

Yucatec Maya Vowel Alternations. Arguments for Syntagmatic Identity and Positional Faithfulness*

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Abstract

In this paper, I will give a detailed account of vowel harmony and vowel dissimilation in Yucatec Maya. These phenomena provide insights for the treatment of assimilation in Optimality Theory (Prince & Smolensky 1993), as well as for the organisation of phonological features. The theoretical topics to be dealt with are (i.) an adequate formalisation of phonological feature assimilation within Correspondence Theory (McCarthy & Prince 1995), and (ii.) an account of morpheme-specific alternations within this framework. I will argue that harmony, or assimilation in general, surfaces due to a Faithfulness constraint family, Syntagmatic Identity, which establishes a correspondence relation between segmental or prosodic entities of the same type within one representation. Idiosyncratic alternations will be analysed with reliance on featural underspecification of underlying forms. Effects which were traditionally attributed to different rules on different levels of derivation are accounted for within the parallelist model of Correspondence Theory by constraint interaction, and without assumptions like serialist candidate evaluations (which were proposed by Benua 1997, Kiparsky 1999, and many others).

1 Introduction

Yucatec Maya vowel harmony is a typical example of a morpheme-specific phonological feature alternation. Some affixes in Yucatec Maya copy the preceding root vowel, while other suffixes retain their underlying feature profile. Moreover, the harmony process is blocked in a rather interesting context – when more than one consonant is placed between the suffix vowel and the root vowel. In this environment, the suffix vowel has always the quality *a*. The situation is even more compelling since the Yucatec Maya morpheme inventory also contains an affix with a vowel which consequently surfaces with the opposite backness value than that of the root vowel. Such contradictory phenomena might be taken as evidence for rule and level based phonological theories, where dissimilation is assumed active on an early level, while vowel harmony is active on a second level of derivation, and disharmonic affixes are assumed to be added on an even later level. This characteristics makes them a challenge for a parallelist theory like Optimality Theory (Prince & Smolensky 1993), in which no intermediate levels or stages between the input and the output of a derivation are assumed.

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The questions to be answered in this paper concerning the Yucatecan data are: i. how can morpheme-specific alternations theoretically be accounted for in a theory which denies the existence of derivational levels? ii. how can harmony and dissimilation both be explained adequately in such a theory? iii. what is it exactly that blocks the application of harmony?

In this paper, two major goals will be pursued: I will introduce a unified theory of assimilation and dissimilation within correspondence theory (McCarthy & Prince 1995). Furthermore, I will give an appropriate account of the Yucatecan data within this theory. The results may be summarised in advance in that assimilation is best analysed as a correspondence relation between segments or prosodic categories like moras or syllables within one representational string, i.e. the surface representation. This correspondence relation will be labelled Syntagmatic Identity.

The paper is structured as follows. In section 2, the basic assumptions of the proposal to treat assimilation as a correspondence relation will be developed. In section 3, Yucatec Maya vowel alternation patterns will be introduced and it will be shown that the moraicity of coda consonants plays a crucial role in the analysis of harmony blocking (section 3.2). Section 3.4 is concerned with vocalic dissimilation and extends the analysis of Yucatec Maya harmony developed in sections 3.1, 3.2, and 3.3 to dissimilation patterns. Section 4 compares the Correspondence approach of harmony with other approaches within OT. Section 5 summarises and concludes the discussion.

2 Basic assumptions

The basic assumptions of Optimality Theory will be taken for granted in this paper. For an introduction to the theoretical architecture the reader may consult Prince & Smolensky (1993), McCarthy & Prince (1995), or Archangeli & Langendoen (1997). Therefore, in this section, I will concentrate on introducing my proposal on how to deal with assimilation within this framework.

2.1 The formalisation of assimilation

What happens in harmony or any kind of assimilation is intuitively the same as what happens in many nonlinguistic neighbourhoods: Somebody wants to look like her neighbour, or somebody wants her neighbours to look like her. Something very similar is encoded in one of the basic faithfulness constraint families of OT: IDENTITY(feature) says that input and output should agree in feature specifications, i.e. they should look alike:

- (1) The IDENT(F) Constraint Family McCarthy & Prince (1995:264)
 Let α be a segment in S_1 and β be any correspondent of α in S_2 .
 If α is $[\gamma F]$ then β is $[\gamma F]$.
 (Correspondent segments are identical in feature F.)

Pulleyblank (1997) proposed to analyse consonantal assimilation as an effect of Syntagmatic Constraints, as opposed to Input-Output constraints.¹ Lombardi (1999:272 and earlier papers) and

¹ An interesting point here is that even though Pulleyblank (1997) proposes Identical Cluster Constraints (ICC), i.e. something very similar to Faithfulness constraints, to handle consonantal assimilation, he formalises

Gnanadesikan (1997) present similar constraints to handle laryngeal assimilation (Lombardi assuming privative voice, Gnanadesikan a ternary voicing scale).

- (2) Pulleyblank (1997:64): IDENTICAL CLUSTER CONSTRAINTS:
A sequence of consonants must be identical in *voicing / place of articulation / continuancy / nasality*.
- (3) Lombardi (1999:272): AGREE: Obstruent clusters should agree in voicing.
- (4) Gnanadesikan (1997:23): ASSIM: The output {scale} value of adjacent segments must be identical.

Such constraints can be incorporated into the correspondence constraint family. The first task is to define the correspondence relation as a relation between distinct elements of the same type within one representation instead of referring to two representations. By this move, the core statement of the above-mentioned assimilation constraints can be formulated more generally, resulting in a uniform formalism for feature assimilation in general, as I have done in (5).

- (5) SYNTAGMATIC IDENTITY(F) (S-IDENT, preliminary schema):²
Let α be a segment in representation R and β be any adjacent segment in representation R, if α is [γ F] then β is [γ F].
(A segment has to have the same value for a feature F as the adjacent segment in the string.)

Under the assumption of flat segmental structure, i.e., CVCVC strings, this constraint directly rules out long-distance consonantal spreading, which is a desirable result (see Gafos 1998). But it would also rule out any kind of vowel harmony, since between each vowel there is a consonant. Two solutions are possible: Either vocalic features are coproduced on consonants, while consonantal features cannot be coproduced on vowels (as proposed by Ní Chiosáin & Padgett 1997), or the 'segment' referred to in the definition of the constraint is only one possible variable of Syntagmatic Identity. This means that vocalic features or nasality for example are associated with other categories than the segment, specifically moras, syllables or feet. In the following, I will explore the latter possibility, drawing on and extending a proposal made in Grounded Phonology (Archangeli & Pulleyblank 1994). Arguments against the Ní Chiosáin & Padgett (1997) coproduction account will be given in section 4.

2.2 Where features reside

Consonantal assimilation applies always from segment to segment (see the discussion of consonantal long distance effects in Gafos 1998), while vocalic assimilation processes apply from mora to mora

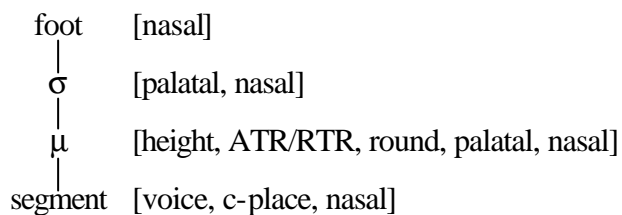
assimilation between vowels as featural Alignment. (See section 4 for a discussion of the Alignment approach to vowel harmony.)

