) and (d) both violate the constraints governing syllable well-formedness: (c) contains a word final short mid rounded vowel while (d) contains an illegitimate coda cluster. Candidates (a) and (b) fare equally well on Syll, MAXseg and the alignment constraint. Note that the output correspondent of the input subsegment in (a) is aligned to the right, i.e. it is in the last syllable, while the subsegment does not have an output correspondent in (b) shown by the indices. Still, (b) does not violate the alignment constraint because there is no correspondent of an input subsegment not aligned with the right edge of the prosodic word. However, candidate (b) violates MAXsubseg since the floating input Place node remains unparsed. This way candidate (a), the actual surface form is allowed to win\(^{120}\).

\(^{119}\) Subscripted numbers indicate corresponding segments in inputs and outputs. A subscripted capital ‘L’ indicates a lowering morpheme.

\(^{120}\) Note that candidates (a) and (b) are phonetically identical. It is only the correspondence relations that are different in these candidates, but it is exactly what matters in this case.
bokrok ‘bush pl.’

Candidates (d), (e) and (f) in (53) are ruled out for reasons of syllable well-formedness since they all contain coda clusters not allowed in Hungarian. Candidate (c) has an alignment violation because the output correspondent of one of the underlying subsegments is not right-aligned with the prosodic word, i.e. is not in the last syllable. Candidates (a) and (b) avoid violating this constraint by having one of the subsegments unparsed. These two candidates fare equally well on all constraints except for Linearity. In candidate (a) the order of the Place nodes of [r] and [o₁] is the reverse of that in the input. Note again that (a) and (b) are phonetically identical but as far as correspondence is concerned (b) is “better” than (a). This way candidate (b) is properly selected as optimal.

121 Note that the capital ‘O’ in the root and the suffix do not represent exactly the same things, the one in the root stands for a floating Place node containing the features [ROUND, -high, -low] while that in the suffix represents a floating Place node containing [ROUND, -high]. Thus the only difference is that the root ‘O’ is but the suffix one is not specified for [low] underlyingly.

122 Note that DEPseg also has to dominate NoCoda because otherwise vowel segments would be added to consonant final words to satisfy NoCoda.
Tableau (55) shows the same root followed by the accusative suffix. In this case there is only one underlying subsegment, i.e. that of the root. Only candidate (e) has the subsegment unparsed in the output. This way an ill-formed coda cluster arises, which is penalizes by Syll. Candidate (f), on the other hand, has the suffix consonant, a full segment, unparsed and thus violates MAXseg. Candidate (d) has an alignment violation because the output correposndent of the subsegment is not in the last syllable. Candidate (c), (b) and (a) fare equally well on the higher ranking constraints. Candidate (c) violates the constraint penalizing complex codas and is eliminated. Candidate (b) violates DEPseg twice because of the two epenthetic vowel root nodes while (a) violates it only once and wins.
Tableau (56) shows the latent segment root with multiple suffixes, plural and accusative. Candidate (f) violates Syll because of the coda cluster of the first syllable. Candidate (b) on the other hand violates IDENTITY(low), proposed in chapter 3, because the underlyingly [ROUND, -high, -low] Place node surfaces as [ROUND, -high, +low]. Candidate (d) violates ALIGNsubseg twice while (a), (c) and (e) violate it only once. Hence (d) is also eliminated. The remaining three candidates all violate DEPseg, but (e) violates it three times while the other two only twice. Candidates (a) and (c) fare equally well on all constraints, i.e. the hierarchy cannot unambiguously select an optimal candidate. Note that Linearity would prefer (c) over (a) because of the reversal of the Place nodes of [o] and [r]. Clearly another constraint is needed. If we compare (a) and (c), we can notice that (a) contains as a substring the plural form of the word, i.e. the string [bokrokt]. For this reason, it can be argued that there is a constraint that prefers identical plural forms of the same stem in every case. This is clearly a case of output-
output correspondence requiring that instances of the plural of a morpheme be identical irrespective of whether there is another morpheme following in the same word or not.

