The lexical tone contrast of Roermond Dutch in Optimality Theory

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1.0 Introduction

The intonational systems of the dialects of Dutch and German in an area covering a large part of the former German Rhineland (the northern half of Rhineland-Palatinate and the southern half of Rhineland-Westphalia), Luxembourg, the north-east of Belgium, and the south-east of the Netherlands resemble those of Norwegian and Swedish: in addition to the tones contributed by the intonation, there is an opposition between two tonal word accents.[1] The purpose of this chapter is to give an account of the way in which the lexical tone contrast in one of these dialects, that of the city of Roermond in the Dutch province of Limburg, is realised under different intonational conditions. The intonation tones with which the lexical tones combine should be divided into tones that mark the focus of the sentence, which appear in the syllable with primary stress in focused words, and tones that signal discoursal meanings, which appear at the boundaries of intonational phrases. Bruce (1977) showed that by making the appropriate comparisons, the lexical tones can be separated from both types of postlexical (intonational) tones:

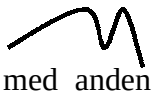
> "By comparing F0-contours of words in final and non-final position, in and out of focus and with contrasting word accent out of focus, the individual F0-contributions of terminal juncture [*sc.* boundary tones, C.G.], sentence accent [*sc.* focus-marking tone, C.G.] and word accent (accent I and accent II) could be isolated." (Bruce 1977: 37).

As is well-known, the location of the focus-marking tone will depend on what the speaker intends to be taken as the contribution to the discourse: it will be in different locations in a sentence like *I've got a couple of Japanese prints*, depending on whether it is intended as an answer to *Have you got any Japanese art?*, in which case it will be on *prints*, or *Have you got any prints?*, in which case it will be on *Japanese.* The tones that mark discoursal meanings like 'Finality', 'Non-finality', 'Interrogative', etc. appear as boundary tones of the intonational phrase. In (1), a Swedish minimal pair is shown in a focused context (Bruce 1977, Pierrehumbert & Beckman 1988:243, Gussenhoven & Bruce 1999; for a general introduction to the phonological model presupposed here, see Ladd 1996.) Both Accent I and Accent II consist of a H+L melody, of which the L-tone is aligned with the stressed syllable (here: *an*) in the case of Accent I, while the H-tone is so aligned in the case of Accent II. Focus is marked by a H-tone, which is pronounced immediately after the lexical tones of the focused word. The contours are completed by the boundary tones of the intonational phrase, indicated by the subscript 'i'. An initial and a final boundary Li mark the edges of the intonational phrase; the initial Li is only realised if there is a syllable available for it. As will be clear, the big dots in the contours represent the phonetic F0-targets of the phonological tones [these dots are to be provided in the published version only].

(1) a.

[med anden]
| | |
L_i H+L H L_i
'with the duck'

b.



[med anden]
| | |
L_i H+LH L_i
'with the ghost'

The focal H can be removed from the nouns by switching the focus to a preceding predicate, as shown in (2). Example (2a), for instance, is well-formed as a reply to *What are you doing with the duck?*

(2)

a. [jag skildrar anden]
| | | |
L_i H+L H H+L L_i
'I'm DEPICTING the duck'

b. [jag skildrar anden]
| | | |
L_i H+L H H+L L_i
'I'm DEPICTING the ghost'

Roermond Dutch can likewise be described in terms of a (movable) focal tone, a number of intonational boundary tones signalling discoursal meanings, and a lexical tone. An important general difference with Swedish is that the tonal targets in the intonation contours cannot always be directly related to the tone strings arising from the concatenation of the underlying tonal morphemes. In the dialect of Roermond, just as in the related dialect of Venlo (Gussenhoven & Van der Vliet 1999), phonological adjustments may have to made. Four phonological generalisations, which are discussed and illustrated in §3, are briefly mentioned here. First, unlike Swedish, which retains the lexical tones on words pronounced without focal tone, Roermond Dutch loses its lexical tone in nonfocused, nonfinal positions, causing a neutralisation of the lexical contrast in those contexts. Second, the final boundary tones of the intonational phrase spread leftward into the phrase, creating both phrase-internal and phrase-final targets. Third, a lexical H-tone undergoes assimilation to L after a focal L-tone in the same syllable. Fourth, and most spectacularly, there is a pattern of tonal infixation which causes the phrasal boundary tones to be realised before the lexical tone, if this tone occupies the last mora of the intonational phrase.

The purpose of this chapter is to account for these generalisations in Optimality Theory (henceforth OT, Prince & Smolensky 1993, McCarthy & Prince 1993, 1995). The main motivation for choosing this theory as the descriptive framework for our data is that it would seem to be the only theory which can account for the infixation referred to above as generalisation 4. It will be shown that it is very difficult to incorporate the generalisation in a derivational description using the model of Chomsky & Halle (1968). Before presenting the analysis, the assumptions of OT are briefly laid out, together with the modifications of the theory by Pierrehumbert (1993) and Beckman (1997).

A crucial aspect in the analysis concerns the distinction that Pierrehumbert & Beckman (1988) make between the association of a boundary tone to the prosodic constituent node and the additional association of such a tone to a tone bearing unit ('secondary association').[2] It will be argued that this distinction is reproduced in OT by exploiting the two interpretations that have been given to alignment constraints, one applying in the case morphemes and the other applying in the case of segmental features. If alignment is interpreted as for morphemes, the edge-alignment of a tone makes demands on the serial order of the tone, and need not imply the association of a tone to a tone bearing unit. The adoption of this interpretation of alignment will allow us to account for the pattern of tonal infixation mentioned above.

The organisation of this chapter is as follows. First, some general phonological characteristics of the dialect and an overview of the data are presented in section 2. In that same section, the underlying representations of the lexical tone, the focal tones and the discourse-marking boundary tones are given and briefly motivated. In section 3, the tonally transcribed data are presented, together with the four generalisations. Section 4 introduces OT as well as the two proposals by Pierrehumbert (1993) and Beckman (1997). In section 5, an OT account will be offered which explains the four generalisations in four consecutive sections. The last of these, section 5.4, lays out our assumptions about the role of alignment constraints. A conclusion is offered in section 6.

2.0 General characteristics of the Roermond tonal system

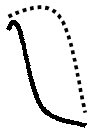
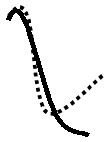
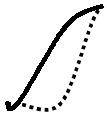
Within the word, two types of restriction conspire to confine the tonal contrast to certain locations. Firstly, the contrast is restricted to the syllable with main stress. The dialect of Roermond has the same stress system as standard Dutch. Main stress falls on either of the rightmost two syllables of the word if the penult is closed, and on one of the last three rightmost syllables if the penult is open. A final syllable without main word stress can be strong, i.e. form a foot. Secondly, the contrast is restricted to syllables with two sonorant moras. Thus, the syllable rime must contain a long vowel, a diphthong, or a lax vowel followed by a sonorant consonant ([m,n,ŋ,l,ʀ]) in order for the contrast to exist. As a result, words whose main-stressed syllable contains only a single sonorant mora have neither Accent I nor Accent II. The distribution of the word accents is to some extent predictable from prosodic and segmental properties of the word, a survey of which is presented in Hermans (1994).[3]

In (3) some tonal minimal pairs are given. As in Norwegian and Swedish, such minimal pairs are not numerous. An interesting feature of Roermond Dutch, as well as of other dialects in central and southern parts of the Dutch province of Limburg, is that some nouns distinguish plural from singular forms by having Accent I for the plural and Accent II for the singular (cf. 3d,e,f)). Only the identical) segmental transcriptions are given: their pitch characteristics depend on the intonation used (cf. below).

