Abstract: Crossing morpheme boundaries in Dutch

On the basis of Dutch data, this article argues that many differences between types of affixes which are usually described by arbitrary morphological diacritics in the literature, can be made to follow from the phonological shape of affixes. Two cases are studied in some detail: the difference between prefixes and suffixes, and differences between 'cohering' and 'noncohering' suffixes.

Prefixes in many languages of the world behave as prosodically more independent than suffixes with respect to syllabification: the former usually do not integrate with the stem, whereas the latter do. Dutch is an example of a language to which this applies. It is argued that this asymmetry does not have to be stipulated, but can be made to follow from the fact that the phonotactic reason for crossing a morpheme boundary usually involves the creation of an onset, which is on the left-hand side of a vowel and not on its right-hand side, plus some general (symmetric) conditions on the interface between phonology and morphology.

The differences between 'cohering' and 'noncohering' suffixes with respect to syllable structure and stress in Dutch is argued to similarly follow from the phonological shape of these affixes. Once we have set up an appropriately sophisticated structure for every affix, there is no need any more to stipulate arbitrary morphological markings: differences in phonological behaviour follow from differences in phonological shape alone, given a sufficiently precise theory of universal constraint and their interactions.

Keywords: Dutch phonology, phonology-morphology interface, prosody

Crossing Morpheme Boundaries in Dutch

1. Introduction

Asymmetries in phonological behaviour between types of affixes are not uncommon in languages of the world.[1] For instance, prefixes in a given language may behave quite differently from suffixes. Particular classes of suffixes (or prefixes) may show different types of behaviour as well. For many Germanic languages, it has been claimed that we should distinguish between so-called Class I and Class II suffixes (or between morpheme boundaries + and #, or between lexical levels I and II, or between 'cohering' and 'non-cohering' suffixes). In many cases, the two classes of suffix have completely different shapes. For instance, Class I suffixes are typically vowel-initial and at most monosyllabic, whereas Class II suffixes often are consonant-initial and have more material than fits in one syllable. The issue arises whether we should set up morpheme structure constraints to account for these differences, or we should rather derive the morphological status from the phonological form.

The goal of this article is to show that morphological diacritics are mostly unnecessary in the phonology of Dutch. Differences in phonological behaviour of different morphemes can be derived from the underlying phonological shape of these morphemes, provided we have a theory of violable constraint interaction such as Optimality Theory.

One particular difference between prefixes and suffixes is their respective behaviour in

[1] This paper has benifitted from comments by Geert Booij, Ben Hermans, Markus Hiller and an anonymous reviewer. All usual disclaimers apply.

syllabification. In this article, it is argued that this difference can be reduced to an inherent asymmetry in syllable structure: the fact that onsets appear on the left-hand side of the vowels heading syllables, not on their right-hand side. The data will be taken primarily from Dutch, but similar facts can be found in languages as diverse as Italian (Nespor and Vogel 1986, Peperkamp 1997, Krämer 2003b), Kihehe (Odden and Odden 1985) and Indonesian (Cohn 1989, Cohn and McCarthy 1998). The difference between Class I and Class II suffixes, similarly, follows from the fact that suffixes in the former class all start with a vowel, while those in the second class start with a consonant. This morphological distinction furthermore is problematic in the sense that there is a class of suffixes that behave as members of Class I according to one criterion and as members of Class II for other criteria. It will be argued that also this 'paradoxical' behaviour can be derived from the phonological shape of these suffixes.

In order to get these results, we will have to make a few assumptions which are not uncommon in the literature. First, we have to assume that every syllable has a head, which is most typically a vowel. Second, we have to accept the idea that there are no language-specific constraints, all conditions on well-formedness are universal, be it that they are ranked on a language-specific basis; there is no notion of 'inherent' or 'universal' ranking in the approach developed here. A lot of theoretical apparatus becomes obsolete, once we take these assumptions seriously.

2. Asymmetries between prefixes and suffixes

Before laying out the theoretical apparatus in full, we will first turn to one set of examples illustrating the topic of interest: syllabification across morpheme boundaries. Tautomorphemic sequences of a consonant and a vowel in Dutch are syllabified together (1a), as might be universally the case (cf. Piggott 2002 for recent discussion). The same happens if the consonant is at the end of a stem and the vowel is initial in the following suffix (1b). However, the picture changes if the consonant belongs to a prefix and the following vowel to another prefix or to a stem. In this case, the syllable boundary will fall between the consonant and the vowel (1c).

(1) a. *ode* [o.də] 'ode'

b. *er*+*en* [e.rən] 'to honour' (=honour+INF)

c. *ont*+*eer* [ɔnt.er] 'dishonour' (=dis+honour)

Two slightly more complicated examples of the same discrepancy between morphological and phonological structure can be found in (2) and (3) below:

(2) a. **morphology:** [[*ont*- [*er*]] -*en*]
dis honour INF

b. **phonology:** ɔnt.e.rən

(3) a. **morphology:** [*on-* [[*en*] *-ig*]]

un- one -y

'disagreeing'

b. **phonology:** on.e.nɪx

The examples in (2) and (3) consist of a prefix, a root and a suffix. The syllable boundary always coincides with the boundary between prefix and root, whereas syllables can cross the boundary between root and suffix, if this is necessary to acquire an onset. Together, the two examples show that the order in which the affixes are added is irrelevant. The fact that (2a) is derived by suffixation to the prefixed form *ont+eer* 'dishonour', or that (3) is derived by suffixation to the prefixed form *enig* 'agreeing', does not change the strength of the respective syllable boundaries. The only morphological distinction that seems to matter, is the one between prefixes and suffixes.

Another morphological property that seems irrelevant is *headedness*. The Dutch prefix *ont-*, for instance, counts as a morphological head according to the usual criterion: it determines the categorial status of the derived form (it is a verbalizing suffix). Yet the phonological behaviour of *ont-* does not differ from that of the prefix *on-*, which does not behave as a morphological head at all. Similarly, derivational suffixes such as *-ig* are not significantly different from the inflectional suffixes *-en, -em, -e,* etc. in their syllable attracting behaviour, even though the former, but not the latter, count as heads from a morphological point of view.[2]

[2] Cf. Van Oostendorp (2002) for arguments that morphological headedness interacts with the assignment of stress in a different way.

It should be noted that the syllable boundaries assigned here do not just correspond to native speakers' judgments, but they also have a clear effect on phonological alternations that are dependent on syllabification. The most important one of these is a schwa-zero alternation found in Dutch, and exemplified in (4) and (5) below:

(4)	*elite*	*elite+air*(Dutch)
	[e.li.tə]	[e.li.tɛr]/*[e.li.tə.ɛːr]
	'elite'	'snobbish'
(5)	*adem*	*be+adem* (Dutch)
	[a.dəm]	[bə.a.dəm]/*[ba.dəm]
	'breathe'	'breathe upon'

In Dutch monomorphemic forms we never find a schwa immediately preceding another vowel. This restriction can be understood as a result of syllable optimization: schwa as a vowel has minimal feature content so that we may assume that it can be deleted relatively easily; it does not have a lot of underlying features that surface structure should faithfully reflect. In particular, we may assume that the faithfulness requirements demanding schwa to surface (Van Oostendorp 2000, Alderete 2001) are ranked below the constraint ONSET. This can be observed in the derivation of the following (hypothetical) underlying form /məɑn/:

(6) /məɑn/	ONSET	KEEP-ə
mə.ɑn	*!	
☞mɑn		*

In affixed forms we find again an asymmetry between prefixes and suffixes, as can be seen in (4) and (5). This asymmetry can be reduced to the syllable structure asymmetry we have just analyzed. The schwa cannot be deleted if it ends a prefix, because the resulting surface syllable would cross a prefix-stem boundary, but the schwa at the end of a suffix can be deleted under the appropriate circumstances, because syllabification over a stem-suffix boundary is not blocked.

In terms of OT, we could say that there is a constraint that blocks syllabification over a prefix-stem boundary, but not over a stem-suffix boundary. Let us provisionally call this constraint *PREFIXSYLL; we will return to its precise formulation below.

