Phonology and Morphology of the Germanic Languages

Edited by
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Phonological output constraints in morphology

1. Introduction

Recent developments in phonological theory have made it clear that the notion 'output constraint' cannot be dispensed with in phonological analysis. Such output constraints form a central ingredient of phonological theories such as Optimality Theory (OT) (McCarthy & Prince 1993, 1994; Prince & Smolensky 1993).

The theoretical concept of output constraint also has a large potential for morphological analysis. This can be illustrated with a simple example from Dutch. In Dutch the nominalizing suffix *-erd* /ərd/ cannot be added to adjectival stems ending in /ər/; this is a phonological restriction on this kind of word formation (Schultink 1962: 203, Booij 1977: 124):[1]

(1)	*Adjectival stem*	*Noun*
	vies /vi:z/ 'dirty'	viez-erd /vi:z-ərd/ 'dirty person'
	goochem /ɣo:xəm/ 'smart'	goochem-erd /ɣo:xəm-ərd/ 'smart person'
	dapper /dɑpər/ 'brave'	*dapper-erd /dɑpər-ərd/'brave person'
	duister /dœystər/ 'obscure'	*duister-erd /dœystər-ərd/ 'obscurant'

This restriction can be expressed as an input constraint on the kind of stems that the suffix *-erd* takes, and it is indeed formulated as such in Booij (1977: 124). However, this fails to express the generalization that this gap in word formation arises from the necessity of avoiding the sequence /rər/ in Dutch, a sequence which is also avoided by other word formation processes. Moreover, the undesirability of this sequence also plays a role in allomorphy. For instance, by using the allomorph *-der* of the suffix *-er* in comparatives, /rər/ is also avoided:

(2)	vies /vi:z/ 'dirty'	viez-er /vi:z-ər/ 'dirtier'
	helder /hɛldər/ 'clear'	helder-der /hɛldər-dər/ 'clearer'

The postulation of an output constraint */rər/, or a generalized version thereof, is therefore called for if we want to formally express this generalization.

The avoidance of /rər/ is an instantiation of more general tendencies in languages to avoid sequences with identical sounds. These tendencies have been discussed by Dressler (1977), Stemberger (1981), and Menn & MacWhinney (1984) in papers on haplology. Interestingly, they already pointed out that the standard approach of generative phonology

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[1] The high vowels are transcribed as phonologically long, because they behave as such, although phonetically they are short except before [r].

does not suffice to make the relevant generalizations, and that we need output constraints. Dressler, for instance, remarked that

(3) [t]he constraint applies at the level of word formation and either prevents actual derivation or calls for haplological simplification. But the structural description of the constraint is in terms of *surface* [my italics, GB] phonetics. (Dressler 1977: 45-46).

Dressler also pointed out that in a rule-based phonology this would lead to assume 'peeking rules', rules that can look ahead to see what kind of output they will lead to. Similarly, Menn & MacWhinney (1984: 529) concluded with respect to iterations of identical morphs that „there is a general output constraint which tends to prohibit sequences of phonological identical morphs".

These ideas are also found in recent work: Raffelsiefen (1996) and Plag (1997, 1998) have argued that certain gaps in word formation should be accounted for in terms of restrictions on the phonetic forms of the derived words, and a number of phonologists have shown that the selection of particular allomorphs should follow from output conditions (cf. Kager 1996, Mascaró 1996, Booij 1997a).

In this paper, which deals mainly with Dutch, I will also argue that certain gaps in word formation and certain patterns of affix and allomorph selection can best be accounted for in terms of phonological output constraints. This raises the question whether competition between affixes and allomorphs can always be accounted for in terms of output constraints. I will argue that this is not the case, and that we still need subcategorization frames for affixes, which must be complied with by Gen, the component of the grammar that generates the set of possible phonological candidates for a complex word.

2. Optimal parsing

In Dutch, some morphological processes apply in such a way that their outputs obey the constraint that a foot consists of two syllables. Dutch feet are preferably disyllabic trochees. However, monosyllabic feet are also allowed if necessary, provided that the vowel of that monosyllabic foot is a full vowel: a schwa can never function as the head of a monosyllabic foot. Since a foot is maximally disyllabic, syllables headed by schwa may be left over, i.e. they cannot be parsed into a foot. In that case, they will be dominated directly by the prosodic word node of the relevant word. I will assume the following constraints:[2]

(4) ParseSyll: syllables must be parsed into feet
FootMin: feet are minimally disyllabic
FootMax: feet are maximally disyllabic

[2] Löhken (1997: 107), who follows Daniel Everett in splitting the constraint of Foot Binarity into two constraints, FootMax and FootMin, assumes the same constraints for German.

In the following subsections, a number of morphological processes will be discussed where these constraints play a role in the selection of competing affixes or affixal allomorphs.

2.1. Pluralization of nouns

Dutch has two plural suffixes for nouns, /s/ and /ən/. The basic selection pattern can be formulated as follows:[3]

(5) -s after an unstressed syllable, -ən after a stressed syllable.

This pattern of selection is illustrated by the following examples:

(6)

kánon 'canon'	- kánon-s [ˈka:nɔns]
kanón 'gun'	- kanónn-en [ka:ˈnɔnən]
nátie 'nation'	- nátie-s [ˈna:tsi:s]
geníe 'genius'	- geníe-ën [žəˈni:jən]

This selection principle also correctly predicts that monosyllabic nouns have *-en* as their plural suffix:

(7)

non 'nun'	- nonnen
knie 'knee'	- knieën
bal 'ball'	- ballen

Note that it is obvious that we cannot derive the plural suffixes from a common underlying form by means of general phonological rules (they have different historical origins). Nevertheless, as is the case in a number of languages (cf. Carstairs 1988), the distribution of competing affixes may be governed by purely phonological principles (I will use the term 'allomorph' if the competing affixes show a clear phonological similarity).

