

# Accentuation of Adpositions and Particles

## Towards a set of rules for predicting accent locations on adpositions and particles for Dutch text-to-speech technology

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### Abstract

In this paper I propose an accent placement algorithm that locates accents on adpositions and particles for the use in a Dutch text-to-speech (TTS) system. The algorithm is intended to be a refinement of the rule that accents only content words, which is used in most TTS systems. Before the algorithm is set up, I discuss when adpositions and particles are accented in Dutch. For this empirical research, I made use of the Spoken Dutch Corpus (CGN) as empirical material. The combination of part-of-speech, syntactic as well as prosodic information for approximately 125,000 words in the CGN made it possible to determine whether the accentuation of adpositions and particles depends on their syntactic use within a sentence, or on the syntactic use of other constituents in the same sentence. The proposed accentuation algorithm takes a dependency tree with part-of-speech information as input.

### 1 Introduction

It is important that the speech generated by computers sounds as natural as possible. This leads to a more intelligible content and as a result it takes less effort for listeners to understand the meaning of an utterance and it will be easier for them to listen to synthetic speech. An important feature that contributes to the naturalness of the quality of speech is prosody. The word prosody refers to certain properties of speech, such as the location and duration of breaks between two parts of utterances, the duration of a syllable and the absence or presence of accents.

In this paper I will concentrate on one aspect of prosody, i.e. which words in an utterance are spoken with accent and which ones are spoken without accent. To correctly predict the location of accents in a sentence one needs a fully specified syntactic analysis and an interpretation of the utterance. Other helpful information is the context in which the sentence is uttered and the intention of the speaker. In general we cannot expect all this information to be available in a TTS system. Therefore, a very simple solution (1) has been proposed to approximate the correct generation of accentuation in a TTS system:

- (1) Put accent only on content words but not on function words.

Content words are nouns, adjectives, adverbs and lexical verbs. Function words are articles, prepositions, pronouns, auxiliaries and conjunctions. The only information needed when a system uses this rule (1) is a distinction between content words and function words. For Dutch, this rule correctly predicts accent for 79% of the words in a sentence (Marsi et al. 2002). Though this is an impressive result with such a simple rule, it still means that on average three words in a sentence

have an incorrect accent (assuming an average sentence length of 15 words), which shows that improvement is desirable.

The goal of this paper is to change rule (1) in such a way that accentuation in TTS systems improves, and that the speech output becomes more natural and intelligible. This study will focus on the accentuation of Dutch function words such as *in* ('in'), *op* ('on') and *naar* ('to'). These words can be used as adpositions<sup>1</sup> and particles. Examples of prepositions, which are adpositions that precede their complement, are given in (2) (the preposition is in italics). Particles are the separable part of separable compound verbs, such as *opbellen* ('to call (up)'), *aanstaren* ('to stare at'), *uitleggen* ('to explain'). These particles can occur separated from the verb, as in (3), where both the verb and the particle are in italics.

- (2) a. Hij zet de bloemen *op* de tafel.  
He puts the flowers on the table
- b. Ik vlieg morgen *naar* Schotland.  
I fly tomorrow to Scotland  
'I will fly to Scotland tomorrow.'
- (3) a. Ik *belde* hem *op*  
I called him up  
'I called him (up).'
- b. Hij heeft altijd al met haar *uit* willen *gaan*.  
He has always already with her out want go  
'He had always wanted to go out with her.'

Odijk (2003) notices that words used as a particle are accented, whereas the same words used as an adposition are often not accented. Accentuation rule (1) does not distinguish this difference in accentuation, as both particles and adpositions belong to the group of function words. In this study I will analyse the relevant facts in more detail.

The main question to be answered in this paper is given in (4).

- (4) How can the accentuation of adpositions and particles be regulated automatically in a Dutch text-to-speech system?

I stated above that "the same words used as adpositions are often not accented", which implies that there are cases where adpositions are accented. In order to answer the question given in (4), a subquestion (5) will be answered.

- (5) When are adpositions and particles accented in Dutch human speech?

<sup>1</sup>In most literature, the notion *preposition* is used instead of *adposition*. But in strict terms, a preposition is a word that precedes its complement. In this paper I also distinguish postpositions, circumpositions, intransitive adpositions, phrasal prepositions, stranded prepositions, and adpositions that are part of a pronominal PP (in Dutch a pronominal PP is called *voornaamwoordelijk bijwoord* and an example is *erop* in the sentence *ik plak het erop* ('I stick it on it')) and therefore I use the notion *adpositions* as a general term.

