

# Feature Domains in Hellendoorn Dutch

Jan Nijen Twilhaar, College for Teachers and Interpreters of Sign Language of the Netherlands, Utrecht  
Marc van Oostendorp, Meertens Institute, Amsterdam

## 1 Introduction

Phonological features sometimes originate in a position which is less than consonantal segments may underlyingly occupy a typically vocalic position. If this happens, the misplaced features of the consonant will tend to move to a better position, or be deleted altogether.

On the other hand, allowing too many spreading and moving operations would destroy the underlying structure and the morphological form of the words: if all consonants were moved to the phonologically ideal position, it would become hard to distinguish morphemes, or to find the boundaries of morphological and syntactic constituents.

The behaviour of misplaced phonological features thus represents the interaction between different factors: phonological wellformedness on the one hand, and faithfulness to the input and respect for morphological and syntactic constraints on the other.

That is in the centre of interest for modern phonological theories that take output constraints, such as Optimality Theory.

In this article we present a case study of this phenomenon, based on phenomena relating to nasal consonants in the Hellendoorn dialect of Dutch.<sup>1</sup> We explained this by saying that nasal consonants appear in a syllable rhyme, three things happen to them: sometimes they disappear completely, leaving a trace of nasality in the vowel; sometimes they assimilate in place to an adjacent consonant; sometimes they are deleted, leaving their nasality feature to an adjacent obstruent. We show that these processes can be understood in terms of phonological domains: the consonantal features of a word are distributed among the domains, and the choice of what to do with a consonant is dictated by the wish to show the boundaries between morphemes and words in the most transparent way possible.

This article is structured in the following way:

- In section 2 we present the facts of Hellendoorn Dutch that need to be explained by a good theory of the phonology-morphology interaction.
- Section 3 gives an analysis of place assimilation of nasals.
- Section 4 formalizes this analysis in terms of Optimality Theory.
- Section 5 extends the analysis to nasalization, nasal deletion and other phenomena.
- Section 6 discusses what is superficially the most problematic aspect of the analysis at hand, viz. a case of opacity.
- The last section is devoted to a conclusion.

---

<sup>1</sup> Hellendoorn Dutch is a Low Saxonian dialect of West Germanic, spoken in the Dutch town of Hellendoorn. Nijen Twilhaar (one of us) is a native speaker of this dialect.

## 2 The behaviour of nasals in Hellendoorn Dutch

In this section we discuss the forms of assimilation in Hellendoorn Dutch. We distinguish between two types of assimilation: (i), nasal consonants as preceding or following consonants in certain positions; (ii), voiced obstruents completely assimilate to a following nasal. The latter process superficially resembles the first: an obstruent almost always assimilates to a nasal which has occurred earlier. We will discuss these phenomena in turn. But before that, let us note a phenomenon that bleeds the type of nasal assimilation we usually encounter: a coronal nasal that follows a preceding vowel.

### 2.1 Nasalization

In many languages, such as English (or, for that matter, Standard Dutch) and immediately following heterosyllabic consonants, nasalization is a regular phenomenon. In Hellendoorn Dutch, however, this type of evidence for regressive nasalization is lacking, because a vowel followed by a coronal nasal is always subject to nasalization, while the coronal nasal itself disappears. This is illustrated in (1):

(1)	[I ]jectie	injection
	[ ]benul	dimwit (on+benul, un+inkling )
	[A ]geven	to hand an+geven, on+give )

We also find nasalization if the vowel+coronal nasal sequence is followed by other consonants:

(2)	daans: d[a ø]s	dance
	(hee) daanst: d[a ø]st(he)	dances

The environment for nasalization is the syllable (rhyme). When the nasal occurs at the onset of the following syllable, we do not find nasalization. Resyllabification can occur across word boundaries:

(3)	in april: [I]n a <sup>n</sup> pri <sup>l</sup> l	
	oneerlijk: [ ]neerlij <sup>k</sup> (eerlijk = fair )	
	an alles: [A]n al <sup>les</sup> s everything	

One of the pluralization suffixes of Hellendoorn Dutch is -(e)n (the other forms need not concern us here; cf. Nijen Twilhaar 1990). This suffix turns up attached to a vowel-final stem, as is to be expected (4a). Interestingly, it already contains a nasalised vowel, the suffix shows up as a coronal syllable, and the vowel is denasalized in those environments.

	singular	plural	
a	r[ɪø]	r[ɪ ø]	deer(s)
	spr[ ø]	spr[ ø]	starling(s)
	vl[oø]	vl[oø ]	flea(s)
b	b[o ]	b[onn']	bill(s)
	m[A ]	m[ann']	man/men
	l[o ø]	l[oønn']	wage(s)

These facts seem to show that the deletion of the nasal consonant is re-nasalization of the vowel. There cannot be an independent rule of nasal since this rule would incorrectly affect the plural of man as much as t

## 2.2 Regressive place assimilation of nasals

Even though most potential cases of regressive assimilation are bled by nasal consonant in the rhyme after a vowel, there is still at least one the reduced form of the indefinite determiner. In Hellendoorn Dutch, we genders, each with its own determiner. The full forms of this article distinguished: n«n (masculine), n« (feminine) and «n (neutral). Yet the reduced, form, which is the same for all genders, viz. a syllabic nasal meets a right environment, it is assimilated regressively to the consonant nasal immediately.

### (5) Regressive nasal assimilation

[n']	doeve	a pigeon
[M']	fietse	a bike
[t']	j sse	a coat
[m']	bal	a ball

Regressive assimilation thus is not completely absent from Hellendoorn its effects are not as clearly visible as those of progressive assimilation to the indefinite determiner for independent reasons.

