PAST TENSE MARKING IN AFRIKAANS*

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Abstract

The system of past tense marking in Afrikaans provides empirical evidence for the need for scope underspecification and multiple exponency of semantic operators within the system of compositional semantics. *Lexical Resource Semantics* (LRS, Richter and Sailer 2003) has incorporated these two features, allowing for a straightforward account of the data.

1 Introduction

Since Montague (1974) the Fregian concept of *compositionality* has been subject to a particular technical incarnation (Partee 1984). In particular it is assumed that the meaning of a lexical element can be stated as an expression of a formal language, and consequently the meaning of a syntactically complex structure results from applying combinatorial operations (such as functional application) to the meaning of the parts of this structure. These assumptions have led to the development of theories of the syntax-semantics interface such as *Transparent Logical Form* (Stechow 1993). On the other hand these strong assumptions require the syntactic structure to contain many nodes which are not motivated by syntax proper. In particular, for semantically ambiguous sentences a different syntactic representation is assumed for each reading. This consequence was the reason to reject the "naive" concept of compositionality within a number of theories such as *Lexical Function Grammar* or *Head-Driven Phrase Structure Grammar*. Instead, Halvorsen (1995) has coined the notion of *systematic* semantics to capture the idea that even though the interpretation of syntactic structures is not "compositional" in the above-mentioned sense, syntax and semantics are still systematically related to each other.

In this paper we will present empirical evidence for phenomena which are hard to account for within a traditional compositional system. We will argue that the system of past tense marking in Afrikaans can best be described in terms of scope underspecification and multiple exponency of semantic operators. Scope underspecification has become a widely discussed issue in computational semantics (Reyle 1993, Pinkal 1996). Multiple exponency, on the other hand, has not been in focus so far.[1]

In the following we will discuss the interpretation of Afrikaans sentences such as in (1) which contains two morphological past markings: the verb *wou,* and the complex *gekoop het*.

(1)	Jan wou	die boek gekoop	het.	
	Jan wanted.IMP	the book bought.PART	AUX	

*For comments and discussion I would like to thank Gerald Penn, Monika Rathert, Ede Zimmermann two anonymous reviewers and the audience of SuB8. Thanks to Guthrun Love for her help with the English.

[1]Another phenomenon, semantic discontinuity, is one of the major motivations for the assumption of a phonologically empty negative head in German in Penka and von Stechow (2001).

In: Cécile Meier, Matthias Weisgerber (ed.) 2004: *Proceedings of the Conference "sub8 – Sinn und Bedeutung". Arbeitspapier Nr. 177, FB Sprachwissenschaft, Universität Konstanz, Germany*

As discussed in the literature (de Villiers 1971, Ponelis 1979, Donaldson 1993, Kleij 1999), sentences of the type illustrated in (1) are systematically ambiguous in Afrikaans In (2) we will indicate the three possible temporal readings,[2] first by an English translation and then by a logical term. In the latter, we use the operator "ˆ" to indicate intensional contexts, and the operator "PAST" to indicate a semantic past tense. In Section 2 we will adopt a more elaborate semantic representation of tense based on Stechow (2002).

(2) a. Jan wanted to have bought the book.
PAST(Jan wants ˆPAST(Jan buys the book))
b. Jan wants to have bought the book.
Jan wants ˆPAST(Jan buys the book)
c. Jan wanted to buy the book.
PAST(Jan wants ˆ(Jan buys the book))

In Section 2 we will introduce some basics of Afrikaans verbal morphology and discuss the temporal value of the past tense forms in simple sentences, and in Section 3 we will discuss some more complex examples. Then we will present the semantic system LRS (*Lexical Resource Semantics*, Richter and Sailer 2001a, 2003) and apply it to simple sentences. In Section 5 we will illustrate the resulting analysis for sentence (1). We will close with a conclusion in Section 6.

2 Basic Data

In this section we will present basic facts about the Afrikaans temporal system. First the inventory of forms will be described (Section 2.1), then we will discuss the temporal interpretation of clauses which contain at most one marker of anteriority in Section 2.2.

2.1 Afrikaans Verbal Morphology

In comparison to the verbal systems of related languages such as Dutch or English, Afrikaans verbal morphology is relatively simple. We will outline this system using a simplification of the terminology from de Villiers (1971).

The copula *wees* (*be*) is the only verb which has a morphological inventory similar to that of related languages.[3] The form *wees* is an infinitive. There is a finite *presens* (present tense) form *is* and a finite *imperfek* (past tense) form *was*. In addition there is a past participle *gewees*. The past participle can combine with either finite forms of the copula (i.e., *is* or *was*) or with the auxiliary verb *het* to form a so called *perfek* (perfect tense). Note that while the combinations *gewees is* and *gewees was* are necessarily finite, *gewees het* can also be used in infinitival contexts.[4]

(3) En inflasie . . . sou sekerlik laer kon gewees het, as . . .
and inflation would surely lower could been.PART AUX if
'and inflation could certainly have been lower if . . . '

[2] In addition to the past tense use, *wou* and *gekoop het* can also be irrealis. Thus we may obtain the readings *Jan would love to have bought the book*, and *Jan would love to buy the book*. We will ignore these irrealis readings throughout this paper.

[3] The verb *hê* (*have*) has almost as many forms as *wees* in formal registers. We will, however, ignore this verb throughout the paper.

