Revisiting Dutch stress:
A bidirectional account of stress assignment through Optimality Theory

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Abstract

Dutch is commonly regarded an exception to typological findings with regard to stress assignment. It is thought to be a quantity-sensitive language, but one that considers closed syllables to be heavier than open syllables with long vowels. This thesis attempts to show how Dutch can be regarded a language that does fit these typological findings, namely through not assigning moras to coda syllables. By introducing a bidirectional approach of adding a "reduced" form to the realisation of each word and copying its phonological structure to the "distinct" (normal) form, the correct stress placement can be achieved, without the need to make concessions with regards to the output forms.

Keywords: Dutch, stress assignment, bidirectional phonology, Optimality Theory

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1 Introduction

It is widely assumed that stress assignment is decided by the setting of certain universal parameters. These parameters are the following: foot type, direction (of assigning feet), quantity-sensitivity, heavy-syllable classification, extrametricality and main stress assignment. For Dutch, these parameters are traditionally thought to be respectively set on: trochee, right-to-left, quantity-sensitive, closed rhyme, extrametrical, rightmost foot (Domahs et al., 2014). However, these settings have been the point of some debate. This thesis aims to mention various existing views on stress assignment in Dutch and ultimately provide a new solution that attempts to solve these issues more elegantly than previously suggested ones.

1.1 Heavy-syllable classification.

Heavy-syllable classification of closed rhymes (e.g. a rhyme with a coda, such as /la:t/ ‘late’, as opposed to /la:/ ‘drawer’) leads to a notorious problem in the classification of Dutch. It has been found that, typologically, all vowels carry a mora, whereas codas only do in certain languages (Hayes, 1989). This would lead to two possible situations: type A languages, in which only syllables with VV or V: (e.g. /lai/ or /la:/) are heavy, versus type B languages, where syllables with long vowels are heavy, as well as closed-rhyme syllables (both /la: and /lɑt/). This is problematic for Dutch, because long vowels seem to not require a foot head (e.g. the stressed syllable in a (bisyllabic) foot), while closed rhyme syllables do (Gussenhoven, 2000). This is illustrated when comparing /xi.ˈbrɑl.tɑr/ ‘id.’ to /ˈɑl.ma:.nɑk/ ‘manual’. The two syllable structures would respectively be CV.ˈCCVC.CVC versus ˈVC.CV:.CVC. In both cases, the syllable with VC rhyme (ignoring the final syllable) attracts the stress, even when they are in different positions of the word, regardless of whether the remaining syllable is CV or CV:. This strongly suggests that closed-rhyme syllables like VC are heavier than VV/V: rhymes in Dutch.

The Dutch case would then indeed create a new type, type C, where closed-rhyme syllables are heavy, while long vowels are not. This is visualised in Table 1.

	V rhyme	VC rhyme	VV rhyme
Type A	μ	μ	μ μ
Type B	μ	μ μ	μ μ
Type C	μ	μ μ	μ

Table 1: heavy-syllable classification types

Gussenhoven (2000) proposes a solution to this problem by showing that VV does project a foot head, but that many vowels are incorrectly presumed to be long (like the /a:/ in the above /ˈɑl.ma:.nɑk/). He argues that certain vowels are only long when they are stressed. This leads him to the conclusion that Dutch is, in fact, a type B language. This view will be further addressed later.

1.2 Extrametricality.

Another interesting parameter setting for Dutch is the extrametricality. Trommelen and Zonneveld (1999) describe the Dutch system as having a rule where closed final syllables are extrametrical, and superheavy syllables (rhymes consisting of three moras, like VVC or VCC) are not. Compare *alcohol* ‘id.’ /ˈɑl.ko.ɦɔl/ to *abrikoos* ‘apricot’ /a.bri.ˈkoʊs/, in the latter, the final superheavy syllable receives the main stress, whereas the final heavy syllable does not in *alcohol*. Because main stress is assigned to one of the three last syllables, this leads to the situation where the location of the unmarked stress is decided by the weight of the last three syllables:

- Words with an open final syllable have penultimate stress.
- Words with a closed final syllable and a light penult have antepenultimate stress.
- Words with a closed final syllable and a heavy penult have penultimate stress.
- Words with a superheavy final syllable have final stress.

However, when Domahs et al. (2014) compared the empirical data of stress assignment of Dutch trisyllabic words with a superheavy final syllable to experimental data, they found that the empirical data, collected in CELEX, assigned final stress in almost all cases (80%, with the other 20% on the antepenult). For the experimental data, which used non-words, this was only about 25% (in approximately 50% of the cases, antepenultimate stress was assigned). This might be dismissed as a consquence of comparing real words to non-words, but interestingly, the two sets of data consisted of different segmental structures: the empirical tokens consisted mostly of VVC or Vnt final syllable rhymes, whereas the experimental tokens consisted solely of VCC rhymes (excluding Vnt). Therefore, the authors logically suggest that there might be segmental-skeletal differences in the weight of certain syllables.

This is attested by Gordon (2006), who finds typological evidence of certain consonants (especially sonorants) adding more weight to a syllable than others. He also finds that VV universally has more weight than VC. This finding is very compatible with type A languages and does not necessarily oppose type B languages (table 1). It does, however, oppose the theory of a type C language. If we look back at the results of Domahs and colleagues, we find that Gordon's universal finding might also serve as (part of) an explanation: the VVC rhymes behaved consistently as superheavy, whereas VCC did not[i].