In order to answer this question I will use the Corpus Gesproken Nederlands (CGN, Spoken Dutch Corpus)<sup>2</sup> as empirical material.

In the next section I discuss when adpositions and particles are accented. In section 3 I present my accentuation algorithm. Section 4 concludes this paper.

In Grégoire (2004) a large part is divided to the different uses of adpositions and adpositional phrases in Dutch. For each P<sup>3</sup> it was empirically tested whether it is accented in Dutch. For the purpose of this paper I will only discuss the Ps that are accented in some occurrences. For each of these Ps I will formulate hypotheses and test them empirically using the prosodically annotated text material of the CGN.

## 2 Accent placement on adpositions and particles

a TTS system generally deals with input text in two stages. In the first stage the input is linguistically analysed. The result is a phonetic representation of the utterance, which serves as input of the second stage, the speech synthesis, which involves converting this representation into a synthetic speech signal. In this thesis I focus on converting an input text consisting of words into the same text in which the accents are marked, ignoring processes such as grapheme-to-morpheme conversion and speech synthesis.

The process I propose that generates an accented text from an unaccented text includes three tasks, viz.

1. part of speech tagging
2. syntactic parsing
3. accent placement

Merely PoS and syntactic information is not sufficient as input for accent placement, as predicting accent locations requires semantic and discourse information as well. As was stated in the introduction to this thesis, syntactic parsing in the CGN project involves - besides the assignment of category labels to each mother node - the assignment of dependency labels that denote the relation of a certain constituent with respect to another constituent dominated by the same mother node. This means that in the output of the syntactic annotation semantic information is visible to a certain extent. Because of this and because I assume that PoS tagging and syntactic annotation can be done automatically, I suggest that the applications used by the CGN project for PoS tagging and syntactic annotation should be used to perform task (1) and (2).

It must be taken into account that since both the PoS tags and the syntactic annotations were manually checked, we cannot just rely on the automatic output and that improvement of these applications is needed. I will discuss this point in

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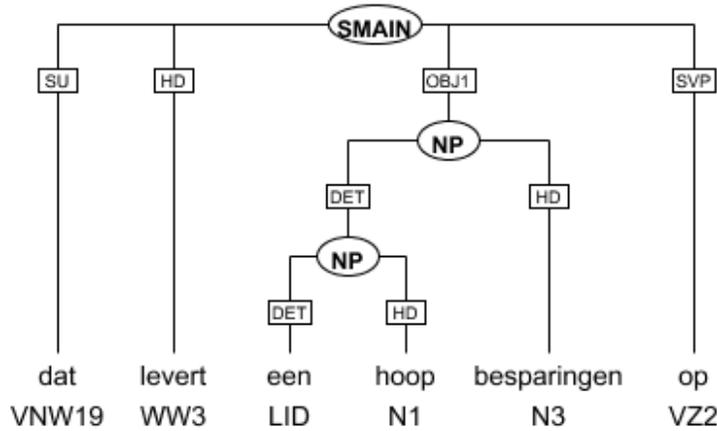
<sup>2</sup>The *Spoken Dutch Corpus* is a database of contemporary Dutch as spoken by adults in the Netherlands and Flanders. The project is funded by the Flemish and Dutch governments and the Netherlands Organization for Scientific Research NWO. Its homepage is <http://lands.let.kun.nl/cgn/ehome.htm>.

<sup>3</sup>I use the notion *Ps* to refer to all adpositions and particles

the next chapter. In this chapter I assume that the output of automatic PoS tagging and syntactic annotation is 100% consistent and reliable.

The output of the CGN PoS tagger and syntactic annotator, which serves as the input for the accent placement task is illustrated in (1).

- (6) ‘that yields a great deal of savings’



In the remainder of this chapter I discuss the assignment of accents to a dependency tree such as (1). I propose an algorithm for accent placement on adpositions and particles for the use in Dutch TTS systems. This algorithm is intended to be a refinement of the basic rule that simply assigns an accent to every content word.

