8 Vowel Duration, Syllable Quantity, and Stress in Dutch

Carlos Gussenhoven

8.1 Introduction

A persistent conundrum in the analysis of Dutch word prosodic structure has been
the fact that closed syllables require a foot head, while long vowels apparently fail
to project a foot (van der Hulst 1984; Kager 1989, 261; Zonneveld et al. 1999, 499;
among others). This type of selective quantity sensitivity is highly marked: in other
quantity-sensitive languages, long vowels are heavy (bimoraic), and will be in a
stressed syllable (type A), while in addition such languages may require closed sylla-
bles to be heavy, and be stressed (type B). The latter option was termed weight-by-
position by Hayes (1989a). In (1), this well-known typology is given.

(1) Type A Type B ?Dutch
   a. Short vowel (V) μ μ μ
   b. Long vowel (VV) μ μ μ μ
   c. Closed rhyme (VC) μ μ μ μ

There have been three responses to the apparent quantity-weight mismatch in
Dutch. First, Lahiri and Koreman (1988) proposed that weight and quantity are rep-
resented separately: while weight is counted in moras, quantity is counted in X-slots.
As a result, the light long vowels of Dutch can be represented as having one mora
dominating two X-slots. Second, Kager (1989, 261) suggested that weight, which in
other languages is determined by the branchingness of the syllable peak (short vowel
versus long vowel, diphthong, short vowel plus C) is determined by “melodic com-
plexity,” or the number of segment root nodes associated with moras after the first
mora in the rhyme (light monophthong versus heavy diphthong or VC). A third re-
response is that by van Oostendorp (1995), who assumes that so-called long vowels are
not in fact represented as long, but differ from short vowels in lacking the vocalic fea-
ture [lax]. The specification of the duration of Dutch vowels will, in his view, be pro-
vided during the phonetic implementation.
It is argued that none of the above responses is tenable, and that the solution lies in a reevaluation of the phonetic facts. Unlike what is generally assumed, the long tense vowels of Dutch are only longer than short lax vowels in stressed syllables— that is, in the head of the foot. This suggests that Dutch stressed syllables are bimoraic, while unstressed syllables are monomoraic. The dependence of vowel length on stress will allow us to assume, with van Oostendorp (1995), that there are no underlying moraic representations for Dutch syllables. Bimoricity (and restricted occurrences of trimoricity) are the result of (i) WEIGHT-BY-POSITION (the projection of moras by coda consonants) or (ii) STRESS-TO-WEIGHT (a bimoricity requirement on stressed syllables). Thus, in the analysis presented here quantity plays a major part in the phonological representation of Dutch vowels, unlike van Oostendorp’s (1995, 1997) analysis, which assumes mora-less surface representations as well as mora-less underlying representations. It will be shown that moraic representations of vowels are in fact part of the lexical phonology of Dutch, and that a description of Dutch word prosodic structure is impossible if the moraic structure is left unspecified.

In section 8.2, some new facts about Dutch vowel duration are given, together with a brief description of the experiment that yielded them. Section 8.3 shows that vowel quantity is partly determined in the lexical phonology, and that the specification of quantity cannot be left to the phonetic implementation in the sense of van Oostendorp. Section 8.4 describes the regular stress patterns of Dutch, drawing on the analyses in Nouveau 1994 and van Oostendorp 1997, while section 8.5 shows that the success of this description crucially depends on the correct analysis of the moraic structure of Dutch words, including the part before the main stress. A conclusion is offered in section 8.6.

8.2 Duration and Distribution of the Vowels of Dutch

Table 8.1 lists the vowels of Dutch that can appear in a stressed syllable nucleus (e.g., Moulton 1962; Gussenhoven 1992; Booij 1995). There is a set of lax, short vowels, a set of tense vowels of which the [-high] vowels are long, a set of tense or lax, oral or

<table>
<thead>
<tr>
<th>Short (lax)</th>
<th>Long or short (tense)</th>
<th>Long</th>
<th>Diphthong</th>
</tr>
</thead>
<tbody>
<tr>
<td>i, y</td>
<td>i, y, u</td>
<td>i: y, u:</td>
<td></td>
</tr>
<tr>
<td>e, æ</td>
<td>e: ø, o:</td>
<td>e: ø: e:, o:</td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>a:</td>
<td>æi, õ: æi, øy, æu</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>æi: ø: æi, øy, æu</td>
<td></td>
</tr>
</tbody>
</table>

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nasal, long “marginal” vowels, which only occur in recent loans and onomatopoeic words, and finally, there are three diphthongs, as shown in table 8.1. The vowel [aː] (not listed) only appears in unstressed syllables.

The heaviness of VC-rhymes is not obvious, but can be seen in trisyllabic words. Dutch has quantity-sensitive trochees, built from right to left. The atypical “fact” that closed syllables are heavy and long-voweled open syllables light can be seen by comparing words of the type *almanak* ‘almanac’ with words like *Gibraltar* (the proper name). Both of these have a closed final syllable, but they differ in the structure of the penult. The closed penult attracts stress, leading to [xi'braltar], while the open penult is regularly skipped, causing main stress on the antepenult. The above interpretation of vowel quantity thus gives rise to the belief that long vowels, like [aː] in [ulmaː,nak], are light, even though closed syllables are heavy.