(3)	Accent I		Accent II	
a.	[ʃoːn]	‘beautiful’	[ʃoːn]	‘shoe (SG or PL)’
b.	[haːs]	‘hare’	[haːs]	‘glove’
c.	[ˈɛʀɣəʀə]	‘worse’	[ˈɛʀɣəʀə]	‘annoy’
d.	[kniːn]	‘rabbit-PL’	[kniːn]	‘rabbit-SG’
e.	[bɛin]	‘leg-PL’	[bɛin]	‘leg-SG’
f.	[ɛʀm]	‘arm-PL’	[ɛʀm]	‘arm-SG’

We present an overview of the tonal data in Table I. Each cell of the matrix shows the contrast between Accent I (solid line) and Accent II (interrupted line). The two rows represent the two discoursal meanings that are expressed in the intonation of the dialect, referred to as ‘Declarative’ and ‘Interrogative’.[4] The three columns represent different positions of the word-accented syllable in the intonational phrase. These are nonfinal focused position, illustrated in (4a), final focused position, illustrated in (4b), and final nonfocused position (4c). The vertical lines mark off the boundaries of the syllable. Thus, when occurring in focused nonfinal position (cf. (4a)), the word [ʃoːn] (Accent II) ‘shoe’ is pronounced with a rise from mid to high, and is followed by a fall (interrupted line, first row, first column), while the same word in focused final position (cf. (4b)) is pronounced with a falling-rising intonation (interrupted line, first row, second column). Obviously, words that do not have the main stress on the final syllable, like those in (3c), lack the patterns given in the second and third columns.

Table I. Schematic representations of the contrast between Accent I (solid line) and Accent II (interrupted line) with two intonation patterns (rows) and three positions in the sentence (columns)

	FOCUS NONFINAL	**FOCUS FINAL**	**NONFOCUS FINAL**
Declarative			
Interrogative			

(4) a. Ich höb ‘ne SJOON gevónje (*focus nonfinal*)
I have a shoe found
‘i have found a SHOE’
b. Ich höb twee SJOON (*focus final*)
‘i have two SHOES’
c. Ich HÖB gein sjoon (*nonfocus final*)
‘i HAVE no shoes’

The fact that a second sonorant mora needs to be present in the syllable for the word accent contrast to be possible leads one to expect that this mora is somehow involved in the representation of the contrast. If we consider the further fact that stressed syllables with one sonorant mora pattern like bimoraic syllables with Accent I, a reasonable assumption is that syllables with Accent II have a lexical tone on the second mora, while syllables with Accent I, just as syllables that have no second sonorant mora, are lexically toneless. Inspection of the ‘Declarative’ pitch patterns in Table I suggests that the lexical tone of Accent II is H. This representation is shown in (5), which is identical to those proposed by Hermans (1985, 1992) for the closely related dialect of Maasbracht and by Gussenhoven & van der Vliet (1999) for the more distantly related dialect of Venlo.

(5) Accent I: $_{F}(\sigma(\text{m m})_{\sigma}$ *or* $_{F}(\sigma(\text{m})_{\sigma}$
Accent II: $_{F}(\sigma(\text{m m})_{\sigma}$
|
H
(where m= represents a sonorant mora)

The two ‘discoursal’ morphemes are expressed by the boundary tones L_i for ‘Declarative’ and H_i L_i for ‘Interrogative’. Accent I, which is lexically toneless, consistently has a low ending in the ‘Declarative’ intonations, and a final high fall in the ‘Interrogative’ intonations, which patterns form the obvious motivation for assuming these boundary tones.[5] To mark focus, the dialect of Roermond uses a high tone in ‘Declarative’ sentences, but a low tone in ‘Interrogative’ sentences. These focal tones, symbolised H* and L* , respectively, associate with the first (or only) sonorant mora of the main stressed syllable of the focused word.[6] In (6), these combinations of focal tones and boundary tones are given. The ‘Declarative’ intonation is typically used for statements and WH-questions, and ‘Interrogative’ for yes/no questions.

(6) Declarative: H* L_i
Interrogative: L* H_i L_i

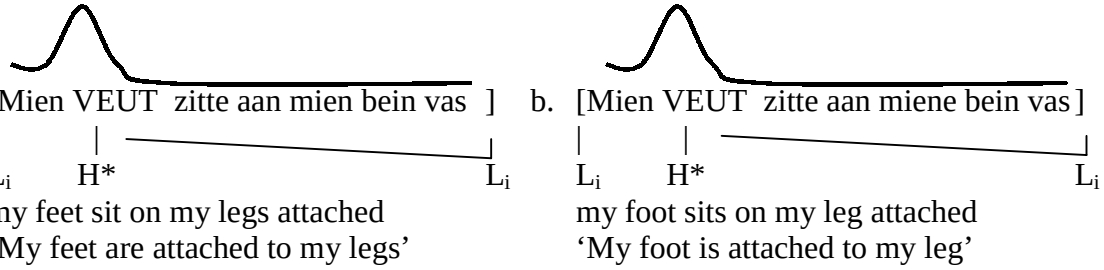
Lastly, an initial boundary L_i is used at the beginning of the intonational phrase. The next section illustrates the data summarised in Table I and the tonal representations introduced in this section. In the course of presenting those data, we will identify four generalisations, which we will accommodate in section 5.

3 The data

3.1 The neutralisation of the contrast in nonfocused, nonfinal position

The first observation to be made here is that the lexical tone contrast is neutralised unless the syllables concerned have a focal tone or if those syllables are final in the intonational phrase (Gussenhoven & Van der Vliet 1999). Words with Accent II lose the lexical H in nonfocused, nonfinal positions, which makes them indistiguishable from words with Accent I. Examples (7ab) illustrate this point. While [bɛin] *bein* 'leg' forms a minimal pair with [bɛin] *bein* 'legs' when spoken in isolation, they are homophonous in the sentences given. The focused words [vøːt] *veut* 'feet' (7a) and [voːt] *voot* 'foot' (7b) both have Accent I, while the final adjective [vɑs] vas 'attached' only has one sonorant mora, so that the example has no lexical tone.

(7)



We give the generalisation in (8).

(8) Generalisation 1: The lexical H is deleted unless T* or T_i is present in the same syllable

Sentences minimally have one focus-marking pitch accent; prefinal focus-marking pitch accent will be ignored in this chapter. The data, therefore, conform to the formula in (9). The elements in brackets are optionally present: (a) the syllable with the focus-marking T * may or may not have a lexical H on a second mora, (b) a final syllable may or may not have a lexical H on a second mora, and (c) the sentence either has 'Declarative' or 'Interrogative'intonation.

(9) [m … m m … m]
| | | | |\
L_i T*(H) (H) $(H_i)L_i$

3.2 The nonfinal 'Interrogative' contours

The second generalisation concerns the assimilation of the lexical H-tone of Accent II in focused 'Interrogative' contexts. When L* precedes the lexical tone in the same syllable, the pitch contour is not a rise from low to high, as we might expect from the representation of the focal tone as L*

and the lexical tone as H, but is fully low throughout the duration of the syllable. One possible analysis is that the lexical H changes to L when preceded by L* in the same syllable. An alternative assumption is that the L* spreads to the second mora, and that the lexical H is delinked, and hence deleted. In section 5.2 it is argued that the former solution is the correct one. Example (10a) gives the contour with Accent I, which has just the L* in focal position. The representation of Accent II with lexical L instead of H is shown in (10b). As will be clear, *bein* in (10a) has rising pitch, which contrasts with low pitch in (10b).

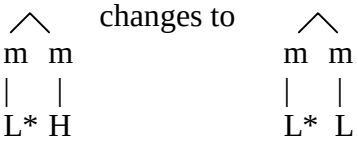
(10)

a. [Zitte dien BEIN^{I} aan dien veut^{I}]
| | |\
L_i L* H_iL_i
sit your legs on your feet
'Are your legs attached to your feet?'

b. [Zit diene BEIN^{II} aan diene voot ^{I}]
| | | |\
L_i L*L H_iL_i
sits your leg on your foot
'Is your leg attached to your foot?'

The second generalisation is given in (11). According to (11), any syllable with Accent II has its lexical H on the second mora transformed into a L-tone whenever it receives the focal L* of the 'Interrogative' on its first mora.