A potential addition to this difference between VVC and VCC is provided by Rosenthall and Van der Hulst (1999). They suggest that languages exist in which VC structures are normally considered heavy, but in some contexts, are light instead. They also argue the existence of the opposite: languages where VC structures are normally considered light, but contextually heavy. VC structures being contextually light can account for extrametricality, because if closed final syllables are contextually light, that would prevent them from attracting stress. This renders the term extrametricality redundant. It is important to note that they follow Hayes' (1989) initial claim that syllables can have a maximum of two moras. It has to be said that Hayes does admit that this claim is probably too strong, given evidence of languages like Dutch, where superheavy syllables have a different effect on stress than heavy syllables. But it is just this point that Rosenthall and Van der Hulst oppose, when they suggest that superheavy syllables are in fact heavy syllables followed by an extraprosodic consonant, as visualised by an example from Cairene Arabic, in Figure 1 (Rosenthall & Van der Hulst, 1999). This would facilitate the possibility to assign the main stress to the last foot, even when the language has a constraint against assigning main stress to the final syllable. It would then be the extraprosodic consonant that is regarded the final syllable.

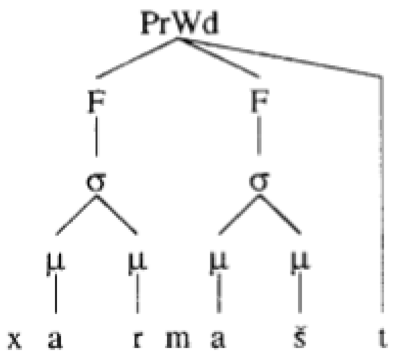

Figure 1: syllabification of [xarmášt]

1.3 Present thesis.

To recapitulate, the heavy-syllable classification of Dutch was regarded to be a very marked type C, different to the two standard types A and B (table 1). Revisiting Gussenhoven (2000), who suggests that Dutch is a type B language where VV and VC are both heavy, we can now see that an argument could be made that Dutch is, in fact, a type A language. Gussenhoven himself mentions that coda consonants in pre-stressed syllables in Dutch are light, and Rosenthall and Van der Hulst (1999) show that this can also be the case for final (non-stressed) syllables. If this theory is combined with Gussenhoven's point that certain vowels are only long when stressed, it is not unimaginable that Dutch is indeed a type A language. This brings us to the following research question: can Dutch be accounted for as a language where only vowels project a mora (i.e. as a type A language)?

In the following sections, Optimality Theory (OT) will first be introduced as the method of analysis. Afterwards, the aforementioned parameter settings will be formulated into OT constraints. Then, a step-by-step analysis of Dutch as a type A language will be made, gradually adding various constraints, while illustrating these in OT tableaus. Ultimately, a comprehensive account will have been given, which is then concluded and discussed.

2 Optimality Theoretic analysis

Optimality Theory (Prince & Smolensky, 1993) provides an excellent tool for the analysis of going from an input form to a phonetic output form, taking into account all the possibilities and, ultimately, selecting the most optimal candidate.

In this particular case, the input form is nothing more than the string of segments that forms the word. The output form is the phonologically optimal form which, after satisfying certain constraints, reflects the correct phonetic output form. This correct phonetic form is (partly) known, of course, and can therefore be checked on the basis of the placement of the stress.

2.1 Metrical constraints.

Looking back at the parameter settings from the introduction, we can formulate (in no particular order) many metrical constraints that ensure the workings of these settings (Gussenhoven, 2000; Prince & Smolensky, 1993; Rosenthall & Van der Hulst, 1999):

(1) Align(Pw,R,F’,R): assign a violation for every syllable that separates the right edge of the foot with main stress with the right edge of the prosodic word.

* ˈσ)#: assign a violation when the final syllable receives main stress.

*(σ): assign a violation for every monosyllabic foot.

*UNSTRESSED $\sigma_{\mu\mu}$: assign a violation for every underlyingly heavy syllable that does not receive main stress[ii].

*.σ.: assign a violation for every unparsed syllable.

*RHTYPE=I: assign a violation for every iambic foot.

*CLASH: assign a violation every time foot heads are adjacent.

The interaction and ranking of these metrical constraints is clearly shown in trisyllabic words consisting of only open-rhyme syllables, like *diploma* 'id.', as visualised in Tableau 1[iii].

(1) diploma	*CLASH	*UNSTRESSED $\sigma_{\mu\mu}$	* ˈσ)#	Align(Pw,R,F',R)	*.σ.
☞ a. diˈ(plo.ma)					*
b. (di)ˈ(plo.ma)	*!				
c. ˈ(di)(plo.ma)	*!			*	
d. ˈ(di.plo)ma				*!	*
e. ˈ(di.plo)(ma)				*!	
f. (di.plo)ˈ(ma)			*!		

As seen in Tableau 1, candidate a. is the winner in this ranking of constraints.

An important note here is that this word is, to some extent, a loanword in Dutch. It is not of Germanic origin, and can thus be regarded one. However, since Germanic words tend to have schwas in their unstressed syllables, these words are not very interesting for an analysis like the present one. Schwas cannot be stressed, and will therefore always play a very predictable role in the assignment of the main stress. For this reason, the words examined in this work will be (loan) words that have no (clear) underlying schwa. Because loanwords are also susceptible to a non-native stress pattern (namely the stress pattern of the source language), a later section will be dedicated to this phenomenon. Lastly, derivational words will also not be examined. About this it can be said that both members of compound words have their own stress patterns, and that affixation is also predictable: a common (Latin) prefix like *in-* will always bear stress in Dutch (*lopen* 'to walk' /ˈlo.pən/ versus *inlopen* 'to walk into' /ˈɪn.lo.pən/), whereas another common (Germanic) prefix like *ont-* /ɔntˈlo.pən/ never does. Because of this predictability, the changes (or lack thereof) to word stress will, at least presently, not be up for debate.

2.2 Moraicity.

With regard to syllable weight, which is arguably the most important thing when deciding between the various types in table 1, Sherer (1994) has proposes two constraints of which the relative ranking determines whether a language allows codas to be moraic or not.

(2) *μ/CONS: assign a violation for every moraic coda consonant.

*APPEND: assign a violation for every nonmoraic syllable appendix.

