

On the Semantics of Complementizers

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Abstract. This paper is about the semantic differences between a sentential complement headed by a subordinate conjunction and a infinitival complement. A proper description of these differences requires a choice between two types of tense systems available in the literature. Both use points of reference but they are different as to the dimensions determining the set up of the system. From this point of view, it will be argued that Reichenbach's 1947-system fails to account for the difference between the two types of complement due to its 3×3 design, whereas a $2 \times 2 \times 2$ set up of Te Winkel's 1866-system accounts much more adequately for the (temporal) semantic properties of the complements in question. As for the content of the differences between the two types of complements, it will be argued that these can be found in the different ways of matching the indices of the subordinate and the main clauses.

Keywords: anteriority, compositionality, index, past, posteriority, present, synchronous, tense, Reichenbach, Te Winkel

1. Introduction

In Dutch, there are verbs having a infinitival complement. The electronic ANS (§ 18.5) distinguishes at least twenty-four different categories (cases). Among these are those that do have a counterpart in the form of a non-infinitival complement, such as *zien* (see) in *Zij zag dat Els een lied zong* (She saw that Els sang a song) as opposed to *Zij zag Els een lied zingen* (lit: She saw Els sing a song) and there are those that do not have such a counterpart, as *wagen* (venture) in *Ze waagden het niet dichterbij te komen* (They did not venture to come closer) witness the ungrammaticality of constructions of the form **Ze waagden [_S dat X_{Subj} . . . (They ventured [_S that X_{Subj} . . .)*. *Zien* is accompanied by verbs like *beloven* (promise), *menen* (mean/think), *vertellen* (tell), etc., whereas *wagen* behaves like *durven* (dare), *vermogen* (be able to), *verzuimen* fail to), *beginnen* (begin), among many others. There is a third category not yet mentioned, as in *weten* (know) in *Wij wisten dat de gasten een diner krijgen aangeboden* (We knew that the guests will be offered a diner). Other examples are *afkeuren* (disapprove), *luiden* (read/run), *volgen* (follow), etc. They do not take infinitival complements.

The present paper will focus on the category that is able to take both an infinitival complement and a sentential complement with a subordinated

* I would like to thank Jan van Eijck for a discussion about certain technical aspects of the formal machinery involved.

conjunction, in particular the Dutch *dat* (that). So, it is about sentences like the following:

- (1) a. Harry zag zichzelf schreeuwen
Harry saw himself scream
b. Harry zag dat hij (zelf) schreeuwde
Harry_isaw that he_iscreamed
c. Harry zag dat zij schreeuwde
Harry saw that she screamed
- (2) a. Els hoopte te slagen
Els hoped to succeed
b. Els hoopte dat ze zou slagen
Els hoped that she would succeed
c. ?Els hoopte dat ze slaagde
lit: Els hoped that she succeeded
- (3) a. Els maakte bekend een oplossing te hebben gevonden
Els announced to have found a solution
b. Els maakte bekend dat ze een oplossing heeft gevonden
Els announced that she has found a solution
c. Els maakte bekend dat Harry een oplossing had gevonden
Els announced that Harry had found a solution

There are many more possibilities of showing all sorts of differences between infinitival and sentential complements, but I will restrict myself here to discussing a complement with a present meaning (1), with a future meaning (2), and with a perfect meaning (3). This is because I want to discuss the question of how to deal with the differences in meaning between the sentences in (1a)–(3a) on the one hand and the b- and c-sentences in (1)–(3) from the point of view of how to construe the temporal structure of the main sentence and those of the two sorts of complements into a complex one. In other words, one may ask what sort of signal it is that is expressed by the presence of the complementizer *dat* (that), often considered the “ultimate landing site” of the finite verb in root sentences (cf. Den Besten (1998), Ch. 2). Or, one may ask why it is that one can say *Harry zag Els schreeuwen* (lit: Harry saw Els scream) but not **Els maakte bekend Harry een oplossing te hebben gevonden* (lit: Els announce Harry to have found a solution). Or one may ask whether or not the resulting configuration of sentences like (2a) is built up compositionally from the bottom to the top, or otherwise.

There are many more questions like these, but before trying to answer some of them I would like to add one more question: what sort of tense system is able to deal most adequately with the two sorts of construction? The answer to that question amounts to showing how a Reichenbachian system based on

a 3×3 -partition deals with the infinitival and the sentential complement and how a Te Winkelian system based on a $2 \times 2 \times 2$ -partition does the job. A choice between these two options (in favour of Te Winkel) provides the basis for plausible answers to the sort of questions raised above, because it can be shown that the two systems involved make different predictions with respect to certain empirical data.

Table I presents the eight tense forms of Dutch as taught at elementary school still based on the tradition invoked by Te Winkel. The abbreviated

Table I. The eight Dutch tense forms

Zij vertelt	(o.t.t)	Zij vertelde	(o.v.t)
She tells		She told	
PRES(SYN)(IMP) ϕ		PAST(SYN)(IMP) ϕ	
Zij zal vertellen	(o.t.t.t)	Zij zou vertellen	(o.v.t.t)
She will tell		She would tell	
PRES(POST)(IMP) ϕ		PAST(POST)(IMP) ϕ	
Zij heeft verteld	(v.t.t)	Zij had verteld	(v.v.t)
She has told		She had told	
PRES(SYN)(PERF) ϕ		PAST(SYN)(PERF) ϕ	
Zij zal hebben verteld	(v.t.t.t)	Zij zou hebben vertellen	(v.v.t.t)
She will have told		She would have told	
PRES(POST)(PERF) ϕ		PAST(POST)(PERF) ϕ	

forms express an opposition between **onvoltooid** (incompleted) and **voltooid** (completed) in the first position, between **tegenwoordig** (present) and **verleden** (past) in the second position and between **toekomend** (posterior) or the absence of it (SYN) in the third position. The last **t** is the *t* of *tijd* (tempus) in all eight forms. The English glosses underscore the parallelism between the Dutch and the English tense system, although the two languages have made different choices as to some of the underlying configurations.

