Topics in the phonology of Dutch

Marc van Oostendorp
Meertens Instituut, Amsterdam

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Background information

Dutch is a West-Germanic language spoken by approximately 22 million people, and an official language in The Netherlands and (part of) Belgium. It is a Continental West Germanic language, and as such it is closely related to German — we will see quite a number of similarities between the phonological systems of the two languages. Dialectologically it mostly derives from the so-called Low Franconian dialects of Germanic, but there are also influences from Low Saxon. Furthermore, there has been influence over the course of time from Standard German, French and English. Every textbook on sociolinguistics will mention that there is a West Germanic dialect continuum: dialects on the border between the Netherlands and Germany are very closely related.

'Holland' in Dutch refers to a part of the Netherlands, the part in the west which contains cities such as Amsterdam, Rotterdam, The Hague and Leiden. This region has been the economic and cultural centre of the Dutch-speaking area for several centuries, which means that the dialects spoken in this region had the strongest influence on the standard language. This standard was basically formed in the 17th century, when a committee installed by the government translated the bible. This *Statenvertaling* (State translation) was adopted by the Church, and read by families at home until very recently. A standard pronunciation probably arose in the course of the 19th century, when traveling became more common among the elite.

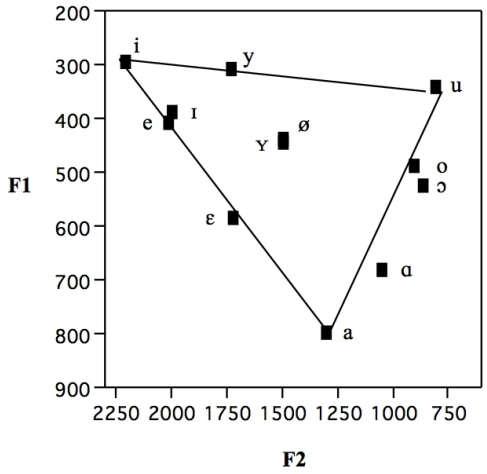
The variety of Dutch spoken in Belgium is sometimes called 'Flemish', but officially the standard language is the same as the one in the Netherlands. Nowadays, the Netherlands, Belgium and Surinam cooperate in an intragovernmental organisation, *Nederlandse Taalunie* (Dutch Language Union), which organizes and subsidizes all official activities concerning e.g. standardisation or the use of Dutch in the European Union — where Dutch is considered to be the 'largest of the small languages', smaller in terms of the number of speakers than English, Spanish, German, Polish, French and Italian, but larger than Portuguese, Danish, Swedish, Czech, Greek, etc. Although most native speakers of Dutch speak English, as well as some French and German, and although some people are afraid that English will become dominant, at present there are no real indications that Dutch is in any realistic sense endangered.

Because of the relatively large number of (generative) linguists in the Netherlands, Dutch is a language that has received a lot of attention in the literature. In this course, we will be mostly concerned with Standard Dutch, in particular in the way it is spoken in the Netherlands; but some attention will be paid to dialects of Dutch as well.

1 Vowels, syllable structure and stress

1.1 The vowel system

Arguably the oldest topic in the study of Dutch phonology is the structure of the vowel system.[1] The following depicts the vowels of Standard Dutch in a vowel triangle.[2]



(1)

Next to the vowels depicted here, it is generally recognized that Dutch also has a contrastive schwa [ə] and three diphthongs [ɛi, œy, ɑu].[3] The question is how we are going to put these vowels into a phonological system. In particular, it can be observed that the vowels in (1) can be divided into two subsets, sometimes called A-vowels and B-vowels respectively:

(2) a. A-vowels: i, y, u, e, ø, o, a
b. B-vowels: ɪ, ʏ, ɔ, ɛ, ɑ

The main motivation for drawing this distinction is phonotactic (taking [aː]-[ɑ] as an example pair):

(3)	A.	r[aː]	r[aː]m	r[aː]p	*r[aː]mp
		'yard'	'window'	'turnip'	—
	B.	*r[ɑ]	r[ɑ]m	r[ɑ]p	r[ɑ]mp
		—	'ram'	'quick'	'disaster'

[1] de Groot (1931); van Ginneken (1934); van Wijk (1939); Heeroma (1959); van Haeringen (1962); Moulton (1962); de Rijk (1967); Brink (1970); Nooteboom (1972); Pols *et al.* (1973); Schutter (1978); Trommelen (1982, 1987); Smith *et al.* (1989); van der Hulst (1984); Lahiri & Koreman (1988); Kager (1989); Booij (1995); van Oostendorp (2000); Gussenhoven (2006).

[2] Copied from Verhoeven & Van Bael (2003), who base their data on Pols *et al.* (1973).

[3] Zonneveld & Trommelen (1980); Trommelen & Zonneveld (1989b); Swets & van Oostendorp (2003).

A-vowels can occur before 0 or 1 consonant, B-vowels before 1 or 2 consonants.[4] These observations are true at the end of the word, in the middle of the word, B-vowels can generally be followed only by one tautosyllabic consonants, and A-vowels by none. Phonetically, the two groups can be generally distinguished in two ways: A vowels are usually longer than B vowels, and als A vowels are considered to be [tense] or [+ATR], while B vowels are [lax] or [-ATR].

The easiest way of understanding the facts in (3) is by taking the length as 'phonological'/underlying and declaring the tenseness as phonetic or, at most, as enhancing. If A vowels occupy two positions in the rhyme, and B vowel occupy one position, we can make the following claim about Dutch syllable structure:

(4) a. A syllable rhyme has to occupy exactly two positions.
b. At the end of the word, a syllable rhyme can be followed by one additional consonant.

Because an A vowel already has two positions, it can be followed by at most one consonant (but it does not have to); because a B vowel has only one position, it has to be followed by at least one and it can be followed by at most two positions.

The alternative theory based on tenseness seems much less attractive:

(5) a. A tense vowel has to be in an open syllable, a lax vowel has to be in a closed syllable
b. The syllable rhyme contains at most two positions
c. At the end of the word, a syllable rhyme can be followed by one additional consonant

In particular the additional claim in (5a) looks suspicious: why would there be this relation between tenseness and syllable structure? Probably for this reason, the length theory has been dominant in the generative literature for quite some time.

Yet despite its initial relative attractiveness, there are quite a few problems with the theory in (4). We will discuss a few of them:

1. It forces us to assume that Standard Dutch does not have the syllable type CV, in spite of a very strong and well-supported claim that this is a universal Trubetzkoy (1939); Jakobson (1942). If A-vowels are long,

[4] This discussion abstracts away from the fact that both after A-vowels and after B-vowels a string of voiceless coronal obstruents can follow: *haast* 'hurry' [ha:st], *herfst* 'autumn' [hɛrfst]. Most scholars assume that these coronals are somehow outside the phonotactic structure proper.

and B-vowels can only be followed by a consonant, Dutch has the following syllable inventory: { CVV(C), CVC(C) }, with the consonants in parentheses only allowed at the end of the word. CV is not in this inventory.
Tenseness theory does not suffer from this problem, since it generates the following set of syllables: { CV, CVC(C) }.

2. It also causes problems in our analysis of Dutch word stress, since 'long' vowels do not make a syllable heavy (different from closed syllables and from diphthongs), as we will discuss in section 1.2. Tenseness theory does not suffer from this problem, since the long vowels are not long, hence they are not specifically expected to attract stress.
3. Another markedness criterion mentioned by Trubetzkoy (1939): if a language has two disjoint sets of segments, we expect the set of the more marked segments to be smaller. We can observe in (146) that the set of A-vowels is bigger than the set of B-vowels. Length theory makes the undesired assumption that there are now several long vowels which do not have a short counterpart. Although this is not completely impossible *a priori*, it is clearly less desirable. Tenseness theory, on the other hand, only has to assume that [-ATR] (or [lax]) is the marked feature in Dutch.
4. Phonetically, some of the A-vowels are actually very short, i.e. the high vowels { i, y, u }, which are usually pronounced much shorter than any of the B-vowels. It must be noted, however that (i) the phonetic correlate of tenseness/laxness is hard to discern, and it is also true that the high vowels sometimes behave as ambiguous between membership of the A- or of the B-vowels
But this problem also has a purely phonological side to it. Consider the following attempt to organize the vowels into a phonological table:

(6)

A-vowels				B-vowels			
	-back -round	-back +round	+back		-back -round	-back +round	+back
+high	i	y	u	+high			
-high,-low	e	ø	o	-high, -low	ɪ	ʏ	ɔ
+low			a	+low	ɛ		ɑ

How can we explain the gaps in this table? For length theory, the gaps are random, or even a bit suspicious. Why are there long high vowels, but no short long vowels, whereas there are more short low vowels than long ones? Generally, it is known that there is a *positive* correlation between being low and being long, and between being high and being short.
Tenseness theory, on the other hand, has no problems with these gaps: they are actually exactly what this theory expects. There are constraints

against the feature combinations *[+high,+ATR] and *[+low,-ATR], and those restrictions occur in many languages with a feature [±ATR] (Archangeli & Pulleyblank, 1994).

5. Phonotactically, schwa behaves as an A-vowel: it can occur in an open syllable (*mod*ə 'fashion') or in a syllable closed by at most one consonant (*adər* 'vein'), but not in a syllable closed by more than one non-coronal consonant (*adərp). Now, although this has led indeed some scholars to assume that schwa is a bipositional vowel (Booij, 1995), this is a very counterintuitive result, leading to many formal problems. For instance, this 'bipositional' vowel *avoids* stress, and phonetically it is ultrashort.
6. There are certain phonological constraints ('Morpheme Structure Constraints') which distinguish between A-vowels and B-vowels (van Wijk, 1939). For instance, there is a constraint against *[ji]-clusters within words: these do not occur, but on the other hand there are e.g. a few perfectly normal words starting with [jɪ-]: *jiddisch* 'Yiddish', *jicht* 'gout'. The working of this filter can also be observed in glide insertion: while we can insert a [j] in *hiaat* 'hiatus' [hijat] as well as *hobbyist* 'amateur' [hɔbijɪst], we cannot do it in *shiiet* 'shiite' [ʃi.it] (*[ʃijit]). We would normally want to reduce this to the OCP, but this would imply that /j/ and /i/ are the same: there is no known formulation of the OCP which would involve length of this type (with the possible exception of Itô & Mester, 2003).
7. Secret languages and language games treat A-vowels as a unit, while cross-linguistically, language games tend to split up long vowels (Vago, 1985).[5] For instance, speakers of Dutch confronted with a few example sentences of the following type (only involving B-vowels and schwa) (van Oostendorp, 2000):

   (7) Dit is erg simpel.
   dɪbɪt ɪbɪs ɛbɛrx sɪbɪmpəbəl
   This is very simple.

   After this, those same speakers were asked to apply the same procedure to new sentences, some of which would contain A-vowels. These A-vowels would never be split up:

   (8) Ik lees dat boek.
   ɪbɪk lebes dɑbɑt bubuk
   *ɪbɪk lɪbebɪs dɑbɑt bubuk
   I am reading that book.

[5] The same is true for the 'long' vowels of English, cf. McCarthy (1991).

8. A number of dialects of Dutch have a threeway (and sometimes even a fourway) distinction between vowels. Tilburg Dutch, for instance, has the following vowels (Swets, 2004):

   (9) *Tilburg vowel system*

   a. tense vowels

i	y	u
e	ø	o

   b. short lax vowels

ɪ	ʏ	ɔ
ɛ	ʌ	ɒ

   c. long lax vowels

ɪː	ʏː	ɔː
ɛː	ʌː	ɒː

   Yet even in this case, the tense vowels behave as long (they do not allow more than one non-coronal consonant). Now one could still argue that tense vowels are long by default (in other words, what is missing in Tilburg are the short tense vowels), but the Antwerp dialect shows that this conclusion is not a necessary one: this dialect probably has a real underlying length distinction, but here all lax vowels are long and almost all tense vowels short (Nuyts, 1989):

(10)	st[i]pt	'prompt'	g[ɪː]r	'scream'
	sp[e]l	'play'	b[ɛː]k	'brook'

   And what is more, the Hofstade dialect (Keymeulen & Taeldeman, 1985) has a complete cross-classification of tenseness and length (so both tense and lax long and short vowels). All in all this dialect has 25 distinctive vowels, some of which are listed below:

(11)	w[i]t	'white'	w[iː]l	'wheel'
	b[e]lt	'image'	v[eː]l	'much'
	[ɛ]mme	'skirt'	w[ɛː]t	'wide'

   Yet even in this dialect, the short tense vowels do not seem to occur in a context before more than one consonant. We need something like (5a) to describe this. But if a statement to this effect is included in Universal Grammar, there is no reason why it could not be referred to in the analysis of Standard Dutch, and this in turn lifts the main argument against the length analysis.

We thus see that the length theory suffers from a number of problems, which tenseness theory could solve quite easily. On the other hand, the typological objections against (5) have become less clear, because analyses along these lines have been proposed for related languages such as English (e.g. Hammond, 1997), German (Féry, 1997) and French (van Oostendorp, 2000; Féry, 2001). For the latter language, the difference may be the clearest. Let us briefly consider the case of Midi ('Southern') French. In the traditional dialectology of this system, we find the following *Loi de Position* (Position Law):

(12) *Loi de Position* Lax (mid) vowels appear in a closed syllable (or an open syllable followed by a schwa-headed syllable); tense mid vowels appear elsewhere

This serves to describe contrasts such as the following:

(13)

fɛt *fête* 'party (N)'	sɛləʁi *céleri* 'celery'	fete *fêter*to party (N)
kɔd *code*code (N)	mɔkəʁi *moquerie* 'mockery'	kode *coder* 'to code (V)'
øʁœz *heureuse* 'happy (F)'	øʁœzəmã *heureusement* 'fortunately'	apøre *apeuré*frightened

The difference between [ɛ] and [e], or between [ɔ] and [o] clearly corresponds to a difference between closed and open syllables, but there is no reason to assume that (Southern) French distinguishes between 'long' and 'short' vowels. Furthermore, some dialects display a process of 'vowel harmony' regarding the feature [tense]: if the following vowel is high, the mid vowel is tense, if it is low, the mid vowel is lax:

(14) a. *bête - bêtise* [bɛt betiz]
b. *dos dossard* [do dɔzaʁ]
c. *aimer - aimable* [eme ɛmabl]
d. *pécher - pécheur* [peʃe pɛʃœʁ]

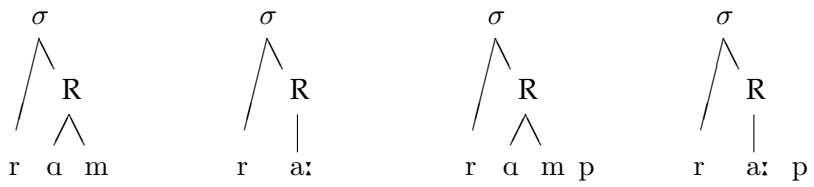
Harmonic behaviour is a clear indication that we are dealing with a feature under standard assumptions in phonological theory; length cannot spread, but a feature can.

We thus seem to need something like a length theory in our description of this language independently; we can then also use it for Dutch. van Oostendorp (2000) therefore proposes that we need constraints such as the following in our inventory of constraints:

(15) CONNECT-([lax],R): a rhyme is branching *iff* it is headed by a lax vowel.

This means that we assign the following syllable structures to words like *ram* 'ram' [rɑm], *ra* 'sail' [ra], *ramp* 'disaster' [rɑmp] and *raam* 'window' [ram]:

(16)



Where in the structure is the final consonants in words such as *ramp* and *raap*? We cannot just assign them to a coda position, since then the CONNECT constraint would no longer be satisfied. van Oostendorp (2000) argues that there are reasons to assume that they are in a separate onset of a syllable with an otherwise empty-head. For one thing, these 'superheavy' structures behave as bisyllabic with respect to stress.

1.2 Word stress

Dutch stress is yet another a well-studied topic within generative phonology.[6] The stress rules are quite similar to those of English, even though there are several interesting and important differences. In any case, like the English and German system, Dutch word stress is very complicated. At first sight, it even looks as if there is no regularity. In words consisting of three open syllables, stress can be on either syllable, depending on lexical specification:

(17) a. *Panama* 'Panama' [pánama]
b. *pyjama* 'pyjamas' [pijáma]
c. *chocola* 'chocolate' [ʃokolá]

Given facts like these, one might be tempted to assume that stress is just a lexical property, not subject to grammatical regularities. However, most scholars of Dutch now agree that there are still quite some regularities, although the system is quite complex. For instance, in long monomorphemic words, stress is never on the preantepenultimate syllable (*mácaroni*), in other words, like many (Indo-European) languages, Dutch stress falls within a three-syllable window at the end of the word. Further, stress is sensitive to weight, as we have mentioned above: if one of the last three syllables is heavy, stress can no longer be placed randomly. We can only give a sketch of an analysis here.

A point of departure for our discussion will be that even in the list in (17), we should differentiate between three levels of unmarkedness: there are reasons to assume that penultimate stress is the least marked of the three.

[6] van der Hulst (1984); Kager (1989); Trommelen & Zonneveld (1989a); Zonneveld (1993); Nouveau (1994); Booij (1995); van Oostendorp (1997a); Gussenhoven (2006).

One reason is language acquisition (Nouveau, 1994): when children acquire the stress patterns of the language, they make mistakes, but these always go in one direction: words of the type *chocolá* may be regularized to either *chocóla* or *chócola*; words of the type *pánama* may be regularized to *panáma*; but words of the type *pyjáma* are never regularized. From this we may conclude that there is a markedness hierarchy of the following structure:

(18) CVCV́CV ≻ CV́CVCV ≻ CVCVCV́

How are we going to model this hierarchy in OT? Regular stress is thus on the penultimate syllable of the word (19a), except if the word ends in a so-called superheavy syllable, i.e. a tense vowel followed by one, or a lax vowel followed by two consonants. In this case, word stress is on the final syllable (19b).

(19) a. *commode* 'chest of drawers' [kɔmódə]
tempo 'tempo' [tɛ́mpo]
motor 'engine' [mótɔr]
b. *ledikant* 'bedstead' [ledikɑnt]
automaat 'automaton' [otomaːt]
paniek 'panic' [paniːk]

The standard analysis of this is that Dutch has trochaic feet, that the last trochee of the word gets main stress, and that superheavy syllables attract stress irrespective of these constraints. We can obtain this effect for instance by the constraints in (20), if ranked according to (21):

(20) a. TROCHEE: Feet are left-headed and bisyllabic
b. ALIGN-R: Feet prefer the rightmost position in the syllable.
c. SUPERHEAVY: Superheavy syllables get stressed

(21) SUPERHEAVY ≫TROCHEE ≫ALIGN-R

(22) a.

