

The Phonological and Morphological Status of the Prosodic Word Adjunct

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0. Introduction

Early versions of Prosodic Phonology, as proposed by Nespor and Vogel (1986), Selkirk (1986), Hayes (1989) and others, were based on a small set of strict, inviolable principles, such as NONRECURSIVITY (a node at level n should not dominate another node at level n), disallowing, for instance, recursive Prosodic Words (PWs), or in more general terms, tree structures such as the one in (1b):¹

- (1) a. NONRECURSIVITY (Selkirk 1986)
A node at level n should not dominate another node at level n .
- b.



During the past years, this strict approach has been abandoned. Former ‘principles’ such as NONRECURSIVITY are now seen as violable constraints in an Optimality Theoretic system (Prince and Smolensky 1993), and recursive PW structures are allowed by many scholars (cf. Selkirk 1996).

This new freedom of course should not go unconstrained. Even within an Optimality Theoretic analysis, NONRECURSIVITY is still a grammatical constraint, only to be violated if there is a higher-ranking constraint forcing such a violation. What are these higher-ranking constraints? Which morphological or phonological material is allowed to occur in the adjoined position to a PW (i.e. a structures of type (1b) in which is a PW)? Concentrating on recursive PWs in Dutch these are the questions I will explore in this article.

The idea is that there are phonological restrictions and morphological requirements on position . Phonologically, the adjoined position can only support elements that do not need a lot of licensing, hence that are (almost) empty as far as phonological features are concerned. For this reason, only schwa and coronal consonants turn up in this position. From the point of view of the interface, phonological recursive structures are used to express similar structures in the morphology. Morphological structures are of course abundant with trees of the type in (1b): in an inflected noun, for instance, is the category N, and the inflectional material. I will argue below that it is desirable to mirror morphological recursivity in the phonological structure. This gives us a violation of NONRECURSIVITY, provided the phonological constraints just discussed are met.

This line of reasoning then gives us some insight into two aspects of inflectional affixes. In the first place, the fact that they only consist of coronal consonants and schwa; and in the second place that they are invisible for stress. Both aspects follow from the fact that the inflectional elements end up in position and the assumption that stress is assigned on the basis of the structure in .

As for derivational suffixes, the issue is further complicated by the fact that they (different from inflectional suffixes) are morphological heads. I argue that there is a further constraint active in the morphology-phonology interface of natural language, which has it that morphological heads should be expressed by phonological heads, hence that

¹ Thanks are due to Birgit Alber, Geert Booij, Ben Hermans, Anthi Revithiadou, Francine Swets and two anonymous reviewers for *Linguistische Berichte* for comments on a previous version.

morphological heads should have main stress. Having main stress is of course conflicting with being in an adjoined position. It turns out that Dutch has two classes of derivational suffixes. Some have the same kind of ('superlight') segmental makeup as inflection and also behave in the same way phonologically. Others rather have a superheavy syllable structure, which forces them to give up the 'MIRRORING' property, but allows them to express their morphological headship by carrying word stress instead.

With this apparatus I will discuss three types of derivational suffixes in Dutch, which I will call Type A, B and C. Type A suffixes are invisible for stress and they only contain schwa and/or coronal consonants; an example is the agentive *-er* [ər] in *waarnemer* 'observer' (from *waarneem* 'observe'). Type B suffixes do not affect the stress pattern of the base, but bear some stress themselves as well, giving the derived form a kind of 'compound stress'; an example of this is *-achtig* '-like' in *oranje-achtig* 'orange-like'. Type C suffixes are visible for stress, they incorporate into the prosodic word of the stem and attract its main stress; an example of this is *-iaan* in *Bollandiaan* 'follower of the Dutch philosopher Bolland'. These examples will be worked out in more detail below.

The structure of the argumentation in this paper is as follows. In section 1, I give a brief summary of Dutch word stress, focusing on the differences between monomorphemic forms on the one hand, and inflected and derived forms on the other. In section 2, I consider some of the theoretical options we have for analysing this difference, and conclude that it should probably follow from the interaction between purely phonological constraints on recursive PWs on the one hand, and the interaction between phonology and morphology on the other. In section 3 I then discuss the inflectional paradigms of Dutch in some more detail and in section 4 I do the same for the different types of derivational suffix. Section 5 discusses some problematic cases and section 6 is devoted to a conclusion.

1. Dutch word stress

Dutch stress is a well-studied topic within generative phonology (Van der Hulst 1984, Kager 1989, Trommelen and Zonneveld 1989, Booij 1995, Gussenhoven 1999). The stress rules are quite similar to those of English, even though there are several interesting and important differences. In any case, like the English system, Dutch word stress is very complicated. We can only give a sketch of an Optimality Theoretic analysis here; the reader is referred to Nouveau (1994), Van Oostendorp (1997), Gussenhoven (1999), as well as to the authors just cited for elaboration.

Regular stress is on the penultimate syllable of the word in most cases (2a), except if the word ends in a so-called superheavy syllable, i.e. a tense vowel followed by one, or a lax vowel followed by two consonants. In this case, word stress is on the final syllable (2b).²

- | | | | |
|--------|-------------------------------------|----|--------------------------------|
| (2) a. | commode [kɔmódə] 'chest of drawers' | b. | ledikant 'bedstead' [ledikánt] |
| | tempo 'tempo' [témpo] | | automaat 'automaton' [otomát] |
| | motor 'engine' [mótɔr] | | paniek 'panic' [paník] |

The standard analysis of this is that Dutch has trochaic feet, that the last trochee of the word gets main stress, and that superheavy syllables attract stress irrespective of these constraints. We can obtain this effect for instance by the constraints in (3a-c), if ranked according to (3d):

² Another type of pattern is constituted by those words which end in a closed syllable (which is thus heavy but not superheavy) and have an open penult. These usually have stress on the first syllable of the word (*máráthon*, 'id.') This is ignored here, since it does not seem very relevant for our discussion of the interaction between morphology and phonology, if only for statistical reasons: this type of pattern simply does not seem to arise often enough in derived or inflected forms to allow us to say anything sensible about them.

- (3) a. TROCHEE: Feet are left-headed and bisyllabic³
 b. Align(Ft,R,W,R): Feet prefer the rightmost position in the syllable.
 c. SUPERHEAVY: Superheavy syllables get stressed⁴
 d. SUPERHEAVY » ALIGN-R, TROCHEE

(4)

tempo	SUPERHEAVY	ALIGN-R	TROCHEE
☞ témpo			
tempó			*!

