TOPICS IN TURKISH PHONOLOGY

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0. **INTRODUCTION**

In this chapter we offer a discussion of some aspects of the phonology of Turkish. Turkish phonology has played a significant role in theoretical discussions on the nature of phonological representation and rule formalism. In particular, the formal description of vowel harmony has attracted a considerable amount of attention in the phonological literature since the 1940s, and we, too, will devote a separate section to this topic.

In section 1 we provide a synopsis of the general facts of Turkish phonology. Besides giving an overview of the phonemes of Turkish, we illustrate its syllabic structure and stress pattern. We also present a number of the phonological rules of Turkish, all of which have received earlier treatment in the literature, in particular compensatory lengthening (section 1.4.3).

A number of linguists have provided analyses of the process of vowel harmony which pervades the Turkish language. In section 2 we lay out the basic facts, discuss some of the earlier analyses, and then provide our own account, which departs from the earlier approaches mainly by availing itself of unary elements which may extend over suprasegmental domains like the word. We believe that significant generalizations can be captured under this approach.

1. **ASPECTS OF TURKISH PHONOLOGY**

1.1 THE PHONEMIC INVENTORY

1.1.1 Vowels

Turkish has eight vowel phonemes which may be plotted on the familiar triangular vowel diagram as follows (cf. Lass 1984: 145; Maddieson 1984:

277):

(1)

high	i,y	u,uu
mid		o
lower mid	e,oe	
low	a	

Following all earlier writers (e.g. Jakobson 1942), we assume that the vowels phonologically pattern into a set of four high and four low vowels, in which /a/ is classified as back. We thus obtain the following rectangular vowel inventory (in which for reasons of typographical convenience we use /i ü u + o e ö a/ instead of the phonetic symbols above):

(2)

	front		back	
	non-round	round	non-round	round
high	i	ü	+	u
low	e	ö	a	o

There are also long vowels, which come from two sources (Underhill 1986a: 10): Arabic and Persian loans have introduced the long vowels /a: e: i: u:/, and thus we find sakin [sa:kin] `quiet' vs. sak+n [sak+n] `beware', etc. In native words, long vowels have also arisen through the loss of a voiced velar fricative, which is preserved as such in various dialects of Turkish and closely related languages, and appears in the current orthography as g. We might assume an underlying /g/ phoneme, which disappears intervocalically, creating a bisyllabic two-vowel sequence: agaç [aac] `tree', eger [eer] `if', etc, with merger into a long vowel in fast speech. In syllable-final position, then, the loss of this abstract phoneme causes lengthening of the preceding vowel: dag [da:] `mountain', tug [tu:] `banner', igne [i:ne] `needle'. We will return to this process in section 1.4.3.

Underlying long vowels shorten in closed syllables (cf. section 1.4.4), although when derived they can occur in closed syllables (cf. 1.4.3). Long vowels do not occur before vowel-initial suffixes: vowels of suffixes are deleted in that situation, and vowels that have become long as a result of compensatory lengthening do not arise in that position. Morpheme-internally,

however, long vowels may occur before short vowels (Sezer 1981: 380):

(3) `poet' s,a:ir
`always' da:ima

This shows that there is no surface constraint against /V:/ followed by /V/ as such.

The most well-known process with respect to vowels is vowel harmony, which is extensively discussed in section 2.

1.1.2 Consonants

The consonantal system is as follows:

(4)

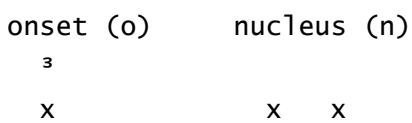
	labial	labiodent.	dental	palato-alveolar	palatal	velar	glottal
voiceless stop	p		t	c,		k	
voiced stop	b		d	j,		g	
voiceless fric.		f	s	s,			
voiced fric.		v	z	z,			
nasal	m		n				
liquid			l,r				
approximant					y		h

Some consonants, notably /k g l/, have two allophones, one palatal and one non-palatal. The distribution of these is determined by the frontness or backness of neighbouring vowels; we will discuss this in section 2.4.4. The evidence for recognizing phonemically palatal and non-palatal consonants is slight. In loans from Arabic, the original velar stop is consistently replaced by a front /k/ in Turkish, and the uvular Arabic /q/ by a back velar. As a result, front velars may appear with back vowels, as in /k,ar/ `profit', which contrasts with the native word /kar/ `snow'. The same goes for palatal /l/, as in hal /hal,/ `condition', which is a near-minimal pair with the native word /bal/ `honey'. Underhill (1986a) recognizes these three as phonemes of the language.

1.2 SYLLABLE STRUCTURE

The canonical structure of Turkish syllables is (C)V(C). We will adopt the following view of internal syllabic structure:

(5) syllable (σ)



Turkish has more complex consonant clusters word-initially and word-finally. For instance, borrowings that have word-initial clusters may, especially in more casual speech styles, be made to conform to the phonotactics of the language by breaking up the clusters by vowel insertion. In (6) we give some examples, taken from Clements and Sezer (1982):

(6)	grup	->	gurup	`group'
	kral	->	k+ral	`king'
	prince	->	pirens	`prince'
	smok,in	->	s+mok,in; simok,in	`dinner jacket'

The epenthetic vowel harmonizes in frontness with the following root vowel after labial and dental consonants. If the clusters are not broken up, as in more careful styles of speech, this velar is invariably back in quality, as Clements and Sezer (1982: 248) note.

Another way of treating word-initial clusters appears to consist of the prothesis of a (usually harmonic) /i/ or /+/ before the onset (typically /sp-, st-, sk-/), shifting the syllable boundary. Thus the dictionary (Steuerwald 1972) lists:

(7)	+spanak	`spinach'
	+statistik	`statistics'
	iskelet	`skeleton'
	istaka	`billiards queue'

Syllables can be closed or open. Word-finally the following consonant clusters are allowed (cf. Clements and Sezer 1982: 245):

(8)

(i)	sonorant + obstruent	k,ent	`city'	harf	`letter'
(ii)	voiceless fricative + stop	c,ift	`couple'	s,evk,	`fervour'
(iii)	k + s	raks	`dance'	boks	`boxing'

Other final clusters are broken up by epenthesis; cf. section 1.4.1.

Kaye (1989) offers an analysis of syllable structure in which empty syllabic nuclei are postulated in such words as kaplar `containers', deriving the shortening of long vowels from the presence of such empty positions, rather than as a result of syllable closure. We will not participate in this discussion, and return to the effect of syllabic structure on stress in the next section.

1.3 STRESS

In this section we offer a discussion of Turkish stress, which according to Underhill (1976) and Lewis (1985) is most accurately described as pitch accent, that is, a high tone on the accented syllable. We will continue, however, to use the term stress.

1.3.1 Regular and exceptional word stress

Stress falls on the final syllable of a word, whether simplex or derived. We discuss exceptional cases below. The following examples (taken from Sezer 1983) nicely illustrate this point:

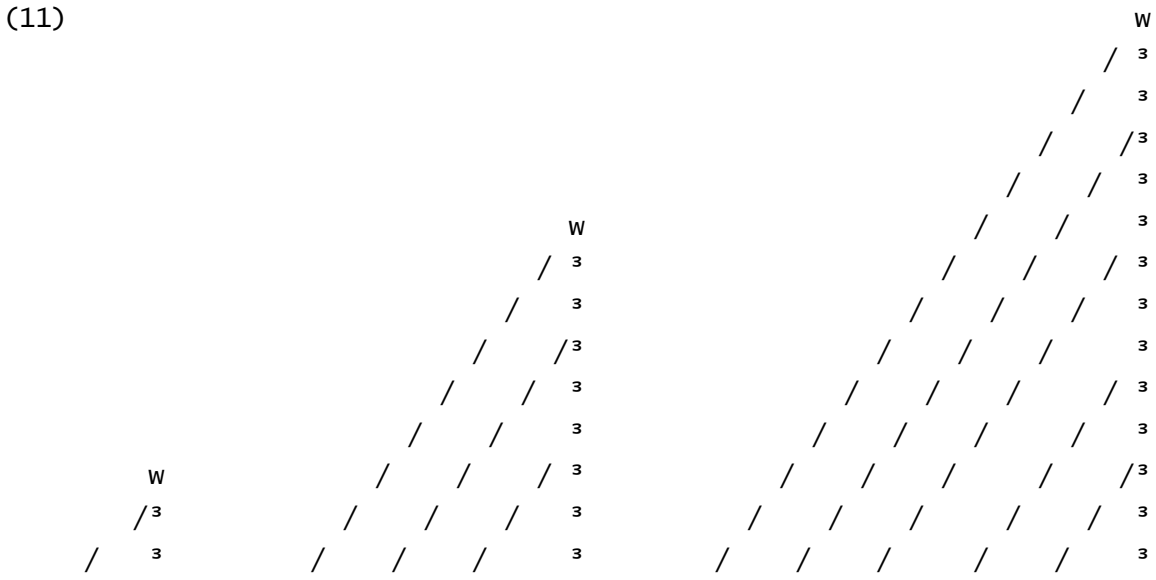
(9)	`know'	tan+
	`acquaintance'	tan+ - d+k
	`acquaintances'	tan+ - d+k - lar
	`my acquaintances'	tan+ - d+k - lar - +m
	`our acquaintances'	tan+ - d+k - lar - +m - +z

Within metrical theory (cf. Hayes 1981, Halle and Vergnaud 1987) stress rules take the form of a recipe for assigning a binary branching tree structure to the syllables making up the word. For every pair of sister nodes, one node is dependent on (or, intuitively, 'is weaker than') the other, which we will call the head. In the case of Turkish the recipe is straightforward:

(10) Assign a right-branching tree in which all left nodes are dependent

Consider the following examples (in the graphs dependent nodes terminate a slanted line in the tree structure):

(11)



In terms of a typology of stress systems, Turkish can be considered a quantity-insensitive, fixed stress system, since differences in syllable structure play no role for the assignment of regular stress, while its location is predictable.

Although the above generalization correctly characterizes a large part of the vocabulary, there are also exceptions. Underhill (1979: 18) even states: "there are many pairs of words that are distinguished from each other only by the placement of accent". Some of the exceptions are morphologically conditioned (such as those involving the so-called unstressable affixes, which we discuss below), while others are said to be purely idiosyncratic.

Sezer (1983) and Kaisse (1985) discuss a set of words which, although they are exceptional to the final stress pattern, show a subregularity which calls for further analysis. They leave it an open question whether all non-oxytones in fact fall into this class.