This constraint should be responsible for both the syllabification effect and the schwa deletion effect (for reasons of clarity, roots are set in bold face in inputs):

(7)

a./ɔnt+**er**/	*PREFIXSYLL	ONSET
☞ɔnt.er		*
ɔn.ter	*!	

b./**er**+ən/	*PREFIXSYLL	ONSET
er.ən		*!
☞e.rən		

c./bə +**adəm**/	*PREFIXSYLL	ONSET	KEEP-ə
☞bə.a.dəm		*	
ba.dəm	*!		*

d./**elitə**+ɛːr/	*PREFIXSYLL	ONSET	KEEP-ə
e.li.tə.ɛːr		*!	
☞e.li.tɛːr			*

The combination of stem plus suffix thus is phonologically indistinguishable from a monomorphemic form. A prefix, on the other hand, seems to behave as a prosodically independent unit. We can find various descriptions of the phenomena involved in the

literature: it has been suggested for instance that prefixes are always attached later in the derivation than suffixes, and to be more precise, after syllabification has applied (e.g. Booij 1981); that prefixes are specified in the lexicon with an underlying prosodic word (e.g. Van der Hulst 1984); or that prefixes are always adjoined to the phonological word by definition (e.g. Booij 1995). Neither of these solutions can be counted conclusive, especially in light of the fact that the type of asymmetry attested here is found in other languages of the world (such as the ones already mentioned: Kihehe, German, Indonesian, Italian). On the other hand, as far as we know there is no language in which the mirror image effect is attested and in which suffixes behave as more independent domains with respect to syllabification than prefixes.

The same problem arises in the OT analysis just sketched, at least as long as we do not have a satisfactory account of the precise nature of the constraint *PREFIXSYLL: as it stands now, we cannot account for the fact why natural language does not have a similar constraint *SUFFIXSYLL. The latter point is relevant for the treatment McCarthy and Prince (1993b) give to these facts. They formalize *PREFIXSYLL as an Alignment constraint (8) and give the tableaux in (7a) and (7b), modified accordingly.

(8) ALIGN-LEFT: $[_{X0} = (_{PrWd}$

This constraint says that the left boundary of every X0 (i.e. every morphological word) should correspond to the left boundary of a phonological word. This constraint is therefore satisfied whenever a stem and a preceding prefix are in separate phonological words, but does not have anything to say about the boundaries between stems and suffixes. Alignment theory does not exclude the possibility of the symmetrical counterpart of this

constraint, ALIGN-RIGHT (cf. Bye and DeLacy 2000, Krämer 2003). Alignment constraints can refer to the right edges of words just as much as to their left edges. In effect, McCarthy and Prince (1993b) suggest that ALIGN-RIGHT has a role in the grammar as well, be it that its formulation is somewhat weaker than that of ALIGN-LEFT: it refers to the edge of a syllable rather than to the edge of a Prosodic Word:

(9) ALIGN-RIGHT: $]_{X0} =)_{\sigma}$

The problem with this analysis is that it overgenerates. We now have three constraints (ONSET, ALIGN-LEFT, ALIGN-RIGHT) which could be ranked in four distinguishable ways:

(10) a. ALIGN-LEFT » ONSET » ALIGN-RIGHT

b. ALIGN-LEFT, ALIGN-RIGHT » ONSET

c. ALIGN-RIGHT » ONSET » ALIGN-LEFT

d. ONSET » ALIGN-RIGHT, ALIGN-LEFT

Ranking (10a) gives us languages like German and Dutch. Rankings (10b) and (10d) give us languages in which we can find no difference between prefixes and suffixes at all: in a language which has ranking (10b) both prefixes and suffixes behave as independent from the stem, and in a language with (10d) both types of affix are incorporated into the stem. we will not go into the question of whether these systems are actually attested, but the approach outlined below makes the same predictions. An important problem with this set of constraints however is ranking (10c). A grammar including this ranking would allow prefix-stem boundaries to be crossed by syllables, but not stem-suffix boundaries. This

type of language does not exist, as we have just seen, and thus this result is undesirable. McCarthy and Prince (1993b) acknowledge this problem, and in a footnote they suggest that there is a universal metaconstraint to the effect that ALIGN-LEFT is ranked over ALIGN-RIGHT. Of course, this metaconstraint itself is hardly more than a stipulation. McCarthy and Prince refer to psycholinguistics for an explanation: since it is well-known that listeners pay more attention to the beginning of words than to their ends, it is more effective to try to keep the left edges of words clean than their right-hand edges.

Several things can be said about this argument. First, it is not at all clear how this psycholinguistic argument — assuming for a moment that it is true — would give us this ranking. Suppose it is clear indeed that left edges of words ought to be respected: this observation could then be translated into the constraint ALIGN-LEFT. Yet ALIGN-LEFT can be violated in languages of the world, viz. in those languages in which prefixes *are* incorporated into the prosodic structure of the stem. From which psycholinguistic fact does it now follow that in these languages the right edges of words should also not be respected? Furthermore, from the psycholinguistic observation that the left edges of words ought to be respected, it does not follow directly that prefixes should behave differently from suffixes. For instance (derivational) suffixes often behave like morphological heads, which means that they contain categorial and other information that is crucial to the interpretation of the word and the sentence. From this one fact one could draw the conclusion that suffixes should be as clearly distinguished from the stem as possible, whereas for prefixes, which often do not enjoy this head status, this is less relevant. Apparently this observation does not help to explain the actual state of affairs in phonology, however.

An alternative explanation for this asymmetry is suggested by Bye and De Lacy (2000),

who argue that constraints referring to the right edge of constituents should simply be eliminated from the grammar. Once again, such a scenario (if at all viable, see Krämer 2003a) does not really address the issue why there would be a difference between left edges and right edges. The asymmetry is simply stipulated and built into the grammar. In the following section an alternative explanation for the types of asymmetries observed here is proposed, which does not rely on any presumed property of the human parser. If there is any relation at all, we might as well suppose that the parser works the way it does, because the linguistic structures happen to be the way they are.

3. Phonological integrity

We assume that every syllable has a head, which is a typically vowel, although under certain circumstances also consonants may serve as a syllable head in some languages. In any case, the head is the most sonorous segment of the syllable. Our second assumption is that instead of directional Alignment constraints on the morphological interface, we have the constraint PR=LEX (Prince and Smolensky 1993) which demands that the edges of morphological constituents should coincide with those of prosodic constituents and vice versa, without stipulating a difference between left and right boundaries:

(11) PR=LEX:

Morpheme boundaries should coincide with the boundaries of prosodic constituents (i.e. a phonological word).

In essence, PR=LEX is a symmetrical version of asymmetrical ALIGN-LEFT and ALIGN-RIGHT;

like these constraints, it bans boundaries that do not coöccur. Unlike these, it does not distinguish between the left-hand side of the word and the right-hand side of the word. It does not need to, because its effects are already as desired, if it is ranked appropriately, as we will show below. In the analysis of Dutch word-stress below, an asymmetric constraint ALIGN-RIGHT will be used, but only in the context of aligning prosodic structure to other prosodic structure. Our claim is that even though purely phonological constraints on foot placement and the like can potentially refer to left and right edges of words, constraints on the interface between phonology and morphology cannot. A reason for this may be that the notions 'left' and 'right' are relevant only for phonology, not so much for morphology or syntax, in which other notions, such as hierarchy and embedding, play a role.

A last assumption is that phonological segments have a morphological domain. Typically, this is the smallest morphological word to which they belong. We will demonstrate this on the example *onteren* 'to dishonour' in Dutch. This word consists of a nominal stem *eer*, a verbalizing prefix *ont-* and an inflectional suffix *-en:*

(12) $[_V[_V$ɔnt $[_N$**er**$]_N]_V$ ən$]_N$

The square brackets in this example indicate the boundaries of words: *eer* can act as an independent word, and so can *onteer* and *onteren* (the fact that *eer* is written with only one <e> in the latter form, is a caprice of Dutch orthography). Let us now consider the phonological domains of each of the three vowels. The /e/ in the stem *eer* has this stem as its morphological domain, since this is the smallest potentially independent word in which it appears. The vowel /ɔ/ in the prefix has the derived form *onteer* as its domain, since the

prefix is not a word in its own right. Finally, the schwa in the suffix has the whole word *onteren* as its domain, since this is the smallest independent word in which it occurs. Slightly more formally we can now define the notion *morphological domain* in the following way:

(13) The **morphological domain** of a segment S is the smallest morphological word in which S occurs.

Next, we can define the morphological domain of syllables. Since syllables are headed, we can do this in terms of segment domains:

(14) The **morphological domain** of a syllable T is the morphological domain of the segment heading T.

Thus, in the example above, the domain of the syllable headed by /e/ is *eer*, the domain of the syllable headed by /ɔ/ is *onteer* (since *ont-* is not a separate word), the domain of the syllable headed by schwa is *onteren*. With this theoretical apparatus set up, we can now propose a formalization for the constraint which can play the role of *PREFIXSYLL. We will call this constraint MS-INTEGRITY:[3]

(15) **Morphological syllable integrity** (MS-INTEGRITY):

[3] The representational approach to the phonology-morphology interface can in some ways be seen as kindred in spirit to Harris' (1993) derivational approach to similar asymmetries in Catalan and Spanish. This is reflected in the name of the

All segments in a syllable should be in the same domain as that syllable.