(5)

pani:k	SUPERHEAVY	ALIGN-R	TROCHEE
páni:k	*!		
☞ paní:k			*

Dutch also has quite a lot of forms which do not conform to this stress pattern: they have stress either on the last syllable of the word, or on the antepenultimate. A plausible solution for these would be to assume that they have some underlying accent marking and faithfulness constraints can refer to this underlying material (Van Oostendorp 1997, Alber 1998, Gussenhoven 1999). Importantly, the relevant faithfulness constraints are not undominated. Superheavy syllables are always stressed,⁵ for instance, so that we may assume that the relevant faithfulness constraint is sandwiched between SUPERHEAVY and the other two constraints (some other stress constraints seem inviolable as well — notably those responsible for the fact that stress is always on one of the last three syllables in Dutch —, but these will be ignored here; since we will be dealing with *suffixes* in our discussion on the interaction between prosodic structure and morphology, structures in which stress is outside of the three-syllable window can be safely left out of consideration).

(6) *chocola* 'chocolate' [ʃokola], *Pánama* (place name) [pánama]

(7) a. IDENT-STRESS: Underlying stress patterns should be respected.

b.

ʃokolá	SUPERHEAVY	IDENT-STRESS	ALIGN-R	TROCHEE
ʃokóla		*!		
☞ ʃokolá				*

c.

pánama	SUPERHEAVY	IDENT-STRESS	ALIGN-R	TROCHEE
panáma		*!		
☞ pánama			*	

³ For present purposes (given the simplified nature of the stress analysis), we do not have to go into the question as to whether the trochees at hand are quantity-sensitive or not.

⁴ This constraint is probably best seen as a shorthand for a number of constraints on the relation between syllable structure and stress; cf. Booij (1995) and references cited there.

⁵ In some forms, they get secondary stress, rather than primary which is on the antepenult.

d.

páni:k	SUPERHEAVY	IDENT-STRESS	ALIGN-R	TROCHEE
☹ paní:k		*		*
páni:k	*!			

(7b) and (7c) show how word stress can show up on the final or antepenultimate syllable of the word, respectively. (7d) shows how stress cannot escape the superheavy syllable, even if it would be underlyingly postulated on a different syllable.

One other generalisation about Dutch word stress is also relevant: the generalisation that stress is on the penultimate syllable is virtually exceptionless if the final syllable contains a schwa (Kager and Zonneveld 1986).⁶ We will provisionally analyse this by positing the constraint in (8), which should outrank IDENT-STRESS (cf. Van Oostendorp 2000 for elaboration and discussion):

(8) WEAK-SCHWA: Schwa should be in the dependent position of a foot.

Because of high-ranking WEAK-SCHWA (and the fact that the Dutch foot is trochaic), the syllable immediately preceding schwa should be in the head position of a foot, hence, stressed. Even if we would posit an underlying accent on any other syllable in a word, such as *commode* 'chest of drawers', the stress would always be attracted to the penultimate syllable:

(9)

kómodə	SUPERHEAVY	WEAK-SCHWA	IDENT-STRESS	ALIGN-R	TROCHEE
kómodə		*!			
☹ kómódə			*		*

Having set up this (heavily simplified) picture of the basics of the Dutch stress system, we can now turn to the interaction with morphological structure, in particular on suffixing, since we are looking at the right edge of the word and since most affixes are right-adjointing in the language.⁷

We can observe immediately that the generalisation just established no longer holds if the final consonant is an inflectional morpheme. In that case, the stress can be on any of the last three syllables of the word, depending only on where it is in the uninflected form; in particular, it can occur in the syllable immediately before a 'superheavy' syllable (*kanaries* 'canaries' [kanári:s], cf. *kanarie* 'canary' [kanári:]; *geharnast* 'armoured' [yəhárnast], cf. *harnas* 'to gird oneself (STEM)' [hárnas]). These examples show that there is no difference between verbal and nominal inflection in this respect. Since these words now end in a 'superheavy syllable' we would expect them to be stressed on this syllable (the sad face indicates a winning candidate that does not correspond to the actually attested form):

⁶ There is one, small, class of exceptions, viz. words (a few place names and the word *weduwe* 'widow') ending in [ywʃ] which have stress on the antepenult (Trommelen and Zonneveld 1989). It is sometimes assumed that in these cases the [y] is 'really' a schwa underlying. In any case, I do not think these examples disconfirm the statement in the text; they just show that it needs further refinement.

⁷ It is not our goal to discuss all details of the behaviour of every individual suffix in Dutch here. See Trommelen and Zonneveld (1989), Booij (1995), Kager (forthcoming) for discussion.

(10)	ge+harnas+t γəhárnaʃt	SUPERHEAVY	IDENT- STRESS	ALIGN- R	TROCHEE
	γəhárnaʃt	*!			
	⊖ γəharnaʃt		*		*

(11)	kanari+s kanári:s	SUPERHEAVY	IDENT- STRESS	ALIGN- R	TROCHEE
	kanári:s	*!			
	⊖ kanári:s		*		*

Similarly, there is a range of inflectional suffixes which host a schwa. In underived words, this schwa forces stress in its lefthand neighbour, but this does not happen if the schwa is part of an inflectional suffix. An example of this is the verbal plural suffix *-en* (pronounced [ʔ] in some dialects and as [ʔn] in others, but this of course is irrelevant):

(12)	harnas+en hárnasə	WEAK-SCHWA	IDENT- STRESS	ALIGN- R	TROCHEE
	hárnasə	*!			
	⊖ harnásə		*		*

If we now turn our attention to derivational suffixes, the picture changes completely. We actually can distinguish between three types of suffix, which I have called type A, B and C above. Most suffixes in Dutch, as in other Germanic languages, are of type C. Most derived words have the same stress pattern as underived words with a comparable phonological structure. Since most derivational suffixes consist of a superheavy syllable or are bisyllabic with the second syllable a schwa, this means that they are stressed:

- | | | |
|------|---|--|
| (13) | <i>anoniem</i> [anoni:m] 'anonymous' | <i>anonimiteit</i> [anoni:mitéit] 'anonymity' |
| | <i>ceremonie</i> [sɛ:rəmoni] 'ceremony' | <i>ceremonieel</i> [sɛ:rəmonijél] 'ceremonial' |
| | <i>hobby</i> [hɔ:bi] 'hobby' | <i>hobbyist</i> [hɔ:bijíst] 'hobbyist' |

There also is a suffix *-isch* [is] which is 'stress attracting', which is to say that it does not bear stress itself, but shifts the stress of the stem. The fact that it does so is of course problematic, since the suffix is a superheavy syllable. It has received quite a lot of discussion in the literature (Haeseryn et al. 1997:718-721, Trommelen and De Haas 1993:328-331, Trommelen and Zonneveld 1989:204-208). A few examples are given in (14):⁸

⁸ Other suffixes are stress-attracting in a somewhat different way. These are suffixes such as *-ig*, *-elijk*, and *-baar* (cf. (i)).