The formulation of the selection principle given above is formulated in terms of properties of the input forms for the pluralization process, the nominal stems, which are formally identical to the singular forms. However, such a formulation does not explain why this particular selection principle holds. In terms of complexity of the grammar, it would make no difference if Dutch were just the other way round, i.e. if *-s* occurred after stressed syllables, and *-en* after unstressed ones. My hypothesis is that the motivation behind this particular affix selection is that plural nouns will end in a disyllabic trochee since the disylla-

[3] A systematic class of exceptions to this generalisation is formed by nouns ending in an unstressed syllable with a final /s/; these nouns, such as *cúrsus* 'course' and *dréumes* 'toddler' always take *-en* as their plural suffix. The reason for this is obvious: Dutch has no consonantal geminates, and therefore, the plural /s/ will not surface after a stem in /s/. That is, the constraint Morpheme Identity that requires that each morpheme receives a phonetic realisation so that it can be identifed, is ranked higher than the Foot constraints.

bic trochee is the preferred pattern of organization of syllables into higher prosodic units in Germanic languages.[4]

The following OT-tableaux show how the selection of the correct plural suffix takes place. Note that we extend the notion 'candidate' as normally used in OT-phonology because the set of candidates is not defined exclusively phonologically, but also morphologically: each combination of stem + competing affix/allomorph is the basis for a set of candidates (geminate consonants indicate ambisyllabicity after short vowels).

(8)

kánon+PL 'canons'	FootMax	ParseSyll	FootMin
☞ (ka:nɔn-s)$_F$			
(ka:nɔn)$_F$(n-ən)$_\sigma$		*!	
(ka:nɔnnən)$_F$	*!		

kanón+PL 'guns'	FootMax	ParseSyll	FootMin
(ka:)$_\sigma$(nɔn-s)$_F$		*!	*
(ka:)$_F$(nɔn-s)$_F$			**!
(ka:)$_\sigma$(nɔnn-ən)$_F$		*!	
☞ (ka:)$_F$(nɔnn-ən)$_F$			*

In these tableaux, FootMax is ranked higher than ParseSyll, so that we do not get trisyllabic feet. Furthermore, I do not consider the candidate in which a schwa-headed syllable forms a foot of its own, since it is an unviolable constraint that syllables with schwa cannot head a foot. ParseSyll is ranked above FootMin because monosyllabic feet are preferred to having an unparsed syllable, cf. (15) below.

The computation of the correct plural suffix presupposes that the stress pattern of the stem is already given, and cannot shift rightward in the plural form. This stress-neutrality can be obtained in two ways: by allowing for levels within OT, or by making use of output-output correspondence constraints (McCarthy & Prince 1995, Benua 1995; cf. Booij 1997a for discussion).

The constraint FootMin implies the choice of the plural suffix *-en* for monosyllabic nouns; FootMin is obviously violated by monosyllabic nouns in their singular forms, and also in plural forms of loanwords which keep the original suffix:

(9) *English* tram - trams 'trams'
French paraplú - paraplu's 'umbrellas'

Dutch children tend to regularize these patterns during the process of language acquisition, and create plural nouns such as *trammen* 'trams', and speakers of Southern Dutch use

[4] Van de Vijver (1998) argues that the trochee is universally the preferred pattern of organisation of syllables into feet.

experten instead of Standard Dutch *experts* as the plural form of *expert* 'id.', and *testen* instead of *tests*.

The output-based approach is not only superior in that it formally expresses the 'why' behind the selection principle, it also makes the prediction that simplex nouns ending in schwa have both /s/ and /ən/ because of the effect of prevocalic schwa-deletion (a schwa deletes before an adjacent vowel within the same prosodic word, cf. Booij 1995), which ensures that the addition of *-en* after a noun ending in schwa does not create a new syllable. This prediction is correct:[5]

(10)	kadə 'quay'	kadəs, kadən
	bodə 'messenger'	bodəs, bodən
	ladə 'drawer'	ladəs, ladən
	methodə 'method'	methodəs, methodən

In some cases, one of them may be preferred, but this is a matter of lexical convention, not a matter of wellformedness.

Complex words ending in a schwa-final suffix also have the two options, as is to be expected on the basis of the phonological properties, unless the suffix requires a particular plural suffix:

(11) *words with both suffixes*:

-adə	marinades 'marinades', balustraden 'balustrades'
-sə	extases / extasen 'ecstasies', hypotheses / hypothesen 'hypotheses'
-də	liefdes / liefden 'loves', kundes / kunden 'arts'
-tə	gedeeltes / gedeelten 'parts', koeltes / koelten 'cools'
-ismə	modernismes / modernismen 'modernisms', mechanismes / mechanismen 'mechanisms'
-inə	sonatines / sonatinen 'sonatines'
-idə	fluorides / fluoriden 'fluorides'

words with only -s:

with non-native suffixes borrowed from French

-airə	documentaire-s 'documentaries'
-agə	massage-s 'massages'
-asmə	orgasme-s 'orgasms'
-essə	secretaresse-s 'female secretaries'
-ierə	cabaretiere-s 'female cabaretiers'
-eusə	masseuse-s 'female massagist'
-icə	directrice-s 'female directors'

[5] Below, the schwa is represented by its IPA symbol for reasons of clarity; in Dutch orthography, the schwa is mostly represented by *e*, and sometimes by *i*, *u* or *ij*. Word-final schwa is always represented by *e*.