² In Krämer (1998, 1999a,b), Syntagmatic Identity was labelled Surface Identity. This was somewhat ambiguous since Output-Output Correspondence is also a kind of 'surface' relation. The term 'Syntagmatic Identity' is more appropriate and less confusing I hope.

or syllable head to syllable head (see e.g. Archangeli & Pulleyblank 1994 or the discussion in van der Hulst & van de Weijer 1995). I will assume different features are associated with different prosodic entities or tiers, based on the observations by Archangeli & Pulleyblank (1994), Piggott (1996), Walker (1994) and others. Piggott (1996) argued that in Lamba, nasal harmony applies from syllable to syllable, while in Kikongo, it goes from foot to foot. The feature [palatal] for example can be said to be licensed by the syllable in languages like Russian or Irish, because the onset of a syllable always agrees in palatality with the following nucleus.

(6) shows the bottom half of the prosodic hierarchy (based on Selkirk 1978) and the features which reside on the respective tiers.^{3, 4}

(6) Prosodic categories and articulatory features



Features are assumed to be associated with or be licensed by or reside on or be anchored on different levels in that hierarchy with the segment at its lowest level. On this basis, Syntagmatic Identity can be reformulated as in (7).

(7) SYNTAGMATIC IDENTITY (S-IDENT(F), preliminary schema):⁵

Let α be an entity of type T in representation R and β be any adjacent entity of type T in representation R, if α is [γ F] then β is [γ F].

Where T is a segment, mora, syllable, or foot.

(A segment, mora, syllable or foot has to have the same value for a feature F as the adjacent segment, mora, syllable or foot in the string.)

³ Note that Piggott (1996:150) proposes a similar typology for harmony, where he expects segmental, syllabic, and foot-sensitive harmony to occur, ignoring the mora. Archangeli & Pulleyblank (1994) propose segments, moras and syllables or syllable heads as anchors for features, ignoring the foot.

⁴ This is only a tentative proposal. Much work is still to be done to find out where exactly each feature resides. It is noteworthy in this respect that [nasal] resides on every tier in this hierarchy. This is because nasality exhibits different behaviour in different languages (see Walker 1994, Piggott 1996). In some, nasality is found only on sonorant consonants; some languages allow vowels to be nasalised (and skip coda nasals); in some languages, a nasal in onset position may transfer its nasality to the whole syllable or the whole foot, and in some it may spread from foot to foot.

⁵ In the remainder of this paper, constraints of this kind (Syntagmatic-Identity) will be abbreviated as S-IDENT σ/μ [feature], where **s** or **m** indicates whether the particular correspondence relation holds for syllables or moras. Within the square brackets, the feature is given which is affected by the correspondence relation.

2.3 The domains of constraints

So far, I have been dealing with the formalisation of assimilation as correspondence and with the question to which categories features may be associated. Another relevant question touches on the domains in which assimilation processes apply and how this can be handled in a theoretic framework which denies the existence of derivational levels. Voicing assimilation applies within phrases (as, e.g., in Breton or Dutch; see Krämer 1999b, Grijzenhout & Krämer 1998 and references therein, respectively), and tonal sandhi phenomena go over word boundaries within a prosodic phrase (see e.g. Wiese 1988 on Chinese). Furthermore, consonantal place assimilation and vowel harmony are restricted to the Prosodic Word or smaller domains. Note that van der Hulst & van de Weijer (1995) argue against this generalisation about the scope of vowel harmony. They take the existence of disharmony within prosodic words as evidence for the claim that vowel harmony is determined by morphological structure. They argue that vowel harmony must be located on certain levels of derivation while it is absent on others. In the Output-Output Correspondence version of Optimality Theory, another analysis is possible: in larger units like compounds simplex output forms combine. For this reason harmony is limited to the respective members of a compound, instead of extending over the whole construction. An alternative view is that compounds consist of different prosodic words as an effect of Alignment constraints on stems and prosodic words, and constraints on vowel harmony are limited to this domain (the prosodic word). Furthermore, disharmony within single words can be accounted for under the assumption of underlying underspecification and prespecification, respectively. This last two assumptions are core ideas to be applied in this paper. The effects that were modelled by derivational steps or levels and the location of particular rules on particular levels or their organisation in a certain order can be covered by Positional Faithfulness within Correspondence Theory. Positional Faithfulness instantiates special faithfulness constraints from more general ones in imposing a local restriction on the domain of their activity. For example IDENTIO(F) demands output segments to be identical in feature specification to their correspondent input, while IDENTONSETIO(F) is restricted to segments which are prosodified in an onset in the output (Lombardi 1999). That vowel harmony and consonantal place assimilation stop at word boundaries, while voicing assimilation and tone sandhi stop at phrase boundaries, can be explained by assuming that the responsible correspondence constraints are also subject to local restrictions to just these categories. That is, the constraint on moraic featural S-IDENTITY holds only within a Prosodic Word, while S-IDENTITY[voice] for example is limited to a larger domain, the Prosodic Phrase.

(8) SYNTAGMATIC IDENTITY(F) (S-IDENT):

Let α be an entity of type T in representation R and β be any adjacent entity of type T in representation R, if α is [γ F] then β is [γ F].

T = seg \vee mora \vee syllable \vee foot

Local Domain = PPh \vee PWd \vee foot \vee syllable

This restriction to local domains also throws some light on the potential function of such assimilation phenomena, which a level-based analysis obscures: Like stress assignment and syllabification, assimilation eventually serves to structure utterances. Assimilation lumps together certain pieces of speech and separates others, marking word boundaries and phrase boundaries.

Technically, this constraint is violable in three ways: 1. features in adjacent categories do not agree in their respective specification; 2. features in nonadjacent categories establish a

correspondence relation and agree (locality); 3. features agree beyond the scope/domain of the constraint in question. We have a disjunctive combination of three conditions.

Note finally that directionality of assimilation is not included anymore in the mechanism of assimilation itself, as was done by rule accounts of the type $[\alpha F] \rightarrow [\beta F]/_[\beta F]$ or by Alignment constraints on features. This omission of direct reference to directionality is necessary because in fact most cases of assimilation have no intrinsic direction. Directionality effects are caused by the interaction of independent faithfulness constraints with S-Identity. This issue will be discussed in more detail in section 3.3.

In the following section, I will apply the model to Yucatec Maya vowel alternations.

3 Yucatec Maya vowel alternations

3.1 Harmony and blocking by prespecification

Yucatec Maya, a Mayan language spoken by roughly 700,000 people in south-eastern Mexico, Belize, and northern Guatemala (Lastra 1998, Lehmann 1990), has the vowels *i, e, a, o, u*, and distinguishes between long and short vowels. Among the long vowels, a distinction is made between high toned vowels and low toned (or neutral) ones.

In this language, some suffixes completely copy the last vowel of the stem (see 9a,b), while another suffix displays a dissimilating pattern. The latter suffix always surfaces as [+high] and dissimilates with respect to the stem vowel in backness. This suffix will be treated in section 3.4. Other Yucatecan suffixes do not exhibit assimilatory or dissimilatory patterns of vowels at all (9c,d).