Consequently, a ranking of *μ/CONS above *APPEND will lead to a language where CVC is light (type A), and the reverse ranking will lead to a language where CVC is heavy (type B, or a language where CVC does not exist, which, in turn, could be prevented by ranking constraints on segment deletion higher). So, for a type A language, the tableau of a word like *Gibraltar,* with two closed syllables, would be the same as that of *diploma* from Tableau 1, with only open syllables. The winner would have an identical stress pattern. Tableau 2 shows *Gibraltar*.

(2) xibrɑltɑr	*CLASH	*UNSTRESSED $\sigma_{\mu\mu}$	* ˈσ)#	Align(Pw,R,F’,R)	*.σ.
☞ a. xiˈ(brɑl.tɑr)					*
b. (xi)ˈ(brɑl.tɑr)	*!				
c. ˈ(xi)(brɑl.tɑr)	*!			*	
d. ˈ(xi.brɑl)tɑr				*!	*
e. ˈ(xi.brɑl)(tɑr)				*!	
f. (xi.brɑl)ˈ(tɑr)			*!		

2.3 High vowels.

A group of words, like *radio* ‘id. ’, *alias* ‘id.’ and *Afrika* ‘Africa’, with an /i/ in the penultimate syllable, would be problematic with this set of constraints: this would incorrectly lead to penultimate stress, while these words should have antepenultimate stress. This can be solved with a minor change, namely the addition of the following constraint. This constraint stems from Gussenhoven (2000), who states that high vowels are monomoraic in Dutch. Combined with his account of stress-to-weight, this means that these vowels cannot receive stress, as they cannot be bimoraic. It is also typologically attested by Gordon (2006), who finds that there are numerous languages that never assign stress to syllables with high vowels (or [-low] vowels).

(3) *HIGH-V STRESS: assign a violation for every strong syllable with a high vowel.

Tableau 3 shows the interaction of this constraint with the previous constraints, leading to a different stress pattern than the one in Tableau 1. Because stress cannot be on the second syllable, the winning candidate is candidate e. (which has antepenultimate stress).

(3) radio	*CLASH	*UNSTRESSED $σ_{μμ}$	* ˈσ)#	*HIGH-V STRESS	Align(Pw,R,F',R)	*.σ.
a. raˈ(di.o)				*!		*
b. (ra)ˈ(di.o)	*!			*		
c. ˈ(ra)(di.o)	*!				*	
d. ˈ(ra.di)o					*	*!
☞ e. ˈ(ra.di)(o)					*	
f. (ra.di)ˈ(o)			*!			

While this rule works for many words in Dutch, there is a group of words in the language that does have stress on a high vowel (most commonly /i/). For this group, a different solution will be posed in a later section.

2.4 Antepenultimate stress.

These tableaus explain (most of the) trisyllabic words with penultimate stress and words with antepenultimate stress (as long as they have an /i,y,u/ in the penultimate syllable). Many questions still remain, however. What about antepenultimate stressed words that do not have these vowel qualities in the penultimate syllable? Words such as *alcohol*? Surely, with reasoning previously applied to *Gibraltar*, we would end up with penultimate stress. The quantity-sensitive accounts for Dutch would correctly end up with antepenultimate stress, but this paper aims to reject this account. Therefore, a different explanation is needed.

2.4.1 Empty heads.

Oostendorp (2012) points out that Dutch could in fact be regarded a *quality*-sensitive language instead of a quantity-sensitive language. He claims that there is no real distinction between light and heavy syllables. Rather, there is a distinction between syllables with an empty head, which are underlyingly reducible to a schwa-like quality, and syllables with a head that cannot be reduced. He forms the following rule: Syllables with an empty head should occur in the weak position of a trochee. I will formulate this as the following constraints:

(4) *STRESSED Ø-HEAD: assign a violation for every strong syllable with an empty head.

These constraints disallow an empty-headed syllable to be in the first position of a binary foot (which is the strong position, because of Dutch being a trochaic language) or to be in a monosyllabic foot. This way, syllables with an empty head cannot be stressed in Dutch. If unparsed empty-headed syllables are also disallowed, it is ensured that they will always take the weak position of a trochee. Perhaps redundant, but still worth noting, every prosodic word needs to also have at least one head. In other words: a word needs to have at least one foot. While this is, in essence, taken care of by the parsing constraint from (3), this constraint is not ranked very highly in Dutch. To ensure that every winning candidate will have (main) stress, the following constraint will be ranked the highest:

5) *FOOTLESS PW: assign a violation when a prosodic word has no feet.

2.4.2 Distinct and reduced forms.

The next question would be which sounds can be underlyingly reducible. Boersma (2011) introduces a programme for bidirectional phonology and phonetics. In its OT tableaus, multiple representations take place in every candidate position. Combined with certain constraints that judge the relation between these representations, the two representations can both be considered. The workings are illustrated in Tableau 4.

(4) | ɑlkoɦɔl |	*ə / $_{\#}$(_$_R$	*ə / ɦ_$_R$	*FULL VOWEL$_R$	IDENT$_{DR}$
a. /ɑl.ko.ɦɔl/$_D$ /əl.kə.ɦəl/$_R$	*!	*		***
b. /ɑl.ko.ɦɔl/$_D$ /əl.kə.ɦɔl/$_R$	*!		*	**
c. /ɑl.ko.ɦɔl/$_D$ /əl.ko.ɦəl/$_R$	*!	*	*	**
d. /ɑl.ko.ɦɔl/$_D$ /ɑl.kə.ɦəl/$_R$		*!	*	**
e. /ɑl.ko.ɦɔl/$_D$ /əl.ko.ɦɔl/$_R$	*!		**	*
☞ f. /ɑl.ko.ɦɔl/$_D$ /ɑl.kə.ɦɔl/$_R$			**	*
g. /ɑl.ko.ɦɔl/$_D$ /ɑl.ko.ɦəl/$_R$		*!	**	*
h. /ɑl.ko.ɦɔl/$_D$ /ɑl.ko.ɦɔl/$_R$			***!	