- (i) *godsdienst* 'religion' (< *god* 'god', *dienst* 'service') - *godsdienstig* 'religious'
sprekwoord 'proverb' (< *sprek* 'speak', *woord* 'word') - *sprekwoordelijk* 'proverbial'
waarneem 'observe' (< *waar* 'true', *neem* 'take') - *waarneembaar* 'observable'

In all these cases the kind of stress that shifts is a kind of compound stress. We do not see the effect if these suffixes are attached to underived stems. For this reason, they fall outside the scope of the discussion.

- (14) *proz* [próza] 'prose' *prozaisch* [[prozá]i:s] 'prosaic'

I will briefly return to the structure of this curious suffix in section 5.2, but leave it aside until then. There are also two classes of derivational suffixes that are stress-neutral: the so-called 'non-cohering' stress-neutral suffixes of Dutch (the terminology is from Booij 1995), an example of which are given in (15a), and a separate class of so-called 'cohering' suffixes, exemplified in (15b):

- (15) a. [[proza]-*achtig*] (**proza*-*achtig*, **proza*-*achtig*) 'prose-like'
 b. [[waarnem]*er*] (**waarnem**er*) 'observer'

I call 'cohering' suffixes 'Type A' and 'non-cohering' suffixes 'Type C'. The difference between non-cohering and cohering suffixes is one of phonological behaviour, for instance with respect to syllabification. There is no resyllabification across the boundary between a stem and a non-cohering suffix, whereas there is resyllabification across the boundary between a stem and a cohering suffix:

- (16) a. *rood-achtig* [rot.ɑx.təx] 'red-like'
 b. [[*spreekwoord*]*elijk*] [sprek.wor.də.lək] 'proverbial'

There is a simple test for resyllabification in Dutch, because the language has final devoicing: all syllable-final obstruents are devoiced. Because of this, we know that the stem-final /d/ has been resyllabified into an onset position in (16b), but not in (16a). This makes the difference between cohering and non-cohering suffixes: the former integrate with the syllable structure of the stem, whereas the latter do not.⁹

These suffixes will be discussed in more detail in section 4. In conclusion, we can now make the following generalisations:

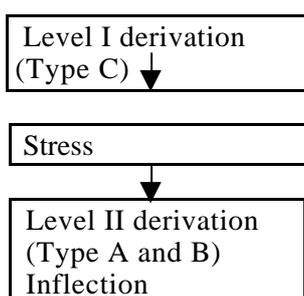
- A. All inflectional suffixes are invisible for stress
- B. There are two types of derivational suffixes: some are invisible for stress; others prefer to bear stress themselves. The derivational suffixes that are visible all start with a vowel and consist of a superheavy syllable (rhyme). The derivational suffixes that are invisible start with a consonant, or they only have a schwa vowel or no vowel at all.

2. Possible explanations for the stress behaviour of suffixes

Why are all inflectional and some derivational suffixes invisible for stress? One possible answer, explored in detail in Booij (1977), is a derivational one: some suffixes are invisible for stress because they are attached to the stem *after* application of the stress rules. We thus have the following picture:

⁹ Another test is the behaviour of schwa, which disappears before a vowel if this vowel belongs to a cohering-suffix (*elite* /elitə/ + *air* /ɛ:r/ = [elitɛ:r], *[elitəɛ:r]; but *elite+achtig* 'elitist' with non-cohering *achtig* = [elitəxtəx]).

(17)



This model has the advantage that it is quite simple and that it explains other phenomena — viz., the fact that inflection is peripheral to derivation and that most Level II derivation is peripheral to Level I derivation. Yet there are several problems with it, in particular as far as the ordering of the two lexical levels is concerned (as has been pointed out by Booij and Van Santen 1998:205-206 and others). For instance, the restrictions on Level I suffixes are such that they can only freely combine with non-native elements (derived or underived stems); since Level II suffixes are arguably 'native', there thus is no reason to explain why Level I suffixes cannot usually be attached in their periphery. Furthermore, there are several classes of cases in which accent-bearing (or -shifting) suffixes follow accent-neutral ones.

Within Optimality Theory, we could alternatively assume that inflected words are in a paradigm and, therefore, sensitive to a form of Output-Output faithfulness (the stress pattern of the inflected form mirrors that of the uninflected form) that does not apply to derived words (Benua 1997, McCarthy 2001). We thus would have a constraint IDENT_{OO}-STRESS, that would be inviolable:¹⁰

(18)

kanarie+s kaná:ri:+s	IDENT _{OO} - STRESS	SUPERHEAVY	WEAK- SCHWA	IDENT- STRESS	ALIGN- R	TROCHEE
kaná:ri:s	*!			*		*
☞ kaná:ri:s		*				

This analysis would share many of its properties with the derivational account just sketched, and it could relate the difference between inflectional affixes on the one hand and derivational affixes on the other to a morphological difference between the two categories (the fact that inflections are also morphologically peripheral to derivations). Technically, it would be possible to derive the relevant contrasts, which is hardly a surprise if we take into consideration the inherent power of a theory of OO-faithfulness.

A problem specific to this account would be that it would not be able to explain why some derivational affixes behave like inflections whereas others do not (although it would of course always be possible to arbitrarily stipulate that only the inflectional endings and a subset of derivational suffixes trigger OO-faithfulness constraints). The derivational account suffers somewhat from the same problem, but at least some predictions would follow about the relative ordering of the derivational suffixes involved (they would have to be peripheral to the derivational endings that do not behave like inflectional endings; and they should potentially be more similar to inflection also in other aspects of phonological behaviour).

¹⁰ Another possibility would be to mimic the derivational approach just outlined, and to assume that there are two different grammatical levels, an early one in which Superheavy, WEAK-SCHWA » IDENT-STRESS, (where the Identity-constraint would refer to underlying stress) and a later one in which IDENT-STRESS » Superheavy, WEAK-SCHWA (where the Identity-constraint would refer to stress assigned in the lexicon).