In (9a,b), the harmonising suffixes for imperfective and subjunctive of intransitive verbs are shown. The imperfective suffix for transitive verbs and the perfective suffix (attaching to both transitive and intransitive stems), on the other hand, never alternate in vowel quality (9c,d).

(9) Yucatec Maya:⁶

a. Intransitive imperfective

?ah-al wake.up-IMPF
 ?ok-ol enter-IMPF
 lub'-ul fall-IMPF
 wen-el sleep-IMPF
 kíim-il die-IMPF

b. Intransitive subjunctive

?ah-ak
 ?ok-ok
 lub'-uk
 wen-ek
 kíim-ik

c. Transitive imperfective

yil-ik see-IMPF
 tsol-ik explain-IMPF

d. Perfective

yil-ah see-PERF
 putʃ-ah hit-PERF

⁶ The Yucatecan data are taken from Ayres & Pfeiler (1997), Blair & Vermont-Salas (1967), and from Bricker & Yah (1981).

On the basis of the examples above, one may conclude that in this language (where harmony is not broadly active) the non-alternating suffixes are fully specified whereas the harmonising ones are underspecified, as indicated in (10).

- (10) a. Fully specified morphemes: /-ik/; /-ah/
 b. Underspecified morphemes: /-Vl/; /-Vk/

This analysis is in line with Inkelas' (1994) assumptions on underspecification within Optimality Theory. Due to Lexicon Optimization (Prince & Smolensky 1993), non-alternating structure is fully specified underlyingly (avoiding DEP(F) violations) while alternating structure is underspecified (avoiding IDENT(F) violations).

An alternative to the underspecification analysis would be one in which different constraint rankings for the two types of morphemes are assumed. This means in fact to tolerate morpheme-specific grammars. In consequence, this predicts that possibly a language may have one individual grammar for each morpheme of the language, which is highly implausible for reasons of economy and of learnability.

Usually, harmony affects only one or two features of a vowel. In Yucatec Maya harmony, *all* features seem to be involved, since harmony consists of total correspondence. From the vowel inventory we know that roundness or ATR plays no role in this language. Both features are predictable. The remaining features which are relevant for the system and for harmony are [\pm high], [\pm low] and [\pm back]. Underspecification of the affected vowels affects these features, because in the case of blocking of harmony, the relevant vowel surfaces as the default one *a*. Furthermore, the underspecified/harmonising vowels do not alternate in length or tone in Yucatec Maya. This length and tone stability must be regarded as an argument against a reduplication analysis, because reduplication would copy virtually all features. The S-IDENTITY constraint for vocalic features can be formulated as follows.

- (11) Moraic SYNTAGMATIC IDENTITY (S-IDENT) $_{\mu}$ [b,h,l]:
 Let α be a vowel in *mora* 1 and β be any correspondent of α in *mora* 2.
 If α is [γ back], [δ high], [ϵ low] then β is [γ back], [δ high], [ϵ low].

The harmonic patterning is restricted to a handful of affixes. Consequently, S-IDENTITY has to be ranked below the relevant IDENTIO(F) constraints on underlying vocalic features, see (12). Lexical entries have to be fully specified, except for alternating structure.

- (12) IDENTIO(F) >> S-IDENT $_{\mu}$ [b,h,l]

The constraint MAX-IO, (McCarthy & Prince 1995:264) forces the underspecified vowel to surface even though the filling-up of the features, which are necessary for its pronunciation incurs DEP(F) violations. Thus, MAXIO must be ranked above DEP(F) constraints.

- (13) MAX-IO: Any segment in the input has a correspondent in the output.
 (14) DEP: Any segment/feature in the output has a correspondent in the input.

The effect of the proposed constraints is shown in the tableau below.

(15) Underspecification and harmony:

/lub'-Vl/	S-IDENT _μ [b,h,l]	MAX-IO	DEP(F)
a. lub'al	*!*		*
b. lub'el	*!*		*
c. lub'ol	*!		*
d. lub'il	*!*		*
e. lub'l		*!	
f. φ lub'ul			*

The candidate *lub'ul* in (15f), is chosen as optimal because it parses the underspecified vowel and obeys S-IDENT in letting the features of this vowel agree with those of the vowel in the neighbouring mora. MAX-IO prohibits skipping the featureless segment in the output (form (e)), which would leave all other constraints unviolated. The ranking of MAX-IO with respect to the involved IDENT constraints cannot be determined on the basis of the data. It is crucial that it is located above any kind of DEP constraint. Filling in of features, which are not specified identically to those of the stem vowel fatally violates S-IDENTITY (forms a-d).

Evaluating a form with a fully specified suffix shows not only that IDENTIO(F) has to rank above S-IDENT. Skipping one of the two vowels of the form would save a candidate from violating either IDENTIO or S-IDENT [see candidates (16d,e)]. To prevent candidates (d,e) from surfacing the correct ranking has to be MAXIO, IDENTIO >> S-IDENT.

(16) Lexical specification and disharmony:

ii.	/tsol-ik/	MAX-IO	IDENT(F)	S-IDENT _μ [b,h,l]
a.	tsolok		*!	
φ b.	tsolik			**
c.	tsolak		*!	*
d.	tsolk	*!		
e.	tslik	*!		

In (16), IDENT(F) rules out the candidate forms that override underlying feature specifications (a,c). This is crucial for fully specified elements, because in order to satisfy IDENT(F), S-IDENTITY, which demands that a vowel should look like the one in the next mora, has to be violated.

The Yucatec harmony grammar established so far is summarised in (17).

(17) MAXIO, IDENTIO(F) >> S-IDENT_μ[b,h,l] >> DEP(F)

With this basic grammar as a background, I turn now to the evaluation of harmony which is blocked by consonants.

3.2 Blocking by consonant clusters

In Yucatec Maya, harmony is blocked if more than one consonant is located between the two potentially involved vowels. (18) illustrates this with the subjunctive suffix, which normally echoes the root vowel (cf. 9b). In (18), the vowel of the subjunctive suffix surfaces as [a].

- | | | | |
|------|--------------|---------------------------|--------------|
| (18) | tùukul-n-ak | think-N-SUBJ ⁷ | * túukulnuk |
| | hèek'-n-ak | break-N-SUBJ | * hèek'nek |
| | ts'íib'-n-ak | write-N-SUBJ | * ts'íib'nik |

The same holds for the other harmonising suffix in (9). The blocking effect due to an intervening consonant is illustrated in (19).

- | | | | | |
|------|----|-----------------------|--------------------|---------------------------|
| (19) | a. | t'otʃ -b'-al | 'to harden (glue)' | instead of * t'otʃ -b'-ol |
| | | harden-PASS-IMPF | | |
| | b. | máís-t-áʔal | 'being swept' | instead of * máístíʔil |
| | | sweep-TRANS-PASS.IMPF | | or * míʔistil |

A consonantal barrier, consisting of more than one consonant, thus blocks the 'transfer' of the vowel features from the stem to the affix. This blocking behaviour is also observed with roots with a final consonant cluster (although they are rare), which shows that this is not a morphematic restriction. This means that the possibility is excluded that adjacency (or locality) of harmonising or otherwise interacting elements is defined over morphemes, with intervening morphemes as blockers. Instead, phonological units block harmony.