(11) Generalisation 2: Underlying changes to



3.3 The nonfinal 'Declarative' contours

In nonfinal syllables with 'Declarative' H*, Accent I is realised as an early fall during the focused syllable (12a), while Accent II has a fall immediately after the focused syllable(12b). (The contours are well-formed replies to *What is(are) attached to your hand(s)?)* A crucial aspect in the contour of Accent I is the early, fairly steep fall. It is this feature that, in this context, signals the distinction with Accent II. However, on the assumption that tonally unspecified stretches of speech are provided with interpolations between one tone and the next, the H* on *erm* and the L_i at the end of the sentence would lead one to expect a more gradual fall. In fact, the Accent I fall is steeper than that for Accent II, as was already indicated in the contours in(7a,b), where both *VEUT* 'feet' and *VOOT* 'foot' have Accent I. This steep fall is not predicted by the representation, which merely suggests that the fall for Accent I is earlier, but not steeper, than that for Accent II. To account for the steep fall of Accent I, the final L_i is assumed to spread to the free second mora of the focal syllable. This has been shown in (12a), where the Accent I syllable [ɛrm] 'arms' has a free sonorant mora, and contrasts with the Accent II syllable [ɛrm] in (12b), which does not.

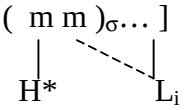
(12)

a. [Mien ERM^{I} zitte aan mien henj vas]
| | |
L_i H* L_i
my arms sit to my hands attached
'My arms are attached to my hands'

b. [Miene ERM^{II} zit aan miene handj vas]
| | | |
L_i H*H L_i
my arm sits to my hand attached
'My arm is attached to my hand'

The third generalisation that we need to account for, therefore, is (13).

(13) Generalisation 3: LEFTWARD TONE SPREADING



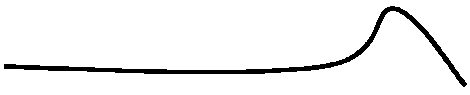
Two observations about the shape of the contour in (12b) are made. First, the focal syllable has a rise from low or mid to high, rather than a level high pitch, as would be expected on the basis of the representation with the two H-tones. It is assumed that the phonetic implementation of H* before H in the same syllable is a mid target. Second, the fall from the accented syllable does not describe a linear interpolation between H and L_i, but tends to descend more rapidly in the initial portion. The slope of this fall is less steep, however, than that in focal syllables with Accent I shown in (12a). The issue of the slope is further discussed in section 5.3.

3.4 The final focused 'Declarative' contours

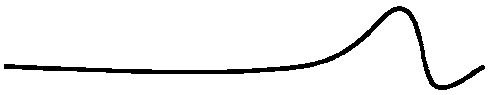
In final focused position, the 'Declarative' contour for Accent I, shown in (14a), has the same shape as the nonfinal contour shown in (12a): a steep fall inside the accented syllable. The contour for Accent II, however, differs from the corresponding nonfinal contour (12b): final Accent II is realised with a falling-rising contour, of which the rise only rises to mid (cf. (14b)). Clearly, a line-up of the focal H*, the lexical H and the boundary L_i does not explain why a falling-rising pattern is observed. A number of possible analyses would seem to be available. Gussenhoven & van der Vliet (1999) analyse a similar case in Venlo Dutch as the result of a tonal assimilation rule, LEXICAL H-LOWERING, which lowers a lexical H on the last mora to L before L_i. This sequence of two L-tones is held to be responsible for the lowish plateau which characterises final 'Declarative' Accent II in the dialect of Venlo. That analysis is independently supported by the behaviour of a final lexical H before the 'Interrogative' L_iH_i of that dialect, which also triggers LEXICAL H-LOWERING. However, for the Roermond dialect that solution is not available. First, the final part of the contour is typically a rise to mid, and it is therefore different from the more nearly level pitch of the Venlo dialect. Second, there is no independent evidence for the lowering of the lexical H, since the dialect of Roermond does not have a L_iH_i boundary sequence before which the same rule could be operative. The correct generalisation for Roermond appears to be that the boundary tone(s) are realised **before** a lexical H on the last mora. In (14b), the tones have been arranged in that order. In spite of the seemingly unorthodox order, the generalisation, given in (15), is exceptionless. In addition to the final focused 'Declarative' in (14b), the final nonfocused 'Declarative' as well as the final 'Interrogative' forms with H_iL_i show the same pattern (cf. the solid contours in the third and fourth columns of Table I, as well as the examples in sections 3.5-3.7).

Two comments are in order. First, example (14b) will strike speakers of most intonation languages as an interrogative intonation. It is stressed that (14b) has the **same** 'Declarative' intonation pattern as (14a); in addition to WH-questions, also statements typically have this pattern, like *D'r is get gebeurd mit diene KNIEN*^{II}*!* 'Something has happened to your RABBIT!'. Second, Roermond Dutch has a downstepping pattern which is frequently used in declarative utterances with two accented positions, in which case the second has a reduced range. Since we are dealing with one-accent contours only, downstep has been left out of our analysis.

(14)



a. [Waat is d'r gebeurd mit dien KNIEN^{I}]
| | ↘
L_i H* L_i
what has-there happened with your rabbits
'What has happened to your rabbits?'



b. [Waat is d'r gebeurd mit dien KNIEN^{I}]
| | |\
L_i H*L_iH
what has-there happened with your rabbit
'What has happened to your rabbit?'

(15) Generalisation 4: If the final mora of the intonational phrase has a lexical H, the boundary tones (L_i and H_iL_i) are realised before it

Generalisation 4 cannot be accommodated in the model of tonal alignment of Pierrehumbert & Beckman (1988), who stipulate that boundary tones associated to some node N are pronounced 'outside' tones associated to nodes dominated by N-1 (1988:158). However, the stipulation does not follow directly from their conception of boundary tone association, but is based on what was known at the time about the behaviour of boundary tones. In section 5, it will be shown that Generalisation 4 can very naturally be accounted for in Optimality Theory.

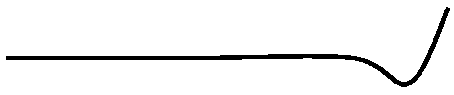
We have now introduced the four relevant generalisations about Roermond tonal structure. The remaining data, to be introduced in sections 3.5, 3.6, and 3.7, provide further evidence for Generalisations 3 and 4.

3.5 The final focused 'Interrogative' contours

In intonation-phrase final position, the focused realisation of Accent I is a rise-fall (16a). The low beginning of the rise is located inside the syllable, which distinguishes this contour from the 'Declarative' pronunciation of final Accent I illustrated in (14a), in which the rising part is located before the final syllable. The contour is readily explained by the expected tonal sequence L* H_iL_i. By contrast, the contour for Accent II is a plain rise, a contour which obviously does not result from an implementation of L* H H_iL_i, which tone sequence would at first sight seem to result from the concatenation of the underlying tones. However, we have seen in the previous section that the boundary tones are located to the left of a lexical tone on the last mora. According to Generalisation 4 (15), therefore, the correct line-up is L* H_iL_i H. Secondly, we saw in section 3.2 that Roermond does not tolerate a nonfinal LH contour on the two moras of a syllable. Generalisation 2 (11), therefore, stipulates that instead of L* H_iL_i H, the representation should be L* L_iL_i H, where the H_i of the boundary sequence has been replaced with L_i. This representation is shown in (16b).

(16)

a. [Ister get gebeurd mit dien BEIN?^{I}]
| | |\
L_i L* H_iL_i
has-there st happened with your legs
'Has something happened to your legs?'



b. [Ister get gebeurd mit diene BEIN^{II}]
| | |\ \
L_i L*L_iL_i H
has-there st happened with your leg
'Has something happened to your leg?'

General well-formedness considerations, like Clements & Keyser's (1983) TWIN SISTER CONVENTION, according to which more than one association of some element to the same site are

automatically reduced to one, will simplify the tonal representation of 'leg' in (16b) to L*L_iH. Since the boundary tones attach to the moras of the final syllable, they are represented as such.

3.6 The final nonfocused 'Declarative' contours

In intonation-phrase final position, the lexical H of Accent II is retained even if the syllable is not focused, and the word accent contrast can therefore be observed in nonfocused, final position. The contours in this context follow the generalisations identified so far. Example (17a) contrasts with (17b) in its final syllable only. (In both examples, the focus is on a word with Accent I, [vø:t] *veut* 'feet' and [vo:t] *voot* 'foot'.) The contour with the singular form [bein] ^{II} shows a rise to mid pitch. This is explained by the location of the final L_i before the lexical H, in accordance with Generalisation 4.