(57) IDENTITY Output-Output (Plural) Output correspondents of the plural of a morpheme are identical. The base form is the bare plural without any other suffixes.

Let us now see whether this constraint together with the others in the hierarchy can correctly select the optimal candidate.

<table>
<thead>
<tr>
<th>bokrokat ‘bush pl. acc.’</th>
<th>UR: bokO₁t+O₂k₂t+t</th>
<th>Syll</th>
<th>ID low</th>
<th>ALIGN subseg</th>
<th>MAX subseg</th>
<th>IDENT -OO</th>
<th>DEP seg</th>
<th>No Coda</th>
<th>*σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bok.ro₁.kɔ₂t</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b. bok.ro₁.kɔ₂t</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c. bok.ro₁.kɔ₂t</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>d. bok.ro₁.ro₂.kɔ₂t</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>e. bok.ro₁.ro₂.kɔ₂t</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>f. bokr.kɔ₂t</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

This way the hierarchy selects (a), the actual surface form as optimal. Note that there is no evidence for the relative ranking of the IDENT-OO constraint. The only thing we can assume is that it must dominate Linearity, which would prefer candidate (c) to (a).

123 The new constraint has to dominate Linearity to yield the right result.
124 Identity is violated by changing or deleting a segment.
farkak 'tail pl.'

<table>
<thead>
<tr>
<th>UR: forgO₁k₇ + O₂k</th>
<th>Syll seg</th>
<th>MAX seg</th>
<th>ID low</th>
<th>Lowering subseg</th>
<th>ALIGN subseg</th>
<th>MAX subseg</th>
<th>DEP seg</th>
<th>No Coda</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. forg.ko₁k</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>b. forg.ko₂k</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>c. forg.ko₁k</td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>d. forg.ro₁ko₂k</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*!</td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>e. forg.ro₁k:</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>f. forg.rok</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

The form in (59) is different from the previous ones in that the root is a lowering morpheme, i.e. it requires that quaternary suffixes have a low vowel after the root. Candidate (c) violates the constraint enforcing this, i.e. Lowering, and is thus eliminated. Candidates (e) and (f) are ruled out by Syll and MAXseg respectively because of the illegitimate coda and the unparsed suffix consonant. Candidate (a) violates IDENTITIY(low) because the latent vowel of the root, which is specified as [-low] underlyingly, corresponds to a low vowel in the output. Candidate (d) violates the alignment constraint on subsegments since the output correspondent of one of the subsegments is not aligned with the right edge of the prosodic word. As candidate (b) does not violate any of these constraints, only lower ranking ones, it is correctly selected as optimal.

125 Recall from Chapter 4 that geminates in codas can only occur if they are underlying, i.e. they never appear as a result of morpheme concatenation (except for the past tense and imperative morphemes in verbs) since the candidate containing a geminate either violates the OCP (if it is a fake geminate) or the constraint MAXseg because of the deleted root node.
Tableau (60) shows the same lowering root with the accusative. Candidates (d) and (e) are eliminated because of the violation of the highest ranking Syll and MAXseg constraints. Candidate (c) violates IDENTITY(low) just like (59.a). Candidate (b) is preferred to (a) because the latter violates Lowering as the suffix vowel is not low after the lowering morpheme. Thus (b), the correct output wins.

Tableau (61) shows the same lowering root with the plural accusative. Candidates (d) and (e) are eliminated because of the violation of the highest ranking ALIGN and MAXseg constraints. Candidate (c) violates IDENTITY(low) just like (59.a). Candidate (b) is preferred to (a) because the latter violates Lowering as the suffix vowel is not low after the lowering morpheme. Thus (b), the correct output wins.
Tableau (61) contains the same stem with multiple quaternary suffixes. Candidate (d) is ruled out because of the violation of IDENTITY(low) by the latent root segment. Candidates (e) and (f) both have a violation of Lowering because the vowel of the plural is mid in (e) and there is no low vowel in the suffix in (f) at all. Candidates (a) and (b) violate the alignment constraint on subsegments. The subsegment is misaligned by one syllable in (b) and there are misalignments worth of three violation in (a): The first latent vowel is misaligned by two syllables, the second one by one. Thus candidate (c) is allowed to win, a perfectly aligned candidate with one unparsed subsegment.