It is a widely shared opinion that consonants in onset position do not contribute to the weight of a syllable, while consonants in coda position do contribute to the weight of a syllable in many languages. The weight of a syllable is measured by the unit mora (μ). A coda consonant which makes a syllable heavy projects a mora, while a coda consonant which has no effect on syllabic weight bears none. If, in Yucatec, only one consonant is found between two vowels it has to be an onset, because Yucatec Maya syllables always have to have an onset. In vowel-initial stems for example, an onset is provided by glottal stop insertion. Of the two consonants, which are situated between non-corresponding vowels, the first one has to be a coda while the second is the onset of the next syllable. So the former is probably moraic. If this is the case this consonantal mora between two vocalic moras explains the absence of harmony. In the following, I will first give evidence for coda moraicity in Yucatec Maya and then further use this fact to explain harmony blocking.

An ongoing discussion in the literature is whether Yucatec Maya has phonemic pitch accent or tones and which ones (see e.g. Pike 1946, Blair & Vermont-Salas 1967, Fisher 1976, Straight 1976, Lehmann 1990). Unfortunately, no work is done so far on the accentual system. Nevertheless, Pfeiler (p.c.) suggests that it is uncontroversial among Mayanists that Yucatec Maya is quantity-sensitive. According to Straight (1976:41), closed syllables (i.e. those ending in a consonant) have more weight than their open syllable counterparts in Yucatec Maya. However he does not provide evidence for this claim. In many transcriptions (in particular those of Blair & Vermont-Salas 1967), phrasal intonation is indicated by little superscripts preceding and following each syllable, with ³ indicating high pitch and intensity, ² indicating medially high, ¹ lower than medial, and \emptyset neutral intonation. Phonemic pitch accent, i.e. high and low or neutral tone, is transcribed by an acute accent and a grave accent, respectively. The arrow at the end of each phrase in the examples below indicates whether the terminal intonation contour of a phrase is stable, falls or rises (to mark a

⁷ The function of the suffix -n- is subject of an ongoing debate. Therefore it has no glossing. For differing proposals see Bricker (1978), Lucy (1994), Krämer & Wunderlich (1999).

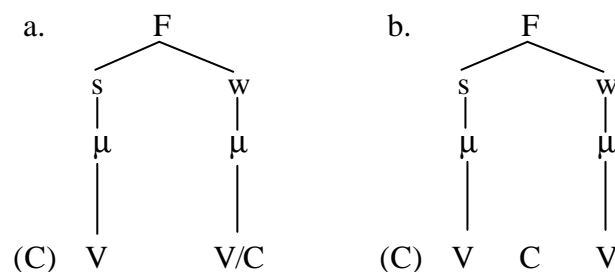
question for example). Below are some intonation patterns of Yucatec Maya (as given in Blair & Vermont-Salas 1967), including some of the harmonising examples mentioned earlier. These data will serve to derive the relevant generalisations on Yucatec Maya stress in general and its quantity-sensitivity in particular.⁸

- (20) a. ²ka wa.²h-al²→ 'you wake up'
 b. ³lúu.¹b'-ul¹→ 's/he falls'
 c. ²kiŋ we.²n-eŋ²→ 'I sleep'
- (21) a. ²ku me.²yah²→ 'he works'
 PRES.3SG work
 b. ²way ka me.ya.²h-e?²↑ 'Are you working here?'
 Q PR-2 work-TERM
 c. ²h me.²yah.-n-a.²k-en¹↓ 'I have worked'
 PAST work-N-SUBJ-1SG

The last syllable of a word or phrase always has a higher intonation than neutral (20a-c, 21a-c). When the last syllable of a word or phrase is preceded by a high toned syllable, the latter gets higher or intenser intonation than the last one, which is still stressed. All Yucatecan words end in a consonant. If they do not have one lexically, a glottal stop or glottal fricative is inserted. Thus, the last (the stressed) syllable is always heavy. The leftmost syllable attracts stress, too. Word-medial light syllables are usually not accented (21b) and thus I assume them to be unfooted. As we can see from the little superscripts, a word-medial CVC syllable gets an intonational marking (21c), so we can conclude that it is stressed or footed. That this syllable does not bear a lexical accent can be inferred from example (21b) where the same syllable is light and unaccented. These data show that Yucatec Maya is quantity-sensitive with coda consonants being moraic and thus contributing to the weight of a syllable.

In his phonetic measurements, Fisher (1976) found that high toned syllables (containing a long vowel) have a contour when in stressed position, that is, they abruptly rise from neutral to high pitch in the first half of the long vowel and then fall back to neutral in the second half. From the accent distribution data and Fisher's measurements, I conclude that in Yucatec Maya, trochaic bimoraic symmetric feet are built.

(22) Yucatecan trochaic foot:



⁸ In phrases containing tone bearing morphemes, stress assignment is a little more complicated. For the sake of clarity, I exclude tone bearing material as far as possible from the considered data.

The diagram in (22) illustrates that the main characteristics of a Yucatecan foot is bimoraicity, containing either one heavy syllable (CVV, CVC or heavier; see 22a) or two light ones (CV.CV; see 22b).

What can be observed in the data in (20, 21) is that an accented foot is built at the right and at the left edge of a phrase or word. Heavy (CVC, CVV or heavier) syllables attract stress. If a phrase starts with two light syllables followed by a heavy one (20a), the first two syllables are grouped into a bisyllabic bimoraic foot and the heavy syllable is one bimoraic foot of its own. The foot structures are illustrated by the rightmost column in (23).

(23)

- | | | | |
|----|--|-------------------------|--|
| a. | ² ka wa. ² h-al ² → | 'you wake up' | (ka.wa) _F (hal) _F |
| b. | ³ lúu. ¹ b'-ul ¹ → | 's/he falls' | (lúu) _F (bul) _F |
| c. | ² kiŋ we. ² n-el ² → | 'I sleep' | (kiŋ) _F we (nel) _F |
| d. | ² ku me. ² yah ² → | 'he works' | (ku.me) _F (yah) _F |
| | PRES.3SG work | | |
| e. | ² way ka me.ya. ² h-eʔ ² ↑ | 'Are you working here?' | (way) _F ka.me.ya (heʔ) _F |
| | Q PR-2 work-TERM | | |
| f. | ² h me. ² yah.-n-a. ² k-en ¹ ↓ | 'I have worked' | (h.me) _F (yah) _F na (ken) _F |
| | PAST work-N-SUBJ-1SG | | |

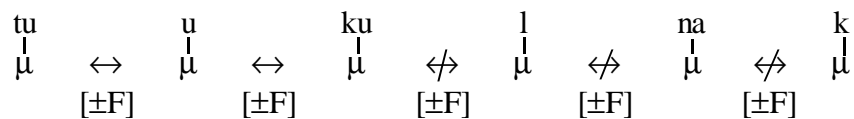
As said already, Piggott (1996) analyses nasal harmony in Lamba as harmony from syllable to syllable, and Kikongo nasal harmony as agreement between feet. From these findings the possibility arises that the foot may be the domain of harmony in Yucatec Maya, and that harmony stops at the foot boundary. Thus, the possibility has to be examined whether the foot is the harmonic domain in Yucatec Maya and whether harmony is blocked at foot boundaries. This would be an alternative to the moraic account argued for in this paper. Consider in this respect once more example (20b) repeated here as (24).