/pijama/	SUPERHEAVY	TROCHEE	ALIGN-R
(píja)ma			*!
☞pi(jáma)			
pija(má)		*!	

b.

/panik/ 'panic'	SUPERHEAVY	TROCHEE	ALIGN-R
(pánik)	*!		
☞pa(ník)			*

Notice, however, that this analysis can be changed if we assume that superheavy syllables are actually bisyllabic structures:

(23)

/panik/ 'panic'	TROCHEE	ALIGN-R
(pá.ni.k)	*!	
(pá.ni).k		*! *
☞pa.(ní.k)		
pa.(ní).k	*!	*
pa.ni.(ḱ)	*!	

Now we turn to our attention to the more marked forms, for instance the word *pánama*, with initial stress. We will assume that this word has an underlying foot structure (/(pana)ma/), and that there is a faithfulness constraint regarding this foot:

(24) a. FAITH-FT: If a vowel is the head of a foot in the input, it should be the head of a foot in the output.

b. TROCHEE ≫FAITH-FT ≫ALIGN-R

c.

/(pána)ma/	TROCHEE	FAITH-FT	ALIGN-R
☞(pana)ma			*
pa(náma)		*!	
pana(má)	*!	*	
(pana)(má)	*!		(*)

Notice that we might assume an underlying foot for *py(jáma)* as well; this would give us the same result, and at least under certain conceptions of Lexicon Optimisation, an underlying foot would be preferred also in this case. In what sense, then is *pánama* more marked? We suggest that it is more marked because its optimal outcome will always violate a constraint (TROCHEE), whereas this is not true for *py(jáma)*. Furthermore, we assume that there will always be a tendency to set up underlying, lexical representations which will surface with as few high-ranking violations as possible. This would be true for instance in language acquisition: a child would prefer an underlying representation which 'does not need faithfulness', or for which the underlying structure already conforms to the optimal output structure of a form which is unmarked. In this way, the old structuralist assumption holds: that form is least marked which has (or needs) the minimal amount of underlying structure.

In principle, given our constraint hierarchy so far, we could *not* derive forms with final stress such as *chocolá*. Even if this form has a lexical marking on the final syllable, this could not survive:

(25)

/choco(lá)/	TROCHEE	FAITH-FT	ALIGN-R
(chóco)la		*	*!
☞cho(cóla)		*	
choco(lá)	*!		

Words such as *chocolá* thus need an extra marking, in order to survive. For this we adopt the theoretical device of *catalexis*, which comes from the study of metrics, like *extrametricality*, to which it is the counterpart. Kiparsky (1991); Kager (1995) show that where extrametricality can be thought of as a syllable which does not correspond to a metrical position in a foot, catalexis inversely can be thought of as a position in a foot which does not correspond to a pronounced syllable. Words which are marked as catalectic are marked as having this extra metrical position. For the sake of concreteness, we assume that this is a completely empty syllable — different from the semisyllables in superheavy syllables we have seen before.

Obviously these catalectic syllables should be limited; there should be a constraint against them.

(26) *EMPTY: No catalectic / completely empty syllables are allowed.

Even if this constraint has the lowest position in our hierarchy so far, it will still make sure that the addition of a catalectic syllable — here represented by σ_0 — generally will not have a lot of effect. For instance, on its own, it will not lead to a stress on the final syllable:[7]

(27)

/chocolaσ_0/	TROCHEE	FAITH-FT	ALIGN-R	*EMPTY
(chóco)laσ_0			*!	*
(chóco)la			*!	
cho(cóla)σ_0			*!	*
☞cho(cóla)				
choco(láσ_0)				*!
choco(lá)	*!			

We will only get the right result if we have an input with both a catalectic syllable and an underlying foot:

[7]There will probably also be faithfulness requirements to the underlying catalectic syllable; these has to be even lower in the hierarchy, because we do not want to be faithful to all kinds of random catalectic syllables everywhere.

(28)

/choco(laσ_0)/	TROCHEE	FAITH-FT	ALIGN-R	*EMPTY
(chóco)laσ_0		*!	*	*
(chóco)la		*!	*	
cho(cóla)σ_0		*!	*	*
cho(cóla)		*!		
☞choco(láσ_0)				*
choco(lá)	*!			

It is thus essential that we need two markings for *chocolá*, one marking for *pánama* and no markings for *pyjáma*. This reflects the markedness hierarchy in (18).[8]

Lexical markings thus account for the observed lexical variation. However, we have already noted that interaction with syllable weight excludes certain possibilities. For instance, if the syllable in the middle is heavy (*agenda* 'diary' [a.ɣɛ́n.da]), stress can never occur on the initial syllable.[9] The reason for this is probably a high-ranking WEIGHTTOSTRESS (WSP):

(29)

/(ágen)da/	TROCHEE	WSP	FAITH-FT	ALIGN-R
(ágen)da		*!		*
☞a(génda)			*	
agen(dá)	*!	*	*	

For our discussion in chapter 2, two further observations will also be important:

(30) a. If the final syllable of the word is schwa, stress will be on the syllable immediately preceding it (no variation is possible).
b. If the final syllable of the word is superheavy, stress will be on that syllable (no variation is possible).

Again, there should be markedness constraints outranking FAITH-FT. Notice that under the assumption that superheavy structures are really superheavy, these observations amount to the same thing: if the last syllable of the word is very weak — either it has a schwa as its head, which presumably is a vowel

[8] How do children 'simplify' *chocolá* to *chócola* instead of the completely unmarked *chocóla*? By taking away one marking in the representation in the main text, they will always get immediately to the completely unmarked form. Notice however that an underlying marking /(choco)laσ_0/ might give the same outcome in (28), under the additional assumption that words are exhaustively parsed into binary feet, and that the final foot will get primary stress. This assumption will also explain why underlying *(máca)roni* will lead to *(maca)(róni)* on the surface. Losing the catalectic syllable here will lead to the *chócola* form.

[9] There is debate on whether stress is possible on the final syllable in this case. We will ignore this debate here for the sake of simplicity. Cf. Nouveau (1994).

with very little feature content, or it has no head at all —, stress is on the syllable immediately preceding it. We will not go into the details of the formalisation of this (van Oostendorp, 2000), but will simply assume that there is a constraint WEAK:

(31) WEAK: A weak syllable has to appear in the weak position of a foot. (It cannot be the head of a foot and it cannot occur outside of a foot.)

This constraint will block again lexical variation:

(32) a.

/(óran)jə/	TROCHEE	WEAK	FAITH-FT	ALIGN-R
(óran)jə		*!		*
☞o(ránjə)			*	
oran(jə́)	*!	*	*	

b.

/(ṕani)k/	TROCHEE	WEAK	FAITH-FT	ALIGN-R
(ṕani)k		*!		*
☞pa(ník)			*	
pani(ḱ)	*!	*	*	

2 Across morphological boundaries

2.1 Asymmetries between prefixes and suffixes

Asymmetries in phonological behaviour between types of affixes are not uncommon in languages of the world. 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 class 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.

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 (33a), 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 (33b). 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 (33c).

(33) a. *ode* 'ode' [o.də]
b. *er+en* 'to honour (+INF' [e.rən]
c. *ont+eer* 'dis+honour' [ɔnt.er]

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 (34) below:

(34) a. *elite* [e.li.tə] 'elite'; *elite+air* [e.li.tɛr] / *[e.li.tə.ɛr] 'snobbish'
b. *adem* [a.dəm] 'breathe'; *be+adem* [bə.a.dəm] / *[ba.dəm] '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 (**?**) are ranked below the constraint ONSET. This can be observed in the derivation of the following (hypothetical) underlying form /məɑn/:

(35)

/məɑn/	ONSET	FAITH-ə
mə.ɑn	*!	
☞mɑn		*

In affixed forms we find again an asymmetry between prefixes and suffixes, as can be seen in (34). 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.

It is easy to think of a number of unsatisfactory solutions to this problems:

- *Suffixes are morphologically attached before prefixes are.* The problem with this solution is that it is arbitrary; furthermore in a case like *ont+eer+en* (dis+honour+INFL), the suffix is inflectional and the prefix is derivational, which makes it somewhat harder to adopt this solution.
- *Dutch adopts a ranking* ALIGN-L≫ALIGN-R. This solution is also arbitrary; does not take into account the fact that this ranking is universal, or otherwise it merely postulates this universality.
- *"Processing pays special attention to the left edge."* Even this solution s to some extent arbitrary, since it does not explain why this is the case; processing also pays attention to the right edge.

We try to find a more principled explanation in terms of the concept *integrity*. We assume that every syllable has a head, which is a 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≈LX (Prince & 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:

(36) PR≈LX: Morpheme boundaries should coincide with the boundaries of prosodic constituents (i.e. a phonological word).

In essence, PR≈LX is a symmetrical version of asymmetrical ALIGNLEFT and ALIGNRIGHT; like these constraints, it bans boundaries that do not cooccur. Unlike these, it does not distinguish between the left-hand side of the word and the right-hand side of the word. In the analysis of Dutch word-stress above, an asymmetric constraint ALIGNRIGHT has been 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*:

(37) $[_V[_V$ 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*.[10] 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:

(38) 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:

(39) 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 a constraint accounting for the difference between prefixes and suffixes:

(40) Morphological syllable integrity (INTEGRITY):
All segments in a syllable should be in the same domain as that syllable.
$\forall$ segment S: $\forall$ syllable T dominating S: the morphological domain of S $\subseteq$ 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

[10] The fact that *eer* is written with only one <e> in the latter form, is a caprice of Dutch orthography.

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):

(41) a.

[ɔn [en ix]] un+one+ish 'disputing'	INTEGRITY	ONSET
☞[ɔn. [e.n ix]]		**
[ɔ.n [e.n ix]]	*!	*

b.

[[ɔnt er] ən]	INTEGRITY	ONSET
[[ɔnt. er.] ən]		**!
☞[[ɔnt. e.r] ən]		*

Alignment is irrelevant in the cases at hand, and we may therefore assume that PR≈LX is ranked below the ONSET constraint. In all, we have three constraints, which may be ranked in the following three distinguishable ways:

(42) a. INTEGRITY ONSET PR≈LX
b. PR≈LX ONSET (ranking of INTEGRITY irrelevant)
c. ONSET PR≈LX, INTEGRITY

The grammar in (42a) gives us the Dutch facts; the grammar of (42b) gives a language in which both prefixes and suffixes are separated from the stem; (42c), 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.

2.2 Lexical levels

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):

(43) a. Class I: *-aal* /al/, *-aan* /an/, *-age* /aʒe/, *-air* /ɛːr/, *-ast* /ɑst/, *-eel* /el/, *-eer* /ɪːr/, *-ees* /es/, *-egge* /ɛɣə/, *-ein* /ɛin/, *-erig* /ərɪx/, *erij* /ərɛi/, *-es* /ɛs/, *-esk* /ɛsk/, *-eur* /øːr/, *-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/

b. 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 later; 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:

(44) a. Class I suffixes trigger resyllabification, Class II suffixes do not (/mohɑmɛd/ +/an^1/ → /mohɑmɛdan/, vs. /halv/ + /lɪŋ^2/ → /hɑlflɪŋ/)

b. Class I suffixes trigger schwa deletion, but Class II suffixes do not (/sinodə/ +/al^1/ → /sinodal/ vs. /wardə/ + /los^2/ → /wardəlos/)

We can see that no resyllabification has applied in (44a) 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 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:

(45)

/mohɑmmɛd/+/an/ mohammed+-an, 'muslim'	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 INTEGRITY and ONSET are irrelevant:

(46)

/vœyl/+/nɪs/ 'garbage' ('dirt'+NOM)	INTEGRITY	ONSET
☞vœl.nIs		
☞vœ.lnIs		

In this case, 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. Therefore, another constraint becomes relevant, the Syllable Contact Law (SC):

(47) *Syllable Contact* (SC)
*$C_i.C_j$, where C_i is less sonorous than C_j.

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

(48)

/ʋɛrk/+/los/	PR≈LX	SC
[[ʋer.k]los]	*!	
☞[[ʋerk.]los]		*

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

(49)

/er/+/ən/	ONSET	PR≈LX
☞[[e.r]ən]		*
[[er.]ən]	*!	

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

(50) INTEGRITY ≫ONSET ≫PR≈LX ≫SC ≫FAITH-ə

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 (51a) or schwa deletion (51b).

(51) a. *roodachtig* 'reddish' [rot.ɑx.tɪx, *ro.dɑx.tɪx]
b. *oranjeachtig* 'orange-like' [o.rɑn.jə.ɑx.tɪx, *o.rɑn.jɑx.tɪx]

There are several ways to solve this problem. I assume 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. 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:

(52)

/rod/+/ʔɑxtɪx/	INTEGRITY	ONSET	PR≈LX
[[ro.d]ʔɑxtɪx]			*!
☞[[rot.]ʔɑxtɪx]			

Both candidates fare equally well with respect to these two constraints. Therefore, there are other constraints that decide between the two. PR≈LX 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.

We now turn our attention to the interaction with 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:

(53) a. *televisie* 'television' [teləvízi]
b. *televisie-achtig* 'television-like' [teləvíziɑxtəx]

'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 (54). 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 (55).

(54) a. *eenvoud* 'simplicity' [énvɑut]
b. *eenvoud+ig* 'simple' [enváudəx]

(55) a. *respect* 'respect' [rɛspɛ́kt]
b. *respectabel* 'respectable' [rɛspɛktábəl]

It is widely agreed upon[11] 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.

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.

(56)

	respect+abel	*televisie-achtig*
Level I: stress assignment	[rɛspɛktábəl]	[teləvízi]
Level II: compound stress		[teləvíziɑxtɪx]

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: Class I suffixes have an independent reason to cross morpheme boundaries. ONSET forces them to do this. Particularly relevant is also the constraint PR≈LX, 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≈LX. The stress on this form is therefore similar to that of a compound.

(57)

/televizi/+/ʔɑxtɪx/	PR≈LX
☞(televízi)(ʔàxtɪx)	
☞(televizi)ʔáxtɪx)	

The stress within each of the phonological words is determined by the constraints outlined in the previous section. However, we have seen that PR≈LX

[11] Booij & van Santen (1995); de Haas & Trommelen (1993); Booij (2002).

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:

(58)

/rɛspɛkt/+/abəl/	ONSET	PR≈LX
☞(rɛspɛktábəl)		*
(rɛspɛ́kt)(àbəl)	*!	

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

2.3 Inflectional suffixes

Inflectional suffixes in Dutch behave as ambiguous (or 'paradoxical') with respect to the criteria for Class I vs. Class II.[12] On the one hand, they are insensitive to stress, just like Class II suffixes, but on the other hand they resyllabify, if they are vowel-initial, just like Class I suffixes.

I will discuss these two properties in turn. In the first place, we find in inflected forms we find exceptions to both generalisations in (30), repeated here for convenience:

(30) a. If the final syllable of the word is schwa, stress will be on the syllable immediately preceding it (no variation is possible).
b. If the final syllable of the word is superheavy, stress will be on that syllable (no variation is possible).

However, if an inflectional suffix contains a schwa (59a), or if it is a consonant which makes the preceding syllable superheavy (59b). As these examples show, the stress on inflected words is always the same as stress on the uninflected forms of those words. In this sense, then, is inflection 'invisible' for stress.

(59) a. [átlɑsə] 'atlasses' (*[ɑtlásə], from [átlɑs])
b. [anvɑŋt] 'start (3S)' (*[anvá̋ŋt], from [ánvɑŋ])

On the other hand, syllabification can see inflection. Inflected forms have a normal syllabification, as is visible if the inflection starts with a vowel. Notice that there is no final devoicing in (60). (Since there are no sonorant-initial inflectional suffixes, nothing can be said about them.)

[12] I will ignore here the class of derivational suffixes which are equally paradoxical. See van Oostendorp (2004).

(60) [levə] ('live (PL)'; from /lev/)

The traditional solution is (also) in this case, that suffigation of inflectional material will have applied after stress, but this leaves the question open why syllabification can reapply but stress cannot.

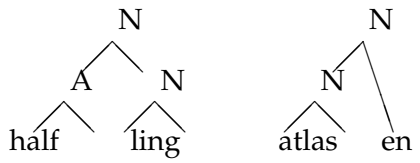
Yet another property of inflectional suffixes has to be mentioned: their segmental structure. Inflectional suffixes (as well as most function words in Dutch) are composed of segments in the following inventory:

(61) [t, s, n, r, ə]

If we assume that coronals are the least marked consonants, and that schwa is the least marked vowel of Dutch, we can see that these are the most unmarked stop, fricative, nasal, liquid and vowel of the language. Why would we find this tendency to unmarkedness?

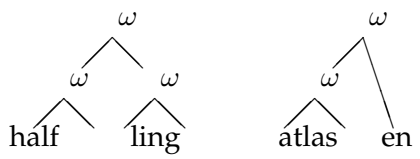
The traditional solution does not have anything to say about this. How can we account for these curious properties? It seems a logical step to assume that the phonological differences between derivation and inflection should follow from the independently needed differences in morphological structure. Traditionally, it is assumed that derivational suffixes are morphological heads, because they determine the morphological category and other properties of the word. Inflectional suffixes, on the other hand, do not determine the category and therefore are not heads.[13] We therefore assign the following morphological structures to these words:

(62) derivation inflection



We furthermore assume that phonological structure will try to mirror morphological structure as far as possible, for instance by way of ALIGN constraints. This means that the morphological difference between derivation and inflection will also be reflected in the phonology, which will aim for the following 'optimal' phonological word structures:

(63) derivation inflection



[13]The ideas presented here owe a lot to Revithiadou (1999), who applies kindred ideas to Greek.

We have already seen, of course, that vowel-initial derivational suffixes get a different structure — one in which the suffix is completely incorporated —, for purely phonological reasons. However, consonant-initial derivational suffixes clearly aim for the structure represented here.

Inflectional suffixes thus will end up in phonologically adjoined positions, unlike derivational suffixes. Their special behaviour in the phonology follows from this. In the first place, if syllable structure behaves as outlined above, resyllabification is possible (σ takes highest constituent as domain).

Furthermore, let us assume that marked material needs to be licensed by being in a constituent; material adjoined to X, does not really count as being dominated by X (α is dominated by β *iff* α is dominated by ever segment of β) If stress constituents need to be dominated by a word node ω, the stress behaviour follows.