Interestingly, the reduced form of the masculine definite determiner unaffected even though it sounds like a syllabic nasal as well. This na however:

(6) Definite article den (with masculines)

[n'] man, boom, kōpe man, tree, head

### 2.3 Progressive place assimilation of nasals

The examples in (7) show that in each case the syllabic nasal is homorg. immediately preceding consonant. The category singular nouns contains n up from a root plus a class I suffix; there happen to be no underived w Dutch which end in a syllabic nasal (cf. Nijen Twilhaar 1990: 71-72)

(7)

Verbs (infinitives, by stem + suffix -(*)n)	<del>found</del> nouns(suffix -(*)n))
loa[tn' t̪o let	boo[tn'] boats
roe[pm'] to call	ree[pm'] strips
w r[kN'] to work	bee[kN'] brooks
po[fM'] to roast	sto[fM'] substances
goo[jl' t̪o throw	buu[jl'] showers
	Singular nouns
	zei[sn' \$cythe
	straam[pm'] wedge
	v r[kN'] pig

Examples such as the following seem to indicate that the domain of this assimilation is the syllable rhyme. Clusters which occur together in an clusters do not assimilate:

(8) k[n] rre old crone

Bruck[n]er

ramp[n]acht night of disaster (ramp disaster + nacht  
haek[n]oale crochet hook (haak crochet + noale hook

loop [n]ie don t walk (loop walk + nie not )  
w rk [n]ie don t work (w rk work + nie not )

There is no progressive assimilation of the syllabic nasal in the follo

<sup>2</sup> Cf. Humbert (1997) for similar facts in a range of other languages.

(9) loop [N'] keer	walk once
w rk [n'] dag	work a day
gooi [m'] bal	throw a ball

The reason for this, informally speaking, is that we already have regre this right environment is absent, which in fact implicates an incomplet determiner is not followed by a noun, nasal assimilation is progressive (10), without a right environment, in which the syllabic nasal after re same syllable as the immediately preceding consonant, with the forms in right environment.

## (10) Progressive nasal assimilation

loo[pm']	walk a ...
w r [kN']	work a ...
goo[jl']	throw a ...

It is as if in these cases regressive assimilation (see above) takes pre-assimilation: we try to apply regressive assimilation first, and only : subsequently apply progressive assimilation. In other words, it is as : disjunctively ordered at the postlexical level.

In addition, progressive place assimilation seems to be subject to following circumst~~an~~<sup>3</sup> examples in (11) the syllabic nasal is not hom the immediately preceding consonant, in the <sup>4</sup>examples in (12) it is.

(11) pa[kn']	took	(12) pa[kN']	take
la[xn']	laughed	la[xN']	laugh
sto[pn']	stopped	sto[pm']	stop
stra[fn']	punished	stra[fM']	punish

This phenomenon is not restricted to the verbal category, or to derived instance the plurals a[kn'] certificates and li [fn'] elevators . I here in order to avoid a cluster CtN of an obstruent C, a /t/ and syllable consonant /t/ in fact does not disappear in comparable clusters in which not an obstruent. Compare for instance: poor[tn'] gates en plan[tn']

In forms such as the verbs in (11), however, the syllabic nasal is assimilated to the immediately preceding consonant, /t/, and apparently afterwards. The nasal is assimilated to the coronal /t/, not to the cor to the nasal on the surface. We have to extrinsically order t-deletion get the right result.

<sup>3</sup> Cf. Humbert (1997) for a similar process in Groningen Dutch.

<sup>4</sup> Some Frisian dialects distinguish between fricatives and stops (nasals tend not to even if they assimilate freely to the latter; cf. Visser 1997, Van Oostendorp in prep such a distinction in Hellendoorn.

In certain constructions we may see progressive and regressive assimilation at the same time. This results in sequences of nonhomorganic syllabic nasals as examples in (13), in which both progressive and regressive assimilation occur.

- (13) de kat[n' m']bettien  
the cats a little

de kip[m' N']keer  
the chickens once

de rek[N' M'] v rfien  
the shelves a coat

Somewhat more complex are the following examples, in which sequences occur involving four nasals respectively.

- (14) a. op de w [NN' m'] bennien snee  
on the roads some snow
- b. op de w [NN' n' n]acht snee  
on the roads the snow of one night

Note that in these examples the fricative (of *weg* /wE~/) road totally assimilates to a syllabic nasal, a phenomenon which will be discussed now.

## 2.4 Total assimilation of voiced obstruents and nasals

Compare the examples in (15) with those in (16).

- (15) ze[tn'] to put (from /zEtbɪ)[nn'] to pray (from /bId/)  
klo[pm'] to knock (from /klɔpɪbɪ)[mm'] to scrub (from /sxrob/)  
slo[fM'] to shuffle (from /slobfM/) to praise (from /loøv/)  
la[xN'] to laugh (from /laʌx/)[NN'] to say (from /zE~/))

(15) gives yet another set of examples of assimilation of nasal place to i.e. progressive nasal assimilation. (16) in addition shows another type of assimilation, where one of the obstruent to the following nasal. The phenomenon is not restricted to the plural nouns: bi[NN'] pigs , vla[NN'] flags , d rae[MM'] ravens . We think that it is possible to analyse the behaviour of the determiner in the same way. It can be seen as /dn/ underlyingly, which means that the onset assimilated to the rhyme, (which means that (14b) even has final

- (14) b . op de w [NN' nn' n]acht snee  
on the roads the snow of one night

One consonant somewhat mysteriously seems to duck out of the process: following examples:

(17) Verbs	Plural nouns
bloa[zn'] to blow	deu[zn'] boxes
l [zn'] to read	loo[zn'] sheds

It is not clear to us why /z/ is an exception (while e.g. /d/ or /v/ are issue open for future research.