In reality, the duration of [eː,øː,oː,aː] in unstressed positions is equivalent to that of short vowels. Using reiterant speech, Rietveld, Kerkhoff, and Gussenhoven (2004) investigated the duration of [aː] and [i] in a large number of word prosodic contexts. While [i,y,u] are tense and have the same distribution as “long” tense vowels, their duration happens to be identical to that of short lax vowels: the vowels of [zit] ‘sit’ and [zit] ‘see-3sg’ have equivalent durations, which may be only 50 percent of the duration of the vowel in [zaːt] ‘seed’ (Nooteboom 1972, 66). To identify the prosodic positions in which the duration contrast between short [i] and long [aː] is made, nine word prosodic patterns were identified, between them covering all word prosodic positions. (Effects of codas on vowel duration were left out of account.) Word stress (as opposed to secondary stress), stress (as opposed to no stress), serial position (initial, nonperipheral, and final syllable in foot, and final foot in word) were each shown to have an effect on the duration of each of the two vowels. A list of words illustrating these patterns is given in (2), where S = word stress, s = secondary stress, and w = unstressed.

(2) *roːdoːdendran*  s w S w ‘rhododendron’
    *paːraːdeis*  s w S ‘paradise’
    *paːsif'kaːsi*  s w w S w ‘pacification’
    *loːkoːmoːtif*  s w S ‘locomotive’
    *mini(,maːli'zaːsi*  s w s w S w ‘minimalization’
    *'olifant*  S w s ‘elephant’
    *'oːli,faŋtʰ*  S w s w (derived word) ‘elephants’
    *pi'raːt*  w S ‘pirate’
    *pi'jaːno*  w S w ‘piano’

To exclude confounding segmental factors, the experiment made use of reiterant CV syllables, as produced by four speakers, with alternating occurrences of two out
of the three consonants /k/, /s/, /m/ for the C-position, in all possible permutations. Because the reiterant words were pronounced in a carrier sentence of the type \textit{Ik DOE} (. . .) \textit{niet}, ‘I do (. . .) not’, where the word \textit{doe} was realized with a pitch accent, the data abstract away from accentual lengthening and utterance-final lengthening (Cambier-Langeveld 2000). Forty-eight (12 reiterant versions \times 4 speakers) realizations were obtained for each of the nine prosodic patterns. The results showed that there was never a significant difference between the durations of the two vowels in positions outside the foot head, while occurrences of [a:] in the foot head were significantly longer than [i]. The contexts in which a significant duration contrast was absent included the word-initial syllable immediately before the word stress, as well as the word-final syllable immediately after the word stress—for example, in the first and last syllables respectively of [pr'ja:no] ‘piano’.

8.3 Making the Moraic Structure Reflect the Phonetic Facts

Since phonological representations of vowel quantity are reflected in phonetic duration (Duanmu 1994; Hubbard 1995; Broselow, Chen, and Huffman 1997), it is proposed that the “long” vowels in the second column of table 8.1 are bimoraic in stressed position and monomoraic in unstressed position. Thus, from now on, a word like \textit{piano} will be given as [pi'ja:no]. This suggests, first, that Dutch ranks a \textit{Stress-to-Weight Principle} (SWP) (3) high, and second, since closed syllables attract stress, that it also ranks a \textit{Weight-to-Stress Principle} (WSP) (4) high.

(3) \textit{Stress-to-Weight Principle} (SWP)

Foot heads are (minimally) bimoraic.

(4) \textit{Weight-to-Stress Principle} (WSP)

Bimoraic syllables are foot heads.

WSP is not only relevant to closed syllables. As observed by Zonneveld (1993), the truly long vowels (see table 8.1, third column) do not tolerate being in an unstressed position: \textit{(Rio de) Janeiro} [z'a'ne;iro], *[z'a'ne;iro]. Nor could the diphthongs (see table 8.1, fourth column) appear in unstressed penults: \textit{Khomeiny} [ko'meini], *[ko'meini]. The truly long vowels must thus be represented in the lexicon with two moras, while diphthongs are bimoraic by virtue of the fact that they contain two segments in the nucleus. These facts are consistent with Dutch being an unexceptional “type B” language. Broselow et al. (1997) assume a default markedness constraint \textit{SylMon} (5), whereby syllables are monomoraic (cf. \textit{NoLongVowel} in Kager, chapter 17, this volume). This constraint will make “long” vowels short in weak positions.

(5) \textit{SylMon}

Syllables are monomoraic.
Tableau (6) illustrates how these constraints characterize [ba:ta] as the correct form of the brand name Bata. The trochee, assumed in (6), causes the first vowel to be bimoraic by SWP, while the weak syllable defaults to a monomoraic [a], since bimoraic [a] in weak position violates WSP.

<table>
<thead>
<tr>
<th></th>
<th>bata</th>
<th>WSP</th>
<th>SWP</th>
<th>SYLMON</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ('ba:ta)</td>
<td>*</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. ('bata)</td>
<td>*!</td>
<td></td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>c. ('ba:ta)</td>
<td>*!</td>
<td></td>
<td>**</td>
<td></td>
</tr>
</tbody>
</table>

The bimoricity of syllables with short lax vowels is due to the following tautosyllabic consonant, which is obligatory in this context. Constraint LAX+C (cf. (7)), a reformulation of part of a constraint proposed by van Oostendorp (1995), requires a lax vowel to be monomoraic and be followed by a consonant in the same syllable. The moricity of the coda consonant is ensured by high-ranking WEIGHT-BY-POSITION (WbP), given in (8) (Hayes 1989).