Let us now consider normal stems without latent segments. The way the constraint hierarchy selects the output candidates is shown in tableaux (62)-(64) for a consonant final non-lowering stem followed by a single suffix and multiple suffixes as well.

<table>
<thead>
<tr>
<th>borok 'wine pl.'</th>
</tr>
</thead>
<tbody>
<tr>
<td>(62)</td>
</tr>
<tr>
<td><strong>UR:</strong></td>
</tr>
<tr>
<td>bor+O₁k</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>MAX seg</th>
<th>ALIGN subseg</th>
<th>MAX subseg</th>
<th>DEP seg</th>
<th>No Coda</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. bo.rok</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. bo.roık</td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. bork</td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If a normal stem is followed by the plural, the candidate with a mid suffix vowel will be selected as optimal. Should it be a lowering stem, the only difference would be that the candidate with a low suffix vowel would be selected.
Tableau (63) shows the same stem followed by the accusative. The actual surface form is selected again since the other two candidates either violate MAXseg or DEPseg. Thus epenthesis or underparsing is only allowed if necessary.

Tableau (64) contains a more complex case, a normal stem with multiple suffixes. We can see that it is the very constraint IDENTITY Output-Output that saves (b) from losing against (d). The other candidates are all eliminated by higher ranking constraints. The decisive constraint between the two remaining candidates is thus IDENT-OO. Candidate
(d) loses since it is not identical to the bare plural form of the stem, i.e. [borok] shown in (62). This way candidate (b) is allowed to win.

Conclusion

In this dissertation I have shown that the so-called quaternary harmony in Hungarian cannot be treated as a purely phonological phenomenon in Optimality Theory. OT forces us towards a morphophonological model by preferring the treatment of the problem with a morphological constraint, Lowering. I have also demonstrated that the difference between the kinds of quaternary suffixes, i.e. plural, accusative and possessive, can be accounted for if we assume that the accusative does not have a vowel underlyingly in any way but all other such suffixes have floating Place nodes not linked to a root node. This way their behaviour different from real vowel initial suffixes, like the terminative -ig, can also be explained. We also have to assume that some suffixes are marked for constraint reranking, i.e. the accusative, the possessive among others, to be able to explain the fact that they never appear with a vowel after vowel final stems. Finally I have suggested that root vowel-zero alternations can also be treated in similar ways if we assume two more constraints, an alignment constraint on the output correspondents of underlying subsegments and an IDENTITY Output-Output constraint which requires that the realizations of the plural of a stem be identical to the bare plural form.
Bibliography

Alderete, J. (1997) "Faithfulness to prosodic heads," ROA 94-0000


Clements, G. N. (1976) "Vowel harmony in nonlinear generative phonology"


Ito, J. and A. Mester (1996) “Rendaku 1: Constraint conjunction and the OCP” ROA 144-0996


Kirchner, R. (1993) “Turkish vowel harmony and disharmony: an optimality theoretic account,” ROA-4


Lombardi, L. (1995a) Positional faithfulness and voicing assimilation in Optimality Theory,” manuscript

Lombardi, L. (1995b) “Why Place and Voice are different: constraint interaction and featural faithfulness in Optimality Theory”. University of Maryland, manuscript.


Ringen, C. (to appear) “Aspiration, preaspiration, deaspiration, sonorant devoicing and spirantization in Icelandic”


Ringen, C. and R. Vago (to appear) "Hungarian vowel harmony in Optimality Theory"


Rutgers University.


Szentgyörgyi, Sz. (1998a) “Hungarian quaternary vowel harmony in Optimality Theory,” paper presented at DOXIMP2, ELTE University, Budapest

Szentgyörgyi, Sz. (1998b) “Vowel-zero alternations,” paper presented at LingDoc2, JATE University, Szeged