The class is referred to as consisting of "place names (both Turkish and non-Turkish) and many words of foreign origin" (Kaisse 1985: 199). Sezer (1983) arrives at the following generalizations:

(12) a. Stress never falls on the final syllable
b. Stress falls on the penultimate syllable if it is either closed or contains a long vowel:

`Samuelson'	Samuelson
`Washington'	Vas,ington
city in Turkey	Antalya
`restaurant'	lokanta
city in Turkey	Istanbul
`Eisenhower'	Ayz+nho:ver

c. Stress fall on the antepenultimate syllable if it is either closed or contains a long vowel and the penultimate is open and contains a short vowel:

city in Turkey	Ankara
`window'	pencere
`buoy'	samand+ra
`Chevrolet'	S,evrole

d. Otherwise (i.e. if both penultimate and antepenultimate are open and contain short vowels) stress is on the penultimate:

`Kennedy'	Kenedi
`Ptolemy'	Pitolemi
`jubilee'	jübile
city in Turkey	Göreme
city in Turkey	Adana

Lewis (1985: 21) makes a different generalization, saying that most exceptional place names have initial stress (noting in particular words like Zonguldak, which runs counter to generalization (12c)).

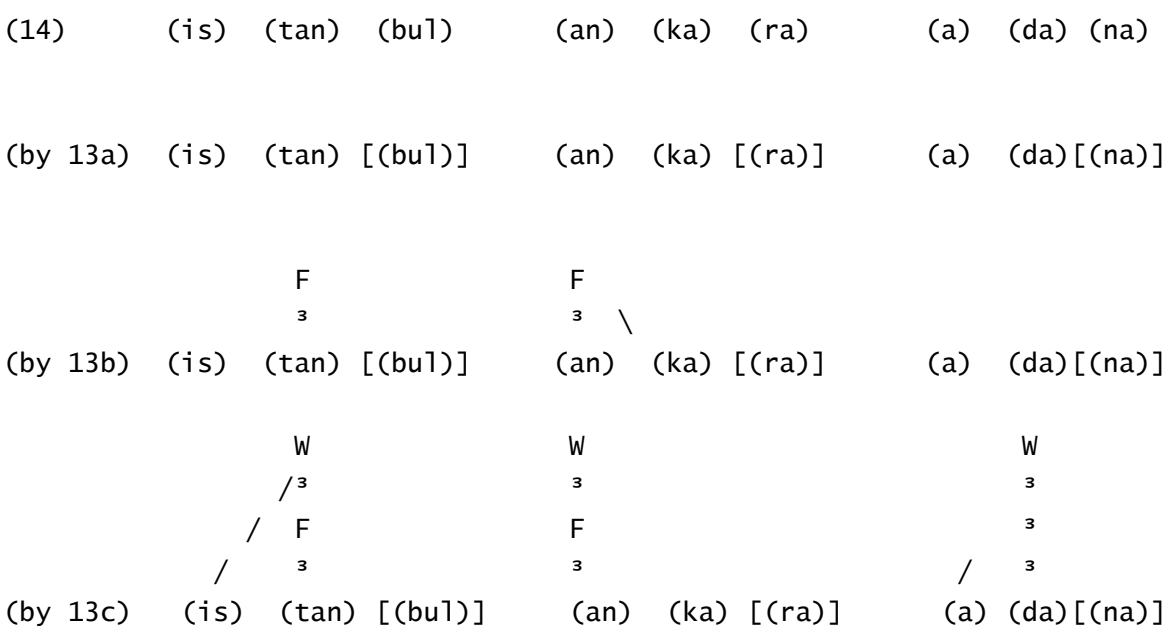
Clearly this stress pattern raises interesting theoretical issues within the metrical approach, as Kaisse observes. The pattern can be analysed by allowing this class of words to undergo a special stress rule which has the following properties:

(13) a. Mark the final syllable as 'extrametrical' (i.e. ignore it)
b. Place a left-headed (i.e. trochaic) stress foot at the right edge of the word with the proviso that the syllable in head position must be closed or must contain a long vowel
c. Assign a right-branching tree in which all left nodes are dependent (= 12)

Contrary to the larger part of the vocabulary, then, in this class of words syllable structure does play a role. Syllables which are closed or

contain a long vowel count as 'heavy', while open syllables with a short vowel are 'light'. Assuming that long vowels are represented phonologically as having two syllabic positions, we can characterize the heavy syllables as syllables having branching nuclei (cf. (5)).

Formally, this class of words differs in two ways from the regular words. First, the final syllable is never stressed and, secondly, prior to the tree building instruction (13c) (which also applies to the regular words), a foot is built which respects syllable structure. Crucial here is that the stress foot cannot be assigned in the words in (12d), because of the condition that the head of the foot must be heavy. As a result no foot can be assigned in these words, and (13c) applies directly, as in regular words. In (14) we illustrate how the three types of word are assigned metrical structure:

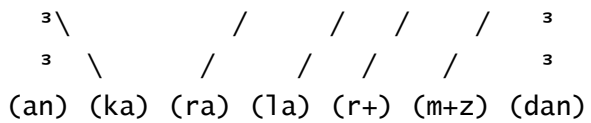


The final extrametrical syllable must still be incorporated into the structure as a dependent node. It has been proposed that the dependent character of formerly extrametrical syllables follows from a universal convention (Hayes 1982).

A further interesting property of this class of words is that they remain exceptions under affixation: that is, when they are affixed main stress still falls on the originally stressed syllable (examples from Kaisse):

(15) `from Ankara' Ankara - dan
`from our Washington' Vas,ington - umuz - dan
`from Göreme' Göreme - den
`from our Ankaras' Ankara - lar - +m+iz - dan

Secondary stress falls on the final syllable. We can interpret this as follows: the special class of words, after being stressed by rule (12), undergoes (with the rest of the vocabulary) the 'regular' stress rule, but the metrical structure already assigned is preserved:

(16)


To account for the fact that the earlier assigned exceptional stress remains the most prominent, Kaisse (1985) makes the proposal that the recipe in (10) (=12c) is slightly different:

(17) The left node is dependent unless it branches

This will make all syllables (ra), (la), (r+), and (m+z) dependent on (dan), but it will make the foot (an)(ka) the head. Support for this analysis comes from the fact that monosyllabic place names never preserve their main stress:

(18) city in Turkey Of
`from Of' Of - dan (*Of - dan)
`from our Of' Of - umuz - dan (*Of - umuz - dan)

The formal explanation is that in this case there is no branching foot over the stem.

1.3.2 Suffixation

According to Lewis (1985: 23) all polysyllabic suffixes (except the adverbial suffixes -leyin and -cesine) are stressed on their first syllable:

(19) `having gone' gid - ince
`by doing' yap - arak

Apparently, then, there is a rule marking final syllables of affixes as extrametrical. In accordance with another general convention, this rule will

not apply to monosyllabic suffixes (Hayes 1982).

There is furthermore a set of suffixes which are never stressed, and which also prevent main stress from being assigned to a following suffix. Stress will fall on the syllable preceding these unstressable suffixes (cf. Lewis 1985: 23, Underhill 1979: 34):

(20)	`with pleasure'	memnuniyet - le
	`while writing'	yazar - ken
	`bestially'	hayvan - ca - sina
	`he did not understand'	anla - ma - d+

Both Underhill (1979: 34) and Kornfilt (1988: xxx) note that a suffix following the 'unstressable' or 'pre-stressed' suffixes will receive a secondary stress, a phenomenon reminiscent of what we have seen above. Following Kaisse (1985), we could derive the behaviour of unstressable suffixes by ordering the main stress rule before the morphological level at which these suffixes are attached. Within the model of Lexical Phonology (Kiparsky 1982 and subsequent work) this is a valid procedure. However, to also derive the fact that secondary stress occurs on the final syllable (which seems a regular phenomenon for all words that have main stress somewhere inside the word), we will assume that the main stress rule in fact re-applies after the assignment of these unstressable suffixes. Since we have already assumed that main stress is assigned both as part of the special rule and, later, after affixation of '... suffixes', we arrive at the following overall picture:

(21)

```
                        I  : Foot assignment to the special class of
                             words
       rule (10)    <---- II : Affixation up to and including the
                             'unstressable suffixes'
                        III: further affixation
```

In other words, we recognize three strata in the lexicon (following Kaisse 1985), all of which access the main stress rule in (10). Stratum I is the locus of exceptional patterns.

Sezer (1983) points out that adverbs in <u>-en</u> are irregular:

(22) `in cash' nakt - en
`economically' iktisa:d - en
`basically' esa:s - en
`by surety' tekeffül - en
`in truth' haki:kat - en
`proportionally' nisbet - en
`specially' münhas+r - an
`mutually' müs,terek - en
`separately' ayriyet - en

The adverbial suffix is never stressed (hence marked extrametrical) and the stem requires a special foot which is again trochaic and quantitysensitive (without the proviso that the head must be heavy (cf. 13b) this time). Kaisse proposes that -en is attached at stratum I where it triggers this special 'recipe'. This stress pattern may be typical of adverbs, which according to Lewis (1985: 22) are usually stressed on the first syllable; his examples are also compatible with the generalization made on the basis of (22), however:

(23) `now' s,imdi
`after' sonra
`firstly' evvela:
`suddenly' ans+z' or ans+z+n

The diminutive suffix -cik shows a similar exceptionality (cf. Lewis 1985: 23). Attachment of such exceptional suffixes could presumably take place at Stratum I, but we have not investigated this matter.

A full discussion of Turkish stress would also have to take compounds into account. Compound verbs formed from a noun and the auxiliary verbal suffix etmek are regarded as a single word (cf. Underhill 1979: 247). Main stress falls on the noun, as illustrated in (24a). Lewis (1985: 23) gives other types of compound as well (24b):

(24) a. `pay attention' dikkat - etmek
`travel' seyahat - etmek
`influence' tesir - etmek
b. `prime minister' bas, - bakan
`stark naked' c,+r+l - c,+plak

There is no mention of secondary stress on the second part, so we do not know whether rule (10) applies to compounds. We shall not discuss the question whether compound formation constitutes a separate stratum.

1.4 PHONOLOGICAL PROCESSES

In this section we discuss a number of the more interesting rules of Turkish phonology. All of these have figured more or less prominently in recent theoretical debate. We reserve the discussion of vowel harmony to section 2, however.