Another point about both of these analyses is that they do not explain what the relation is between the fact that inflectional suffixes are phonologically almost completely empty and their stress behaviour. They do not contain a vowel, or if they do, the vowel is schwa, and all consonants involved are coronals (-s, -t, -n), i.e. consonants with a minimally marked place specification.¹¹ The following is a complete list of inflectional suffixes in Standard Dutch:

- (19) **verbal:** *-en* /ə(n)/ (infinitive, plural; e.g. *werken* 'to work'), *-t* /t/ (2nd & 3d person present tense; *werkt* 'work(s)'), *-te/-de* /tə/- /də/(singular past tense; *werkte* '(he) worked'), *-ten/-den* /tən/-/dən/ (plural past tense; *werkten* '(they) worked'), *-t/-d* /t/-/d/ (past participle; *gewerkt* '(have) worked'),¹² *-end* /ənd/(present participle; *werkend* 'working')
adjectival: *-e* /ə/(agreement; e.g. *mooie* 'beautiful')
nominal: *-en/-eren/-s* /ə(n)/ -/ərə(n)/ -/s/ (plural; e.g. *boeken* 'books', *kinderen* 'kids', *werkers* 'workers'), *-s* /s/ (genitive; e.g. *Jans boek* 'John's book')

Type A derivational suffixes, which show the same behaviour, strikingly also have the same form:

- (20) *-e* /ə/ (several functions), *-el* /əl/ (denominal verbalizing suff.), *-en* /ən/, (pl.suff.), *-er* /ər/ (several functions, plus allomorph /a:r/¹³), *-erd* /ərd/ (creates deadject. pejorative names), *-erig* /ərɪŋ/ 'ish', *-ing* /ɪŋ/ 'ing', *-nis* /nɪs/ 'ness'¹⁴, *-s* /s/ substantivizing suff, pl. suff., gen. suff.), *-sel* /səl/ (creates de-verbal nominalizing suff.), *-st* /st/ (superl., de-verbal nominalizing suff.), *-ster* /stər/ (feminizing suff.), *-t* /t/ (de-verbal nominalizing suff.)¹⁵, *-te* /tə/ 'ness', *-tje* /tjə/ diminutive (plus allomorphs)

A purely representational approach therefore seems more viable. Such an approach would derive the phonological behaviour of the various suffixes of their phonological shape. This is indeed suggested by Booij (1995) and Booij and Van Santen (1997), but the details are yet to be worked out in full detail. We have seen above that the way a given suffix will behave is indeed almost completely predictable, if we know its phonological shape. If it has a schwa, it will be Type C, if it has a full vowel it will be either Type A or Type B.

It seems more attractive to assume that phonological properties of morphemes can be deduced from their phonological shape. There still is a problem with such an approach however: inflected and derived words ending e.g. in a schwa syllable are still different from their monomorphemic counterparts. Furthermore, inflected words ending in a superheavy

¹¹ A similar observation has been made by Hoekstra (2000:138-139), who extends it to function words. Hoekstra states two generalisations (i. Function words often contain schwa, ii. Function words often contain a coronal consonant) and claims: "Both of these generalisations not only are true for Standard Dutch, but also for the Dutch dialects I know of." Hoekstra points out that similar generalisations can be made for English.

¹² The choice of a voiced vs. a voiceless stop in past tense forms is dictated by the voice specification of the last segment of the stem.

¹³ Cf. Van Oostendorp (1999) for an account that is compatible with the one presented here.

¹⁴ It is not clear to me why this suffix is included in this list, i.e. why Booij supposes it to be non-cohering; if it is, it obviously is exceptional, be it that Booij (1995) notes that some people pronounce this suffix always with schwa. Also, suffixes with coronal vowels will be shown to be exceptional also in other cases.

¹⁵ This suffix also functions as a (equally stress-neutral) inflection for the third person singular. This function is not mentioned by Booij (1995).

syllable are different from both the derived and the monomorphemic forms with a similar segmental makeup.

I conclude from this that we need an analysis in which the phonological structure of derived and inflected words needs to reflect on the one hand the underlying phonological material of both stem and affix, and on the other hand the fact that these words are morphologically complex. I will try to develop such an analysis in the next section.

3. Morphology and phonology in the stress behaviour of inflection

If the stress behaviour of suffixes is to be seen as a result of the interaction of phonological constraints on the relation between segmental makeup and stress on the one hand, and morphological constraints on the other, we should first try to establish what the relevant constraints are, and then what the interaction between those constraints is.

As far as the phonological constraints are concerned, the null hypothesis is that these are the same for polymorphemic as for monomorphemic forms, except perhaps in so far as the morphology forces us to assume 'exceptional' phonological structures.

I propose that one of the most important morphological constraints in explaining the behaviour of inflected forms is MIRRORING:

(21) MIRRORING

The prosodic structure of a word should be isomorphic to its morphological structure.

According to MIRRORING, a prosodic word should be recursive if it corresponds to a recursive word. Inflected forms are instances of such recursive morphological structures: they are a word embedded in a word. For instance, an plural noun *kanaries* recursively contains a singular noun *kanarie*.

MIRRORING is a fairly general (one might even say imprecise type of constraint). We will see below that it is possible to break it down, at least partly, into a set of formally simpler constraints. A fairly plausible candidate for part of MIRRORING would be the Anchor-constraint schema as proposed by McCarthy and Prince (1999):

(22) {Right, Left-}ANCHOR(S_1, S_2)

Any element at the designated periphery of S_1 has a correspondent at the designated periphery of S_2 .

If we set the value of S_1 to the morphological word, and S_2 to the phonological word, we obviously get mirroring of morphological and syntactic constituency. Yet I will argue below that mirroring might also be satisfied in other ways, in particular by mirroring of morphosyntactic headedness into phonological headedness (stress).

I will not go into this matter any further, since one general constraint of the type in (21) will do and make my tableaux easier to read. Furthermore, we will see below that there are other ways in which morphological structure can be mirrored in prosody, beyond demarcation of left and right boundaries. In principle, it clearly is possible however to replace this one constraint by a family of constraints in many cases. Another question that will be left unanswered is what is the ontological basis for MIRRORING or ANCHORING.

As such, the principle claims that the optimal prosodic structure for such words should also contain a recursive prosodic word (PW), so that the structure looks as follows:

(23)	((kanari:)PW s)PW	Prosodic Structure
	[[kanarie]N s]N	Morphology

Formally, MIRRORING expresses the tendency for different levels of linguistic structure to be isomorphic (Jackendoff 1996). In more functional terms, the fact that morphological

structure is reflected in the phonology, might make it easier for the listener to parse that word (cf. Kaye 1995¹⁶).

The fact that words are pronounced in a way that is impossible for monomorphemic forms is a clue that they have more structure.