Te Winkel (1866) proposed a system in which the three oppositions just mentioned play a role:

1. Present (PRES) vs. Past (PAST)
2. Synchronous (SYN) vs. Posterior (POST)
3. Incompleted (IMP) vs. Completed (PERF)

It is possible to give a type-logical interpretation of the original system in which the three oppositions can be formalized in terms of an opposition

between operators (functors).¹ I have parenthesized the operators here and will treat them informally until § 3.1. The important thing to note at this stage is that the pair PRES-PAST will receive a different type-logical status than the other two pairs. The intuition behind this is that no sentence expressing tense in Dutch does occur without a Present or a Past tense, whereas tensed sentences may lack the presence of the auxiliaries *zullen* (will) or *hebben* (have).

So far Te Winkel's system has been illustrated by showing its $2 \times 2 \times 2$ -partitioning and by introducing the operators that will play a role later on in describing the differences between complements with and without a complementizer. At this stage I simply want to compare this system from that point of view with the architecture of the Reichenbach-system given in Table II. It gives seven Dutch tenses (with English glosses) based on a dimension in

Table II. Reichenbach's matrix

	Past R < S	Present R, S	Future S < R
Anterior E < R	1. Past Perfect E - R - S <i>had gevonden</i> had found	2. Present Perfect E - R, S <i>heeft gevonden</i> has found	3. Future Perfect E - S - R, E, S - R, S - E - R <i>zal hebben gevonden</i> will have found
Simple E, R	4. Simple Past E, R - S <i>vond</i> found	5. Simple Present E, R, S <i>vind</i> finds	6. Simple Future S - E, R <i>zal vinden</i> will find
Posterior R < E	7. Past Future R - E - S, R - S, E, R - S - E <i>zou vinden</i> would find	8. Present Future S, R - E <i>zal vinden</i> will find	9. Posterior Future S - R - E <i>zal vinden</i> will find

which a division between Past, Present and Future is made and which crosses another tripartite dimension: Anterior, Simple (Synchronous), Posterior.² The matrix in Table II has appeared so many times in the abundant literature on Reichenbach (1947) that it needs no further explication as to how the con-

¹ I have done so in Verkuyl (2001) and further developed in Verkuyl (2003).

² Reichenbach's system does not give the tense form *zou hebben gevonden* (would have found).

figurations of the points E, R and S are to be understood. In spite of the attempt in Verkuyl and Loux-Schuringa (1985) to show that Reichenbach's system—how innovative it may be with respect to the linguistic tense systems as proposed in the first half of the 20th century, in particular to Jespersen's system—is inferior to the system proposed in the 19th century in Te Winkel (1866), the linguistic and logical tense community seems to be totally fixed on Reichenbach's system.

Two of its properties should be distinguished: (a) its use of reference points in order to create temporal structure; (b) its choice in favour of a 3×3 -set up. The two properties of the system are quite independent. One may see (a) as the (re-)introduction of a valuable insight into tenses as not expressing a direct relation between the point of speech and the eventuality involved, so that extra points are necessary. On the other hand, (b) could be seen as a choice that may turn out to be not well-motivated for Germanic languages. So, one could maintain (a) but change the matrix in Table II, in particular the crossing of the triples Past-Present-Future and Anterior-Simple-Posterior, into a binary set up in which Past and Present are the real genuine tenses occurring with auxiliaries in order to express anteriority and posteriority in the three lower rows of Table I. This yield exactly Te Winkel (1866) (with a little help of modern semantic friends).

Let me articulate the implications of what I just sketched with the help of a syntax for the Dutch tense structure that yields all and only the eight Dutch tenses that are generally recognized as belonging to the system.

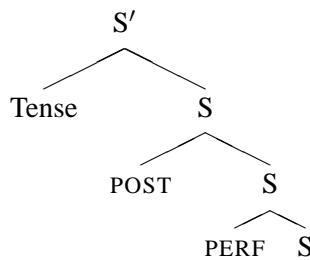


Figure 1. Tense structure

At this point it is sufficient to see that the tree in Figure 1 yields Simple Present and Simple Past in the absence of POST and PERF, that the Present Future and the Past Future are due to the presence of POST and the absence of PERF, that the Present Perfect and Past Perfect are due to the absence of POST and the presence of PERF and that the complex posterior perfect forms are due to the presence of the two auxiliaries. This syntax seems to me to be the appropriate one for generating the Germanic tenses: it presents all eight

forms. Of course, one can bedeck the tree with functional nodes and all sorts of projections, but I will only do so when appropriate.³

At this point it can be observed that the syntax in Figure 1 is not really tuned to the 3×3 -set up of Reichenbach. The only proper way to get a syntax underlying the nine tense forms of the system would be to have a rule: $\{\text{Past, Pres, Fut}\}(\{\text{Ant, Sim, Post}\})(\phi)$, where $\text{Past}(\text{Ant})(\phi)$ would cover the Past Perfect, $\text{Fut}(\text{Sim})(\phi)$ the Simple Future, $\text{Fut}(\text{Post})(\phi)$ the Posterior Future, etc. In other words, one would get a binary tree with two branches before ϕ each of which has three options.