(7) LAX+C

(8) WEIGHT-BY-POSITION (WbP)

As shown by van der Hulst (1985), a consonant after a short lax vowel is ambisyllabic in Dutch if it is required to be in the onset of the next syllable by ONSET (9). For instance, a word like Hetty (a proper name) has an ambisyllabic [t], transcribed [t.t].

(9) ONSET

In (10), SWP $\succ$ SYLMON, together with ONSET, causes the [t] to be ambisyllabic, and the first syllable to be bimoraic as a result. Lengthening of [e], as in candidate (10c), is correctly prevented by LAX+C.
Our account does not so far explain why words like [laːt] ‘late’ have long vowels: the bimoricity of the syllable would already be guaranteed by the coda [t]. It is suggested that the long tense vowel in these forms results from the effect of a constraint that maximizes the sonority of the syllable peak. The bimoricity of tense vowels before a tautosyllabic consonant is thus unrelated to the prosodic status of the syllable. The relevant constraint, given as SONPeak (11), can be seen as part of the family of HNuc (Prince and Smolensky 1993, 134). SONPeak must be ranked below Lax+C, to prevent short lax vowels from lengthening.

(11) * SONPeak

\[ \mu \]
\[ [\neg \text{cons}] \]

Constraints Onset, WSP, and SWP are irrelevant in tableau (12), which shows the crucial ranking Lax+C ≫ SONPeak

Finally, the diphthongs (column 4 of table 8.1) and the truly long (marginal) vowels will behave like long vowels: both elements of the diphthong are [\neg \text{cons}]. If these long vowels are lax, they escape shortening by Lax+C because of high-ranking FaithMora (13), which preserves the lexical mora structure.
FaiMora
Preserve mora structure.

The rankings FaiMora \(\gg\) Lax\(+\)C, and Lax\(+\)C \(\gg\) SonPeak \(\gg\) SyLMon, together with Onset and WSP/SWP, account for the moraic structure of Dutch vowels, with the exception of short tense [i,y,u], which are short even in stressed position. In the next section we will see how the quantity of these vowels must be accounted for in the lexical phonology, which provides us with an argument for rejecting the (implicit) assumption of van Oostendorp (1995) that the duration of Dutch vowels is purely a result of the phonetic implementation.

8.3.1 Short Tense Vowels
The quantity of Dutch [i,y,u] is determined by the segmental context: they are long when appearing before [r] in the same foot (Gussenhoven 1993). In (14), words in which [i] appears before [r] in the same foot are compared with words in which this vowel appears in prosodically identical words, but in which it is not followed by [r].

   b. Olivier [o:li:ri:] ‘Oliver’ kolibri [ko:li: bri:] ‘kolibri’
   e. fakir [fa:ki:r] ‘fakir’ kieviet [ki:viet] ‘peewee’

When [r] is in the next foot over, the high vowels are short, as in piraat [pi:ra:at] ‘pirate’, corduroy [ko:rdy,ra:r] ‘corduroy’, admiraal [a:tmi:ra:l] ‘admiral’. The constraint HighV-\(\mu\) (15) reflects the widespread tendency for high vowels to be shorter than nonhigh vowels. The relatively short distance between the tongue body and the roof of the mouth explains this effect (see Laver 1994, 435).

(15) HighV-\(\mu\)
High vowels are monomoraic.

To ensure that [i,y,u] are long before [r] in the same foot, we postulate Pre-\(r\)-\(\mu\) (16). The articulatory motivation for this constraint is probably to be found in the conflict between a vocalic tongue posture (a convex dorsum and a tongue blade curling down into the lower jaw) and the tongue posture for a coronal [r], for which the front is held in a concave shape behind a tongue tip that curls up. The articulatory transition from a vocalic posture to that required for [r] will thus be more elaborate than a transition to the position for postvocalic [t,s,n,l], for which the front of the tongue may, but need not be concave. Evidently, Pre-\(r\)-\(\mu\) \(\gg\) HighV-\(\mu\), for otherwise high vowels could never be bimoraic in Dutch.

(16) Pre-\(r\)-\(\mu\)
Tense vowels are bimoraic before [r] in the same foot.
Tableau (17) shows how this works for short and long occurrences of high tense vowels. Candidate aiii, in which the intervocalic onset consonant is ambisyllabic, is ruled out by \textsc{SonPeak}, which for this reason must be ranked above WSP/SWP. That is, we cannot satisfy SWP by filling a second mora with the following [t].

<table>
<thead>
<tr>
<th></th>
<th>rita</th>
<th>Pre-r-µ</th>
<th>HIGHV-µ</th>
<th>SonPeak</th>
<th>WSP/SWP</th>
<th>SylMon</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>‘ri.ta</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>‘ri.ta</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>‘rit.ta</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td></td>
</tr>
</tbody>
</table>

(17) b.

<table>
<thead>
<tr>
<th></th>
<th>xiro</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>‘xi.ro</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>‘xi.ro</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>‘xir.ro</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td>!</td>
<td></td>
</tr>
</tbody>
</table>

I give the constraint rankings established so far, with the generalizations they account for:

\textbf{WSP/SWP} \gg \textbf{SylMon}: Stressed syllables are bimoraic, unstressed syllables monomoraic.

\textbf{Pre-r-µ} \gg \textbf{HIGHV-µ}: High tense vowels are long before [r] in the same foot, but short otherwise.