[4] Found at: `http://www.accountancysa.org.za/archives/2002jan/columns/wik.htm`

In contrast to this morphological richness, the majority of verbs such as *koop* (*buy*) in (1) have just two forms: a base form, e.g. *koop*, and a past participle, e.g. *gekoop*. The base form is used as a finite verb to form the *presens*. The base form is also used as a bare infinitive, for example as a complement of the verb *wil* (*want*). The participle is used to form the *perfek* when combined with the auxiliary *het*. Like the form *gewees het*, the *perfek gekoop het* can be both finite or infinite. For verbs like *koop* there is no *imperfek* form.

A small group of verbs, such as *wil* (*want*) or *kan* (*can*) have a base form which is used as bare infinitive and as *presens* form. Instead of a past participle, however, these verbs have a morphologically simple *imperfek* (imperfect tense): *wou* (*wanted.IMP*), *kon* (*could.IMP*). The *imperfek* forms also occur as bare infinitives such as in (4).[5]

(4) Ek het niks oorgehad om te kon deel nie
I AUX nothing left over for to could.IMP share NEG
'I didn't have anything left over to be able to share.'

The auxiliary *het* can be used in finite and infinitival contexts (see (1) for the latter). It lacks a participial form, however. Thus a hypothetical "pluperfect tense" realized morphologically as a "double perfect" such as in Southern German dialects or in Yiddish (see (5-a)) cannot be formed in Afrikaans.

(5) a. Yiddish: ikh hob aykh gehat gevarnt ir zolt nit geyn.
I have you.PL had.PART warned.PART you.PL ought not go.INF
'I had warned you (formal) not to go.' (Katz 1987, p.,138)

b. Afrikaans: ek het u gewaarsku *het/ *gehad
I AUX you (formal) warned.PART AUX/ have.PART

2.2 The Interpretation of Tense in Simple Clauses

The way in which Afrikaans makes use of its morphological potential is intriguing. For the purpose of this paper we will confine ourselves to outlining a number of central phenomena. The method of past tense marking differs according to the verb (*wees*, *koop*, *wil*). We will first consider the use of finite *presens* forms in Section 2.2.1. Then we will discuss properties of finite uses of the *perfek* (Section 2.2.2) and of the finite *imperfek* (Section 2.2.3).

2.2.1 *Presens* in Simple Clauses

The terminology introduced above suggests that *perfek* and *imperfek* would be the tenses used to indicate anteriority. In Afrikaans, however, a *presens* can also be used for this purpose if there is another indication of anteriority in the context. This is illustrated in (6) (quoted from de Villiers 1971, p. 47).

(6) a. Hy het dadelik huis toe gestap.
he AUX really house towards stepped.PART
'He really stepped towards his house.'

[5] For the sake of simplicity, we will assume that the forms *wil* and *wou* can be past participles since the combinations *het wil/wou koop* are possible. In a syntactically more adequate system these forms might possibly count as *Ersatzinfinitiv* since bare infinitives are used in German and Dutch instead of a past participle in similar contexts (see Robbers 1993).
Example (4) is taken from: `http://home.global.co.za/~gfjh7up/s_mug05.htm`

b. Toe stap hy dadelik huis toe.
Then goes he really house towards
'Then, he really stepped towards his house.'

c. Verlede week stap hy huis toe, en daar sien hy sy buurman ...
last week steps he house towards and there sees he his neighbor ...
'Last week, he stepped towards his house and there he saw his neighbor ... '

Parallel data can be given for verbs with an *imperfek* form. Note that except for the case illustrated in (a), either the *presens* or the *imperfek* can be used.

(7) a. Hy wou huis toe stap.
he wanted.IMP house towards step

b. Toe wou/ wil hy huis toe stap.
then wanted.IMP/ wants.PRES he house towards step

c. Verlede week wou/ wil hy huis toe stap ...
last week wanted.IMP/ wants.PRES he house towards step ...

This indicates that the *presens* form does not make explicit reference to the speech time as part of its meaning. Instead, it can require overlap with any contextually given time. We will use the notation in (8-b) for the logical forms of a verb in *presens*.

(8) a. Jan bel.
Jan calls.PRES 'Jan calls.'

b. $\exists e(\tau(e) \odot s^* \wedge \mathsf{call}'(e, j))$

We will take s^* to be the contextually given speech time. In accordance with Stechow (2002) we will write $\tau(e)$ for the time of the event. This time overlaps ("$\odot$") with the speech time.

We will also specify the logical form of the verb *wil* (*want*) in (9-b). This specification should be regarded as an outline which contains the necessary ingredients for our analysis rather than a fully fledged semantic analysis.

(9) a. Jan wil bel.
Jan want call 'Jan wants to call.'

b. $\exists s(s \odot s^* \wedge \mathsf{want}'(s, j, {}^\wedge\exists s^*(s^* \approx s \wedge \exists e(\tau(e) \odot s^* \wedge \mathsf{call}'(e, j)))))$

The verb *wil* denotes a state. States are assumed to be true or false of times. Therefore the verb *wil* introduces a time, s, which appears as a temporal argument of the constant want'. In the *presens*, Jan's desire to call is true of a time s which overlaps with the speech time s^*. In addition what Jan wants is a proposition. This proposition is an intensional object — indicated by the "up" operator. Within the proposition a new "speech time" s^* is introduced. This new s^* is said to correspond to the time of Jan's wanting ($s^* \approx s$).[6] The rest of the logical form is identical to the logical form of the *presens* example in (8).

Note that the base form *bel* is interpreted in the same way whether it is used as a finite verb or as an infinitive under our analysis. In the latter case, however, s^* is not the matrix speech time but shifted by the intensionality of the verb *wil*.