(17)

a. [Mien VEUT ^{I} zitte aan mien bein ^{I}]
| | |
L_i H* L_i
my feet sit on my legs
'My feet are attached to my legs'

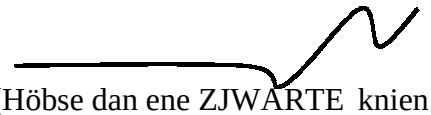
b. [Miene VOOT ^{I} zit aan miene bein ^{II}]
| | | |
L_i H* L_iH
my foot sit on my leg
'My foot is attached to my leg'

3.7 The final nonfocused 'Interrogative' contours

The contrast in the final unfocused 'Interrogative' condition can likewise be predicted on the basis of the data discussed above. Example (18a) is like (16a). The focused [ʒwɑʀtə] *zjwarte* 'black' has a stressed syllable with a single sonorant mora, since [ʀ] is devoiced before voiceless consonants (Kats 1939:85). The final word has Accent I. In (18b), we observe a high-mid-high contour on the final syllable, which is explained by the infixation of the boundary tones before the final lexical tone.

(18)

a. [Höbse dan ZJWARTE knien ^{I}?]
| | | |
L_i L* H_iL_i
have-you then black rabbits
'So do you have black rabbits?'



b. [Höbse dan ene ZJWARTE knien ^{II}?]
| | | |\
L_i L* H_iL_i H
have-you then a black rabbit
'So do you have a black rabbit?'

This concludes our survey of the tonal data of Roermond Dutch. In the next paragraph, we will briefly explain why these facts do not lend themselves to a derivational account.

3.8 SPE's failure to deal with Generalisation 4

As observed in the Introduction, Generalisation 4 provides the chief motivation for the adoption of constraint-based OT. In order to show why a rule-based description isn't available, it is sufficient to consider the interaction between the only two feature changing rules that would be needed to account for the data. First, Generalisation 2 (11), which requires the lexical tone to be L if L* occurs in the same syllable, could be formulated as (19).

(19) H-ASSIMILATION: $H \rightarrow L / (L^* \_\_\_)_\sigma$

Giving an SPE formulation of Generalisation 4 (15) is more difficult. We would need a metathesis rule, which changes a final tone string HHL into HLH, as in (20).

(20) METATHESIS: H H L]
1 2 3 4 ⇒ 1 3 2 4

METATHESIS would correctly apply in three of the four contexts in which Accent II is in final position. A final focused 'Declarative' with Accent II, underlyingly H*HL$_i$, is duly transformed into the correct H*L$_i$H (cf. (14b)). If the leftmost H-tone in the structural description in (20) occurs in a different syllable, the rule also applies in nonfocused syllables. These have HL$_i$ underlyingly, and have either a lexical H to their left (if the preceding focused word has Accent II) or a focal H* (if the preceding focused word has Accent I). The output would be L$_i$H. Final nonfocused Accent II syllables with 'Interrogative' intonation, underlyingly HH$_i$L$_i$, are also correctly dealt with: they are transformed to HL$_i$H$_i$, accounting for the falling-rising pattern observed (cf. 18b)).

The problem, however, is posed by the final focused 'Interrogative', underlyingly L*HL$_i$H$_i$. This form requires the application of both METATHESIS and H-ASSIMILATION. Derivation (21) shows that if METATHESIS applies before H-ASSIMILATION, the output is correctly derived, as shown in (21a), where parentheses stand for syllable boundaries. However, in (21b), where the focal syllable is not phrase-final, and underlying L*H is in a different syllable than H$_i$L$_i$, METATHESIS would apply incorrectly so as switch round the two boundary tones, this time in a syllable with Accent I. The order METATHESIS before H-ASSIMILATION, therefore, is not usable.

(21)	Input	a. (L*H H$_i$L$_i$)	b. (L*H) (H$_i$L$_i$)
	METATHESIS	L$_i$H$_i$	L$_i$H$_i$
	H-ASSIMILATION	L	L
	Output	(L*L L$_i$H$_i$)	* (L*L) (L$_i$H$_i$)

Since the reverse order produces the wrong result in the final focused syllable with Accent II, as shown in (22a), we are stuck with an ordering paradox: while the counterbleeding order of (21) is required for a tautosyllabic input of L*H H$_i$L$_i$, a bleeding order would be required for a correct derivation of the heterosyllabic (L*H) (H$_i$L$_i$), as shown in (22). It is not possible to restrict the rule to HHL-strings in final syllables, as it would then fail to apply to the nonfocused final 'Declarative' contour (H*H)(HL$_i$) or (H*)(HL$_i$), where the leftmost H is in a different syllable.

(21)	Input	a. (L*H H$_i$L$_i$)	b. (L*H) (H$_i$L$_i$)
	H-ASSIMILATION	L	L
	METATHESIS	*not applicable*	*not applicable*
	Output	* (L*L H$_i$L$_i$)	(L*L) (H$_i$L$_i$)

To salvage the derivational account, METATHESIS would have to be provided with a condition 'If either the first or the second H is associated to the final mora', a description which patently fails to put the finger on the spot. Before moving on to the constraint-based account, the principles of Optimality Theory are briefly presented in section 4.

4. Some background: Optimality Theory

4.1 General

Optimality Theory (henceforth OT; Prince & Smolensky 1993, McCarthy & Prince 1993, 1995) holds that phonological surface forms (the output forms) optimally satisfy a ranked series of constraints. Rather than serving as a structure to be modified by successive applications of phonological rules, the underlying form (the input form) serves as the structure that is to be maximally preserved, subject to the prescriptions and proscriptions of a set of universal constraints. The interactions among three components in the theory ensure this result. First, a set of universal operations (GEN) generates a very large set of candidate output forms, by freely improvising on the input form, subject to general wellformedness constraints, like Goldsmith's (1976) NO CROSSING CONSTRAINT on associations. Second, a number of faithfulness constraints stipulate that the output form should be identical to the input form. Third, a set of phonological constraints specify universal phonological unmarkedness, according to which output forms must be maximally unmarked. The constraints are universal, but their ranking is language-specific. The set of output forms generated by GEN is vetted by the ranked constraints: any form that violates a constraint where one or more other forms satisfy it or violate it less is discarded from the set of candidates. If more than one form violates the same constraint, these all proceed to the following constraint, for as long as is needed for a single, winning candidate to emerge. Because the faithfulness constraints are typically interleaved with the phonological unmarkedness constraints, surface forms will deviate from underlying forms wherever a phonological unmarkedness constraint is in conflict with a lower-ranking faithfulness constraint. In addition, OT employs alignment constraints, which are used for instance for locating affixes relative to their base.

GEN, a relevant formulation of which is given in Myers & Carleton (1996), is here taken for granted. The remaining paragraphs contain very brief discussions of faithfulness, markedness, positional faithfulness, and alignment.

Faithfulness

Faithfulness is expressed in terms of correspondences between the elements in the input and elements in the output (McCarthy & Prince 1995). There are three constraint 'families'. The first two are MAX-IO (Maximality: 'Every element in the input has a correspondent in the output') and DEP-IO (Dependence: 'Every element in the output has a correspondent in the input'), which militate against the deletion and insertion of phonological elements, respectively (cf. Myers & Carleton 1996). Third, in addition to the requirements that every output tone should have a correspondent in the input and that every input tone should have a correspondent in the output, we need to stipulate that a tone's input value should correspond to its output value. IDENT(T) (25) expresses this.

(23) DEP-IO: Insertion of tones is prohibited.

(24) MAX-IO: Deletion of tones is prohibited.

(25) IDENT(T): $*\alpha T_{input}$
$|$
$-\alpha T_{output}$

These faithfulness constraints potentially come in as many forms as there are features.