-iennə	lesbienne-s 'female homosexuals'
-ettə	wasserette-s 'launderettes'
-urə	doublure-s 'duplications'

with native suffixes

-ə	acrobate-s 'female acrobats'
(t)jə	toetje-s 'desserts', boekje-s 'booklets'

words with only -(ə)n

-ə	blonde 'blonde' - blonden (nominalizing deadjectival suffix)

The importance of these data is that they show that the selection of one of the plural suffixes cannot always be accounted for in terms of phonological output conditions. For instance, diminutive nouns allow for *-s* only, although a diminutive like *toetjen* would not violate the constraints discussed. So we have to conclude that the selection may be governed by a particular suffix in cases where phonology cannot make a choice.

The output-based analysis of affix and affix-allomorph selection makes it also possible to give a proper account of the interaction between stem allomorphy and selection of plural suffix in words ending in *-or*, *-on* and *-ol*. These words have two stem allomorphs, with the last syllable containing either a short vowel or its long counterpart. It is only the short allomorph that occurs as independent word. In the case of the allomorphs with the long final syllable such as *motoor*, main stress must be located on that syllable because it is superheavy (long vowel plus consonant in the rhyme).

(12)	mótor 'engine'	mótors [ˈmo:tɔrs] /motóren [mo:ˈto:rən]
		*motóors [mo:ˈto:rs] / *mótorrən [ˈmo:tɔrən]
	professor 'id.'	professors/professóren
	néutron 'id.'	néutrons/neutrónen

The long stem allomorphs must be selected obligatorily before non-native suffixes, and can also, and this is exceptional, occur in plural nouns. What is explained under the present analysis is why the short allomorphs choose the plural suffix *-s*, and the long allomorphs the suffix *-en*.

The conspiracy of stem allomorphy, stress location (weight-sensitive assignment of primary stress) and choice of plural suffix follows directly from an output constraint approach.[6]

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[6] A similar generalisation concerning the form of plural nouns in terms of the required output can be made with respect to German (leaving aside the special category of plural nouns ending in *-s*), as pointed out by Wiese (1996: 106): "plural nouns in Modern Standard German must end in a bisyllabic foot, with the second syllable being a schwa syllable". Cf. also Golston & Wiese (1996).

2.2. Derived nouns

The working of the prosodic output constraints given in (4) can also be related to the allomorphy of the denominal and deverbal nominalizing suffix *-er* /ər/ that has the allomorph *-aar* /a:r/ after stems ending in schwa plus a coronal sonorant:

(13) *denominal nouns*

Bloemendaal /blu:mənda:l/	Bloemendal-er 'inhabitant of B.'
Diemen /di:mən/	Diemen-aar 'inhabitant of D.'
Uddel /œdəl/	Uddel-aar 'inhabitant of U.'

deverbal nouns

spin /spɪn/ 'to spin'	spinn-er 'spinner'
luister /lœystər/ 'to listen'	luister-aar 'listener'
bedel /be:dəl/ 'to beg'	bedel-aar 'beggar'
reken /re:kən/ 'to compute'	reken-aar 'computer'

The distribution of these two allomorphs is describable in phonological terms, but there is no regular phonological process that can derive *-aar* from *-er*, or vice versa. Both derive historically from the Latin suffix *-arius*. The allomorph *-aar* is the more restricted allomorph; it only occurs after stems ending in schwa followed by /l,r,n/. The non-phonological nature of the allomorphy involved here is also clear from the following observations:

- the allomorph *-aar* is not available for comparatives, which are also formed by suffixation with /ər/. Instead, the allomorph *-der* is used after stems in *-er*. Thus, we get a comparative like *duisterder* 'darker' instead of the prosodically more optimal **duisteraar*.
- we find *-aar* also exceptionally in words like *dien-aar* 'servant', *ler-aar* 'teacher', *winnaar* 'winner', and *zond-aar* 'sinner', i.e. after a syllable with a full vowel. The condition that the preceding consonant must be a coronal sonorant is never violated.

The distribution of these two allomorphs can now be related to the parsing constraints, because it is the choice of *-aar* after a stem ending in a schwa-syllable that avoids the creation of a sequence of two schwa-headed syllables of which the second cannot be parsed into a foot. On the other hand, for a word like *Amsterdam* the optimal inhabitant name is that with *-er*, and similarly, the optimal form for the verb *eten* 'to eat' is *eter*, and not **etaar*. In order to make the correct selection in the case of *eter*, we also have to invoke the constraint Superheavy:

(14) Superheavy: superheavy syllables must head a foot

A superheavy syllable has a threepositional rhyme: a long vowel followed by a consonant, or a short vowel followed by two consonants. This constraint is ranked higher than Foot-Min because Dutch words that end in a superheavy syllable, bear the word stress on that syllable, which must therefore form a monosyllabic foot, as in the example *kantóor* 'office' given above.

The following tableaux show how the selection proceeds for the base words *Diemen* and *spin* 'to spin':

(15)

	SuperH	FootMax	ParseSyll	FootMin
$(di:mən\text{-}ər)_F$		*!		
$(di:mə)_F(n\text{-}ər)_σ$			*!	
☞ $(di:mə)_F(n\text{-}a:r)_F$				*
$(di:mə)_F(n\text{-}a:r)_σ$	*!		*	

	SuperH	FootMax	ParseSyll	FootMin
☞ $(spɪn\text{-}ər)_F$				
$(spɪn\text{-}a:r)_F$	*!			
$(spɪ)_F(n\text{-}a:r)_F$				*!*

The word *Diemenaar* ends in a monosyllabic foot that bears secondary stress. This is apparently preferable to leaving the syllable unparsed, and hence, the form with *-aar* is selected. In the case of the verb *spin*, it is the form with *-er* that is selected.