This processes, which we call regressive obstruent assimilation or a voiced obstruent and a following nasal if the nasal also assimilates a consonant. For instance, underlying voiced obstruents do not assimilate

- (18) bi[t n]og n keer pray once again  
schro[p n]og n kserub once again  
loo[f n]og n keepraise once again  
ze[x n]og n keersay once again

Further, if a nasal assimilates progressively, we do not find regressivity of the other consonant to the preceding nasal.

- (19) bi[t N'] keer pray once  
schro[p N'] keer scrub once  
loo[f N'] keer praise once  
ze[x N'] keer say once

It thus looks as if application of obstruent assimilation is dependent on nasal assimilation: regressive obstruent assimilation only applies to the progressive nasal assimilation has applied first.

## 2.5 Rule ordering analysis of the Hellendoorn Dutch facts

In the above, along with the facts of Hellendoorn Dutch, we have provided a rule-based analysis. It turns out that such a rule-based analysis requires quite a lot of extrinsic rule ordering:

- Nasalization has to be ordered before regressive nasal place assimilation;
- Regressive nasal assimilation and progressive nasal assimilation have disjunctively;

- T-deletion has to be extrinsically ordered after progressive nasal as opaque (counterfeeding) order;
- Regressive obstruent assimilation has to be extrinsically ordered after assimilation.

This dependence on rule ordering seems to constitute a serious problem such as Optimality Theory, which denies the existence of all sorts of recent times, several mechanisms have been proposed which could potentially instance, the opaque ordering of T-deletion and regressive voicing assimilation. One such mechanism, popular among these undoubtedly is Sympathy Theory of McCarthy (1998, 2000). We could invoke one such theory to account for this type of effect.

Yet this does not solve all our problems. For instance, we have seen that the process of progressive nasal assimilation is restricted to a very small domain, while this is not true for regressive assimilation, which applies even across word boundaries.

Furthermore, a rule based analysis has problems of its own. It can only tell us why regressive nasal assimilation would have a different domain than progressive assimilation, or why the first rule is ordered before the second, rather than the other way around. It can formulate these things, but it does not provide us with an explanation of the nature of the interaction between various forms of assimilation.

We believe that it is possible to formulate a theory about the domain of assimilation processes which is sufficiently simple and intuitive and which does not appeal to some of these questions. An upshot of this theory about domains is that neither Optimality Theory nor Sympathy Theory need to be invoked. The facts can be made to fit into a fairly classical version of Optimality Theory.

In the following two sections, we provide an analysis of the Hellendoorn Dutch data along these lines. In section 3, we explain how the difference between the domains of regressive and progressive assimilation, and the relative ordering of the rules can be derived from the assumption that phonological structure should mirror morphological structure as much as possible. In section 4 we then turn to the the interaction of t-deletion, and the interaction of plural formation and nasal deletion and show how both can be made to follow from the interaction between the desire to make the phonological structure inherently well-formed, and to match it to the morphological structure in a natural way.

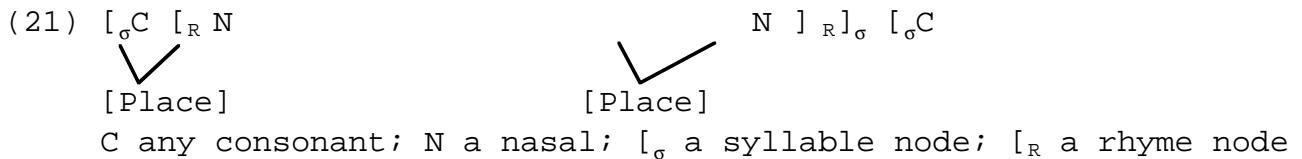
### *3. Progressive and regressive assimilation as a uniform process*

In a constraint-based analysis, it is of course no longer possible to derive the two types of assimilation from a single constraint, which are ordered in a different way. On the other hand, the fact that the two types of assimilation are formally independent, rules to describe this phenomenon itself is somewhat surprising. The two rules seem to conspire to achieve the following effect:

(20) ASSIMILATE: (Coronal) nasal consonants in the rhyme are assimilated to the same consonant.

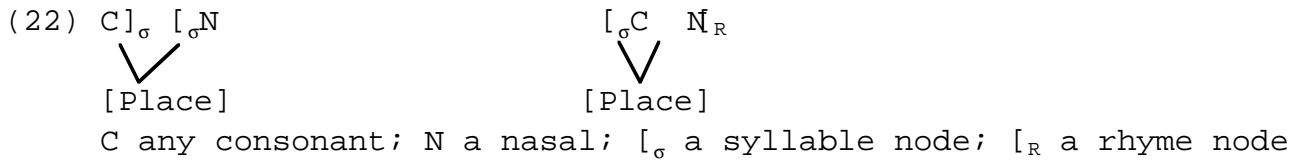
Conspiracies are the classical argument against a purely rule-based analysis (e.g. Hellendoorn 1970). In this case it is a simple truth that surface forms always satisfy ASSIMILATE. A consonant in a rhyme position can only have its own, independent place feature, not adjacent to any other consonant. Since (coronal) nasal consonants do not have a coda in Hellendoorn Dutch<sup>5</sup> they are always deleted in that position, leaving nasalization on the vowel /ə/, this is, in actual practice, a restriction on the surface form.

The following two possible structures are crucially in a conflict:



The lefthand structure gives us the result of progressive assimilation, the righthand structure the result of regressive assimilation.