The approach adopted to attain this goal starts from the focus and accentuation proposals in Marsi (2001). Although Marsi's rules are implemented in a concept-to-speech system,<sup>4</sup> whereas my proposals are for a text-to-speech system, I will show that using a dependency tree such as (1) as input for the accentuation rules, Marsi's proposals can be adapted in such a way that they can predict the accent locations of adpositions and particles in a TTS system.

First I present the accentuation algorithm in Section 5.2. Possible complications are discussed in Section 5.3. The chapter ends with a summary in Section 5.4.

## 2.1 Accentuation Algorithm

In this section I adapt Marsi's accentuation algorithm so that it can take a dependency tree with part-of-speech information, such as (1), as its input. In addition I propose a set of rules that locate accents on those Ps that are to be accented according to the claims formulated in the previous chapter. The rules of the algorithm for pitch accent placement are presented in (2) (Marsi 2001).

<sup>4</sup>In concept-to-speech systems, spoken output is generated on the basis of a text that has been produced by the system itself.

**(7) Rules of the algorithm for pitch accent placement**

1. Sentence Accent Assignment Rule (SAAR)
2. NP premodifier Deaccentuation (NPPD)
3. Rhythm Rule (RR)
4. Lexical Rhythm Rule (LRR)
5. Unit Rhythm Rule (URR)

In Marsi's implementation focus assignment and applying the Focus Projection Rules - as discussed in the previous chapter - are performed in a module other than the one where the rules for pitch accent placement are carried out. In this chapter I focus on rules for accent placement on adpositions and particles. Because rules (2)-(5) do not affect the accentuation of Ps, I will not discuss them in this thesis. For more information on these rules I refer to Marsi (2001, Chapter 7). The accentuation algorithm I propose is presented in (3).

**(8) Accentuation algorithm**

1. Assign focus
2. Apply the Focus Projection Rules
3. Apply the Rules for Focusing Adpositions and Particles
4. Apply SAAR

The input of the accentuation algorithm is restricted to a dependency tree that contains at least one verbal domain. A verbal domain is a constituent which head (HD) is a (finite or infinite) verb. Six verbal domains are distinguished in the CGN. The category label and a description of each verbal domain are given in table 1.

Table 1: Category labels of verbal domains in the CGN.

<i>c</i> -label	description
SMAIN	declarative sentence (verb second)
SSUB	subordinate clause (verb final)
SV1	verb first sentence
INF	infinitive clause
PPART	past participle clause
PPRESS	present participle clause

A verbal domain may be embedded in another verbal domain. The accentuation rules I propose are to be applied to each verbal domain.

**2.2 Focus assignment**

The first task of the accentuation algorithm is to assign focus (the feature FOC) to every content word. Since it is not so clear whether adverbs are content words or

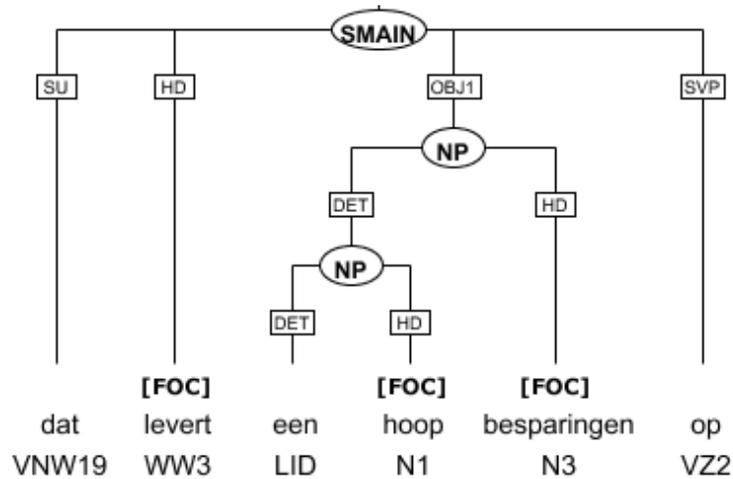
Table 2: Parts-of-speech distinguished in the CGN that are content words.

part-of-speech	abbreviation for	translation
ADJ	<i>adjectief</i>	adjective
N	<i>nomen</i>	noun
TW	<i>telwoord</i>	numeral
WW	<i>werkwoord</i>	verb

function words (Marsi 2001, p. 232), I follow Marsi in his decision not to focus adverbs. The following part-of-speech tags - used in the CGN - are content words:

The focus assignment rule has no access to the given-new information of the sentence constituents. This means that every content word is focused, even if it conveys 'old' information. In dependency tree (1) the words *levert*, *hoop* and *besparingen* are content words according to their part-of-speech labels. In the dependency tree shown in (9) the feature FOC is assigned to each content word.