It should be noted that the allomorph *-aar* is not always available when it would help to avoid violation of the ParseSyll constraint: after stems ending in /m/ such as *bezem* 'to sweep', we get *bezemer* /be:zəmər/ 'sweeper' rather than *bezemaar*, i.e. a form with a final unfooted syllable. This also holds for the restricted number of verb stems that end in an obstruent such as *vonnis* /vɔnəs/ 'to sentence': the corresponding deverbal agent noun is *vonnisser*. That is, the more restricted allomorph *-aar* must be subcategorized as appearing only after coronal sonorant consonants. In other words, phonological output constraints must be supplemented by other conditions, just as in the case of the nominal plural suffixes discussed in the preceding section, where morphological properties of the nominal stems appeared to play a role.

The ParseSyll constraint also plays a role in the formation of feminine nouns. In Dutch, the feminine suffix *-ster* /stər/ creates feminine nouns, and takes as its base either verbs or nouns:

(16)

verbal base	*feminine noun*
bak /bɑk/ 'to bake''	bak-ster
verdedig /vɛrde:dəɣ/ 'to defend'	verdedig-ster
nominal base	
kruidenier /krœydəni:r/ 'grocer'	kruidenier-ster
vliegenier /vli:ɣəni:r/ 'pilot'	vliegenier-ster

In the case of deverbal agent nouns, the choice between a nominal or a verbal base now appears to be determined by the principle of avoiding a sequence of two unstressed syllables, as pointed out by Shannon (1991): if the verbal stem ends in a schwa-syllable, *-ster* selects the deverbal noun in *-aar* as its base, and if the verbal stem ends in a syllable headed

by a full vowel, the verbal stem is selected as the base (there is no meaning difference between these two kinds of feminine nouns):

(17)	*verb*	*deverbal noun*	*feminine noun*
	bak /bɑk/ 'to bake'	bákk-er /bɑkər/	bák-ster, *bákker-ster
	loop /lo:p/ 'to walk'	lóp-er /lo:pər/	lóop-ster, *lóper-ster
	dobbel /dɔbəl/ 'to gamble'	dóbbel-àar /dɔbəla:r/	*dobbel-ster, dóbbelàar-ster
	reken /re:kən/ 'to compute'	réken-àar /re:kəna:r/	*reken-ster, rékenàar-ster

It will be clear that in the analysis proposed here these data can be accounted for by the ParseSyll constraint: the grammar generates two morphologically well-formed feminine nouns, one from the verbal stem, and one from the deverbal noun, and ParseSyll will select words like *bak-ster* /bɑkstər/ over *bakkerster* /bɑkərstər/, and *dobbelaarster* /dɔbəla:rstər/ over *dobbelster* /dɔbəlstər/.

2.3. Inflected adjectives

In present-day Standard Dutch, adjectives in attributive position are inflected: the stem is followed by schwa, except when the adjective forms part of an indefinite NP headed by a neuter noun. In the latter case, there is no overt inflection. Traditionally, these forms are called uninflected adjectives. This is strange from a conceptual point of view: if a particular syntactic configuration requires inflection of a word class (i.e. contextual inflection, cf. Booij 1994), then members of this word class are by definition inflected. It is only in the case of inherent inflection such as pluralization of nouns that speakers have the option not to inflect a noun. Therefore, we should say that the inflectional morpheme involved is the zero-morpheme. In the examples below, *boek* 'book' is a neuter noun, and *tafel* 'table' is a non-neuter noun.

(18)	een goed-ø boek	'a good book'
	het goedə boek '	the good book'
	(de) goedə boeken	'(the) good books'
	een goedə tafel	'a good table'
	de goedə tafel	'the good table'
	(de) goedə tafels	'(the) good tables'

When the stem of the adjective ends in /ən/, however, the schwa does not appear:

(19)	het opən-ø boek	'the open book'
	de hout-ən-ø tafel	'the wooden table'
	de ge-slag-ən-ø room	'the whipped cream'
	de ver-get-ən-ø jas	'the forgotten coat'

The absence of the schwa in this position does not follow from a purely phonological rule of schwa apocope, because there is only absence of schwa if the schwa is the inflectional morpheme of the adjective. In other cases, the schwa remains, e.g. in the nominalized forms of adjectives:

(20)	het ge-slag-ən-ə	'the beaten' (neuter)
	de ge-slag-ən-ə	'the beaten (person)' (non-neuter)

Moreover, it is only after /ən/ that the inflectional schwa does not surface; it does surface after other consonants, and after the combination full vowel + /n/:

(21)	de mager-ə /ma:ɣərə/ vrouw	'the lean woman'
	de lelijk-ə /le:ləkə/ man	'the ugly man'
	de edel-ə /e:dələ/ mens	'the noble man'
	de groen-ə /ɣru:nə/ stoel	'the green chair'

That it is the output configuration /ənə/ only that is to be avoided, can be concluded from the fact that past participles used as attributive adjectives do have a final inflectional schwa if they have an exceptional form ending in full vowel + /n/, which is the form for the verbs *doen* /du:n/ 'do', *gaan* /ɣa:n/ 'go', *staan* /sta:n/ 'stand', *zien* /zi:n/ 'see' and their derivatives:

(22)	ge-dan-ə /ɣə-da:n-ə/ zaken	'lit. done business, finished matters'
	door-stan-ə /do:r-sta:n-ə/ moeite	'lit. suffered effort, efforts'
	be-gan-ə /bə-ɣa:n-ə/ wegen	'trodden paths'
	een ge-zien-ə /ɣə-zi:n-ə/ collega	'lit. a seen colleague, a respected colleague'