In the input we find the underlying form | ɑlkoɦɔl |. The candidates consist of two surface forms: a distinct one, and a reduced one. Various constraints stimulate or limit the amount of differentiation between the two. The IDENT$_{DR}$ constraint prevents any difference between the two, whereas the constraint against the usage of full vowels, which stems from the articulatory ease for a speaker, stimulates it. However, the reduction that would arise from this constraint is prevented in certain positions: in the first syllable without onset, following the onset /ɦ/, following /ŋχ/, following an /r/ that follows a diphthong and following a complex onset (specifically: a liquid following an obstruent) (Kager, 1990). These constraints can then be formulated for the reduced forms as follows:

(6)

*ə / $_{\#}$(_$_R$:	assign a violation for every reduced word-initial vowel.
*ə / ɦ_$_R$:	assign a violation for every reduced vowel following /ɦ/.
*ə / ŋχ_$_R$:	assign a violation for every reduced vowel following /ŋχ/.
*ə / V_iV_jr _$_R$:	assign a violation for every reduced vowel following a sequence of a diphthong and /r/.
*ə / $V_{Obs}V_{Liq}$ _$_R$:	assign a violation for every reduced consonant following a cluster of an obstruent followed by a liquid.

Without these structural constraints on the reduced form, naturally, there would only be candidate h., because there is no deviation between the two forms. But if we add the metrical constraints, including the one following from Oostendorp (2012), we find that a winner on the basis of high-ranked DR-constraints also leads to metrical differences. This is shown in Tableau 5 (next page), which compares winning candidate f. and candidate h. from Tableau 4.

Without the DR-constraints, candidate a. would have been the most optimal one, leading to penultimate stress. The inclusion of the DR-constraints, however, leads (correctly) to stress on the antepenult, shown in winning candidate k.

This explains the correct winning candidate for words like *alcohol*, where the last syllable starts with /h/. This then begs the question as to how this works for a similar word that does not have this same onset to a syllable. *Almanak* has the same stress pattern as *alcohol*, so only the second syllable should have a schwa in the reduced form. To ensure the correct winner, a new constraint has to be introduced.

Kager (1990) (as well as many others) states that lax vowels cannot occur in open syllables in Dutch. If a lax vowel is followed by an intervocalic consonant, this consonant is regarded to be ambisyllabic, in order to maintain the laxness of the vowel. Schwa, contrastively, can occur both in open and closed syllables. However, a crucial observation is that when schwa occurs in closed syllables, it already was a schwa underlyingly: /mu.dər/ 'mother', /wɔr.təl/ 'carrot'. So, (unstressed) vowels in open syllables can be turned into a schwa, but vowels in closed syllables cannot (schwa can occur there, but not when it is a full vowel underlyingly). There are some limitations to schwa occurring in open syllables as well. It seems that final open syllables are never reduced to schwa (no native speaker would say [ˈa.fri.kə] instead of [ˈa.fri.ka] for *Afrika* or [ˈanimə] instead of [ˈanimo] for *animo* 'id.'). Here, too, it can be stated that schwa can occur in this position of a word, but only when it was schwa underlyingly. Think of words that end in the suffix *-e* or *-isme* in Dutch: these suffixes end in a schwa[iv]. With regards

(5) | ɑlkoɦɔl |	*FOOTLESS PW	*ə/ #(_$_R$	*ə / ɦ_$_R$	*CLASH	*UNSTRESSED $σ_{μμ}$	* ˈσ)#	*HIGH-V STRESS	*FULL VOWEL$_R$	*STRESSED Ø-HEAD	Align (Pw,R,F’,R)	*.σ.	IDENT$_{DR}$
a. /ɑlˈ(ko.ɦɔl)/$_D$ /ɑlˈ(ko.ɦɔl)/$_R$								***!			*	
b. /(ɑl)ˈ(ko.ɦɔl)/$_D$ /(ɑl)ˈ(ko.ɦɔl)/$_R$				*!				***				
c. /ˈ(ɑl.ko)ɦɔl/$_D$ /ˈ(ɑl.ko)ɦɔl/$_R$								***!		*	*	
d. / ˈ(ɑl.ko)(ɦɔl)/$_D$ /ˈ(ɑl.ko)(ɦɔl)/$_R$								***!		*		
e. /ˈ(ɑl) ko (ɦɔl)/$_D$ /ˈ(ɑl) ko (ɦɔl)/$_R$								***!		**	*!	
f. /(ɑl) ko ˈ(ɦɔl)/$_D$ /(ɑl) koˈ(ɦɔl)/$_R$						*!		***			*	
g. /ˈ(ɑl) ko.ɦɔl/$_D$ /ˈ(ɑl) ko.ɦɔl/$_R$								***!		**	**	
h. /ɑlˈ(ko.ɦɔl)/$_D$ /ɑlˈ(kə.ɦɔl)/$_R$								**	*!		*	*
i. /(ɑl)ˈ(ko.ɦɔl)/$_D$ /(ɑl)ˈ(kə.ɦɔl)/$_R$				*!				**	*	*!		*
j. /ˈ(ɑl.ko)ɦɔl/$_D$ /ˈ(ɑl.kə)ɦɔl/$_R$								**		*	*!	*
☞ k. /ˈ(ɑl.ko)(ɦɔl)/$_D$ /ˈ(ɑl.kə)(ɦɔl)/$_R$								**		*		*
l. /ˈ(ɑl) ko (ɦɔl)/$_D$ /ˈ(ɑl) kə (ɦɔl)/$_R$								**		**!	*!	*
m. /(ɑl)ko ˈ(ɦɔl)/$_D$ /(ɑl) kə ˈ(ɦɔl)/$_R$						*!		**			*	*
n. /ˈ(ɑl) ko.ɦɔl/$_D$ /ˈ(ɑl) kə.ɦɔl/$_R$								**		**!	*!*	*

to the present topic, I will argue that lax vowels can never be reduced to a schwa. Additionally, I will posit that final open syllables also cannot be reduced to schwa.