Similarly, if markd segmental material needs to be dominated by ω, it follows that marked material cannot be in an adjoined position, hence that inflectional suffixes will not be able to carry marked segments. To make this more concrete, imagine we have constraints of the following type:

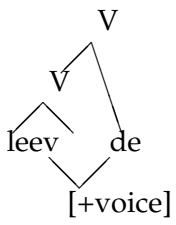
(64) WORD(F): A phonological feature F can only occur inside a word.

Assuming that features F are somehow arranged in an order of relative markedness (e.g. coronal$\prec$ labial, velar) or some form of monovalency, we get the required result: only coronals are allowed in inflectional position.

One potential problem concerns the past tense suffix, which sometimes contains a voiced [d] (65). The feature [+voice] can hardly be considered unmarked.

(65) *ik lee[f]* 'I live' - *ik lee[*vdə*]* 'I lived'

However, the past tense suffix only takes this shape if it follows a stem which has an underlyingly voiced obstruent, so that it can safely be assumed that this suffix is itself underlyingly -/tə/, and that voicing is shared with the preceding stem:

(66)


In this representation, the feature [+voice] is properly dominated by the verb (or the phonological word corresponding to it); the fact that it also occurs outside, is irrelevant for WORD([voice]).

This also explains why in this case we have progressive assimilation of voicing. Usually voicing is in the opposite direction, e.g. in the nominalizing suffix *-te*:

(67) a. *stijf-te* 'stiffness' from /stɛiv/ 'stiff'
b. *stil-te* 'silence' from /stɪl/ 'silent'

Notice that in this case, the suffix, which underlyingly has the same phonological shape, has a different (derivational) status. Apparently, the morphological origin of features is also important: morphological heads win.

3 Minimal morpheme expression

3.1 Introduction

One of the fundamental problems for constraint-based theories of phonology is the issue of opacity: a phonological process applies where it should not, or does not apply where it should, if we look at the phonological context on the surface. We find many cases of this in Dutch dialectology as well; a specific subclass is the topic of this class.

Leaving aside the question whether this level of abstractness is required for other cases, I argue that one class of cases of phonological opacity can be handled without stipulating an extra level of representation, but by taking into account the morphological structure of the forms in question. In particular, deleted segments sometimes still seem to influence the surface representation of morphologically complex words, since without this influence a whole morpheme would be lost. I argue that there is a principle of the following general shape:

(68) *Phonological recoverability*. Every morpheme in the input should be represented in the phonological output.[14]

A functional explanation to (68) is possible, if needed: if a morphologically complex form needs to be parsed, it is preferable to have cues in the phonological shape for every independent morpheme, but (68) can also be seen as a purely formal requirement on linguistic structure, perhaps a consequence of some more general principle of the architecture of the language faculty. In particular, it can be seen as an instance of what Jackendoff (1993) calls 'correspondence rules' between components of grammar; Jackendoff makes it clear that such rules satisfy a conceptual necessity under any view of the grammar.

[14]Constraints which are similar to this in one way or another have been proposed among others by Samek-Lodovici (1993); Akinlabi (1996); Gnanadesikan (1997); Rose (1997); Walker (1998, 2000); Piggott (2000); cf. Kurisu (2001) for an overview.

It can be shown how a number of apparent cases of phonological opacity can be dealt with if we use this mechanism. My examples in the following are taken from the literature on various Dutch dialects. These have been fairly well-studied in the Dutch dialectological literature, but are not well-known outside of this tradition.

I have made a further restriction to *inflectional* morphology. The reason for this is that inflection usually is rather 'weak' as we have seen in the preceding class. If any morpheme ever is a likely candidate for violating (68), it most likely is an inflectional morpheme. Furthermore, we have a relatively clear view of the internal morphological structure of inflectional elements (which consist of purely 'formal' features only), whereas this is much less the case for derivational affixes, in which some amount of lexical semantics is also involved.

The structure of the argumentation will be the same in each example. An inflectional morpheme is phonologically weak in the way just outlined and therefore bound to be deleted. At the same time, if it would be present, it would either trigger or block a process of assimilation. In order to satisfy the requirement in (68) the deletion of the morpheme is not complete; the constituent of the original segment which is necessary to participate either positively or negatively in the assimilation process is left behind as a trace. For example, in Hellendoorn Dutch, an otherwise active process of progressive nasal consonant assimilation seems to be blocked in the past tense (in the cases below, the plural suffix may be assumed to be syllabic /n/; the orthographic examples represent Standard Dutch):

(69) a. *werken* '(to) work' [wɛrkn̩]
b. *werkten* '(we) worked' [wɛrkn̩]
c. *hopen* '(to) hope' [hopm̩]
d. *hoopten* '(we) hoped' [hopn̩]

As can be seen from the orthography, and as will become evident if we study other instances in Hellendoorn Dutch, the imperfective suffix underlyingly contains at least a coronal obstruent /t/. We can now analyze this as a case of rule opacity: first we have an assimilation rule, and afterwards a rule of t deletion, obscuring the original environment of assimilation.

An alternative approach is to assume that /t/ is not deleted fully, but leaves behind a trace, in the form of the feature [coronal], which is then realized on the nasal consonant. The reason for this could be a general requirement that linguistic structure should be visible and expressed, i.e. the principle in (68). The consequences of this approach are explored in this article. The discussion will be embedded within Optimality Theory, currently the most popular theory of input-output mapping; but (68) is virtually theory-

independent and its effects could be couched within other frameworks as well.

We could wonder whether many apparent cases of opacity do not actually disappear if we assume a somewhat more sophisticated view of phonological representations, taking into account the literature on prosodic organization, autosegmental structure and the interaction with morphological and syntactic boundaries. One representation, which is enriched by independently necessary elements, may then do the work of two poorer representations.

In Antwerp Dutch, for instance, we have a process velarising a nasal consonant in coda position. We also have a process shortening a vowel before the resulting velar nasal (Taeldeman, 1982). Both processes can be seen at work in the following examples:

(70) a. *grune* 'green' [ɣrynə] ∼ *gruun* 'green' [ɣryŋ][15]
b. *schoenen* 'shoes' [sxunə] ∼ *schoen* 'shoe' [sxuŋ]

Interestingly, the velarisation process only applies to words with underlyingly long vowels (Antwerp Dutch presumably differs from Standard Dutch in having really long vowels, although this is not absolutely crucial to us), and not by words which have short vowels already underlyingly:

(71) a. *kin* 'chin' [kin] ∼ *tien* 'ten' [tiŋ]
b. *zon* 'sun' [zɔn] ∼ *zoon* 'son' [zon]

In order to describe this, we could write the following rules (following Taeldeman, 1982):

(72) a. n → ŋ / Vː___
b. Vː → V / ___ ŋ

When applied to the different inputs in the right order, these rules will yield the correct results. While strictly speaking the rule in (72a) is opaque, this is only so because it has a rather unnatural shape: it is very uncommon in languages of the world for velar nasals to only show up after long vowels. As a matter of fact, most variants of Dutch (and Germanic) allow the velar nasal to occur only after short vowels. This is even true for Antwerp Dutch, at the surface; rule (72b) is responsible for that. A much more natural rule would therefore be the one in (73):

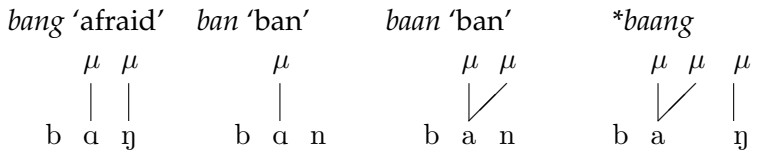
(73) n → ŋ / V ___

[15] Apart from some cases of optional schwa deletion, the form without schwa can only be used in the singular neuter of adjectives in indefinite noun phrases. The form with schwa can be used in all other inflections (plural or non-neuter, or both).

Yet this process would be very opaque indeed, since we obviously find cases where underlying /n/ did not turn into a velar. We would therefore have to distinguish between underlyingly short and shortened vowels: the process seems so opaque that even an analysis based on rules (with arbitrarily many intermediate representations) cannot deal with it satisfactorily.

On closer inspection, there is evidence that the velar nasal, different from the other nasal consonants, is restricted to the coda position in many varieties of Dutch (Trommelen, 1982; van Oostendorp, 2001; van der Torre, 2003). This could explain, for one thing, the fact that velar nasals can only occur after lax vowels, given the fact that only these can occur in closed syllables .[16] A velar nasal after a tense vowel would then be prohibited, because it could only occur in an onset:

(74)



There undoubtedly are other ways to capture the same intuition: that both long vowels and velar nasals need space in the syllable and that if we would have both, this would be too much. Under the one chosen here, the opacity of the Antwerp Dutch velarisation process disappears, if we assume that there is a strong faithfulness requirement on the number of mora's in this dialect — or in rule-based terms, that we are not allowed to insert any mora's in the underlying representation. A change from /tiːn/ — two underlying mora's attached to the vowel — to [tiŋ] (two surface mora's, one for the vowel and one for the nasal) is then allowed, but a change from /kin/ (one underlying mora attached to the vowel) to [kiŋ] (two surface mora's) is not. If we allow ourselves to introduce a few ad hoc constraints to make things work technically, an OT analysis might then run along the following lines. We need the constraints in (75), and the ranking in (76) in order to get the tableau in (77):

(75) a. FAITH(μ): Do not add or delete mora's
b. VELAR: Nasal consonants in coda position shoul be ŋ.
c. *$\mu\mu\mu$: No trimoraic syllables

(76) FAITH(μ)$\gg$VELAR

[16]It is sometimes assumed that the reason for this restriction is that velar nasals underlyingly are /ng/ or /nɣ/, just like this is assumed for English. The Antwerp facts actually show that this analysis cannot be correct: here we find the same restriction but there is absolutely no possibility for postulating an underlying obstruent.

(77) a.

☞[tiŋ]			
/tiːn/	FAITH(μ)	*$\mu\mu\mu$	VELAR
[tiːn]			*! W
[tiːŋ]	*! W	*! W	
[tin]			*! W

b.

☞[kin]			*
/kin/	FAITH(μ)	*$\mu\mu\mu$	VELAR
[kiːn]	*! W		*
[kiːŋ]	*!* W	* W	L
[kiŋ]	*! W		L

More in general it seems to be the case that next to a more sophisticated view of phonological structure, also a more precise view of the interaction between phonology and morphology, and in particular of the 'visibility' of morphology for phonology, may help to make many apparent examples of phonological opacity actually vanish. Constraints to not uniquely refer to segments, arranged in a one-dimensional string; what we actually have is a more fine-grained, multidimensional vision referring to the internal structure of these segments, and to the relations between them.[17]

3.2 Nasal assimilation in Hellendoorn Dutch past tense

As outlined above, Hellendoorn Dutch — a dialect spoken in the northeastern parts of the Netherlands —, like many other languages in the world, displays a process of nasal assimilation. Interestingly, the process works from right to left as well as from left to right. The following facts are all from Nijen Twilhaar (1990), the orthography again is Standard Dutch:

(78)

	orthography	underlying	surface	gloss
a.	*lopen*	lopən	lopm̩	'to walk'
b.	*weten*	wetən	wetn̩	'to know'
c.	*pakken*	pɑkən	pɑkŋ̩	'to grab'
d.	*loop een*	lop ən	lopm̩	'(I) walk a (mile)'
e.	*rampnacht*	rɑmpnɑxt	rɑmpnɑxt	'disastrous night'
f.	*loop een keer*	lop ən ker	lopŋ̩kɪːr	'(I) walk one time'

Nasal assimilation in Hellendoorn Dutch has some interesting properties. Examples (78a-c) show that a (syllabic) nasal assimilates to a preceding obstruent. In contradistinction to the first analysis in (69), the plural suffix is

[17] See Kaye (1974); Gussman (1976); Kissebert (1976) for 'Recoverability'.

represented here as underlyingly /ən/. I will return to this assumption below. For now it suffices to see (78d) that the indefinite article, which unquestionably has a schwa underlyingly (because this schwa surfaces e.g. if an indefinite nominal phrase occurs at the beginning of a sentence), displays the same behaviour. (78e) shows that nasals in onset position are not affected by the process, and (78f) that in certain cases assimilation is *regressive*, to a following consonant.

The key facts are the ones in (79):

(79) a. /stɔp+t+ən/ (stop+past+plural) >[stɔpn̩] 'stopped'
b. /zɛt+t+ən/ (put+past+plural) >[zɛtn̩] 'put'
c. /pɑk+t+ən/ (grab+past+plural) >[pɑkn̩] 'grabbed'

This is a case of opacity because within a rule-based framework, we could state two rules (disregarding regressive assimilation), one of progressive nasal assimilation, and another one of /t/ deletion (the following is based on Nijen Twilhaar, 1990):

(80) a. t deletion: t → ∅ / C ___ C

x x

b. progressive assimilation (PA): [nasal]

PA is rendered opaque by t deletion (schwa deletion is implied to be proceeding the processes described here):[18]

(81)	/stɔp+t+ən/	/zɛt+t+ən/	/pɑk+t+ən/
schwa deletion	stɔptn̩	zɛttn̩	pɑktn̩
PA	stɔptn̩	zɛttn̩	pɑktn̩
t deletion	stɔpn̩	zɛtn̩	pɑkn̩

It is fairly easy to set up an analysis of the non-opaque facts in (78). Again, we use a few constraints which may not be hallmarks of theoretical sophistication, but which give the required results.[19]

[18]Interestingly, this is a case of opacity either of type (i) or of type (ii) in terms of Kiparsky's definition in (**??**), depending on how we look at it. We have surfacing CAD in the sense that it looks as if the nasal has not been subject to assimilation even though the context is present; we have XBY in the sense that it looks as if the nasal has been subject to assimilation to a segment which is no longer there. I have chosen the second possibility here. There would be ways to test which of these two theories is correct, if we would be able to find e.g. cases where the deleted consonant is non-coronal.

[19]It would certainly be possible to give more sophisticated analyses using more elegant constraints, but these would require more different constraints, and the point would remain the same: an extra faithfulness constraint is necessary to understand the exceptional behaviour of past tense forms.

(82) a. ASSIMILATE: A coda nasal and an adjacent obstruent should have the same place of articulation.
b. *CCC: Clusters of three consonants are not allowed.
c. FAITH(PLACE): Input place features should surface.

(83)

☞pakŋ			
/pak+ən/	*CCC	ASSIMILATE	FAITH(PLACE)
pakn̩		*! W	
patn̩			*! W

Hellendoorn differs from other languages displaying faithfulness of place features in that even after the consonant deletion, another obstruent stays present that could still enforce assimilation. Therefore, the opaque cases here cannot be dealt with without additional means:[20]

(84)

pakn̩		*!	
/pak+t+ən/	*CCC	ASSIMILATE	FAITH(PLACE)
✘pakŋ		L	
patn̩			*! W

What we need to express, here, is the idea that the nasal gets its feature from the underlying past tense suffix. One way of doing this, is by formalizing the following constraint:

(85) EXPRESS-[F]: The morphological feature F should be expressed in the phonological surface.
(Some phonological feature connected to the input expression of F should be present in the output.)

This is a special type of faithfulness constraint, basically stating that it is not allowed to delete a morheme fully. An instance of this general constraint scheme could now be EXPRESS-TENSE: some part of the past tense suffix /-ən/ should be expressed in the output. Adding this constraint to our tableau gives us the desired result:

(86)

☞pakn̩			*	*
/pak+t+ən/	*CCC	EXPRESS-TENSE	ASSIMILATE	FAITH(PLACE)
pakŋ		* W	L	*
patn̩	* W		L	L

[20] It is assumed here that deletion of /k/ or /n/ is not an option for satisfying *CCC. As we will see below, /t/ is particularly prone to deletion in dialects of Dutch, but other consonants cannot be deleted. Exploring the reasons for this is beyond the scope of this article.

How exactly does EXPRESS-TENSE work? The phonological input is a /t/, i.e. a feature bundle like the following:

(87)

$$\begin{array}{ccc} & \sigma_{tense} & \\ [\text{coronal}]_{tense} & & [\text{-sonorant}]_{tense} \end{array}$$

Every morpheme consists of a number of feature bundles, connected to a root note, and/or a timing slot. I marked this by adding a subscript to every individual element. Seen in this notation, EXPRESS-TENSE states that the output should contain at least one element which has this subscript.

Until this point, we have silently assumed that the plural suffix /ən/ has a schwa underlyingly. We can find some arguments for this in Nijen Twilhaar (1990). Most convincing perhaps is the argument that we also find monomorphemic nouns ending in a syllabic nasal, and nouns ending in /-ə/, but no nouns ending in /-ən/. This shows at least that a productive process of schwa deletion before n is going on. Furthermore, the schwa sometimes surfaces, viz. in very formal styles of speech (Nijen Twilhaar, 1990, :165); these are styles where typically the surface form is closer to the underlying representation (van Oostendorp, 1997b).

There are various reasons why schwa should not surface; being phonologically and phonetically empty, it seems a less desirable nucleus, etc. There will thus be a constraint *ə or something more motivated but to the same effect (cf. van Oostendorp, 2000, for fuller detail).

We can distinguish betwee three groups of dialects of Dutch (van Hout & van der Velde, 2000). In some, schwa is deleted, and in others /n/ is deleted under various circumstances; in line with the previous discusssion, this could be formalized as a constraint *n. The third variety is one in which neither schwa nor /n/ is deleted. Crucially absent are those dialects in which *both* schwa *and* /n/ are deleted. This may be seen as an indication for the high level of activity of recoverability, formalized in this case as a constraint EXPRESS-PLURAL. This constraint would then dominate at least one of *ə and *n.

These facts are not unique for Hellendoorn Dutch; we find very similar phenomena even in typologically unrelated languages. The interaction between nasal assimilation and consonant deletion from the Ojibwa dialect of Odawa (Piggott, 1974; Kaye, 1974) show a very similar pattern:

(88)

Underlying	/takossin-k/	'he arrives'
Assimilation	takoʃʃiŋk	
Deletion	takoʃʃiŋ	

These facts are clearly very similar to those of Hellendoorn in the relevant respects. Viewed from a purely segmental point of view, Assimilation and

Deletion are in an opaque ('counterbleeding') order. Yet if we consider the possibility that the place feature [velar] is on an independent plane, and that it can be retained even after deletion of the segment /k/, these facts follow. Also in this case, it appears that /k/ is an independent morpheme, having a conditional meaning. If we assume that this conditional morpheme has to be retained at the surface somehow, the feature [velar] would then show up on the nasal as a trace of this morpheme in order to satisfy EXPRESS-[cond]. All in all, we would get an analysis such as the following:

(89) a. EXPRESS-[cond]: The conditional morpheme should be expressed at the surface

b. *CC: Consonant clusters are not allowed.