Furthermore, the same pattern can be observed for infinitives with *te* used in attributive position. After infinitives in -/ən/, the inflectional schwa does not occur, whereas the four exceptional infinitives for the verbs *doen, gaan, slaan* and *zien*, mentioned above, and the verb *slaan* 'strike' do have the final schwa:

(23)	nog te nemən-ø /ne:mən/ maatregelen	'lit. still to take measures'
	versus	
	nog te doen-ə /du:nə/ zaken	'matters still to be done'
	nog te gan-ə /ɣa:nə/ wegen	'ways that must be gone'
	nog te door-stan-ə /do:rsta:nə/ beproevingen	'trials still to be suffered'
	niet af te slan-ə /sla:nə/ voorstellen	'proposals not to be rejected'
	niet te zien-ə /zi:nə/ organismen	'organisms that cannot be seen'

In sum, the inflectional schwa of words used as attributive adjectives has a zero-allomorph if the stem ends in /ən/. In addition, the zero allomorph also occurs after adjectives that end in an unstressed vowel (cf. Van Oostendorp 1995). Compare:

(24) een blíj-ə dag 'a cheerful day'
een wée-ə pijn 'a sickly pain'
versus
een príma-ø lezing 'an excellent lecture'
een séxy-ø vrouw 'a sexy woman'

In a rule-based analysis of this kind of schwa apocope, we would have to assume the following rule:

(25) $ə \rightarrow ø / \left\{ \begin{matrix} ə\ n \\ V_i \end{matrix} \right\} \_\_]_A$ Condition: V_i is =unstressed

Such a description does not express, however, why it is only in this context, that is after a preceding schwa, that the final schwa deletes. A rule with the context '[+voc] n __' , i.e. a rule that deletes schwa after /n/ whatever the preceding vowel, would be formally simpler. Yet, it is obvious that it would not be simpler from the point of view of the overall systematics of the grammar. It is obvious that the occurrence of the zero-allomorph is related to the prosodic constraints discussed above, which imply the avoidance of sequences of unstressed syllables and the creation of disyllabic feet.

The parsing constraints can be violated however, since we do find words with a sequence of two schwa-syllables, even if the word ends in a schwa, as in the following cases:

(26) (a) in inflected adjectives with another consonant than /n/, e.g. edələ mens 'noble man'
(b) in the inflected present participle: lopənd-ə mensen 'walking people'
(c) if the schwa is a nominalizing suffix: het opən-ə 'the open, neuter', de gebor-ən-ə 'the born person'.

Violable constraints are an essential ingredient of OT. In this case, the prosodic constraints can be assumed to be dominated by Morpheme Identity (cf. fn. 3):

(27) het opən-ə

	MorphI	SuperH	FootMax	ParseSyll	FootMin
☞ $(o{:}pə)_F(n\text{-}ə)_σ$				*	
$(o{:}pən\text{-}ə)_F$			*!		
$(o{:}pən)_F\text{-}<ə>$	*!				

The question thus arises how we account for the difference between the behaviour of the inflectional schwa of adjectives, which alternates with zero, and the other word-final schwas which always appear on the surface. Such differences in behaviour could be accounted for in terms of different constraint rankings. However, I do not want to assume affix-specific rankings of constraints, because this implies that the language learner would have to acquire a number of affix-specific grammars for his native language, not a very attractive position from the learnibility point of view. Therefore, I prefer an analysis in

which the inflectional schwa has a zero-allomorph listed in the morphological module of the grammar.

This zero-allomorph of inflected adjectives only appears after a stem ending in /n/ and after adjectives ending in an unstressed vowel. Thus, the zero-allomorph has to be subcategorized for appearing after vowels or /n/. Again, as in the case of the suffix *-aar*, subcategorization is required as an additional mechanism:

(28)

	MorphI	SuperH	FootMax	ParseSyll	FootMin
$(o{:}pə)_F(n\text{-}ə)_σ$				*!	
☞ $(o{:}pən\text{-}ø)_F$					

The second form, with the allomorph ø, does not violate ParseSyll, and is therefore to be preferred. The inflectional schwa of adjectives must therefore be assumed to have a zero-allomorph which is subcategorized for appearing after /n/. Note that we do not have to subcategorize this zero-allomorph for appearing only after /n/ if it is preceded by schwa, because the necessary presence of a preceding schwa follows from the constraint FootMin already discussed in the preceding section. That is, it follows automatically that the zero-allomorph does not appear after /n/ preceded by a full vowel, as is the case for an adjective like *groen* 'green':

(29)

	MorphI	SuperH	FootMax	ParseSyll	FootMin
☞ $((ɣru{:})_σ(n\text{-}ə)_σ)_F$					
$((ɣru{:}n\text{-}ø)_σ)_F$					*!

In other words, if Dutch has the option to create a word that ends in a disyllabic foot, it will do so, and not choose the zero-allomorph that results in a less optimal phonetic form. As in the cases discussed in the previous sections, the distribution of the two allomorphs is not completely accounted for by the output condition. In this case, we have to subcategorize the zero-allomorph for appearing after /n/ and vowels only. There are also a few adjectives, ending in /ər/, that have the zero-form of the inflectional ending: denominal geographical adjectives such as *Limburger* and *Groninger*, and the adjectives *linker* 'left' and *rechter* 'right'. In other words, the zero-allomorph of the adjectival inflection must also be specified as being permitted to appear after such geographical adjectives in *-er*. This zero-allomorph will then be selected by the constraint system proposed above, because forms like **linkere* [lɪɔkərə] will be less optimal. However, this zero-allomorph is not allowed for all adjectives in *ər*: comparatives, which end in *-er*, do have the schwa. This implies that the specification of the context of the zero-allomorph has to refer to specific classes of adjectives.