1.4.1 Vowel epenthesis

Vowel epenthesis in word-initial clusters was already briefly discussed above. Here we are concerned with word-final clusters. Loanwords that do not conform to the permissible syllable templates (cf. 1.2 above) lose their final consonant, or, again, the syllable boundary is shifted by attachment of a vowel (examples from Clements and Sezer 1982):

(25) a. `direct' direk,
b. `protest' purotesto

There are also a number of forms which show a vowel in the nominative singular alternating with zero in the third person possessive. For forms like these, Clements and Sezer (1982) also suggest an epenthesis rule. Consider the following forms (from Clements and Sezer 1982: 243):

(26)

	nom. sg.	3. poss.	abl. sg.
`time'	vakit	vakti	vakitten
`womb'	rahim	rahmi	rahimden
`resolution'	azim	azmi	azimden
`volume'	hajim	hajmi	hajimden
`tomb'	kabir	kabri	kabirden
`tribe'	kavim	kavmi	kavimden

Notice that the suffix vowel is always front here. To account for the alternation, Clements and Sezer (1982) posit final opaque consonants, that is, consonants pre-associated to a feature which participates in the harmony process. In the framework to be developed below, this would be identical to a consonant being pre-associated to a Front prosody. Thus, the underlying representation of vakit `time', would be:

(27) F
      ³
  / v a k t /
    ³
    σ

The final cluster does not conform to the possible Turkish codas (cf. 1.2 above), as none of the clusters that would be postulated in (26) would. The final /t/ cannot be syllabified in the case of the nominative singular. One means of making the segment pronounceable is breaking up the cluster by insertion of a 'vocalic position', to which the F-prosody associates, producing in effect an /i/ (cf. section 2). In the third person possessive, the consonant is made pronounceable because it can be syllabified as an onset consonant of the syllable headed by the suffix /i/.

It therefore seems that a wider range of coda consonant combinations is allowed underlyingly than on the surface. This observation helps us to account for the following data (from Clements and Keyser 1983: 59):

(28)

	nom. sg.	acc. sg.	abl. sg.
`feeling'	his	hissi	histen
`right'	hak	hakk+	haktan
`increase'	zam	zamm+	zamdan

With Clements and Keyser, we assume that the underlying form in these cases ends in a geminate (/-ss/, etc.). The geminate is subject to degemination in syllable-final position, while it shows up when it is heterosyllabic. We can also explain why epenthesis (which would produce */hisis/, etc., for the nominative) is not an option here, as it was in the case of final clusters with two different consonants. The structure of a geminate is as follows:

(29) C C
       \ /
       [...]

That is, two consonantal points are associated to a single segmental matrix. Epenthesis of a vowel would result in crossing association lines (Schein and Steriade 1986):

(30) *C V C
       \   X
       [...] [..]

It is in order to note that the explanation for 'Geminate Integrity' (as this general phenomenon is called) is considerably weakened by the fact that Turkish allows bare V-positions, that is, vowels not linked to a segmental matrix, which are phonetically /+/ (cf. section 2). This problem, however, goes well beyond the case at hand, and we will not dwell on it here.

1.4.2 Final devoicing

Final devoicing in Turkish is similar but not quite identical to the rule of Auslautverhärtung in languages like German, Dutch, or Russian. Consider the following alternations:

(31)

	nom. sg.	3. poss.	abl. sg.	nom. pl.
`horse'	at	at+	attan	atlar
`taste'	tat	tad+	tattan	tatlar
`ball'	top	top+	toptan	toplar
`container'	kap	kab+	kaptan	kaplar

For words which show the voiceless stop - voiced stop alternation, the underlying forms have a voiced stop. Final devoicing does not operate on voiced fricatives or sonorants (e.g. k+z `girl', köy `village') and is therefore formalized as follows (cf. for example Sezer 1981):

(32) ÚÄ Ä¿
      ³-son ³
      ³-cont³ --> [-vce] / ___]₀
      ÀÄ ÄÙ

If a vowel-initial suffix is added, resyllabification of the voiced stop bleeds the application of (32).

Interestingly, various exceptions seem to exist to rule (32), and the whole voicing situation in Turkish is therefore more complex than suggested here. Sezer (1981: fn. 2) gives the following cases:

(33) `name' ad ad - + ad - dan

`sleep' hab ha:b - + hab - dan (obsolete)

There also appears to be some dialectal variation with respect to (32). This may, moreover, be related to the fact that in some place names final stops are not devoiced, so that suffixes with initial obstruents show up voiced, as Kaisse (1985: fn. 4) observes. We leave this issue for further investigation.

Now consider the ablative suffixes in (31) above. The first consonant of this suffix alternates between [t] and [d], with [d] appearing after voiced sounds, as in k+zdan `girl-abl.', köyden `village-abl.', and [t] after voiceless ones, including final underlying voiced sounds. To account for this we assume a voice assimilation rule which has the effect that a sequence of two stops must agree in voicing, with the leftmost stop determining the specification.

1.4.3 Compensatory lengthening

Well-known from the diachronic or synchronic phonology of many languages is the phenomenon that the disappearance of one segment appears to result in the lengthening of a neighbouring segment. The autosegmental approach to phonology has been credited for providing an explanatory account of this phenomenon and in this section we will discuss some literature on the topic which bears on Turkish.

Sezer (1986) offers an extensive discussion of various processes in the synchronic phonology of Turkish which result in compensatory lengthening (henceforth CL). In a number of cases, consonants are deleted in non-formal styles of speech. We will not be concerned here with the sociolinguistic variables determining these deletion, nor can we be more detailed than Sezer is with respect to the phonological conditions. The consonants affected are /h/, /y/ and /v/.

/h/-deletion occurs syllable-finally if a continuant or nasal follows consonant, (cf. 34a) and syllable-initially after a vowel or a voiceless consonant (34b):

(34) a. `steward' kahya - ka:ya
`special to' mahsus - ma:sus
b. `seed' tohum - toum
`diarrhea' ishal - isal

/y/-deletion occurs after a front vowel and a following sonorant consonant or /i/. In the latter case (35b) the /y/ is in the onset position of the

syllable:

(35) a. `thus' öyle - ö:le
`watch' seyret - se:ret
b. `good' iyi - ii
`is not' deyil - deil

/v/-deletion seems to occur after a labial vowel and before either a labial consonant or a vowel:

(36) a. `praise (inf)' övmek - ö:mek
b. `praise (3 aor.) över - öer

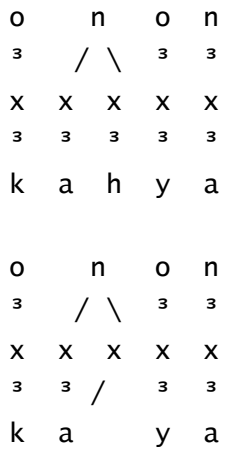
In all three cases, we see that deletion in syllable-final position leads to lengthening of the vowel, while loss from onset position has no such effect. The number of syllables in both cases remains the same; öer, for example, is a bisyllabic word.

To explain this difference, current approaches to syllabic phonology make a distinction between two types of syllabic positions, which we will refer to as stable and unstable. A stable positions is the nucleus position together with a following tautosyllabic consonant, while the unstable position is that which is traditionally called the onset position:

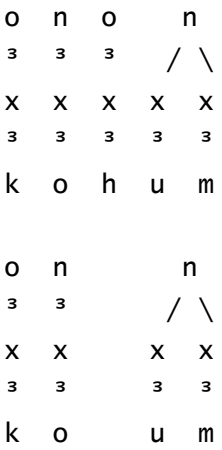
(37) onset nucleus
³ / \
x x x

The rationale behind this terminology is the following. When a segment is deleted which occurs in the onset, the whole position is lost, but when a segment is deleted from the rhyme the position remains and can be filled by the other segment in the nucleus. We illustrate the difference with two examples from (34):

(38) a. Deletion from the onset



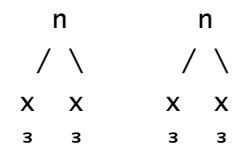
b. Deletion from the nucleus



Another way of capturing the same insight would be to assume that CL can only occur if there is another segment within the same syllabic constituent. We cannot test this variant for Turkish, but cross- linguistic evidence points to the fact that within onsets we never find CL. This suggests that there is a fundamental difference between onset position and nucleus position.

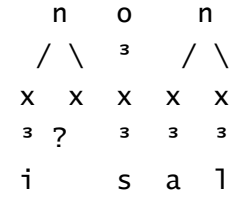
A special word must be said about the case ishal - isal (34b). One might expect CL to take place here. Consider the representation after /h/-deletion has taken place:

(39)



The second syllable now lacks an onset, which on the surface is presumably filled by /s/, according to the universal principle that a sequence ...vcv...is syllabically parsed as ...v][cv..., with the syllable break after the first vowel.

(40)



We would now expect CL to take place, but it does not, according to the data in Sezer's article. Hayes (1989) considers a case in Ancient Greek, comparable to the Turkish situation, in which CL takes place when a consonant has moved from a stable to an unstable position. It would be interesting to look into this subtle difference. The question as to whether or not CL is an automatic result of creating empty morae is one that we cannot explore in this article. Nonetheless we want to offer two further considerations which are relevant here.

First, as Sezer points out, some cases of deletion fail to trigger CL. When in syllable-final position, the progressive suffix -Iyor may lose its /r/ in informal speech . No CL occurs:

(41)	`laugh 3 sg.'	gülüyor	-	gülüyo
	`laugh 2 sg.'	gülüyorsun	-	gülüyosun
	`laugh cont/1 sg'	gülüyorum	-	*gülüyoum

Similar /r/-dropping is found in the word bir `one'. These examples are unique and we might simply deal with them as lexicalized forms. As Sezer points out, in certain dialects /r/'s are dropped regularly, and in these cases we do find CL.

A second point of interest concerns the claim that CL occurs just in case a language has phonemic vowel length (De Chene and Anderson 1979). Turkish presents an interesting case, since the vowel length opposition is marginal.

In both traditional and recent literature, stable positions are referred to as morae or weight units. The distinction between both kinds of position plays an important role when stress placement is sensitive to syllable structure. Typically we find in such cases that the 'weight' of a syllable is determined by the number of segments occurring in the nucleus. Whether the onset contains zero, one or more consonants does not seem to matter. Turkish shows limited evidence of this kind of sensitivity, as stress placement depends on syllable structure only in special cases (cf. 1.3). The phenomenon of CL also points to the usefulness of the distinction between stable positions (or morae) and unstable (or onset) positions.

In some approaches, it is argued that the mora is actually a constituent of the syllable. In this view a syllable can consist of either one or two morae. Universally, the first mora consists of the vowel preceded by 'onset consonants' and the second mora consists of a following segment which does not form part of a following syllable:[1]

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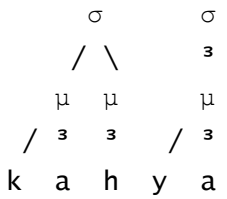
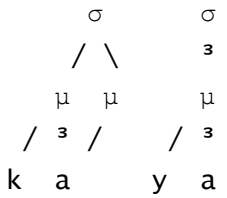
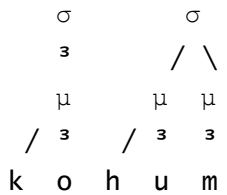
[1] We do not address the issue here whether sequences of prevocalic consonants form a constituent (i) or are diectly linked to the syllable node

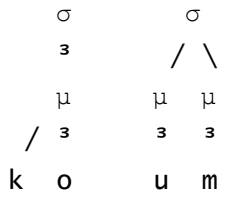
(42) a. Deletion from the nucleus





b. Deletion from the onset





An appealing aspect of this proposal is that we now explain why the deletion of onset material does not cause CL, because such a deletion does not lead to a 'vacant' mora. If, on the other hand, we delete a segment which constitutes a mora, we leave behind an empty syllabic position. In this paper, we will of course not attempt to settle the issue as to whether onset-nucleus theory or mora theory should be preferred. We merely wish to point out how the CL data from Turkish fit into this theoretical debate.