(24)

kanarie+s kanári:+s	MIRRORING	SUPERHEAVY	WEAK- SCHWA	IDENT- STRESS
kanarí:s	*!			*
☞ kanári:s		*		

If we assume that stress assignment is restricted to the internal PW,¹⁷ MIRRORING has the same effect as IDENT_{oo}-STRESS in the hypothetical OO-analysis given above: stress is decided at the level of the singular form, and the inflectional suffix is irrelevant. In my view, MIRRORING has the additional advantage of helping to explain why all suffixes which display this behaviour are also very minimally specified from a phonological point of view. We propose that the reason for this is a form of Prosodic Licensing, formalised as a family of constraints on feature licensing (Itô 1986 and much subsequent work):¹⁸

- (25) LICENSE/F: The phonological feature F should be in the head of a recursive Prosodic Word (i.e. not adjoined).

Notice that LICENSE/F is a scheme of purely phonological constraints, which are not used hitherto in the analysis of underived forms. This may look like we are abandoning our null hypothesis, but the only reason for doing this is that we have not yet seriously considered the possibility of recursive prosodic words. Below, it will be shown that we need LICENSE also for monomorphemic forms once we take this formal possibility into account.

A hierarchy of LICENSE/F constraints is arranged according to the usual criteria of segmental markedness. For instance we have a subranking LICENSE/LABIAL, LICENSE/VELAR » LICENSE/CORONAL, since labial and velar segments are usually assumed to be more marked than coronals.

Combining this hierarchy of constraints with MIRRORING gives us the desired effect. We can now postulate a ranking LICENSE/Labial, LICENSE/Velar » MIRRORING » LICENSE/Coronal, so that coronal segments are, but labial and velar consonants are not allowed to occur in an adjoined position to the word. We thus could not have labial and velar consonants in a suffix displaying the same behaviour:

¹⁶ Kaye (1995) distinguishes in this regard between 'analytic' and 'non-analytic' morphology. An example of the former is English *peeped*, an example of the latter English *kept*. The former contains a structure (a long tense vowel followed by two consonants) that is not attested in English forms. The latter could be a monomorphemic form in principle, and Kaye assumes that in a way, it is (it is stored in the lexicon). Kaye observes that non-analytic forms are often exceptional, get specialized meaning, etc.

¹⁷ This can be accomplished by assuming that every Prosodic Word needs to correspond to exactly one location of main stress. If that is the case, stress can only be in the innermost Prosodic Word (where it is inside the outermost Prosodic Word at the same time). If it would be somewhere outside the innermost Prosodic Word, this innermost PW would not have stress; or if it would have stress, there would be two loci for main stress in the outermost PW. In both cases we would violate the assumed principle (or constraint).

¹⁸ Note that LICENSE/F is a form of positional markedness constraint which can do much of the work of the universal hierarchy of positional faithfulness constraints Faith[stem]»Faith[affix] which is assumed in other parts of the literature.

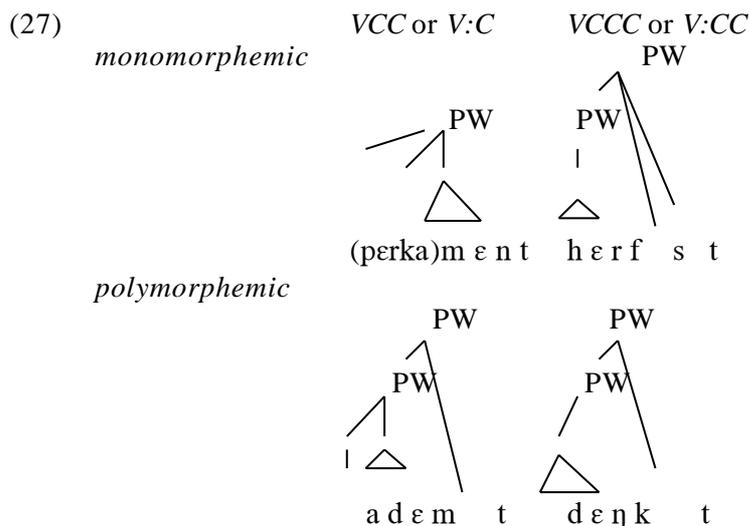
A similar ranking for vocalic material will give us as a result that only the most unmarked vowel (schwa) can occur in an adjoined position. In this case, we may assume that schwa does not have any place feature marking at all.

On the other hand, not every coronal consonant and not every schwa is adjoined. In monomorphemic forms, they are usually incorporated in the word, at least if this is possible, as is attested by examples such as *automaat* 'automaton' and *perkament* 'parchment' above. Even coronal segments are subject to Licensing only occur in an adjoined position if this is necessary for some reason; e.g. to satisfy MIRRORING. Since these are monomorphemic forms, MIRRORING does not play a role. Therefore the coronal consonants are integrated into the PW in these cases:

(26)

automaat autómat	LICENSE/ Labial	MIRRORIN G	LICENSE/C oronal	SUPERHEAVY	IDENT- STRESS	ALIGN-R	TROCHEE
☞ autómát					*		*
autómat			*!	*			

Interestingly, coronal consonants (but no others) can still be outside the PW in monomorphemic forms. If all the positions in the final syllable of the word are 'filled up' as it were, we can still find one or more coronal obstruents. We thus have words such as *herfst* 'fall' in which a superheavy syllable is followed by *st*. Consonants with other places of articulation are not allowed in this position (this is an observation that is of course quite familiar from the literature: cf. Halle and Vergnaud 1987, Van Oostendorp 2000, and references cited there). We thus have the following structures for different classes of words:¹⁹



The difference between monomorphemic and polymorphemic forms thus is that the final coronals are always in adjoined position in the latter, whereas this only happens in the former if this is necessary for phonotactic reasons. In both cases, coronals are the only segments that can occur in such a position. The hierarchy of LICENSE constraints thus also plays a role in monomorphemic forms. This is why their introduction does not qualify as a departure of the null hypothesis, that the phonology 'proper' of inflected and derived forms is not different from that of monomorphemes.²⁰

¹⁹ Glosses: *perkament* 'parchment', *herfst* 'autumn', *adem+t* 'breathes', *denk+t* 'thinks'.

²⁰ Schwa does not seem to be in an adjoined position in monomorphemic forms, since there is no phonotactic reason for vowels to occur in such a position.