Table III provides a basis for a comparison with Te Winkel's syntax in Figure 1. On the left hand side, one can see the syntactic base for Reichenbach's

Table III. Reichenbach and Te Winkel

Reichenbach	Tense forms	Te Winkel
$\text{Past}(\text{Sim})(\phi)$	She found X	$\text{PAST}(\text{SYN})(\text{IMP})(\phi)$
$\text{Past}(\text{Post})(\phi)$	She would find X	$\text{PAST}(\text{POST})(\text{IMP})(\phi)$
$\text{Past}(\text{Ant})(\phi)$	She had found X	$\text{PAST}(\text{SYN})(\text{PERF})(\phi)$
??	Mary would have told	$\text{PAST}(\text{POST})(\text{PERF})(\phi)$
$\text{Pres}(\text{Sim})(\phi)$	Mary finds X	$\text{PRES}(\text{SYN})(\text{IMP})(\phi)$
$\text{Pres}(\text{Post})(\phi)$	Mary will find X	$\text{PRES}(\text{POST})(\text{IMP})(\phi)$
$\text{Pres}(\text{Ant})(\phi)$	Mary has found X	$\text{PRES}(\text{SYN})(\text{PERF})(\phi)$
$\text{Fut}(\text{Sim})(\phi)$	Mary will find X	$\text{PRES}(\text{POST})(\text{IMP})(\phi)$
$\text{Fut}(\text{Post})(\phi)$	Mary will find X	$\text{PRES}(\text{POST})(\text{IMP})(\phi)$
$\text{Fut}(\text{Ant})(\phi)$	Mary will have found X	$\text{PRES}(\text{POST})(\text{PERF})(\phi)$

system. The problem for Reichenbach's 3×3 is now that in the tense form in cell 6 of Table II the future relation $S < R$ and the posterior relation $R < E$ have to be expressed by the same form *will*, whereas in *She will have found X* in cell 3 *will* only expresses $S < R$, because *have* fulfills the $E < R$ -duty. Moreover, in cell 8 *She will find X*, the auxiliary *will* expresses both $S \approx R$ and $R < E$, whereas in cell 9 it expresses both to $S < R$ and $R < E$. In other words, one cannot proceed compositionally here on the basis of 3×3 , whereas it is possible to fix the meanings of the operators in a $2 \times 2 \times 2$ set up. These may be technical shortcomings that should be seen as tiny spots on an otherwise perfect system, but on the whole one may conclude that the binary approach is more attractive from a compositional point of view because each

³ In order to keep the size of the present paper manageable I do not take relate the present formal-semantic exercise to generative-syntactic work like Enç (1991) and Guéron and Hoekstra (1994).

of the elements that are present seems to contribute a constant meaning to the complex that is going to be the temporal structure expressed by the sentence.

2. Some observations

Let me first extend the range of observations on the two sorts of complements that we are going to analyze with an eye on the possibility for the two systems— 3×3 or $2 \times 2 \times 2$ —to deal with them.

The first observation is that infinitival complements cannot express a number of interpretations that are possible in a *that*-clause. As shown in (4b) – (4d), the *that*-clause may have the same subject-NP as in the main clause, but it may also be a different one.

- (4)a. Els zei de oplossing te hebben gevonden
Els said to have found the solution
- b. Els zei dat ze/Harry de oplossing heeft gevonden
Els_isaid that she_i/Harry has found the solution
- c. Els zei dat ze/Harry de oplossing had gevonden
Els_isaid that she_i/Harry had found the solution
- d. Els zei dat ze/Harry de oplossing voor morgen zal hebben gevonden
Els_isaid that she_i/Harry will have found the solution before tomorrow

This is impossible in (4a): the external PRO-argument of *zeggen* (say) must be the same as the one of the infinitival complement. I will not pay attention to this sort of atemporal restriction on the infinitival complement here because I am focussed on temporal properties only. One temporal restriction shows in comparing (4a) with (4b) and (4c) interpreted with the pronoun subject NP *ze_i* in the subordinate clause. The difference in meaning between the Present Perfect interpretation of (4b) and the Past Perfect interpretation of (4c) is that (4b) connects the information to the utterance time of the sentence, whereas (4c) makes a connection with some reference point in the past. However, (4a) does not make clear to which point the information about finding the solution should be connected: (4a) expresses neither a Present Perfect interpretation nor a Past Perfect interpretation. In that sense, the infinitival complement is neutral or underdetermining as compared to what is expressed by (4b) and (4c). In my opinion, the analysis of the opposition between (4a) on the one hand, and (4b) and (4c) on the other in terms of the predictions made by a 3×3 - or by a $2 \times 2 \times 2$ -system is in favour of the binary system in which PRES and PAST are taken to form the primary opposition. It is this opposition that is neutralized in the infinitival complement.

The second observation is that some main verbs require the absence of auxiliaries in their infinitival complement.

- (5) a. Harry zag zichzelf schreeuwen
Harry saw himself scream
b. *Harry zag zichzelf te zullen schreeuwen
lit: Harry saw himself to will scream
c. *Harry zag zichzelf (te) hebben geschreeuwd
lit: Harry saw himself to have screamed

In (5a) the screaming is synchronous to the act of seeing.⁴ In (5b) and (5c) it is impossible to have an infinitival complement. The lexical meaning of *zien* (see) requires synchronicity of the eventualities involved. Note that the interpretation of (5a) is predicted in the binary system: the absence of *zullen* (will) and *hebben* (have) simply prevents an interpretation in terms of overt posteriority or anteriority. It is difficult if not impossible to have the same sort of correct prediction in a Reichenbachian 3×3 -set up. On the basis of the second tripartition that makes up the matrix in Table II, viz. Anterior-Simple-Posterior, one should expect the unwellformedness of (5a) because it is quite arbitrary to have unwellformedness in the case of Anteriority, as in (5c), and Posteriority, as in (5b), and not in the case of Simple.