[6]As noted in Katz (2001), in such contexts the embedded event is usually interpreted as occurring after the matrix time. A simple solution would be to incorporate this shifting into the restrictions on the embedded speech time. To keep our logical forms simple, we will ignore this problem.

2.2.2 *Perfek* as Past

Kleij (1999) argues that (in unembedded clauses) the Afrikaans *perfek* is interpreted as semantic past tense, i.e., it corresponds to the Dutch imperfect. In order to remain concise we will present just one of her arguments.

The sentence in (10-a) shows that the *presens* is not only compatible with past tense adverbials, but can also be subject to a future interpretation if modified by *môre* (*tomorrow*). On the other hand, as shown in (b), the *perfek* cannot be subject to a future interpretation of that kind — in contrast to the German *Perfekt* for example. To express the idea of a "future perfect", the future tense auxiliary *sal* must be used (c.f. (c)).

(10) a. Môre sien ek hom.
tomorrow see.PRES I him 'I'll see him tomorrow.'
b. * Môre het ek hom gesien (en dan sal ek alles vir jou vertel).
tomorrow AUX I him seen.PART and then will I everything to you tell
c. Môre sal ek hom gesien het ...
tomorrow will I him seen.PART AUX ...

We may conclude that the Afrikaans *perfek* explicitly locates an event before the speech time. In (11-b) we will present the logical form of a *perfek* sentence.

(11) a. Jan het gebel.
Jan AUX called.PART 'Jan called.'
b. $\exists t(t < s^* \wedge \exists e(\tau(e) \odot t \wedge \mathsf{call}'(e, j)))$

The *perfek* introduces a new time t which is explicitly located before s^*. This assumption immediately explains the ungrammaticality of (10-b). The adverb *môre* requires the event to follow s^*, whereas the temporal meaning specifies anteriority to s^*.

In contrast to the semantic effect of the adverbial *môre* we assume that, analogously to the logical form of *wil* in (9-b), the future auxiliary *sal* in (10-c) introduces a new s^*, which has been shifted . The use of the (infinite form of the) *perfek* is now unproblematic, because the time introduced by the *perfek* precedes this new s^*. Note that we can assume the same temporal interpretation for the finite and the infinite uses of *het*.

2.2.3 *Imperfek* as Past

In simple clauses the distribution of the *imperfek* is identical to that of the *perfek*. To illustrate this point, let us consider the parallel data with a future adverb in (12).

(12) a. Môre is Jan tuis.
tomorrow is.PRES Jan home 'Jan will be home tomorrow.'
b. * Môre was Jan tuis.
tomorrow was.IMP Jan home
c. Môre sal Jan tuis gewees het.
tomorrow will Jan home been.PART AUX
'Jan will have been home tomorrow.'

The parallel data lead us to assume the same temporal interpretation for both the *perfek* and the *imperfek*. To illustrate this we will present the logical form for a simple *imperfek* sentence in (13-b). In this logical form *s* is the state of Jan's being home. This state is said to be true at a time *s* which overlaps with a time *t* which precedes s^*.

(13) a. Jan was tuis.
Jan was.IMP home 'Jan was home.'
b. $\exists t(t < s^* \wedge \exists s(s \odot t \wedge \textsf{be-home}'(s, j)))$

We argued in this section that both the *perfek* and the *imperfek* have the same temporal meaning; that of a past operator. This operator introduces a new time which precedes the given time s^*. In contrast to this we analyzed the *presens* as being temporally unmarked. Thus there is no new time introduced and no explicit reference made to s^*. In the following section we will maintain this basic interpretation of the tenses, but we will argue that there is underspecification and multiple exponency in the use of the past operator.

3 The Interpretation of Tense in the Verbal Complex

Given the interpretation of simple tenses we can now reconsider the data in (1). We will demonstrate that these data corroborate three empirical generalizations about tense marking in Afrikaans:

G1 Every verb in *perfek* or *imperfek* introduces a past operator.

G2 The scope of a past tense is not fully determined by the verb which introduces the operator.

G3 The number of *perfek* and *imperfek* verbs determines the upper-bound of the number of past operators in a clause, but not the exact number.

G1 In Section 2 we argued for the existence of a past operator in the logical form of finite *perfek* and *imperfek* forms. For sentence (1) we also observed a reading, (2-a), which expresses two past operators. Thus we have positive evidence that each of the two verb forms, which are potential candidates for introducing a past operator, actually does so.

G2 In (14) we will give a sentence with the *imperfek* form of *wil*, followed by an English translation for each of the possible readings.

(14) Jan wou die boek lees.
Jan wanted.IMP the book read
a. Jan wanted to read the book.
b. Jan wants to have read the book.

We may conclude that in both readings there is a past operator. The ambiguity of sentence (14) is, however, a well-established observation in the description of Afrikaans (de Villiers 1971, Ponelis 1979, Donaldson 1993, Kleij 1999). This means that even though the verb *wou* can be assumed to introduce a past operator, the scope of this operator with respect to the constant $\textsf{want}'$ is not fully determined.

The underspecification of the past operator also goes the other way. If there is an infinite *perfek* or *imperfek*, then there is also a past operator in the logical form. Note that in fact this past operator can have scope over the higher *presens* verb. Therefore the sentences in (14) and (15) have the same readings.

(15) Jan wil die boek gelees het.
Jan wants.PRES the book read.PART AUX
a. Jan wants to have read the book.
b. Jan wanted to read the book.

Kleij (1999) gives the following example from her literary corpus. For clarity we will characterize the intended reading with a simple logical form. Note that *moet* (*must*) is the only verb which is not marked for anteriority in this sentence. Nonetheless it is in the scope of the past operator.