(9) 'that yields a great deal of savings'



### 2.3 Focus Projection Rules

The accentuation algorithm employs a set of Focus Projection Rules proposed by Marsi (2001, 217), based on Selkirk (1984 and 1995):

(10) **Focus Projection Rules**

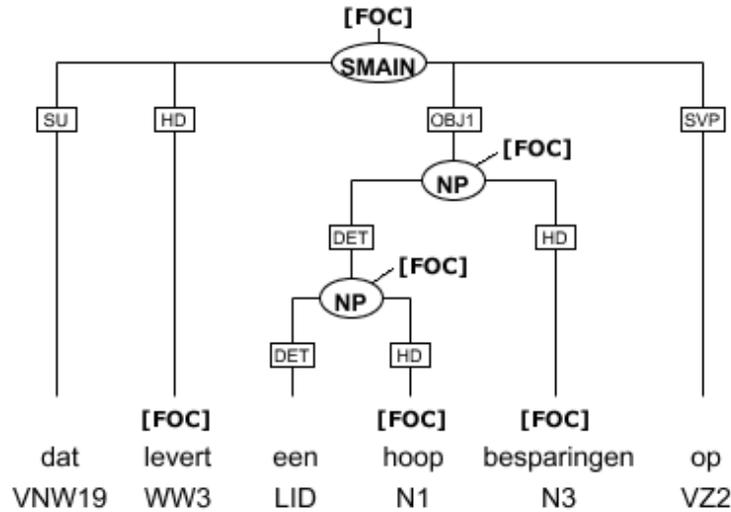
- a. If the head of an NP is focused, then the NP is focused as well.
- b. If the head of an AP is focused, then the AP is focused as well.

- c. If the NP argument of a P is focused, then the PP is focused as well.
- d. If the main verb in an S is focused, then the S is focused as well.
- e. If all the conjuncts of a coordination are focused, then the coordination is focused as well.

According to these rules it is not sufficient if only the modifier of an NP, AP or S is focused. If, for example, only the N London but not the N train in the NP the train to London is focused, rule (2c) will project focus on the PP to London, but there is no rule in (2) that licences any further projection. This means that the NP is not focused, according to FPR. However, if the N train is focused, rule (2a) will project focus onto the whole NP.

Applying the Focus Projection Rules to the output of the focus assignment task results in (11).

- (11) ‘that yields a great deal of savings’



#### 2.4 Rules for Focusing Adpositions and Particles

In this section rules for focusing adpositions and particles are proposed. According to the claims for the accentuation of adpositions and particles - formulated in the previous chapter - initial Ps are never accented, i.e. words that are labelled 'VZ1' should not be assigned focus. Furthermore, not all final Ps are to be focused. The claims that state that a P is accented under certain circumstances are repeated in (12).

- (12) a. The second part of a circumposition is accented if and only if its complement is not accented.

- b. An intransitive adposition is always accented.
- c. A particle is accented if and only if it is not directly adjacent to a focused argument or when there is no focused argument in the verbal domain at all.
- d. A stranded preposition in an LD PP is accented if and only if it is not adjacent to a focused constituent.

On the basis of these claims I propose the following sets of focus rules:

(13) **Focus Rules for Adpositions (FRA)**

Assign the feature [FOC] to each 'VZ2' word if,

- (i) it carries the d-label HDF and if the OBJ1 within the PP does not have the FOC-feature, or
- (ii) 1. it is directly attached to the verbal domain without an intervening PP c-label, and  
2. does not have the d-label SVP, or
- (iii) it carries the d-label OBJ1 within a PP, or
- (iv) 1. it carries the d-label HD within a PP, and  
2. the OBJ1 within the PP has the PoS label 'VNW20'<sup>5</sup> or 'VNW15'<sup>6</sup>.  
3. this PP has the d-label LD, and  
4. there is no constituent that is marked with the FOC-feature adjacent.

(14) **Focus Rule for Particles (FRP)**

Assign the feature [FOC] to a 'VZ2' word that has the d-label SVP, if there is no argument that is marked with the FOC-feature adjacent.