Acknowledging that the reason behind both progressive and regressive assimilation is to achieve (20) at the surface, means that it is no longer necessary to list the properties of these two processes. For instance, it has been claimed that progressive nasal assimilation is restricted to the domain of the syllable, so it is not necessary to explicitly state this fact. Progressive assimilation would therefore be represented by the following configuration:



The nasal would always be in an onset in cases like this. Therefore, (22) is the driving force behind the process. And we may assume that in all configurations where the nasal is in the rhyme, progressive assimilation is not absolutely necessary, assimilation is disallowed. It is therefore not surprising that the following constraint is violated:

(23) WFC: Every (place) feature should be linked to exactly one segment

The structures in both (21) and (22) violate the WFC, but the structures in (21) satisfy ASSIMILATE, and ranking ASSIMILATE ≈ WFC in Optimality Theory therefore give us the required results. As for the structures in (22), they violate the WFC here (ASSIMILATE is not applicable), so that they are simply ruled out.

The question arises, of course, whether the restriction to rhyme makes sense. We believe that it does: it is well-known that the rhyme is a well-formed syllable.

<sup>5</sup> In other languages, (20) may be the driving force behind regressive assimilation to /ə/. In Dutch, however, regressive assimilation to this position would then be due to the assimilation of an obstruent to an adjacent nasal in the rhyme, which is a logical impossibility. An intervening vowel in a well-formed syllable. It would be possible to assimilate pre-coda consonants, however (e.g. in a cluster [VCN], where C is a liquid). The issue whether this is true in all languages of the world is worthy of further exploration.

position for consonantal material (or, in terms of moraic theory, that preferably not attached to a mora). In particular, this could be true of Articulation. ASSIMILATE could then be restated in the following way:

- (24) \*RHYME/CONSONANT: Consonantal place features should be linked to some outside the syllable rhyme.

The formula in (24) does not explain, why this constraint would mainly concern consonants, or why it is always the place feature that originates from survives, but answering these questions would lead us into the question as to why only underlyingly coronal nasals are affected by underlyingly labial ones (/bEsmstEln'/ broom stick does not turn into /bEsmstEln'/. We simply assume that faithfulness to a coronal specification is weaker than to labial (or velar) specification, a quite natural assumption in our view.

- (25) IDENT(velar), IDENT (labial) " \*RHYME/CONSONANT " IDENT (coronal)

We are now ready to tackle another question, however, which is more central to concerns, viz. the relative ordering of regressive versus progressive assimilation in a phonological context such as work [n'] dag work a day, involving a vowel. Both regressive and progressive assimilation in principle are possible, but which one occurs?

- (26)
- |                  |                   |                 |                  |
|------------------|-------------------|-----------------|------------------|
| [ <sub>σ</sub> C | [ <sub>R</sub> N] | R] <sub>σ</sub> | [ <sub>σ</sub> C |
|                  |                   |                 |                  |

It seems strange to say that syllabic domains are involved in this, because counts, the obstruent following the nasal is further away than the one before it. Furthermore, in many cases, Hellendoorn Dutch actually prefers progressive assimilation. These are the cases which involve a suffix -en or a stem ending in a vowel.

- (27) lo[pm' k] nnen can walk (lopen walk, k nnen can )

These facts give us a clue about what may actually be going on in these cases. It is hard to think of a reason why the syllabic nasal assimilates to the consonant in the same word rather than to one which is in a following word. We could say that the nasal assimilates to consonants which are as close to them as possible. This can happen in various ways, one of them being Alignment (cf. Ittervoort and Mester 1996):

- (28) Alignment (Crisp Edge)

Association lines should not cross morphological (or syntactic) boundaries.

---

<sup>6</sup> See Humbert (1995) for some discussion.

In a regressively assimilated structure \*lo[ $pN'$ ] k] nnen a word boundary would not be the case in lo[ $pm'$ ] k] nnen. This may be the reason which would not be the case in lo[ $pm'$ ] k] nnen. This may be the reason structure is preferred. Presumably, also in the latter case a morpholog crossed, viz. the one between the stem and the affix. Apparently, this violation that is as fatal as crossing a word boundary. We thus have to morphological boundaries, for instance along the following lines:

- (29) affix boundary < word boundary < syntactic boundary

Association lines prefer not to cross any boundaries at all; if they do still prefer the weaker boundaries over the stronger ones.

We can now turn to w rk [n'] dag work a day and similar cases. It is controversial to assume that this phrase has approximately the following structure:

- (30) [<sub>VP</sub> w rk [<sub>NP</sub> n' dag ]]

In other words, there is a major syntactic boundary between the verb and which is absent between the determiner and the noun. Of course there is a syntactic boundary between the latter two words in most grammatical theories. It does not seem absurd to say that this is a weaker kind of boundary than a major syntactic boundary. We should thus refine (29) in the following way:

- (31) affix boundary < word boundary within XP < XP boundary

The idea thus is that in structures such as w rk [n'] dag Hellendoorn I assume that the structure is more like (31), reflecting regressive rather than progressive assimilation, because this gives a better reflection of the morphosyntactic structure.

There are various ways of combining a constraint such as Crisp Edge with a hierarchy such as (31). One way would be to declare Crisp Edge a constraint which is more specific than Crisp(affix) and Crisp(word), and which would get this (possibly universal) ranking order. (Crisp(affix) is not considered, in the remainder of this article, since it does not play a role in the analysis.)

As a matter of fact, syntactic XP boundaries possibly are never crossed in Dutch at all. This we can conclude from facts such as the following:

- (32) Hee lik [n'] aanderen man  
He resembles a different man  
He looks like a different man

In this example, the syllabic nasal cannot assimilate to the following vowel. Apparently, it also does not assimilate to the preceding vowel, which would have surfaced as [N']).