(16) Ek moet los kon rondgeloop het.
I must.PRES freely can.IMP around.walked.PART AUX
'I had to be able to run around freely.'
$\text{PAST}(\mathsf{must}'(\hat{}\mathsf{can}'(i, \hat{}\mathsf{run\text{-}around\text{-}freely}'(i))))$

G3 Note also that there cannot be more past operators in the logical form of a clause than there are *perfek* or *imperfek* verb forms. This means, that sentence (14) cannot express the idea *Jan wanted to have read the book.* If we combine two verbs which are marked for anteriority we can have at most two past operators in the logical form — and, according to **G2**, we must have at least one. Here the example in (1) comes into play. The three generalizations predict exactly the three readings given for (1) above. Also the interpretation of (16) can be accounted for: There is an *imperfek* and a *perfek* verb. Nonetheless there is only one past operator in the logical form. This operator has wider scope than the verbs which introduce it.

It should be noted that the generalizations stand in contradiction to standard assumptions on compositionality: If a *perfek* contributes a past tense operator in (15), it is then unexpected that this operator can have scope over the higher verb *wil* in any of the readings. Furthermore, if there are two past operators contributed to the logical form of (1), then traditional semantic systems would only allow us to derive a reading with two past operators, i.e. the reading in (2-a). There would be no means in such a system to "eliminate" one of these operators.

In the next section we will present a different system for combinatorial semantics which can cope with the empirical facts in a natural way.

4 Lexical Resource Semantics

Lexical Resource Semantics (LRS) was developed as a semantic system for Head-Driven Phrase Structure Grammar (HPSG, Pollard and Sag 1994). An introduction to LRS is given in Richter and Sailer (2003). LRS combines the techniques of underspecified semantics (Reyle 1993, Bos 1996, Pinkal 1996) with the properties of an HPSG grammar to yield a new system for phrasal semantics. Richter and Sailer (2003) also compare the architecture of LRS with that of other semantic systems. LRS has been applied to scope ambiguity (Bouma 2003) and to the analysis of various cases of multiple exponency of semantic operators such as multiple wh-questions in German (Richter and Sailer 2001a) and negative concord in Polish (Richter and Sailer 2001b). In this paper we will use an HPSG-independent notation for LRS which is based on a notation used in a joint enterprise for the implementation of LRS, conducted by Gerald Penn, Frank Richter and the present author.

If we assume a given semantic representation language L, then expressions of LRS are taken from a semantic meta language $\mu(L)$. Every expression of L is in $\mu(L)$. In addition, we assume a set *VAR* of meta variables (written as $A, B, \ldots$). For each $V \in VAR$ and for each n-tuple

$\phi_1, \ldots, \phi_n$ of expressions of $\mu(L)$ which no not contain an occurrence of V, $V[\phi_1, \ldots \phi_n]$ is in $\mu(L)$. Furthermore, all logical connectors of L can be used to combine expressions of $\mu(L)$, but note that quantification and lambda abstraction are only possible over variables from L, not over meta variables. For convenience we will write $\vec{\phi}$ for n-tuples of $\mu(L)$ expressions, and V for $V[\,]$.

Since $\mu(L)$ is a meta language, expressions of $\mu(L)$ denote expressions of L. This denotation is defined with respect to a meta variable assignment function *ASS*, which assigns an expression of L to each element of *VAR* . We will write $[\![\phi]\!]^{ASS}$ for this meta denotation. Expressions of the form $V[\phi_1, \ldots, \phi_n]$ are interpreted as $ASS(V)$ if for each ϕ_i, $[\![\phi_i]\!]^{ASS}$ is a subexpression of $ASS(V)$. Otherwise the denotation is undefined. The denotation of syntactically complex expressions is defined recursively. For example, the denotation of $\phi \wedge \psi$ is the L expression $[\![\phi]\!]^{ASS} \wedge [\![\psi]\!]^{ASS}$.

In the following we will indicate expressions of $\mu(L)$ as the logical forms of sentences. Usually these meta expressions can denote more than one expression of L, depending on the meta variable assignment. Thus we may define a *reading* of an expression from $\mu(L)$ as in (17).

(17) For each $\phi \in \mu(L)$, $\phi_{lf} \in L$, ϕ_{lf} *is a reading* of ϕ, iff there is a meta variable assignment function *ASS* such that

(i) $\phi_{lf} = [\![\phi]\!]^{ASS}$, and

(ii) for each ψ which is a subexpression of ϕ_{lf},
if ψ is a variable or a constant, then ψ is a subexpression of ϕ,
if ψ is of the form $\psi_1 \wedge \psi_2$, then there is a ψ' such that
ψ' is a subexpression of ϕ and has the form $\psi'_1 \wedge \psi'_2$,
where $[\![\psi'_1]\!]^{ASS} = \psi_1$ and $[\![\psi'_2]\!]^{ASS} = \psi_2$,
analogously for the other complex expressions of L.

A reading of a $\mu(L)$ expression ϕ is an interpretation of this expression (clause (i)). This condition guarantees that all the L variables, constants and connectors that occur in ϕ will also be present in the reading ϕ_{lf}. In addition, the second clause imposes an exhaustivity condition on this interpretation: every subexpression of ϕ_{lf} must appear in ϕ, possibly in “disguised” form by the presence of meta variables.