\textbf{Lax+C} \gg \textbf{SonPeak}: Lax vowels are short, despite their occurrence in bimoraic syllables, and thus must be followed by C in the rhyme (or do not maximize a lax vocalic peak).

\textbf{SonPeak} \gg \textbf{SylMon}: Tense long vowels are long even before a coda C (or do not minimize moraic structure at the expense of a vocalic peak).

\textbf{SonPeak} \gg \textbf{SWP}: Do not make consonants ambisyllabic merely to have bimoricity in stressed syllables.

\textbf{Faithmora} \gg \textbf{Lax+C}: Do not shorten long lax (marginal) vowels.

\textbf{8.3.2 Why Vowel Duration Is Represented in the Phonology}

At this point it might be objected that the durational phenomena we have dealt with could be accounted for in the phonetic implementation. Specifically, the question arises of whether we couldn’t have a single articulatory instruction, to be carried out with reference to a phonological representation without quantity distinctions, which says: “make nonlax vowels long when stressed or followed by a tautosyllabic conso-
nant, but not when they are high, except when [r] appears in the same foot.” This

course of action is unavailable, however, because the quantity of high tense vowels

is subject to a lexical process. Crucially, this means that moraic structure must be

represented in the lexical phonology.

There are five irregular past-tense forms that have short [i] before [r] in the same

foot. In (18), an example is given.

(18) wierp [virp] ‘threw’ (cf. vier-t [fi:rt] ‘celebrate+3SG-PRES’)

As Booij (1995, 94) points out, these forms end in a cluster of [r] and a labial obstru-

ent, while no other words do. A phonological account that exploits this observation

might assume, first, that all coda consonants project a mora, except postconsonantal

[t,s], and second, that there is a constraint *μμμμ (19), undominated in Dutch, dis-

allowing tetramoraic syllables. The first assumption is widely supported in work on

Dutch phonology (see Booij 1995, 26). The second is evidently supported by the ty-

pology of quantity, trimoraic syllables already being rare.

(19) *μμμμ

Syllables are maximally three moras long.

As shown in (20), to represent wierp with a long vowel would mean violating undom-

inated *μμμμ. The form [fi:rt] escapes shortening, because coronal [t] fails to project

a mora. The correctness of this solution is underscored by examples like Ataturk

[‘a:t,a,yrk] ‘Ataturk’ and kirsch [kirs] ‘Kirsch’ (Paul Boersma, personal communica-

tion), which have short pre-[r] vowels, as expected under this analysis.

(20) a. * μ μ μ μ

b. μ μ μ

While these facts already look pretty phonological, the clinching reason why it is not

possible to translate the effect of *μμμμ into a phonetic implementation rule is that

the short [i] of the past-tense forms survives an inflectional affixation process that

removes the labial obstruct from the coda. The structure that arises can be com-

pared with phonologically underived forms, as in (21), to show that long [i] appears

in phonologically comparable contexts.

(21) a. wierpen [vir.pen] ‘threw+PLUR’

b. Kierkegaard [ki:r.ko:xa:rt] ‘proper name’

This means that vowel quantity differences are involved in lexical representations.

The facts of (21) are consistent with a lexical phonology version of Optimality

Theory (Kiparsky, forthcoming): wierp is subjected to the constraint grammar at

the stem level, and its output is evaluated as the input of the constraint hierarchy

at the word level, where the moraic structure specified at the stem level is preserved.
8.4 Dutch Stress

In this section, I consider the implications of our representation for a description of regular Dutch stress. The description essentially follows Nouveau 1994 and van Oostendorp 1997, but differs from these in that it describes the foot structure of the whole word, not just of the foot with main stress. I show that regular main stress cannot be satisfactorily described if the prosodic status of the section of the word before the main stress is ignored. Crucially, the assumption must be made that, in Dutch, quantity sensitivity is restricted to the right-hand part of the word, and that before the main stress WEIGHT-BY-POSITION is not in effect.

8.4.1 The Regular Stress Pattern

The basic facts about Dutch stress are summarized in (22) and (23) (van der Hulst 1984; Kager 1989; Nouveau 1994; van Oostendorp 1997; among others). The examples in (22) show the simplest case: main stress falls on the penult.

(22) a. a.'xaː.ta ‘Agatha’
    b. a.'man.da ‘Amanda’
    c. 'a:ɾɔn ‘Aaron’

Penultimate stress systematically fails to appear in three situations. First, it does not appear when the word is monosyllabic, as in (23a). Second, it is systematically omitted when the word is minimally trisyllabic, has an open penult and a final closed syllable, and word stress is on the antepenult, as illustrated in (23b). Third, as shown in (23c), superheavy syllables, which can appear in word-final position only, attract main stress.

(23) a. 'la: ‘drawer’
    'kot ‘cat’
    b. ma:ɾaːˌɔn ‘marathon’ (but: pa.'lem.ban ‘Palembang’)
    c. ət.mi.'ra:l ‘admiral’
    ˌle:ki.'kɔnt ‘bed’

A treatment in OT was presented by Nouveau (1994, 184ff.) and modified by van Oostendorp (1997). The present analysis differs from these earlier ones in that the representation of long vowels is bimoraic in stressed syllables, rather than monomoraic, but otherwise it essentially follows the older analysis in the characterization of regular main stress. All constraints are from Prince and Smolensky 1993 as well as McCarthy and Prince 1995 unless indicated otherwise.

