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# The interface between morphology and phonology

A comment on Ellen Kaisse: *Word-formation and phonology*

Geert Booij

In this paper, a comment on Kaisse's article on the role of phonology in English word formation, a range of phenomena is discussed that confirm Kaisse's conclusion that "the relation between word formation and phonology is complex." The article deals with a number of types of interaction between morphology and phonology, in particular prosodic determinants of the shape of bound morphemes, the way in which affixes compete, and restrictions on stacking up affixes. The data are taken mainly from Dutch.

## 1. Introduction

This contribution is a comment on Ellen Kaisse's chapter 'Word formation and phonology' in the *Handbook of English Word-formation* edited by Pavol Štekauer and Rochelle Lieber.

The basic claim by Kaisse is that "the morphological make-up of a word has considerable influence on its pronunciation" (2005: 25). This is a very essential claim as to how morphology interacts with phonology that Kaisse convincingly shows to be correct on the basis of data from English.

A particular model of how morphology interacts with phonology is the theory of Lexical Phonology that Kaisse discusses in detail. This theory comprises a set of hypotheses of which the two most important ones are the following (cf. Booij 2000 for a survey):

- (1) (i) morphology and (lexical) phonology apply in tandem;
- (ii) there is a distinction between lexical and post-lexical phonology.

The first assumption is essential for so-called cyclicity effect, and also makes the correct prediction that derived phonological properties of stems may be relevant in word formation (examples from Dutch are given in Booij 1995: Chapter 5). The relevance of the distinction between lexical and post-lexical phonology carries over to non-derivational frameworks such as Optimality Theory, as argued in Booij (1997), Hermans and Van Oostendorp (eds., 1999), Kiparsky (2000), and Ito and Mester (2001).

The theory of Lexical Phonology is usually associated with a third hypothesis as well, that of level ordering. Level ordering is a mechanism for expressing constraints on affix ordering, and the correlation between the order of affixes and their phonological behaviour. For instance, for English it has been claimed that stress-neutral suffixes are peripheral to stress-shifting suffixes. Level ordering, if a sustainable claim at all, is certainly language-specific in nature since languages may differ in the number of levels they have, and they may exhibit no level ordering at all. For English, Kaisse assumes two classes of suffixes, cohering and non-cohering suffixes. This distinction is also referred to as class I versus class II suffixes, or stress-affecting versus stress-neutral suffixes. Some examples of these two classes of suffixes as given by Kaisse are listed in (2):

- (2) a. stress-shifting suffixes: *-age, -al, -ant, -ance, -ary, -ate, -ic, -ion*;  
 b. stress-neutral suffixes: *-able, -er, -en, -ful, -hood, -ish, -ism, -less, -like, -ment*.

A serious problem for this classification (pointed out in Booij (1977) for similar suffixes of Dutch, and reiterated by Raffelsiefen (2005) for English) is that the set of stress-neutral suffixes does not coincide with the class of non-cohering suffixes if we take the latter notion seriously. The vowel-initial stress-neutral suffixes listed in (2b) such as *-er* and *-able* behave in fact as cohering suffixes, like the suffixes in (2a). A cohering suffix is a suffix that does not form a prosodic domain of its own, but forms one prosodic word with the stem to which it is attached. Such behaviour is exhibited by stress-neutral suffixes of English such as *-er* and *-ing*, as can be seen from the syllabification patterns of words with these suffixes: *ba.ker*, *ba.king* (the dots indicate syllable boundaries). The distinction cohering / non-cohering has been introduced by Dixon (1977: 93); cf. also Booij 2005: 162-165). On the other hand, the consonant-initial suffixes in (2b) do behave as non-cohering: they either form a prosodic word of their own (for instance, *-ful* and *-hood*), or they form an extra syllable adjoined to the prosodic word node of the stem, as in the case of *-ness* and *-less* (these suffixes cannot form a prosodic word of their own since they lack a full vowel).

Raffelsiefen's work in this domain (cf. Raffelsiefen 2005) is discussed by Kaisse in relation to Paradigm Uniformity effects. As Raffelsiefen argues, to my mind convincingly, the influence of morphological structure on the phonetic realisation of complex words is mediated by the prosodic structure of such words. First we map morphological structure onto prosodic structure, and subsequently the relevant prosodic constituents form the domain of phonological rules or constraints (cf. Booij 2005, Chapter 7 for general discussion of this point). Thus, many phonetic similarities between derived words and their stems can be explained, without making use of output-output conditions as used in Optimality Theory.