For example the $\mu(L)$ expression $A[\mathsf{call}'(e, j)]$ can denote any L expression which contains $\mathsf{call}'(e, j)$ as a subexpression. However, it has only one *reading*, in which *ASS* assigns $\mathsf{call}'(e, j)$ to the meta variable A. The expression $\exists e(\mathsf{call}'(e, j))$ is an interpretation of $A[\mathsf{call}'(e, j)]$, since $ASS(A)$ contains the subexpression $\mathsf{call}'(e, j)$. Nonetheless, it is not a *reading* of $A[\mathsf{call}'(e, j)]$ because the original $\mu(L)$ expression does not have a subexpression of the form $\exists e(\ldots)$.

In LRS the semantic contribution of linguistic signs will be written as expressions of $\mu(L)$. The logical forms of an utterance are the readings of the meta expression associated with the utterance. The combinatorial system specifies principles of how to combine $\mu(L)$ expressions of daughters to form the semantic contribution of a mother node in a syntactic tree.

In order to specify the combinatorial principles of LRS we will define an *lrs* as a triple of $\mu(L)$ expressions $\langle \phi, \phi_{-}, \phi_{\#} \rangle$. In accordance with the terminology of Richter and Sailer (2003) we will call ϕ the *parts structure* of the *lrs*, ϕ_{-} the *internal content* and $\phi_{\#}$ the *external content*. In an *lrs*, ϕ_{-} is a subexpression of ϕ, and there is a meta variable assignment *ASS*, such that (i) $[\![\phi_{-}]\!]^{ASS}$ is a subexpression of $[\![\phi_{\#}]\!]^{ASS}$, and (ii) $[\![\phi_{\#}]\!]^{ASS}$ is a subexpression of $[\![\phi]\!]^{ASS}$. For utterances we even require that the external content ($\phi_{\#}$) be a *reading* of the parts structure.

We will write the semantic contribution of a word as an *lrs*. For example with the Afrikaans verb *bel* (*call*) we will assume the *lrs* in (18-a). For convenience we will use an abbreviated notation in which we prefix the external content with a # sign and underline the internal content.

This notation is illustrated in (18-b).

(18) a. $\langle A[s^*, \exists e(\tau(e) \odot T \wedge B[\mathsf{call}'(e,j)])], \mathsf{call}'(e,j), A\rangle$
b. $^{\#}A[s^*, \exists e(\tau(e) \odot T \wedge B[\underline{\mathsf{call}'(e,j)}])]$

An L expression is a *reading of an lrs* $\langle \phi, \phi_-, \phi_\# \rangle$ iff it is a reading of ϕ as defined in (17). Note that the *lrs* in (18-a) has exactly one reading, given in (19) together with the meta variable assignment which is responsible for this reading.

(19) a. $\exists e(\tau(e) \odot s^* \wedge \mathsf{call}'(e,j))$
b. $T = s^*$
$A = \exists e(\tau(e) \odot s^* \wedge \mathsf{call}'(e,j))$
$B = \mathsf{call}'(e,j)$

We can show that (19) is indeed a reading of the parts structure of the *lrs* in (18-a). For the sake of convenience we will write ϕ for this parts structure. The logical form in (19) satisfies the first condition of the definition of a reading, since $[\![\phi]\!]^{ASS} = ASS(A)$. $ASS(A)$ is defined, because both $[\![s^*]\!]^{ASS}$ and $[\![\exists e(\tau(e) \odot T \wedge B[\mathsf{call}'(e,j)])]\!]^{ASS}$ are subexpressions of $ASS(A)$. For the second condition we must check the subexpressions of the logical form in (19-a). Let us consider the case of $\psi = \exists e(\tau(e) \odot s^* \wedge \mathsf{call}'(e,j))$. There is a ψ', $\psi' = \exists e(\tau(e) \odot T \wedge B[\mathsf{call}'(e,j)])$ which is a subexpression of ϕ. ψ contains the two immediate subexpressions $\psi_1 = e$ and $\psi_2 = \tau(e) \odot s^* \wedge \mathsf{call}'(e,j)$. For ψ' the immediate subexpressions are $\psi'_1 = e$ and $\psi'_2 = \tau(e) \odot T \wedge B[\mathsf{call}'(e,j)]$. As can be seen from the meta variable assignment in (19-b), $[\![\phi'_1]\!]^{ASS} = \phi_1$ and $[\![\phi'_2]\!]^{ASS} = \phi_2$. The other subexpressions of (19-a) can be checked analoguously. Thus the meta variable assignment indicated in (19-b) leads to a reading as defined in (17).

At this point it is not obvious why we use the meta variable T in the *lrs* of *bel*. We will see later that this corresponds to our intuition that the base forms do not directly express temporal location with respect to the speech time.

We will also need the notion of a *constraint lrs*. This is a pair $\langle \lambda, \kappa \rangle$, where λ is an *lrs* and κ is a finite set of constraints of one of the forms: (i) $\phi \triangleleft V$, where $\phi \in \mu(L)$, and $V \in VAR$ both occurring in λ, or (ii) $\phi = \psi$, where ϕ, ψ both occur in λ. Every constraint *lrs* can be rewritten as a normal *lrs* applying the following algorithm: To eliminate a constraint of the form $\phi \triangleleft V$, replace each $V[\vec{\psi}]$ in λ with $V[\vec{\psi}, \phi]$. For constraints of the form $\phi = \psi$ we will take a meta variable W which does not occur in λ and replace each occurrence of ϕ and ψ with $W[\phi, \psi]$.

We will use the notion of constraint *lrs* in the *Semantics Principle* (SP). The SP specifies how the semantic contributions of daughters are combined depending on the syntactic structure. In this paper we will only refer to parts of the full SP for LRS.