∀ segment S: ∀ syllable T dominating S:

the morphological domain of S ≤ the morphological domain of T.

This constraint says, roughly, that all segments within a syllable should be in the same (smallest) word as the head of that syllable. To see how this works, consider once again our example *onteren*. The domain of the second vowel /e/ is the root, therefore all the segments in the syllable headed by this vowel should be in the root *eer*. The /t/ of the prefix is outside of this domain, therefore the syllabification **on-teren* is not allowed. The domain of the schwa vowel in the suffix, on the other hand, is the whole word. The /r/ at the end of the root obviously is within this domain and therefore the syllabification *onte-ren* is allowed by INTEGRITY. In constraint tableaux (irrelevant morpheme boundaries have been omitted in (16) and (17)):

(16) [ɔn [en ix]]	MS-INTEGRITY	ONSET
☞[ɔn.[e.nix]		**
[ɔ.[ne.nix]]	*!	*

contraints.

(17) [[ɔnter]ən]	MS-INTEGRITY	ONSET
[[ɔnt.er].ən]		**!
☞[[ɔnt.er]ən]		*

Alignment is irrelevant in the cases at hand, and we may therefore assume that PR=LEX is ranked below the Onset constraint. In all, we have three constraints, which may be ranked in the following three distinguishable ways:[4]

(18) a. MS-INTEGRITY » ONSET » PR=LEX

b. PR=LEX » ONSET (ranking of MS-INTEGRITY irrelevant)

c. ONSET » PR=LEX,MS-INTEGRITY

The grammar in (18a) gives us the Dutch and German facts; the grammar of (18b) gives a language in which both prefixes and suffixes are separated from the stem; (18c), finally is a language in which both prefixes and suffixes are incorporated into the syllable structure of the stem. A language in which suffixes behave as more separate from the stem than prefixes, cannot be generated, as expected.

[4] The reason why three constraints give only three distinguishable rankings is Panini's Theorem: technically, MS-INTEGRITY is more specific than PR=LEX (all candidates violating the former will also violate the latter, but not vice versa). Hence, with high-ranking PR=LEX, MS-INTEGRITY becomes 'invisible'. Further, if ONSET in inviolable, the ranking of the two Paninian competitors becomes irrelevant as well (since ONSET will force violation of both constraints at the same time).

4. An extension of MS-INTEGRITY: Lexical levels in Dutch

Following the original proposals of Booij (1977), most phonologists have assumed that there are two types of Dutch suffixes: 'Class I' suffixes and 'Class II' suffixes in the original terminology. The following lists are copied from Booij (1977):

(19) *Class I*

-aal /al/, *-aan* /an/, *-age* /aʒe/, *-air* /ɛːr/, *-ast* /ɑst/, *-eel* /el/, *-eer* /ɪːr/, *-ees* /es/, *-egge* /ɛɢə/, *-ein* /ɛin/, *-erig* / ərɪx /, *erij* /ərɛi/, *-es* /ɛs/, *-esk* /ɛsk/, *-eur* /œːr/, *-eus* /øs/, *-iaan* /ijan/, *-ide* /idə/, *-ief* /if/, *-iek* /ik/, *-iet* /it/, *-ieus* /ijøs/, *-in* /ɪn/, *-iseer* /isɪːr/, *-isme* /ɪsmə/, *-ist* /ɪst/, *-iteit* /itɛit/, *-ei* /ɛi/

(20) *Class II*

-achtig /ɑxtɪx/, *-loos* /los/, *-ling* /lɪŋ/, *-baar* /baːr/, *-dom* /dɔm/, *-heid* /hɛit/, *-nis* /nɪs/, *-schap* /sxɑp/

At least three phonological differences are supposed to be related to the distinction between Class I and Class II suffixation. One of these has to do with stress and we will return to this in section 7; the other two criteria are the by now familiar syllabification and schwa deletion, which apply across the boundary between a stem and a Class I suffix, but not across a Class II boundary:

(21) *Syllabification*

a. /mohɑmɛd/ + /an/ -> [mo.hɑm.mə.dan] (*[mo.hɑm.mɛt.an]) 'Mohammedan'

b. /hɑlv/+/lɪŋ/ -> *[hɑl.vlɪŋ] ([hɑlf.lɪŋ]) 'hobbit' (litt. half-PERSON)

(22) *Schwa deletion*

a./sinodə / + /al/ -> [sinodal] (*[sinodəal]) 'synodal'

b. /wardə/ + /los/ -> *[wartlos] ([wardəlos]) 'worthless'

We can see that no resyllabification has applied in (21a) because the stem-final /v/ is devoiced: final devoicing does not normally apply to obstruents in the onset of a syllable. Since prefixes trigger neither resyllabification nor schwa deletion, Booij (1981, 2002) assumes that all Dutch prefixes belong to Class II inherently. We have seen above that this somewhat arbitrary stipulation is no longer necessary if we adopt MS-INTEGRITY. Similarly, it seems that the distinction is superfluous for almost all of the suffixes as well. Since all Class I suffixes start with a vowel we get the desired result from the constraint ranking immediately, as we have in fact seen above:

(23) [[**mohɑmmɛd**]an]	MS-INTEGRITY	ONSET
☞[[mo.hɑm.mɛ.d]an]		
[[mo.hɑm.mɛt.]an]		*!

For most consonant-initial suffixes, the miniature grammar developed until now also gives

the correct output, but vacuously so, since both MS-INTEGRITY and ONSET are irrelevant:

(24) /**vœyl**/+/nɪs/ 'garbage' ('dirt'+NOM)	MS-INTEGRITY	ONSET
☞[vœy.lnɪs]		
☞[vœyl.nɪs]		

In the case of *vuilnis*, the cluster /ln/ is not even a potential syllable onset in Dutch so that we do not have to worry about the fact that we cannot distinguish between these two syllabifications in terms of alignment between morphological and phonological structure. If a suffix starts with a liquid (*-loos*, *-ling*), and the preceding stem ends in an obstruent, a potentially ambiguous situation arises. The word *werkloos* 'idle' (litt. 'work-less') could be syllabified either as *werk.loos* (respecting the boundary between stem and suffix) or as *wer.kloos* (satisfying the maximal onset condition).

The former option is actually chosen, and Booij (1977) takes this as evidence for his claim that consonant-initial suffixes belong to Class II: the syllabification rules of Class I do not apply in *werkloos* as they do in *mohammedaan,* therefore the two suffixes should be different. In the framework presented here, however, this line of reasoning does not hold. There is no single 'process' or 'rule' which syllabifies consonants into onset positions. Rather, there are several independent wellformedness constraints on the syllabified output structure. One such constraint is ONSET, but this is irrelevant in the case of *werkloos*, because it does not select between the two competing candidates:

(25) /**ʊɛrk**/+/los/	MS-INTEGRITY	ONSET
☞ [[ʊer.k]los]		
☞ [[ʊɛrk].los]		

Yet there is another syllabification constraint which is relevant. We will provisionally call this constraint *Syllable Contact* (Vennemann 1988) and formulate it as follows:

(26) *Syllable Contact* (SC)

*Ci.Cj, where Ci is less sonorous than Cj.

This constraint is normally undominated in Dutch, giving syllabifications such as [ta.blo] rather than [tɑp.lo] for *tableau*. Yet it cannot be undominated in this case, because this would give us the incorrect results:

(27) /**ʊɛrk**/+/los/	SC
☞ [[ʊer.k]los]	
[[ʊɛrk].los]	*!

We therefore need to find a constraint that can dominate SC. We have already seen this constraint above: PR=LEX:

(28) /**ʊɛrk**/+/los/	PR=LEX	SC
[[ʊer.k]los]	*!	
☞ [[ʊɛrk].los]		*

We should now establish the relative order between the two subrankings MS-INTEGRITY » ONSET and PR=LEX » SC. The order between ONSET and PR=LEX is readily established: once we have another look at the vowel-initial suffixes we see that ONSET should dominate PR=LEX:

(29) /**er**/+/ ən/	ONSET	PR=LEX
☞ [[e.r]ən]		*
[[er]. ən]	*!	

The rest of the ordering follows by transitivity. We have therefore established the following constraint ranking for Dutch:

(30) MS-INTEGRITY » ONSET » PR=LEX » SC » KEEP-ə

5. The suffix *-achtig*

There is now one suffix left which is problematic for the account presented here. This is *-achtig* '-like'. The problem with this is that it seems to be the only vowel-initial suffix which does not belong to level I. It does not trigger resyllabification (31a) or schwa deletion (31b).