Kaisse rightly concludes that Level Ordering is not the right mechanism for expressing restrictions on affix combinations in English. However, we should realize that rejecting Level Ordering does not imply rejection of the basic tenets of Lexical Phonology as summarized in (1).

The basic comment that I have on Kaisse's paper is that it focuses on one type of interaction between word formation and phonology, the influence of morphological structure on the phonetic shape of complex words. In this contribution I would like to draw attention to other forms of interaction between word formation and phonology, in particular the phonotactics of bound morphemes, phonologically motivated periphrasis, the role of phonological output conditions in making a choice between competing affixes, and the relevance of prosodic properties of affixes for their combinability.

## 2. The phonotactics of affixes

A classic observation by Roman Jakobson is that lexical morphemes differ in their phonotactics from grammatical morphemes, including affixes. For instance, the following generalisation can be made with respect to the phonotactic properties of Dutch lexical morphemes: they do not begin with a schwa-headed syllable, and they do not contain sequences of schwa-headed syllables. That is, the following configurations are not allowed within lexical morphemes:

- (3) a. .. ə.. V..  
 b. .. V .. ə.. ə

The only exceptions are French loanwords such as the following that begin with a schwa-headed syllable:

- (4) b[ə]sógne `task'  
 b[ə]tón `concrete'  
 l[ə]gáat `legacy'

The driving force behind these constraints is that the optimal prosodic shape of a Dutch word of one of the lexical categories should be such that it can be parsed into one or more feet, without any syllable left over. The preferred Dutch foot is a trochee, a disyllabic foot of which the first one is the head and carries some degree of stress. Feet can, however, be monosyllabic if they contain a full vowel, and have a certain minimum weight, that of two moras. Hence, the configurations in (3) will lead to prosodic structures in which the first or the last syllable cannot be parsed into a foot and thus leads to a prosodically less optimal structure. In complex words, however, we do find such prosodic structures due to the attachment of a prefix that consists of a schwa-headed syllable such as *be-* /bə/ or a schwa-containing suffix such as *-er* /ər/. This is in line with Kaisse's observation: morphology may create structures that are less optimal from the phonological point of view. Thus, morphology appears to be ranked above phonology.

Another phonological constraint of Dutch is that prosodic words (correlating with either a simplex or a complex word) cannot begin with a schwa. This is an inviolable condition. The consequence of this constraint is that if a morpheme begins with a schwa, it must be either a suffix or an enclitic. Suffixes and enclitics attach prosodically to the left, and hence this schwa will be syllabified with the preceding stem or word into one prosodic word. Thus, violation of this exceptionless constraint is avoided.

An additional relevant observation is that a Dutch prosodic word consists of one or more feet optionally followed by an appendix of coronal obstruents. A similar generalization can be made for English. Hence, there are Dutch and English suffixes that consist of consonants only, *-s*, *-t*, and *-st*, since such suffixes can be accommodated in the prosodic structure of words. On the other hand, there are no consonantal prefixes since there is no appendix position at the beginning of prosodic words that could accommodate such consonants. Moreover, consonantal suffixes can only consist of *-s*, *-t*, and combinations thereof, since other consonants cannot be accommodated by a word-final appendix position. In short, the shape of affixes is co-determined by the prosodic constraints of the language, an important general claim about the way in which phonology interacts with morphology.

This point is also relevant for the distinction between cohering and non-cohering affixes. Non-cohering affixes are in most cases prosodic words of their own. This is reflected by their phonological make-up: they begin with a syllable headed by a full vowel, and can thus form a proper prosodic word of their own.