The tableaux of Hellendoorn and Ojibwa thus become strikingly similar. Again, there is no need to rank most of the relevant constraints in order to get the difference between conditionalis and realis forms:

(90)

☞takoʃʃin				
/takossin/	*CC	EXPRESS-COND	ASSIMILATE	FAITH(PLACE)
takoʃʃiŋ				* W

(91)

☞takoʃʃiŋ				*
/takossin+k/	*CC	EXPRESS-COND	ASSIMILATE	FAITH(PLACE)
takoʃʃin		*! W		L
takoʃʃink	*! W		* W	L
takoʃʃiŋk	*! W			*

As a matter of fact, there thus is no opacity, or any problem for surface-based phonology within Hellendoorn Dutch or Ojibwa at all, given the fairly standard assumption that place or articulation features can exist independently of their segments — an assumption that was not available in the work of Kiparsky and Kaye just referred to above.

3.3 Voicing Assimilation in Flanders and Brabant

The next example which deserves discussion is widespread in the Dutch-speaking parts of Belgium (at least in Flanders and Brabant). In this case a process of voicing assimilation interacts with the deletion of word final /t/, which is the phonological shape of the third person singular verbal inflection (Taeldeman, 1982) in a way that may be considered opaque:

(92) a. [-sonorant, +continuant] → [-voice] / [-sonorant] ___

b. $t_{3,sg} \rightarrow \emptyset$ / ___ # C

(93) *hij doe/*t v*/eel* 'he does a lot'

a. *hij doe/*t f*/eel*

b. *hij doe[f]eel*

Voicing assimilation in Dutch is a well-known and widespread phenomenon (cf. Lombardi, 1999; van der Torre & van de Weijer, in press, for various analyses within the OT framework). Lombardi (1999, p. 277) analyses it in terms of the following constraint:

(94) AGREE: Obstruent clusters should agree in voicing.

AGREE is of course very similar in form and spirit to the constraint ASSIMILATE, which we used above to describe nasal assimilation. Under this formulation, the process in question becomes unmistakenbly opaque, quite independent where we rank AGREE (if *CC≫FAITH(VOICE)):

(95)

[f]			*!
*hij doe/*t v*/eel*	*CC	AGREE	FAITH(VOICE)
[tv]	*! W	*W	L
[tf]	*! W		*
✘[v]			L

In order for a solution along the lines of EXPRESS-[F] (in this case: EXPRESS-[3PS]) to work, we need to know what exactly is the phonological element that expresses the inflectional suffix in this case. Lombardi (1999) employs a theory of laryngeal features in which [voice] is monovalent, i.e. there is no phonologically active [-voice]. This means that the underlying and surface representations are schematically as follows (representing [v] as a /f/ with attached [voice]):

(96) *underlying* *surface*

h ɛ i d u t f e l h ɛ i d u f e l

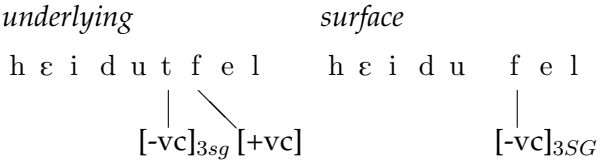
|

[+vc]

The underlying representation of the [3sg] suffix seems to have disappeared without leaving a trace; there is nothing in the surface form to represent it, given the plausible assumption that absence of a feature cannot act as a representative.

Wetzels & Mascaró (2001) and various other authors have argued on independent grounds that there are empirical arguments to assume that [-voice] should be assumed to be phonologically present. In that case, the inflectional suffix does indeed leave a trace at the surface representation, viz. the feature [-voice], realized on the [f]:

(97)

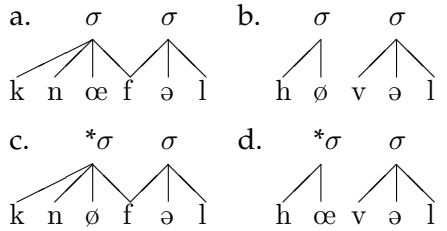


In van Oostendorp (2002), on the other hand, it is argued that the difference between voiced and voiceless fricatives phonologically behaves like a length distinction in many Westgermanic dialects. Intervocalically, at least, 'voiced' fricatives are short, and 'voiceless' fricatives are long. This explains, among other things, why in many of these dialects we find voiced fricatives after tense or long vowels and voiceless fricatives after lax or short vowels (the following examples are from Dutch):

(98) *knuffel* 'hug' [knœfəl] *[knœvəl]
heuvel 'hill' [høvəl] *[høfəl]

These facts are easily explained if — given our analysis so far — tense vowels occur in open syllables and lax vowels occur in closed syllables, and voiceless fricatives are ambisyllabic (so that they close the syllable):

(99)



(149c) has a tense vowel in a closed syllable, and (149d) a lax vowel in an open syllable; both are excluded by CONNECT (15), whereas the structures in (149a) and (149b) are correctly allowed.

There is some empirical support for this assumption in the work of Ernestus (2000, p. 177). Based on a corpus of spontaneous (Standard Dutch) speech, Ernestus notes that

> Clusters of fricatives of the same place of articulation arise when a word-final fricative is followed by a word-initial one. These clusters are generally realized with a duration that is shorter than the duration of two segments (...). In what follows, clusters consisting of two segments with the same manner and place of articulation will be referred to as geminates. [...] The problem is that fricative geminates are always realized as voiceless, independently of their context, exact duration, etc.

From this we can thus at least conclude that longer fricatives are always voiceless.

If this analysis is correct, it could be the *position* of the /t/ that is retained after the disappearance of the segment:

(100)

underlying	*surface*
h ɛ i d u t_{3s} f e l	h ɛ i d u $\bullet_{3s}$ f e l
[labial]	[labial]

It thus is the phonotactic position (represented here as a dot, since it does not matter whether this is a mora, a root node, or something else), that could be seen as the trace of the suffix, necessary to satisfy EXPRESS-3SG.

(101)

☞[f]				*
hij doe/t v/eel	*CC	EXPRESS-3SG	AGREE	FAITH(VOICE)
[tf]	*! W			*
[tv]	*! W		* W	L
[v]		*! W		L

Notice that the tableau is very similar to the ones given for Hellendoorn and Ojibwa above: the morphological faithfulness constraint EXPRESS-3SG outranks the phonological faithfulness constraint FAITH-voice.

Taeldeman (1982) asserts that the opacity effect attested in the dialects just discussed is typical for deleted /t/ as a morpheme. Similar effects can however be found in the literature purely internal to the phonology in other dialects of Dutch. E.g. in Wilsum Dutch, the final /t/ of function words such as *net* (just), *met* (with) and *det* (that) can disappear, but still have the effect of devoicing the following /f/. We thus get examples such as the following (Spa, 2000, 46):

(102) a. *ne/*t z*/o dudelijk >ne[*s*]o dudelijk* 'just as clear'
b. *me/*t z*/ien ome >me[*s*]ien ome* 'with his uncle'
c. *as ie de/*t v*/raogen >as ie de[*f*]raogen* 'if he that asks=if he asks that'

In this case, the relevant type of faithfulness cannot be morphological, since the function words in question are expressed by an onset consonant and a vowel; EXPRESS constraints are thus satisfied in any case. It could be argued that we thus have an instance of faithfulness to the segmental position, usually formalized as a DEP constraint (every segment in the input should have a correspondent in the output). The correspondent of *t* will be filled by material from the fricative (which means that a lower-ranking IDENTITY-constraint will be violated).

(103)

☞[sː]				*
*ne/*t z/*o dudelijk*	*CC	DEP	AGREE	FAITH(VOICE)
[ts]	*! W			*
[tz]	*! W		* W	L
[z]		*! W		L

The situation is somewhat more complicated, because we need to explain why this only involves the final /t/ of function words. It has been argued that the final /t/ of words such as these is also in some abstract sense a suffix (Vanacker, 1949); the /t/ shows other types of deviant behaviour in other contexts as well. Taeldeman & Schutter (1986, 114) propose that there is a hierarchy of positions where devoicing after deleted /t/'s may occur:

i. verbal inflection
ii. the 'small words' *daT* 'that', *waT* 'what', *nieT* 'not' and (sometimes) *meT* 'with'
iii. frequent adjectives of the type Vːd (e.g. *goed* 'good', *kwaad* 'angry/bad', *koud* 'cold', *dood* 'dead')

This hierarchy seems to reflect the straightforwardedness of the inflectional nature of the /t/ in question. The hierarchy is based on the fact that in some dialects (the ones just discussed) we only find this effect in environments (i), in other dialects (the one spoken in Bruges) we find them in (i) and (ii), and yet in others (e.g. Ghent) we find them in (i), (ii) and (iii).

(104)

	Bruges	Ghent
*hij doe/*t v/*eel* 'he does a lot'	[f]	[f]
*da/*t v/*uur* 'that fire'	[f]	[f]
*goe/*d z/*aad* 'good seeds'	[z]	[s]

The question then remains why only frequent adjectives of a specific shape participate in Ghent. The frequency effect might be attributable to the fact that there tends to be more deletion in frequent words than in less frequent words in general (Goeman, 1999). It is not exactly clear to me why there should be a preference for adjectives ending in long vowels plus /d/. Yet one aspect is of particular importance here: the fact that in this case an analysis in which an underlying feature [-voice] would be the trace of the deleted segment cannot work. This gives indirect support for the analysis presented above in which it is the position of the coronal stop that surfaces, filled with the material of the fricative, which thereby lengthens and thus remains voiceless.

3.4 Remnants of the first person singular morpheme

A relatively well-known case of opacity within Dutch dialectology is provided by Aalst Dutch. At least according to the very careful phonetic study of Colinet (1896), this dialect used to display an interesting opaque application of nasal assimilation: the disappearing element (an inflectional schwa) did not trigger assimilation (as was the case in the previous examples of voicing assimilation), but rather to block it (Colinet, 1896; Taeldeman, 1980). (Taeldeman (2002) reports that some speakers still had the phenomenon in fieldwork in the second half of the twentieth century.) If an inflectional schwa (in the case at hand a schwa which expressed adjectival agreement) disappeared before a nasal, the nasal did *not* assimilate to the consonant following it on the surface, in spite of the fact that the environment for assimilation seems to be present:

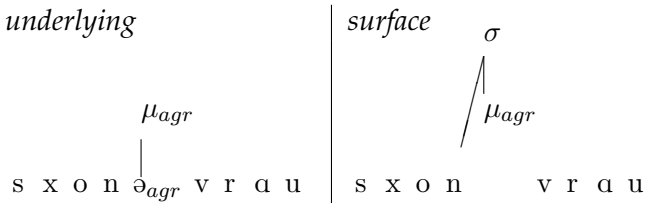
	*schoo/*n*/ ventje* 'handsome guy'	*schoo/*n*/+/*ə*/ vrouw* 'beautiful woman'
(105)	*schoo/*ŋ*/ ventje* assimilation	*schoo/*n*/+/*ə*/ vrouw* d.n.a.
	*schoo/*ŋ*/ ventje* d.n.a.	*schoo/*n*/ vrouw* schwa deletion

It is hard to see what the 'trace' of the adjectival inflection could be that would be necessary to satisfy EXPRESS-[Agr] ('Agr' standing for whatever the morphological features of overt adjectival inflection are). The reason for this is that the schwa seems to have gone on the surface completely, and there is nothing in e.g. the segmental make-up final [n] of *schoon* that could be seen as a trace of the existence of this segment:

(106)	*underlying*	*surface*
	s x o n $ə_{Agr}$ v r ɑ u	s x o n v r ɑ u

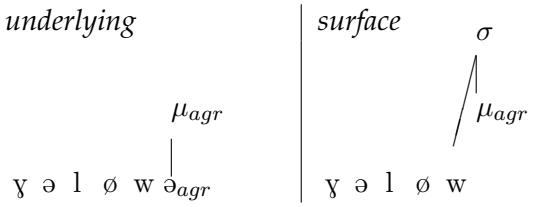
How can we explain these facts? The crucial observation is that nasal consonants only assimilate in dialects of Dutch if they are *not* in syllable onset. The conclusion therefore is that the trace of the agreement morpheme that is necessary in order to derive the opacity effect, is the syllable structure. We could suppose, for instance, that the inflectional schwa has a mora underlyingly. Under this view, it is the mora then that serves as the trace of adjectival inflection. The mora then necessarily projects an (empty-headed) syllable. Notice that this should mean that this morphologically sponsored empty head should have a different status from a purely phonological one (Scheer, 2004).

(107)



A similar account may be able to explain a quite spectacular examples, cf. the lack of final devoicing in Tilligte Dutch (Goeman, 1999, p. 216). Even though this dialect displays the effects of syllable-final devoicing elsewhere pervasively, we find forms such as *ik geleuv* 'I believe' (or *ik geleuw*) in the first person singular (Schoemans & van Oostendorp, 2004; van Oostendorp, 2005). Importantly, Goeman (1999) notes that in neighbouring dialects we find a schwa serving as an overt first person singular suffix in the neighbouring dialects where the suffix has not yet been lost. The analysis here could be exactly the same as for Aalst Dutch:

(108)



(Goeman, 1999, 216-217) lists a large number of dialects where this phenomenon may be found; furthermore such dialects can be found in quite a large part of the Dutch language area. The reason Goeman gives for this, is a historical one: the first person singular schwa has been deleted 'recently' and therefore the final devoicing has not yet taken place. We could say that this statement depends on the opacity of diachronic language change: the final devoicing process proceeds as if the historical ending were still there.[21]

It is of interest that once again fricatives are the main focus of this exceptional behaviour, as is to be expected if we assume that fricative voicing is primarily an issue of syllable positions and those positions can be used to express morphological structure.

Other phonological processes may also be influenced by this vocalic position and the onset it licenses. In Brussels Dutch (De Vriendt & Goyvaerts, 1989) we see that various phonological processes act as if the first person singular still ends in a vowel. For instance, words in this dialect are not allowed to end in a velar nasal. Words which have such a segment underlyingly, develop a [k] at the end by some process of /k/ insertion:

[21] Taeldeman & Schutter (1986); De Vriendt & Goyvaerts (1989); Goeman (1999); van Bree (2003); Schoemans & van Oostendorp (2004); van Oostendorp (in press).

(109) 'k-insertion'

[puliŋk] 'eel'	[puliŋə] 'eels'
[ɣɑŋk] 'corridor'	[ɣɑŋə] 'corridors'

We can see that the /k/ is inserted here at the end of the word since it does not occur in the plural forms, before a schwa (there is a difference here with a form such as *plank-planken* 'plank(s)' which do have an underlying /k/).[22] Yet velar nasals can be found at the end of verbs in the first person singular (present):[23]

(110) a. *ik hang* 'I am hanging' [ikɑŋ]
b. *ik zing* 'I am singing' [iksiŋ]

The behaviour of this form could be explained in various ways, depending on one's analysis of the behaviour of the velar nasal. One could state for instance, that a velar nasal is not allowed to occur as the last segment of the syllable. In the first person singular, this condition would not apply, since there is an (empty) syllable head following the velar nasal. The segment therefore would occur in the onset of such a syllable, and there would be no need to insert a /k/.

In the same dialect, we find paradigms such as the following:

(111) a. *kleden* 'to dress' [klejə]
b. *hij kleedt hem* 'he dresses himself' [a+klit+əm] (shortening)
c. *ik kleed mij* 'I dress myself' [ik+klej+ma]

One way of analysing this is to assume that the verb 'to dress' has an underlying /d/, which is subject to final devoicing at the end of the word and to a process of weakening before a vowel (Zonneveld, 1978; Swets, 2004). The important point is that the first person singular patterns with the infinitive rather than with the third person singular. In other words, the first person singular behaves as if it stands in front of a vowel. Again, this is something which can be understood if we assume that

There is a well-known fact of Standard Dutch phonology that could be accounted for along similar lines. We have already cited the rule deleting /n/ after schwa, which is very productive in at least some varieties of Dutch. This rule affects (inflectional) suffixes, but also stems, such as *open* 'open' or *teken* 'sign'. However, it is a clear fact of Dutch phonology that /n/ deletion

[22] Alternatively, one might argue that these words end e.g. in /ng/ underlyingly, which devoices at the end. In this case, we need to say that the /g/ is deleted in the first person singular, just as it is deleted before a schwa. The puzzle for the phonology-morphology interface stays the same.

[23] The first person singular preterite did not have a schwa ending and therefore is irrelevant from our perspective.

is much harder in the first person singular form of verbs (112a) than it is in other stems (cf. Zonneveld, 1982; Ernestus, 2000).[24]

(112) a. *dat ik de deur open* 'that I open the door'
b. *de deur is open* 'the door is open'

There have been several proposals in the literature that word-final consonants are onsets rather than coda's (cf. Piggott, 2002, for an overview). Most of these do not differentiate between morphological contexts: *all* words are supposed to end in a consonant. Such proposals cannot differentiate between the two instances of *open* in Standard Dutch, and the two instances of *geloof* 'belief' (the verbal form which ends in a voiced consonant and the nominal form which is subject to final devoicing) in Twente, or at least they have to find another way to do so.

4 Tonal dialects

4.1 Introduction

Limburg dialects of Dutch have two distinctive tonal contours on syllables with primary stress. These tones are traditionally called *Schleifton* ('dragging tone') and *Stosston* ('bumping tone'), but here we will use the terms 'level high tone' and 'falling tone'.[25] The tones fall on the stressed syllable in the word, and serve to distinguish between minimal pairs. The following examples are from the Maasbracht dialect[26]:

(113)

falling tone	*level high tone*
míǹ 'minus'	míń 'vile'
dǽǹ 'fir'	dǽń 'then'
klǽm̀ 'trap'	klǽḿ 'hardly'
bîi 'bee'	bíí 'with'
zîi 'side'	zíí 'she'
pîip 'to squeak'	píip 'pipe'

[24]In standard Dutch paradigms, there is one other form which consists of a pure stem only: the second person singular in inversion (*open jij* 'open you'). I do not have any evidence whether or not /n/ deletion is blocked in this environment just as much as it is in the first person singular form. It seems to me that there is a contrast between *tekenen (ook) jullie* 'draw also you', in which the final /n/ is part of the plural inflectional ending /ən/ and in which this /n/ can be deleted quite freely, and *teken (ook) jij* 'draw also you', in which the /n/ is part of the verbal stem and resists deletion. If this intuition is shared by other speakers, the explanation may be that the second person singular in this particular context also has extra morphological structure. Otherwise, the second person would have a different structure. (The central thesis of this section does not seem to be affected either way.)

[25]This class is based on van Oostendorp (2006).