(31) a. *roodachtig* 'reddish' [rot.ɑx.tɪx, *ro.dɑx.tɪx][5]

b. *oranjeachtig* 'orange-like' [o.rɑn.jə.ɑx.tɪx, *o.rɑn.jɑx.tɪx]

There are several ways to solve this problem. A first approach is to assume that *-achtig* is lexically prespecified as a foot (or a prosodic word). A special type of faithfulness constraint (32) might then be held responsible for the lack of resyllabification:

(32) FAITHFULFOOT:

If a surface foot F_i corresponds to an underlying foot F_j, all segments in F_i should be present in F_j.

[5] I denote the final vowel in this case with an /ɪ/, but it may be pronounced with a schwa as well; on the interchangeability of schwa and ɪ before ŋ, see section 10.1.

(33) /**rod**/+/ɑxtɪx/	FAITHFULFOOT	ONSET
☞ (rot)(ɑxtɪx)		*
(ro)(tɑxtɪx)	*!	

Yet there is a theory-internal technical problem with this. There are arguments to assume that we need to specify underlying metrical structure for certain 'Class I' suffixes, such as the feminine suffix *-in*, which bears exceptional stress. A word like *bazin* 'female boss' would be stressed on the prefinal syllable [bázin] if it followed the default stress rules of Dutch, but in actual fact stress always falls on this suffix. It can be argued that the best way to describe this is to assume that *-in* gets assigned a lexical stress, i.e. an underlying foot (cf. the discussion of stress in sections 6 and 7). The problem now is that *-in* clearly is a 'Class I' suffix; *bazin* is syllabified as [ba.zɪn] and therefore FAITHFULFOOT cannot be operative here, in this word the way it is supposed to work in (33). As far as we can see, there is no non-arbitrary way to amend this problem.

An alternative approach assumes that *-achtig* has an underlying initial consonant like all (other) Class II suffixes. An obvious candidate for this would be the glottal stop which is also present on the phonetic surface. Furthermore, Dutch phonology gives us more reasons to posit such a segment in the phonology, as we will briefly see in section 6.

The advantage of this assumption is that the facts about *-achtig* now follow without any stipulation, because this suffix has the same phonological shape as *-loos* in all relevant respects:

(34) **rod** + ʔɑxtɪx	MS-INTEGRITY	ONSET	PR=LEX
a. [[ro.d]ʔɑxtɪx]			*!
☞ b. [[rot.]ʔɑxtɪx]			

Both candidates fare equally well with respect to these two constraints. Therefore, there are other constraints that decide between the two. PR=LEX is one such constraint, but onset clusters of an obstruent followed by a glottal stop are also never found in Dutch. The constraint responsible for this, will naturally select candidate (b) in the table above. A similar explanation holds for the derivation of *oranjeachtig*:

(35) **oranjə** +ɑxtɪx	MS-INTEGRITY	ONSET	PR=LEX
a. [[o.rɑn..j]ʔɑx.tɪx]			*!
☞b.[[o.rɑn.jə.]ʔɑx.tɪx]			

Again, the constraints MS-INTEGRITY and ONSET cannot distinguish between the two candidates, and PR=LEX (or alternatively a constraint ruling out [jʔ] cluster, which are never found) will start being operative and select [o.rɑn.jə.ʔɑx.tɪx].

A small technical problem arises here. We noted before that the sequence of a full vowel followed by a schwa is not allowed in Dutch monomorphemic forms. There are no monomorphemic words such as *[xɑəs] or *[xəɑs]. But, as a matter of fact, there are also no

words such as *[xəʔɑs]. In other words, the sequence *[əʔɑ] is disallowed in monomorphemic words. One possible constraint that can rule this out is the following variant of the OCP (Cohen et al. 1958), if we assume that both the schwa and the glottal stops are segments without a specified place of articulation:

(36) *∅∅: It is not allowed to have two placeless segments next to one another.

Apparently this constraint only holds within certain morphological (or possibly prosodic) boundaries. For instance, it certainly does not apply across morphological word boundaries: *oranje asbak* 'orange ashtray' [orɑnjəɑsbɑk] is perfectly wellformed in Dutch. We could now say for instance that *∅∅ only holds within the phonological word. It is not unreasonable to assume that the suffix /ʔɑxtɪx/ projects a phonological word of its own (Van Oostendorp 2002). Therefore, [(o.rɑn.jə-ʔɑx.tɪx)] will conform to *∅∅. On the other hand, [xəʔɑs] is still not allowed, presuming that the constraint which requires the relation between morphemes and phonological words to be one-to-one (PR=LEX), is sufficiently high-ranking, so that monomorphemic */xəɑs/ cannot project two phonological words.

6. Dutch word stress

Three properties are usually considered indicative of the morphological level to which an affix belongs. The first two of these are syllabification and schwa deletion, which have been discussed in some detail in the previous two sections. The third property is stress: Class I

suffixes are 'stress-shifting' (i.e. they require stress to be placed in a syllable in their immediate neighbourhood) or 'stress-bearing' (they get word stress themselves). Class II suffixes on the other hand are 'stress neutral': the word stress on the stem is exactly the same as when this stem occurs as an independent word (and usually the suffix gets some secondary stress).

In this section and the next we will go into this distinction in some more detail. It is our aim to show that also it can be understood in terms of the phonological shape of these morphemes in the same way as the syllabification and schwa deletion behaviour (see Kager 2000, Van Oostendorp 2002,Grijzenhout 2002 for different aspects of the interface between stress assignment and morphological structure.) The general idea is that since vowel-initial suffixes are forced to blur the morpheme boundary because of the ONSET constraint anyway (and thereby violate the constraint PR=LEX), they will merge with the prosodic word of the stem also metrically. However, for consonant-initial suffixes (and -*achtig*), ONSET is irrelevant, as we have just seen. For this reason, PR=LEX gets a chance: every morpheme should get its own prosodic word. This difference between vowel-initial and consonant-initial suffixes — the former have a reason to integrate, the latter do not have such a reason — will then account for a difference in stress.

We will make this idea more precise in the section 7. In this section we first give a general overview of the stress pattern of Dutch monomorphemic words, following the general idea of Nouveau (1994), Van Oostendorp (1997) and Gussenhoven (2000, 2003).

Dutch stress is not too different from its English counterpart. Variation is possible, but only within certain limits. For instance, in words consisting of open syllables only, main stress can fall on any of the last three syllables of the word, but not on any other syllable:

(37) a. *Panama* [pánama] (id.)

b. *pyjama* [pijáma] 'pyjamas'

c. *chocola* [ʃokolá] 'chocolate'

d. *[mákaroni]

It is quite generally agreed upon that some of the stress patterns in (37a-c) are more marked than others. Here, we will assume that penultimate stress (37b) is the most unmarked, that antepenultimate stress is slightly more marked, and that final stress is the most marked stress pattern (cf. Nouveau 1994). If the final syllable is light and the penultimate syllable is heavy (i.e. if it contains a diphthong or is closed), the latter is always stressed.

(38) *agenda* [axɛ́nda] 'diary' *[áxɛnda], *[axɛndá]

Gibraltar [xibráltɑr] (id.) *[xíbrɑltɑr], *[xibrɑltár]

According to Nouveau (1994), the basic facts of unmarked Dutch stress can be described by the constraints in (39), ranked in the order given in (40):

(39) ALIGN-RIGHT: Stress should be as much to the right as possible.

*CLASH: Don't put two heads of feet in adjacent positions.

FTBIN: Feet are binary at some level of representation.

TROCHEE: Feet are left-headed.

SUPERHEAVY: The segments of a 'superheavy syllable' should be together in a foot.

WEIGHT-TO-STRESS (WSP): A heavy syllable should be in the head position of a foot.

(40) *CLASH, FTBIN, TROCHEE, SUPERHEAVY » WSP » ALIGN-RIGHT

Notice that we have introduced an asymmetric alignment constraint here, ALIGN-RIGHT; this is allowed since the right-hand edge of the word is defined in purely phonological terms; morphology does not play a direct role in stress assignment. Most of these constraints are known from the literature (e.g. Prince and Smolensky 1993, McCarthy and Prince 1993ab, 1995, Kager 1999, 2000). A special word needs to be said about 'superheavy syllables'. In Dutch, these units consist of a tense vowel followed by one consonant, or a lax vowel followed by two consonants. Superheavies only occur at the end of the word in Dutch, because within the word, tense vowels only occur in open syllables and lax vowels only occur in syllables closed by one consonant. Zonneveld (1993) and Nouveau (1994), among others, analyze superheavies as disyllabic and this is the analysis that will be pursued here as well; we assume that the 'extra' consonant at the end of the word forms a degenerate syllable. In order to make sure that stress always falls on the non-degenerate syllable of a superheavy, we postulate the constraint SUPERHEAVY (postponing further analysis).