The question why all inflectional elements are empty, while many derivational elements are not, is still an open one. First, we observe that it is quite desirable for a suffix to be underlyingly specified as coronal only, for it can satisfy MIRRORING and the highest ranking members of the LICENSE family at the same time in this way. The principle of Lexicon Optimisation will thus cause productive suffixes to eventually end up as being specified as coronal (or containing a schwa): the best suffix is the one that will have a possibility of surfacing unharmed in the relevant environments. For inflectional suffixes this is even more profitable than for derivational ones, since the former are always peripheral to the latter. The reasons for this are probably independent: they have to do with the fact that inflection needs to be visible for syntax. `Empty' suffixes that often occur before `non-empty' ones, still cannot satisfy MIRRORING. Otherwise, they would drag the following suffixes to a peripheral position. We thus, correctly, expect the more peripheral suffixes to be emptier than the more central ones.²¹

But there might be another reason as well: derivational suffixes might reflect the morphological structure of words in some other way. A morphological difference between inflectional and derivational morphemes is that the latter but not the former are morphological heads. This means that they are sensitive to another constraint on the interface between morphology and prosody, a constraint that describes the way in which morphological headedness should be expressed in the phonology, namely by phonological headedness, i.e. stress. This line of reasoning will be pursued in the next section.

4. The stress pattern of derivational suffixes

We have seen in section 2 that there are basically three types of derivational suffixes in Dutch:

- A. suffixes that are invisible for stress and that contain a schwa or only coronal consonants, such as *-de* and *-s*. These derivational suffixes can get the same analysis as the inflectional suffixes in the previous section; they will be ignored here,
- B. suffixes that do not affect the stress pattern of the stem, but rather give some kind of 'compound stress',
- C. suffixes that are visible for stress, and that are (usually) stress-bearing.

We have argued above that the behaviour of type A suffixes can be explained by the tendency to reflect morphological recursion by phonological recursion. The question now arises whether and how the other phonological structures reflect the morphology.

The answer to this question seems easiest to provide for type B suffixes. The following list is exhaustive:

- (28) *achtig* /ɑxtɪx/ '-like', *-loos* /lo:s/ '-less', *-ling* /lɪŋ/ '-PERSON', *-baar* /ba:r/ '-able', *-dom* /dɔm/ '-NOM', *-heid* /heit/ '-NOM', *-nis* /nis/ '-NOM', *-schap* /sxɑp/ '-NOM', *-zaam* /za:m/ '-ADJ'

²¹ An additional reason might be syntactic visibility: maybe the fact that morphological structure is mirrored in the phonology is particularly relevant for the type of morphology that plays a role in syntax, i.e. inflection. However, this does not explain why some derivational suffixes, but not others, behave in the same way.

Furthermore, a reviewer of this paper points out that there might be functional considerations at stake: in a language such as Dutch, we only have a handful of inflectional endings, but considerably more derivational suffixes. It would be hard to make all the relevant distinctions needed for derivation with only coronals and schwa.

These forms all have a full vowel, and even a superheavy syllable. Therefore, they cannot occur in an adjoined position to the phonological word. Instead of this they phonologically have a compound structure with a primary stress on the first syllable that would get primary stress in 'normal' compounds as well (Booij 1995):

(29) a. *werkzaam* [uérkzà:m] 'working'

PW PW

b. u é r k z à : m

The intuition to be formally worked out here, is that the structure in (28) is 'second best', given that adjunction is unattainable for suffixes of this shape: the morphological complexity is at least reflected in some kind of phonological complexity. One way of implementing this is by invoking an Alignment constraint:

(30) ALIGN(PW, X0): Boundaries of morphosyntactic words should be aligned with boundaries of phonological words.

ALIGN and MIRRORING are in a so-called Paninian relation (Prince and Smolensky 1993): the latter is more specific than the former, in the sense that there are forms satisfying ALIGN but not MIRRORING (Class B suffixes are an instance of this) but not the other way around.

I will argue below that class B suffixes are actually close to the ideal type of derivational suffix, as far as their phonological shape is concerned. Before we go into this, we first have to look at the suffixes of class C. Words with such a suffix are indistinguishable from monomorphemes as far as their phonological shape is concerned. The suffixes themselves have the following shape (in parentheses I have provided a rough English equivalent for every Dutch suffix):

(31) *-aal* /a:l/ '-al', *-aan* /a:n/ '-an', *-age* /a:ʒə/ '-age', *-air* /ɛ:r/ '-air', *-ast* /ast/ '-ast', *-eel* /e:l/ '-al', *-eer* /i:r/ '-ize', *-ees* /es/ '-ous', *-egge* /ɛʝə/ '-in', *-erij* /ərei/ '-ery', *-es* /ɛs/ '-ess', *-esk* /ɛsk/ '-esque', *-eur* /ø:r/ '-or', *-eus* /ø:s/ '-ous', *-iaan* /ija:n/ '-ian', *-ide* /i:də/ '-ide', *-ief* /i:f/ '-ive', *-iek* /i:k/ '-ic', *-iet* /i:t/ '-ite', *-ieus* /ijø:s/ '-ious', *-in* /ɪn/ '-in', *-iseer* /isɛr/ 'ize', *-isme* /ismə/ '-ism', *-ist* /ɪst/ '-ist', *-iteit* /i:teit/ '-ity', *-ei* /ɛi/ '-y'

These elements have two things in common: they all start with a vowel, and they all have a superheavy syllable rhyme, or else a schwa. In other words, they seem to be built to capture stress.

Two questions now arise. First, why would all these suffixes be superheavy? Secondly, what is the difference in shape between these suffixes and those in (28) that can explain the differences in behaviour?

I think the answer to the first question can be found in Revithiadou (1999), who claims that in languages such as Modern Greek and Russian, stress is determined by morphological headedness. In all of these languages, every morpheme can be specified for underlying accent, yet in any given word, at most one accent can surface. Revithiadou suggests that the question *which* of the underlying accent specifications surfaces is decided by morphological considerations: the 'morphological head' of a complex form tends to win.

Revithiadou (1999) shows that in Greek this means that in derivational morphology it is the derivational suffix that determines the accentual pattern of the word, whereas in inflected forms it is always the stem that decides.²² The reason for this is that derivational suffixes are morphological heads, e.g. because they determine the category of the stem, whereas inflectional suffixes are not heads. We thus find that stress specifications of stems are unaffected by inflectional endings (32a), but they can shift in derived forms (32b):

- (32) a. papa al-os 'parrot-NOM.SG.'
 papa al-u GEN.SG.
 papa al-i NOM.PL.
 papa al-on GEN.PL.
 b. papa al-aku 'little parrot'

Revithiadou (1999) proposes constraints of the following type in order to account for this:

- (33) a. HEAD-FAITH: Morphological heads should be faithful to their underlying accentual specification.
 b. HEAD-STRESS: Morphological heads should be stressed.

What I want to propose here is that in the Dutch lexicon we can still see the traces of HEAD-STRESS. This is true in particular for HEAD-STRESS. This implies that derivational suffixes prefer to be stressed, and this in turn makes it most profitable for them to be superheavy.