[26]Hermans (1994).

The distinction between these two tones is also used to in inflectional morphology, e.g. to differentiate between neuter and feminine forms of adjectives (114a); if the neuter is level high (*wíís*), the feminine has a falling tone (*wîs*). If the neuter itself has a falling tone, nothing happens to the feminine, which still has a falling tone (114b).[27]

(114)

	neuter	feminine	masculine	
a.	wíís	wîs	wîzə	'wise'
	dóúf	dóùf	dóùvə	'deaf'
	láám	láàm	láàmə	'lame'
b.	kál̀m	kál̀m	kál̀mə	'calm'
	kléèn	kléèn	kléènə	'small'

The only distinction between the neuter form and the feminine form thus is one of tone. Given the fact that neuter adjectives can have both falling and level tones, depending on lexical specification, it is reasonable as well as customary to assume that this form of the adjective represents the 'underlying' tonal distinction.

These facts have been taken by some analysts (notably Alderete, 1999) as evidence for the relevance of paradigmatic relations within phonology: the tones in (114a) would switch because in this way an opposition within the paradigm would be maintained (and higher-ranking markedness constraints would make such a switch impossible in cases such as (114b)).

We defend what could be called a more 'traditional' approach to these facts, assuming a combinatorial view of morphology in which all alternations are due to the fact that one word consists of a different combination of morphemes than another word. There are no 'paradigms' in this view, only morphemes and configurations of morphemes. It is argued that we need a sophisticated representational analysis rather than one defined in terms of interparadigmatic (anti)faithfulness. We set up an inventory of inflectional tonal affixes such that the inflectional tonal differences follow. The patterns shown in (114) are argued to represent allomorphy rather than something else.

4.2 Tones and adjectival inflection: data

The phonology of tones

Limburg Dutch dialects, like the neighbouring Rhineland German dialects, are well-known for their use of lexical tone. There is quite some dialectal variation as to the phonetic realisation of these tones, but as far as is known,

[27] A similar distinction is made in the realm of nouns, where singular nouns may carry a level tone, while the corresponding plurals have a falling tone.

this does not really affect the phonology: the split between *falling tone* and *level high tone* is common to all dialects in this area.

In order to understand the interface between the phonology and the morphology, it is first necessary to understand the phonological identity of the so-called falling tone and the so-called level high tone. The following two pictures represent the F0 values for these two tones (for a speaker from the Roermond dialect, very close to Maasbracht[28]):

(115) falling tone level high tone

The 'falling' tone is characterised by a clear downward movement; the 'level high' tone also moves slightly downward, but then goes up again towards the end. There are several ways to translate this into the phonology, but many analysts have converged on the following (see Gussenhoven, 2004, for an authoritative overview):

(116) falling tone level high tone

```
   HL            H(L)H
   | |            |  |
   μ μ            μ  μ
   | |            |  |
 m i n          m i  n
```

Dialectology

The Limburg dialects are spoken in Dutch and Flemish provinces which are both called 'Limburg'. Like most dialects in Europe, they are under a strong pressure of convergence to the standard language, in this case to Standard Dutch, but maybe to a slightly lesser extent than in some other areas in this particular corner of Europe (Kroon & Vallen, 2004). The area is on the periphery of the Dutch-speaking area, neighbouring both German and French dialects. For a large part, it did not become an administrative part of The Netherlands (or Belgium) until well into the 19th century (Kessels-van der Heijde, 2002). The following map shows the positioning of Limburg (the grey spotted area) with respect to the other parts of the Netherlands (the western most part of Limburg is Dutch, the eastern part is Flemish):

(117)

29

[28]The data were analysed with the *Praat* programme; `http://www.praat.org/`. The data are almost identical to those presented in Gussenhoven (2000).

[29]Data come from a few different sources. These are, first, Hermans (1994), presenting a wealth of native speaker's intuitions on one individual dialect, Maasbracht Dutch, plus a very insightful analysis of some of these data, on which we will draw. Secondly, we use the so-

The GTR data were mainly used to check the robustness of the Maasbracht intuitions. With this goal in mind, we compared the feminine forms of the adjectives *klein* 'small', *oud* 'old', *goed* 'good', *heel* 'very', *rijp* 'ripe', *rond* 'round', *lang* 'long', *scheef* 'oblique' and *hoog* 'high' with their neuter or citation forms in the database.[30] After filtering out those forms for which the tones were not transcribed, or not transcribed in an understandable way, we obtained 473 neuter-feminine pairs, with the following distribution (HH=level high tone, HL=falling tone):

(118)

Tone on neuter	Tone on feminine	Number of adjectives	Proportion
HH	HL	157	.33
HH	HH	64	.14
HL	HL	246	.52
HL	HH	6	.01

It is easy to see that the number of falling neuter - level high feminine pairs is extremely small, especially given the fact that more than half of all the adjectives have an 'underlying' falling tone in the neuter. Furthermore, if we look at these six cases in more detail, we see that two of them can be discarded out of hand, in one case since the transcriber has noted that he was not sure about the tone, and in another case because a different adjective was used in the neuter than in the feminine. This leaves us with only 4 pieces of data (out of 473) with a falling-level high pattern for which we will not be able to provide a solution.

Further analysis shows that 46 out of the 64 level - level patterns are found for one single adjective, *rijp* 'ripe', the only one in our sample which ends underlyingly in a voiceless obstruent.[31] This will turn out to be significant in the following section. As a matter of fact, given that we have reliable tonal data on 59 dialects for *rijp*, we can say that for this word level high-level high is the dominant pattern.[32]

called Goeman-Taeldeman-Van Reenen (GTR) database, a large survey on the phonology and morphology of dialects in The Netherlands and Flanders in the 1980s and 1990s. Maasbracht is approximately in the center of this area, as the map in (117) shows.

[30]Neuter forms are those forms given in attributive position with a neuter noun; citation forms are those words which were elicited when the adjective was given in isolation, without any noun. We used the neuter forms for 'klein', 'oud' and 'geel' and the citation forms for the other adjectives. The reason why we did not make a uniform choice was purely pragmatic: there are not enough pure neuter/feminine pairs in the GTR database. Given the fact that both the neuter form and the citation form reflect the underlying representation, we trust that this choice does not affect the argument.

[31]From the orthography, it might appear that *scheef* 'oblique' ends in a voiceless fricative, but this voicelessness is not underlying. It is a quirk of Dutch orthography that final devoicing is represented in fricatives, but not in stops. The word *rijp* actually has a fricative in some of the tonal Limburg dialects — *rijf* —, and this behaves as underlyingly voiceless. We will discuss some the implications of final devoicing in section 4.4.

[32]Eleven dialects show a level high-falling pattern, and one dialect shows a falling-falling pattern. These will be left out of consideration.

All in all we can make the following observations:

(119) a. If the stem ends in a voiced obstruent, a sonorant, or a vowel we find two patterns:
  i. neuter: falling, feminine: falling
  ii. neuter: level high, feminine: falling
  b. If the stem ends in a voiceless obstruent (*rijp* 'ripe'), we find level-level patterns (possibly next to the other two)

This conforms to the findings of Hermans (1994). As we have already seen above, this author describes a pattern in which underlyingly level high tones turn into falling tones on the surface, while underlyingly falling tones do not change at all. But Hermans also notes that "it is a curious fact of Limburgian morphophonology that tonal alternations can never take place when the base ends in a *voiceless* obstruent."

Hermans gives the following Maasbracht facts by way of illustration:

(120)

neuter	feminine	masculine	
ríík	rííkə	rííkə	'rich'
nááks	nááksə	nááksə	'naked'
záát	záátə	záátə	'lame'

Although it is not true that all Limburg dialects display this 'curious fact' — we have just seen there are a few dialects where an alternation was found after all —, it is true for the majority, and we take this to be an absolute fact for Maasbracht. The generalisation was, incidentally, already made by van Wijk (1935). Given that we have sufficient detailed native speaker evidence only for the Maasbracht dialect, we will concentrate on this dialect in what follows; see Hinskens & Muysken (1986) for a thorough analysis of a slightly different system.

One fact will turn out to be absolutely crucial for our present purposes: in the examples in (120), a schwa shows up on the feminine suffix. This schwa is crucially lacking in the examples in (114). We thus can make the following generalisation:

(121) a. if the feminine has a level high tone, it also has a schwa
  b. if the feminine has a falling tone, the schwa does not show up, regardless whether there is alternation in the paradigm or not

This is the correlation that will form the core of our discussion in the next two sections.

4.3 A representational analysis

We may simplify the representations in (116) in a number of ways. First, if we consider the low tone in the level high pattern as a phonetic effect, or as the effect of the OCP, we may further simplify this pattern into HH, which then contrasts with HL. We have of course already implied this in our discussion above, by introducing the term 'level' high tone.

Notice also that both tones feature a high tone on the first mora. It is true that these lexical tones are realized on exactly one syllable in every word: the syllable with main stress. In other words, the initial tone seems to be uniquely due to some principle relating high tone and stress, which of course has been known for a long time in the phonological literature (cf. Hulst & Smith, 1988, for an overview):

(122) PITCH: The head mora of the syllable with primary stress needs to have a high tone.

One can view (122) as an Optimality Theoretic constraint (possibly formalized along the lines of de Lacy, 1999, 2002), in which case this constraint is inviolable in the grammar of Limburg. It is only the tone on the second mora in the main stressed syllable which can be either H or L, subject to lexical specification.

It is most likely that of these two, the Low tone is the phonologically marked one. For instance, if we have a minimal pair of words, one with a level tone and the other with a falling tone, and if one of those two is a function word and the other one a lexical word, it will be typically the one with the level high tone which is the function word and the one with the falling tone which is the lexical word (e.g. *bíí* 'with' - *bîì* 'bee', *zíí* 'she' - *zîì* 'silk'). If we assume that function words are usually phonologically less marked than lexical words, we can understand these patterns as an indication that H will be the default tone.[33]

The next step in our analysis is that the neuter suffix is a truly empty morpheme with neither a schwa nor a mora nor a tone. The masculine suffix we assume to consist of a schwa plus a low tone. The feminine suffix, on the other hand, would consist of two parts: an empty vocalic position, and a tone.[34]

[33]Laura Downing (p.c.) points out that this analysis could be taken to imply that high tones also surface on stressless syllables. Usually they are taken to be toneless in the dialectological literature. In order to explain this, we we will invoke TONETOSTRESS below, requiring all tones to be in a stressed syllable.

[34]See van Oostendorp (2005) for extensive argumentation for the existence of empty-headed morphemes in dialects of Dutch.

(123)

Neuter	Feminine	Masculine
	σ	σ
	μ	μ
		ə
∅	L	L

Neuter and masculine suffixes

Let us first consider the neuter and the masculine suffixes. We can either of these add these to either a stem with an underlying low tone, or to one with an underlying high tone (or no underlying tone at all). This gives us four possibilities, two for the neuter and two for the masculine:

1. If we add a neuter (empty) suffix to a lexical form with a low tone, the underlying low tone will show up on the second mora. The reason for this is that tones need to be within the main stressed syllable, and the first mora is already occupied by a high tone, according to PITCH:

   (124) a. TONETOSTRESS: Tones need to be in the syllable bearing main stress
   b. MAXTONE: Do not delete tones
   c. PITCH≫TONETOSTRESS, MAXTONE[35]

   (125)

/kalm +Low/ + ∅	PITCH	TONETOSTRESS	MAXTONE
a. [kàlm]	*!		
b. [ká̀lm]			*!
c. ☞[ká̀lm]			

2. If we add an empty neuter empty suffix to a lexical form with an underlying level high tone, the result is a level high tone. If the adjective does not have any tone at all, we may surmise that the form will also turn up with a level high tone — this is the sense in which this tone is 'unmarked'. In order to achieve this result, we assume that every mora in the stressed syllable needs to have a (high) tone. If the relevant constraint is ranked below MAXTONE, this does not affect the results we have obtained so far:

   (126) STRESSTOTONE: All moras in the syllable bearing main stress must bear tone.

[35] We do not have evidence yet for TONETOSTRESS≫MAXTONE, but we will see this below.

(127)

/laam/ + ∅	PITCH	TONETOSTRESS	MAXTONE	STRESSTOTONE
a. [laam]	*!			**
b. [láam]				*!
c. [làam]	*!			**
d. [laám]	*!			*
e. ☞[láám]				

The forms in (127a), (127c) and (127d) do not have a tone on one of the moras in the stressed syllable; they are therefore unacceptable. The choice is between (127b) and (127e). The latter wins, because it has high tones on all moras of the stressed syllable. From this we can conclude that PITCH is a more specific version of STRESSTOTONE, which again could be formalized along the lines of de Lacy (1999, 2002).

3. If we add a masculine (low tone) suffix to a lexical form with a low tone, we will get a low toned form. At present, we have no clue as to which of the two underlying low tones is actually surfacing:

(128)

/kɑlm + Low/ + /ə+ Low/	PITCH	TONETOSTRESS	MAXTONE	STRESSTOTONE
a. [kɑlmə]	*!		**	**
b. [kálmə]			**!	*
c. [kálmə]			**!	
d. [kálmə]		*!		*
e. [kàlmə]	*!			*
f. ☞[kálmə]			*	*

Note that this paradigm provides us with information on the ranking of TONETOSTRESS and MAXTONE: one of the two underlying tones has to be deleted here, because it cannot surface in a non-stressed position.

4. If we add a masculine (low tone) suffix to a lexical form without a tone, the low tone of the suffix will surface, and a falling tone will ensue:

(129)

/laam/ + /ə+ Low/	PITCH	TONETOSTRESS	MAXTONE	STRESSTOTONE
a. [laamə]	*!		*	**
b. [láamə]			*!	*
c. [láámə]			*!	
d. [láàmə]		*!		*
e. [lààmə]	*!			*
f. ☞[láàmə]				*

This concludes our analysis of the masculine and neuter forms (of stems not ending in a voiceless obstruent; we will return to the latter in section 4.3). Notice that the set of constraints that we require is relatively small and furthermore fairly 'natural', at least from a typological point of view. The only con-

straints we need are those establishing a relation between metrically strong positions and tones – and preferring high tones over low tones in this respect.

Feminine suffixes

We now turn to the feminine suffix, for which I propose that it consists of an empty mora plus a low tone. Independent phonological constraints will need to interpret the empty vocalic position. We propose that the default choice is that it simply does not get a phonological interpretation at all. In this way, it satisfies better the constraints of the family *STRUC, instantiated here as *SCHWA. If faithfulness (in particular a constraint against deletion of vowels, MAX-V) dominates this markedness constraint, masculine forms will not be affected:

(130)

/laam/ + /ə+ Low/	MAX-V	*SCHWA
a. [láàm]	*!	
b. ☞[láàmə]		*

Yet feminine suffixes can do without the schwa without being unfaithful (we use /μ+Low/ in the tableaux to represent the feminine suffix of which the 'real' structure is the one given in (123)):

(131)

/laam/ + /μ + Low/	MAX-V	*SCHWA
a. ☞[láàm]		
b. [láàmə]		*!

The Low tone in the feminine is underlyingly present, just like in the masculine, and therefore will show up wherever it can. The difference between neuter, masculine and feminine thus is a difference in lexical specification of the respective morphemes. Most important, at present, is the difference between the neuter and the feminine: whereas the latter has an underlying low tone, the former does not.

Without having to stipulate additional constraints we can now derive the pattern for the feminine suffix. If we add it to an adjective with an underlying low tone, one of the two low tones surfaces, and if we add it to an adjective without an underlying tone, the low tone of the suffix surfaces. The empty position will stay empty for faithfulness reasons just outlined. All of this is exactly like what we found for the masculine suffix. The only difference is that in this case we do not find a schwa:

(132)

/kɑlm + Low/ + /μ +Low/	PITCH	TONETOSTRESS	MAXTONE	STRESSTOTONE
a. [kɑlm]	*!		**	**
b. [kálm]			**!	*
c. [kálm]			**!	
d. [kàlm]	*!			*
e. ☞[kálm]			*	*

(133)

/laam/ + /μ + Low/	PITCH	TONETOSTRESS	MAXTONE	STRESSTOTONE
a. [laamm]	*!		*	**
b. [láam]			*!	*
c. [láám]			*!	
d. [làam]	*!			*
e. ☞[láam]				*

Stems in voiceless obstruents

Let us now turn to stems ending in a voiceless obstruent. These forms never alternate: neuter, masculine and feminine forms all have a level high tone. In addition a schwa shows up on the feminine, as the facts of (120), repeated here for convenience, show:

(120)

neuter	feminine	masculine	
ríík	ríík ə	ríík ə	'rich'
nááks	nááks ə	nááks ə	'naked'
záát	záát ə	záát ə	'lame'

The fact that low tones are avoided on syllables ending in an underlyingly voiceless obstruent is obviously in need of an independent explanation. There are reasons to assume that some constraint is active in the phonology of Limburg, disallowing the combination of low tone and voicelessness (see Hermans & van Oostendorp, 2001; Hinskens & van Oostendorp, 2005, for more discussion). One way to formalize this, is by assuming an implicational relation such as the following:

(134) L⊃[+voice]: A Low tone implies a feature value [+voice]

We could read this constraint as one requiring consonants always to be voiced in the vicinity of low tones, or as low tones dispreferring to land next to voiced consonants. This constraint can be seen as phonetically grounded in the sense that there is a clear connection between voicing of consonants and lowering of F0 values (Maddieson & Hess, 1987) — a more radical version of this analysis would have it that Low and [voice] are the same feature, see Halle & Stevens (1971); Bradshaw (1999); Harris (1994) among others, for arguments in favour of such a position. This constraint, then, directly

blocks low tones from surfacing, if it dominates the faithfulness constraints on tone.[36] This is illustrated in the following tableau for the masculine form of *rijk* 'rich' (assuming, irrelevantly, that the adjective itself does not carry a low tone):

(135)

/riik/ + /ə+ Low/	L⊃[+voice]	MAXTONE	STRESSTOTONE
a. [ríikə]		*	*!
b. [rîikə]	*!		*
c. ☞[rííkə]		*	

The only form which can win has a high tone on the second mora. A low tone is disallowed next to a voiceless obstruent, and the second mora needs some tone because it is in a stressed position. Therefore the masculine suffix is realized only partly in this particular position.

How about the feminine morpheme? If things would work the same way as for the masculine forms, we would select *[ríík], which would be homophonous to the neuter form. This apparently does not happen. Notice, however, that the homophony itself is not always a fatal problem, since the feminine and neuter forms of *calm* with a falling tone are also homophonous: [káàlm]. Furthermore, the feminine form which is selected, [rííkə] is homophonous to the masculine. So avoidance of homonymy within the adjectival paradigm cannot serve as an explanation.