Certain words, which Sezer calls 'the dag-type words' behave as if they end in a consonant, although they end in a (long) vowel. Consider the following examples, taken from Sezer's article:

(43)	Absolutive	Dative	Genitive	1 Possessive
`horse'	at	ata	at+n	at+m
`room'	oda	odaya	odan+n	odam

These examples illustrate cases of suffix allomorphy: a/ya (dative), +n/n+n (genitive), +m/m (1 possessive). The first two lose their initial consonant when the stem ends in a consonant, and the third loses its vowel when the stem ends in a vowel. As Sezer points out, C-deletion does not apply blindly

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(ii):

(i) 

(ii) 

to all consonant-initial suffixes, and the consonants which are deleted do not form a natural class either. For example, the locative suffix -da never loses its /d/. Whether or not the consonant drops is therefore a lexical property of the suffix. V-deletion only affects native suffixes and can therefore not be seen as purely phonological either. Nonetheless, in all these cases the environment for the deletion can be clearly related to whether the last segment of the stem is a vowel or a consonant.

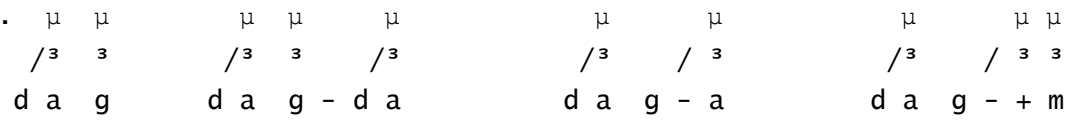
Now consider how dag-type words behave:

(44)

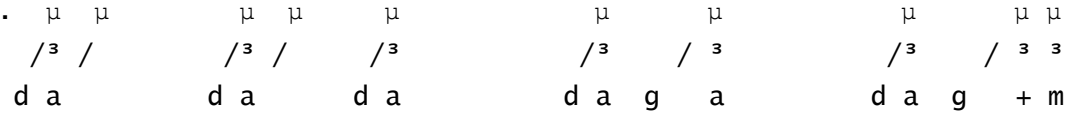
	Absolutive	Locative	Dative	1 Possessive
`topic'	mevzu:	mevzu:da	mevzua	mevzuum
`mountain'	da:	da:da	daa	da+m

As can be seen from in the dative the suffix consonant is deleted while the suffix vowel is preserved in the possessive (although the stem vowel is now short). This is precisely the opposite of what one expects after examination of the data in (43). The historical explanation is that these words originally ended in a consonant /g/, which was lost. On the basis of what we have learned about CL above, we can understand that /g/-loss triggered CL, unless it occurred in onset position. This is borne out, since no CL has taken place in the dative and 1st possessive forms. We will use a moraic representation to make this clear:

(45) a.



b.



Assuming that the /g/ syllabifies as an onset with the vowel-initial suffix, no vacant mora arises if /g/ is deleted in the dative and the 1st possessive.

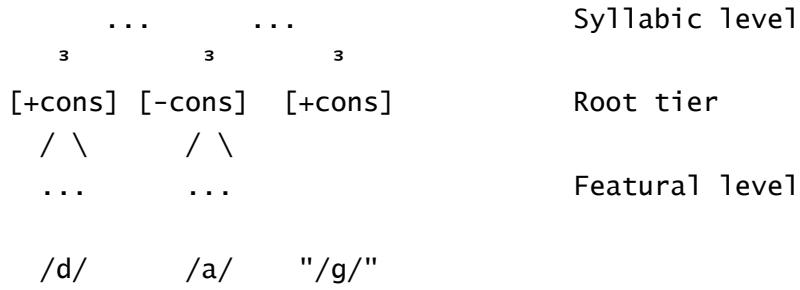
(45) represents a historical change. In the synchronic analysis there is no reason to assume that a fully specified segment /g/ is present underlyingly. One possible analysis would be that the long vowel is underlying, assuming a shortening rule in case a vowel-initial suffix is added. Of course, the C-deletion and V-deletion rule needed to deal with the alternation in (43) would then have to be reformulated: C-deletion takes place after a consonant or a long vowel, while V-deletion only applies after short vowels. Both rules are followed by the shortening rule just mentioned.

Apart from the fact that introducing arbitrary complexities in both deletion rules is unsatisfactory, we point out that such an analysis cannot be correct. Turkish has words ending in a long vowel which do not behave like the dag-words:

(46)	Absolutive	Locative	Dative	1 possessive
`building'	bina:	bina:da	bina:ya	bina:m

How then do we represent the dag-words in the synchronic grammar of Turkish? The simplest answer seems to be that we provide such words with a final empty consonantal position. One can think of such an empty unit as a segment merely containing the feature [+consonantal]. The fact that we need such heavily underspecified segments has been used to argue in favour of a phonological model in which major class features such as [±consonantal] define an independent tier of representation, mediating between the syllabic constituents, i.e. the syllabic level, and the other phonological features, which all associate to this major class tier. We shall call the tier made up by the major class features the root tier (cf. Clements 1985; Sagey 1986; McCarthy 1988).

(47)



Whether we view this root tier as associated to morae or onsets and nuclei does not change the point.

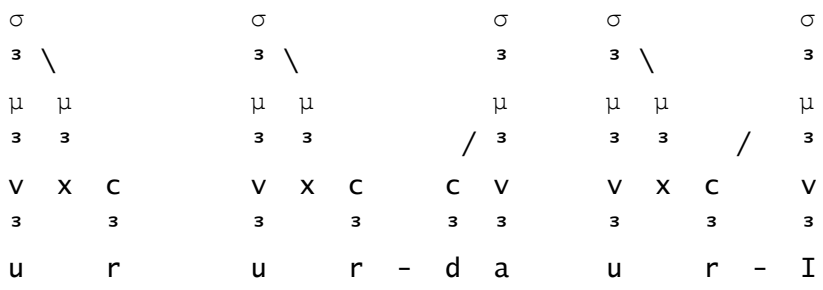
To guarantee the appropriate application of C-deletion and V-deletion, we need not assign any other features to the final 'segment', because these rules only make reference to the feature [±consonantal]. A wrinkle in the analysis might be that it produces long vowels the second half of which is [+consonantal]; this argues for unspecified root nodes, such that [+cons] may be thought to stand for C, [-cons] for V, and [0/cons] for X. We shall henceforth use these symbols as abbreviations for the relevant feature specifications.

Kornfilt (1986) discusses a further set of cases in which empty consonants are postulated:

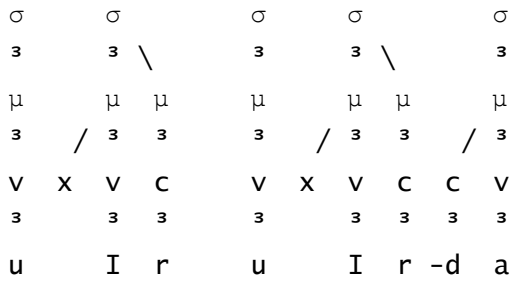
(48)		Nominative	Locative	Accusative
a.	`era'	c++r	c++rda	c+:r+
	`good omen'	uur	uurda	u:ru
	`rump'	ba+r	ba+rda	ba:r+
	`flank'	böür	böürde	bö:rü
	`son'	oul	oulda	o:lu
b.	`breast'	göüs	göüste	gö:sü
	`mouth'	a+z	a+zda	a:z+

At issue is how we can account for the vocalic alternations. Kornfilt proposes to represent these roots with an 'empty' segment in prefinal position and to derive the high vowel through epenthesis. Here we translate her proposal into the moraic representation:

(49) a.



b.



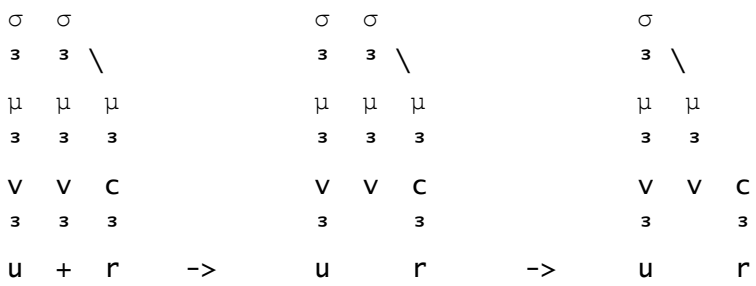
c.

Precisely where epenthesis need not apply because the final consonant forms an onset, the vowel can spread to the empty position.

Sezer (1986) offers another analysis. He assumes that stems showing the

alternation at hand contain an underlying high vowel in the second syllable which undergoes regular vowel harmony, and two additional optional processes: height assimilation and syllabic merger.

(50)



Sezer suggests that the long vowel of the accusative is optional in all cases mentioned in (48) and he also offers assimilated and long vowel variants for the nominative, which are in free variation:

(51)	`heavy'	a+r	~	aar	~	a:r
	`paper'	k,a+t	~	k,aat	~	k,a:t
	`disperse'	da+l	~	daal		
	`sewer'	l,a+m	~	l,aam		
	`donation'	ba+s,	~	baas,		
	`yoghurt'	yourt	~	yoort	~	yo:rt
	`retch'	öür	~	öör		
	`knead'	your	~	yoor		
	`bellow'	böür	~	böör	~	bo:r
	`son'	oul	~	ool		
	`hour'			saat	~	sa:t
	`tree'			aac,	~	a:c,
	`era'			c,++r	~	c,+:r

Sezer notes that the assimilation is more compelling for /+/ than for /ü/ and /u/, these three vowels being the only targets:

(52) `couplet' beit - *beet

Kornfilt (1986) suggests that although Sezer's analysis can be generalized over all cases, at least for some speakers the forms in (48) do contain an empty segment. We refer to her article for further discussion.

1.4.4 Vowel shortening

In the preceding section we have seen that long vowels in Turkish are either underlying or derived by CL or vowel assimilation. Now consider the following alternations (cf. Lees 1961):

(53)

	Nominative	Possesive	Ablative
`hay'	saman	sama:n+	samandan
`life'	hayat	haya:t+	hayattan
`law'	merak	mera:k+	meraktan
`good deed'	seva:b+	seva:b+	sevaptan
`method'	usul,	usu:l,u	usul,den

We can conclude on the basis of these data that underlying long vowels in open syllable alternate with short vowels in closed syllables (cf. also Kaye 1989).