In addition I propose a rule for defocusing the verbal part of a particle verb.<sup>7</sup>

(15) **Defocusing Rule for Verbal parts of particle verbs (DRV)**

Delete the FOC-feature from the head of the verbal domain in which a word that has the PoS label 'VZ2' and the d-label SVP occurs.

As claimed, a preposition in a pronominal LD PP is accented if and only if it is not adjacent to a focused constituent. In Chapter 3 it was stated that pronominal PPs in the CGN do not belong to the adposition set, but are tagged as 'BW'. Since there are many types of adverbs, which are not further subdivided in the CGN, a more refined classification is needed in order to distinguish the pronominal PPs from

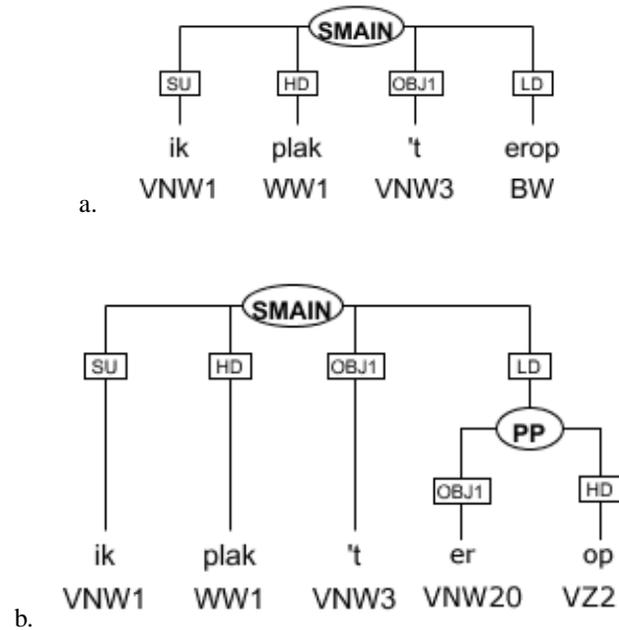
<sup>5</sup>The PoS tag 'VNW20' is used for the R-pronouns *er*, *d'r*, *daar* and *hier*.

<sup>6</sup>The PoS tag 'VNW15' refers to the R-pronoun *waar* ('where'), which is attached to the PP by a secondary edge.

<sup>7</sup>In the previous chapter, no conclusions were drawn regarding the accentuation of the verbal parts of particle verbs. Therefore, I follow Marsi in his assumption that if a particle verb is accented, the accent goes to the particle.

other adverbs. This problem can be solved by assuming that pronominal PPs can be recognised in the CGN by the lexicon and that they are split into two separate words that are PoS tagged and syntactically annotated as stranded prepositions. An example is given in (16): in (16a) it is shown how pronominal PPs are dealt with in the CGN and (16b) shows my suggestion on how the CGN should deal with pronominal PPs.

(16) 'I stick it on it'



Since the preposition in a pronominal PP is to be focused under the same circumstances a stranded preposition is focused under, no extra focus rule for pronominal PPs is needed.