In section 8.3, we already took the effect of RHYTHM-TROCHEE (24) for granted. NONFIN (25) is interpreted to ban main stress on the final syllable, as in Nouveau 1994, while F̂,RIGHT (26) will see to it that a foot with main stress is rightmost in the word.
(24) **RHYTHM Trochee**  
Feet are left-dominant.

(25) **NonFin**  
Main stress is not on the word-final syllable.

(26) **F,Right, or Align(Pw,Rt,Fs,Rt)**  
The right edge of the word coincides with the right edge of a strong foot.

**NoClash** (27) forbids adjacent stressed syllables (i.e., adjacent foot heads). High-ranking **NoClash** ensures that monosyllabic feet can only exist word-finally (see Gussenhoven 1993).

(27) **NoClash**  
Foot heads are not adjacent.

Finally, **FootBin** requires that feet are binary, either at the moraic level or at the syllable level. Violations are incurred by trisyllabic feet and monomoraic feet. In effect, because high-ranking **WSP/SWP** already weeds out all monomoraic foot heads, **FootBin**’s only role in our analysis is to ban ternary feet.

(28) **FootBin**  
Feet are neither monomoraic nor trisyllabic.

Cases like *Agatha*, with three open syllables, are derived straightforwardly: the winning candidate manages to obey all four constraints. Candidate (29b) is ruled out by **NoClash**, and forces the prestress initial syllable to be unfooted—that is, directly attached to the Pword node. This is in accordance with the finding in Rietveld et al. (2004) that no quantity contrast exists in such syllables. Candidates (29c–f) all founder on one of the other three constraints, as shown in tableau (29).

<table>
<thead>
<tr>
<th>axata</th>
<th>FOOTBIN</th>
<th>NoClash</th>
<th>NonFin</th>
<th>WSP/SWP</th>
<th>F,Right</th>
</tr>
</thead>
<tbody>
<tr>
<td>a' (xa:.ta)</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a:) (xa:.ta)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>' (a:.xa)ta</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a:.xa) (ta:)</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a:.xa) (ta:)</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a:.xa.ta)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The same result obtains if the penult is closed, as in [a.'man.da], the only difference being that the equivalents of candidates (29c,d) are taken out by **WSP** as well as **F,Right**. The ranking of **WSP/SWP** becomes critical in words with final closed
syllables. To stay with trisyllabic words, type (23b) (e.g., marathon) provides evidence that Dutch is quantity-sensitive, as shown in tableau (30). The winning candidate (30ai) violates $F_R$ (which ranks below WSP/SWP): it alone incurs no WSP/SWP violation, because both foot heads are bimoraic and the only weak syllable is monomoraic. Words like \['pa\text{-}lem\text{-}ban\] 'Palembang', which in addition have a closed penultimate syllable, incur WSP/SWP violations regardless of whether the main stress is on the penult or the antepenult (see candidates (30bi) and (30bii) in particular), and avoiding a violation in the penultimate syllable, as in candidate (30bi), is therefore pointless. The decision falls to $F_R$. Candidates (30aiv), (30biv), and (30bv) are excluded by NoCLASH. FtBIN is omitted, but will reappear in section 8.5.

<table>
<thead>
<tr>
<th>(30) a. maraton</th>
<th>NoCLASH</th>
<th>NonFIN</th>
<th>WSP/SWP</th>
<th>$F_R$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ('ma\text{-}ra)\text{(ton)}'</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>2. ma ('ra\text{-}ton)'</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
</tr>
<tr>
<td>3. ('ma\text{-}ra)ton)'</td>
<td>*</td>
<td></td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>4. (ma:) ('ra\text{-}ton)'</td>
<td>*!</td>
<td></td>
<td>!</td>
<td></td>
</tr>
</tbody>
</table>

b. palemban
g| (30b) palembang | NoCLASH | NonFIN | WSP/SWP | $F_R$ |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ('pa\text{-}lem)\text{(ban)}'</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*!</td>
</tr>
<tr>
<td>2. pa ('lem)\text{ban})'</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. ('pa\text{-}lem)\text{ban})'</td>
<td>*!</td>
<td></td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td>4. (pa:) ('lem)\text{ban})'</td>
<td>*!</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>5. (pa:) ('lem)\text{ban})'</td>
<td>*!</td>
<td></td>
<td>*!</td>
<td>*</td>
</tr>
</tbody>
</table>

Penultimate stress in disyllables with a closed final syllable is due to NoCLASH and NonFIN, both of which rank above WSP/SWP. In tableau (31), [\'a\text{-}ton\] shows that the language prefers incurring a WSP violation to violating NonFIN (see candidates (31a,b)).

<table>
<thead>
<tr>
<th>(31) a. aron</th>
<th>NoCLASH</th>
<th>NonFIN</th>
<th>WSP/SWP</th>
<th>$F_R$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ('a\text{-}ton)'</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. a ('ton)'</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. ('a\text{-}ton)'</td>
<td>*!</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>4. (a:) ('ton)'</td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To continue with the examples in (23), monosyllabic words (see 23a) have stress because of the constraint \( \text{LEX} \approx \text{PWD} \) (not given as a numbered item), which requires every morphological word to be footed. Superheavy syllables (see 23c) only occur word-finally. The relevant contextual constraint allowing this (“No trimoraic syllable unless at right word edge”) is here taken for granted. Superheavy syllables attract the word stress because trimoraic syllables are disfavored in weak positions, in the foot as well as in the word. This constraint, the \text{SUPERHEAVY-TO-STRESS-PRINCIPLE} (32), can best be seen as belonging to the same family as WSP—that is, as a stricter version of the latter (see Prince 1990). Nouveau (1994) and van Oostendorp (1997) achieve the effect of SHSP by postulating a degenerate or abstract final syllable for the final consonant, which makes these words escape the censures of \text{NONFIN}; the effect is that of final consonant extrametricality.