The effect of the ParseSyll constraint on the form of inflected adjectives with a stem in /ən/ can also be seen in Frisian (Dyk 1996), but in this language the zero-allomorph is optional. In this respect it mirrors the historical development of Dutch: in Middle Dutch, the inflectional schwa was obligatorily present, but gradually its absence became an option,

leading to the situation in Modern Dutch where the absence of this schwa is obligatory (cf. Raidt 1968).

Phonological output conditions may also be invoked to explain particular word formation patterns. As pointed out by Neef (1996), German has a circumfix *Ge ... e* /gə ... ə/ used to derive nouns from verbs:

(30) Gehopse 'dancing', Gesinge 'singing', Gerede 'speaking'

However, if the verbal stem ends in a schwa-syllable, another form may be chosen for the deverbal noun, without a final schwa. For instance, the noun for the verbal stem *hampel*, with the meaning 'stumbling', has the following possible forms in addition to the form *Gehampele*:

(31) gə-hampəl, gə-hamplə

(in the first form, we may also have a syllabic [l] instead of [əl]). In this way, a sequence of two unstressed syllables is avoided.

One may ask the question under which conditions zero-allomorphy is allowed for. As far as zero-allomorphy in inflection is concerned, an important point to be noted here (also mentioned by Dyk 1996) is that the kind of inflection involved is what has been called weak (Kiparsky 1982) or contextual (Booij 1994) inflection: is is inflection that is completely dependent on and governed by the syntactic context, and has no independent information content. Therefore, it is omissible from the informational point of view.

As observed by Kiparsky (1971) [1982: 67], it is contextual inflection that gets lost first:

(32) Morphological material which is predictable on the surface tends to be more susceptible to loss than morphological material which is not predictable on the surface.

A number of illustrations of this principle can be found in Booij (1994). For instance, Romance languages such as Spanish, Italian and French have lost their case endings (mainly contextual inflection), whereas the formal distinction between singular and plural nouns (inherent inflection) has been kept. In conformity with this generalization, schwas that have a non-predictable function, e.g. the function of nominalizer (changing an adjective into a neuter or a non-neuter noun) always surface, and do not have a zero-allomorph.[7] Menn & MacWhinney (1984: 815) also observed that "[v]acuous application [=ø-allomorphy, G.B] is common only in inflectional morphology, however, where it has the support of sentential redundancies. Derivational morphology is supported by far fewer redundancies". In the German examples of *Ge*-nominalizations in (30), a case of derivational morphology, the prefix *Ge-* can be seen as the expression of the nominal nature of these words, hence the schwa-suffix can be omitted.

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[7] In his LSA summer school lectures, Cornell, 1997, Kiparsky has pointed out that in Finnish it is structural cases only that exhibit zero allomorphy, thus supporting this generalisation.

These considerations with respect to the occurrence of zero-allomorphs are of a functional nature, and are not claimed to be part of the set of formal constraints.

In Frisian, where this kind of schwa-apocope is optional, the zero-allomorph after /n/ is optional, and not an obligatory allomorph. The optionality of the allomorph suggests that phonology has not yet completely won the victory over morphology. In the classical rule-based framework we would say that Frisian has an optional rule of inflectional schwa-deletion, and this is in conformity with the following generalization (Kiparsky 1982: 68):

(33) Grammatically conditioned variability in the application of optional rules favours optimal outputs.

It is interesting to see how in the formulation of this generalization the notion 'output' already plays a direct role. A similar kind of variation is found for Dutch inflected adjectives of which the stem already ends in two schwa-headed syllables:

(34)	het onvermijdələk(ə) gevolg	'the unavoidable consequence'
	ons hartələk(ə) weerzien	'our cordial meeting again'
	gebruikələkər(ə) gevallen	'more usual cases'
	een voorzichtəgər(ə) formulering	'a more prudent formulation'

A parallel development can be seen in the form of inflected infinitives. In Middle Dutch, infinitives could be inflected: the preposition *te* assigned dative case, expressed by the ending -ə:

(35)	te copene /ko:pənə/	'to buy'
	te kerene /ke:rənə/	'to turn'
	te vellene /vɛlənə/	'to fell'

In Modern Dutch, this inflectional ending is no longer found. Again, this inflection is a case of contextual, syntactically determined inflection, which can be lost without loss of information.

3. OCP-effects

As pointed out in the introduction, the sequence /rər/ is to be avoided in Dutch, by means of blocking of morphological processes such as *-erd*-suffixation, and also by using particular allomorphs, as we will see below (a point also made by Shannon 1991) .

The non-occurrence of /rər/ can be seen as an instantiation of a much more general constraint: a schwa cannot be preceded and followed by the same consonant. Since the schwa is the neutral vowel of Dutch, it has no features except on the root node (Van Oostendorp 1995). Therefore, in a sequence /C_iəC_i/, we get adjacency of identical features, thus violat-

ing the Obligatory Contour Principle (OCP).[8] The only sequences of this type that are permitted in native words of Dutch are those with the coronal consonant /n/:

(36)	linnən	'linen'
	binnən	'inside'
	bonnən	'tickets'

This analysis correctly predicts that it is only identical consonants separated by a full vowel with its own place features that are possible:

(37)	pap	'porridge'
	kak	'shit'
	lol	'fun'
	raar	'strange'
	mam	'mom'
	non	'nun'
	sis	'sizzle'

Thus, there are no words in Dutch that contain the sequence /C_iəC_i/ except /nən/.