(20) The *Semantics Principle* (SP):

Let $\langle \phi, \phi_-, \phi_\# \rangle$ be the *lrs* of the head daughter, $\langle \psi, \psi_-, \psi_\# \rangle$ the *lrs* of the nonhead daughter, and V a meta variable which does not occur in either *lrs*,
then the *lrs* of the mother results from eliminating the constraints from

$$\left\langle \left\langle V[\phi, \psi], \phi_-, \phi_\# \right\rangle, \kappa \right\rangle,$$

where κ contains exactly the following constraints:

1. $\phi_\#$ is of the form $\beta[\vec{\phi}]$, and $\psi_\# \triangleleft \beta$ is in κ,
2. • if the non-head is a raised complement of the head, then $\phi_- = \psi_-$,
   • …

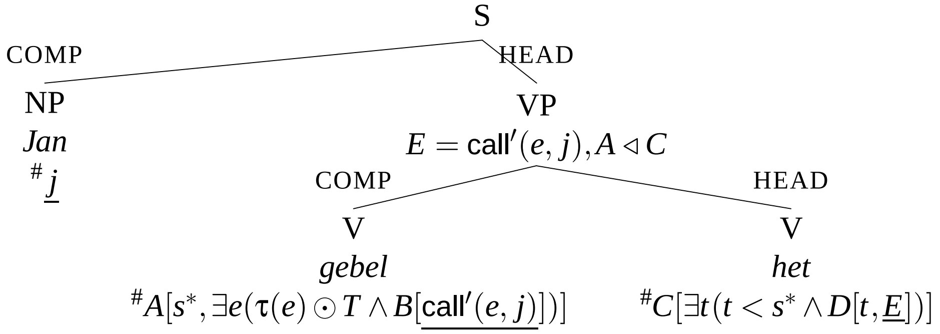

Figure 1: The structure of *(dat) Jan gebel het*

To illustrate the SP we will consider the sentence *(dat) Jan gebel het* (*(that) Jan called*), which is similar to (11-a). Figure 1 shows the syntactic structure.[7] At the leaves we indicate the semantic contribution of the words.[8] Note that we assume that the past participle *gebel* and the base form *bel* have identical meaning contributions.

Given the lexical specifications in Figure 1 we will state the constraint *lrs* which results from applying the SP at the VP level in (21-a). In (b) the constraints are eliminated. The elimination of "$\mathsf{call}'(e,j) = E$" leads to the introduction of a new meta variable, G.

(21) a. $\left\langle F[^{\#}C[\exists t(t < s^* \wedge D[t,\underline{E}])], A[s^*, \exists e(\tau(e) \odot T \wedge B[\mathsf{c}'(e,j)])]], \left\{A \triangleleft C, \mathsf{c}'(e,j) = E\right\}\right\rangle$

b. $F[^{\#}C[\exists t(t < s^* \wedge D[t, G[\underline{E}, \mathsf{call}'(e.j)]]]), A[s^*, \exists e(\tau(e) \odot T \wedge B[G[\underline{E}, \mathsf{call}'(e,j)]]])]],$
$A[s^*, \exists e(\tau(e) \odot T \wedge B[G[\underline{E}, \mathsf{call}'(e,j)]]])]]$

At the S node nothing interesting happens semantically because the subject is translated as a semantic constant j. Thus we can continue working with the *lrs* in (21-b). Even though this *lrs* looks rather complicated, there is only one meta assignment, given in (22-a), which provides a reading, the logical form in (b).

(22) a. $T = t$
$A = C = F = \exists t(t < s^* \wedge \exists e(\ldots))$
$B = E = G = \mathsf{call}'(e,j)$
$D = \exists e(\tau(e) \odot t \wedge \mathsf{call}'(e,j))$

b. $\exists t(t < s^* \wedge \exists e(\tau(e) \odot t \wedge \mathsf{call}'(e,j)))$

It can be seen that for the *perfek* sentence the metavariable T is not interpreted as s^* but as t instead, i.e. the event time is located after the speech time. The alternative assignment ($ASS(T) = s^*$) would not result in a reading because under such an assignment $ASS(D)$ could not contain an occurrence of t, thus $ASS(D)$ would be undefined.

A similar analysis applies to the sentence in (23-a). In (b) we indicate the *lrs* of the verb *wil*. As noted in connection with (9-a) the semantic contribution of the base form *bel* is the same in finite and infinite uses.

[7]We will use verb final clauses to avoid issues of V2. We will not discuss details of the Afrikaans verbal complex either (see e.g. Robbers 1993 for an overview), but simply assume a selectional behavior analogous to the standard HPSG analysis of German (Hinrichs and Nakazawa 1994, Kiss 1995, Kathol 2000, Meurers 2000), i.e., that the complements of the auxiliary *het* and the verb *wil* are a verbal word and the complements of this verb.

[8]Note that the constant j already appears in the correct argument position of call' in the semantic contribution of *gebel*. We have adopted the general assumption of HPSG and other lexical grammar formalisms, that the lexical entry of a verb has access to information about the referential indices of its complements (see Halvorsen 1995).

(23) a. (dat) Jan wil bel
that Jan want.PRES call
b. *wil*: $^{\#}F[EXs(s \odot T' \wedge \mathsf{want}'(s, j, \hat{}\exists s^*(s^* \approx s \wedge G[s^*, \underline{H}])))]$

In this paper we are only concerned with verbal complexes. Thus at the phrasal level the SP identifies the internal contents of the head and the nonhead, and places their respective lrs representations within a larger one. Therefore we can ignore the additional meta variables added by the SP, since they will eventually be identical to meta variables which are already present. Taking this into consideration, the meta variable assignment in (24-a) will result in the only possible reading of the sentence, the logical form in (b).