1.4.5 The k/0/-alternation

Sezer (1981) offers a comprehensive discussion of /k/-deletion. Morpheme-final /k/'s delete before native vowel-initial suffixes, provided the stem is polysyllabic and the preceding vowel is short:

(54) monosyllabic

	Nominative	Ablative	Possessive
`affix'	ek	ek - ten	ek - i

(There are a few exceptions here: c,ok `many, gök `sky', yok `there is not' which do undergo the rule; cf. Sezer note 4).

(55) a. polysyllabic

	Nominative	Ablative	Possessive
`foot'	ayak	ayak - tan	aya - +

b. preceding long vowel

	Nominative	Ablative	Possessive
`curiosity'	merak	merak - tan	mera:k - +
`explosion'	infilak	infilak - tan	infila:k - +

The failure to undergo /k/-deletion cannot be directly attributed to the loan status of the words containing a preceding long vowel. Arabic loans which have lost vowel length do undergo the rule. As Sezer points out in dialects of Turkish which have lost length in certain words, these words regularly undergo /k/-deletion. Only few Arabic loans without length fail to undergo the rule (cf. Sezer 1981: 362).

Non-native vowel initial suffixes fail to trigger the rule:

(56)		
	`worthy'	la:y+k
	`I am worthy'	la:y+ - +m
	`deservedly'	la:y+k - i:

The final suffix is non-native.

A second category of suffixes, the auxiliary suffixes -etmek, and -olmak fail to trigger /k/-deletion:

(57)	Nominative	Ablative	Possessive	Verb
`deserving'	la:y+k	la:y+k - tan	la:y+ - +	la:y+k - olmak
`prohibition'	yasak	yasak - tan	yasa - +	yasak - etmek

Observe that both categories of suffixes are also exceptional with respect to vowel harmony. We could assign the /k/-deletion rule to a stratum which precedes that of non-native suffixation and suffixation of auxiliaries, but we have not investigated whether the ordering relations between suffixes warrant such a move.

In any event we cannot assign these non-native suffixes to a level where no 'native' rules apply, since their presence bleeds such rules as final devoicing:

(58)		
	`number'	adet
	`numerical'	aded - i: (and not *adet - i:)

Sezer discusses a further class of words failing to undergo /k/-deletion. Verbal stems ending in /k/ fail to undergo the rule:

(59)	Stem	Present Cont.	Future
`accumulate'	birik-	birik - iyor	birik - ej,ek
`be visible'	gözük-	gözük - üyor	gözük - ej,ek
`let go'	b+rak-	b+rak - +yor	b+rak - aj,ak

Most stems, but not for example b+rak, can be synchronically derived from

nouns or other categories (e.g. bir `one', göz `eye'). The mere fact of being derived would not explain their behaviour anyway. Derived nouns, however, do undergo /k/-deletion:

(60)	Stem	Noun	Accusative
`open'	ac,	ac, - +k	ac,+ - +
`hard'	pek	pek - lik	pekli - i

The failure to undergo /k/-deletion in verbs also occurs before inflectional suffixes, while in non-verbal categories /k/-deletion occurs before both derivational and inflectional suffixes. Hence, as Sezer concludes, the lack of /k/-deletion is a property of verbs, and not of any type of morphology. Consider the minimal pair which makes this point clear:

(61)				
	`be necessary'	gerek	`it is necessary'	gerek - ir
	`necessity'	gerek	`its necessity'	gere - +

Of further importance is the fact that a /k/ of a verbal inflectional suffix does delete:

(62)	stem	I (future)	II (future first)
`appear'	gözük	gözük - ej,ek	gözük - ej,e - im

Hence, /k/ of uninflected verbal stems (whether derived or not) fails to undergo the rule.

The analysis of /k/-deletion has triggered an interesting theoretical debate. Lees (1961) proposed to represent deleting /k/'s as /g/ underlyingly. These were weakened to /g-/ and then deleted by a deletion rule we need anyway (cf. section 1.4.3). When not weakened, /g/ undergoes final devoicing. Zimmer (1975) and Zimmer and Abbott (1978) already argued against this analysis on theoretical and psycholinguistic grounds and Sezer (1981) convincingly shows that it simply does not work. For example: underlyingly /k/ would have to devoice before the auxiliary suffixes, but in this context other voiced stops do not become voiceless:

(63)	Nominative	Ablative	Accusative	Verb
`ruined'	harap	harap - tan	hara:b - +	hara:b - olmak

This commits us to having an underlying /k/. Sezer suggests that the deletion of /k/ is triggered by a particular set of mainly denominal affixes, explaining why verbs fail to undergo the rule, except before the personal

suffixes -Im and -Iz (cf. (62)), which are formally identical to copula suffixes which also trigger /k/-deletion. Whether this set constitutes a separate stratum which can be independently motivated remains to be seen.

This solution predicts that underived polysyllabic verbal stems ending in /k/ will also undergo the rule before the personal affixes, which in fact is shown by the fact that some of the examples cannot be synchronically derived.

2. **VOWEL HARMONY**

Vowel harmony processes have played an important role in the development of theoretical phonological models. The analysis of Turkish vowel harmony forms no exception. The most recent extensive treatment is offered in Clements and Sezer (1982), from which this section takes much of its examples and analysis.[2] The formal description that we offer, however, assumes a rather different conception of the nature of phonological features.

In the most general terms, vowel harmony involves the requirement that all vowels within some domain, usually the non-compounded word, agree with respect to some property or properties. In Turkish the vowel properties involved in the harmony system are 'round' and 'front'.

2.1 TURKISH VOWEL HARMONY: THE BASIC FACTS

It is not difficult to formulate the general vowel harmony requirements that hold for Turkish. The statement appears again and again in elementary textbooks. Any one of the eight Turkish short vowels may appear in the first syllable of a word. Any following vowel assimilates to the preceding vowel in frontness. As a result, all vowels in a regular stem agree in front or backness. We shall refer to this as palatal harmony. For example:

(64) palatal harmony:

hüviyet	`identity'	k+m+lt+	`movement'
küsülü	`annoyed'	oyuncak	`plaything'
netice	`result'	sogukça	`ice cold'

Besides, a following high vowel assimilates to the preceding vowel in roundness, regardless whether this is itself round or non-round. This is

[2] Other examples are taken from Harris (1987 UCL class notes), Kardestuncer (1982a), Underhill (1976), and Steuerwald (1972).

apparent in the form oyuncak `plaything': the high /u/ is rounded just like the initial /o/, and the /a/ need not be rounded as it is low.

Because the roundness of initial vowels does not extend to low vowels in the second syllable, the vowels /o/ and /ö/ may not occur in any syllable except the first. We shall refer to this last constraint as the "non-initial /o-ö/ prohibition".

There is a host of exceptions, to both palatal and round harmony, as well as to the non-initial /o-ö/ prohibition. We shall illustrate these below.

2.2 PREVIOUS ANALYSES

The case of Turkish played a role in the development of a distinctive feature framework out of the distinctive-oppositions framework advanced by the Prague school (Trubetzkoy 1939). In a series of lectures (On Sound and Meaning, Jakobson 1942) delivered at the École Libre des Hautes Études in New York, Jakobson pointed out that in a vowel system like that of Turkish sets of vowels are in opposition, like front vowels opposed to back vowels, and not individual vowel phonemes. In this way a phoneme like Turkish /i/ is a complex entity composed of three differential elements: closed, front, unrounded. The vowels of a Turkish word, then, must be taken from either the set of front vowels or the set of back vowels. This reasoning ultimately lead the characterization of phonemes as bundles of distinctive features, which can be manipulated by rule. Kardestuncer (1982a) is a late exponent of the generative approach. In (65) we give his rules for Turkish vowel harmony in a somewhat simplified version:

(65) palatal harmony:

$$V \rightarrow \begin{bmatrix} +back \end{bmatrix} \Big/ \begin{bmatrix} \text{ÚÄ} \\ \text{³ V ³} \\ \text{³+back³} \\ \text{ÀÄ} \end{bmatrix} \begin{matrix} \text{Ä¿} \\ C_0 \\ \text{Ù} \end{matrix} \_\_\_\_\_$$

labial harmony:

$$\begin{bmatrix} \text{ÚÄ} \\ \text{³ V ³} \\ \text{³+high³} \\ \text{ÀÄ} \end{bmatrix} \begin{matrix} \text{Ä¿} \\ \\ \\ \text{ÄÙ} \end{matrix} \rightarrow \begin{bmatrix} +round \end{bmatrix} \Big/ \begin{bmatrix} \text{ÚÄ} \\ \text{³ V ³} \\ \text{³+round³} \\ \text{ÀÄ} \end{bmatrix} \begin{matrix} \text{Ä¿} \\ C_0 \\ \text{ÄÙ} \end{matrix} \_\_\_\_\_$$

In the meantime, the so-called school of Prosodic Analysis had developed under J.R. Firth in London, in which properties like 'front' or 'back' were not necessarily regarded as properties of single segments, but might also extend over larger domains like the syllable or the word. Such properties were called 'prosodies' (Firth 1948). A representative exponent here would be Waterson (1956), who analyses Turkish vowel harmony by means of four prosodies, viz. a front and a back prosody, and a rounded and a non-rounded prosody. The prosodies can either extend over the word or the syllable.

The most recent approach to vowel harmony is the study of Clements and Sezer (1982), cast in the framework of autosegmental phonology. They represent, much in the spirit of prosodic phonology, distinctive features on independent tiers, i.e. there is an [αback] plane, an [αround] plane, etc. Vowel harmony is then described as the association of a feature specification, for example [+back], to different vowels in a root or root plus affixes. Feature specifications may be positive or negative, while vowels that are predictably harmonic are left unspecified for that feature.

Our own approach, to be developed below, most closely resembles Clements and Sezer's, although it is more 'reductionist' in that it essentially recognizes only one value for each feature, that is, we make use of unary elements in our analysis. We might note that current underspecification theory (Archangeli 1984 and subsequent work) also takes the idea that at most one specification of a given feature is present in underlying representation.

2.3 A NEW ANALYSIS

Exceptionless harmony systems can be described in a number of ways, and it would be difficult to choose between different descriptions if one is not predisposed toward a particular framework. It is often the case that the exceptions to a particular harmonic pattern shed more light on its nature. We shall show how it is possible to integrate the disharmonic stems into an analysis of synchronic harmony. To achieve this goal, we first review which stem vowel combinations are regular, which are disharmonic but do occur, and which are disharmonic and categorically ruled out, i.e. are not attested. Then we shall go on to state the framework in which the present analysis is cast. We shall recognize intrinsic properties of vowels, such as lowness, and properties like frontness and roundness, which are not lodged in individual vowels, but rather seem to be word properties. These are mapped onto vowels in a predictable fashion, and we will therefore represent them prosodically. We then examine in what ways the intrinsic and prosodic properties can combine. As it will turn out, the statement as to which vowels can occur in

disharmonic roots and which cannot, can be reduced to a rather simple formula. We will take this as evidence that our account deals with vowel harmony in a promising way.