Extending the analysis to other main verbs, one can observe that the posterior sense of the infinitival complement of *verwachten* (expect) in sentences like (6) is also due to its lexical meaning.

- (6) a. Els verwacht te slagen
Els expects to succeed
b. Els verwachtte te slagen
Els expected to succeed
c. Els verwacht dat ze slaagt
lit: Els expects that she succeeds

Like the verb *hopen* (hope), *verwachten* (expect) requires that the time of its complement be put after the time at which the expectation is expressed. The unacceptability of (2c) *?Els hoopte dat ze slaagde* (lit: Els hoped that she succeeded) should be accounted for in a formal characterization of the temporal structure of sentences like (6a,b) as opposed to (6c) and (2c).

⁴ And synchronous or later if one allows the verb *zien* (see) to see an image, in which case *zien* is not taken literally. I picked up this example from internet where the sentence *Hij zag zichzelf schreeuwen* clearly pertains to Harry Potter who on some sort of screen must have seen a video or a movie in which he saw himself crying. In the absence of any knowledge about Harry Potter this is what I must give as an appropriate interpretation.

3. The two sorts of complements in a binary tense approach

3.1. INTRODUCTION

In the present subsection, I shall briefly discuss the formalism necessary to characterize the Dutch tense system in a(n as) compositional way (as possible) yielding the correct temporal structures necessary to compute the location of eventualities with respect to the point of speech and to other points that are part of the temporal information expressed in a tense system (see the references in the footnote on page 4).

For the present exposition it suffices to represent the tenseless sentence ϕ (7a) as (7b),

- (7) a. Harry scream
b. $\lambda k'.\text{Scream}(k')(h)$

which is of type $\langle i, t \rangle$, the type standing for a set of indices making a predication true.⁵

The two tense-operators of the first opposition in the system can now be defined as in (8):

- (8) a. $\text{PRES} := \lambda \phi \exists i [\phi[i] \wedge i \approx n]$
b. $\text{PAST} := \lambda \phi \exists i [\phi[i] \wedge i < n]$

The two operators are of type $\langle \langle i, t \rangle, t \rangle$, so they take a ϕ to form a tensed sentence S' (= CP) of type t . The notation $\phi[i]$ expresses that the index i is present somewhere in the structure of the tenseless ϕ . Definition (8a) takes PRES as the set of all predications such that i is synchronous with the utterance time n , whereas PAST locates i earlier than n .

The operator POST, standing for the Dutch verb *zullen*, or for the English verbs *will* and *shall*, can be defined as in (9a), whereas its covert counterpart can be defined as in (9b).

- (9) a. $\text{POST} := \lambda \phi \lambda i \exists j [\phi[j] \wedge i < j]$
b. $\text{SYN} := \lambda \phi \lambda i \exists j [\phi[j] \wedge j \approx i]$

The POST-operator yields the set of all i such that i is located before the index j . The definition does justice to the idea that the sense of future should not be

⁵ Please note the difference between writing i (in formulas) or i (in the running text) as an index (as opposed to other indices, say i' , j or k) and i as the indication of a type. In general, the easiest way to interpret i as a type is to see it as a positive integer standing for something actual in real time (see Verkuyl (1999)). I will use the term *index* in order to stay neutral with respect to a choice between points, instants, intervals or events. The variables k, k' , etc will be used in order to designate the values involving PERF/IMP in the three-stage tree of Figure 1; the variables j, j' , etc. will be used for the POST/SYN-level and i, i' , etc. for the PRES/PAST-level.

associated uniquely with the utterance time but also with times located in the past introduced by the PAST-operator. As to the SYN-operator: in principle, one may do without it in order to evade empty operators, but as pointed out in Verkuyl (2001) the opulent version of the system—the version including the covert operators SYN and IMP below—are empirically more adequate in creating the temporal structures associated with tenses in which *zullen* (will) and *hebben* (have) are absent.

The operators PERF and IMP are defined as in (10).

- (10) a. PERF := $\lambda\phi\lambda j\exists k[\phi[k] \wedge k \subset j]$
 b. IMP := $\lambda\phi\lambda j\exists k[\phi[k] \wedge j \subseteq k]$

As in the case of posteriority, the operator PERF is visible in the form of an auxiliary: *hebben* in Dutch and *have* in English.⁶ Its presence says that the eventuality is a proper subset of *j*.

An explication of the \subset -relation in (10a) can be given by describing the information contributed by a Present Perfect in sentences like (11).

- (11) Els heeft de oplossing (vandaag) gevonden
 Els has found the solution (today)

Suppose we say this sentence at 14.11 today. Then Els found the solution in an interval between say 0.00 and 14.11 at some time t_{sol} represented by the index *k*, such that $[0.00 < k < 14.11]$. The interval $j = [0.00, 14.11]$ counts as today's present-so-far which by SYN is synchronous with *i* which is synchronous to *n* by PRES. The notion of synchronicity should be understood as 'sufficiently cotemporal so as to have the sense of a shared present'. Overlap is a related notion, coincident would be one, also Reichenbach's comma in S, R and R,E, but synchronicity has the extra sense of two different temporal units that are understood as occurring in or belonging to or constituting or one might even say experienced in the same present. In the latter sense, the utterance time *n* may be seen as synchronous with the point 0.03 in *j* in the sense that both are harboured in what counts as today's present even though a lot of things happened in between including the eventuality of the predication itself. The interval *j* is by the sense of presentness of (11) directly accessible at index *i* (which is synchronous to the utterance time). One could say that *j* connects the present of the *k*-index of the eventuality to the present of the utterance by the $j \approx i$ -information.