- (24) a. ³lúu.¹b'ul¹→ 's/he falls' b. (lúu)_F (bul)_F c. *(lúu)_F (bal)_F

According to the assumptions of moraic weight and foot structure in Yucatec Maya, (24b) is the correct prosodic analysis for (24a). Under the assumption of foot-internal harmony, harmony should be blocked, since the underspecified vowel of the suffix /-VI/ is not in the same foot as the stem vowel. The expected output is (24c), which is not the case. Thus, the Yucatecan blocking effect cannot be attributed to foot structure.

The insights from this short excursion to stress patterns are that coda consonants indeed do count as a mora in this language and that the foot is not relevant to the harmony patterns under investigation. This supports the assumption that blocking of harmony can be explained by the existence of a consonantal mora (i.e., one without vocalic features) between two vowels. With this in mind we can proceed to the discussion of the treatment of harmony and its blocking.

The diagram below illustrates how moraic harmony is blocked when a consonant bears a mora between two vocalic moras which should otherwise interact. The crucial assumption is that consonants phonologically do not carry vocalic features. If one of two feature bearing elements lacks the respective features there is no base for an Identity relation. Establishing this relation with the next feature bearing element by skipping a featureless one violates the locality requirement of S-Identity (i.e., that corresponding moras have to be adjacent).

(25) *tuukulnak* 'think' (subjunctive form)

A different line of argumentation is found in Ní Chiosáin & Padgett (1997), who argue that harmony goes from segment to segment. They assume the 'bottleneck effect' to exclude long distance consonantal spreading. Vowels are changed into consonants if consonantal place features spread onto them, resulting in homorganic CCCCC sequences from underlying /CVCVC/ segments. Consonants instead do not change into vowels if vocalic features are coarticulated on them. An explanation in the sense of Ní Chiosáin & Padgett for the blocking effect observed in Yucatec Maya would be that over two consonants the speech organs have enough time to return to rest position. So this kind of blocking would be an instance of articulatory laziness. The question remains why in other languages – like Turkish – coda consonants have no opacity effect on vowel harmony. Are Turkish speakers less lazy than Yucatecans? In the approach given in this paper, the answer is quite straightforward: Turkish coda consonants do not project a mora (they only do so in the so-called Sezer stems (see Inkelas 1998) which are disharmonic anyway), while Yucatecan coda consonants do.

In tableau (26), where the blocking case is evaluated, S-IDENTITY plays a crucial role in excluding candidate (b) from winning, because there two vocalic moras are faithful to each other even though a consonantal mora intervenes.

(26) Harmony blocking:

/tuukul+n+Vk/	MAX-IO	IDENT (F)	S-IDENT _{μ[F]}	MARKEDNESS
a. tuukulnk	*!			
b. $\begin{array}{c} \mu\mu \mu \mu \mu \mu \\ \\ \text{tu} \text{u} \text{k} \text{u}_1 \text{l} \text{n} \text{u}_1 \text{k} \end{array}$			*!	*
c. tuukulnok				*!
d. tuuku ₁ lnu ₂ k				*!
e. tuukulnik				*!
f. tuukulnek				*!
g. tuukulnak				

Candidates (c-g) show that the language-particular ranking of featural Markedness constraints accounts for the choice of the right vowel in case harmony is blocked and the features of the underspecified vowel cannot be licensed via Syntagmatic correspondence. In the tableau, I skipped the details of the markedness hierarchy active in Yucatec Maya. What matters with regard to this point is that *a* is relatively unmarked in comparison to the other vowels in the Yucatecan system. Therefore it gets no markedness violation in the tableau, while the other vowels get one. Note that also the least marked vowel incurs markedness violations, since it has to be fully specified on the surface. It is only that the relevant markedness constraints are the lowest in the hierarchy and, therefore, they can be ignored. This surface feature specification of the least marked vowel also prevents all lexical *a*'s from being overwritten by the neighbouring vowel features in the respective context. For example the *a* of the suffix in *yilah* 's/he saw' (9d) would have no surface feature

assume that the direction of assimilation is influenced in this case by a highly ranked Faithfulness constraint on morphological information, like MAX_{morph} ('Morphological information in the input has to be salient in the output'). Assimilation of underlyingly specified vowels of clitics results from a weaker input-output faithfulness for clitics than for the material contained in the core prosodic word (i.e. stem plus affixes). Optionality of harmony within the clitic cluster is an effect of a crucial non-ranking of S-IDENT and Faithfulness to clitics, as indicated in (28).¹⁰

(28) IO-IDENT_{CorePWd} >> S-IDENT, IO-IDENT

I will save the reader from the details of the analysis of harmony within the clitic cluster and from the candidate evaluation, in order to proceed to the discussion of the lack of regressive harmony within affixed forms.

3.3.2 Absence of regressive harmony

The data in (27) have illustrated that the vocalic assimilation pattern can also be regressive in Yucatec Maya. From this, one would expect that harmony applies regressively if a suffix containing an underspecified vowel is followed by a morpheme with a specified vowel, and harmony with the stem vowel is blocked. Affixes marking person and number potentially follow the subjunctive marker *-Vk*, as can be seen in (29a,b). Harmony does not apply from right to left in this context when it is blocked between the stem vowel and an underspecified suffix vowel.

(29) Blocking and directionality of harmony:

- | | | | |
|----|---|----|---|
| a. | káʔah tʃuy-l-ak-en
occur hang-POS-SUBJ-1.SG
'I might hang.' | b. | káʔah tʃuy-l-ak-óʔob'
occur hang-POS-SUBJ-PL
'They might hang.' |
|----|---|----|---|

Once we have abandoned the Alignment approach to assimilation including its left/right parametrisation we face a problem with such data: When harmony is blocked by a preceding consonant cluster (as in 29a,b), the vowel of the subjunctive affix should copy the features of the following vowel, if harmony were not restricted in directionality. But it does not, as shown in example (29). One might ascribe this directionality effect to Positional Faithfulness, which is encoded in the division of faithfulness constraints into FAITH_{Stem} and FAITH_{Affix}, as postulated by McCarthy & Prince (1995). Bakoviæ(2000) argues for similar cases in Turkish that Positional Faithfulness is not capable to treat such instances of directionality.¹¹ This is indeed true if we consider Identity constraints only, because the underspecified affix does neither belong to the root (and as an inflectional affix nor to the stem, if we assume that only derivational affixes form new stems with the

¹⁰ Faithfulness to clitics is regulated by general Faithfulness in (28), while faithfulness to affixed forms is covered by IO-IDENT_{CorePWd}. In the remainder of this paper, clitics play no role. Therefore, IO-IDENT refers to IO-IDENT_{CorePWd} in the following, while lower ranking general faithfulness is left out of consideration for the sake of simplicity.

¹¹ Bakoviæ discusses in particular why in forms like Turkish *gel-iyor* 'coming' the medial *i* agrees in backness and roundness with the stem vowel (*gel*) and not with the opaque affix vowel *o*. The analysis developed here can be extended straightforwardly to such data.

root), nor has it any IO faithfulness to maintain. The following analysis relies crucially on the affix-stem asymmetry of another Faithfulness constraint: McCarthy & Prince (1995:372) propose the faithfulness constraint INTEGRITY to exclude an input from mapping to several outputs (as in gemination), as cited in (30).