The working of these constraints is briefly illustrated in the tableaux in (41)-(43), in which the constraints *CLASH, FTBIN, TROCHEE have been put together under the heading TOP in order to save space:

(41) /**piama**/	TOP	WSP	ALIGN-R
(píja)ma			**!
☞pi(jáma)			*
pija(má)	FTBIN!		
(pijá)ma	TROCHEE!		

(42) /**xibraltar**/	TOP	WSP	ALIGN-R
(xíbral)tar		**!	**
☞xi(bráltar)		*	*
xibral(tár)	FTBIN!	*	
(xíbral)tar	CLASH!		

The main stress is always on the prefinal syllable in the default case. There is one notable exception: word-final superheavy syllables always get stressed:[6]

[6] Cf. Gussenhoven (2003) for treatment of possible counterexamples.

(43) /**myzik**/	TOP	WSP	ALIGN-R
☞my(zík)			
(myzík)	TROCHEE!		
(mýzik)	SUPERHEAVY!	*	*

The problem we now have to solve is, how to account for the fact that exceptional stress patterns such as ['σLσ] and [σL'σ] are possible, whereas ['σHσ], [σH'σ] and ['σSu] are not? In Van Oostendorp (1997) and Gussenhoven (2000, 2003) it is proposed that the lexical marking we need to posit is underlying prosodic structure. In accordance with the spirit of Optimality Theory, it is proposed that feet can occur underlyingly anywhere in the word. The interaction of a faithfulness constraint on underlying feet with the constraint hierarchy in (40) will give us the desired results.

we formulate the faithfulness constraint as follows:

(44) MAX-FOOT: An underlying foot needs to have a correspondent in the output.

If we rank this constraint just below the WSP, we can explain why *pánama* is a possible stress contour, whereas *múziek* is not:

(45) /(**pána)ma**/	TOP	WSP	MAX-FOOT	ALIGN-R
☞ (pána)ma				**
pa(náma)			*!	*
pana(má)	FTBIN!		*	
(paná)ma	TROCHEE!		*	

(46) /(**mýzik**)/	TOP	WSP	MAX-FOOT
☞my(zík)			*
(myzík)	TROCHEE!		
(mýzik)	SUPERHEAVY!	*	

The constraints given until now account for most of the relevant facts of Dutch primary word stress. However, they still cannot explain why *chocolá* is a possible word of Dutch:

(47) /ʃoko(lá)/	TOP	WSP	MAX-FOOT	ALIGN-R
(ʃ'oko)la			*	**!
✘ ʃo(kóla)			*	*
ʃoko(lá)	FTBIN!			
ʃo(kolá)	TROCHEE!		*	

An underlying foot on the final syllable would always violate one of two high ranking constraints, FTBIN and TROCHEE, and therefore it would not be allowed to surface. Words with such a marking would therefore surface with default stress. Although it is true that *chocolá* is more marked than *Pánama* as far as its stress pattern is concerned (Nouveau 1994), it still is a well-formed word of Dutch and it should be generated by the grammar. We therefore need an extra type of lexical marking. One possibility we might entertain in this connection is *catalexis* (Kiparsky 1991, Kager 1995): there is an empty mora or an empty syllable at the end of the word *chocolá*. This word thus really ends in a trochee, be it that its final syllable is phonetically null. See Van Oostendorp (2000, 2002) for independent arguments. (The possibility of a catalectic analysis for Dutch is also considered, but later rejected, in Nouveau 1994).

For this reason we assume that words like these do indeed end in a consonant, and that this consonant is empty. For the sake of concreteness we might also assume that the empty consonant phonologically to be /h/ or /ʔ/ (if no feature material spreads into it, as happens in (52)), since neither of these two segments is 'phonemic' word-finally in Dutch. Furthermore, we have seen that there are independent reasons to assume an underlying /ʔ/ in the analysis of the suffix *-achtig*.

Assuming an underlying empty consonant in *chocola* explains the word-final stress in this word, which now ends in a superheavy syllable (consisting of tense [a] plus the empty consonant):

(48) /ʃokoláC/	TOP	WSP	ALIGN-R
(ʃ'oko)laC	SUPERHEAVY!	*	**
ʃo(kólaC)	SUPERHEAVY!		*
☞ʃoko(láC)			

Because these words now end in a superheavy syllable, they get word-final stress. Unfortunately, the picture just sketched is somewhat too simplistic. In the first place, it does not address the fact that there is evidence that the stress pattern of *chocolá* is *more* marked than that of *pánama*.[7] Nouveau (1994) shows, for instance, that both children acquiring the language and adult native speakers tend to 'simplify' words like *chocolá* as *chócola*, whereas *pánama* is never changed into *panamá*. The account just sketched cannot deal with this. *Chocolá* has an empty segment and *pánama* an lexical foot, and there is no reason for any speaker of Dutch to 'simplify' one form to the other. Another problem is that the distribution of empty consonants seems very restricted; they occur in a very limited number of positions only (only at the edges), and this is not taken into account.
In order to properly describe the latter phenomenon we need to refer to two constraints. The first disallows empty segments anywhere in the word:

(49) *EMPTY: Empty syllables (e.g. degenerate syllables with an empty consonant) are not allowed (cf. *∅∅ in (36)).

The second constraint prohibits deletion of empty material:

(50) MAX-C: Don't delete underlying consonants.

Clearly, if we rank *EMPTY over MAX-C, we get the result that empty consonants do not surface, except where they are necessary for other reasons. The interaction between these two constraints now solves our first problem: why is *chocolá* more marked than *pánama*, not just marked differently? Unfortunately, assuming that *EMPTY and MAX-C are ranked below all other constraints we have just seen, there is no reason any more why *chocola* would not surface as *chocóla* if it only has an underlying empty consonant:

(51) *CLASH, FTBIN, TROCHEE, SUPERHEAVY »
WSP » MAX-FOOT » ALIGN-RIGHT » *EMPTY » MAX-C

[7] This is also a problem with Gussenhoven's (2000, 2003) account.

(52) /**ʃokoláC**/	TOP	WSP	ALIGN-R	*EMPTY	MAX-C
(ʃóko)laC	SUPERHEAVY!	*			**
ʃo(kólaC)	SUPERHEAVY!				*
ʃoko(láC)			*	*!	
✘ ʃo(kóla)			*		*
(ʃ'oko)la			**!		*

The only way to let *chocolá* surface with final accent is by providing it with *both* an underlying empty consonant *and* a lexical foot:

(53) /(**ʃoko)laC**/ or /**ʃoko(laC**)/	TOP	WSP	MAX-FT	ALIGN-R	*EMPTY	MAX-C
(ʃ'oko)laC	SUPERHEAVY!	*				**
ʃo(kólaC)	SUPERHEAVY!					*
☞ (ʃoko)(láC)				*	*	
ʃo(kóla)			*!	*		*
(ʃ'oko)la				**!		*

We can now understand why *chocolá* can be regularized to *chócola*: the form may loose its lexical marking for an underlying empty consonant, only retaining the lexical foot, so that

the underlying form of the word becomes the same as that of *pánama*. This lexical foot itself may actually also be lost, in which case the default pattern arises: *chocóla, panáma*.

7. Underlying stress and morphological form

After this summary of the basic facts of Dutch word stress within an OT frame, we can now start to analyze the behaviour of suffixes with respect to stress. 'Class II' suffixes are always stress-neutral. The stress pattern on their base is exactly the same as it would have been if the suffix were not attached. Furthermore, primary stress stays on the stem, even though the suffix may get a secondary stress:

(54) *televisie* 'television' [tèləv'izi]

televisie-achtig 'television-like' [tèləv'izi-ʔɑ̀xtɪx]

'Class I' suffixes on the other hand are either 'stress-attracting' or 'stress-bearing'. In the former case, stress falls on the stem, but on some other position than where it would be if the suffix were not attached (55). This is always a position closer to the suffix, hence the name 'stress-attracting'. In the case of 'stress-bearing' suffixes, stress falls on the suffix (56).