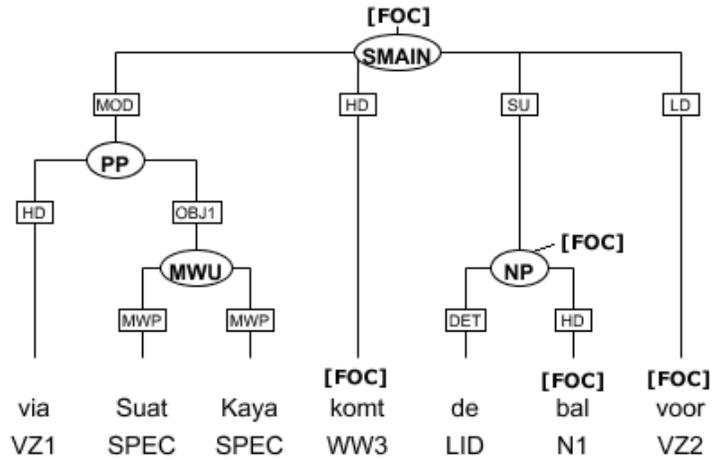
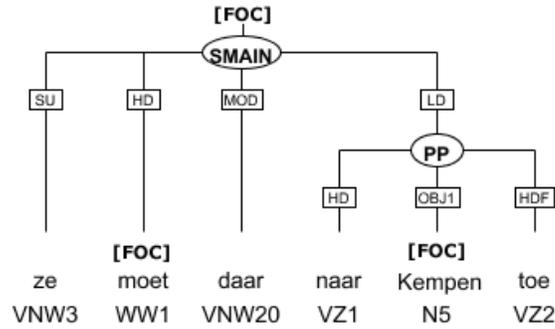
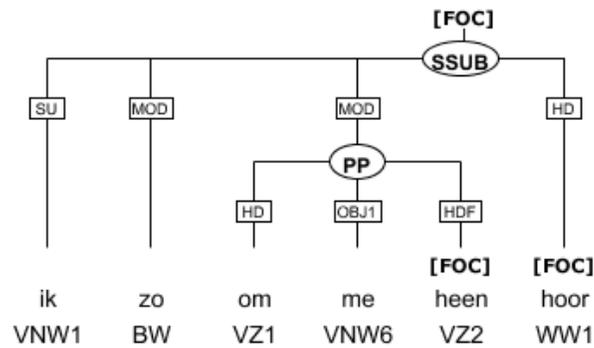
The output of FRA (i) is given in (17). In (17a) the *heen* is assigned the feature [foc], because it has the PoS tag 'VZ2' and the d-label HDF, and the OBJ1 within the PP does not have the FOC-feature. Although *toe* in (17b) has the PoS tag 'VZ2' and the d-label HDF FRA does not assign the FOC-feature to it, because the OBJ1 within the PP is focused.

- (17) a. 'I have heard in my environment'
- b. 'she has to go to Kempen over there'

An illustration of the output of FRA (ii) is shown in (18).

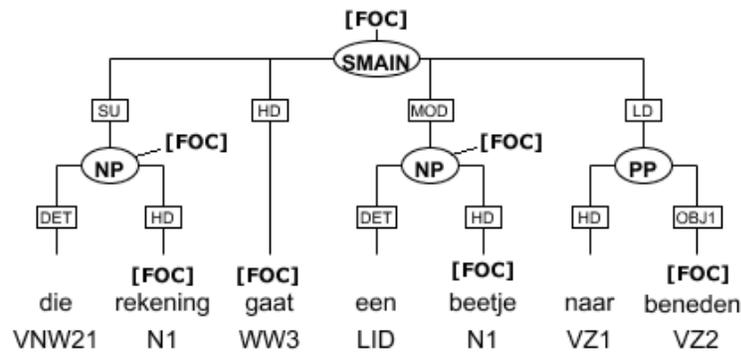
(18) 'the ball comes at the goal via *Suat Kaya*'

An example of the output of FRA (iii) is given in (19).



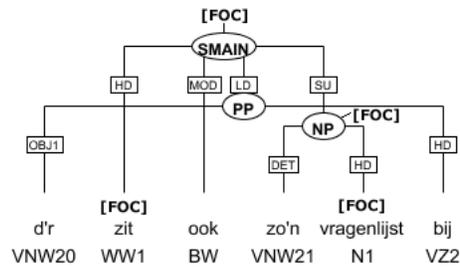
(19) 'that bill will be reduced a bit'

FRA (iv) is illustrated in (20). In (20a) *bij* is PoS tagged as 'VZ2', it is the head of the PP, the OBJ1 within that PP is a 'VNW20', and this PP had the d-label LD. However, *bij* is not accented, because there is an adjacent focused constituent, in

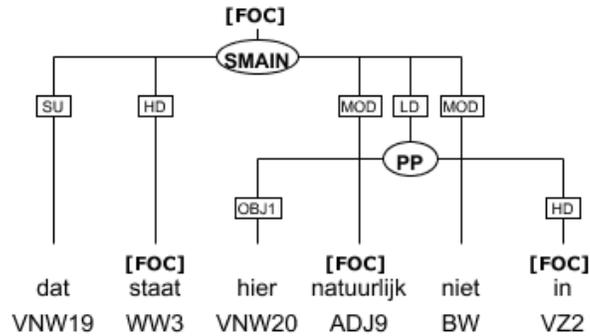


this case the subject NP zo'n vragenlijst. In (20b) the stranded preposition in is focused, because no focused constituent is adjacent. In (20c) the pronominal PP is annotated as proposed and since no focused constituent is adjacent to the LD PP, the preposition op in this PP is assigned the FOC-feature.