(7) *[-tense]$_D$ ə$_R$: assign a violation every time a lax vowel is turned into schwa.

*V)#$_D$ ə)#$_R$: assign a violation every time a final open vowel is turned into schwa.

The relevant constraint is applied in Tableau 6 (there is no open vowel in this word, so the constraint final open vowel is not shown, for clarity).

(6) | ɑlmanɑk |	*V)#$_D$ ə)#$_R$	*ə / #(_$_R$	*[-tense] ə$_{DR}$	*FULL VOWEL$_R$	IDENT$_{DR}$
a. /ɑl.ma.nɑk/$_D$ /əl.mə.nək/$_R$		*!	*		***
b. /ɑl.ma.nɑk/$_D$ /əl.mə.nɑk/$_R$		*!		*	**
c. /ɑl.ma.nɑk/$_D$ /əl.ma.nək/$_R$		*!	*	*	**
d. /ɑl.ma.nɑk/$_D$ /ɑl.mə.nək/$_R$			*!	*	**
e. /ɑl.ma.nɑk/$_D$ /əl.ma.nɑk/$_R$		*!		**	*
☞ f. /ɑl.ma.nɑk/$_D$ /ɑl.mə.nɑk/$_R$				**	*
g. /ɑl.ma.nɑk/$_D$ /ɑl.ma.nək/$_R$			*!	**	*
h. /ɑl.ma.nɑk/$_D$ /ɑl.ma.nɑk/$_R$				***!	

The version of Tableau 5 for | ɑlmanɑk | would be identical to that of | ɑlkohɔl |, resulting in /ˈ(ɑl.mə).nɑk/. A question that arises after this is whether this theory also correctly selects the winner in words that were previously accounted for without use of the DR-constraints. A potential problematic word like that would be the word from Tableau 1: *diploma*. These are shown in Tableau 7.

(7) | diploma |	*V)#$_D$ ə)#$_R$	*ə / V$_{Obs}$V$_{Liq}$ _$_R$	*[-tense] ə $_{DR}$	*FULL VOWEL$_R$	IDENT$_{DR}$
a. /di.plo.ma/$_D$ /də.plə.mə/$_R$	*!	*			***
b. /di.plo.ma/$_D$ /də.plə.ma/$_R$		*!		*	**
c. /di.plo.ma/$_D$ /də.plo.mə/$_R$	*!			*	**
d. /di.plo.ma/$_D$ /di.plə.mə/$_R$	*!	*		*	**
☞ e. /di.plo.ma/$_D$ /də.plo.ma/$_R$				**	*
f. /di.plo.ma/$_D$ /di.plə.ma/$_R$		*!		**	*
g. /di.plo.ma/$_D$ /di.plo.mə/$_R$	*!			**	*
h. /di.plo.ma/$_D$ /di.plo.ma/$_R$				***!	

In Tableau 7, we find that candidate e. turns out to be the winner, which would indeed lead to stress on the penultimate syllable, which is the correct placement. However, candidate h. should win over candidate e., since no native speaker would turn the unstressed /i/ into schwa. Nor would this be the case for the unstressed /i/ in *timide* 'timid' /ti.ˈmi.də/, or in *pagina* 'page' /ˈpa.gi.na/. Looking at the other high vowels, it also seems very unlikely that /y/ and /u/ would behave differently: the city *Padua*, in Dutch mostly realised as /ˈpa.dy.ʊa/ would not be pronounced with an /y/ reduced to schwa, nor would this be the case for *Papoea* /ˈpa.pu.ʊa/ in *Papoea-Nieuw-Guinea* 'Papua New Guinea', or *burrata* 'id.' which is realised both as /by.ˈra.ta/ and /bu.ra.ta/ in Dutch. Therefore, I pose the following claim:

(8) *V$_{+high\ D}$ ə$_R$: assign a violation every time a high vowel is turned into schwa.

Adding this constraint leads to the correct winner in candidate h., as candidate e. is dismissed over it. Because the faithful candidate wins, we also reach the same surface form as previously, in Tableau 1. One common exception to this rule in (8) is the reduction of the /i/ in *minuut* 'minute', which is generally realised as /mə.ˈnyt/. One might even go as far as to argue that the unreduced realisation is so rare that the schwa might actually be underlying here, which would not make it an exception to (8).

2.5 Quadrisyllabic (and longer) words.

The stress assignment for words with four or more syllables is not that different from that for trisyllabic words. Most words consist of trochees built up from the right sight of the word, to satisfy the most important constraints. An example without underlying schwa would be *Colorado* 'id.' /ˌkɔl.o.ˈra. do/ (the /l/ is included as coda in the initial syllable, on account of the laxness of the vowel[v]), where the metrum consists of two trochees (the latter bearing the main stress). Other cases arise when the final syllable is not reducible to schwa, while the penultimate is. This can lead to antepenultimate stress. An example of this is the word *catalogus* 'catalogue' /ka.ˈta.lo.xʏs/. In order to reach the correct stress placement, another constraint needs to be introduced, one that was irrelevant for trisyllabic (or shorter) words.

Elenbaas and Kager (1999) formulate an anti-lapse constraint. This constraint prevents strong syllables from being too far apart (in essence, it is the counter to the clash constraint from (1), as that one prevents strong syllables from being too close). Specifically, they state that every weak syllable must be adjacent to a strong syllable or the word edge:

(9) *LAPSE: assign a violation every time a weak syllable is not adjacent to a strong syllable or the word edge.