The facts with incomplete constructions (from (10), repeated below somewhat mysterious:

- (10) Progressive nasal assimilation

loop m'walk a ...

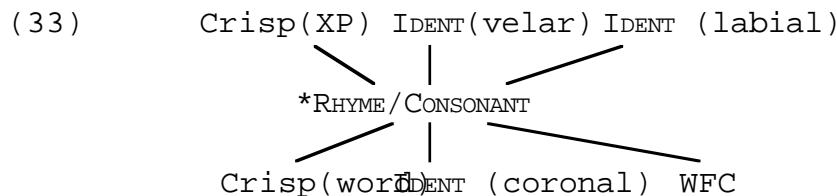
w rk Nwork a ...

gooj l'throw a ...

In these cases, the association line seems to cross the boundary between determiner indeed. We can assume that a determiner without a following : project a full NP (or DP), but of course it is difficult to get any case the constructions in (10) do not count as grammatical or normal . hardly count as crucial evidence for anybody s theory.

#### 4. *Progressive and regressive assimilation: OT analysis*

We can now formalise the analysis in terms of constraint tableaux. We have established the following constraint ranking:



The fact that Crisp(XP) dominates \*RHYME/CONSONANT gives us that XP boundaries can be crossed; the fact that \*RHYME/CONSONANT dominates the other constraints gives us that the other boundaries can be crossed (albeit only minimal). It is dominated by \*RHYME/CONSONANT, finally, implies that we only find assimilation cases where this is necessary (in particular, with syllabic nasals at onset position).

We give a few selected examples below to illustrate this:

- (34) w rk nie work not

	Crisp(XP)*RH/C	WFC	Crisp(word)
⇒ a. w rk [n]ie			
b. w rk [N]ie*!)		*!	*!

Nasals in an onset do not assimilate, because there is no reason for as some analysts may argue that there is a major syntactic boundary between negation in this particular example; if that is true, the assimilated e: additional violation of Crisp(X), marked here in parentheses.)

- (35) lo[pm' k] nnen

	Crisp(XP)*RH/C	WFC	Crisp(word)
a. lo[pN' k] nnen	(*!)	*	*!
b. lo[pn' k] nnen	*!		
⇒c. lo[pm' k] nnen		*	

In this particular instance, there are three possibilities: the nasal a obstruent (35a), to the preceding obstruent (35c), or not at all (35b). necessary (and possible), so that we can immediately discard option (35b) between (35a) and (35c), and in that case the latter form is clearly preferred. stem-final obstruent is closer than the one in the other verb. (Again posit a major syntactic boundary between the two verbs in some analyses (35a) would get an extra<sup>7</sup> violation.)

- (36) loop [N'] keer

	Crisp(XP)*RH/C	WFC	Crisp(word)
⇒a. loop [N'] keer		*	*
b. loop [n'] keer	*!		
c. loop [m'] kee*er		*	*

In this syntactic environment we have the same three possibilities as in assimilation is possible and necessary, we can immediately discard the (36b). But in this case, the closest obstruent is the one following the

- (37) lik [n'] aanderen man

	Crisp(XP)*RH/C	WFC	Crisp(word)
⇒a. lik [n'] aanderen	*		
b. lik [N'] aander*en		*	*

In this case, the syllabic nasal could only assimilate to the preceding allowed to do that, because this obstruent is too far away.

<sup>7</sup>Feature alignment in these cases arguably corresponds to syntactic structure, not to determiner behaves as an enclitic rather than a proclitic as far as syllabification is concerned (Zonneveld p.c.) for pointing this out.

## 5. Nasalization, nasal deletion and obstruent assimilation

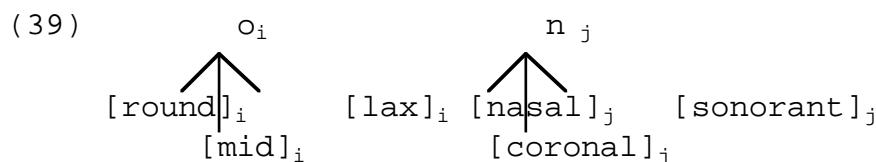
We now have a fairly straightforward analysis of nasal assimilation: syllables need to acquire a place of articulation and for this they grab the place consonant that is nearest. This replaces the extrinsic ordering of two assimilation rules. We are now ready to consider some of the other phonemes see how they fit into this general picture.

First we turn to nasalization and nasal deletion. These two processes we find nasalization of the vowel in exactly those environments in which it is deleted. Furthermore, nasal deletion seems to be subject to more or restrictions as nasal assimilation: it does not occur if the nasal appears mysteriously in a rule-based analysis.

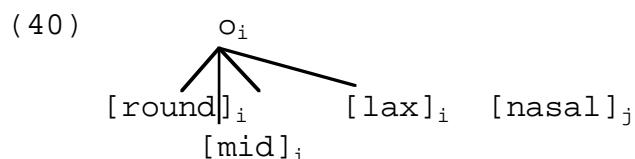
We propose that there is a causal relation between the two: the vowel because the consonant disappears. In other words, the nasal consonant disappears completely, but it leaves behind its feature [nasal] on the vowel. A more specific kind of faithfulness:

(38) TRACE: No segment may disappear without a trace.

TRACE can be seen as a kind of constraint on the morphology - phonology segment that is present in the underlying, morphological, representation of the surface phonological structure as well. As often, there are many ways. For instance, we could invoke a kind of Correspondence. The underlying prefix /on/ is approximately the following (concentrating on the most important disregarding details of feature geometry):



Every segment has a unique index. TRACE says that all indexes in the input must have at least some correspondent in the output. The output [ $o\sim$ ] satisfies this condition because the indexes i and j are represented in the output:



Why does the consonant disappear at all? We propose that the reason for this is a constraint \*RHYME/CONSONANT. Until now we have interpreted this as strictly Place features in rhyme position, but of course we may also give it a more general interpretation and have it disallow any kind of consonantal feature in

course, the question then remains why this affects only nasals, a question here.)