(30) INTEGRITY — "No Breaking"

No element of S_1 has multiple correspondents in S_2 .

For $x \in S_1$ and $w, z \in S_2$, if $x \mathfrak{R}w$ and $x \mathfrak{R}z$, then $w = z$.

A basic defining element of this constraint is the notion "element". What is meant by "element" by McCarthy & Prince is in fact the "segment", but an element may also be a feature. So INTEGRITY can theoretically be extended to INTEGRITY(feature).

(31) INTEGRITY(F)

No feature of S_1 has multiple correspondents in S_2 .

With INTEGRITY separated into atomic constraints like this, one can ascribe the Yucatecan blocking effect to the ranking of INTEGRITY(F)Affix ('No affix feature has multiple correspondents') above S-IDENT, which in turn is ranked above INTEGRITY(F)Stem ('No stem feature has multiple correspondents') or general INTEGRITY. This grammar is shown at work in tableau (32).

(32) Featural integrity: *tʃuylaken* 'I might hang'

	/tʃuy+1+V _k +en/	IDENT(F)	INTEGRITY (F)Affix	S- IDENT _{[u][F]}	INTEGRITY (F)Stem	MARKEDNESS
a.	tʃuylukun	*!		*		
b.	tʃuylakan	*!				
c.	tʃuyle ₁ ke ₁ n		*!			
d.	tʃu ₁ yl ₁ ken			*!*	*	
e.	tʃu ₁ yl ₂ ken			*		*!
f.	tʃuyle ₁ ke ₂ n			*		*!
☞ g.	tʃuylaken			*		

Leftward spreading of vocalic features as in candidate (c) is ruled out by high ranking INTEGRITYAffix. The other undesired candidates lose by the mechanisms discussed above. This grammar still allows for the regressive harmony in clitic contexts, since clitics are not affixes. They require a special status, and thus are not affected by INTEGRITYAffix.

In the next section, a completely different question will be addressed: How can it be explained in a non-derivational model that the same language also displays a vocalic dissimilation pattern?

3.4 Dissimilation

In this section, I will investigate morpheme-specific dissimilation of backness or palatality in Yucatec Maya. It will be shown that dissimilation is limited in this case to a more narrow domain than harmony, in particular to that of the stem.

Vowel dissimilation is observed with only one suffix, a stem-forming derivational suffix on denominal and deadjectival verbs. The vowel of the suffix */-kV:^[+high]n/* surfaces as [u] after front

vowels and as [i] after back vowels. This is illustrated with stems containing the vowels *u*, *a* (*a* is a front vowel in Yucatec), and *i* in (33).

(33) Dissimilation of $-/kV.^{[+high]}n/$

- | | | | |
|----|-----------------|----------------------------|------------------------------|
| a. | uts-kiin-t-ik | good-D-TR-IMPF | 'enhance/repair sthg.' |
| b. | haw-kuun-t-ah | lie.down.face.up-D-TR-PERF | 'lay sthg. down face up' |
| c. | sáasil-kuun-s | le k'oʔob'en-oʔ! | 'Light up the/that kitchen!' |
| | light.up-D-CAUS | DET kitchen-DEM | |

Since the affix always occurs with a high vowel I regard height as prespecified lexically, as indicated in the notation above. The whole pattern can be described as in the following table.

(34) Dissimilation pattern:

Stem		affix	stem		affix
CiC, CeC, CaC		-kuun	CuC, CoC		-kiin

Yucatecan stems almost always end in a consonant. As this affix has an initial consonant, the result is an intervening consonant cluster in all cases. Vowel dissimilation takes place in this context, where, as we saw earlier, harmony would be blocked.

Such a dissimilation pattern may be analysed as an effect of the Obligatory Contour Principle (OCP; Leben 1973, Goldsmith 1976, McCarthy 1986). The OCP has been incorporated into OT as a Local Conjunction of Markedness constraints by Alderete (1997).

(35) *OCP effects are derived by markedness constraints, doubled in a local context.* (Alderete 1997:18) $*(\text{feature})^2L$. L = local domain, e.g. stem

This proposal suffers from several weaknesses. For example, it can perfectly account for long distance dissimilation patterns like Lyman's Law in Japanese, and also for hypothetical manner or place dissimilation of nonadjacent consonants. A different line of thought is to regard dissimilation as a principled violation of assimilation constraints, so to say *S-IDENTITY. What one gets by this move is in fact a complex markedness constraint ranging over neighbouring segmental or prosodic categories and affecting the respectively associated features.

(36) The OCP: *S-IDENTITY(F) (preliminary definition):

Let α be an entity in representation R and β be any adjacent entity in representation R, if α is $[\gamma F]$ then β is **not** $[\gamma F]$.

Entities = seg \vee mora \vee syll \vee foot

Local Domain = ?

Expressed in nontechnical terms, this constraint is violated whenever two adjacent feature specifications are the same. One can satisfy this constraint in three ways: by dissimilation, by deletion of one of the feature bearing units in question or by epenthesis of a feature bearer with opposite feature specification.

Obviously this approach to the OCP within OT is not capable of capturing the Japanese Rendaku/Lyman's Law data discussed by Alderete. This is no disadvantage at all, since Vance (1999) argues that Japanese Rendaku is idiosyncratic to such an extent that any generative account trying to capture the data as grammatical effects is bound to fail. According to Vance, the respective voicing alternations in Japanese compounds have to be stored lexically. If one accepts this, one has to admit that a theory of assimilation and dissimilation which cannot account for Japanese Rendaku fails better than one that can do so.

Now I will consider the OCP constraint at work in Yucatec Maya. As I have shown above dissimilation happens in a segmental context where harmony would be blocked. One cannot switch off mora assignment to codas for that particular morpheme. So, is dissimilation in contrast to assimilation not local? Here the locality theorem can be saved if one assumes that it is dissimilation in palatality what happens here. Above, it was postulated that palatality probably is a feature associated with the syllable instead of segments. Here we see a little piece of evidence for that claim from an unexpected direction. So the OCP active in Yucatec Maya can be formulated as follows.

(37) The palatal OCP: *S-IDENTITY σ [pal] (preliminary definition):

Let α be a syllable in representation R and β be any adjacent syllable in representation R, if α is [γ palatal] then β is **not** [γ palatal].

Local Domain = ?

Highly ranked, this constraint produces sequences of, e.g., palatal-nonpalatal-palatal-nonpalatal syllables. Unfortunately, this would override any kind of harmony. So the constraint on moraic harmony must be ranked above the OCP (S-IDENT μ _[b,h,l] >> *S-IDENT σ _{[pal]). Furthermore, there is no dissimilation of the underspecified inflectional affixes to the stem vowel when harmony is blocked. With the given ranking, exactly in this environment, then, dissimilation should apply.}

(38) Unattested overapplication of dissimilation

	/ts'íib'-n-Vk/	S-IDENT μ _[b,h,l]	*S-IDENT σ _[pal]
a.	ts'íib'-n-ik	*!(locality)	*
☠	b. ts'íib'-n-ok	✓	✓
☹	c. ts'íib'-n-ak	✓	*!