The occurrence of a sequence like /n ən/ is not excluded by OCP if /n/ is not specified for place at the underlying level because it has the default place of articulation of consonants, the coronal place. However, the invisibility of unmarked place features for such constraints should probably be expressed in a different way, i.e. not by underspecification, because, as pointed out in the literature, there are also rules that crucially refer to, for instance, the set of coronal consonants (cf. Booij 1995: 74). For instance, one could assume that OCP will not take the Place features of the default consonant of a language into account, /n/ being defined as the default consonant of Dutch.

OCP plays two roles: it blocks certain word formation processes, and it governs the selection of allomorphs. In an output constraint based grammar, blocking is interpreted as 'null parse'. For instance, the ill formed word *dappererd* given in the introduction should be blocked as there is no allomorph of this suffix available that would avoid violation of OCP:

(38)

	OCP
dɑpər-ərd	*!
☞ dɑpər-<ərd>	

In this respect, we see a difference between derivation and inflection: a particular derivation can be avoided because derivation is optional: we can always use either an alternative word formation process, or a syntactic construction to express a particular meaning, whereas (contextual) inflection is obligatory. This may explain why inflection makes use

[8] The C_iəC_i-constraint also holds for Frisian (Visser 1997).

only of competing allomorphs and affixes, and not of blocking, i.e. null parse.[9] This difference between derivation and inflection is thus of a primarily functional nature. It could be incorporated into a set of formal constraints by assuming a condition that prohibit null-parse in the case of inflectional morphemes: *Null-parse-Inflection, which is ranked above the phonological constraints that might require null-parse in order not to be violated.

For the suffix *-erd* the alternative suffix *-ling* exists, and this suffix is then used after stems ending in /r/:

(39)	*deadjectival nouns:*		*denominal nouns:*	
	goorling	'dirty person'	kamerling	'valet'
	zuurling	'crab'	voedsterling	'nursed animal'
	zuiderling	'Southerner'	kleurling	'coloured person'
	ouderling	'presbyter'	zilverling	'silver coin'

Similarly, the suffix *-ig* /əɣ/ cannot be attached to a stem ending in /ɣ/. Instead, another suffix has to be used, *-achtig* /ɑxtəɣ/:

(40)				
	berg	'mountain'	*berg-ig / berg-achtig	'mountainous'
	dwerg	'dwarf'	*dwerg-ig / dwerg-achtig	'dwarfish'

If OCP is not violated, both suffixes can be used, e.g. both *rod-ig* and *rood-achtig* with the same meaning 'reddish' are wellformed.

Dutch has a number of *-er*-suffixes, the comparative suffix, the deverbal nominalizing suffix, and the denominal nominalizing suffix. All of them have the allomorph /dər/ to be used after a stem ending in /r/.

(41)	*adjective*		*comparative:*
	duister /dœystər/	'dark'	duisterder
	helder /hɛldər/	'clear'	helderder
	noun		*denominal noun*
	Bijlmermeer /bɛilmərme:r/		Bijlmermeerder
	Almere /ɑlme:rə/		Almeerder
	verb		*deverbal noun*
	leer /le:r/	'to learn'	leerder
	beroer /bəru:r/	'to touch'	beroerder

As pointed out above, the nominalizing *-er* also has the allomorph *-aar*. I will now illustrate how the selection of the right allomorph is made for *Bijlmermeer*.

[9] The lacking of inflectional gaps is not exceptionless. For instance, as mentioned in Halle (1973), Russian verbal paradigms exhibit certain gaps, but these gaps are not due to violation of phonological constraints.

(42)

	OCP	SuperH
(bɛilmər)$_F$(me:r-ər)$_F$	*!	
(bɛilmər)$_F$(me:r-a:r)$_F$		*!
☞ (bɛilmər)$_F$(me:r-dər)$_F$		

In the case of *Amsterdam*, we have to account for the choice between *Amsterdammer* and *Amsterdamder* (the form *Amsterdammaar* is excluded due to violation of SuperH, cf. above). The correct choice (*Amsterdammer*) can be effected in two ways: one solution is to assume that the NoCoda constraint prefers *Amsterdammer* to *Amsterdamder* because the third syllable of the latter is a closed syllable. Note, however, that in *Amsterdammer* the /m/ of the third syllable is ambisyllabic because the preceding vowel is short (Booij 1995). In other words, this solution only works if we assume that the NoCoda constraint is not violated if the relevant consonant is ambisyllabic. The alternative is to assume that the allomorph *-der* is subcategorized for appearing after /r/ only. As we have seen above, such phonological subcategorization requirements cannot be dispensed with in other cases.

There is evidence for the autonomous existence of the allomorph *-der* in that it also occurs in a number of other complex words after stems that do not end in /r/ but in another kind of sonorant consonant:

(43)

dien-der /di:n-dər/	'lit. servant, policeman'
vil-der /vɪldər/	'skinner'
maal-der /ma:ldər/	'miller'
Afrikaan-der /a:fri:ka:ndər/	'id.'

The allomorph /dər/ also occurs in certain suffix combinations which synchronically function as one suffix, *-er-ig* /ərəɣ/ and *-er-ij* /ərɛi/:

(44)

zeur-der-ig	'nagging'
klier-der-ig	'nagging
boer-der-ij	'farm'
grossier-der-ij	'wholesale trade'
poelier-der-ij	'poulterer's firm'
maal-der-ij	'mill'

Again, the allomorphy serves to avoid the sequence /rər/ which violates OCP.[10]

An interesting interaction of the constraints OCP and ParseSyll can be observed in the formation of denominal geographical adjectives. Geographic nouns in *-en* have a shortened

[10] Two exceptional words that violate OCP are *hoererij* [hu:rərɛɪ] 'whoredom' and *narrerij* 'foolish behaviour'. In addition, as Jaap van Marle pointed out to me, some speakers of Dutch claim that they find words like the comparative *barrer* [bɑrər] 'more awful' acceptable. In the latter two examples, the first /r/ is also part of the first syllable because the preceding vowel is short. This suggests that for those speakers the /rər/-constraint would only hold for completely tautosyllabic identical consonants.