The combination of TRACE and \*RHYME/CONSONANT gives us the required result:

- (41) [ ~]benul dimwit

	TRACE	*RH/C
⇒a. [ ~]benul	*	
b. [ ]benul*		
c. [ n]benul	**!	

We have given the winning candidate one violation for \*RHYME/CONSONANT, as the feature [nasal] gives a minimal violation of this constraint. Yet this is the whole consonantal segment, as happens in (41c) (which should probably have more violations than just one).

On the other hand, in cases such as in april, the nasal get resyllabified to the following syllable. There thus is no reason to delete the nasal consonant (and no reason to assimilate a syllabic nasal in these contexts):

- (42) i [n] april

	TRACE	*RH/C
⇒a. [I.n]april		
b. [I]apri*!		
c. [I~]april	*	

The question now is: why doesn't the syllabic nasal get deleted, if it satisfies \*RHYME/CONSONANT and if deletion is an option. Why don't we get e.g. \*[lop] [lop'm'] to walk? According to Nijen Twilhaar (1990), the underlying form suffix and all other instances of the syllabic nasal underlyingly actually becomes syllabic after the schwa has been deleted. But in any case it's possible to epenthetrize a schwa. Why doesn't this happen?

We suspect the reason is that nasalized schwa is strongly avoided in Dutch, as it is in many other languages: schwa, being a phonologically empty vowel, is not sufficiently strong to carry nasalization (cf. Van Riemsdijk & Zwarts 1977 for an overview of the literature on the phonological properties of schwa). Note that there is a specific constraint to this effect, although this might be a more general requirement that nasals should be realized with a place specified (as pointed out to us by Wim Zonneveld, p.c., cf. Trigo 1988):

- (43) \*NASAL/« : Schwa should not be nasalised.

Interaction of this constraint with the ones just established gives us

(44) loop+*<<n*

	*NASAL / <<	TRACE	*RH/C
⇒a. loop	[m`]		*
b. loop	[<<~]*!		*
c. loop	[<<]	*!	

Another candidate, satisfying all of these constraints as well as (a), depends on the underlying forms we posit which constraint should be held the fact that this alternative is not selected. If the underlying form at work (dispreferring vowel epenthesis); if the underlying form is /*<<n* be one preferring schwa to be in an open syllable rather than a closed 1995, 1998 gives ample evidence for this preference).

Finally, we want to discuss the phenomena of nasals surfacing in the surface in the singular. The relevant facts in (4) are repeated below.

## (4) singular plural

- |    |         |           |             |
|----|---------|-----------|-------------|
| a. | r[IØ]   | r[IØ ]    | deer(s)     |
|    | spr[ Ø] | spr[ Ø ]  | starling(s) |
|    | vl[oø]  | vl[oø ]   | flea(s)     |
| b. | b[o ]   | b[onn` ]  | bill(s)     |
|    | m[A ]   | m[ann` ]  | man/men     |
|    | l[oø ]  | l[oønn` ] | wage(s)     |

In the plural forms in (4a) and the singular forms in (4b), the vowel generally satisfies TRACE after the deletion of a consonant which itself is necessarily \*RHYME/CONSONANT.

The crucial facts are the plurals in (4b). These show that a nasal is not appropriate context. We give the relevant tableau below:

(45) bon+*<<n*

	TRACE	*RH/C
⇒a. b[onn` ]		
b. b[ɔ~n` ]		*
c. b[ɔ~]*!		

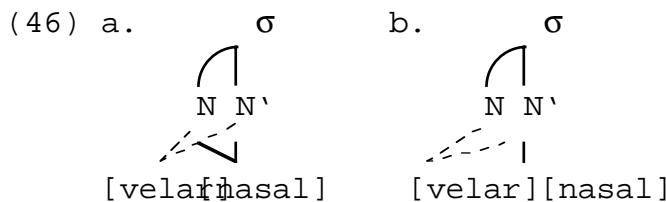
The form in (45c) does not survive, because two nasals have disappeared necessity) only one nasalization mark on the vowel. One of the two unde therefore violates the constraint TRACE, while in (45a) and (45b) both s

visible. However, in (45b) the rhyme has to bear a consonantal place feature it can share it with an onset in (45a). This causes<sup>8</sup> the latter candidate to be ruled out.

Another phonological process that can now be understood in somewhat more detail is consonant assimilation: voiced obstruents in the onset of a syllabic nasal can assimilate to the nasal feature themselves. Some examples are given in (11) and repeated below:

- (11) bi[nn'] to pray (from /bId/)  
 schro[mm'] to scrub (from /sxrob/)  
 loo[MM'] to praise (from /loøv/)  
 ze [NN'] to say (from /zE~/))

What is the reason behind this assimilation process? We propose that the constraint \*RHYME/CONSONANT: no consonantal feature likes to be in the rhyme if it is not in the nucleus. That is why (46a) is preferred over (46b):



In (46a) there is literally no consonantal feature at all which is attached to the syllable nucleus. We thus propose that in cases like this, \*RHYME/CONSONANT is violated. This is the cause of Place features spreading to a nasal consonant, but of the feature itself as well.