(55) a. *eenvoud* 'simplicity' ['envɑut]

b. *eenvoud+ig* 'simple' [env'ɑudəx]

(56) a. *respect* 'respect' [rɛsp'ɛkt]

b. *respectabel* 'respectable' [rɛspɛkt'abəl]

It is widely agreed upon (see e.g. the recent textbook of Booij and Van Santen 1995, and the recent handbooks of De Haas en Trommelen 1995 and Booij 2002) that the distinction between 'stress-bearing' and 'stress-attracting' suffixes can be derived from their respective phonological shapes. *-abel* '-able' is stress-bearing because it is disyllabic (and furthermore, its final syllable contains a schwa; as a rule syllables immediately preceding schwa always attract main stress). *-ig* '-y' on the other hand is monosyllabic and therefore is more likely to be stress attracting: as we have seen in the preceding section, final syllables only get stress in exceptional cases also in monomorphemic words. Most authors draw the conclusion from this that the stress in 'Class I' suffixed words is not in any essential way different from that in underived words. As far as stress is concerned, the boundaries between Class I suffixes and stems are invisible.[8]

This observation was quite easily captured in the derivational framework of Lexical Phonology. In this framework, we can assume that the stress rules applied at the end of Class I, i.e. after Class I suffixation, but before Class II suffixation. If we assume furthermore that metrical structure is respected after it is built, we get the proper characterization of the facts: words derived at Class II receive a stress pattern much like a compound.

[8] See Gussenhoven (2003) for a few potentially problematic cases.

(57)	*respect+abel*	*televisie-achtig*
Level I: stress assignment	[rɛspɛktábəl]	[teləvízi]
Level II: compound stress	—	[teləvíziàxtɪx]

Yet these same facts can be made to follow just as easily without the stipulation of lexical levels. The reason for this has already been sketched in section 6: Class I suffixes have an independent reason to cross morpheme boundaries. ONSET forces them to do this. Particularly relevant is also the constraint PR=LEX, the constraint which requires every morpheme boundary to correspond to a phonological word boundary. This constraint plays a decisive role in the derivation of a word like *televisie-achtig*. In forms like this, both the root and the affix get their own phonological word, because of PR=LEX. The stress on this form is therefore similar to that of a compound.

(58) /**televisie**/+/achtig/	PR=LEX
☞ (televísie)(ʔàchtig)	
(televisieʔáchtig)	*!

The stress within each of the phonological words is determined by the constraints outlined in the previous section. PR=LEX does not interact with the constraint ranking in (51). However, we have seen in section 4 that this constraint does interact with (is dominated by) ONSET. This was the core of our analysis why Class I suffixes are integrated into the

syllabic structure of the stem. It can now also provide us with an explanation why they are integrated with the *metrical* structure of the stem:

(59) /**rɛspɛkt**/+/abəl /	ONSET	PR=LEX
☞ (rɛspɛktábəl)		*
(rɛspɛ́kt)(àbel)	*!	

The difference in stress between Class I and Class II suffixes is therefore already explained: it is parasitic on their difference in segmental shape.

An explanation in terms of underlying prosodic structure, on the other hand, cannot work, as we have indicated above. Such an analysis would provide *-achtig* with an underlying foot, and would leave Class I suffixes without any underlying structure. Yet, in order to explain the stress in *bazín* ('female boss'), we need to assign it a lexical foot (and an empty consonant):

(60)

/**baz**/+/(ɪn.C)/	TOP	WSP	MAX-FT	ALIGN-R	*EMPTY	MAX-C
☞ ba(zín.C)				*	*	
(bá.zɪn).C	Superheavy!	*	*	**	*	
ba(zín).C	Superheavy!		*	*	*	
ba(zín)	FTBIN!		*			*

(bázɪn)		*!	*	*		*

Assigning an underlying foot to *-achtig* therefore would not be sufficient; it would not explain why this suffix behaves differently from *-in*.

8. Prosodic word deletion

In the preceding sections we have shown that the prosodic word status of Dutch prefixes and suffixes can be derived from their phonological shape. All the major phonological tests for prosodic wordhood but one have now been discussed The one exception is due to Booij (1977, 1981, 1995), who notes that Dutch has a rule of deletion that is sensitive to prosodic word status. In a conjunction of two partially similar elements, the first of these two can be deleted, provided that it has phonological word status:

(61) a. rood~~achtig~~ en groenachtig
redlike and greenlike
b. eet~~baar~~ en drinkbaar
eatable and drinkable
c. *groen~~ig~~ and rodig
greenish and reddish

we will not go into the details of the deletion process here. We might surmise, however, that the constraints involved have the following effect:

(62) ALLORNOTHING: Do not delete only part of a phonological word.

Another constraint might roughly have the following effect:

(63) *XANDX (special case of TELEGRAPH, Pesetsky 1997): Delete redundant material in conjunctions.

Together these two, admittedly rough, constraints will give the appropriate results (curled brackets denote phonological words):

(64) a.

eet+baar+en+drink+baar	ALLORNOTHING	*XANDX
{eet}{baar}{en}{drink}{baar}		*!
☞ {eet}{en}{drink}{baar}		

b.

groen+ig+en+rood+ig	ALLORNOTHING	*XANDX
☞ (groenig)(en)(rodig)		*
(groen)(en)(rodig)	*!	

9. Paradoxical suffixes

Several suffixes are problematic for approaches trying to provide a unitary explanation for the syllabification and the stress behaviour of suffixes. A list of these is given in (70), which is copied from Booij (1995):

(65) *-e* /ə/ (several functions), *-el* /əl/ (denominal verbalizing suff.), *-en* /ən/ (pl.suff.), *-er* /ər/ (several functions, plus allomorph /ar/), *-erd* /ərd/ (creates deadject. pej. names), *-erig* /ərəɣ/ '-ish', *-ing* /ɪŋ/ '-ing', *-nis* /nɪs/ '-ness', *-s* /s/ substantivizing suff, pl. suff., gen. suff.), *-sel* /səl/ (creates de-verbal nominalizing suff.), *-st* /st/ (super., de-verbal nominalizing suff.), *-ster* /stər/ (feminizing suff.), *-t* /t/ (de-verbal nominalizing suff.), *-te* /tə/ '-ness', *-tje* /tjə/ diminutive (plus allomorphs)

The problem with these elements is that they behave as Class I suffixes as far is syllable structure is concerned, i.e., they integrate with the syllable structure of the stem they are attached to (Booij 1977, 1995, 2003, Langeweg 1988, and references cited there), but not as far as stress is concerned.
A classic example is the following:

(66) a. *Judas* [jý.dɑs] 'Judas'

b. *judasserig* [jý.dɑs.sə.rɪx] 'Judas-like' (i.e. treacherous)

Booij (1995) has shown that even the stress behaviour of these suffixes can sometimes provide us with arguments that they are incorporated in the phonological word. For instance the plural suffix for nouns has two allomorphs: *-s* and *-en*. The choice among these forms is dependent on many factors, but at least one of these seems to be prosodic well-

formedness. Words with a final stressed syllable usually adopt the form *-en* (/ən/ or /ə/, in most variants of Dutch the final n never surfaces), whereas words with penultimate stress select *-s*, as is shown in (67):

(67) *familie* 'family' [famíli] *families* [famílis]

encyclopedie [ɛnsiklopedí] *encyclopedieën* [ɛnsiklopedíjə]

It is easy to see that this follows from the general tendency in Dutch to build trochaic feet and to have stress on the antepenultimate syllable of the word. Assuming that allomorph selection is free, the constraints FTBIN, TROCHEE and ALIGN-R together will select between *families* and *familiën* and between *encyclopedies* en *encyclopedieën*. They will prefer the forms presented in (67).

This line of reasoning is based on two assumptions. First, the stress in both *encyclopedíe* and *famílie* should be fixed independent of the plural suffix. This could be due to an underlying marking in *encyclopedíe*, as we have seen in section 6, but it is not so clear that there is any lexical marking in *famílie.* However if stress in this form is not established independent of plural suffixation, we cannot understand why we could not get the form *familí(j)en*, where stress is also on the penultimate syllable.

The second assumption we have to make is that the plural suffix is indeed incorporated into the prosodic word structure of the base, wherever this is possible. If the choice of the plural suffix is indeed determined by considerations of prosodic well-formedness, we have no other option than making this assumption. On the other hand, these suffixes are still 'stress neutral'. If *families* were an underived word, it would get stress on the final syllable,

because that syllable is superheavy.