### 3. Phonologically motivated periphrasis

Periphrasis, the expression of certain cells of a morphological paradigm by means of multi-word units, may be conditioned by phonology. English is a straightforward case of such a language. The comparative form of adjectives is only synthetic if the stem is monosyllabic (*warm* - *warmer*), or bi-syllabic with a light second syllable, as in *silly* - *sillier*. This is an example of a phonological input condition on morphology. In the case of Dutch, it is prosodic output considerations that determine the choice between synthetic and analytic form of the comparative. The comparative and the superlative form may be expressed in a periphrastic form, by making use of the adverbs *meer* ‘more’ and (*het*) *meest* ‘most’ respectively (*het* is omitted after a determiner). The choice for the periphrastic form of the superlative form in Dutch is partially governed by phonological output conditions. With adjectival stems ending in *-isch* /is/, *-sk*, *-st* phonetically complex and/or opaque forms can thus be avoided:

- |     |                    |                                       |
|-----|--------------------|---------------------------------------|
| (5) | bruusk ‘sudden’    | *bruusk-st [bryskst] / meest bruusk   |
|     | log-isch ‘logical’ | ?logisch-st [lo:gist] / meest logisch |
|     | vast ‘solid’       | *vast-st [vastst] / meest vast        |

The second example carries a question mark since speakers of Dutch hesitant with respect to the well-formedness of this form. Indeed, in itself the cluster /st/ is not bad at the end of a prosodic word after a vowel, yet speakers tend to avoid this superlative form, may be because the suffix *-st* is not realized completely due to degemination. For the two other cases, it will be clear that the word-final consonant sequences are tongue twisters that cry for a periphrastic alternative.

### 4. Competing affixes

The choice between competing affixes may be determined by prosodic output conditions. A good example in the domain of word formation is the competition in Dutch between the deverbal nominalizing suffixes *-er* and *-aar* (discussed in detail in Booij 2005: 172-175 on which the text here is based).

These two suffixes look like allomorphs in the sense that they are phonologically similar. However, it is not possible to assign them a common underlying form, and derive the two surface forms by means of well-motivated general phonological rules or constraints of Dutch. There is no general phonological constraint for Dutch that vowels in word-final unstressed syllables must be reduced to schwa. Hence, *-er* cannot be derived phonologically from *-aar*. So in fact you can see them as competing affixes: different affixes with the same meaning and domain of application.

The basis for choosing between the suffixes *-er* and *-aar* is the following: *-aar* is used after a stem ending in an unstressed syllable, with /l/, /r/, or /n/ as its final consonant (these are the coronal sonorant consonants of Dutch); *-er* is used elsewhere.

- |     |                               |                                     |
|-----|-------------------------------|-------------------------------------|
| (6) | bedel /be:dəl/ ‘to beg’       | bedel-aar /be:dəla:r/ ‘begger’      |
|     | luister /lüystər/ ‘to listen’ | luister-aar /lüystəra:r/ ‘listener’ |
|     | reken /re:kən/ ‘to compute’   | reken-aar /re:kəna:r/ ‘computer’    |

bezem /be:zəm/ ‘to sweep’	bezem-er /be:zəmər/ ‘sweeper’
verdedig /vərde:dəɣ/ ‘to defend’	verdedig-er /vərde:dəɣər/ ‘defender’
bak /bək/ ‘to bake’	bakk-er /bəkər/ ‘baker’

It is possible to account for this pattern by assigning a phonological subcategorization feature to the suffix *-aar* that specifies its restricted distribution (only after stem-final coronal sonorants preceded by a schwa). The suffix *-er* does not need to have such a subcategorization feature: it is the default suffix that can be used elsewhere. The priority of *-aar* above *-er* for verbs ending in an unstressed syllable with /l,r,n/ can be taken care of by Panini’s Principle. In the case of the base word *bedel* the suffix *-aar* will be selected, and hence suffixation with *-er* is excluded. The base word *bezem*, on the other hand, although it ends in an unstressed syllable, does not end in a coronal sonorant since the /m/ is a labial consonant. Thus, attachment of *-aar* is impossible, and *-er* will be attached.

This analysis can be qualified as an analysis that makes use of input constraints: each competing suffix imposes certain requirements on its input forms. The drawback of such an analysis is that it does not provide any explanation for this particular selection pattern. The factor behind this pattern is the avoidance of a sequence of two unstressed syllables. If we added *-er* after an unstressed syllable, we would get a sequence of two unstressed syllables.

Consider the word *reken-aar* and its ill-formed counterpart *reken-er*. Their prosodic structure in terms of syllables and feet will be as follows (syllable boundaries indicated by dots):

- (7) a. (re:.kə)<sub>F</sub>(na:r)<sub>F</sub>  
 b. (re:.kə.)<sub>F</sub>nər

In (7b), the last syllable cannot be made part of a foot (that is, cannot be parsed into a foot), because it does not have a full vowel. Hence, (7a) is better from the point of view of prosodic structure. This prosodic structure correctly implies that the last syllable also bears a degree of stress, i.e. secondary stress.