Nasal spreading seems to be much more restricted than the other types discussed here. For instance, both the target and the source of spreading are subject to restrictions: spreading only occurs from a syllabic nasal (and not from a voiceless obstruent (and not a voiceless one)). The latter restriction can be seen as a kind of faithfulness. One could say that voiced obstruents are more faithful to their voiceless counterparts. Therefore, turning the latter into nasals would be a violation of faithfulness rather than doing this to the former. This still leaves the question why /bon/ does not turn into \*[mo~] (rather than [bo~]): why is this type of spreading restricted to syllables with a syllabic nasal as their head. The reason for this is that the scope of spreading is limited to the boundaries between a vowel and a consonant, which is kept to a minimum; we are not aware of any cases where this type of spreading is needed in the analysis of Hellendoorn Dutch phonology.

Nasal spreading is restricted in other ways as well. Its scope is limited to the boundaries of the syllable. The feature [nasal] spreads from a syllabic consonant leftward to another syllable, not rightward to another syllable: [m' bAl] a ball [mAl]. Similarly, the feature does not seem to leave the morpheme for which it is impossible in the incomplete constructions mentioned above.

---

<sup>8</sup> Another possible candidate is [b ~nn'], which presumably is ruled out by a constraint against unnecessary nasal vowels.

- (47) [hEp m' ] \*[hEm m' ] have a ... (heb /hEb/, een /n'/)

This latter case however is difficult to analyse straightforwardly, since the construction which can hardly be counted as grammatical, and since it deals with Final Devoicing, a general process devoicing obstruents at the end of syllables.

We thus only find hard evidence for a restriction on phonological feature spreading. This could be formulated in for instance the following way (languages may have active constraints for larger domains):

- (48) NASALDOMAIN: The feature [nasal] cannot be associated to segments in a single syllable.

It remains to be seen whether (48) can be grounded in phonetics or in phonology, and whether some deeper phonological explanation can be given to it.

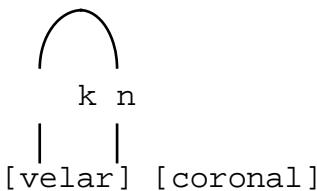
## 6. *Opacity effects*

Even though we believe that we have gained some insight into the nature of the processes in Hellendoorn Dutch, one problem still needs to be resolved. In particular, the behaviour of the plural suffix, once it is attached to a stem ending in a denasalizes the vowel and surfaces itself as a syllabic nasal which is not assimilated.

Opacity facts provide a strong argument in favour of rule-based approaches of a theory incorporating a mechanism such as Sympathy Theory. On the other hand, in particular the behaviour of the plural suffix is extremely problematic from the ordering of processes, as we will show below. We will argue here that a solution can be found if we take the theoretical instruments which have been introduced seriously.

Let us therefore consider past tense cases such as [pAkn'] took, present tense cases such as [pAkN'] take. What causes the different kinds of forms? Clearly the past tense morpheme should have something to do with this morpheme is a suffix -t- (after a stem ending in a voiceless obstruent in the cases). It thus looks as if the syllabic nasal has assimilated to the coronal consonant within a theory that bases itself on the analysis of output structures since the coronal consonant is no longer present on the surface. Furthermore, in the particular analysis presented here, another problem arises: if assimilation is desirable for consonantal features to be present in a position outside the benefit is there in assimilating to a consonant which itself does not occur in that position at all?

We propose that in these cases there is no assimilation in the sense that the features associated to two segments at the same time. We thus propose that the syllable of [pAkn'] is something along the following lines:

(49)  $\sigma$ 

This means that in this case the nasal has an independent place feature probably originates from the past tense morpheme /t/, which has itself structure in (49) represents a very marked violation of the constraint first sight, we might think that this violation is forced by some const morpheme to be visible on the surface: if the feature [coronal] would d would spread in (49), the resulting structure would be indistinguishabl tense form.Yet this cannot be the whole story, since also the plural fo elevator ends in a heterorganic cluster [fn'] and there is no indepen the underlying /t/ is a morpheme in this case.

It thus looks as if we have found another effect of the constraint input in (50a) (the last three relevant segments of pak+t+n) with the and (50c):

- (50) a.  $k_i \quad t_j \quad n_k$
- 
- ```

graph TD
    k_i --- velar_i[velar]_i
    t_j --- coronal_j[coronal]_j
    n_k --- nasal_k[nasal]_k
    n_k --- coronal_k[coronal]_k
  
```
- b.  $k_i \quad N_k \quad c.$
- 
- ```

graph TD
    k_i --- velar_j[velar]_j
    N_k --- nasal_j[nasal]_j
    velar_j --- velar_i[velar]_i
    velar_i --- coronal_j[coronal]_j
    coronal_j --- nasal_k[nasal]_k
  
```
- c.  $k_i \quad n_k$
- 
- ```

graph TD
    k_i --- velar_j[velar]_j
    n_k --- nasal_j[nasal]_j
    velar_j --- velar_i[velar]_i
    velar_i --- coronal_j[coronal]_j
    coronal_j --- nasal_k[nasal]_k
  
```

The subscripts represent underlying segmental affiliation; a segment an are underlyingly associated to it, get the same indices.

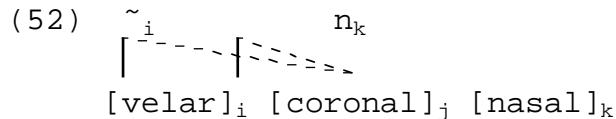
Candidate output (50b) violates the constraint TRACE, because one u segment has disappeared without leaving a visible trace (there is no ma index j). In (50c), on the other hand, all underlying segments are preso. Both in (50b) and in (50c), the underlying Place feature of the nas irrelevant, however, since other features of this segment (such as nasa still is material with index k on the surface.