The superheaviness of derivational 'Level I' suffixes in my view is not necessarily the result of constraint ranking; it may also be simply due to Lexicon Optimisation: in the course of time most suffixes happen to have taken up this shape, but this is not a necessary property of suffixes. In the course of time, superheavy forms of suffixes would have been preferred over smaller shapes:²³

(34)

Mohammed+aan mohamed+a:n	SUPERHEAVY	IDENT- STRESS	ALIGN -R	TROCHEE	HEAD- STRESS
☞ mohamedán				*	
mohamédan	*!				*

(35)

*Mohammed+aan mohamed+an	SUPERHEAVY	IDENT- STRESS	ALIGN -R	TROCHEE	HEAD- STRESS
mohamedan				*!	
☞ mohamédan					*

In actually attested forms such as (34), with a superheavy syllable rhyme, the winning candidate as far as the phonology is concerned, is also the candidate that is preferred by HEAD-STRESS. A hypothetical *-an* with a short vowel and one consonant, would prefer a different shape from a phonological point of view. If something like HEAD-STRESS is involved in the selection of optimal lexical forms, 'superheavy' syllable rhymes should eventually emerge.

²² In present-day generative syntax, the standard conception seems to be that inflectional affixes *are* heads. This raises the question what the relation is between the morphological and the syntactic head (as well as what is left of the distinction between inflection and derivation in syntactic theories of this type).

²³ There actually are two exceptions to this generalisation, both of them deriving the feminine form of words: *-in* (*boer* 'farmer' - *boerin* 'woman farmer') and *-es* (*leraar* 'teacher' - *lerares* 'female teacher'). These are not superheavy, but interestingly, they are still stress-attracting. They thus seem to have some kind of exceptionality marking which attracts stress, presumably the same as is found in *chocola* 'chocolate'.

The class B suffixes are actually also not bad from the point of view of HEAD-STRESS: they do not carry the primary stress of the compound, but since they are independent prosodic words, they still carry word stress. There are various ways to implement this idea. We could imagine, for instance, that HEAD-STRESS is a gradient constraint, and that structures such as those in (29b) give one violation rather than two. Furthermore, these suffixes also satisfy the requirements on the prosody-morphology interface quite well, since, as we have seen, they still satisfy Alignment.

For inflectional suffixes, only MIRRORING is relevant (HEAD-STRESS assigns the main stress to the stem anyway) but for derivational suffixes *both* and HEAD-STRESS play a role. Now it is impossible to satisfy both of the constraints at the same time. Now apparently derivational suffixes have taken one of two routes:

- Type A suffixes satisfy MIRRORING (and therefore also Alignment) completely, thereby necessarily violating HEAD-STRESS;
- Type B and Type C suffixes satisfy HEAD-STRESS, and therefore necessarily violate MIRRORING; Type C suffixes also violate Alignment, Type B suffixes do not.

The difference between Type A suffixes on the one hand, and Type B and Type C suffixes on the other, can be deduced from their phonological shape: the former are superheavy, the latter are superlight. It looks as if MIRRORING and HEAD-STRESS are unranked with respect to one another, maybe because they are only forces at work in Lexicon Optimization (hence outranked by all relevant wellformedness constraints). Some suffixes obey the one constraint, others obey the other (but there are no suffixes that are underlyingly structured in such a way that they have to disobey both of them, even though this is a possibility in principle).

Is there anything to be said about the difference between the difference between Type B and Type C? It has been observed already by Booij (1977, and subsequent work) that all Type C suffixes are vowel initial, whereas almost all Type B suffixes are consonant-initial; the one exception is consonant-initial *-achtig* '-like' which nevertheless behaves as Type B, maybe because it is compound-like for other reasons (Van Oostendorp 1994, 1999). Setting this morpheme apart, then, the difference can simply be made by constraint ranking: Onset » Align. The idea is that syllables cannot cross the boundary between two prosodic words; therefore, vowel-initial suffixes still prefer to be integrated with the prosodic word of the base.

(36)

Mohammed+aan mohamed+a:n	Onset	Align
PW ☞ mohamed+a:n		*
PW mohamet+a:n	*!	

(37)

werk+zaam wɛrk+za:m	Onset	Align
PW wɛrk+za:m		*!
PW PW wɛrk+za:m		

5. Problematic cases

We now have diminished the number of morphological diacritics in the lexicon by deriving the phonological behaviour of sets of affixes from their underlying form, plus constraints on mapping the input to the output. A few problematic cases remain. These will be discussed in this section. In 5.1. I discuss the suffix *-ing*, which behaves as Type A, even though it has the full vowel [ɪ]; in section 5.2. I discuss the suffix *-isch* which is 'preaccenting', even though it has a superheavy syllable.

5.1 *-ing*

The Dutch suffix *-ing* is mentioned by most scholars as an example of a Type A affix. It derives nouns from verbs, just like its counterpart in English. It is however much less productive than the corresponding English form (cf. Van Haeringen 1971, De Haas and Trommelen 1993). In essence, productive *-ing* formation seems to be restricted to words derived by the suffixes *-eer* (or *-iseer*, 38a) or by prefixes (38b), although there are a few words which are formed of a simple verb plus the suffix *-ing* (38c):

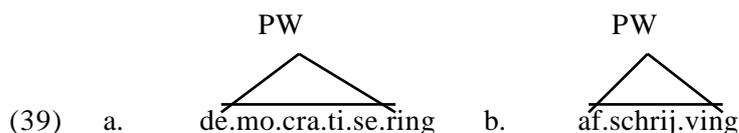
- (38)
- standaardisering* 'standardisation', *accentuering* 'accentuation',
democratisering 'democratisation'
 - onderbreking* 'interruption' (*breking 'breaking'), *aanraking* 'touch'
(*raking 'touch'), *afschrijving* 'copy' (*schrijving 'writing')
 - wrijving* 'irritation' (from *wrijf* 'rub'), *speling* 'leeway' (from *speel* 'play')

The reputation of *-ing* as a stress-neutral suffix probably derives from forms such as those in (70b).²⁴ The word *afschrijving* for instance has the stress pattern [áfsxreivɪŋ], which is not the stress pattern of an underived word, because in such a word stress cannot occur to the left of a diphthong. In other words, the form of *afschrijving* is different from that of an underived form. Presumably, this is the reason why this form has been called 'stress-neutral'.