allomorph without this sequence, and this shortened stem is used before *-er* in order to avoid violation of ParseSyll:

(45)

noun	*adjective*
Assen /ɑsən/	Ass-ər (*Assen-er)
Beilen /bɛilən/	Beil-ər (*Beilen-er)
Groningen /ɣro:nɪŋən/	Groning-ər (*Groningen-er)

However, in the case of the geographical noun *Haren* /ha:rən/, a short stem without /ən/ would create a violation of OCP in the adjective **Harer* /ha:rər/. Therefore, the adjective for *Haren* is *Harener* /ha:rənər/ (as in *Harener Weekblad* 'Harener weekly') because OCP is ranked higher than ParseSyll:

(46)

	OCP	ParseSyll
$(ha:r\text{-}ər)_F$	*!	
☞ $(ha:rə)_F(n\text{-}ər)_\sigma$		*

The number of morphological processes that could give rise to OCP-place violations is rather restricted for other consonants than /r/. There are two relevant suffixes with /l/: the no longer productive diminutive suffix *-el* /əl/, and the allomorph *-elijk* /ələk/ of the adjectival suffix *-lijk*. As predicted, the suffix *-el* (as in *eik-el* 'acorn' and *drupp-el* 'drop') never occurs after stems ending in /l/, and after /l/-final stems it is always the suffix allomorph *-lijk* /lək/ which is preferred to *-elijk* /ələk/, as in *adel-lijk* /a:dəl-lək/ 'noble' with the phonetic form [a:dələk].

The avoidance of the sequence /rər/ can also been seen in post-lexical phonology. Dutch has a number of clitics spelled as *'r*, with the form /ər/ or /dər/. This clitic always fuses with the preceding word into one prosodic word (Booij 1995, 1996), which is the domain of the OCP-constraint discussed here. A compound like *ere-rij* /e:rərɛi/ 'row of honour' is wellformed because the sequence /rər/ is distributed across two prosodic words. Since the clitic form /ər/ (the feminine pronoun *er* and the adverbal pronoun *er*) has the allomorph /dər/, it is this allomorph that is obligatorily used after a host word ending in /r/:

(47)

(Ik) koester 'r	'I cherish her'	*[ku:stərər], [ku:stərdər]
(Ik) boor 'r	'I drill there'	*[bo:rər], [bo:rdər]

Again, the selection of the right allomorph of these clitic forms follows from the OCP-constraint proposed above. This suggests that this constraint also applies to prosodic words created postlexically. For clitics of the form /əC/, with C being /m/ or /t/, there is no allomorph available, and hence we do find sequences like [tət] and [məm], as in *ziet 't* [zitət] 'sees it' and *noem 'm* [numəm] 'name him' respectively: the clitic must surface somehow due to Morpheme Identity.

4. Conclusions

In this paper I have shown that making use of phonological output constraints is essential for a proper account of the choice between competing affixes, and between allomorphs of affixes and stems in the morphology of Dutch. Thus, it is possible to express the fact that there are general phonological constraints that are relevant for more than one morphological process, and to account for the observation that the selection process can be governed by output forms.

However, the set of phonological conditions on morphological operations cannot be completely reduced to output conditions, and thus to phonology. The set of coocurrence restrictions on morpheme concatenation that form part of the definition of the set of wellformed complex words of a language also comprises subcategorization requirements on the phonological forms of these morphemes. These phonological subcategorization features form part of a larger set of subcategorization features of affixes and stems that serve to define morphological welformedness. For instance, affixes also impose requirements as to the syntactic category of the stems they attach to, and to the layer of the lexicon to which the stem should belong, for instance the non-native stratum. We might therefore assume that the morphological module of the grammar contains a generator that generates the set of possible complex words within the boundaries set by such constraints. By locating these requirements within the morphological generator, they are correctly qualified as unviolable constraints. The phonological module will then serve to make a choice between those candidate complex words that obey the Gen-constraints but differ in the selection of affix or allomorph. In the case of derivation, this evaluation procedure will also include the possibility of null-parse, and thus the blocking of a particular complex word. This view also implies that morphology cannot be equated with the morpheme-concatenating function of the Generator. Morphology is an autonomous module of the grammar (cf. Booij 1997b) in that it imposes its own, non-reducable requirements on the forms of complex words.

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Chris Golston and Richard Wiese

The structure of the German root

'Nur das Geheimnis der Wurzeln oder des Benennungsgrundes der Urbegriffe lassen wir unangetastet.' (Bopp 1833)

0. Goals[1]

The goal of the present study is to make the notion of the root more accessible to morphology and phonology by looking at a large corpus of roots and describing the frequency of different types of root in a constraint-based grammar.

Our research is based on a computer-readable data base of German roots compiled by Ortmann (1993) from ten different sources. We identify a number of phonological properties of roots and demonstrate that unmarked root shapes are much more common than marked ones. To base the research in a theoretical framework we use Direct OT (Golston 1996b), according to which underlying forms are represented solely in terms of markedness, as sets of constraint violations. Our goals are to show that phonologically unmarked roots are more common than marked ones, and to contribute to the theory of morpheme structure constraints.

1. Morphemes and roots

Every serious theory of language is based on morphemes. This is true even of theories that explicitly deny them. We know that aside from a grammar a language learner must learn a large number of arbitrary pairings of signals-to-meanings. The overwhelming majority of such pairings are of the familiar type in (1):

(1) Typical morpheme

 <=> [kæt]

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