(24) a. $T = s^* \qquad T' = s^*$
$A = G = \exists e(\tau(e) \odot s^* \wedge \mathsf{call}'(e, j))$
$B = H = \mathsf{call}'(e, j))$
$F = \exists s(s \odot s^* \wedge \mathsf{want}'(s, j, \hat{}\exists s^*(s^* \approx s \wedge \exists e(\ldots))))$
b. $\exists s(s \odot s^* \wedge \mathsf{want}'(s, j, \hat{}\exists s^*(s^* \approx s \wedge \exists e(\tau(e) \odot s^* \wedge \mathsf{call}'(e, j)))))$

In this section we gave a brief outline of LRS. For clarity we presented a framework neutral version of the theory. In the following section we will address the more complex data of Section 3. We will show that the data follow directly from lexical specifications and from the notion of an LRS reading as defined in (17).

5 Analysis

We will now address the data discussed in Section 3. We will present the lexical LRS specification for the *imperfek* form *wou* and show how the different readings can be derived.

In (25) the LRS specification of the verb *wou* (*want.IMP*) is given. It can be seen that this *lrs* contains both a past operator ($\exists t(t < s^* \wedge \ldots)$) and an intensional operator ($\hat{}\exists s^*(\ldots)$). However, the relative scope of these two operators is not specified. The only information given is that the internal content ($\underline{K}$) must be in the scope of both operators. Due to the semantics principle the internal content of the verb *wou* will be identical to that of its infinite complement.

(25) *wou*: $^{\#}I[\exists t(t < s^* \wedge J[t, \underline{K}]), \exists s(s \odot T' \wedge \mathsf{want}'(s, j, \hat{}\exists s^*(s^* \approx s \wedge L[s^*, \underline{K}])))]$

In (26) we will give a simple sentence which contains the verb *wou*. The syntactic structure is identical to that of sentence (23-a). In (a) and (b) are given the two possible readings of this sentence which correspond to the readings indicated in (14). The respective meta variables assignments follow in (27).

(26) (dat) Jan wou bel
that Jan want.IMP call
a. $\exists t(t < s^* \wedge \exists s(s \odot t \wedge \mathsf{want}'(s, j, \hat{}\exists s^*(s^* \approx s \wedge \exists e(\tau(e) \odot s^* \wedge \mathsf{call}'(e, j))))))$
b. $\exists s(s \odot s^* \wedge \mathsf{want}'(s, j, \hat{}\exists s^*(s^* \approx s \wedge \exists t(t < s^* \wedge \exists e(\tau(e) \odot s^* \wedge \mathsf{call}'(e, j))))))$

(27) a. $T = s^* \qquad T' = t$
$A = L = \exists e(\tau(e) \odot s^* \wedge \mathsf{call}'(e, j))$
$B = K = \mathsf{call}'(e, j)$
$I = \exists t(t < s^* \wedge \exists s(\ldots))$
$J = \exists s(s \odot t \wedge \mathsf{want}'(s, j, \hat{}\exists s^*(\ldots)))$
b. $T = s^* \qquad T' = s^*$

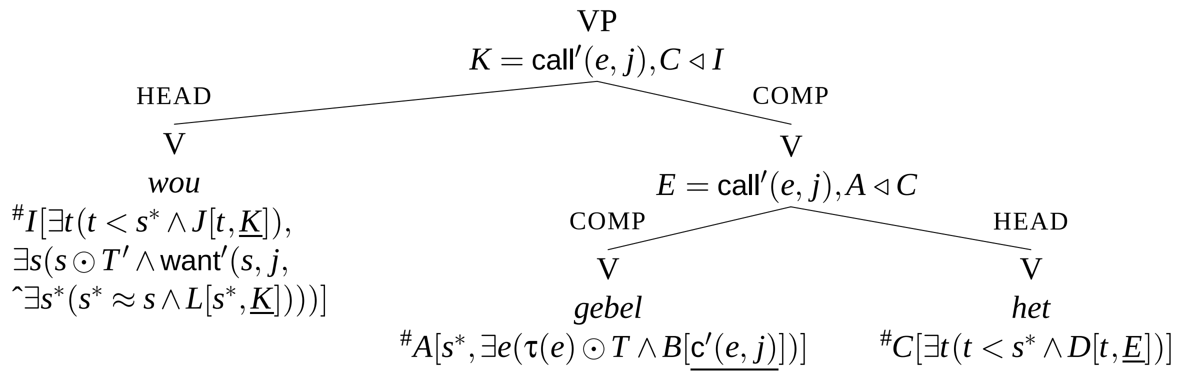

Figure 2: The structure of the verbal complex *wou gebel het*

$A = I = \exists s(s \odot s^* \wedge \text{want}'(s, j, \hat{}\exists s^*(s^* \approx s \wedge \exists t(\ldots))))$
$B = K = \text{call}'(e, j)$
$J = \exists e(\tau(e) \odot t \wedge \text{call}'(e.j))$
$L = \exists t(t < s^* \wedge \exists e(\ldots)$

These meta variable assignments show that we can express generalization **G1** directly in LRS, because we do not need to specify the relative scope of the temporal and the intensional operator in the lexicon.