The examples discussed so far all involve a voiceless obstruent. Be example with a voiced obstruent underlyingly:

- (51) /lE~/+/n/ [lENN'] lay  
       /lE~/+/d/+/lENn' ] layed

We thus see that the nasal feature still spreads to the preceding cons preceding consonant is not the source of the place feature for the nasa notion nasal spreading is preferable over total obstruent assimilation

forms is as follows (dashed lines are used simply to facilitate the representation of the three-dimensional structure in a two-dimensional picture):



The nasal feature spreads in these cases because of \*RHYME/CONSONANT. It is a constraint that is violated by the place feature already, but this does not prevent violations of this constraint<sup>9</sup> from being acceptable:

- (53) /lE~/+/d/+/n/

|                            | TRACE | *RH/C |
|----------------------------|-------|-------|
| ⇒a. [lE <sup>~</sup> Nn']  | *     |       |
| b. [lEFn']                 | **!   |       |
| c. [lE <sup>~</sup> N'*]!  | **    |       |
| d. [lE <sup>~</sup> NN'*]! | *     |       |

The so-called opacity cases in the interaction between t-deletion (or c) and nasal assimilation thus turns out to be not opaque at all. They are the same interaction of factors which is also responsible for the fact that they are a direct consequence of nasal deletion.

## 7. Conclusion

Nasals in Hellendoorn Dutch display a pattern which is quite complicated to call upon an analysis involving extrinsically ordered rules. We have however, that these facts are more profitably seen as a result of the i factors. In the first place, the features of nasal consonants prefer no rhyme; in order to achieve this, they either get deleted, or they associate with a consonant in a nearby onset. In the second place, phonological structure should be morphosyntactic structure as much as possible: association lines should cross little morphological and syntactic boundaries as possible and certainly not across any boundary at all. And finally, underlying segments should not completely; preferably they should leave at least a minimal trace. This is as a purely phonological type of wellformedness. The second and third factors interface between morphological and syntactic structure and phonological essence, they suggest that the phonological structure should mirror the syntax as exactly as possible.

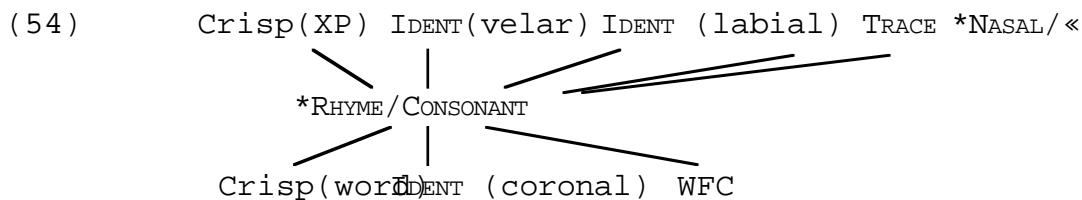
These assumptions obviate the need for many of the presumed ordering mentioned above:

---

<sup>9</sup> Of course, all of these purely phonological phenomena interact with considerations of the phonology-syntax interface in ways outlined above.

- Nasalization bleeds nasal assimilation because it better satisfies \*RHYME/CONSONANT; it is better to delete a consonant than to assimilate preceding or following consonant;
- There is no need to distinguish between regressive nasal assimilation assimilation, or to order these processes disjunctively; they are two same medal; whether a nasal consonants assimilates to the left or to which consonant is nearest;
- There similarly is no need to distinguish between obstruent assimilation and nasal assimilation, because again, both are instances of a general requirements of \*RHYME/CONSONANT, be it that the former is somewhat more than the latter.
- Even apparent opacity, such as the interaction between t-deletion and can be analysed in a fairly simple constraint-based system, assuming segments are preferably not deleted entirely; this idea has been formalized condition TRACE.

All in all, we have established the following constraint rankings:



We have thus set up a fairly simple grammar of Hellendoorn Dutch nasalization based on constraints we think are quite plausibly universal and which we put forward in this article: that Hellendoorn Dutch nasalization result from phonological domains in which consonantal material prefers to be in consonant and morphological and syntactic domains in which all phonemes should submit to morphological boundaries should be respected.

## References

- Humbert, Helga. 1995. Phonological Segments. Their Structure and Behavior. Holland Academic Graphics. HIL Dissertations 12.
- Humbert, Helga. 1997. On the Asymmetrical Nature of Nasal Obstruent Rules. In Kusumoto (ed.) NELS 27: 219–233.
- Itaya, Junko and Armin Mester. 1995. Reflections on CodaCond and Alignment. Manuscript, UC Santa Cruz. Available at <http://ruccs.rutgers.edu/roa.html> as ROA-14.
- Kisseberth, Charles. 1970. On the Functional Unity of Phonological Rules. Language 46: 291–306.
- McCarthy, John. 1998. Sympathy and Phonological Opacity. Manuscript, University of Massachusetts at Amherst, Amherst. To appear in Phonology.

- McCarthy, John. 1999. Sympathy, Cumulativity, and the Duke-of-York Gam Manuscript, University of Massachusetts at Amherst, Amherst. To appear van de Vijver (eds.) *The Syllable in Optimality Theory*.
- Nijen Twilhaar, Jan. 1990. Generatieve fonologie en de studie van Oostendorp. Amsterdam: Meertens Instituut.
- Oostendorp, Marc van. 1995. Vowel quality and phonological projection. Tilburg University.
- Oostendorp, Marc van. 1998. Schwa in Phonological Theory. GLOT Internat.
- Oostendorp, Marc van. In prep. Klaaifrysk Schwa Deletion in Constraint-Ms., Meertens Institute.
- Trigo, L. 1988. On the Phonological Derivation and Behavior of Nasal Gl. Dissertation, MIT.
- Visser, Willem. 1997. *The Syllable in Frisian*. The Hague: HAG.