2.3.1 Root disharmony

As Clements and Sezer (1982) (henceforth: CS) point out in great detail, within stems many exceptional patterns to vowel harmony arise. In particular, vowels from the set /i e a o u/ may combine quite freely. However, patterns which include the vowels /ü ö +/ are absent except for the occurrence of a number of stems combining /i/ and /ü/ (in violation of labial harmony). CS do not offer an explanation for the difference beteen the two vowel sets, but decide on the basis of the exceptions that harmony is no longer active in roots. We shall argue against this below, and suggest that the disjunction in the vowel set can be understood if we assume that vowel harmony is governed by unary prosodies that either regularly extend over the word domain, or, irregularly, are linked to specific vowel positions.

First, we summarize the cooccurrence patterns of vowels. In the table below, an empty box indicates that the pattern /...V1...V2.../ is regular (and attested). A mark in a box indicates that the pattern is disharmonic with respect to either palatal (P) and/or labial (L) harmony. However, as was pointed out above, disharmonic roots involving the vowels /i e a o u/ may still occur. If a pattern is not attested on account of its violating either palatal or labial harmony, or on account of its violating the /o-ö/ prohibition, we indicate this by means of an asterisk.

(66)

V2 / V1	/i/	/e/	/ü/	/ö/	/+/	/a/	/u/	/o/
/i/			L	*R	*P	P	P,L	P,R
/e/			*L	*R	*P	P	P,L	P,R
/ü/	L			*R	*P,L	*P	*P	*P,R
/ö/	*L			*R	*P,L	*P	*P	*P,R
/+/	*P	*P	*P,L	*P,R			*L	*R
/a/	P	P	*P,L	*P,R			L	R
/u/	P,L	P	*P	*P,R				*R
/o/	P,L	P	*P	*P,R				*R

Legend : L = disharmonic due to labial harmony
P = disharmonic due to palatal harmony
R = violates the "non-initial /o-ö/ prohibition"
* = not attested as an exception

On the basis of the exceptions, CS conclude that within stems neither palatal nor labial harmony holds in Turkish. We fail to see that we should draw that conclusion. Synchronic harmony on suffix vowels is independently needed. The stems which conform to the harmonic pattern can therefore simply get a 'free ride' on the harmony rules. This simplifies their underlying representation considerably. Furthermore, within stems epenthetic vowels also harmonize (cf. section 2.4.4).

2.3.2 Formal preliminaries

In our analysis of the vowel system and the harmony process we will make use of unary primitives, or 'elements', instead of the perhaps more familiar binary features [αback], [αround], [αlow] (or [αhigh]). If present, an element contributes to the phonetic interpretation of a segment. The absence

of an element, however, also requires a phonetic interpretation: either the gesture corresponding to its presence is not activated, or some opposite gesture is activated. In traditional terms (see, e.g. Trubetzkoy 1939) we might say that all vowel primitives are regarded as privative. Under this approach the vowel inventory of Turkish is represented as follows:[3]

(67)	/i/	/e/	/ü/	/ö/	/+/	/a/	/u/	/o/
LOW		L		L		L		L
FRONT	F	F	F	F				
ROUND			R	R			R	R

We also recognize vowel position (as opposed to consonant position) as a primitive in its own right, and represent it as V. Observe that the phoneme /+/ is represented as a bare V-position. With these four primitives (F, L, R, and V) we now tackle the harmony system.

2.3.3 Harmony and disharmony

In harmonic stems, i.e. stems with show the harmony generalizations, prosodic properties are not associated to V-positions. The property 'low' is unpredictable in stems, and therefore must be intrinsic, i.e. associated to specific positions.

If we take bisyllabic stems as representative, we obtain four combinations of vowel position and lowness, i.e. the intrinsic properties:

(68) V - L L - V L - L V - V

(V = high vowel, L = low vowel)

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

(69) (i) No prosody

[3] In other work (e.g. Van der Hulst 1988, 1989) the prosodies 'Low', 'Front', and 'Round' are represented as 'elements' or 'particles' like A, I, and U, respectively.

(ii) Front prosody only
(iii) Round prosody only
(iv) Front and Round prosodies

We shall discuss the combinations of intrinsic properties and prosodic properties in turn.

2.3.3 (i)
If no prosody is present the regular patterns surface as follows:

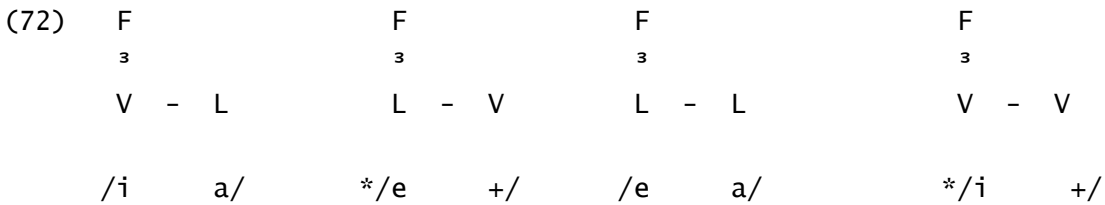
(70)	V - L	L - V	L - L	V - V
	/+ a/	/a +/	/a a/	/+ +/
Exx:	g+rtlak `throat'	alt+ `six'	kara `black'	k+s+m `part'
	h+tta `province'	yal+ `villa'	tavs,an `rabbit'	s+n+r `border'
	k+yak `excellent'	kad+ `judge'	hasta `sick'	s+ig+r `sick'

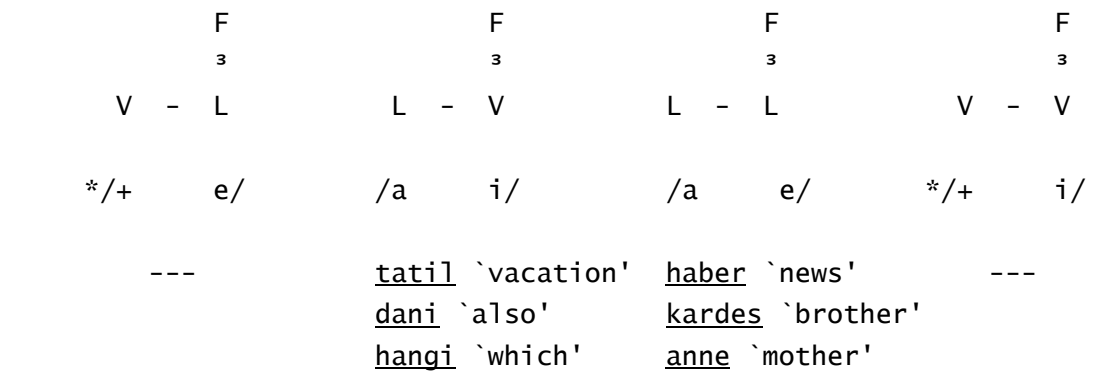
2.3.3 (ii)
We now move to the stems which contain one prosody. First, let us consider regular cases with the F-prosody. This prosody associates to all vowels in the stem:

(71)	F : . V - L	F : . L - V	F : . L - L	F : . V - V
	/i e/	/e i/	/e e/	/i i/
	ince `thin'	degis `change'	kere `time'	kis,i `person'
	igne `needle'	yedi `seven'	gebe `pregnant'	gibi `like'
	diçer `other'	eski `cold'	tepe `hill'	inci `pearl'

Stems with the F-prosody can be disharmonic in two ways. F can be pre-associated (or lexically associated) to either the first or the second V-position, in which case the prosody cannot associate to any other vowels (the asterisks in front of the vowel combinations again indicates that the pattern in question is not attested):

(72)





We see that all patterns are possible exceptions, except those which would produce an empty V-slot on the surface.

We have assumed that pre-associated prosodies will not associate to other V-positions within the same morpheme. If a prosody is valid for all vowels in a stem we leave it unassociated (as in (71)), as a result of which it will associate to all accessible anchors in a morpheme. Below, we will see, however, that lexically associated prosodies do associate to suffix vowels. In accordance with current views, we will assume a convention which allows the spreading of pre-associated prosodies unless such association destroys a potential lexical contrast (Kiparsky 1982, Van der Hulst and Smith 1986). Consider, for example, the following two distinct stem patterns:

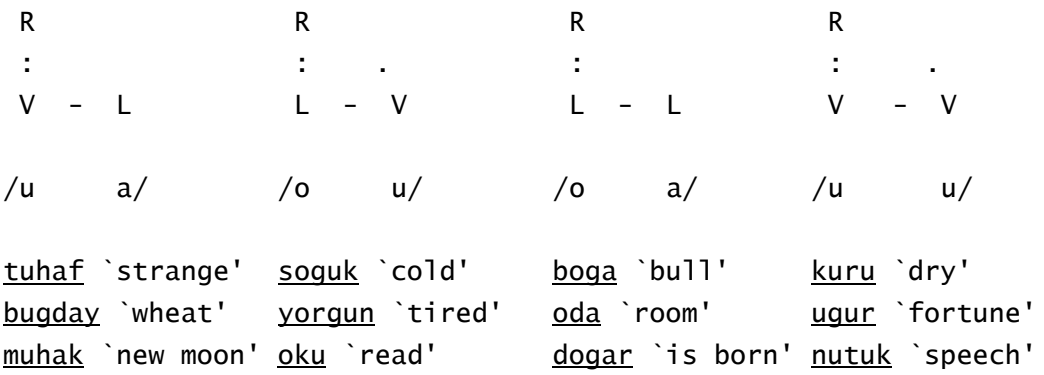
(73)

(a) has pre-association, while (b) does not. If we allow F to spread in (a), both forms will end up the same, namely as /i-e/ (in the case of Turkish). This would destroy a potential lexical contrast, as (a) and (b) are different underlying representations. The fact that lexically associated F and R still spread to suffixes, prevents us from treating them on a par with L, which

does not spread.