One way of seeing the relation between *i* and *j* could be to say that the *i*-index of PRES is in fact the "moving border" of *j*. So, somewhere in *j* there

⁶ In Dutch the auxiliary *zijn* can also be used as a perfect auxiliary as in *Zij is gekomen* (She has come), but although there are certain interesting aspectual differences between the two auxiliaries, I will restrict myself here to sentences with *hebben* (have) as prototypical for the perfect auxiliaries.

is some k which is clearly ordered before the utterance time due to the perfect meaning of *hebben* (have). This is expressed by the proper subset relation embedding k into something that may count as present due to the tense information expressed by PRES(SYN) in *heeft* (has). In this way, the extra index provided by the $2 \times 2 \times 2$ -set up creates the possibility of having two different presents: one connected with the utterance index, the other one (the present in which the eventuality took place) connected with the eventuality index. The index j will always be connected with i if SYN is applied, from which it follows that in past tenses j will not be immediately connected with n . The derivation of (11) shows how the interpretation on the basis of structures like Figure 1 proceeds.

$$\begin{aligned}
(12) \quad & \text{PERF}(\text{Els find the solution}) \rightsquigarrow \\
& \lambda\phi\lambda j\exists k[\phi[k] \wedge k \subset j](\lambda k'.\text{Find}(k')(s)(e)) \\
& = \lambda j\exists k[\lambda k'.\text{Find}(k')(s)(e)[k] \wedge k \subset j] \\
& = \lambda j\exists k[\text{Find}(k)(s)(e) \wedge k \subset j] \\
& \text{SYN}(\text{PERF})(\text{Els find the solution}) \rightsquigarrow \\
& \lambda\phi\lambda i\exists j[\phi[j] \wedge j \approx i](\lambda j'\exists k[\text{Find}(k)(s)(e) \wedge k \subset j']) \\
& = \lambda i\exists j[\lambda j'\exists k[\text{Find}(k)(s)(e) \wedge k \subset j'][j] \wedge j \approx i] \\
& = \lambda i\exists j\exists k[\text{Find}(k)(s)(e) \wedge k \subset j \wedge j \approx i] \\
& \text{PRES}(\text{SYN})(\text{PERF})(\text{Els find the solution}) \rightsquigarrow \\
& \lambda\phi\exists i[\phi[i] \wedge i \approx n](\lambda i'\exists j\exists k[\text{Find}(k)(s)(e) \wedge k \subset j \wedge j \approx i']) \\
& = \exists i[\lambda i'\exists j\exists k[\text{Find}(k)(s)(e) \wedge k \subset j \wedge j \approx i'][i] \wedge i \approx n] \\
& = \exists i\exists j\exists k[\text{Find}(k)(s)(e) \wedge k \subset j \wedge j \approx i \wedge i \approx n]
\end{aligned}$$

The last line says that the index i introduced by PRES coincides with the point/interval of speech n , that i synchronizes with the index j which is to be considered the present of the eventuality k , and that k is properly included in j . Note that this analysis does justice to the use of the present tense form in *heeft* (has), which pertains to the information connecting the utterance time to j and to the use of the perfect auxiliary which determines that k must precede i and n because it is a proper subset of j . Current relevance (the sense of a present) and anteriority are thus expressed in quite a natural way, because it follows from the last line of (12) that $j \approx i \approx n$ and that $k < n$.

Figure 2 gives all eight tense configurations produced on the basis of the definitions of the present section. Note that by the division between PRES and PAST each of the substructures on the left-hand side involving j and k is identical to the one on the right-hand side. This means that i located in the past of n in the b-cases is seen as coinciding with some point that could have been synchronous to the utterance time of that moment with regard to the eventuality in question. Note also that the four IMP-configurations (1a, 1b, 2a, 2b) present j as a subset or equal to the k -index and that j may have a considerable extension of what counts as the present in which k is to be embedded. The four SYN-configurations (1a, 1b, 3a, 3b) give j as synchronous

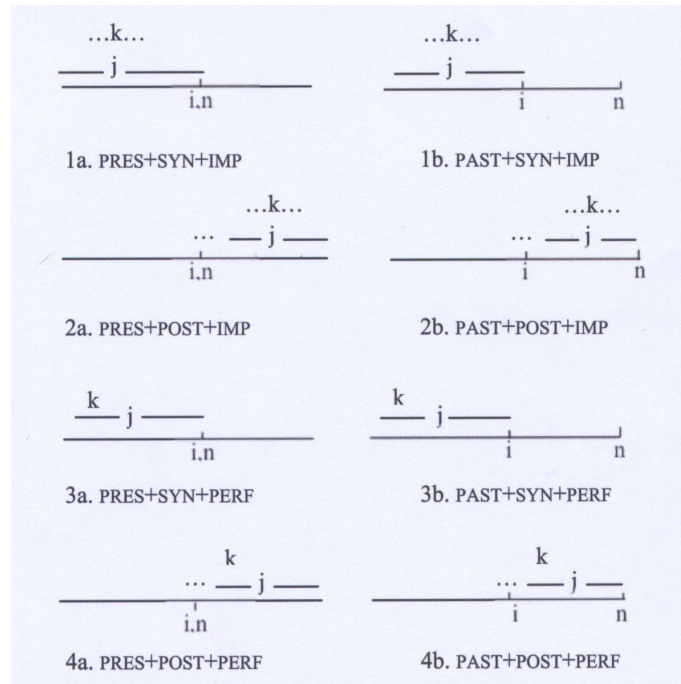


Figure 2. The eight tense configurations of simple sentences

to *i*. The best way to understand the relation between *i* and *j* could be to consider *i* as the last part of *j*. Some of the details of what is expressed in Figure 2 will be discussed in the following sections when more complex cases of temporal structure will be drawn into the analysis. The problem at hand is: where do we find information about which indices in the subordinate clause should be connected to indices in the main clause.