In order to understand what is going on, I propose to refer to the REALIZE-MORPHEME, in accordance with a tradition in the phonological literature[37] and define it as a special type of faithfulness constraint.:

(136) REALIZE-MORPHEME (RM): For every morpheme in the input, some phonological element should be present in the output.

This constraint could be interpreted in the light of recent work on Optimality Theory in semantics and pragmatics; see for instance Buchwald *et al.* (2002) and the contributions to Blutner & Zeevat (2004).[38] A central notion is *recoverability* (there is some debate in the literature on the correct terminology and the proper way of implementing this idea). This notion explains, for instance the 'reduction' of nominals to pronominals. If somebody says 'He is coming' in stead of 'John is coming', she may be satisfying the requirements of *STRUC, since pronouns contain less information (hence less structure) than

[36] In section 4.2, we noticed that there are a few dialects which do seem to display alternations in this case. If those data turn out to be right, this could be a result of a reranking of the relevant constraints.

[37] The name of this constraint is due to Samek-Lodovici (1996). See Kurisu (2001) for a different perspective, and an overview of earlier literature.

[38] A somewhat similar idea can be found in the work of Boersma (1999).

nouns (or proper names). Why don't people then reduce all nouns all the time? The answer is recoverability: a higher ranking constraint demands that we can only use 'he' if from the context we can recover the extra information that we are talking about John.

I propose that we have something very similar here in the phonology-morphology interface. We usually prefer the schwaless form for the feminine, since it contains less structure. However, in the case of stems ending in voiceless obstruents, this would mean that the suffix is not realized at all (it contains only a Low tone, and this cannot surface). But that would mean that the morpheme is completely unrecoverable: there is no trace in the phonological surface form which shows that it is there. In this case, then, we choose the allomorph with schwa, which will still be recoverable.

Let us now see how this constraint affects the analyses of the neuter, masculine and feminine forms for words ending in a voiceless obstruent. For neuter forms, evaluation of RM is vacuous: since there is no underlying material at all, nothing can serve as a representative of the neuter suffix on the surface. For the masculine, there are in principle two elements which can satisfy RM and since the schwa always surfaces for independent reasons, the tone is not necessary, so that also in this case addition of the constraint does not affect the argumentation.

For the feminine form, we now have to assume that recoverability outranks structural markedness, i.e. RM≫*SCHWA:

(137)

/riik/ + /μ + Low/	RM	*SCHWA
a. [ríík]	*!	
b. ☞[rííkə]		*

One way of picturing the working of RM is by assigning a subscript to the elements of every morpheme. RM then has it that every subscript has to be present on some element on the surface:

(138)

underlying representation	bad surface form	good surface form	good surface form
$r_i i_i i_i k_i ə_j$	$r_i i_i i_i k_i$	$r_i i_i i_i k_i$	$r_i i_i i_i k_i ə_j$
L_j		L_j	

The underlying representation has two morphemes, corresponding to two subscripts, i and j. The candidate surface form in the middle is bad because it has only one of those two subscripts. The two forms at the right hand side obey RM, because they have both subscripts. (The rightmost one will eventually be chosen because of the phonological constraint L⊃[+voice].)

Note that the required visibility, if seen this way, is somewhat abstract, because it is intermediated by subscripts. This provides us with a way to

distinguish between the two possible output representations for forms such as the feminine for *calm*:

(139)

underlying representation	bad surface form	good surface form
$k_i a_i l_i m_i ə_j$	$k_i a_i l_i m_i$	$k_i a_i l_i m_i$
$L_i \quad L_j$	L_i	L_j

Even though the two potential output forms are homophonous, we now have a theory-internal reason to choose for the rightmost one: this one still contains all indices of the underlying representation. For this reason, there is no need to insert a schwa (or preserve it) in this case. Note that the 'bad' surface form will surface in the derivation of the neuter, simply because the rightmost form will be unavailable here.[39]

This completes our analysis of tone in adjectival inflection in Limburg Dutch. We repeat the constraint rankings we have called upon in (140):

(140)
a. PITCH≫TONETOSTRESS≫MAXTONE≫STRESSTOTONE
b. L⊃[+voice]≫MAXTONE
c. MAX-V,RM≫*SCHWA

The subhierarchies in (140a) and (140b) regulate the distribution of tone, and (140c) regulates the occurrence of schwa. The two processes are almost independent, except that deletion of underlying tone will affect RM in exactly one case: that of feminine suffixes before voiceless obstruents.

4.4 Paradigms and representations

Lenition and final devoicing

The previous section presented the main line of analysis. In this section we will fill in a few details, and compare our analysis to two alternatives.

In addition to the tonal behaviour already mentioned, the feminine form of the Limburg Dutch adjective is different from the neuter in another respect: stem-final underlying /d/ lenites to [j]:

(141)

	neuter	feminine	masculine	
a.	róòd	róòj	róòjə	'red'
b.	ríík	rííkə	rííkə	'rich'
	zɔ́ɔ́t	zɔ́ɔ́tə	zɔ́ɔ́tə	'salted'

[39]This means either that we restrict the Generator function in such a way that it cannot add morphological affiliations to segments (this was called *Consistency of Exponence* in Prince & Smolensky (1993)), or that the faithfulness constraint RM only looks at those subscripts which are already present underlyingly: none, in the case of the neuter.

Lenition of this type usually only happens to /d/'s in (intervocalic) onset position in dialects of Dutch (such as in the masculine form here Zonneveld, 1978). Yet in the feminine form chosen here, there is no vowel.[40]

Notice that this fact gets a natural explanation under the analysis proposed here. Since the feminine suffix contains an empty vocalic position, the /d/ will still be literally intervocalic in the feminine, even if one of the two vowels is not pronounced, and hence be prone to lenition. The neuter does not provide such a position, on the other hand, and therefore the /d/ at the end of the neuter is not subject to lenition.

There is also an alternative analysis, for which we first have to consider the most likely output candidate for *rood* 'red' without lenition. Hitherto we have assumed that this is the following:

(142)
```
r oo d
   |
   L
```

However there is something definitely uncomfortable about this analysis and this is that Limburg Dutch, like all Dutch dialects has a process of final devoicing, which is to say that the final segment is not [d], but rather devoiced [d̥] (or [t]). The problem with this obviously is that we have evidence that (underlyingly) voiceless obstruents such as /t/ do not permit Low tones in front of them.

This implies that we have to distinguish between underlyingly voiceless and devoiced consonants. One way to achieve this effect is by following Ernestus (2000) and assume that while voiced consonants are [+voice] and voiceless consonants are [-voice], the result of final devoicing has no specification for voicing at all (Ernestus, 2000, gives a range of phonetic, phonological and experimental evidence for this). In that case, we could split up the constraint called L⊃[+voice] above into two parts:

(143) a. $*\begin{bmatrix} \text{L} \\ \text{-voice} \end{bmatrix}$: disallowing the combination of [-voice] with a low tone

b. L⊃[+voice]: requiring low tones to be accompanied by [+voice] segments.

An underlyingly voiceless [t] would violate both constraints, whereas a devoiced [d̥] would only violate the second one. If we then put the constraint in (143a) at the inviolable position we have awarded to the voicing constraint in the previous section, and demote L⊃[+voice] to a much lower position,

[40]Furthermore, this lenition is pervasive in the Limburg dialect area. The GTR database contains 58 Limburg Dutch dialects with reliable data on the adjective *goed* 'good'. None of these end in a plosive (whereas all the neuter forms do). For 24 dialects, the final segment is transcribed as [i]; 28 dialects have [j], and the rest have [w], [u] or [y].

the result is that devoiced consonants are more permissive, and will usually tolerate low vowels before them.

Yet among these devoiced consonants, [d̥] happens to be the only one which can avoid violating the second constraint at a relatively low cost, viz. by turning into a sonorant [j]. In this way, then, the lenition can be seen as an Emergence of the Unmarked effect on the constraint in (143b): falling tones are permitted before devoiced consonants, but only in case nothing can be done to change those devoiced consonants into something more acceptable (see Hinskens & van Oostendorp, 2005, for an elaboration on this idea).

Paradigms or morphemes

Having now set up a representational OT analysis, we may compare it to another OT account of the same phenomenon, one in terms of paradigms, proposed by Alderete (1999).[41]

Alderete (1999) gives a purely morphological approach based on output-output correspondence relations. To be more precise, Alderete (1999) defends a notion of Anti-faithfulness: some morphological forms – e.g. forms in a paradigm – desire to be *different* from other surface form in some properly described way. (Again, we will not go into all of the technicalities of the approach.)

For the Limburg data, Alderete assumes that low tones are absent altogether: a falling tone is represented with a high tone on the first mora, and nothing on the second mora. This makes them thus less marked than level high tones. Further, there is a constraint ¬NO-FLOP-TONE, which informally states the following:[42]

(144) ¬NO-FLOP-TONE If a segment s_1 is linked to a tone T_1 in the neuter, a corresponding segment s_2 should not be linked to a corresponding tone T_2 in the feminine (and masculine)

The following gives the input-output pair for the masculine form of *lame* as well as the neuter form (which does not change from input to output):

[41] The representational analysis presented here is forecasted in a derivational framework by Hermans (1994). We are aware of only one further analysis, by Hinskens & Muysken (1986), but we will not discuss this here because it deals with a dialect with a slightly different pattern, and favours an analysis which is based on theoretical assumptions very different from the one presented here.

[42] Alderete (1999)'s approach is based on antifaithfulness of the feminine form with respect to the neuter or citation form. Note that it would also be possible to construct a paradigm uniformity approach with faithfulness to the masculine form. As far as I can see, this would have the same properties as the Alderete (1999)'s theory – it would share its advantages, but also its problems.

(145)

input	output	neuter
l a a m+ ə	l a a m+ ə	l a a m
H L	H	H

The output form of the masculine has changed from input to output, because ¬NO-FLOP-TONE requires the tonal association of the masculine to be different from that of the neuter. The reason why this affects the last mora of the word is because of tonal alignment: within syllables, tones prefer to be at the left edge. (We interpreted the same facts to mean that the masculine suffix has a low tone, which the neuter suffix does not have.)

¬NO-FLOP-TONE does not take effect if the neuter has a falling tone. In that case there is only one tonal association: of the high tone to the first mora, but this cannot be undone because of a high-ranking constraint (we argued this to be PITCH, for Alderete (1999) it is again left alignment of tone in syllables).

Alderete (1999) mentions the following advantages of his approach (p. 226):

1. "The analysis presented here accounts for accent purely in terms of H tones, and as emphasized above, the analysis is in line with recent approaches to tonal accent systems like the one given in Pulleyblank 1986 for Tonga."
2. "A second point in favor of [Alderete (1999)'s] analysis is that it relates a wide range of morphologically triggered shifts as effects of a specific type of Anti-Faithfulness. Thus, the loss of a link in the dragging tone mutation is treated on a par with the obligatory shifts found in Japanese and Aguaruna."
3. "A final argument in favor of the account of the accentual mutation in terms of AntiFaithfulness is that it explains the relation between the properties of the accent shift with independently needed constraints. "

I believe that none of these arguments hold. Ad 1, it can be observed that there are independent reasons to assume that Low tone is the marked tone in Limburg Dutch, and the morphologically active one. It serves to mark the plural (which thus has a falling tone) from the singular (with a level tone) in nouns, for instance (e.g. *béín* - *béìn* 'leg - legs'), and in all minimal pairs where one of the two forms is a lexical word and the other one a function word, the lexical word has the falling tone and the function word the level tone (e.g. *zíí* - *zíì* 'she - silk'). This can be understood if function words are supposed to have an unmarked phonological structure, whereas lexical words are more marked, and if the Low tone is marked, i.e. present in the phonological representation. Whatever the merits of the assumption that only High tones are present for the analysis of Tonga, it seems to be jumping to conclusions to

assume that this should carry over to all other languages, including Limburg dialects.

Points 2 states that the anti-faithfulness analysis has as an advantage that it relates the Limburg facts to those of the morphologies of other languages. But the same seems to be true for an analysis which holds that neuter and feminine have different suffixes.

Finally, Alderete (1999) mentions as an advantage of his analysis that it uses phonological constraints which are motivated independently; but the same is true for the analysis presented here. In sum, none of the 'favourable' properties mentioned by Alderete (1999) seem to be convincing enough to blow out the approach mentioned here.

In return, Alderete (1999) does not discuss the interaction with voicelessness on obstruents, and it is hard to see how those facts could be incorporated into a paradigmatic approach. We might be able to constrain ¬NO-FLOP-TONE in such a way that it does not affect words ending in a voiceless obstruent, but even then, there is no reason why a schwa should appear at the same time. Allomorphy is not a notion to which we can refer, since this approach does not refer to morphemes at all: the tonal shift if encoded in the morpheme-specific constraint ¬NO-FLOP-TONE, not in the representation of any kind of constraint.

On a formal level, we argue that interparadigmatic faithfulness is too abstract and too powerful a formal device to incorporate into our theory too lightly. The approach defended here might be slightly abstract since it involves an empty vocalic position. At the same time, the antifaithfulness approach is abstract in many more ways. Not only does it posit 'toneless' mora's in stressed syllables, which then have to be interpreted as low, but also do we have to assume correspondence relations among individual segments and tones in words - and none of these can be observed phonetically anymore than morphological superscripts can.

Since the latter approach is more parsimonious, and at the same time seems more succesful from an empirical point of view, we conclude that it is preferable over its current competitors. We claim that it is the interaction between phonology and morphology which gives us exactly the pattern we find in Limburg Dutch adjectival inflection.

5 Extra: Some voicing phenomena

5.1 Devoicing and morphology

All Continental West-Germanic dialects display the effects of a process called *final devoicing (FD)*, illustrated in (146) for Standard Dutch: an underlyingly

voiced obstruent devoices when it occurs at the end of a syllable.[43][44] That the obstruent is underlyingly voiced can be seen in other morphological contexts, where it does not end the syllable. Thus in there is a contrast between 'wet', which has an underlying /t/, and 'bed' which has an underlying /d/, but the contrast only shows up when a vowel-initial plural suffix is added:

(146) /bɛd/ 'bed' [bɛt] 'bed' /bɛd+ən/ → [bɛdən] 'beds'
/bɛt/ 'to wet' [bɛt] '(I) wet' /bɛt+ən/ → [bɛtən] '(we) wet'

As far as is known, there are no Dutch dialects which do not have FD at all. On the other hand, there are quite a few dialects which display exceptions to FD in certain lexical or morphological contexts[45]. A relatively widespread phenomenon, found both in eastern and in southern dialects of Dutch (including Flemish), is that the final fricative of a verbal stem (with a long vowel in the final syllable) remains voiced in the first person singular, as we have seen in 3.4.

At first sight it may seem absurd that the fricatives of all segments are the possible exceptions to FD, regardless of our morphological theory: phonetically they are less compatible with voicing than plosives. It even is the case that in those cases in which exceptions to final devoicing are not triggered by the morphology, we seem to find the inverse pattern: fricatives devoice before plosives do. In a survey of Dutch dialects, van Bree (2003) mentions that:

> not all potential target sounds take their turn at the same time: there clearly is earlier devoicing with fricatives than with occlusives [...]; this might be related to the fact that the unmarked state for fricatives is voicelessness.

We will have to take into account the fact that there is a difference between those cases in which morphology is involved and those cases in which it is not. Here, let us concentrate on the former case. Interestingly, there is another well-known case where fricatives constitute exceptions to FD, viz. Turkish (Kaisse, 1986; Rice, 1993):

(147) *şara[*p*]* 'wijn, NOMSG' *a[*z*]* ' weinig'
*şara[*bɪ*]* 'wijn, ACCSG' *e[*z*]* 'thuis'

[43]This class is based on (van Oostendorp, in press). For more discussion, see Booij (1995); Ernestus (2000); Warner *et al.* (2004); Ernestus & Baayen (To appear,t); van der Torre & van de Weijer (in press).

[44]There are a lot of differences among dialects; it is well-known for instance that so-called Standard Yiddish does not devoice consonants at the end of the word (Lombardi, 1991, 1999; Wetzels & Mascaró, 2001) and it is claimed for Frisian that FD did not occur until the beginning of the 20th century (Tiersma, 1985). See van Bree (2003) for an overview.

[45]Taeldeman & Schutter (1986); De Vriendt & Goyvaerts (1989); Goeman (1999); van Bree (2003).

There arguably is a special relation between fricatives and voice if we look at it from a cross-linguistic perspectives. According to Maddieson (1984) "bilabial, dental and palatal non-sibilant fricatives are found to occur *without* a voiceless counterpart more often than with one."

Several authors[46] argue on the basis of phonotactic distribution that in some West-Germanic dialects and in particular in Dutch the opposition voiced/voiceless should be replaced for fricatives with the opposition short/long. Phonetically these oppositions are clearly correlated.[47] This explains facts such as those above: in Turkish, fricatives are not sensitive to FD if they do not bear the feature [voice] — an idea which is clearly present also in the approach of Rice (1993) referred to above. The fact that short fricatives should occur more often than long ones is hardly surprising either from this point of view. (We have seen this argument from the size of inventories in the first class as well.)

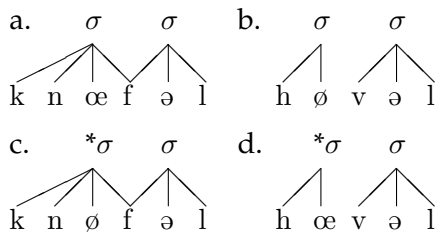
It seems problematic to replace the voicing opposition with a length opposition completely in Dutch (at least in Standard Dutch and the dialects under consideration here), but there clearly are facts showing that the two dimensions are correlated, e.g. the fact that lax vowels (almost) exclusively occur before voiceless fricatives and tense vowels (almost) exclusively before voiced ones.

(148)

knuffel	[knœfəl]	'hug'	*[knøfəl]
heuvel	[høvəl]	'hill'	*[hœvəl]

These facts are easily explained if — given our analysis so far — tense vowels occur in open syllables and lax vowels occur in closed syllables, and voiceless fricatives are ambisyllabic (so that they close the syllable):

(149)



(149c) has a tense vowel in a closed syllable, and (149d) a lax vowel in an open syllable; both are excluded by CONNECT (15), whereas the structures in (149a) and (149b) are correctly allowed.

There is some empirical support for this assumption in the work of Ernestus (2000, p. 177). Based on a corpus of spontaneous (Standard Dutch) speech, Ernestus notes that

[46] van Oostendorp (2002); Iverson & Salmons (2003); see also Avery (1996).