2.3.3 (iii)
Let us turn to stems containing the R-prosody:

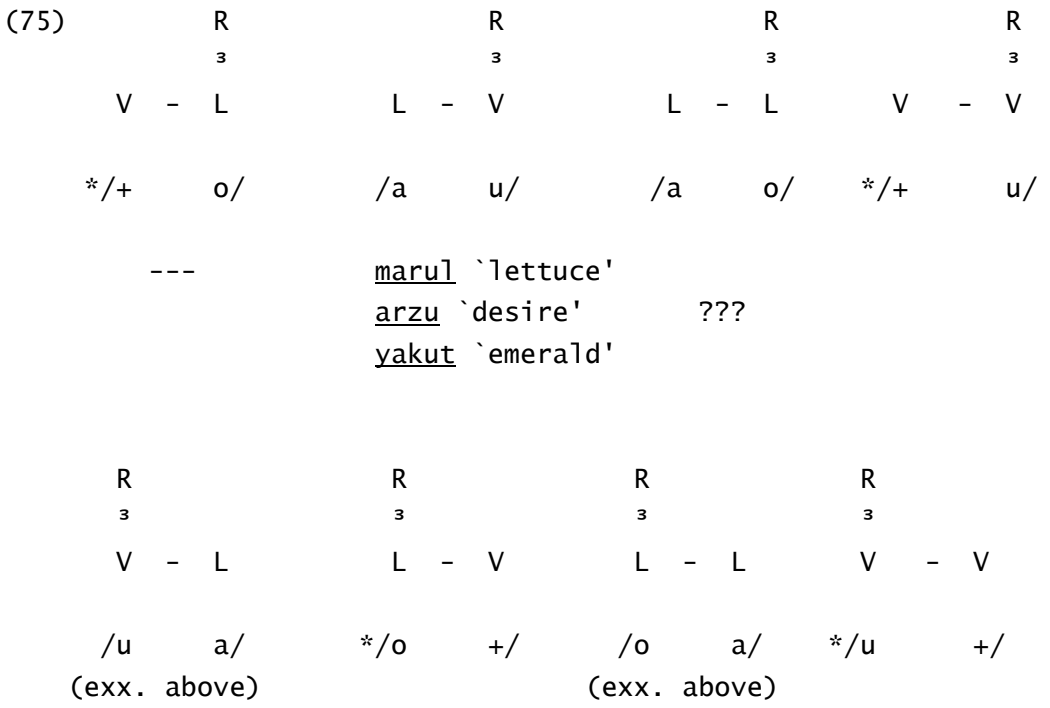
(74)



We observe that R does not associate to non-initial L, which must be stated in the propagation of the prosody.
The pattern /o-o/ does occur, however, which would require a lexical association of R to both V-positions. /u-o/ is not reported in CS.

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

(75)

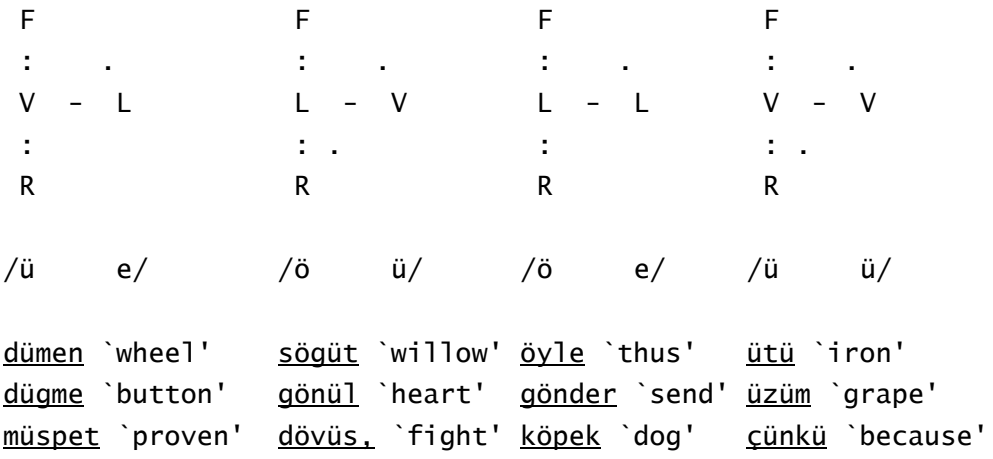


As in the case of the F prosody, we note that disharmonic patterns which would result in an empty V-position are ill-formed.

2.3.3 (iv)

With respect to the combined presence of both prosodies, we also start with the regular pattern (we present the two prosodies on different lines):

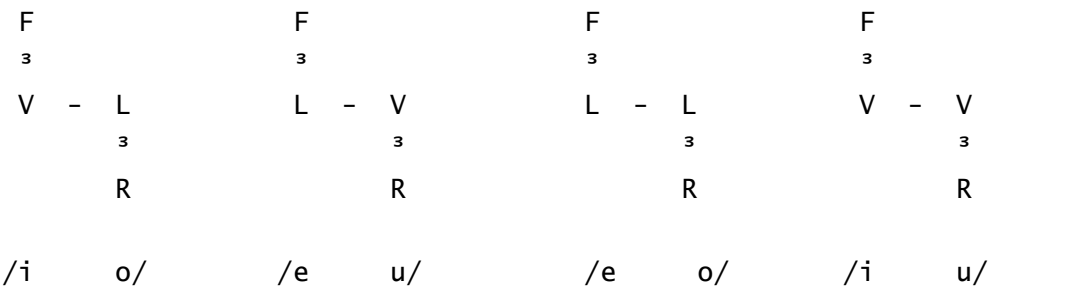
(76)



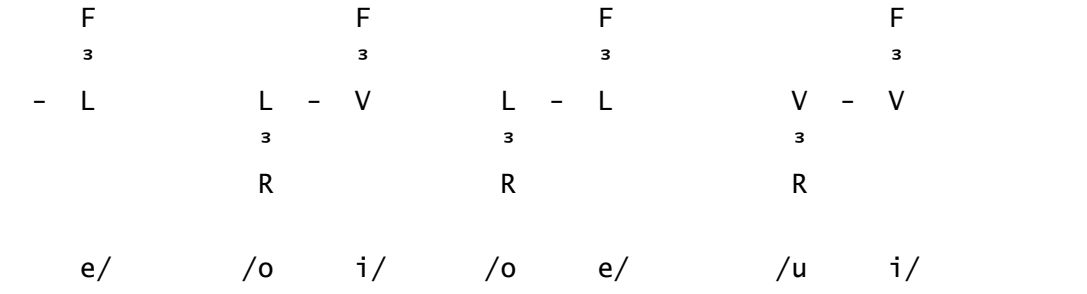
We have assumed that R does not associate to L. The patterns that would arise if such association were to occur (/ü-ö/, /ö-ö/) are not attested according to CS.

Analogous to the above we can imagine a number of patterns with lexical associations. For example, F and R can each be pre-associated to one of the V-positions:

(77)



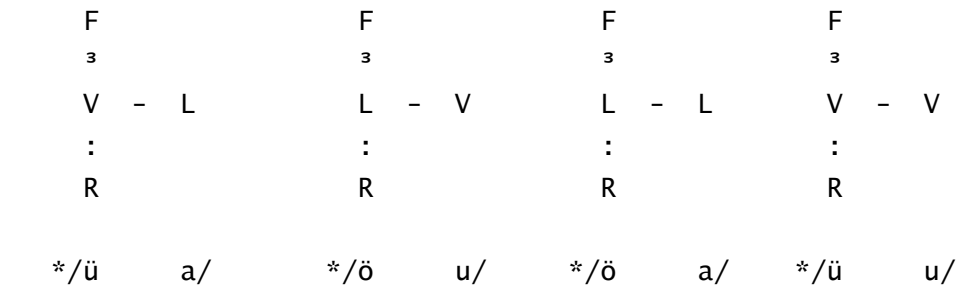
pilot `pilot'	mevzu `topic'	petrol `petrol'	billur `crystal'
cinko `zinc'	memur `official'	peron `platform'	(rare)
sifon `toilet flush'	mebus `MP'	metot `method'	



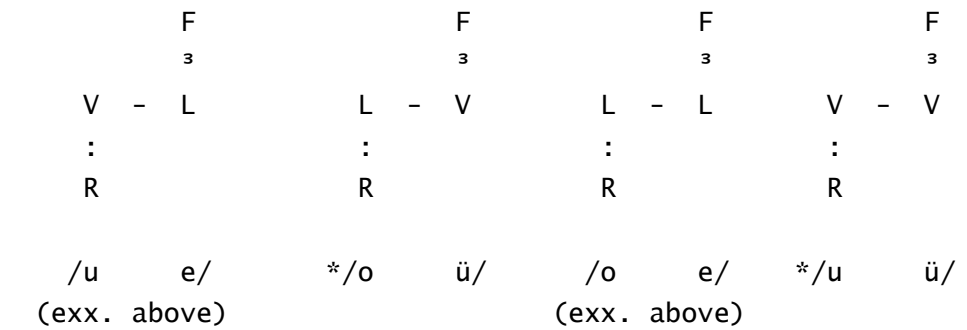
lutfen `please'	bobin `spool'	otel `hotel'	muzip `mischievous'
suret `manner'	polis `police'	rozet `collar pin'	kulis `stage wing'
kudret `power'	torik `blue fish'	model `model'	muhit `neighbour-hood'

All these patterns are reported by CS as possible exceptions. All other disharmonic patterns will involve either the presence of both prosodies on one of the V-positions, or the presence of one prosody on a single V-position with the other on both; twenty of such patterns are logically possible and of these only two cases occur that we have not seen before:

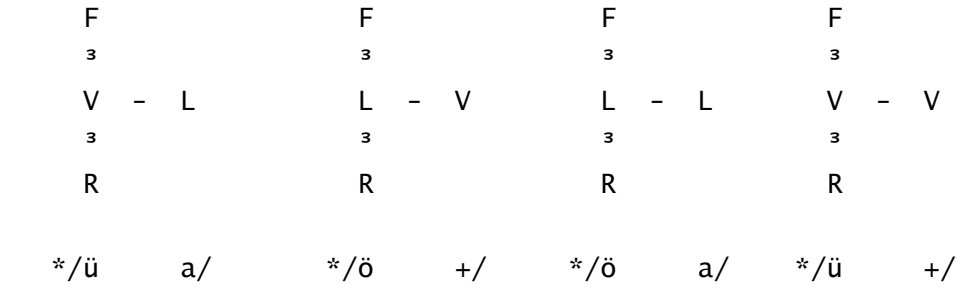
(78) a.


F F F F
V - L L - V L - L V - V
: : : :
R R R R
*/ü a/ */ö u/ */ö a/ */ü u/

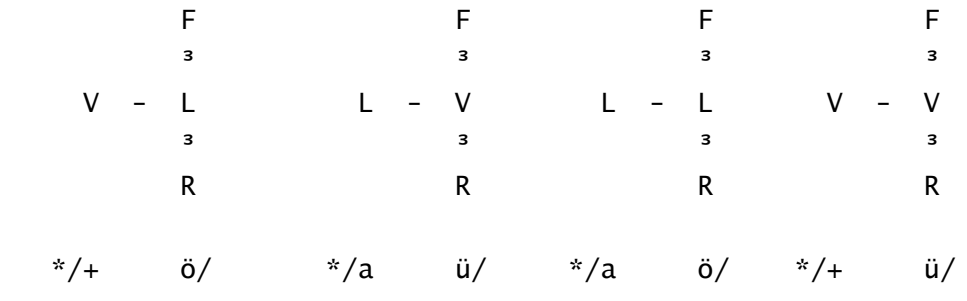
b.