Preparing the temporal analysis of complex sentences, I will now give the derivation of *Els hoopte X* (Els hoped X), where the (meta) variable *X* stands informally for the propositional content of the complement of the verb *hopen* (hope).

$$\begin{aligned}
 (13) \quad & \text{IMP}(\text{Els hope } X) \rightsquigarrow \\
 & \lambda\phi\lambda j\exists k[\phi[k] \wedge j \subseteq k](\lambda k'.\text{Hope}(k')(X)(e)) \\
 & = \lambda j\exists k[\lambda k'.\text{Hope}(k')(X)(e)[k] \wedge j \subseteq k] \\
 & = \lambda j\exists k[\text{Hope}(k)(X)(e) \wedge j \subseteq k] \\
 & \text{SYN}(\text{IMP})(\text{Els hope } X) \rightsquigarrow \\
 & = \lambda\phi\lambda i\exists j[\phi[j] \wedge j \approx i](\lambda j'\exists k[\text{Hope}(k)(X)(e) \wedge j' \subseteq k]) \\
 & = \lambda i\exists j[\lambda j'\exists k[\text{Hope}(k)(X)(e) \wedge j' \subseteq k][j] \wedge j \approx i] \\
 & = \lambda i\exists j\exists k[\text{Hope}(k)(X)(e) \wedge j \subseteq k] \wedge j \approx i]
 \end{aligned}$$

$$\begin{aligned}
& \text{PAST}(\text{SYN})(\text{IMP})(\text{Els hope X}) \rightsquigarrow \\
& \lambda\phi\exists i[\phi[i] \wedge i < n](\lambda i'\exists j\exists k[\text{Hope}(k)(X)(e) \wedge j \subseteq k] \wedge j \approx i') \\
& = \exists i[\lambda i'\exists j\exists k[\text{Hope}(k)(X)(e) \wedge j \subseteq k \wedge j \approx i'][i] \wedge i < n] \\
& = \exists i\exists j\exists k[\text{Hope}(k)(X)(e) \wedge j \subseteq k \wedge j \approx i \wedge i < n]
\end{aligned}$$

3.2. INFINITIVAL AND THAT-COMPLEMENTS

Two questions arise with respect to sentences like (1) – (3). The first is how to build to connect the temporal information in the clause *X* in *Els hoopte X* (*Els hoped X*) to the temporal structure provided by the main clause and the second is how to formally capture the difference between the two types of complement. Both questions may involve an adaptation or an extension of the rules given earlier because these were formulated with respect to simple sentences. So, let us have a closer look at these questions before trying to derive the sentences under analysis.

As to the second question, the answer seems to be quite straightforward for infinitival complements: one might say that infinitival complements are tenseless sentences, so they should be of type $\langle i, t \rangle$. This amounts to saying that the operator connecting this complement to the main structure is of type $\langle \langle i, t \rangle, \langle i, t \rangle \rangle$. For *that*-complements it is easy to see that a *that*-complementizer, unless some provision to the contrary is made, should be of type $\langle t, \alpha \rangle$, because the tensed sentence that it takes is of type t according to the definitions of PRES and PAST in (8). To specify the semantics of the complementizer means to solve the problem of determining the nature of α . An immediate solution could be to take α as being of type t but this makes only sense if the index i introduced by the complement tense-operator PRES or PAST would already be identified as the i of the main clause. This is not the case. Another solution is to assume that the *that*-complementizer is going to fulfill its subordinating duty by first adapting the complement. This may be done by making the tensed sentence tenseless by temporarily “switching off” the force of its PRES- or PAST-operator because these are exactly the ones that are subordinated to the higher PRES and PAST. The complementizer is thus made of type $\langle t, \langle i, t \rangle \rangle$, which makes it an operator expressing a relation between an index and a proposition. The solution makes life easier if infinitival complements are taken to be of type $\langle i, t \rangle$. From the point of view of the main verb both types of complements are then of type $\langle i, t \rangle$, in terms of argument structure. This makes it easier to give an answer to the first question: how does temporal information encapsulated in an argument connect to temporal information outside in the rest of the main clause.

3.2.1. *Infinitival Complements*

In sentence like (14a) there are two (tenseless) predications to deal with: (14b) and (14c).