(32) \text{SUPERHEAVY-TO-STRESS PRINCIPLE} (SHSP)

Trimoraic syllables are strong foot heads.

Ranking SHSP above \text{NONFIN} will have the desired effect, as shown in tableau (33).

<table>
<thead>
<tr>
<th></th>
<th>kapital</th>
<th>NOCLASH</th>
<th>SHSP</th>
<th>NONFIN</th>
<th>WSP/SWP</th>
<th>F₃.RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(kaː.pi).'(taːl)'</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>' (kaː.pi). (taːl)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td>ka'(pi.taːl)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td>**</td>
</tr>
</tbody>
</table>

In this section, the following generalizations were achieved:

\( \text{LEX} \approx \text{PWD} \) undominated: Monosyllables have word stress.
\( \text{SHSP} \gg \text{NONFIN} \): Final superheavy syllables have word stress.
\( \text{NONFIN} \gg \text{WSP/SWP} \): No word stress on a final closed syllable in disyllables.
\( \text{NONFIN} \gg F₃\text{RIGHT} \): No word stress on a final closed syllable in trisyllables.
\( \text{WSP/SWP} \gg F₃\text{RIGHT} \): Trisyllables with final closed syllable and open penult have antepenultimate stress (i.e., do not make a disyllabic final foot with heavy weak syllable).

8.5 Whole-Word Foot Structure

The description of Dutch stress presented in the previous section would appear to be seriously challenged once words with closed initial prestress syllables like armada [ar'maːda] ‘armada’ are considered. If the attested candidate (34a) is disregarded for the moment, high-ranking NOCLASH would incorrectly characterize *[urma₃da],

\[ \text{armada'} \]
candidate (34c), as the optimal form. Candidate (34b) violates NoCLASH, and candidate (34c) violates NonFIN. The choice between candidates (34d) and (34e) would be decided by WSP/SWP, which will not tolerate an unfooted bimoraic syllable. Importantly, to characterize the attested candidate (34a) as optimal, we must remove the foot from the initial syllable, so as to satisfy NoCLASH, and declare it monomoraic, so as to satisfy WSP/SWP.  

(34)  

<table>
<thead>
<tr>
<th>armada</th>
<th>NoCLASH</th>
<th>NonFIN</th>
<th>WSP/SWP</th>
<th>Fₐ,RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. (ar).'(ma:da)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. (ar).'(ma:da)</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. (ar.ma).'(da:)</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. (ar).'(ma:da)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. (ar.m(a).da:)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The inevitable conclusion that closed word-initial prestress syllables are monomoraic in Dutch is supported by three independent arguments. The first is based on duration measurements. The best comparison we can make is with the first syllable of a word-initial weak foot. If, for example, the duration of [kən] in cantorij [ˌkanˈtiːrə] ‘church choir’ were to be shorter than that of [kən] in kantoren [ˌkɑntoˈrən], this would be strong evidence that kantoren has an unfooted first syllable, for if it were footed, it would either have to be equal in duration to the first syllable of cantorij, or, in view of the fact that there are widespread tendencies to shorten the foot head as more syllables occur in the foot, longer. In a production experiment with four speakers, it was consistently the case that the prestress syllable was shorter than the segmentally identical head of a disyllabic foot before the main stress (Elise Hofhuis, unpublished research). This is strong evidence that closed prestress syllables are not footed. The second argument was presented in Gussenhoven 1993 and concerns the fact that the Dutch intonational pattern known as the “chanted call,” which potentially produces a new pitch level on every postnuclear foot, systematically fails to produce such a pitch level on word-initial prestress syllables, whether closed or open, but may produce one on (binary) feet before the word stress. The difference would be brought out if cantorij and kantoren were to be used as second members in compounds, as in nepcantorij and nepkantoren, where nep ‘fake’ would be accented. Whereas can- could begin a second pitch level, kan- could not. The third argument is distributional. Monomorcity of the word-initial prestress syllable predicts that one type of segment should be systematically excluded there, namely, the “marginal” long vowels (see table 8.1, third column). Rhymes consisting of strings of dif-
ferent segments can be accommodated, however marked multiple association of seg-
ments with a single mora may be, as shown by *pneumatisch* [pnoæ.'ma:ti:s] ‘pneu-
matic’, which has a monomoraic diphthong in its first syllable, but the combination
of a single mora and a long vowel amounts to a contradiction in terms. Interestingly,
while words like *crémerie* [kreb.'ma:ri] ‘creamery’ can exist, in which [e:] occurs in a
foot head, words like *[fe:'tap.pæ] are impossible (cf. *étape* [e.'tap.pæ] ‘leg (sport)’). In
conclusion, not only open, but also closed word-initial prestress syllables are mono-
moraic and unfooted, as argued in Gussenhoven 1993, which explains the fact that
candidate (34a) is optimal.