(8) | kataloxʏs |	*LAPSE	*[-tense] ə $_{DR}$	*FULL VOWEL$_R$	IDENT$_{DR}$
a. /ka.ta.lo.xʏs/$_D$ /kə.tə.lə.xʏs/$_R$	*!		*	***
☞ b. /ka.ta.lo.xʏs/$_D$ /kə.tə.lo.xʏs/$_R$			**	**
☞ c. /ka.ta.lo.xʏs/$_D$ /kə.ta.lə.xʏs/$_R$			**	**
☞ d. /ka.ta.lo.xʏs/$_D$ /ka.tə.lə.xʏs/$_R$			**	**
e. /ka.ta.lo.xʏs/$_D$ /kə.ta.lo.xʏs/$_R$			***!	**
f. /ka.ta.lo.xʏs/$_D$ /ka.tə.lo.xʏs/$_R$			***!	*
g. /ka.ta.lo.xʏs/$_D$ /ka.ta.lə.xʏs/$_R$			***!	*
h. /ka.ta.lo.xʏs/$_D$ /ka.ta.lo.xʏs/$_R$			***!*	*

In Tableau 8, we can already see that, on the basis of the DR constraints, the candidates with two reduced syllables are the most likely winners (namely b., c. and d.). Note that, for clarity, the candidates that violate constraint of turning lax vowels into schwa are excluded. Additionally, it is noteworthy that the *LAPSE constraint is not a DR constraint, but it (indirectly) prevents candidate a., because this candidate leads to three adjacent weak syllables (as schwa cannot occur in a strong syllable).

If the metrical constraints are added, these candidates would respectively lead to the (reduced) forms /kə.təˈ(lo.XYS)/, /kəˈ(ta.lə)(XYS)/ and /(ka.tə) ləˈ(XYS)/. The winner of these would be the first one. However, the correct winner should be the second one. This can be ensured by slightly expanding on the *LAPSE constraint from (9):

(10) *Ø-LAPSE: assign a violation every time two syllables with empty heads are adjacent.

All of the above is shown in Tableau (9).

(9) | kataloXYS |	*Ø-LAPSE	*ˈσ)#	*FULL VOWEL$_R$	Align (Pw,R,F',R)	*.σ.	IDENT$_{DR}$
a. /ka.taˈ(lo.XYS)/$_D$ /kə.təˈ(lo.XYS)/$_R$	*!		**		**	**
b. /kaˈ(ta.lo)XYS/$_D$ /kəˈ(ta.lə)XYS/$_R$			**	*	**!	**
☞ c. /ka.ˈ(ta.lo)(XYS)/$_D$ /kəˈ(ta.lə)(XYS)/$_R$			**	*	*	**
d. /ka(ta.lo)ˈ(XYS)/$_D$ /kə(ta.lə)ˈ(XYS)/$_R$		*!	**	*	*	**
e. /(ka.ta)loˈ(XYS)/$_D$ /(ka.tə)ləˈ(XYS)/$_R$		*!	**		*	**

The irrelevant candidates and constraints are not shown again. Indeed, the *Ø-LAPSE constraint successfully prevents candidate a. from winning, leading to the correct winner in candidate c.

Similar stress placement can occur in words that end in a tense vowel as well, if there is an /i/ vowel in the penultimate syllable. This syllable is prevented from receiving stress by the

*HIGH-V STRESS constraint from (3). An example would be *cosmetica* ‘cosmetics’ /kɔs.ˈme.ti.ka/.

2.6 Lexical stress.

Some words do not follow the previously described patterns. This could work in multiple ways. Firstly, as mentioned before, some loanwords carry the stress pattern from their source language. Secondly, some segments might have some underlying qualities (for example, an /i/ could be underlyingly long, which makes it attract stress because the *UNSTRESSED μμ constraint dominates the *HIGH-V STRESS constraint). For words in one of these groups, stress or certain (vowel) qualities are determined lexically. The following sections will illustrate how lexically determined characteristics are shown in the underlying form, which, consequently, determines the winning candidate.

2.6.1 Loanwords.

Dutch has many loanwords from French that fall into the category that retains the stress pattern of the source language. In French, the final syllable always carries main stress, unless that syllable is a schwa. In this case, the schwa is either deleted or the stress moves to the penultimate syllable (Anderson, 1982). Take a word like *anarchie* ‘anarchy’. According to the Dutch stress pattern, the main stress would end up on the second syllable (through the constraint on final syllable stress, but also the constraint that prevents high vowels to receive stress): /ɑn.ˈɑr.xi/ , but the correct stress placement is on the final syllable: /ɑn.ɑr.ˈxi/. The unstressed syllables cannot be reduced here, so there is not much to say about the metrical structure. If we compare this to another word with French stress, like *chocola* ‘chocolate’, we either end up with a final stressed syllable in a monosyllabic foot, or as the strong syllable in an iamb. In order to get a better idea of the process, we ought to look at a quadrisyllabic word with French stress (without underlying schwas), like *fonologie* ‘phonology’. Its reduced Dutch realisation would be /ˌfo.nə.ləˈxi/. This suggests a trochee followed by an iamb, as will show in Tableau 10. The winning candidate is decided through the addition of a lexically indexed constraint.