Markedness

A general descriptive schema is that phonological markedness constraints forbid the parsing of a (valued or privative) feature F (expressed as *F, known as an anti-association constraint, Prince & Smolensky 1993). These anti-association constraints are pitted against MAX(Feature), which requires the parsing of the input feature specified. Tableau (26) gives the input form in the top lefthand corner, lists possible output forms in the rows (in any order), and gives the constraints in the columns, ordered left to right according to dominance. In the cells, * indicates a constraint violation, ! indicates that a constraint violation is fatal, while ☛ points at the winning candidate. The effect of ranking MAX(nasal) above *[+nasal] is that [+nasal] is parsed, i.e. that the language has nasal segments. If the reverse ranking were to obtain, the language would not have nasal segments.

(26)

[+nasal]	MAX(+nasal)	***[+nasal]**
a. ∅	*!	
☛b. [+nasal]		

Positional faithfulness

Phonological features are frequently restricted to specific locations in prosodic structure. Dutch, for instance, which contrasts voiced and voiceless obstruents in syllable onsets, does not permit voiced obstruents in the coda (e.g. Booij 1995). Likewise, the vowels of English are largely restricted to stressed syllables, with only three vowels occurring in unstressed syllables (Bolinger 1986:347), while Shona has a five-vowel system, which is fully employed only in word-initial syllables: in non-initial syllables, mid vowels do not occur, unless preceded by a mid vowel (Beckman 1997). In like manner, prosodic features tend to shun weak and nonperipheral locations. Some Chinese dialects have tone on both weak and strong syllables in the foot, some only on strong syllables (Yip 1996). The significance of prosodic heads has been emphasized at least since Liberman & Prince (1977), while the special status of peripheries is evident, for instance, from Selkirk's treatment of vowel lengthening in Chi Mwi:ni (1986) or Prince's (1983) End Rules.

To account for such positional neutralisations, Beckman (1997) proposes a family of positional faithfulness constraints. She observes that the onset is a privileged position in the syllable, and that the set of privileged syllables consists of stressed syllables and peripheral syllables. The general idea is that faithfulness constraints can be restricted to these privileged locations. Thus, in Guaraní, where nasal vowels may only occur in stressed syllables, a constraint MAX-σ'[+nasal] would ensure that [+nasal] is banned from all positions except stressed syllables, provided it is ranked above *[+nasal], which in turn would be ranked above the generic MAX(+nasal). This is illustrated in Tableau (27).

(27)

ˈCĩCĩ	MAX-ˈσ[+nasal]	***[+nasal]**	MAX(+nasal)
☛ a.ˈCĩCi		*	*
b.ˈCĩCĩ		**!**	
c.ˈCiCĩ	*!	*	*
d. ˈCiCi	*!		**

Evidently, these positional faithfulness constraints can be used to restrict the association of tones to focal and final syllables, so as to account for Generalisation 1.

Alignment

An important role in our account of Roermond Dutch tone is played by Alignment constraints (McCarthy & Prince 1993). Alignment constraints determine the location of a phonological element or a (tonal) morpheme relative to the phonological or morphological structure of the expression. They do this by stipulating that the right/left edge of some element (foot, affix, tone, etc.) should coincide with the right/left edge of some other morphological or phonological constituent. For instance, the English plural suffix [z] is subject to the constraint in (28), according to which the suffix's right edge coincides with the right edge of the derived word (cf. McCarthy & Prince 1993:102).

(28) ALIGN-z: Align($[z]_{PLUR}$,R,Word,R).

Since the location of tones is determined by constraints, it is conceivable that alignment constraints for different tones compete for the same position in the output form, and that their ranking determines which tone is given precedence.

This brief outline enables us to present our account of the data.

5.0 The analysis

5.1 The first generalisation: Licensing the lexical tone

The first generalisation about our data is that the lexical tone contrast is suspended in nonfinal positions outside the focus. In such positions of neutralisation, both Accent I-word and Accent II-words act as if they are toneless, and the F0-contour is just interpolated through them. Apparently, the lexical tone must be licensed by another tone in the same syllable. There are different interpretations of the notion 'licensing' in the literature. In one view, licensing is done by 'strong' structural positions. Thus, Lombardi's (1991) proposes that final devoicing in Dutch, according to which no voiced obstruents can occur in the coda of the syllable, can be interpreted to mean that the feature combination [+voice, -son] is licensed by the syllable onset. Another view, proposed by Steriade (ms), is that licensing amounts to the requirement that for a phonological element to be legitimate in a position, some phonetic property should be uniquely available in that position which enhances the perception of the phonological element. The 'positional' view suggests we should account for the neutralisation of the lexical tone contrast with the help of positional faithfulness constraints (Beckman 1997), while Steriade's conception would suggest a constraint that makes the tone on a weak mora dependent on the presence of a tone on the strong mora. We opt for the conceptually simpler solution of making MAX-constraints sensitive to position, as proposed by Beckman.

Constraint (29) stipulates that tone should be parsed in focused syllables, or the Designated Terminal Element (DTE) of the focused constituent (cf. Liberman & Prince 1977), while (30) does the same for intonational phrase final positions. If these positional faithfulness constraints are ranked above a constraint banning tone (*T), which in turn is ranked above the more general faithfulness constraint MAX(T), the effect is that tones survive only in the desired syllables. Tableau (31) shows the deletion of the lexical H, where the input is a nonfinal, nonfocal syllable with Accent II.

(31)

(H) …]	MAX-DTE(T)	*T	MAX(T)
a. (m m) …] | H		*!	
b. (m m) …]			*

The retention of the lexical tone is achieved by the same constraints. For the sake of completeness, we first introduce the alignment constraints that are responsible for locating the lexical tone and the focal tone. The presence of the lexical tone on the second mora is interpreted as resulting from ALIGNLEXRT, according to which the lexical H is aligned with the right edge of the syllable.

(32) ALIGNLEXRT - (H,R,Syl,R): The right edge of Lexical H coincides with the right edge of the syllable.

The alignment of the focal tone is governed by ALIGN-T*. Pierrehumbert (1993) proposes that in addition to edges, alignment constraints may refer to prosodic heads. Pitch accent assignment in English is one of the phenomena that is cited in support of this proposal: the starred tone of the pitch accent is aligned with the head of the foot. A similar characterisation is possible of the location of the focal tone of Roermond Dutch. Instead of saying that the tone is left-aligned in the foot, we can say it is aligned with the foot head. In fact, if we make the reasonable assumption that no language aligns its tones with the non-prominent edge of the foot, head alignment is to be preferred, since a statement about the edge alignment of the focal tone would duplicate the independently needed statement of the foot prominence edge of the language (iamb or trochee). Therefore, the ALIGN-T* is given by (33), where 'pitch accent' is a variable ranging over H* and L* in Roermond Dutch.[7]

(33) ALIGN-T*: Align(<pitch accent>,DTE,Foot,DTE)

In Tableau (34), the two alignment constraints are included; their ranking with respect to MAX-DTE(T) cannot be established.

(34)

(H* H) ...]	ALIGN-T*	ALIGNLEXRT	MAX-DTE(T)	*T	MAX(T)
☛ a.(m m) …] | | H* H				**	
b..(m m) …] | | H H*	*!	*		**	
c..(m m) …] | H*			*!	*	*
d.(m m) …]			*!*		

Generalisation 3: Banning rises in nonfinal position

Ohala (1978) cites evidence that F0 rises take longer to produce that F0 falls, and tentatively suggests that falls are perceptually more salient and make better tonal contrasts than rises. Indeed, it is not uncommon for languages to favour falls over rises. In Hausa, no syllable has rising tone (Leben 1978:206), while falls are common on bimoraic syllables. Hermans (1996) gives an an account of the remarkable case of Toura (Bearth 1971), which has ten distinctive tones on bimoraic syllables. Of these, four are level tones and six are falling tones: the language does not have a single rising contour within the syllable.