8.5.1 Accounting for Monomoraic Closed Syllables

If closed word-initial prestress syllables are monomoraic, *Weight-by-Position*
(WbP)—the constraint that requires coda consonants to project a mora—must not
be operative in that syllable. In fact, to the left of the main stress there is little or no
evidence for the working of WbP at all (see Booij 1995, 106; Zonneveld et al. 1999,
504). Indeed, van der Hulst and Kooij (1992) proposed that main stress in Dutch
results from quantity-sensitive footing from the right, but that the rest of the word
is subsequently footed quantity-insensitively from the left.10 The weightlessness of
syllables before the word stress can be observed in words that contain a string of
three syllables prior to the main stress, of which the first is open and the second
closed. If the second syllable attracted stress, the three-syllable stretch would be real-
ized as an unfooted syllable followed by a binary foot. The words in (35) belie that
expectation: the secondary stress is on the first syllable.11

(35) *aristo*vratisch ‘aristocratic’, *decompo*stie ‘decomposition’, *enunci*atie
‘enunciation’, *evange*list ‘evangelist’, *emanci*patie ‘emancipation’, *identi*iteit
‘identity’, *paterna*listisch ‘paternalistic’, *potenti*eel ‘potential’, *protestan*tisme
‘protestantism’, *tubercu*losis ‘tuberculosis’

Evidently, quantity sensitivity only obtains in the stretch from the main stress to the
word end. Constraint WbP’ (36), a version of WbP which is confined to the stretch
beginning with the main stress, expresses this.

(36) WbP’

From the main stress onward, a coda consonant projects a mora.

The pattern illustrated in (35) suggests that Dutch ranks high *ALL-Ft-LEFT* (37),
a constraint that imposes a violation for every syllable by which the left edge of
any foot fails to coincide with the left edge of the word. With *PARSE-* (38), which
requires that syllables be parsed into feet, ranked above *ALL-Ft-LEFT*, exhaustive
footing is achieved (Prince and Smolensky 1993). Tableau (39) shows this for *enun-
ciatie*. The tableau dispenses with *NoCLASH, F,RIGHT, SHSP, and NONFIN*, which all
relevant candidates satisfy: the point is that the low ranking of generic WbP allows the second syllable to escape the censure of WSP/SWP, which, had it been bimoraic, would have had to be a foot head, causing candidate (39d) to be optimal. As it is, the competition is decided by ALL-Ft-LEFT, which the winning candidate (39a) best satisfies; the fact that the syllable [nyn] is in a weak position and therefore violates WbP is no longer relevant to the outcome.

(37) ALL-Ft-LEFT, or Align(Ft,Li;Pwd,Li)

The left edge of every foot coincides with the left edge of the Pword.

(38) Parse-σ

Syllables are parsed into feet.

(39)

<table>
<thead>
<tr>
<th>envensiasi</th>
<th>Foot Bin</th>
<th>WbP′</th>
<th>WSP/SWP</th>
<th>Parse-σ</th>
<th>ALL-Ft-LEFT</th>
<th>WbP</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. (e:nyn).si.'(a:si)</td>
<td></td>
<td></td>
<td>*</td>
<td>***</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. (e:nyn.si).'(a:si)</td>
<td>*!</td>
<td></td>
<td></td>
<td>***</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>c. e:nyn.si.'(a:si)</td>
<td></td>
<td></td>
<td>**<em>!</em></td>
<td>***</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>d. e(nyn.si).'(a:si)</td>
<td></td>
<td></td>
<td>*</td>
<td>**<em>!</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8.6 Conclusion

The present account of the duration of the vowels of Dutch, the moraic structure of its syllables, and its foot structure shows that Dutch is an unexceptional “type B” language: truly long vowels and diphthongs (see columns 3 and 4 in table 8.1) attract stress in the same way that closed syllables do. The reason the language has been characterized as atypically requiring long vowels to be light and closed syllables to be heavy is that earlier researchers failed to accommodate the fact that the long vowels concerned only acquire bimoricity (and thus length) as a result of their being in a stressed location, as determined by the regular foot structure of the language. By attributing their length to the working of STRESS-TO-WEIGHT, a phonetically realistic representation of vowel quantity has become possible. Moreover, there has been no need to represent [i,y,ui], which are short even in stressed positions, as bimoraic, either underlyingly or on the surface, as earlier analyses were forced to do. They are only long, and bimoraic, when occurring before [r] in the same foot.

Solutions to the special status of quantity sensitivity in Dutch provided by Lahiri and Koreman (1988) (separate representation of weight and length) and Kager (1989) (counting segments in the rhyme rather than moras) are thus rendered unnee-
necessary. My solution confirms the representation proposed by van Oostendorp (1995): underlyingly, the difference between [a] and [a:], for instance, is captured by including [lax] in the representation of the former vowel, and quantity is not present in underlying representations. However, it disagrees with van Oostendorp’s analysis in requiring moraic structure to be present in the surface representation, a position enforced by the fact that quantity differences are in part morphologically determined. Exceptionally long lax vowels (see column 3 in table 8.1) are accounted for by lexical specification of bimoricity, which is respected due to the high ranking of F\textsuperscript{aithMora}. Interestingly, as pointed out by Sharon Inkelas, this analysis correctly predicts that there are no exceptionally short tense vowels (other than [i,y,u]): marking [a] as monomoraic will not prevent this vowel from being long in stressed positions, due to SWP/WSP.