[47] Slis & van Heugten (1989); van Rooy & Wissing (2001)

> Clusters of fricatives of the same place of articulation arise when a word-final fricative is followed by a word-initial one. These clusters are generally realized with a duration that is shorter than the duration of two segments (...). In what follows, clusters consisting of two segments with the same manner and place of articulation will be referred to as geminates. [...] The problem is that fricative geminates are always realized as voiceless, independently of their context, exact duration, etc.

From this we can thus at least conclude that longer fricatives are always voiceless. A somewhat more complicated argument, finally comes from those (Brabantish and Flemish) dialects of Dutch (Taeldeman & Schutter, 1986) where deletion of /t/'s in clusters cause the fricative in those clusters to devoice. So, instead of *hij doe/*t v*/eel* 'he does a lot', people pronounce *hij doe[*f*]eel*. The same thing does not happen — or happens much less frequently — if the consonant which followed the /t/ in underlying form was a plosive. One could of course analyze this as opaque interaction between progressive assimilation, which does indeed exist in Dutch in clusters ending in fricatives, and t deletion. But under the assumption that voiceless fricatives are long, a different solution presents itself: deleting /t/ would leave a position to be filled up by the fricative, which would thereby become long. Devoicing would thus be a form of compensatory lengthening.

Based on these arguments, we could conclude that the following correlation exists, at least in ambisyllabic position:

(150) a. If a fricative is attached to one position, it is voiced.
b. If a fricative is voiced, it is attached to one position.

The problem is, however, that in two clear senses voicing on fricatives behaves clearly like a feature, rather than like a voicing distinction. In the first place, in the usual case, fricatives devoice in Dutch just like stops. Devoicing is usually described as delinking of the feature [voice] or of the Laryngeal node (Lombardi, 1991, 1999). If we would subscribe to a length theory of fricatives, we clearly need an alternative account. Furthermore, it is not immediately clear that the alternative account which would need to say that somehow fricatives lengthen at the end of the syllable or at the end of the word can give an explanation why the fricatives in first person singulars do not lengthen.

The second problem seems even more severe. One of the most well-known aspects of Dutch phonology is that it has voicing assimilation in obstruent clusters. This assimilation (which comes in two flavours) involves stops and fricatives alike. We will return to the phenomenon in more detail below, but here one example suffices to show the problem:

(151) a/f+d/oen → a[vd]doen 'take off'
a/f+t/akelen → a[ft]akelen 'go to seed'

In autosegmental terms, this change can be easily described in terms of a feature [voice] spreading from the stop to the fricative. This then is clearly a contraindication to the assumption that the distinction among fricatives is primarily one of length.

Since there seem to be quite some problems with the length-based account, we now turn to alternative accounts based on features. In the view of Vaux (1998), voiceless fricatives are represented as [+spread glottis] (like aspirated stops).[48] The proposal is dubbed Vaux's Law in Avery & Idsardi (2001); we will formulate in the form of an implicational constraint:

(152) VAUX: Fricative ⊃ [spread glottis].
'Fricatives preferably have the feature [spread glottis]'

Some of the facts discussed above might be amenable to an analysis of this type. For instance the fact that fricatives seem more resistant to devoicing than stops can be understood, because voiced fricatives might be seen as actually more marked than voiceless ones, in the sense that also aspirated stops are more marked than unaspirated stops. Devoicing a fricative involves adding [+spread glottis] and this is incompatible with an analysis in which final devoicing is an instance of delinking the Laryngeal node. On the other hand, we would obviously need a new account of final devoicing, one which would regard it in some cases as a form of final fortition. Notice by the way that this approach seems necessary for all obstruents in German, if we take the suggestion seriously that this language has a distinction between aspirated and unaspirated stops and we assume that the language has 'final devoicing'.

Another interesting consequence of the proposed equality between voiceless fricatives and aspirated plosives, is that it is well-known that aspirated plosives are also known to be substantially longer than unaspirated plosives. Furthermore, it has been proposed (by Ringen, 1999) in the context of aspiration that there is a constraint MULTILINK:

(153) MULTILINK The feature [+spread glottis] has to be linked to two positions

The relation expressed by MULTILINK could be seen as a (mutual) enhancement of contrast. Ringen (1999) uses this constraint to explain why underlyingly aspirated stops in Icelandic are not allowed to surface as aspirated

[48] Vaux (1998)presents arguments from (several dialects of) Armenian, as well as from Sanskrit, Pali, the historical development of Modern Greek and from Thai for this implication.

when they occur in a cluster (i.c. when they are followed by a sonorant). In this case, they occur as 'preaspirated' stops, sharing their [spread glottis] with an [h]. The fact that in English onset clusters, aspiration spreads from the stop to the onset ([pl]ead, [tr]ain etc.) could be similarly explained by this constraint.

Extending the interpretation of MULTILINK just a little bit, we could also use it to explain why voiceless fricatives are (preferably) long or in a cluster. It has indeed been proposed in the literature that a feature [tense] on fricatives is cued phonetically primarily by length[49]. To the extent that we can in this case see [tense] and [spread glottis] as the same formal object, MULTILINK can be seen as a formalisation of this idea. A short voiceless fricative prefers to share its [spread glottis] specification; it can do this either by being long (assuming the parts of the long fricative help each other satisfy MULTILINK), or by occuring in a voiceless cluster. In order to account for the fact that Dutch does not have aspirated (i.e. [spread glottis]) stops, we invoke the following:

(154) NOGEMINATEONSETS (NGO): Stops in onsets are never long (no initial geminate stops).

The constraint clearly has some typological value, since geminates are absent more often from onset positions than elsewhere. MULTILINK, together with VAUX can help us actually formulate the behaviour of intervocalic fricatives in a much more insightful way, as will be shown now. An interesting aspect of our current findings is that it allows us to understand the dual behaviour of voicing in fricatives: it behaves both as a length distinction and as a feature difference, because it involves both.

5.2 Formalisation in OT

We will now try to put the pieces together to see whether we can produce a coherent analysis that can deal with all of these facts at the same time.

The core of the analysis are VAUX, requiring fricatives to be [spread glottis] ('voiceless'), and MULTILINK, requiring [spread glottis] to be spread over two positions. It is first necessary to show how these two constraints can account for the behaviour of fricatives in intervocalic context, in interaction with a constraint on syllable well-formedness, i.e. CONNECT ((15) on p. 8) and assuming that faithfulness constraints are ranked conveniently (i.e. vowels are not allowed to change their length, but fricatives can change both their length and their voicing specification) (remember that /a/ is the tense vowel, and /ɑ/ the lax vowel):

[49]Cf. Jessen (1998) for an overview; cf. also van Rooy & Wissing (2001)

(155)

/aza/ /azː a/ /asa/ /asː a/	CONNECT	MULTILINK	VAUX
☞aza			*
asa		*!	
asː a	*!		
ɑzː a	*!	*	*
/ɑsː a/ /ɑzː a/ /ɑsa/ /ɑza/	CONNECT	MULTILINK	VAUX
☞ɑsː a			
ɑsa		*!	
ɑza			*!
ɑzː a		*!	*

In order to describe the behaviour of fricatives at the end of the word, we need to take into account the extra position which is available:

(156)

/as/ /az/	CONNECT	MULTILINK	VAUX
☞asː			
as		*!	
az			*!
azː			*!
/ɑs/ /ɑz/	CONNECT	MULTILINK	VAUX
☞ɑsː			
ɑs		*!	
ɑz			*!
ɑzː			*!

On the other hand, in the exceptional cases such as *ik geleuv* in (149) can be dealt with if we assume that (a) here the fricative appears in an onset of an empty headed syllable (as is the point of the preceding discussion), and (b) geminates are not allowed in an onset in this position:

(157)

/ɣəløv/	CONNECT	NGO	MULTILINK	VAUX
☞ɣəlø.v*V*				*
ɣəløf.f*V*	*!			
ɣəlø.ff*V*		*!		
ɣəlø.f*V*			*!	

(157) gives a comparison of [ɣəlø.v*V*] with all of the conceivable possible outputs that have a voiceless consonants. The actual winner is beaten by all of

these on account of VAUX (since it does not have the feature [spread glottis]), but it beats its competitors on some higher-ranking constraint.

The difference between the dialects which display this phenomena, and those which do not, should have something to do with the licensing power of an empty vowel which is a morpheme (Scheer, 2004); remember that we assume that there are non-morphological empty vowels in all cases where a tense vowel is followed by a consonant.

Notice, however, that we still do not have a formal answer to the question why stops do not display the same kind of behaviour. The answer is that in this case the relevant property (voice) is not dependent on syllable positions directly, and not interpreted in terms of length.

Yet according to this definition, [voice] also cannot appear in the onset of otherwise empty syllables, since it is not followed there by a tautosyllabic sonorant. We thus have the following tableau:

(158)

/bad/	CONNECT	FD
ba.dV		*!
☞ba.tV		
bat	*!	
bad	*!	*

Obstruents will thus always devoice, regardless of the morphological structure.

5.3 Extension to the phonology of fricatives

The theory presented here can hardly be taken seriously if it cannot be embedded within a larger fragment of Dutch voicing phonology. As a matter of fact, it turns out that this is indeed possible, and we do not need specific extra assumptions to be able to deal with the other phenomena. We have now dealt with intervocalic contexts and with word-final contexts, which leaves us with two types of position to consider: the word-initial position and the position in clusters. As to clusters, the following generalisation can be made:

(159) Clusters of fricatives are always voiceless.

Fricative clusters thus behave exactly as long fricatives, presumably because they can share their [spread glottis] specification, thus satisfying MULTILINK:

(160)

/hœyz/+/vœyl/	CONNECT	MULTILINK	VAUX
☞hœysfœyl			
hœyzvœyl			*!*
hœysvœyl		*!	*
hœyzfœyl		*!	*

In this case, we start out with two underlyingly voiced fricatives, but lengthening is not necessary for either of them to become lengthened: all that is needed is that the two share [spread glottis]:

(161) s f
[spread glottis]

Another issue we have to worry about is the representation of fricatives in onset position. This is basically the only position where we have a contrast, at least in some dialects. There are also many dialects in which the contrast has disappeared altogether, even in this position, and the whole contrast has become completely allophonic; we return to them briefly below, but it should be clear that they pose less of a problem.

Notice that faithfulness on fricative voicing (or length) does not play any role at all in the analysis given thus far. But in the dialects under consideration, voicing is contrastive in onsets:

(162)
a. *zee* 'sea' [ze] *C* '(the letter) C' [se]
b. *vee* 'cattle' [ve] *fee* 'fe' [fairy]
c. *chloor* 'chlore' [xlɔːr] *gloor* 'gleam' [ɣlɔːr]

The example with velars is marginal to the extent that it is very hard to find speakers who actively sustain the contrast, but this may be due to the rather marginal status of initial velar fricatives in general. For now let us concentrate on the labial case as exemplary. We have two options: either we allow initial 'geminates' in the cases at hand, or we do not allow them. But in both cases the result is less than satisfying. If we do not allow for geminates, we get the result that all fricatives should be voiced:

(163)

/ve/, /fe/	MULTILINK	VAUX
☞ve		*
fe	*!	

But if we do allow for geminates, the result is that all fricatives should be voiceless:

(164)

/ve/, /fe/	MULTILINK	VAUX
☞fːe		
ve		*
fe	*!	
vːe		*

This result is not without interest, by the way, since there are indeed dialects of Dutch which neutralize in voicing also in initial position, either in the direction of only voiceless consonants (Holland Dutch) or in the direction of only voiced consonants (Roermond Dutch, cf. Kats (1939); van Oostendorp (2002)). On the other hand, we do not yet have an analysis for those dialects which do allow for contrast in this position. We cannot allow a faithfulness constraint on e.g. [spread glottis] to outrank MULTILINK, since this would affect the whole of our analysis: faithfulness would also prevail in intervocalic contexts.

One possible account for this would be to capitalize on the preservation of length contrast. Suppose word-initial geminates cannot be generally created, but they may surface if they are underlyingly present (this is called a 'grandfather effect' by McCarthy (2003)). We know from the previous discussion that geminate onsets are always disallowed in Dutch, without any exception, so how could geminates be allowed to surface in the first syllable at all?

Dutch, like many other Indo-European languages, allows for an 'exceptional' [s] to surface at the beginning of a word, just like it allows for exceptional, extra coronals at the end of the word. Thus, while we usually have words starting with an onset of at most two segments, with a 'normal', declining, sonority slope, we also have words of the following structure:

(165) *staat* 'state', *sfeer* 'atmosphere', *schuiven* 'shove' [sx-], *straat* 'street', *schrijven* 'write' [sxr-], *splijten* 'split'

In all of these cases, the 'extra' consonant has three characteristics: (i) it is a fricative, (ii) it has unmarked (coronal) place, (iii) it is voiceless (Dutch does not allow a /z/ in this position). We could formulate this observation as follows:

(166) A word-initial appendix consonant has to be a voiceless fricative without independent place.

This should obviously be related to our constraint WORD in (64). Suppose that appendix obstruents can be of one of two types: either they are independent segments, displaying unmarked place, i.e. Coronal, or they share place with the following fricative, and thus are part of geminates. Word-initial

voiceless fricatives would thus involve such a geminate; voiced fricatives would be single fricatives. Since this is the only position in which we find a distinction between voiced and voiceless fricatives, we still need to invoke positional faithfulness (Beckman, 1998):

(167) FAITH-APP: Do not insert or delete segments in appendix position.

This constraint has to be ranked somewhere above VAUX, the only constraint with which it is in crucial conflict:

(168)

/sːai/	WORD	MULTILINK	FAITH-APP	VAUX
☞sːai				
zai			*!	*
zːai				*!
sai		*!	*!	

(169)

/zai/	WORD	MULTILINK	FAITH-APP	VAUX
sːai			*!	
☞zai				*
zːai				*!
sai		*!	*!	

The length approach may have the advantage of linking the phenomena to the behaviour of sC clusters, but the link is not very strong. It has the further advantage that it does not refer to notions such as 'first syllable (or first segment) of the word', which do not have a clear theoretical status, but can refer instead to appendix positions; but again, this is not necessarily seen as a convincing argument. The issue is therefore open to more subtle investigation than can be provided here.

Bibliography

Akinlabi, Akinbiyi (1996). 'Featural Affixation'. *Journal of Linguistics*, 32: 239–289.

Alderete, John (1999). *Morphologically Governed Accent in Optimality Theory*. Ph.D. thesis, University of Massachusetts at Amherst.

Archangeli, Diane & Douglas Pulleyblank (1994). *Grounded Phonology*. The MIT Press.

Avery, Peter (1996). *The Representation of Voicing Contrasts*. Ph.D. thesis, University of Toronto.

Avery, Peter & William J. Idsardi (2001). 'Laryngeal dimensions, completion and enhancement'. In: Hall, T. Alan (ed.), *Distinctive Feature Theory*, pp. 41–69. Berlin: Mouton de Gruyter.

Beckman, Jill (1998). *Positional Faithfulness*. Ph.D. thesis, University of Massachusetts at Amherst.

Blutner, Reinhard & Henk Zeevat (2004). *Optimality Theory and Pragmatics*. London: Palgrave/Macmillan.

Boersma, Paul (1999). 'On the need for a separate perception grammar'. URL `http://www.fon.hum.uva.nl/paul/papers/percgram.pdf`. Manuscript, University of Amsterdam.

Booij, Geert (1977). *Dutch morphology: A study of word formation in generative grammar.* Dordrecht: Foris.

——— (1981). *Generatieve fonologie van het Nederlands*. Utrecht/Antwerpen: Het Spectrum.

——— (1995). *The Phonology of Dutch*. Oxford: Oxford University Press.

——— (2002). *The Morphology of Dutch*. Oxford: Oxford University Press.

Booij, Geert & Ariane van Santen (1995). *Morfologie: De woordstructuur van het Nederlands*. Amsterdam: Amsterdam University Press.

Bradshaw, Mary (1999). *A Crosslinguistic Study of Consonant-Tone Interaction*. Ph.D. thesis, Ohio State University.

van Bree, Cor (2003). 'Auslautsverscherping bij de oude grammatici en in de dialecten en het Fries'. Manuscript, Leiden University.

Brink, Daniel (1970). *Problems in Phonology. A Generative Phonology of Dutch*. Ph.D. thesis, University of Wisconsin.

Buchwald, Adam, Oren Schwartz, Amanda Seidl, & Paul Smolensky (2002). 'Discourse Anaphora and Bidirectional Optimization: Recoverability Optimality Theory'. *Proceedings of EDILOG 2002*. URL `http://www.ltg.ed.ac.uk/edilog/papers/037.pdf`.

Colinet, Ph. (1896). 'Het dialect van Aalst. Eene Phonetisch-historische Studie'. *Leuvensche Bijdragen*, pp. 1–59, 99–206, 223–309.

De Vriendt, Sera & Didier L. Goyvaerts (1989). 'Assimilation and sandhi in Brussels'. *Leuvense Bijdragen*, 78.

Ernestus, Mirjam (2000). *Voice Assimilation and Segment Reduction in Casual Dutch. A Corpus-Based Study of the Phonology-Phonetics Interface*. Ph.D. thesis, Vrije Universiteit Amsterdam.

Ernestus, Mirjam & Harald Baayen (to appear). 'The functionality of incomplete neutralization in Dutch. The case of past-tense formation'. In: *Papers in Laboratory Phonology 8*.

——— (To appear). 'Intraparadigmatic Effects on the Interpretation of Voice'. In: Torre, Erik Jan van der & Jeroen van de Weijer (eds.), *Voicing in Dutch*. Amsterdam/Philadelphia: John Benjamins. URL `http://www.mpi.nl/world/persons/private/baayen/submitted/ernestusbaayen2.pdf`.

Féry, Caroline (1997). 'The Mora as a Measure of Weight and as a Syllabic Constituent'. In: Bertinetto, P.M., L. Gaeta, G. Jetchev, & D. Michaels (eds.), *Certamen Phonologicum III. Papers from the Third Cortona Phonology Meeting*, pp. 91–110. Torino: Rosenberg & Sellier.

——— (2001). 'Markedness, Faithfulness, Vowel Quality and Syllable Structure in French'. In: Gärtner, Hans-Martin & Ruben van de Vijver (eds.), *Phonology in Potsdam*, pp. 1–31. Potsdam: Potsdam University.

van Ginneken, Jacques (1934). 'De phonologie van het Algemeen De phonologie van het Algemeen Nederlands'. *Onze Taaltuin*, 11: 321–340.

Gnanadesikan, Amalia (1997). *Phonology with Ternary Scales*. Ph.D. thesis, University of Massachusetts at Amherst.