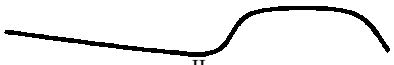
If rises are less efficient than falls in both production and perception, we may expect a constraint NoRise to emerge in the constraint hierarchies of languages. It is reasonable to assume that rises, and indeed contours in general, are more readily excluded from unfavourable positions than from positions in which more time is available for their execution. Thus, rises should be more probable in phrase-final position, where the availability of final lengthening favours the execution of the F0-rise, than in phrase non-final position. Following a suggestion independently made by Jaye Padgett and Lisa Selkirk, such positionally determined degrees of markedness should not be included in the phonological markedness constraints themselves (e.g. by assuming a constraint *****NonfinalRise), but be expressed in positional faithfulness constraints, in line with Beckman's (1997) proposal. Accordingly, we split off IdentFin(T), which demands the faithful parsing of the last tone of the IP and is given in (35), from the general Ident(T) given in (25), and position NoRise (36) between them. This has the effect of disallowing rises in all positions except when the rise is (wholly or in part) defined on the last TBU of the IP. (In (35), the square bracket stands for the IP-boundary, and in (36), the parentheses stand for syllable boundaries, as usual.)

(35) IdentFin(T): *αT]$_{input}$
|
-αT]$_{output}$

(36) NoRise: * (m m)
| |
L H

The fully low contour in nonfinal focused 'Interrogative' syllables with Accent II, illustrated in (10b) and repeated here as (37), thus results from the ranking IdentFin (T) >> NoRise >> Ident(T). Tableau (38) illustrates this interaction. Candidate a., with the LH contour, is rejected, because it violates NoRise. Max(T) has been included to show how deletion of the lexical tone, as in candidate b., is prevented by ranking this constraint above Ident(T). Thus, the lexical tone is preserved, but can only be parsed as a L-tone. Or, put differently, instead of a deletion of the feature [-H(ightone)], shown in candidate a., the correct form, candidate c., is characterised by its replacement with the feature [+H(ightone)]. Observe that this account implies that there are indeed two L-tones, rather than a single L* which has spread to the second mora.

(37)



[Zit diene BEIN^{II} aan diene voot ^{I}]
| | | |\
L_i L*L H_iL_i

(38)

(L*H) …]	IDENTFIN(T)	NORISE	MAX(T)	IDENT(T)
a. (m m) …] | | L* H		*!		
b. (m m) …] | L*			*!	*
☛ c. (m m) …] | | L* L				*
d. (m m) …] | H			*!	

There is a fourth possible output form, not listed in Tableau (38), which is not explicitly excluded in our analysis: H*H. It is assumed that L* is more highly valued by IDENT(T) than the lexical tone: changing the value of the T* constitutes a worse violation of this constraint than changing the value of the lexical H. This indicates the need to separate Max(T) into constraints that are sensitive to the morphological identity of a tone. This is of course no different from the morpheme specificity of alignment constraints for segmentally encoded affixes.

We now move on to an account of the third generalisation, the leftward spreading of the boundary tone.

5.3 Generalisation 3: Spreading the boundary tones

In section 3.3, it was observed that the boundary L_i will spread left to a nonfinal syllable with Accent I, so as to create a low target in the focused syllable. To create the effect of leftward spreading, the boundary tones are assumed to obey two seemingly contradictory alignment constraints. ALIGNT_iLEFT, given in (39), requires the postfocal boundary tone to be aligned leftmost, without violating the universally undominated constraint against crossed associations. The other, ALIGNT_iRT, given in (40), ensures that boundary tones will always appear at the end of the intonational phrase.

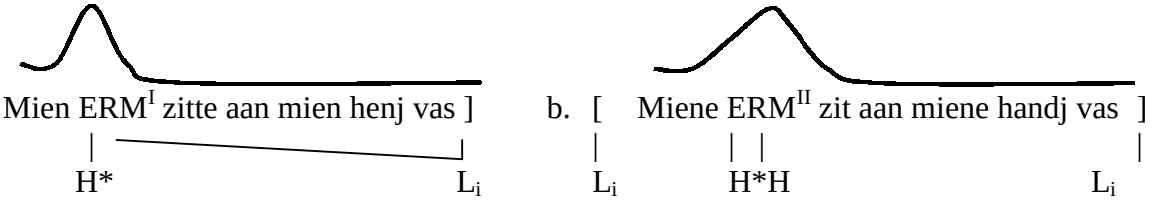
(39) ALIGNT_iLEFT - (T_i,L): The left edge of the Phrasal boundary tones is aligned leftmost.

(40) ALIGNT_iRT - (T_i,R,Phrase,R): The right edge of the Phrasal boundary tones coincides with the right edge of the Phrase.

In the case of 'Declarative' L_i, the leftward alignment can be honoured with an association to the free second mora of a focal syllable with Accent I, which results in a low target inside the focal syllable. However, in focused syllables with Accent II no such association can take place, because there is no free TBU available. Strictly speaking, ALIGNT_iLEFT is violated for every sonorant mora to the left of the final syllable to which the boundary tone fails to spread. Of course, the undominated positional faithfulness constraints effectively restrict the tonal phonology to the focal and final syllables, and in order not to clutter up our tableaux, we will ignore violations of ALIGNT_iLEFT that are due to a failure of T_i to spread to nonfocal syllables. As observed in section 3.3, the difference between these two representations is observable in the slope of the fall, which is

quite steep in (12a) (repeated here as (41a)), but less steep in (12b) (repeated here as (41b)). A further prediction is that if the focal syllable has one sonorant mora, as in words like [kɑt] 'cat' and [taˈbɑk] 'tobacco', the slope should resemble that for Accent II, i.e. it should not be steep. This is because both Accent II and monomoraic syllables lack a free mora for the boundary tone to associate with. Phonetic evidence for the correctness of these predictions is presented in Gussenhoven (in press).

(40)



In Tableau (42), the spreading of L_i to focal syllables with Accent I is shown to be the preferred output.

(42)

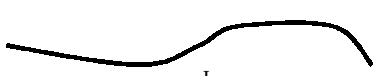
(H*) …] L_i	ALIGNT_iRT	ALIGNT_iLEFT
☛ a. (m m) …] H* L_i		
b. (m m) …] H* L_i		*!
c. (m m) …] H* L_i	*!	

It is not entirely self-evident that in a contour with Accent II or in a contour with a monomoraic focal syllable, left-alignment of L_i is impossible. After all, we do not observe a linear interpolation between the target for the H-tone and L_i, but a decidedly 'drooping' contour. Arguably, this form could be attributed to the working of ALIGNT_iLEFT, with the left-hand target creeping up to the focal syllable in a gradient fashion. Hayes & Lahiri (1992), however, make it clear in their treatment of Bengali that such early realisation of boundary tones should be left to the phonetic implementation rules. This would appear to be the correct position. That is, we should not see phonetic implementation as somehow mimicking phonological constraints. Rather, the relationship is the other way around: phonological constraints may arise when phonetic implementation gets codified in the grammar. The motivation for phonetic behaviour is efficiency in production and perception, and it is not difficult to see why an early, steeper fall is a more efficient perceptual cue that a gradual, drawn out fall. For the speaker, too, controlling steep falls may be easier than controlling gradual falls, because the time span over which the control is to be exercised is shorter. The 'droop', therefore, is the expected situation: this is what the phonetic implementation typically does. Only if such behaviour leads to categorical effects do we need the services of the ontologically derivative phonological constraint.

The contrast between Accent I and Accent II in 'Declaratives' is interestingly different from that in 'Interrogatives'. A focused syllable with Accent I followed by the 'Interrogative' boundary sequence H_iL_i does not find its free mora occupied by a left-spreading H_i. The rising movement

observed in this position typically extends across the postfocal syllable(s), and is clearly not finished within the focused syllable. If left-aligned L_i associates as in (41a), then why doesn't H_i do so in the corresponding 'Interrogative' contour (10a), repeated here as (43)?

(43)



a. [Zitte dien BEIN^I aan dien veut^I]
| | |\
L_i L* H_iL_i

Spreading of the H_i of the 'Interrogative' boundary tones H_iL_i is prevented by NORISE. This is shown in Tableau (44), where candidate a., in which H_i does not associate, is preferred over candidate b., where it does. We cannot be happy with the candidate c. either, in which the H_i has been changed to L_i: while it escapes the censure of NORISE, it incurs a gratuitous violation of IDENT(T). Recall that in Tableau (38) the form that violates IDENT(T) was the optimal form, because it is the only one that succeeds in satisfying MAX(T). However, in Tableau (44), the a-candidate does not incur a violation of MAX(T), because H_i is preserved by virtue of its right alignment. We thus see that NORISE has two rather different effects in nonfinal syllables: in focused Accent II syllables, it forces the parsing of H as L, while in focused Accent I syllables, it prevents the H_i from spreading to the free second mora.