The relevance of moraic structure was further underscored by the foot structure of the word before the main stress foot, where crucially \textsc{Weight-by-Position} must be suspended. Failing to do so predicts incorrect main stress in words like ‘armada’, which contain a closed word-initial prestress syllable. My analysis demonstrates that it may be unwise to present analyses of part of the data representing some phenomenon, like the data for main stress, and ignore other parts, like the data for secondary stress and vowel duration.

Notes

I thank the audiences at the universities of Groningen, Constance, Leiden, Nijmegen, and Amsterdam (Free University), where earlier versions of this chapter were presented in 1998 and 1999, for their useful comments, in particular Geert Booij, Mirco Ghini, Haike Jacobs, Wouter Jansen, Aditi Lahiri, and Dominique Nouveau. René Kager, Aditi Lahiri, and Marc van Oostendorp commented on earlier drafts, thus allowing me to make various improvements. This chapter represents a revised version of the first half of a paper “Duration and Quantity in the Dutch Word” presented at the Conference on the Phonological Word in Berlin (ZAS), held October 24–26, 1997. The second half of the paper, on exceptional stress, will appear elsewhere.

1. The marginal nasal vowels (third column) are generally given without the length mark, but as Ton Broeders pointed out to me, they are in fact long.

2. \textit{Pace} Prince (1990), who argues that SWP does not exist, and that the tendency is for the heads of trochees to shorten, as in Hayes 1987. Prince admits that what looks like the effect of SWP may be seen in languages with dynamic stress. In fact, Dutch also has Trochaic Shortening, though it is variable and confined to disyllabic feet to the left of the main stress, as in [potli\textsuperscript{\textregistered}tik] or substandardly [p\textsuperscript{o}lo\textsuperscript{\textregistered}tik] ‘politics’. René Kager points out that an effect similar to SWP is obtained by H\textsc{NUC}, as shown in a handout to his Metrical Phonology class at the University of Utrecht of November 29, 1996: “The best main stress is the heaviest syllable.” As in van Oostendorp 1997 he assumes that length is coded by an underlying tenseness feature, while H\textsc{NUC} is held responsible for the bimoricity of main stressed vowels. His restriction to main stress equates the categorical occurrence of short vowels in unfooted syllables and in weak
syllables with syllables with secondary stress, leaving their (frequent) bimoricity unexplained. Also, no account of the quantity of [i,y,u] is given.

3. Trommelen and Zonneveld (1989) assume that [e:] is the surface form of underlying [ei] before [r], observing that the latter combination does not occur and that all occurrences of [e:] before a full-voweled syllable precede [r]. However, there are counterexamples in both directions: \textit{theta} [\lq\lq\theta\texttt{ta} \rq\rq\rq\textit{theta} and \textit{Teixeira (de Mattos)} [tek\texttt{seira}] (proper name).

4. Van Oostendorp also makes the complementary assumption that vowels that are not lax—that is, our “long” tense vowels—have no coda, in spite of the fact that they apparently do (e.g., \textit{laut} ‘late’). This assumption is not made here.

5. Zonneveld et al. (1999, 500) make the notion of such a phonetic implementation rule explicit, but they reject the analysis and go on to defend the solution presented in Lahiri and Koreman 1988.

6. The biblical name is often pronounced [a:\a:xn], as pointed out to me by Marieke Polinder.

7. Both Nouveau and van Oostendorp have a constraint that requires the main stress to be on the last syllable of the word, while the present analysis assumes a constraint aligning the main stressed foot with the right word edge. No crucial differences in coverage follow from this.

8. Unlike what is the case in English, where a closed word-initial prestress syllable is footed if it does not represent a Latin prefix (Chomsky and Halle 1968), in Dutch all prestress initial syllables, whether closed or open and whether or not they are prefixes, are unfooted (Gussenhoven 1993).

9. This word has a suffixal [ei], which attracts main stress; compare simplex [\texttt{seld\ae ri}] ‘celery’, which has the regular pattern of words with final heavy and penultimate light syllables (see section 8.3).

10. The notion of different directions for main stress assignment and secondary stress assignment already occurs in Booij 1983 with reference to Kenneth Pike’s work on Auca (though without differentiation for quantity sensitivity).

11. There are words like this that, in addition to the pattern exemplified in (35), may alternatively be pronounced with secondary stress on the second, closed syllable \textit{karakter\texttt{stiek}} ‘characteristic’, \textit{gerontolo\texttt{gie}} ‘gerontology’, \textit{appendi\texttt{tis}} ‘appendicitis’, \textit{electric\texttt{itie}} ‘electricity’, \textit{amon\texttt{tillado}} ‘amontillado’. A case for quantity sensitivity cannot easily be made on the basis of these words, all the more so since, as pointed out by Booij (1995, 106), there are words like \textit{pirater\texttt{ij}} [pi\texttt{ra:te\texttt{ri}}], which show that a light second syllable may have secondary stress. That example also shows that the situation is more complex, since the reason for the location of the secondary stress on the second syllable in this word would seem to be that [a] is open, more sonorous, than [i]; similarly, as pointed out by Haike Jacobs, the word \textit{caleidoscoop} [ka\texttt{li:do\texttt{sko:p}] ‘kaleidoscope’ illustrates that diphthongs can attract the foot in competition with [a] (cf. variable \textit{amontillado}).