Goeman, Ton (1999). *T-deletie in Nederlandse Dialecten. Kwantitatieve analyse van structurele, ruimtelijke en temporele variatie*. Ph.D. thesis, Vrije Universiteit Amsterdam. URL `http://www.meertens.nl/uitgeverij/extern/tonpdf/download.html`.

de Groot, Albert W. (1931). 'De wetten der phonologie en hun betekenis voor de studie van het Nederlands'. *Nieuwe Taalgids*, 25: 225–239.

Gussenhoven, Carlos (2000). 'The lexical tone contrast of Roermond Dutch in Optimality Theory'. In: Horne, Merle (ed.), *Intonation: Theory and Experiment*, pp. 129–167. Dordrecht: Kluwer. URL `http://www.let.ru.nl/gep/carlos/roermond.pdf`.

——— (2004). *The Phonology of Tone and Intonation*. Cambridge: Cambridge University Press.

——— (2006). 'Vowel duration, syllable quantity and stress in Dutch'. In: Hanson, Kristin & Sharon Inkelas (eds.), *The Nature of the Word. Essays in Honor of Paul Kiparsky*. Cambridge: MIT Press. URL `http://www.ru.nl/contents/pages/314295/vowelkiparsky.pdf`.

Gussman, Edmund (1976). 'Recoverable derivations and phonological change'. *Lingua*, 40: 281—303.

de Haas, Wim & Mieke Trommelen (1993). *Morfologisch handboek van het Nederlands: Een overzicht van de woordvorming*. Den Haag: Sdu Uitgevers.

van Haeringen, Coenraad B. (1962). 'De plaats van ie, oe en uu in het Nederlandse klinkerstelsel'. In: *Gramarie*. Assen: Van Gorkum.

Halle, Morris & Kenneth Stevens (1971). 'A note on laryngeal features'. In: *Quarterly progress report 101*, pp. 198–213. Cambridge, Mass: Research Laboratory of Electronics, MIT.

Hammond, Michael (1997). 'Vowel Quantity and Syllabification in English'. *Language*, 73, 1: 1–13.

Harris, John (1994). *English Sound Structure*. London: Blackwell.

Heeroma, Klaas (1959). 'De plaats van ie, oe en uu in het Nederlandse klinkersysteem'. *Nieuwe Taalgids*, 52: 297–304.

Hermans, Ben (1994). *The Composite Nature of Accent" With Case Studies from Limburgian and Serbo-Croation*. Ph.D. thesis, Free University of Amsterdam.

Hermans, Ben & Marc van Oostendorp (2001). 'Voice-tone interaction in a Limburg dialect: evidence for feature licensing'. In: de Hoop, Helen & Ton van der Wouden (eds.), *Linguistics in the Netherlands*, pp. 81–92. Amsterdam/Philadelphia: John Benjamins.

Hinskens, Frans & Pieter Muysken (1986). 'Formele en functionele benaderingen van dialectale variatie; de flexie van het adjectief in het dialect van Ubach over Worms'. In: *Syntaxis en Lexikon. Veertien artikelen bij gelegenheid van het emeritaat van Albert Sassen*, pp. 13–24. Dordrecht: Foris Publications. Online available at `http://www.dbnl.org/tekst/hins001form01/`.

Hinskens, Frans & Marc van Oostendorp (2005). 'Subtractive morphology in Limburg Dutch'. Manuscript, Meertens Instituut Amsterdam.

van Hout, Roeland & Hans van der Velde (2000). 'N-deletion in reading style'. In: *Linguistics in the Netherlands 2000*, pp. 209–219. Amsterdam: John Benjamins.

van der Hulst, Harry (1984). *Syllable Structure and Stress in Dutch.* Dordrecht: Foris.

Hulst, Harry van der & Norval Smith (eds.) (1988). *Autosegmental Studies on Pitch Accent*. Dordrecht: Foris.

Itô, Junko & Armin Mester (2003). *Japanese Morphophonemics. Markedness and Word Structure.* Cambridge, Mass.: MIT Press.

Iverson, Gregory & Joseph C. Salmons (2003). 'Legacy specification in the laryngeal phonology of Dutch'. *Journal of Germanic Linguistics*, 15, 1: 1–26.

Jackendoff, Ray (1993). *The Architecture of the Language Faculty*. Cambridge, Mass.: The MIT Press.

Jakobson, Roman (1942). *Kindersprache, Aphasie und allgemeine Lautgesetze*. Uppsala: Lundequist.

Jessen, Michael (1998). *Phonetics and phonology of tense and lax obstruents in German*. Amsterdam/Philadelphia: John Benjamins.

Kager, René (1989). *A metrical theory of stress and destressing in English and Dutch*. Dordrecht: Foris.

——— (1995). 'Consequences of catalexis'. In: *Leiden in Last*, vol. I of *HIL Phonology Papers*, pp. 269–298. The Hague: HAG. URL `http://www.let.uu.nl/~Rene.Kager/personal/Papers/catalexi.pdf`.

Kaisse, Ellen (1986). 'Locating Turkish devoicing'. *WCCFL*, 5: 119–128.

Kats, J.C.P. (1939). *Het phonologisch en morphonologisch systeem van het Roermondsch dialect*. Ph.D. thesis, Katholieke Universiteit Nijmegen.

Kaye, Jonathan (1974). 'Opacity and Recoverability in Phonology'. *Canadian Journal of Linguistics*, 19: 134–149.

Kessels-van der Heijde, Marina (2002). *Maastricht, Maestricht, Mestreech. De taalverhoudingen tussen Nederlands, Frans en Maastrichts in de negentiende eeuw*. Hilversum: Verloren.

Keymeulen, Lut & Johan Taeldeman (1985). 'Tussen fonologie en morfologie. De vokaalverkorting in een Brabants dialekt'. *Taal & Tongval*, 37: 124–164.

Kiparsky, Paul (1982). *Explanation in Phonology*. No. 4 in Publications in Language Sciences. Dordrecht: Foris.

——— (1991). 'Catalexis'. Ms., Stanford University and Wissenschaftskolleg zu Berlin.

Kissebert, Charles (1976). 'The Interaction of Phonological Rules and the Polarity of Language'. In: Koutsoudas, Andreas (ed.), *The Application and Ordering of Phonological Rules*, pp. 41–54. The Hague: Mouton.

Kroon, Sjaak & Ton Vallen (2004). 'Dialect en schoolprestaties: een terugblik'. In: *Dialect en school in Limburg*, pp. 33–53. Amsterdam: Aksant Academic Publishers.

Kurisu, Kazutaka (2001). *The Phonology of Morpheme Realization*. Ph.D. thesis, University of California at Santa Cruz.

de Lacy, Paul (1999). 'Tone and Prominence'. Manuscript, Rutgers.

——— (2002). *The formal expression of markedness*. Ph.D. thesis, University of Massachusetts at Amherst.

Lahiri, Aditi & Jacobus J.M Koreman (1988). 'Syllable weight and quantity in Dutch'. *Proceedings of the West Coast Conference on Formal Linguistics*.

Lombardi, Linda (1991). *Laryngeal Features and Laryngeal Neutralization*. Ph.D. thesis, University of Massachusetts.

——— (1999). 'Positional Faithfulness and Voicing Assimilation in Optimality Theory'. *Natural Language and Linguistic Theory*, 17: 267–302.

Maddieson, Ian (1984). *Patterns of Sounds*. Cambridge: Cambridge University Press.

Maddieson, Ian & Susan Hess (1987). 'The effect on F0 of the linguistic use of phonation type'. *UCLA Working Papers in Phonetics*, 67: 112–118.

McCarthy, John (1991). 'L'infixation réduplicative dans les langages secrets'. *Langages*, 25: 11–29.

——— (2003). 'Comparative Markedness'. *Theoretical Linguistics*, 29: 1–51.

Moulton, William (1962). 'The vowels of Dutch: Phonetic and distributional classes'. *Lingua*, 11: 294–312.

Nijen Twilhaar, Jan (1990). *Generatieve fonologie en de studie van Oostnederlandse dialecten*. Amsterdam: P.J. Meertens-Instituut.

Nooteboom, Sieb (1972). *Production and perception of vowel duration; A study of durational properties of vowels in Dutch*. Ph.D. thesis, Rijksuniversiteit Utrecht.

Nouveau, Dominique (1994). *Language Acquisition, Metrical theory, and Optimality: A Case Study of Dutch Word Stress.* Ph.D. thesis, University of Utrecht.

Nuyts, Johan (1989). 'Het Antwerpse vokaalsysteem: Een synchronische en diachronische schets'. *Taal en Tongval*, pp. 22–48.

van Oostendorp, Marc (1997a). 'Lexicale variatie in optimaliteitstheorie.' *Nederlandse Taalkunde*, 2: 133–154.

——— (1997b). 'Style levels in conflict resolution'. In: Frans Hinskens, Roeland van Hout & Leo Wetzels (eds.), *Variation, Change and Phonological Theory*, pp. 207–229. Amsterdam: John Benjamins.

——— (2000). *Phonological Projection*. Berlin/New York: Mouton de Gruyter.

——— (2001). 'Nasal Consonants in Variants of Dutch and Some Related Systems'. *Neerlandistiek.nl*. URL `http://www.neerlandistiek.nl/01/08/index.html`.

——— (2002). 'Ambisyllabicity and Fricative Voicing in West-Germanic Dialects'. In: Féry, Caroline & Ruben van de Vijver (eds.), *The Syllable in Optimality Theory*. Cambridge: Cambridge University Press.

——— (2004). 'Crossing Morpheme Boundaries in Dutch'. *Lingua*.

——— (2005). 'The first person singular in dialects of Dutch'. In: *Proceedings of NELS*.

——— (2006). 'Expressing Inflection Tonally'. *Catalan Journal of Linguistics*, 4, 1: 107–126.

——— (in press). 'An Exception to Final Devoicing'. In: van der Torre & van de Weijer (in press).

Piggott, Glyne (1974). *Aspects of Odawa Morphophonemics*. Ph.D. thesis, University of Toronto.

——— (2000). 'Against Featural Alignment'. *Journal of Linguistics*, 36: 85–129.

——— (2002). 'Challenging the NoCoda Hypothesis and Other Myths: A Tale of Two Theories'. *GLOT International*, 101. URL `http://www.linguistlistplus.com/glot/html/Gi6208/GI6802SQB.htm`.

Pols, Louis, H. Tromp, & R. Plomp (1973). 'Frequency analysis of Dutch vowels from 50 male speakers'. *Journal of the Acoustical Society of America*, 53: 1093–1101.

Prince, Alan & Paul Smolensky (1993). 'Optimality Theory: Constraint Interaction in Generative Grammar'. Manuscript, Rutgers University and University of Colorado at Boulder. Available at ROA.

Revithiadou, Anthi (1999). *Headmost Accent Wins: Head Dominance and Ideal Prosodic Form in Lexical Accent Systems*. Ph.D. thesis, University of Leiden.

Rice, Keren (1993). 'A Reexamination of the Feature [sonorant]: the Status of 'sonorant obstruents''. *Language*, 69: 308–344.

de Rijk, Rudolf (1967). 'Apropos of the Dutch vowel system'. Manuscript, MIT.

Ringen, Catherine (1999). 'Aspiration, preaspiration, deaspiration, sonorant devoicing and spirantization in Icelandic'. *Nordic Journal of Linguistics*, 22: 137–156.

van Rooy, Bertus & Daan Wissing (2001). 'Distinctive [voice] implies regressive voicing assimilation'. In: Hall, T. Alan (ed.), *Distinctive Feature Theory*. Berlin: Mouton de Gruyter.

Rose, Sharon (1997). *Theoretical Issues in Comparative Ethio-Semitic Phonology and Morphology*. Ph.D. thesis, McGill University, Montreal.

Samek-Lodovici, Vieri (1993). 'Morphological Gemination'. Paper presented at Rutgers Optimality Workshop I.

——— (1996). 'A Unified Analysis of Crosslinguistic Morphological Gemination'. In: *Proceedings of CONSOLE-1*. Utrecht: Console. URL `http://roa.rutgers.edu/view.php3?id=161`.

Scheer, Tobias (2004). *A Lateral Theory of Phonology. Volume I: What Is CVCV, and Why Should It Be?* Berlin: Mouton de Gruyter.

Schoemans, Marjolijn & Marc van Oostendorp (2004). 'Stemhebbende eindfricatieven in het Twents'. *TABU*, 33, 3/4: 79–90.

Schutter, George De (1978). 'Aspekten van de Nederlandse klankstruktuur'. In: *Antwerp Papers in Linguistics*, vol. 15, pp. 23–54. Antwerp: UAL.

Slis, I. & M. van Heugten (1989). 'Voiced-voiceless distinction in Dutch fricatives'. In: Bennis, Hans & Ans van Kemenade (eds.), *Linguistics in the Netherlands*. Amsterdam/Philadelphia: John Benjamins.

Smith, Norval, Roberto Bolognesi, Frank van der Leeuw, Jean Rutten, & Hans de Leeuw (1989). 'Apropos of the Dutch vowel system 21 years on'. In: Bennis, Hans & Ans van Kemenade (eds.), *Linguistics in the Netherlands 1989*. Dordrecht: Foris.

Spa, J.J. (2000). *De dialecten van Groot-IJsselmuiden. Klank- en vormleer*. Kampen: IJsselacademie.

Swets, Francine (2004). *The Phonological Word in Tilburg Dutch. Government Phonology and a City Dialect*. Ph.D. thesis, University of Amsterdam.

Swets, Francine & Marc van Oostendorp (2003). 'The structure of Dutch /Au/'. In: Cornips, Leonie & Paula Fikkert (eds.), *Linguistics in the Netherlands 2003*. Amsterdam: John Benjamins.

Taeldeman, Johan (1980). 'Inflectional aspects of adjectives in the dialects of Dutch-speaking Belgium'. In: et al., Wim Zonneveld (ed.), *Studies in Dutch Phonology*, pp. 265–292. Den Haag: Martinus Nijhoff. URL `http://www.dbnl.org/tekst/tael002infl01/`.

——— (1982). 'Regelordening, taalverandering en ruimtelijke taalvariatie'. *Taal en Tongval*, 34, 3/4: 120–131.

——— (2002). 'Vlaamse klankfeiten en fonologische theorieën'. In: Schutter, Georges De & Steven Gillis (eds.), *Fonologische kruispunten*. Gent: KANTL.

Taeldeman, Johan & George De Schutter (1986). 'Assimilatie van stem in de zuidelijke Nederlandse dialekten'. In: Vos, Magda De (ed.), *Vruchten van zijn akker. Opstellen van (oud)medewerkers en oud-studenten voor Prof. V.F. Vanacker*. Gent: Universiteit Gent. URL `http://www.dbnl.org/tekst/schu031assi01/`. Een digitale versie van dit artikel verscheen in 2002 in de DBNL.

Tiersma, Pieter Meijes (1985). *Frisian reference grammar*. Dordrecht: Foris Publications.

van der Torre, Erik Jan (2003). *Dutch Sonorants: The Role of Place of Articulation in Phonotactics*. Ph.D. thesis, Leiden University.

van der Torre, Erik Jan & Jeroen van de Weijer (eds.) (in press). *Voicing in Dutch*. Amsterdam: John Benjamins.

Trommelen, Mieke (1982). *The Syllable in Dutch: With Special Reference to Diminutive Formation*. Ph.D. thesis, University of Utrecht. Published at Dordrect: Foris, 1984.

——— (1987). 'On *ie*, *uu* and *oe*: Dutch vowel length revisited'. In: *Formal parameters of generative grammar*, vol. III of *OTS Yearbook*. Utrecht: OTS.

Trommelen, Mieke & Wim Zonneveld (1989a). *Klemtoon en metrische fonologie*. Muiderberg: Coutinho.

——— (1989b). 'Stress, diphthongs, [r] in Dutch.' In: Bennis, Hans & Ans van Kemenade (eds.), *Linguistics in the Netherlands 1989*. Dordrecht: Foris.

Trubetzkoy, Nikolai (1939). *Grundzüge der Phonologie*. Prag: Travaux du Cercle Linguistique de Prague Travaux du Cercle Linguistique de Prague.

Vago, Robert (1985). 'The treatment of long vowels in word games'. *Phonology Yearbook*, 2: 329–342.

Vanacker, V.F. (1949). 'Over enkele meervoudsvormen van voegwoorden'. *Taal en Tongval*, 1: 32–45, 77–93, 108–112.

Vaux, Bert (1998). 'The Laryngeal Specification of Fricatives'. *Linguistic Inquiry*, pp. 497–512.

Verhoeven, Jo & Christophe Van Bael (2003). 'Akoestische kenmerken van de Nederlandse klinkers in drie Vlaamse regio's'. URL `http://lands.let.kun.nl/literature/vanbael.2002.3.pdf`. Unpublished manuscript, Nijmegen.

Walker, Rachel (1998). *Nasalization, Neutralization, and Opacity Effects*. Ph.D. thesis, University of California, Santa Cruz. Published from Garland Press, 2000.

——— (2000). 'Nasal Reduplication in Mbe Affixation'. *Phonology*, 17: 65–115.

Warner, Natasha, Allard Jongman, Joan Sereno, & Rachel Kemps (2004). 'Incomplete neutralization and other sub-phonemic durational differences in production and perception. Evidence from Dutch'. *Journal of Phonetics*, 32: 251–276.

Wetzels, Leo & Joan Mascaró (2001). 'The typology of voicing and devoicing'. *Language*, 77: 207–244.

van Wijk, Nicolaas (1935). 'De klinkerrekking en de stoottoon vóór stemhebbende medeklinkers in het Limburgs en in andere dialekten en talen'. *Nieuwe Taalgids*, 29: 405–411.

——— (1939). *Phonologie; Een hoofdstuk uit de structurele taalwetenschap*. Den Haag: Nijhoff.

Zonneveld, Wim (1978). *A Formal Theory of Exceptions in Generative Phonology*. Dordrecht: Foris.

——— (1982). 'The Descriptive Power of the Dutch Theme-Vowel'. *Spektator*, 11: 342–365.

——— (1993). 'Schwa, superheavies, stress and syllables in Dutch.' *The Linguistic Review*.

Zonneveld, Wim & Mieke Trommelen (1980). 'Egg, Onion, Ouch! On the Representation of Dutch Diphthongs'. In: Zonneveld, Wim, F. van Coetsem, & O. Robbinson (eds.), *Studies in Dutch phonology*, pp. 265–292. Martinus Nijhoff. URL `http://www.dbnl.org/tekst/zonn004eggo01/`.