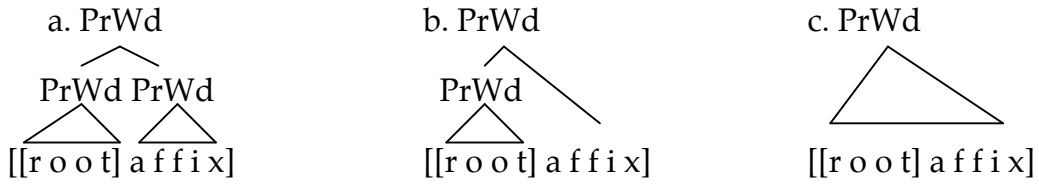
These suffixes thus behave in a paradoxical way, viz. as if they are part of the phonological word as far as syllable structure is concerned and also with respect to the rhythmic organization of the resulting word, but as invisible for stress assignment itself.

Up unto this point we have been rather unspecific about the exact way in which the constraint PR=LEX in (11), repeated here as (68) for convenience, is satisfied.

(68) PR=LEX: Morpheme boundaries should coincide with the boundaries of prosodic constituents (i.e. a phonological word).

As far as PR=LEX is concerned, we have two options. We can either assign a separate prosodic word to every morpheme, as is illustrated in (69a), or we can build a recursive structure such as (69b). Both of these structures would contrast with (69c) in which PR=LEX is violated:

(69)



PR=LEX is trivially satisfied in (69a): since there is a one-to-one mapping from morphemes to prosodic words, every morpheme boundary as a matter of course corresponds to a prosodic word boundary. In (69b), on the other hand, the prosodic structure is homomorphous to morphological structure in all relevant respects. Also in this case every boundary of every morpheme corresponds to the boundary of some prosodic word. The only difference between (69a) and (69b), as far as PR=LEX is concerned, is that the left

boundary of the suffix and the right boundary of the stem correspond to the *same* prosodic word in (69a), while they correspond to *different* prosodic words in (69a).

There are ways to empirically distinguish between (69a) and (69b). All segments in (69b) are still part of the same phonological word. We may therefore assume that they can be syllabified together, while this cannot be done in (69a): segments in two separate phonological words cannot be part of the same syllable, due to a (possibly universally) high-ranking constraint on Prosodic Word Integrity:

(70) **Prosodic syllable integrity (PSI):**

Every segment should be in the same prosodic domain as the syllable to which it belongs.

∀segment S ∀ syllable T dominating S: the prosodic domain of S ≤ the prosodic domain of T.

But this means that the structure in (69b) offers a way to satisfy PSI and PR=LEX at the same time.

If we can assign such a structure to the 'paradoxical' suffixes in (65), their behaviour can be accounted for rather straightforwardly, because the recursive structure can easily accommodate this paradoxical behaviour. We may assume that main stress is assigned within the most deeply embedded Prosodic Word, even though syllable structure can be embedded within the larger domain. The stress pattern could be described for instance by reference to a high-ranking constraint HDWD (Kager 1996):

(71) HDWD: The head of PrWd is the innermost PrWd.

Also the syllabification facts can be made to follow quite straightforwardly (the relative ranking of PSI cannot be determined at this point):

(72) **rod**+ə	ONSET	PR=LEX	PSI
☞ a.[[ro.d]ə] (69b)			
b.[[ro.d]ə] (69c)		*!	
c.[[rot.]ə] (69a)	*!		
d.[[ro.d]ə] (69a)			*!

What determines allomorph selection in (68)? General rhythmic principles might be involved here, such as the constraints TROCHEE and FTBIN, blocking stress on a final syllable, and a constraint NOLAPSE, which forbids sequences of unstressed syllables.
The problem now resides with the 'real' Class I and Class II suffixes. Why would not these suffixes end up with a similar structure to the one in (69a), in other words, why do not all suffixes behave as paradoxical?
If we compare the list of suffixes in (65) to the ones in (19) and (20), we may observe that (almost) all elements of the last two classes contain at least one full (i.e. non-schwa) vowel. The suffixes in (65), on the other hand, have a schwa as their only vowel or otherwise consist of consonants exclusively. There is a handful of apparent exceptions to this generalization: a few suffixes in (65) contain a full vowel. We will return to these in section

10 below. For now, the generalization in (73) will be held true:

(73) A suffix behaves as 'paradoxical' iff it does not contain a full vowel.

Since we have established that paradoxical behaviour equals the structure in (69b), a structure which seems very desirable in the constraint system established hitherto, we can conclude from (73) that (74) should hold as well:

(74) Full vowels are not allowed in a position that is adjoined to the prosodic word.

We may assume that there is a relation between this constraint and the constraint HDWD in (71). Schwa in Dutch, as in many other languages, is the typical unstressed vowel. Full vowels tend to reduce to schwa in unstressed positions, and underlying schwa itself never surfaces as stressed. The domain of stress is the innermost Prosodic Word in an adjunction structure, and apparently, this is the domain of the full vowels as well. We may therefore stipulate principle (75):

(75) LICENSE: Full vowels are only allowed in the head word.

This constraint might be formalized in several ways. For instance we may assume that schwa is an 'empty vowel', formally represented by a bare [-cons] root node, whereas full vowels would have at least some specification for height and/or place of articulation. We could then say that it is these latter features that have to occur in the head of the word. Generalizing this observation might help us to understand why the suffixes in (65) all seem

to have coronal consonants only (with the exception of *-ing*, on which see section 10). We will not attempt to give a full formal account of this intuition here. LICENSE will do the job, as far as necessary.

We need to rank LICENSE topmost in the hierarchy, to get the required result. Since it only mentions full vowels, the constraint will be irrelevant for suffixes that do not have a vowel, or that only have a schwa. Therefore, these suffixes will end up in an adjoined structure. Such a structure is not attainable however for true Class I suffixes (or true Class II suffixes, for that matter):

(76) /**mohɑmmed**/+/an/	LICENSE	ONSET	PR=LEX
a.[[mo.hɑm.me.d]an] (74b)	*!		
☞b.[[mo.hɑm.mɛ.d]an](74c)			
c.[[mo.hɑm.met.]an] (74a)		*!	

The structure of the paradoxical forms with a schwa suffix can now be accounted for. The last question to answer is what happens to the three paradoxical suffixes that seem to have a full vowel on the surface: *-ing*, *-aar* and *-aard*.

10. Paradoxical suffixes without schwa

It is the goal of this article to diminish the number of morphological diacritics in the lexicon

by deriving the phonological behaviour of sets of affixes from their underlying form. The only three suffixes for which this is still to be done, are *-ing*, *-aar* and *-aard*.[9] These are the topic of this section. We will discuss the latter two suffixes together in section 10.2. The former will be discussed in section 10.1.

10.1 The suffix *-ing*

Most scholars mention the Dutch suffix *-ing* as an example of a paradoxical affix. It derives nouns from verbs, just like its counterpart in English. It is however much less productive than the corresponding English suffix (cf. Van Haeringen 1971, De Haas and Trommelen 1993, Booij 2002). In essence, productive *-ing* formation seems to be restricted to words derived by the suffixes *-eer* (or *-iseer*, 77a) or by prefixes (77b), although there are a few words which seemed to be formed of a simple verb plus the suffix *-ing* (77c):

(77) a. *standaardisering* 'standardization', *accentuering* 'accentuation', *democratisering* 'democratization'

b. *onderbreking* 'interruption' (**breking* 'breaking'), *aanraking* 'touch' (**raking* 'touch'), *afschrijving* 'copy' (**schrijving* 'writing')

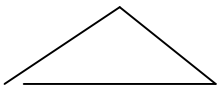
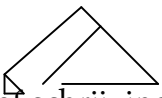
c. *wrijving* 'irritation' (from *wrijf* 'rub'), *speling* 'leeway' (from *speel* 'play')

The reputation of *-ing* as a stress-neutral suffix probably derives from forms such as those

[9] Two suffixes not discussed here are *-ig* [əx] and *-elijk* [ələk]. These contain schwa's only (plus a velar consonant), and they behave differently in the sense that they 'retract' stress in an intricate way, in particular on bases which are compounds. See Kager (2000), Grijzenhout (2002) for recent discussion.

in (77b). The word *afschrijving* for instance has the stress pattern [ˈafsxrɛivɪŋ], which is not the stress pattern of an underived word, because in such a word stress cannot occur to the left of a diphthong. In other words, the form of *afschrijving* is different from that of an underived form. Presumably, this is the reason why this form has been called 'stress-neutral'.