(10) | fonoloxi^F |	FINAL IAMB^F	LAPSE*	*Ø-LAPSE	*CLASH	*ˈσ)#	*HIGH-V STRESS	*FULL VOWEL$_R$	Align (Pw,R,F',R)	*.σ.	IDENT$_{DR}$
a. /fo.no(loˈxi)/$_D$ /fə.nə (ləˈxi)/$_R$		*!			*	*	*			***
b. /fo.no(loˈxi)/$_D$ /fə.nə (loˈxi)/$_R$			*!		*	*	**			**
c. /fo.no(loˈxi)/$_D$ /fə.no (ləˈxi)/$_R$					*	*	**		**!	**
d. /foˈ(no.lo)(xi)/$_D$ /fəˈ(no.lə)(xi)/$_R$	*!						**			**
e. /(fo)ˈ(no.lo)(xi)/$_D$ /(fo)ˈ(no.lə)(xi)/$_R$	*!			*			***			*
f. /fo(no)(loˈxi)/$_D$ /fə(no)(loˈxi)/$_R$					*	*	***!			*
☞ g. /(fo.no)(loˈxi)/$_D$ /(fo.nə)(ləˈxi)/$_R$					*	*	**			**
h. /(fo.no)(loˈxi)/$_D$ /(fo.nə)(loˈxi)/$_R$					*	*	***!			*
i. /(fo.no)(loˈxi)/$_D$ /(fo.no)(ləˈxi)/$_R$					*	*	***!			*

This is a constraint that applies to a certain group of words that are lexically determined. In this specific case, the Dutch words, to which this French pattern applies, are denoted by a superscript F (for French). It is only these words that the constraint in (11) (marked with the same superscript) applies to. This mechanic is based on work by Pater (2009) on Yine.

(11) FINAL IAMB^{F}: assign a violation when the final syllable is not part of an iambic foot (only applies to words with a lexically determined French^{F} stress pattern).

Processes like these can happen for loanwords from any language. For example, Spanish loanwords like *tornado*, *armada* and *desperado*. Whereas *desperado* happens to not pose a problem (because of its four syllables), the other two words do. These words would end up with a reduced form of /tɔrnədo/ and /ɑrməda/ respectively, leading to stress on the antepenult. These words are, however, pronounced with penultimate stress. Underlyingly, these vowels (/a/ in all these cases) seem to not be reducible. This could be interpreted as an underlying property of these vowels, namely an extra mora. This will be shown in the following section.

2.6.2 Underlying moras

Some words (loanwords, but often names as well) can be underlying assigned an extra mora to attract stress. Examples of loanwords can be the Spanish words, mentioned before, but also a word like *analyse* ‘analysis’ /a.na.ˈliː.zə/, loaned from French. Where the constraint from (3), stating that high vowels cannot attract stress (which was already overruled in the previous French example), would rule out the surfacing of this form, the higher ranking of the constraint *UNSTRESSED $\sigma_{\mu\mu}$ requires it. If the underlying form shows this longer vowel (consequently with two moras), it will ensure the correct winner, as shown in Tableau 11 (only the relevant constraints are shown).

(11) | ɑnali:zə |	*UN-STRESSED $\sigma_{\mu\mu}$	*HIGH-V STRESS	*FULL VOWEL$_R$	Align (Pw,R,F',R)	*.σ.	IDENT$_{DR}$
a. /ɑn.aˈ(li:.zə)/$_D$ /ɑn.əˈ(li:.zə)/$_R$		*	**		**!	**
b. /ɑnˈ(a.li:)zə/$_D$ / ɑnˈ(a.li:)zə/$_R$	*!		***	*	*!*	**
c. /ɑnˈ(a.li:)(zə)/$_D$ / ɑnˈ(a.li:)(zə)/$_R$	*!		***	*	*	**
d. /ɑn(a.li:)ˈ(zə)/$_D$ / ɑn(a)ˈ(li:.zə)/$_R$		*	***!	*	*	**
☞ e. /(ɑn.a)ˈ(li: zə)/$_D$ /(ɑn.ə)ˈ(li:.zə)/$_R$		*	**		*	**

Where, in the case of Tableau 11, the vowel attracts stress because it is long, a vowel can also attract stress without surfacing as a long vowel. (Loan) words like *casino*, *bikini,* but also names like *Maria* and *Marina* show stress on the high vowel, while this one is not long like the one in *analyse*. In these cases, the underlying form needs to assign an extra mora for the vowel (attracting main stress), without it lengthening to a long vowel. This would also work for the Spanish words, as mentioned earlier. This process is illustrated in Tableau 12, for the word /ka.ˈsi.no/[vi].

(12) kasi$_{\mu\mu}$no	*CLASH	*UNSTRESSED $\sigma_{\mu\mu}$	* ˈσ)#	*HIGH-V STRESS	Align(Pw,R,F',R)	*.σ.
☞ a. kaˈ(si.no)				*		*
b. (ka)ˈ(si.no)	*!			*		
c. ˈ(ka)(si.no)	*!	*			*	
d. ˈ(ka.si)no		*!			*	*!
e. ˈ(ka.si)(no)		*!			*	
f. (ka.si)ˈ(no)		*!	*			

The reduced form is excluded for clarity, but its realisation would be /kəˈ(si.no)/, through the constraints on reducing the /i/ and the word final /o/.

2.7 Superheavy syllables

The point that remains is the account of type A (no mora assigned to codas) for superheavy syllables. There are two types of heavy syllables: VVC/V:C and VCC. The first type is easy to explain for any account. The syllable carries two vowel segments, and is therefore stressed, through the high-ranked constraint *UNSTRESSED $\sigma_{\mu\mu}$, as visualised in Tableau 13, showing *oncoloog* ‘oncologist’.

(13) ɔŋkolo:x	*CLASH	*UNSTRESSED $\sigma_{\mu\mu}$	*ˈσ)#	*HIGH-V STRESS	Align (Pw,R,F’,R)	*.σ.
a. ɔŋˈ(ko.lo:x)		*!				*
b. (ɔŋ)ˈ(ko.lo:x)	*!	*				
c. ˈ(ɔŋ)(ko.lo:x)	*!	*			**	
d. ˈ(ɔŋ.ko)lo:x		*!			*	*
e. ˈ(ɔŋ.ko)(lo:x)		*!			*	
☞ f. (ɔŋ.ko)ˈ(lo:x)			*			

The reduced realisation would be /ɔŋ.kəˈlo:x/.