In tableau (38), the ☹ marks the actual output of the Yucatecan grammar, and the ☠ marks the output of this OT grammar. The harmonic candidate (a) fails because it violates the locality condition of S-Identity. The desired candidate (c) is ruled out for violating *S-Identity. A closer look at the morphological nature of the affixes under discussion provides the missing insight to construct an appropriate grammar: The harmonising affixes are inflectional while the dissimilating affix is derivational, i.e. stem-forming. It derives verbs out of adjectives and nouns. From this I conclude that dissimilation is locally restricted to the domain of the stem, to which inflectional affixes do not belong.

(39) *S-IDENT σ [pal]: Local Domain = stem.

(40) Nonapplication: locally restricted dissimilation

/ts'íib'-n-Vk/	S-IDENT μ [b,h,l]	*S-IDENT σ [pal] stem	MARKEDNESS
a. ts'íib']-n-ik	*!		*
b. ts'íib']-n-ok		*!	*
☞ c. ts'íib']-n-ak			

The square bracket in tableau (40) indicates the right stem boundary. Candidate (a) is rejected because it violates the locality requirement of S-IDENT, which has to go from mora to mora, while candidate (a) skips one mora. Candidate (b) has dissimilated backness values as *S-IDENT demands, but the dissimilation goes beyond the domain of this constraint, since the dissimilating affix vowel is not part of the stem. Therefore it gets a violation mark. Candidate (c) then is perfect. As mentioned already in section 3.2, inserting features for *a* does not mean incurring no markedness or DEP violation. It is only that insertion of *a* feature specifications violates only the lowest ranked markedness constraints in the Yucatecan hierarchy. Potentially the *o* in candidate (b) could be inserted without correspondence to the stem vowel. In this case it would get more grave markedness violations than *a*, because *o* is more marked than *a* in Yucatec Maya. The same holds for the second *i* in candidate (a).

This completes what we have to know about the peculiarities of the OCP constraint visible in Yucatec Maya. In the tableau below we see the grammar construed so far in action, evaluating the actually occurring dissimilative pattern.

(41) Evaluation of vowel disharmony for $/-kV^{[+high]}n/$:

/uts+kV ^[+high] n+t+ik/	IDENT[pal]	IDENT[high]	S-IDENT	*S-IDENT stem
a. its.kun]tik	*!			
b. its.kin]tik	*!			*
c. uts.kun]tuk	*!			* *
d. uts.kan]tik		*!		
e. uts.ken]tik		*!		
f. uts.kun]tik				*!
☞ g. uts.kin]tik				

In tableau (41), the first two candidates (a,b) are trivially ruled out because the stem vowel is underlyingly specified for its feature values. The emergence of the vowel *a* in the stem-forming suffix (41d) is odd, because the vowel of the first suffix underlyingly contains the feature [+high] which has to be identical to the surface form in satisfaction of IDENT[high]. This feature specification is contradictory to the feature profile of the Yucatecan unmarked vowel. The same holds for candidate (e); IDENT[high] is violated by this form. The form with identical vowels in (c) is out because both have the same backness or palatality value, which violates *S-IDENT. *S-IDENT is violated twice for extending dissimilation over the stem boundary, that is beyond the domain of *S-IDENT. Identity feature constraints have to be ranked higher than *S-IDENT in order to prevent polysyllabic stems and compounds in Yucatec Maya from undergoing dissimilation. S-IDENT, the constraint responsible for harmony, is satisfied vacuously by all candidates, because all syllables are closed by consonants.

So there are no adjacent vocalic moras. Note finally that the dissimilating suffix itself contains a long vowel, that is two adjacent vocalic moras which agree in feature specification.

This completes the analysis of Yucatec Maya vowel alternations.

3.5 Summary

I will finish section 3 with a summary of the Yucatecan grammar provided in this paper. It was shown in section 3.1 that Input-Output faithfulness has to rank above the constraint on harmony, which ranks above markedness constraints. Together with the assumption of underspecification of alternating vowels, this describes morpheme-specific harmony. Section 3.2 gave evidence for the claim that the mora is the relevant feature anchor which stands in a correspondence relation with neighbouring elements of the same type. This is the reason why the locality requirement blocks harmony when a consonant cluster stands between two vowels which should otherwise harmonise. In 3.3, empirical evidence was given that harmony is not progressive per se, and directionality effects were explained by the ranking of INTEGRITY(F)Affix above S-IDENT and general INTEGRITY or INTEGRITY(F)Stem. The latter has to be ranked below S-IDENT to derive any harmony effect at all. The constraint on dissimilation was defined over the syllable as the relevant anchor for the feature palatality in section 3.4. Its scope was defined as holding only over the domain of the stem, whereas the harmony constraint has a larger scope, i.e. the Prosodic Word. Furthermore, S-IDENT ranks crucially above *S-IDENT. This explains why in blocking environments no dissimilation of underspecified inflectional suffixes is observed. The complete ranking is given in (42).

(42) Yucatec Maya ranking:

$$\begin{aligned} & \text{MAXIO, IDENTIO, INTEGRITY(F)Affix} \gg \text{S-IDENT}_{\mu[\text{b,h,l}]\text{PWd}} \gg \\ & \quad * \text{S-IDENT}_{\sigma[\text{pal}]\text{stem}} \gg \text{INTEGRITY(F), MARKEDNESS} \end{aligned}$$

4 Comparison with other OT approaches to harmony

In the preceding sections, a correspondence approach to vowel harmony was developed and applied to vocalic alternations in Yucatec Maya. The question remains why one should prefer this account over other well-established theoretical devices to handle such data. This will be discussed in the following. I will not discuss shorthand constraints like HARMONY (Inkelas 1994), SPREAD[feature] (Kaun 1994), which certainly are meant only as place holders for more elaborated technical devices. Otherwise they would inflate the system of constraint families, and such an enrichment of theoretic tools should be avoided if possible. Within OT there are two main streams with regard to the analysis of vowel harmony: the Alignment approach (Kirchner 1993 and many others) and the Positional Faithfulness approach (Beckmann 1997).

4.1 Alignment

The Yucatecan vowel harmony does not pose an empirical problem for the alignment approach to vowel harmony as developed by Kirchner (1993), Cole & Kisseberth (1994), Pulleyblank et al (1995), Ringen & Vago (1995), Padgett (1995), Pulleyblank (1996) and others. In this approach, it is assumed that certain constraints of the Alignment family (McCarthy & Prince 1993) demand that the edges of certain features coincide with the edges of other phonological or morphological categories like 'stem' or 'word'. The major problems of an alignment approach are of theoretical

nature: There is no intrinsic ban against long distance consonantal feature assimilation. Goad (1996, 1997) presents an alignment analysis of consonantal place harmony in child language. In her conclusion, Goad addresses the question why long distance consonant harmony is not found in adult speech, but she has to leave this issue open.¹² The only possible explanation would be to assume a universal ranking for adult grammars of LOCALITY or NOGAP (Padgett 1995, Pulleyblank 1996) higher than ALIGNL/R(feature, P-Cat) ('the left/right edge of every feature span F coincides with the left/right edge of a phonological category P'). However, long distance phenomena among consonants always involve complete copying of all features of a segment in adult language. This led Gafos (1998) to a convincing analysis in terms of reduplication for consonantal copying.