It should be observed, however, that the stress of *schrijving* is not unusual for a simple phonological word at all. In other words, there is nothing in the facts in (77) that argues against prosodic analyses such as those in (78), in which *-ing* is always incorporated in the phonological word of the base:

(78) a.  democratiseering b. af  schrijving

The problem is that *-ing* does not seem to be sufficiently productive to provide us with those cases which would really be a good testing bed to see whether it is stress attracting or not. All the stems we have found to which *-ing* could be attached either ended in a stressed syllable (*wrijving*) or in a stressed syllable followed by schwa (*gijzeling* [ɣˈɛizəlɪŋ] 'kidnapping' from *gijzel* [ɣˈɛizəl]). In both cases, it is hard to see where stress could have actually been other than in the position than where it is.

We can actually observe that the rhyme sequence [ɪŋ] *always* avoids stress in Dutch, even in underived forms. Although there are quite a few words such as *koning* 'king', *paling* 'eel', *honing* 'honey', each of them with stress in the first syllable, there is no word in Dutch which ends in stressed *-ing*, with the exception of those words in which *-ing* is the only available rhyme, such as *zing* 'sing' and *ring* 'ring' and those in which the other vowels are

schwa, such as *sering* 'lilac'. As a matter of fact, there is a series of place names in Dutch, such as *Scheveningen*, *Wateringen*, etc., which are exceptions to the three-syllable window requirement, because they have stress on the first (the preantepenultimate) syllable of the word. Typically, the final three syllables in these words contain either schwa or *-ing*. This provides us with extra indications that the rhyme sequence *-ing* is not likely to be stressed, even if it is not a suffix. Its behaviour in derived forms therefore can probably be derived from its phonological shape.

10.2 The suffixes *-aar* and *-aard*

A more problematic pair of suffixes is formed by *-aar* ([a:r]) and *-aard* [a:rt]. These behave as truly paradoxical. On the one hand, they are vowel-initial and consequently they attract a preceding onset into their syllable. In the following, we will concentrate on *-aar*, but we assume that similar things can be said about *-aard*.

On the other hand, however, they seem to form superheavy syllables. If they would really be 'Class I', they would consequently attract main stress. Yet they are perfectly stress neutral (compare (79a) with (79b), where the latter has the regular Class I suffix *-ier*).

(79)	a.	wɑ́ndəl	wɑ́n.də.la.r
		walk	walker
	b.	wínkəl	wɪn.kə.lí.r
		shop	shopkeeper

-aar in (79) is one of the very few superheavy syllables that does not attract main stress. This could be explained if the suffix were in an adjoined position, but [a] clearly is at least as much a full vowel as the [i] of *winkelier* in (79). An important observation here, however is that *-aar* has an allomorph *-er*, with a schwa (and *-aard* similarly has an allomorph *-erd*). Indeed, it has been argued that *-er* is the unmarked allomorph of the two: *-aar* is chosen after a stem ending in a schwa-headed syllable, *-er* is selected elsewhere:

(80) *wand*[ə]*laar* 'walker' *danser* 'dancer'

bewond[ə]*raar* 'admirer' *schrijver* 'writer'

tek[ə]*naar* 'illustrator' *voorzitter* 'chairperson'

In order to account for the fact that *-aar* is the more marked suffix of the two, we have to introduce a constraint prohibiting it. For the sake of concreteness, we might call this constraint *AAR; it would be an instance of a more general constraint against 'marked' allomorphs. *AAR is dominated by a constraint prohibiting two schwa syllables next to one another: *əə (presumably resulting from the interaction between the requirement that schwa syllable be in the weak position of a trochee; cf. Van Oostendorp 2000). This admittedly rather crude analysis at least has the virtue of giving the desired result:

(81) /wɑndəl/+{/ar/,/ər/}	*əə	*AAR
☞[wɑndəlar]		*
[wɑndələr]	*!	

(82) /sprek/+{/ar/,/ər/}	*əə	*AAR
[sprekar]		*!
☞[sprekər]		

There should be some connection between the fact that *-aar* has an allomorph with schwa, and the fact that it behaves phonologically as if it has a schwa itself. In Smith (1976), it is argued that the agentive suffix is /ər/ underlyingly and that /ə/ is 'strengthened' to /a/ under certain circumstances, but only *after* the relevant stress rules have applied. In an abstract way, this seems to be the appropriate analysis. It is the one we will adopt here as well, modulo certain technical details.

The odd behaviour of *-aar* thus is a consequence of opacity, from the point of view of Smith (1976): a superheavy syllable is created after stress has applied. One way to deal with opacity phenomena within Optimality Theory has been proposed by McCarthy (2002): a specific relation called 'Sympathy' among candidate outputs in the set evaluated by the function Eval. In McCarthy's view, a candidate output can be declared sympathetic if it obeys some faithfulness constraint and if it is more harmonic than all other candidates that obey the same faithfulness constraint. A *sympathy constraint* can subsequently require all candidates in the 'real evaluation' to be as close to the sympathetic candidate as possible. An analysis of the *-aar*/*-er* alternation could use the constraint *AAR as the selector of the sympathetic candidate: the most optimal form satisfying this constraint would be the most harmonic form that satisfies this constraint (this using the allomorph /ər/), and the optimal candidate would be required to resemble the sympathetic form as much as

possible.[10] This comparison would involve faithfulness constraints on foot and word structure, abbreviated in the following tableau as SYMPATHY.

(83) /wɑndəl/ +{/ar/, /ər/}	*əə	SYMPATHY	*AAR	LICENSE	PR=LEX
[wɑ́ndələr]	*!		❀		
[wɑndəlár]	*!				*
☞[wɑ́ndəlar]			*	*	
[wɑndəlár]		*!	*		*

[w'ɑndələr] is the sympathetic candidate: it is more harmonic than the other candidate that satisfies the constraint *AAR ([wɑndəlár], which violates PR=LEX). The form [wɑ́ndələr] itself is not considered as the actual output form, because it violates *əə. Yet it influences the choice of the actual output, which is the form that resembles it most from a prosodic point of view: [wɑ́ndəlar].

The notion of sympathy thus offers a way to capture Smith's (1976) insight in optimality theoretic terms. The importance of Smith's idea for the approach developed here is that it allows us to maintain the original hypothesis: that the morphological status of Dutch affixes is determined by their phonological form. Like **aar*, also **aard* has an allomorph

[10] Note that this would mean that the *AAR should count as a faithfulness constraint, since this is how McCarthy (2002) restricts Sympathy. Seeing the constraint against 'marked' allomorphs as a form of faithfulness does not seem to be very bizarre; it certainly reflects Smith's (1976) intuition that /ər/ is underlying and /ar/ derived.

with schwa (*-erd* [ərt]), so this suffix similarly does not pose a particular problem.

11. Conclusion

we have argued in this paper that it is not necessary to stipulate an underlying lexical marking for 'Class I' versus 'Class II' suffixes. Their phonological behaviour follows from their phonological shape. It is also not necessary to stipulate a morphological difference between prefixes and suffixes beyond the obvious fact that prefixes are attached on the left-hand side of the stem and suffixes on the right-hand side.

Underlying morphological diacritics seem no longer necessary once we assume a theory of violable and rankable output constraints. The main theme of this paper is that isomorphy between phonological and morphological structure is enforced by two constraints: Integrity and PR=LEX. Yet these constraints interact with constraints on phonotactic well-formedness, such as ONSET. The latter constraint may force a less-than-perfect mapping from the morphology onto the phonology.

In due course the following constraint rankings have been established for Dutch:

(84) MS-INTEGRITY»ONSET »PR=LEX»SC » KEEP-ə

PARSE-ə » MAX-X,Y » *CLASH, FTBIN, TROCHEE, SUPERHEAVY » WSP » MAX-FOOT »

PR=LEX-RIGHT » *EMPTY » MAX-C

ALLORNOTHING » *XANDX

*əə»SYMPATHY»*AAR»LICENSE»PR=LEX

This miniature grammar can account for the basic facts of syllabification and primary stress assignment in monomorphemic forms in Dutch, as well as the interaction of these processes with the affixation. It should be noted that these constraints do not refer to 'left' or 'right' edges (except, irrelevantly, for the constraints responsible for stress).

Finally, a note should be added about the methodology used here. Even though the claim made in this paper has clear methodological ramifications (asymmetries between morphemes should be reducible to differences in morphological shape), we have chosen not to apply the core of the constraints used here to a large range of languages, as is customary in much work on OT. The reason for this is that it requires quite some work to be able to show the reductions which are necessary: one cannot see that reduction is possible in Dutch, unless one has a reasonably worked-out view of the segmental, syllabic and metrical phonology of the language. Furthermore, in this way we are able to show that the constraints proposed can be actually embedded in a serious fragment of the phonological grammar of a natural language. Even though large-scale typological studies are clearly necessary and a source of much insight, in many cases, the importance of in-depth analyses of a single language is something that should not be underestimated.

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