(44)

(L*) …]H_iL_i	NORISE	MAX (T)	IDENT(T)	ALIGNT_iRT	ALIGNT_iLT
☛ a. (m m) …]					*
| /\					
L* H_iL_i					
b. (m m) …]	*!				
| ＼ |					
L* H_iL_i					
c. (m m) …]			*!		
| ＼ |					
L* L_iL_i					
D . (m m) …]		*!			*
| |					
L* L_i					

In this section, we have seen that the observance of ALIGNT_iLEFT causes the L_i to spread to the free mora of a nonfinal focused syllable with Accent I. The corresponding 'Interrogative' contour, in which H_i is not associated to the free mora, shows that, in addition to the earlier established ranking NORISE >> MAX(T) >> IDENT(T), it must be the case that IDENT(T) outranks ALIGNT_iLEFT, which prevents H_i from changing to L_i in order to satisfy ALIGNT_iLEFT. No ranking between ALIGNT_iRT and ALIGNT_iLEFT could be established.

5.4 Generalisation 4: Competing Alignment constraints

As observed earlier, the most striking feature of the tonal system of Roermond is the location of the intonational boundary tones: when the final syllable has Accent II, and therefore the last mora of the intonational phrase is occupied by a lexical tone, the boundary tones are positioned before the

lexical tone in question, which appears as the last tone of the utterance. We intend to account for this pattern by ranking ALIGNLEXRT above ALIGNT_iRT. To see how this works, we need to be more explicit about what we mean by 'alignment' in these constraints. There are two possible interpretations, one modelled on the alignment of affixes or feet and one modelled on the alignment of segmental features. As an example of the former, consider the algnment constraint governing the position of the English plural suffix again, given in (28). The requirement here is that the right edge of the derived word should coincide with the right edge of the affix. In this interpretation, ALIGNT_iRT requires that the end of the IP and the right edge of H_iL_i and L_i should coincide. Featural alignment, however, implies not just coincidence of edges - assuming we can speak of the 'edge' of a feature, but association to the appropriate node. If rightward spreading of [+nasal] is described by means of an alignment constraint, then that constraint is satisfied if the [+nasal] is associated with the supralaryngeal node in the feature tree of the last segment of the word. In the case of tone, both interpretations are available. If only edge coincidence is required, the tones need not be associated with the final mora(s) for the alignment constraint to be obeyed, and in this interpretation, a separate constraint is therefore needed to enforce association. This ambiguity in fact accurately reproduces the distinction drawn by Pierrehumbert & Beckman (1988), who point out that tones may have more than one type of association. Boundary tones are associated with the relevant prosodic constituent node, but they also recognise a configuration whereby a boundary tone, in addition to its association with the constituent node, acquires an association with a TBU, a configuration known as 'secondary association'. Following Hayes & Lahiri (1991), I have shown association to the constituent node as association to the constituent bracket. It is proposed that it is this type of association which is demanded by an alignment constraint. Association to a TBU, required by the constraint TBU, is shown as such, but without the additional association to the constituent node. Thus, the task of alignment is to determine the location of each tone, while association to a TBU will follow if a legitimate TBU is available in the location concerned. In this view, all tones are aligned, but only some are associated. Constraint TBU (45) stipulates that tones should be associated with a sonorant mora in a stressed syllable in the output.[8]

(45) TONE BEARING UNIT (TBU): [+son]
|
(…μ…)'σ

(45) can be interpreted as an abbreviation of two constraints, one requiring that tones should associate to TBUs, and one that requires that TBUs should be associated with tone. For the purposes of our description, it seems unnecessary to separate these. This means that free TBUs in focal or final stressed syllables will demand the association of tones that are aligned so as to be near them. Our assumptions vindicate the tonal representations presented in section 3, because wherever boundary tones are aligned with stressed syllables, they will associate with the free sonorant moras in these syllables. For instance, in (18a), repeated as (46), the representation not only satisfies ALIGNT_iRT, but also TBU.

(45)

[Höbse dan ZJWARTE knien^{I}?]
| | | |
L_i L* H_iL_i

Following Anttila & Bodomo (1995), we assume that the unmarked relation between TBUs and their tone bearers is one-to-one. That is, both spreading of tones and contouring of tones need to be

enforced by constraints that rank above the constraints forbidding these many-to-one configurations. These are given, again somewhat crudely, as *****SPREAD (47) and *****CROWD (48).

(47) *****SPREAD: Do not spread tone.

(48) *****CROWD: A TBU is associated with at most one tone.

We now return to the issue of the serial position of the tones in final syllables with Accent II. When the lexical H appears on a nonfinal syllable, ALIGNT_iRT and TBU can always be satisfied, since there are no other tones that seek to be in the same position. However, when the lexical H is on the last mora of the intonational phrase, its final position is compromised by the presence of the phrasal boundary tones. If ALIGNLEXRT is to be satisfied in phrase-final position, the lexical tone must appear in rightmost position in the tonal string. This is because the edges of phonological constituents are themselves edge-aligned with the corresponding edges of the dominating constituents in which they have a peripheral position. If a tone is to be rightmost in a phrase-final syllable, it will have to be rightmost in the phrase. Therefore, if we rank ALIGNLEXRT above ALIGNT_iRT, the effect is that in intonational phrase-final position, the boundary tones are inserted before the lexical tone, which is exactly the configuration we have observed in the data. Consider the final syllable in (17b), repeated here as (49), which needs to accommodate the 'Declarative' L_i in a situation in which the lexical tone is demanding to be the last tone of the syllable.

(49)

[Miene VOOT^{I} zit aan miene bein^{II}]
| | |
L_i H * L_iH

Tableau (50) shows that (50a) emerges as the winning candidate: it is the only one with the lexical tone in final position (making it better than candidates c. and d.) in which both moras are provided with tone (making it better than candidates b. and d.). The violation of ALIGNT_iRT is unavoidable.

(50)

(H)] L_i	ALIGN(LEX,RT)	ALIGN(T_i,RT)	TBU
☛a. (m m)] | | L_i H		*	
b. (m m)] ◠ L_i H		*	*!
c. (m m)] | | H L_i	*!		
d. (m m)] ◠ L_i H		*	*!

A somewhat more complicated situation arises when three tones need to be accommodated in the final syllable, which occurs in the 'Interrogative' counterpart of (49). This nonfocus 'Interrogative' with Accent II, was given in (18b) and is repeated in (51).

(52)

[Höbse dan ene ZJWARTE knien ^{II}?]
| | | |\
L_i L* H_iL_i H

Even though there are only two moras in the final syllable, and there may be a free mora available in the focal syllable (which happens not to be the case in *zwarte*, because of the voiceless [R], as observed in section 3.7), the three tones are parsed in the final syllable. This is shown in Tableau 52. Although the winning a-candidate violates NORISE in the final syllable, it manages to satisfy NORISE in the focal syllable, which constraint removes candidate b. from the candidate set. The fact that this form is better than the winner by a number of lower ranking constraints, like *****CROWD (not shown) and TBU, cannot save it. The c-candidate, which avoids a violation of NORISE in the focal syllable by parsing the H_i as L_i, cannot offer any relief, as it violates IDENT(T) for a tone which can safely be parsed outside the focal syllable. Candidate d. attempts to win by avoiding a NORISE violation altogether, but it is frustrated by IDENTFIN(T), an undominated constraint in Roermond Dutch. And avoiding any violation of NORISE by ordering the lexical H before the boundary tones of the intonational phrase, as attempted by the e-candidate, is futile, because ALIGNLEXRT is undominated.[9]

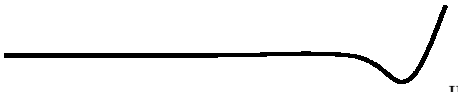
(52)

(mm) … (mm) (L*) … (H) H_iL_i	LEXRT	IDFIN(T)	NORISE	ID(T)	T_iRT	T_iLT	TBU
☛ a. (m m) … (m m)] | | |\ L* H_iL_i H			*		*	*	*
b. (m m) … (m m)] | | | | L*H_i L_i H			**!		*		
c. (m m) … (m m)] | | | | L*L_i L_i H			*	*!	*		
d. (m m) … (m m)] | | |\ L* H_iL_i L		*!		*	*	*	*
e. (m m) … (m m)] | | |\ L* H H_iL_i	*!					*	*

There remain the final focused syllables to be accounted for. The final focused 'Declarative' with Accent II, underlyingly H*HL_i, will come out as H*L_iH, because ALIGNLEXRT >> ALIGNT_iRT. The treatment of final focused 'Interrogative' with Accent II represents an interesting confirmatory case for our analysis. Underlyingly, this syllable has no less than four tones to accommodate, as

shown in (16b), repeated here as (53). The form shows the effects of complying with NORISE in nonfinal position, as well as ALIGNLEXRT.