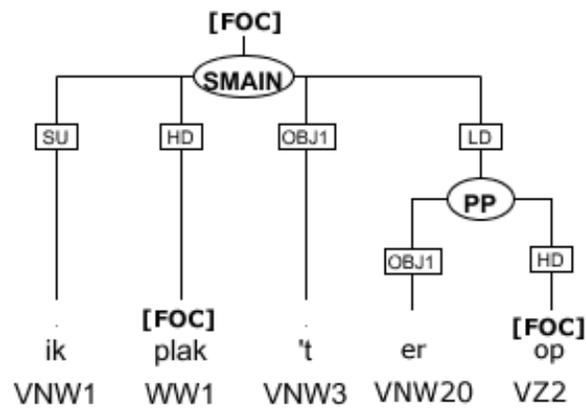
(20) a. 'there is also such a questionnaire included'



b. 'that is not in here of course'

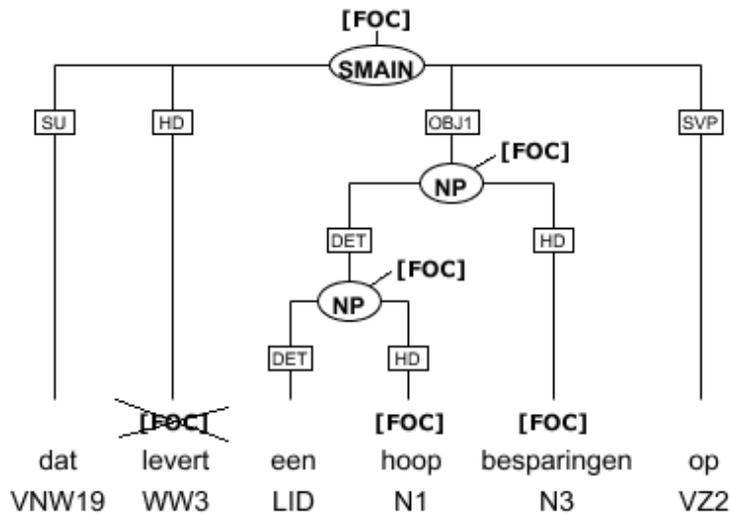


c. 'I stick it on it'

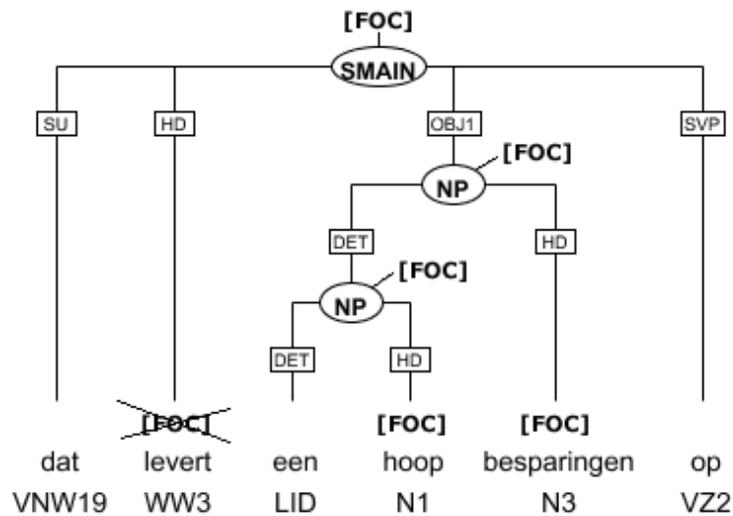


The output of FRP and DRV is illustrated in (21). In both (21a) and (21b) DRV deletes the FOC-feature on the head of the verbal domain, because a word - in (21a) *op* and in (21b) *uit* - that has the PoS label 'VZ2' and the d-label SVP occurs in the same domain. In (21a) the particle *op* remains unfocused, because a focused argument - the OBJ1 NP *een hoop besparingen* - is adjacent, whereas in (21b) the FOC-feature is assigned to the particle *uit*, since no focused argument is adjacent.

(21) a. 'that yields a great deal of savings'



b. 'one way or the other you radiate that'



## 2.5 SAAR

The outputs of the preceding section constitute the input of the Sentence Accent Assignment Rule

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