This selection process of competing allomorphs can be modelled in terms of optimality-theoretical tableaux: each combination of a stem and an allomorph is a candidate, and the ranked set of phonological constraints will determine the optimal candidate. The advantage of this theory is that it makes use of output constraints. The crucial constraints involved here are ParseSyll, Foot-Min, and Foot-Max. ParseSyll requires syllables to be made part of feet, Foot-Max requires feet to be maximally binary, and FootMin requires feet to be minimally binary. Note that we cannot parse the last syllable of *reken-er* into a foot since it has no full vowel.

/re:kən + a:r or ər/	ParseSyll	FootMax	FootMin
☞ (re:.kə) <sub>F</sub> (na:r) <sub>F</sub>			*
(re:.kə.) <sub>F</sub> na:r	*!		
(re:.kə.) <sub>F</sub> nər	*!		
(re:.kə.nər) <sub>F</sub>		*!	

Table 1 OT-tableau for *rekenaar*

The ranking of ParseSyll and FootMax is not crucial in these cases. What is crucial is that these two are ranked higher than FootMin. As a result of this ranking, the first candidate is designated as the optimal one.

In the analysis outlined here, the selection of these two competing suffixes is done by output constraints. Such constraints thus appear to play an important role in the interface between morphology and phonology: morphology provides a number of alternatives, equivalent from the morphological point of view, and the phonology then computes which of them is optimal from the phonological point of view (cf. Carstairs 1988, Rubach and Booij 2001).

This does not mean that phonological subcategorization constraints are superfluous. For instance, we still have to state that *-aar* can only occur after stems ending in a coronal sonorant consonant (that is, /l/, /r/, or /n/). Therefore, the deverbal noun for *bezem* ‘to sweep’ is *bezemer* ‘sweeper’ even though this deverbal noun contains a sequence of two unstressed syllables.

Note that these constraints are all violable as we saw above. For instance, Dutch diminutives such as *ball-etje* [bələtjə] ‘ball, dim.’ and *kamm-etje* [kəmətjə] ‘comb, dim.’ end in a sequence of two unstressed syllables, and hence ParseSyll will be violated. In this case there is no morphological alternative that can be used to avoid this violation. In other words, when necessary, morphology takes precedence over phonology, even if this leads to less optimal phonological structures.

## 5. Affix ordering

The ordering of affixes and the restrictions on their combination within complex words is one of the traditional topics of morphology. Recently, new attempts have been made to find generalizations for restrictions on stacking up affixes, in particular Hay (2002) for English, and Aronoff & Fuhrhop (2002) for English and German. In Booij (2002) I argued that phonological properties of affixes play a role in accounting for the restrictions on affix sequences in Dutch. This is another example of how phonology influences morphology.

Let us assume the following hypothesis:

- (8) The more it leads to violations of prosodic output conditions, the more attachment of an affix will be avoided.

The native suffixes of Dutch divide phonologically into two classes: non-cohering and cohering suffixes, whereas the non-native, Romance ones are all cohering. Recall that the distinguishing property of non-cohering suffixes is that they form a prosodic word of their own, and do not form a prosodic word together with the stem to which they attach. The set of non-cohering suffixes of Dutch is listed and exemplified in (9):

- (9) *Non-cohering suffixes*
- |                 |                           |
|-----------------|---------------------------|
| -achtig /axtəɣ/ | rood-achtig ‘reddish’     |
| -baar /ba:t/    | eet-baar ‘edible’         |
| -dom /dom/      | adel-dom ‘nobility’       |
| -heid /heid/    | schoon-heid ‘beauty’      |
| -ling /luŋ/     | naar-ling ‘unkind person’ |

-loos /lo:z/	draad-loos 'wireless'
-schap /sxap/	vriend-schap 'friendship'
-zaam /za:m/	deugd-zzaam 'virtuous'

The non-cohering nature of these suffixes is illustrated by the contrast between the suffix *-achtig* and its cohering semantically equivalent counterpart, the suffix *-ig*; both occur with the adjectival stem *rood* 'red', and contribute the same meaning '-ish', but show different phonological behaviour:

- (10) rood-achtig [ro:t.ɑx.təx]      rodig [ro:.dəx]

Since *-achtig* forms a prosodic word of its own, it is an independent domain of syllabification. Hence, the /d/ of *rood* occurs in syllable-final position, and is devoiced due to the constraint Final Devoicing (obstruents are voiceless in coda position). On the other hand, the suffix *-ig* is cohering, and forms one prosodic word with its base. Therefore, the morpheme-final /d/ of *rood* fills an onset position in *rodig*, and will be thus exempted from Final Devoicing, and remains voiced.

The role of prosodic structure in stacking up affixes can be observed for the non-cohering suffixes *-dom* and *-schap*. These suffixes can be followed by schwa-initial cohering suffixes, even by the suffix *-elijk* /ələk/ with its two schwa-headed syllables:

- (11) weten-schapp-elijk 'scientific', land-schapp-elijk 'landscape-', maat-schapp-elijk 'societal', vriend-schapp-elijk 'friendly', weten-schapp-er 'scientist', bood-schapp-er 'messenger', christen-domm-elijk 'christian'

The non-cohering suffixes begin a new prosodic word, and hence such words with two suffixes are prosodically not more marked than words consisting of a simplex stem followed by the suffix *-elijk* as in *vriend-elijk* [vrindələk] 'friendly'.

Languages tend to have their inflectional endings peripheral to derivational morphemes, and this may be seen then as a general principle on affix ordering. However, as shown in Booij (1993, 1996), there are systematic exceptions to this generalization in Dutch. In particular, inherent inflection such as pluralization of nouns, comparative forms, and the formation of non-finite forms of verbs may precede the attachment of non-cohering derivational suffixes. Such inflectional endings never occur before cohering derivation suffixes. The effect is that inflectional endings will always occur at the right edge of a prosodic word. The following data from Dutch show that inherent inflection can indeed feed certain types of derivation:

- (12) *plural nouns*  
boeken 'books'                      boeken-achtig 'bookish'  
meisjes 'girls'                      meisjes-achtig 'girlish'  
helden 'heroes'                      helden-dom 'heroism'  
leerlingen 'pupils'                      leerlingen-dom 'the group of pupils'
- passive participles*  
aangepast 'adjusted'                      aangepast-heid 'adjustedness'  
gesloten 'closed'                      gesloten-heid 'closedness'



*present participles*

opwindend ‘exciting’  
doeltreffend ‘effective’

opwindend-heid ‘excitingness’  
doeltreffend-heid ‘effectiveness’

*comparatives*

beter ‘better’  
ouder ‘older’  
ouder ‘older’

beter-schap ‘recovery’  
ouder-dom ‘old age’  
ouder-ling ‘elder’

*infinitives*

nalaten ‘to leave’  
weden ‘to bet’  
weten ‘to know’  
zeggen ‘to say’

nalaten-schap ‘heritage’  
weden-schap ‘bet’  
weten-schap ‘science’  
zeggen-schap ‘authority’

Crucially, these inflection endings only occur in complex words that consist of more than one prosodic word. The suffix forms a prosodic word of its own, and hence, the inflectional ending occurs at the end of the prosodic word that precedes the suffix. This shows how prosody influences the interaction between inflection and derivation.

Similar observations can be made for Dutch prefixes. A sequence of two unstressed prefixes is avoided. A prefix can be added to an already prefixed word, however, if that prefix is a prosodic word of its own, and hence does not create a sequence of two unstressed prefixes at the beginning of a word, a prosodically very marked configuration (Booij 2002).

In sum, phonology plays an important role in restrictions on stacking up affixes in multiply complex words.

## 6. Summary

In this paper, a short comment on Kaisse’s insightful article on the role of phonology in English word formation, I have discussed a range of phenomena that confirm Kaisse’s conclusion at the end of her article that “the relation between word formation and phonology is complex” (2005: 45). In particular, by considering a range of Dutch data I argued for the importance of phonological, in particular prosodic factors for understanding the shape of bound morphemes, the way in which affixes compete, and the restrictions on stacking up affixes. I hope that these observations will serve to complement the survey of forms of interface between morphology and phonology as discussed by Ellen Kaisse on the basis of English.

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