For a type A account of Dutch, this second type might be problematic, because if codas do not project a mora, how can a syllable like VCC be heavy? A solution by Rosenthall & Van der Hulst (1999) was earlier mentioned. The second consonant in the coda cluster can be regarded an appended syllable with an empty head, for which the same constraint from (4) would apply. This is shown in Tableau 14, featuring the word *ledikant* ‘crib’.

(14) | ledikant |	*CLASH	*UNSTRESSED $\sigma_{\mu\mu}$	*ˈσ)#	*HIGH-V STRESS	Align (Pw,R,F’,R)	*.σ.
a. ˈ(le.di)(kan.t)					*!*	
☞ b. (le.di)ˈ(kan.t)						
c. (le)ˈ(di.kan)t	*!			*	*	*
d. le.(di)ˈ(kan.t)	*!					*
e. ˈ(le.di)(kant)					*!	
f. (le.di)ˈ(kant)			*!			
g. leˈ(di.kant)				*!		*
h. (le)ˈ(di.kant)				*!		

3 Conclusion

All in all, it seems that there is a strong case to be made for regarding Dutch a type A language. The biggest advantage is that, through this account, Dutch does not have to be an exception to the typological findings of V:/VV being heavier than VC. Gussenhoven's (2000) account for Dutch as a type B language also does this, but his account requires lengthening of certain vowels (in order to make them have an extra mora, to outweigh a coda) that is controversial to say the least. An example of this would be that of a vowel in the first syllable of *kapitaal* 'capital' /ka:pi.ˈta:l/. The /a:/ in the final syllable is realised with a much longer duration than the first one, even though that is also argued to be long by Gussenhoven.

4 Discussion

The most important question now is which account describes Dutch the best. To answer that question, we need to establish what defines "the best". My view is that the most elegant account is the best account. Elegant, in this sense, means that it explains the most cases without exceptions, but also with the fewest steps. Specifically, which account needs the least lexically determined "exceptions", and which account needs the fewest constraints? Aside from these things, the quality of the constraints and the general fit with established theories are also important.

The biggest problem of Dutch as a type C account (Table 1), following Trommelen & Zonneveld (1989) (and others), is that it is not consistent with typological findings. It can, however, account for many words. But words with an open final syllable without penultimate stress are problematic for that account. Words like *Afrika*, *animo*, *pagina*, *alias*, *Panama*, etc. are not in line with their theory. Both Gussenhoven's (2000) and this account solve that problem. However, Gussenhoven's account needs to lengthen the vowels in the initial syllables in order to do it. This is arguably less elegant than the present account, because, as mentioned, these vowels seem to not be lengthened in (quick) speech.

Gussenhoven has a problem with *armada*, just like the current account, but solves this by stating that the coda in the first syllable has no weight. In fact, he states that only the codas in the stressed syllable, and the ones in the following syllables have weight. This makes it less of a pure type B account. Cumulatively, Rosenthall and Van der Hulst (1999) even state that only the codas in the stressed syllable have weight. This takes away even more from the pure type B hypothesis. While the present account needs a lexical mora assigned to the stressed vowel, at least it is still consistent with the type A hypothesis.

This theory could be further tested for different languages that also have reduction mechanics. Germanic languages generally have a tendency to reduce vowels to schwa, although it has to always be noted that certain sounds might already be schwa underlyingly, regardless of how they are spelled. Additionally, various claims made in this thesis can be tested for Dutch and other languages. For example, are high vowels indeed rarely reduced to schwas? What happens to the ones that are, like the one in *minuut*? Or is that one a schwa underlyingly, as suggested above? Many questions need answering, but the most important one cannot be stressed enough: what type of quantity-sensitive language is Dutch?

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[i] Vnt is an exception to this statement, as Domahs et al. (2014) found it to behave like VVC, instead of VCC. However, Gordon (2006) also found that there is a certain gradation to the heaviness of consonants. Nasal segments are generally heavier than obstruents, which can be explained through their higher sonority. Thus, the finding that Vnt behaves more like VVC than VCC can still be consistent with Gordon's findings.

[ii] Throughout this thesis, I will refrain from showing lengthening on vowels in stressed syllables. Gussenhoven (2000) uses the STRESS-TO-WEIGHT PRINCIPLE to turn stressed vowels into long vowels. This is a somewhat controversial view: Prince (1990, as cited in Gussenhoven (2000)) argues against it, among others. In this thesis, I will assume that syllables experience some lengthening as a consequence of being stressed. But to distinct this group of long vowels from vowels that are underlyingly long, I will only indicate the latter group by means of the lengthening sign ":".

[iii] The high-ranked constraint *RHTYPE=I is already taken into account in the selection of candidates for every tableau: every bisyllabic foot is trochaic. Additionally, because the constraint *(σ) is ranked below *.σ, it does not add much value to show it in the tableau, but it does rule out candidates with two monosyllabic feet instead of one bisyllabic one. This is also taken into account in all the tableaus.

[iv] One might even argue that the schwa in closed syllables also only occurs in affixation in Dutch, if one goes as far as to state that *-er/el* are suffixes (evidence for this is found in work by Nijen Twilhaar in 1990 and 1992 on morphological gender), even in words like *moeder* 'mother' and *wortel* 'carrot', but this is beside the main point of this thesis.

[v] Van der Hulst (Van der Hulst, 1985)has argued for ambisyllabicity in Dutch, which occurs when an intervocalic consonant follows a (short) lax vowel. This would, in the case of *Colorado*, lead to /ˌkɔl.lo.ˈra. do/. For the main point of this thesis, the difference between these two variants is not relevant. Therefore, the most simplistic version will be chosen: the one without ambisyllabicity.

[vi] In Dutch, this word can also be realised with a voiced sibilant. This does not affect the present analysis.