It should be observed, however, that the stress of *schrijving* is not unusual for a simple phonological word at all. In other words, there is nothing in the facts in (38) that argues

²⁴ In words ending in *-ering*, stress is on *-eer*, just as it would be if the word were underived (i.e. from these forms alone we cannot tell whether *-ing* is stress attracting or stress neutral.)

against prosodic analyses such as those in (39), in which *-ing* is always incorporated in the phonological word of the base:²⁵



The problem is that *-ing* does not seem to be sufficiently productive to provide us with those cases which would really be a good test to see whether it is stress attracting or not. All the stems I have found to which *-ing* could be attached either ended in a stressed syllable (*wrijving* [wreivɪŋ]) or in a stressed syllable followed by schwa (*gijzeling* [ɣéizəlɪŋ] ‘kidnapping’ from *gijzel* [ɣéizəl]). In both cases, it is hard to see where stress could have been other than in the position where it is.

We can actually observe that the rhyme sequence [ɪŋ] never gets stressed in Dutch, not even in underived forms: although there are quite a few words such as *koning* ‘king’, *paling* ‘eel’, *honing* ‘honey’, each of them with stress in the first syllable, there is no word in Dutch which ends in stressed *-ing* (with the exception of those words in which *-ing* is the only available rhyme, such as *zing* ‘sing’ and *ring* ‘ring’.) As a matter of fact, there is a series of place names in Dutch, such as *Scheveningen*, *Wateringen*, etc., which are exceptions to the three-syllable window requirement, because they have stress on the first (preantepenultimate) syllable of the word. Typically, the final three syllables in these words contain either schwa or *-ing*. This provides us with extra indications that the rhyme sequence *-ing* is not likely to be stressed, even if it is not a suffix.²⁶ Its behaviour in derived forms therefore can probably be derived from its phonological shape, just as is expected given the general assumptions of this paper.

5.2 *-isch*

Another suffix that is problematic, but for somewhat different reasons, is *-isch*/i:s/ ‘-ic’. This suffix does not get stressed, even though it is superheavy. On the other hand, it is not stress-neutral either (which of course we do not expect because it is superheavy but does not start with a consonant). Rather, it is stress-attracting (like its English counterpart), and in a way it is the only real stress-attracting suffix of Dutch. Stress is on the syllable preceding *-isch*.

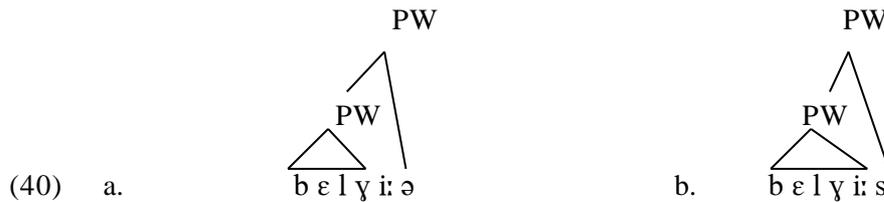
Trommelen and Zonneveld (1989:204-208) try to account for this special behaviour by assuming that the underlying structure of *-isch* is approximately /i:əs/. They argue that this type of phonological structure automatically gives stress on the antepenultimate syllable (i.e. directly in front of schwa). The suffix thus is similar in behaviour to English *-ity*, according to Trommelen and Zonneveld (1989). We may also note that the high front vowel /i~/ behaves unusually in other parts of the stress system as well. Regular stress rules would predict penultimate stress on words such as *Italië* /italiə/, for instance, but stress in this case skips the penultimate syllable and falls on the antepenultimate: [itálijə]. Still this is not

²⁵ The only type of ‘stress shift’ that we might expect to occur, but that is not actually attested, is a shift of compound stress from the first phonological *word* to the second. This type of stress shift does occur with certain Class I suffixes (*afvallen* [áfvalə] ‘lose faith’ (litt. fall off) - *afvallig* [afvállɪx] ‘having lost faith’) but apparently not with *-ing*. The reason why compound stress shift occurs in the first place, however, is very far from clear. I will not go into this here.

²⁶ In some analyses (Kager and Zonneveld 1986), *-ing* is supposed to be derived from an underlying schwa+N.

completely satisfactory under the approach presented above, since we have claimed that in underived words are on the syllable immediately preceding schwa. So from this point of view, both *-isch* and *-ië* are problematic suffixes. It therefore is not possible for us to accept Trommelen and Zonneveld's (1989) proposal without modification.

Morphologically, these two suffixes are probably related; there is a number of roots which can host both of them: *België* 'Belgium' - *Belgisch* 'Belgian', *Indië* 'India' - *Indisch* 'Indian', *Servië* 'Serbia' - *Servisch* 'Serbian', *Karinthië* 'Carinthia' - *Karinthisch* 'Carinthian', etc.²⁷ Both of these suffixes start with an /i/ and have a second element (a coronal fricative or a schwa) that can be adjoined to the prosodic word. It is almost as if this /i/ a separate morpheme. What I propose, then, is that these forms behave as if they have two suffixes, one of which is the structure of this forms is as in (40):



These suffixes are exceptional then, in that they have some internal structure (we cannot assume that /i/ is a separate suffix, since it cannot occur on its own). But this internal structure is expressed in the phonology in exactly the same way as other forms of internal morphological structure are.²⁸

6. Conclusion

In this paper, I have argued that there is an intimate relation between the phonological shape of Dutch suffixes and their morphological function. The morphological structure has to be expressed in the phonological shape. There are two ways in which this should be done: phonological trees are ideally isomorphic to the morphological trees they serve to mirror (formalized here in the constraint MIRRORING), and morphological heads should get word stress (formalized in the constraint HEAD-STRESS).

In inflectional forms, the two constraints do not conflict: they have a recursive phonological word, in which stress is on the stem. In derivational forms, the two constraints do conflict: on the one hand we would like to have the suffix in an adjoined position, but on the other hand, this is not possible because in this adjoined position the suffix can never be heavy enough to get main stress. Derivational suffixes therefore come in two flavours: some respect the phonological structure, hence do not assign stress to the suffix. Others assign stress to the suffix, and therefore do not mirror the morphological tree in the phonology. If the latter is the case, there are two options: if the suffix is vowel-initial it is completely integrated with the prosodic word of the stem, in order for it to satisfy Onset. If the suffix is consonant-initial, it is not integrated with the prosodic word of the stem, but rather it forms a

²⁷ There are quite a lot of exceptions to this generalisation as well, both forms ending in *-ië* that do not have a correspondent in *-isch* (*Wallonië* 'the Walloon provinces' - *Waal* 'Walloon') as words ending in *-isch* that cannot be related to any regional name (*typisch* 'typical' - **typië*).

²⁸ This still does not solve the whole problem, since /i:/ is still not a typical derivational suffix: it does not attract main stress. There is something special about coronal vowels, however, in the sense that they sometimes seem to behave schwa-like. Maybe this is going on here as well.

compound-like structure with it, in this way compromising between the requirements of HEAD-STRESS and MIRRORING.

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