Under the assumptions made so far, dispensing with traditional planar segregation (i.e. different consonantal and vocalic tiers in the feature geometric sense), vowel harmony automatically skips consonants because it goes from mora to mora, while consonantal harmony cannot permeate through vowels, which by their vocalic nature do not bear consonantal features. An Identity relation can only be established between features that are already salient. Consonantal features are not salient on vowels, so corresponding consonantal features in a CVCV string would violate the locality requirement. With such a theory of assimilation, it is not necessary to assume something like a "bottleneck effect" (Ní Chiosáin & Padgett 1997). Arguments against Ní Chiosáin & Padgett's account also come from the simple fact that not only place and roundness features but also height features participate in assimilatory long distance phenomena. Height harmonies are observed in several languages (see Goad 1993, Beckman 1997 and many others), and total harmonies are attested at least in Ainu (Dettmer 1989, Îto 1984), Mazahua (Spotts 1953), and Mayan. Even though rounding might be coarticulated on consonants, it is doubtful whether this is of any phonological relevance. For height features, it may be physically impossible to let the tongue remain in a certain position while articulating the intervening consonant (if it is not accidentally one which is articulated without tongue involvement, e.g., a labial or glottal stop). Another point is that the number of intervening consonants is relevant, as was shown above.

Another drawback of the Alignment analysis as well as of rule based solutions is the intrinsic directionality of assimilation which is inherent to them. Nondirectionality of assimilation seems to be the rule rather than the exception. Clements and Sezer (1982) have shown that Turkish vowel harmony is bidirectional, too. Another well known example is the bidirectionality of voicing assimilation as is observed in Dutch for example (see Grijzenhout & Krämer 1998).¹³ A rule or constraint containing the direction of assimilation like $X \rightarrow [\alpha F] / _ Y [\alpha F]$ or ALIGNLeft/Right(feature, P/M-Cat) does not adequately cover such data, unless it has a mirror image counterpart. Therefore, Kirchner (1993) had to assume two constraints ALIGNRight(feature, word) and ALIGNLeft(feature, word) to cover the nondirectional nature of Turkish vowel harmony. Rule-based approaches to laryngeal assimilation had to write additional unintuitive rules. If assimilation is seen as a transitive Identity relation among elements within the same representational string, the theoretical expenditure is reduced.

Additional arguments against an Alignment analysis can be found in Beckman (1997). She proposes alternatively to capture vowel harmony solely by Positional Faithfulness and Markedness

¹² In fact Goad assumes the reason for this to lie outside of grammar.

¹³ See also the discussion of the directionality issue in Bakovian (2000) and references cited there.

constraints. This approach has its own benefits and disadvantages as is discussed in the next subsection.

4.2 Positional Faithfulness

Beckman (1997) proposes to analyse vowel harmony as an effect of the interaction of Positional Faithfulness with Markedness. Positional Faithfulness guarantees that the underlying specification of a vowel triggers harmony (for instance, the one in the first syllable of a word). Markedness militates against the realisation of feature specifications in other, non-prominent positions. On the one hand, the account is rather appealing since a) it implies a typology of vowel harmony, because harmony effects are directly related to the markedness hierarchy, and b) it describes harmony as an effect of the interaction of independently motivated constraints, without reliance to a specific harmony constraint.

On the other hand, this account cannot capture the consonantal blocking effect observed in Yucatec Maya. This would require a modification of Beckman's assumption on the structural organisation of features and the introduction of a (potentially rankable and violable) constraint on Locality of feature association. Nor can Beckman explain why vowel harmony stops at certain boundaries. She would have to assume that words are evaluated in isolation and not in whole utterances or phrases. Under this premise, however, phenomena which apply in larger domains, like that of the prosodic phrase, become problematic. Another difficulty arises with the regressive harmony in clitic clusters in Yucatec Maya. The Positional Faithfulness account would predict that the clitic cluster acquires the feature specifications of the initial syllable of the stem, which is not the case. Thus, I conclude that Syntagmatic Correspondence is needed in addition.

5 Conclusion

In this paper, I have given arguments for analyzing assimilation as correspondence. Evidence for this theoretical assumption comes from several sources: The apparent nondirectionality of featural assimilation like palatal and labial vowel harmony in Turkish or nasal place assimilation in German, to name only two examples in addition to the Yucatecan phenomenon, is a challenge for directional rule based or constraint based Alignment approaches. It can be expressed adequately by the transitivity of featural Identity relations as provided by Standard Correspondence Theory if these are extended to Syntagmatic Identity. Correspondence intrinsically provides us with an explanation of locality effects like blocking of vowel harmony by coda consonants, because a rather abstract notion of Locality is incorporated into the definition of Correspondence already. There are no intermediate representations allowed between two corresponding elements in whatever dimension of correspondence. This only had to be spelled out more expressively. In the understanding of phonological feature interaction developed here the notion of 'domain' plays two crucial roles: On the one hand, it is assumed that phonological features are associated with prosodic domains or – better – with categories, instead of exclusively relying on feature nodes. On the other hand, it is to be noted that (besides stress and syllabification) harmonising features group together words to utterances or phrases, syllables or moras to words and segments to syllables. That is, assimilation has an integrative domain identifying function. This assumption makes sense if one takes into consideration that linguistic structures are in fact redundant and that the structuring of information is very important for the task of perception/understanding. Besides this prosodic/syntactic grouping it is also important to maintain the identity of morphological atoms of which larger units are composed, therefore

dissimilation and IO-Faithfulness are constrained to morphological domains. We have on one side categories to which features are associated, and on the other side domains to which Syntagmatic Identity, IO-Faithfulness and OCP constraints are limited. It might be noted that with the device of Positional Faithfulness not only the preferred direction of harmony can be modelled adequately. Additionally, effects which were ascribed to different levels (i.e., dissimilation on the stem level vs. assimilation on the word level of derivation) or Base-Output Correspondence (Benua 1995, 1997, Kenstowicz 1996) can be explained by Positional Faithfulness without reference to such powerful devices. To illustrate the latter: the blocking of leftward harmony in forms like *tʃuylaken* 'I might hang' (where the quality of *a* is an effect of harmony blocking) may also be explained by a stipulated Output-Output correspondence relation of this complex form with the simpler form *tʃuylak* 's/he might hang'.

One side effect of the view of assimilation provided in this paper is that dissimilation or dissimilatory OCP effects can be described as the Markedness correlate to Syntagmatic Correspondence. As outlined above this has some advantage to the theory of the OCP available within OT so far, in that it is more restrictive.

A second side effect of the investigation made in this paper are arguments for archephonemic underspecification (Inkelas 1994, Inkelas, Orgun & Zoll 1997). As argued by Inkelas, alternating structure is taken to be underspecified, and nonalternating structure as specified in underlying forms due to Lexicon Optimization (Prince & Smolensky 1993). Without this premise, the morpheme-specific harmonies explored here would have to be explained by the assumption of different constraint rankings for individual morphemes, or by different rankings on different levels of evaluation. These questionable moves have been avoided in this analysis and the fully parallelist architecture of Optimality Theory has been maintained.

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