F F F F
V - L L - V L - L V - V
: : : :
R R R R
/u e/ */o ü/ /o e/ */u ü/
(exx. above) (exx. above)

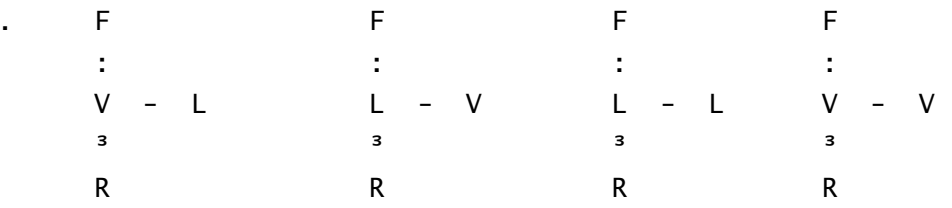
c.


F F F F
V - L L - V L - L V - V
R R R R
*/ü a/ */ö +/ */ö a/ */ü +/

d.


F F F F
V - L L - V L - L V - V
R R R R
*/+ ö/ */a ü/ */a ö/ */+ ü/

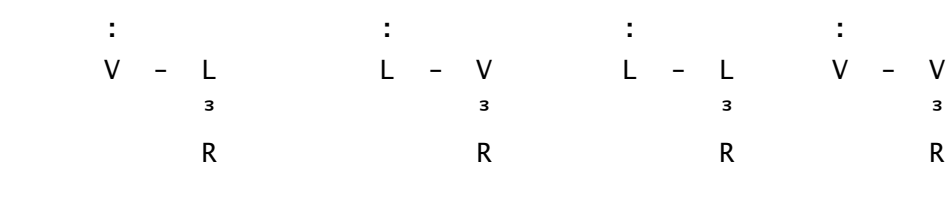
e.



*/ü e/ */ö i/ */ö e/ /ü i/

--- --- --- ümit `hope'
mümbit `fertile'
ümmi `illiterate'

f.



*/i ö/ */e ü/ */e ö/ /i ü/

--- --- --- tifüs `typhus'
virüs `virus'
bitüm `bitumen'

The only attested cases are /ü-i/ and /i-ü/. We summarize our findings regarding exceptional patterns as follows:

(79) - if there is one prosody present, no vowel receives less than one property
- if there are two prosodies present, no vowel receives more than one prosody (except if one of the vowels is /i/)

In the exceptional vocabulary, the fact that every single vowel position has distinctive F and R properties is 'compensated for' by the exclusion of the marked vowels /+ ü ö/.

2.4 OTHER ISSUES IN VOWEL HARMONY

2.4.1 Labial attraction

In the literature on vowel harmony, special status is sometimes assigned to the pattern /a C^w u/, in which C^w is a labial consonant. The unexpected rounding of the non-initial high vowel is attributed to the preceding labial consonant. However, CS show that the pattern /a - u/ also frequently occurs when the consonant is non-labial (80a), while on the other hand the pattern /a C^w +/ (80b) can also easily be found:

(80) a.	marul	`lettuce'	b.	sab+r	`patience'
	fatura	`invoice'		kap+	`door'
	yakut	`emerald'		kam+s,	`reed'

We conclude that 'labial attraction' does not form part of the synchronic phonology of Turkish.

2.4.2 Suffixes

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

(81)	nom. sg.	poss.	abl.	nom. pl.	poss./acc. pl.
`room'	oda	odas+	odadan	odalar	odalar+
`end'	son	sonu	sondan	sonlar	sonlar+
`pipe'	boru	borusu	borudan	borular	borular+
`village'	köy	köyu	köyden	köyler	köyleri
`worm'	kurt	kurdu	kurttan	kurtlar	kurtlar+
`fox'	tilki	tilkisi	tilkiden	tilkiler	tilkileri
`cow'	inek	inei	inekten	inekler	inekleri
`river'	dere	deresi	dereden	dereler	dereleri
`horse'	at	at+	attan	atlar	atlar+
`taste'	tat	tad+	tattan	tatlar	tatlar+
`girl'	k+z	k+z+	k+zdan	k+zlar	k+zlar+
`container'	kap	kabi	kaptan	kaplar	kaplar+
`iron'	ütü	ütüsü	ütüden	ütüler	ütüleri

The fact that low suffix vowels do not undergo labial harmony follows from the constraint on non-initial /o-ö/, which we already assumed for stem-initial harmony. It is not necessary, then, to assign low suffix vowels a specification such as [-R]. The fact that after low vowels only non-round vowels can appear, follows from our assumption that all assocation is local,

i.e. involves vowel positions in adjacent syllables. Consider the underlying representation of pullar+n `stamp nom.pl.':

(82) a.

```
     R

  p V l  -  l L r  - V n
```

b.

```
     R
     :
  p V l  -  l L r  - V n    ->  [pul - lar - +n]
```

The R prosody cannot associate to the vowel of the plural suffix /lLr/ because of the non-initial /o-ö/ prohibition. In addition, R cannot associate to the vowel of the nominative plural suffix /Vn/ because that would violate the locality requirement. Given our use of unary primitives an absolute minimum of computation is required.

2.4.3 Irregular suffixes

CS discuss a number of exceptional suffixes. In (83) we list their (31):

(83)

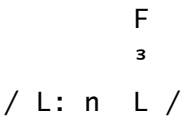
a.	gel-iyor-um	`I am coming'		
	kos,-uyor-um	`I am running'		
	gül-üyor-um	`I am laughing'		
	bak-+yor-um	`I am looking'		
b.	üc	`three'	üc-gen-ler	`triangles'
	alt+	`six'	alt+-gen-ler	`hexagonals'
	sekiz	`eight'	seki-gen-ler	`octagonals'
	cok	`many'	cok-gen-ler	`polygonals'
c.	arab-istan-+	`Arabia'		
	ermeni-stan-+	`Armenia'		
	mool-istan-+	`Mongolia'		
	türk-istan-+	`Turkestan'		
d.	gid-edur-sun	`let him keep going'		
	kos-adur-sun	`let him keep running'		
	gül-edur-sun	`let him keep laughing'		
	bak-adur-sun	`let him keep looking'		

We represent these suffixes as follows:

(84)

None of these suffixes requires the specification of [-R] or [+B]. In two other suffixes, however, an invariant /a:/ occurs preceding an invariant front vowel:

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



How can we explain that an F prosody of a stem cannot associate to the suffix initial /a:/ without marking this vowel as [+B]? We tentatively suggest that such suffixes have a compound-like character.

Vowel harmony in Turkish is sometimes argued to be non-directional. The fact that we only find rightward spreading from the stem would be a result of the absence of prefixes falling within the harmonic domain. However, given our approach, the notion of directionality does play a role in the case of non-harmonic suffixes.

For example, a back vowel stem, i.e. a stem which does not contain the F prosody followed by a suffix like /gil/, which does bear the F prosody, does not become front. The F prosody of /gil/ does not spread leftward into the stem. Anderson (1980) argues on the basis of such cases that harmony in Turkish is directional.

In various publications Kardestuncer argues that the suffixes which fail to undergo harmony do not really qualify as suffixes. For example, in Kardestuncer (1983xx) the point is made that [yor] is not a suffix but a compound component, i.e. a stem. If Kardestuncer is right, the problem noted by Anderson does not arise. Otherwise, we will have to accept that some statement or other must be made in the grammar of Turkish to account for the fact that back stems do not become front before front suffixes. This does not necessarily have to be a statement about directionality. We could also say that for Turkish stems are dominant. We know that there are also harmony systems in which suffixal prosodies do spread into the stem. In such systems, then, stems are recessive.

2.4.4 Consonants and harmony

Kumbarac+ (1966) discusses a different type of interaction between consonants and vowel harmony. It is claimed that suffixal palato-alveolar consonants (e.g. /s/ <s,> and /j/ <j> or <c>?) and the suffixal /y/ influence preceding and following vowels. It is claimed that to their left these consonants only allow /i/ or /+/ (the choice depending on the frontness of preceding vowels), while to their right /i/ and /+/ as well as /e/ and /a/ occur (the choice again depending on the harmonic property of the root). In other words, the suffixal consonants deround and raise vowels to their left, while rightward only derounding applies.

The forms in (86) illustrate the leftward derounding and raising effect. The forms in parentheses show up if these assimilations do not apply). The stems are ye `eat', sakla `hide', üs,ü `be cold', oku `read'

(86)

Verb suffix ('let me')		2nd Imperative		Adverb formative	
yi-yim	(ye-yim)	yi-yin	(ye-yin)	yi-yeli	(ye-yeli)
sakli-yim	(sakla-y+m)	sakl+y+n	(sakla-y+n)	sakl+-yal+	(sakla-yal+)
üs,i-yim	(üs,ü-yüm)	üs,i-yin	(üsü-yün)	üs,i-yeli	(üs,ü-yeli)
ok+-y+m	(oku-yum)	ok+-y+n	(oku-yun)	ok+-yal+	(üs,ü-yeli)

Pierce (1966) argues that these assimilations are not obligatory. They are also discussed in Anderson (?1974: xx), Lees (1961, 1966).

CS offer the following account of the distribution of the palatal variants of /k g l/:

(87) Velars
-palatal if tautosyllabic with a front vowel
-initially and medially unpredictable occurrences

/l/
-palatal if adjacent to a front vowel
-palatal if word-initial position
-medially and finally unpredictable occurrences

Unpredictable occurrences of palatal consonants can be lexically associated to F. The predictable occurrences can be derived. In fact, the distribution of predictably palatal /l/ can be derived as part of the 'vowel' harmony process.

Palatalization of velars requires a separate harmony statement. Palatal

consonants cause vowels to be front in suffixes. Front suffixes can occur not only after palatal /l/'s but also after velars (CS (57)):

(88)

`explosion'	infil,ak	infil,a:k,i
`alliance'	ittifak	ittifa:k,i
`fasting'	imsak	imsa:k,i
`real estate'	eml,ak	eml,ak,i

Since palatal velars do not occur word-finally, the palatal character of these velars will only show up if a suffix is added.

CS note that some velars sometimes require suffix vowels to be back. These velars, then, are represented with [+B], a possibility which is not an option in the framework outlined above. For the time being, we will mark such cases as simply not triggering vowel harmony.

3. **CONCLUDING REMARKS**

In this paper we have discussed various topics in Turkish phonology. We hope to have provided a useful summary of recent theoretical debate with regard to Turkish. We also hope that in particular our discussion of vowel harmony will stimulate further investigation.

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