With the specification of *wou* we can return to the analysis of the data in (1). In (28) a simplified version of the sentence will be given together with the three available readings. Figure 2 shows the syntactic structure of the verbal complex together with the lexical LRS specification at the leaves and the constraints added by the semantics principle. The semantic specifications given for *het* in Figure 1 and for *wou* in (25) both contain a temporal operator. Thus we express the generalization **G2** by lexical specification.

(28) (dat) Jan wou gebel het
that Jan want.IMP call.PART AUX

a. $\exists t(t < s^* \wedge \exists s(s \odot t \wedge \text{w}'(s, j, \hat{}\exists s^*(s^* \approx s \wedge \exists t(t < s^* \wedge \exists e(\tau(e) \odot t \wedge \text{c}'(e, j)))))))$
b. $\exists s(s \odot s^* \wedge \text{w}'(s, j, \hat{}\exists s^*(s^* \approx s \wedge \exists t(t < s^* \wedge \exists e(\tau(e) \odot t \wedge \text{c}'(e, j))))))$
c. $\exists t(t < s^* \wedge \exists s(s \odot t \wedge \text{w}'(s, j, \hat{}\exists s^*(s^* \approx s \wedge \exists e(\tau(e) \odot t \wedge \text{c}'(e, j))))))$

In (29) we indicate the meta variable assignments which determine the respective readings.

(29) a. $T = t \quad T' = t$
$A = C = L = \exists t(t < s^* \wedge \exists e(\ldots))$
$B = E = K = \text{call}'(e, j)$
$D = \exists e(\tau(e) \odot t \wedge \text{call}'(e, j))$
$I = \exists t(t < s^* \wedge \exists s(\ldots))$
$J = \exists s(s \odot t \wedge \text{want}'(s, j, \hat{}\exists s^*(\ldots)))$

b. $T = t \quad T' = s^*$
$A = C = L = \exists t(t < s^* \wedge \exists e(\ldots))$
$B = E = K = \text{call}'(e, j)$
$D = J = \exists e(\tau(e) \odot t \wedge \text{call}'(e, j))$
$I = \exists s(s \odot s^* \wedge \text{want}' s, j, \hat{}\exists s^*(\ldots))$

c. $T = s^* \quad T' = t$
$A = L = \exists e(\tau(e) \odot s^* \wedge \text{call}'(e, j))$
$B = E = K = \text{call}'(e, j)$

$C = I = \exists t(t < s^* \wedge \exists s(s \odot t \wedge \mathsf{want}'(s, j, \hat{}\exists s^*(\ldots))))$
$D = J = \exists s(s \odot t \wedge \mathsf{want}'(s, j, \hat{}\exists s^*(\ldots)))$

The meta variable assignments in (29) define readings according to the definition in (17). The important property of an LRS reading is that even if a semantic operator appears in the *lrs* of more than one word, it may be that there is only one occurrence of this operator in a given reading. To illustrate this we will consider the past operator in reading (28-b). In the reading, there is a subexpression $\psi = \exists t(t < s^* \wedge \exists e(\tau(e) \odot t \wedge \mathsf{c}'(e, j)))$. In the *lrs* of the sentence, there are two subexpressions which stand in the required relation to ψ: clause (ii) in the definition of a reading is satisfied by both $\psi' = \exists t(t < s^* \wedge J[t, K])$ and $\psi' = \exists t(t < s^* \wedge D[t, E])$. In the definition of a reading in (17) we do not impose a uniqueness requirement on ψ'. This immediately allows for multiple exponency.

It should be noted in addition that it is not possible to derive a reading for (28) which contains three past operators. An LRS reading must consist exclusively of the *L*-subexpressions of a given *lrs*. Since there are only two past operators in the *lrs* of the clause, we cannot construct a reading with three such operators. This shows that the notion of an LRS reading is defined in an adequate way to allow for multiple exponency of semantic operators. This correctly accounts for our generalization **G3**.

Before we can close this section we should reflect on the question of whether we are excluding other non-available readings. In particular logical forms such as outlined in (30), i.e. readings where both past operators have either wide or narrow scope with respect to the intensional operator, would be conceivable.

(30) a. $\textsc{past}(\textsc{past}(\mathsf{want}'(j, \hat{}\mathsf{call}'(j))))$
b. $\mathsf{want}'(j, \hat{}\textsc{past}(\textsc{past}(\mathsf{call}'(j))))$

A "pluperfect" reading of this kind is not available in Afrikaans and correctly excluded by our semantic representations, because the past operator always uses the variable s^* to locate time introduced by the temporal operator.

In this section we demonstrated that the readings of more complex examples follow immediately from the general LRS system and the way in which we specify the lexical contribution of certain verbs.

6 Conclusion

The system of past tense marking in Afrikaans provides empirical evidence for the need for scope underspecification and multiple exponency of semantic operators within the system of compositional semantics. Since LRS has incorporated these two features, it allows for an adequate account of the data.

The Afrikaans data follow directly from the way LRS is constructed together with the lexical specifications for the particular verbs. Interestingly the data considered in this paper did not require further assumptions about the syntax-semantics interface. While we only discussed simple clauses, the present study provides a basis for a more comprehensive account of the Afrikaans temporal system which would include an account of temporal adverbials, and several sequence-of-tense patterns (see de Villiers 1971).

LRS was originally developed as a semantic formalism for HPSG. In the original formulation the notion of an LRS reading followed directly from the HPSG formalization. In contrast to this we had to introduce it explicitly for a framework-independent definition. Nonetheless, we think that defining this notion explicitly is helpful for a better understanding of LRS, and will make the predictions of an LRS theory more transparent.

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