(53)



[Is d'r get gebeurd mit diene BEIN^{II}]
| | |\ \
L_i $L^*L_iL_i$ H

Our analysis straightforwardly accounts for this form, as shown in Tableau (54). The winning a-candidate satisfies ALIGNLEXRT, and is therefore better that candidates b. and c. Candidate d. has the lexical tone in the right location, but violates NORISE twice, thereby losing to candidate a.

(54)

(mm) (L*H)] H_iL_i	LEXRT	IDFIN(T)	NORISE	ID(T)	T_iRT	T_iLT	TBU
☛ a. (m m)] | |\ \ L* L_iL_i H			*	*	*		
b. (m m)] | |\ \ L* HH_iL_i	*!		*				
c. (m m)] | |\ \ L* LH_iL_i	*!		*	*			
d. (m m)] | |\ \ L* H_iL_i H			**!		*		

As observed in section 3.5, the tonal specification of winning candidate d. is equivalent to L^*L_iH, it being meaningless to repeat information (cf. TWIN SISTER CONVENTION, Clements & Keyser 1983). The maximum number of tones associated to a final TBU is thus two, while the maximum for a nonfinal TBU is one. Constraint *CROWD is therefore violated in final moras, in deference to MAX(T), which outranks it. An output in which the first mora rather than the second mora of the final syllable has two tones associated to it is ruled out by ALIGNT_iRT, which penalises gratuitous non-rightmostness. There are of course further conceivable outputs for this form, for instance those in which the boundary tones do not associate to a mora, but are only aligned with the phrase end. All of these are ruled out by ALIGNLEXRT.

Finally, there is the final focused 'Declarative' contour to account for, given in (16a), repeated here as (55).

(55)

[Is d'r get gebeurd mit dien BEIN?^{I}]
| | |\
L_i L* H_iL_i

Our account forces us to assume that the boundary sequence H_iL_i here fails to associate to the final TBU. Constraint NORISE was taken to be violated if the rising movement was defined on the last mora of a syllable. In the correct a-candidate in Tableau (56), NORISE is satisfied, because H_i does not have an association with a TBU. That is, the b-candidate is to be rejected on theory-internal evidence, there being no empirical phonetic predictions to be derived from the different representations. The final focused 'Interrogative' syllable with Accent I, then, provides additional theory-internal evidence for the need to separate the alignment of tones from the association of tones to TBUs.

(56)

(m m) (L*)]H_iL_i	NoRise	Max(T)	Id(T)	Align(T_i,RT)	Align(T_i,LT)	TBU
☛ a. (m m)] | /| L* H_iL_i					*	*
c. (m m)] | | | L* H_i L_i	*!					
b. (m m)] | | | L* L_i L_i			*!			

6. Conclusion

A characterisation of the surface intonational patterns of Roermond Dutch requires an account of a number of phonological adjustments of the underlying representations (our four generalisations). One result of our treatment is that a derivational description is not available. The reason for this appeared to be that the rules that express the two most important generalisations, the assimilation of H to L after L* (Generalisation 2) and the infixation of the boundary tones of the intonational phrase (Generalisation 4) (or H-ASSIMILATION and METATHESIS), would have to apply in different orders in different forms to obtain the correct output, an ordering paradox which is inconsistent with the premise that rules apply in the same order to all forms.

A description in the framework of OT was shown to give the desired outputs. We adopted the position of Beckman (1997), who argues that faithfulness constraints can be sensitive to locational information, such that faithfulness is valued more highly in more privileged phonological positions than in less privileged ones, where order of 'privilege' is universally given. Our analysis has yielded at least two interesting results. First, we characterised spreading as the simultaneous satisfaction of two alignment constraints with opposite directions. The distinction between boundary tones that undergo leftward spreading to the focal syllable and boundary tones that do not was put at the door of the interaction with other constraints, notably NORISE, when L* appeared in a syllable with an empty second mora, and *CROWD, when no free mora was available in the focal syllable.

Moreover, we reproduced the representational difference drawn by Pierrehumbert & Beckman (1988) between association to the prosodic constituent node and association to a TBU by assuming that an alignment constraint makes a purely string positional demand on a tone and that the association with a TBU is enforced by a separate association constraint like TBU. This enabled us to explain the pattern of boundary tone infixation given as Generalisation 4. The facts yielded to a

natural analysis in which two alignment constraints seek to place their tones in the same location, with one of them winning. This conception of competing constraints makes the infixation appear as a very ordinary consequence of the organisation of the grammar. That is, OT not only makes a description available at all, it also in a sense explains how this situation can arise.

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Notes

[1] A map with the approximate geographical distribution of the tonal opposition is given in Gussenhoven & Bruce (1999).

[2] The OT use of the term 'alignment' should be kept distinct from the term referring to the phonetic timing of tonal targets relative to anchor points in the syllable, like the voice onset or the sonorant rhyme offset.

[3] There is probably also a good deal of variation, both across speakers and within speakers. Some speakers of the closely related dialect of Montfort, for instance, pronounce certain monosyllabic words (e.g. [tuː] *toe* 'closed') with Accent II in nonfinal position and with Accent I in final position (Bakkes 1996:52).

[4] The 'Continuative' intonation, typically used for nonfinal intonational phrases, is the same as the 'Interrogative' intonation with the exception of the pitch on focused phrase-final syllables with Accent II, which have a fall to mid rather than a fall-rise. This difference is most probably to be attributed to a phonetic implementation rule which is sensitive to the utterance boundary, where the utterance is the prosodic constituent dominating the intonational phrase.

[5] A bitonal HL boundary sequence is also used for interrogative intonation in Bengali (Hayes & Lahiri 1991) as well as in Greek, Hungarian and Romanian (Ladd 1996).

[6] The 'star' is here used to indicate the morphological category 'focal' tone. Its more conventional task is that of indicating the aligning tone in a bitonal pitch accent (Pierrehumbert1980).

[7] Tones that do not have an association with either the TBU or higher-level constituents may still survive. Bruce (1987 cf. also Gussenhoven & Bruce 1999) show that the focal H of Stockholm Swedish does not have either type of association, but nevertheless surfaces. This is illustrated in examples (1) and (2), where the focus-marking H is shown as 'floating'. The main motivation for this representation is that the tone does not align consistently with a specific location in the prosodic or segmental structure. Rather, its location is determined by the distance to the preceding lexical H (and is therefore later after Accent I than after Accent II), and, in the case of a phrase-final word, by the distance to the end of the intonational phrase. The constraint MAX(T) is satisfied if the tone is realised, regardless of its association.

[8] Again, this constraint is one of a number of increasingly restrictive versions of the TBU, running from any moraic segment to moraic segments in focused syllables only. Our data do not allow us to answer the question if sonorant moras in final unstressed syllables are TBUs in Roermond. The assumption is that they are not.

[9] A conceivable output form in which H_i and L_i are split up so as the allow the lexical H to come between them can be ruled out by the assumption that the tones of multi-tonal morphemes are edge-aligned with each other, or by the constraint CONCAT(enate), proposed by Riad (1996) in his treatment of Scandinavian tone.