- (14) a. Harry zag zichzelf schreeuwen
 b. $\lambda k_0. \text{See}(k_0)(X)(h)$
 b.' $\exists i \exists j_0 \exists k_0 [\text{See}(k_0)(X)(h) \wedge j_0 \subseteq k_0 \wedge j_0 \approx i \wedge i < n]$
 c. $\lambda k_1. \text{Scream}(k_1)(h)$
 c' $\lambda i \exists j_1 \exists k_1 [\text{Scream}(k_1)(h) \wedge j_1 \subseteq k_1 \wedge j_1 \approx i]$

The tenseless structure (14b) will be subjected to the operators PAST(SYN)(IMP) in order to yield *Harry zag ...* (Harry saw ...) along the lines of derivation (13) sketched in § 3.1. The tenseless structure in (14c), however, will become (14c') by the force of the operators SYN and IMP. The predication (14c) or its extension (14c') takes the place of X in (14b) and it thus has the status of an argument of the predicate *zien* (see). This raises the problem of how to connect the temporal structure of the complement sentence with the temporal structure of (14b'). This is not an easy thing to do, because one cannot simply conjoin the two pieces of information: (14c) or (14c') has the status of an argument in the sentential structure (14b'). However, it is clear that once a connection is made between crucial indices, one may infer the rest of the temporal information, even in the absence of a logical normal form.

In § 2 it was pointed out that certain main verbs require a synchronous infinitival complement whereas others are characterized by requiring a posterior relation although not necessarily expressed by the presence of an auxiliary as demonstrated with the help of sentences like (15).

- (15) a. Ze hoopte te slapen
 She hoped to sleep
 b. Ze verwachtte hem daar te ontmoeten
 She expected to meet him there

The sense of posteriority expressed in (15a,b) is due to the main verb. Not to its tense but to its lexical content: hope is directed forwards and the same holds for expectations. I will take this as an indication that one has to take the infinitival complements in (14a) and (15) as bare complements, that is, without (SYN) and (IMP), because the presence of these operators would prevent a direct connection between the k-indices. The influence of the main verb can be given a form by positing a lexically determined \emptyset -operator, as shown in Figure 3 and illustrated in (16). The general idea is then to characterize the absence of the overt complementizer as a semantic operation defined in (16a) for *zien* (see) and in (16b) for *hopen* (hope).

- (16) a. $\emptyset_{\text{see}} \rightsquigarrow \lambda \phi \lambda k_0 \exists k_1 \phi[k_1] \wedge k_0 \approx k_1]$
 b. $\emptyset_{\text{hope}} \rightsquigarrow \lambda \phi \lambda k_0 \exists k_1 \phi[k_1] \wedge k_0 < k_1]$

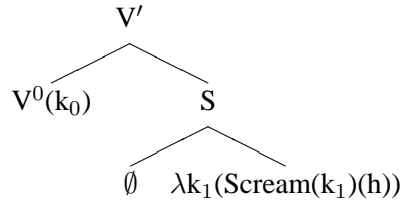


Figure 3. Relating indices

Applied to $\lambda k_1.\text{Scream}(k_1)(h)$ in (14c), the operator in (16a) this yields:

$$\begin{aligned}
 (17) \quad & \lambda \phi \lambda k \exists k_1 \phi[k_1] \wedge k_1 \approx k'](\lambda k'_1.\text{Scream}(k'_1)(h)) \\
 & = \lambda k \exists k_1 \lambda k'_1.\text{Scream}(k'_1)(h)[k_1] \wedge k_1 \approx k] \\
 & = \lambda k \exists k_1(\text{Scream}(k_1)(h)) \wedge k_1 \approx k] \\
 & \text{Applied to } k_0 : \\
 & \lambda k \exists k_1(\text{Scream}(k_1)(h)) \wedge k_1 \approx k](k_0) \\
 & = \exists k_1(\text{Scream}(k_1)(h)) \wedge k_1 \approx k_0]
 \end{aligned}$$

By this, sentence (14) expresses a see-relation between Harry and an eventuality located at the see-index. For the sentences in (15) this operation would yield $k_0 < k_1$ in both cases.

For sentences like (18) the picture turns out to be different.

- (18) a. Ze maakte bekend een oplossing te zullen vinden
 a.' $\lambda i \exists j \exists k_1[(\text{Find}(k_1)(s)(e)) \wedge j \subseteq k \wedge i < j]$
 b. Ze maakte bekend een oplossing te hebben gevonden
 b.' $\lambda i \exists j \exists k_1[(\text{Find}(k_1)(s)(e)) \wedge k \subset j \wedge j \approx i]$

Here the infinitival representations plausibly include IMP and SYN, plausibly because the auxiliaries in (18) require information about i and j . The connection between the temporal structures of the complement and the main clause is now to be made at the point at which the index i is bound by the PRES or PAST operator of the main clause. Note that in these cases there is no direct relation between the two k -indices: in *Zij hoopte een oplossing te hebben gevonden* (She hoped to have found a solution) there is no argument for stipulating lexically that $k_0 < k_1$.

3.2.2. That-complements

A *that*-complementizer has to take a complete tense structure encapsulated as one of the arguments of the main predicate. This does not distinguish it from an infinitival complement as can be seen in (14b) on page 14. That is, *dat hij schreeuwde* (that he screamed) in *Harry zag dat hij schreeuwde* (Harry saw that he screamed) occupies the same place as *zichzelf schreeuwen* (himself scream) in (14b). The difference should be found in the type-logical status

of the *that*-complement, because PAST has been applied yielding a semantic object of type *t*. The technical question is whether *that* is a function having a *t* as input and a *t* as output or that it brings about a type-logical change because some information is harboured in the complementizer itself.

There are several options for dealing with the role of the *that*-complementizer, certainly in view of the many problems that arise in accounting for the match between the temporal structure expressed by the main clause and the subordinate clause. One of these problems is well-known: in the literature the *consecutio temporum* has been abundantly discussed in terms of the question of whether the embedded tense is to be anchored to the utterance time of the main clause or directly to some other point in the system. Other problems are visible in sentences like (19)

- (19) a. Zij_i voorvoelde dat hij met haar_{i/j} ?*belde/zou bellen
 b. Zij wist dat hij met Els belde/zou bellen
 c. Hij voorspelde dat hij ?*belde/zou bellen
 d. Ze beweerde dat hij nog leefde/*zou leven

Here lexical semantics interferes with structural relations between some of the indices between the main clause and the subordinate clause: one cannot predict at time *t* that one is calling at *t*, so the main verb in (19a) forces its complement into taking the posterior auxiliary (or, put differently, it requires a complement with *zullen* (will)). In (19b,c), the difference between *weten* (know) and *voorspellen* (predict) determines the need for using the auxiliary *zullen* (will). In (19d) there is some tension between the force of an assertion and the weakening of the certainty about his life by the use of *zou* (would). I will not take these subtleties into account because a lot of more elementary work on the basis of the relation between the two sorts of temporal information (main clause and subordinate clause) must be done before phenomena like these can be fully understood.

One thing can be carried over from the analysis of the infinitival complement: it is important to locate the eventualities with respect to one another. Note that, in general, if one of the four indices involved (n, i, j, k) of the main clause is related to its correspondent in the subordinate clause, there is a way to construe the remaining part. If there is uncertainty about the precise relations between the other indices involved, this could be empirically justified if indeed this uncertainty shows in the interpretation.

I will now discuss a promising way of dealing with the problem under discussion: how to specify the role of the *that*-complementizer in the connection between two temporal structures? The leading idea is that, of course, the subordinate clause has a full-fledged temporal structure including a real tense, i.e. a PRES or a PAST, but that in some way this temporal structure must be made subordinate with respect to the more prominent tense of the main clause. So, the proper way to go seems to apply abstraction over the

proposition resulting at the S' in Figure 4, which is the part of the structure underlying sentence (20a). We know that PAST introduces the index i relating

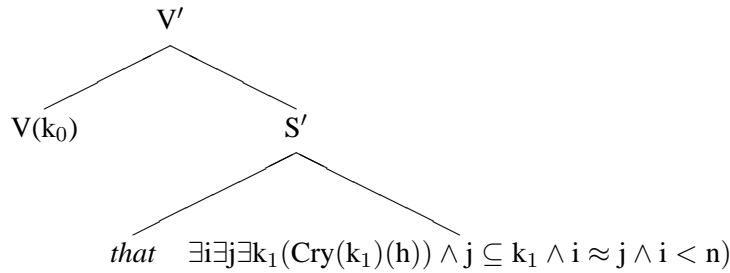


Figure 4. Relating indices

it to the utterance time by assigning the same values to the i in the past tense of the main clause and of the subordinate clause. So, suppose that the task of *that* is to provide for λ -abstraction over the i -index in order to relate the subordinate temporal structure to the i -index of the main clause. For the sentences in (20) this will yield the structures in Figure 5.

- (20) a. Zij zag dat Harry huilde
?She saw that Harry cried
- b. Zij zag dat Harry had gehuild
 She saw that Harry had cried

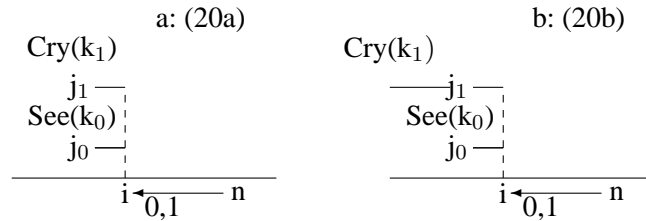


Figure 5. Matching the temporal structures of a main and a subordinate clause

This seems to be a reasonable outcome of the matching problem. It is not necessary in this case to relate the index k_0 of See directly to the k_1 of the Cry-predication. The subordinate clause of (20b) contains the information $k_1 \subset j \wedge j \approx i$ which means that at i the index k_1 precedes i as shown in Figure 5b. The k_0 -index of see contains j , so k_0 does not precede i . This determines the relation between k_0 and k_1 . In Figure 5a, k_0 and k_1 are synchronous.

This solution predicts that sentences like (20) are more well-formed than sentences like (21).

- (21) a. ??Els ziet dat Harry huilde
 ?lit: Els sees that Harry cried
 b. ?Els ziet dat Harry had gehuild
 lit: Els sees that Harry had cried
 c. ??Els ziet dat Harry zou huilen
 lit: Els sees that Harry would cried

This is because on the interpretation of these sentences the i -index of the two clauses cannot be synchronized, so one has to adapt the interpretation by making room for the subordinate $i < n$ -interpretation in a $i \approx n$ -situation. It should be observed that there are cases in which it is less difficult to match $i_1 < n$ and $i_0 \approx n$, although these predicates cannot take all:

- (22) a. Els stelt dat Harry huilde
 lit: Els poses that Harry cried
 b. Els hoopt dat Harry thuis was
 lit: Els hopes that Harry was at home

In all these cases, it is necessary to assume a special context in which the situation described in the complement clause has to be understood. For example, in (22b) Harry had testified to the police that he was at home at a certain time and now Els hopes that Harry was at home indeed so that he did not tell a lie.

An internet search on main predicates the third person singular present tense with verbs like *beweren dat*, *zien dat*, *hopen dat*, *vertellen dat*, etc. shows that the complement tense is practically always a present tense: *Hij meent dat Harry gehuild heeft*, *Zij hoopt dat Jan slaapt*, *Zij hoopt dat Jan heeft geslapen*, *Zij maakt nu bekend dat Harry zal gaan zingen*. Note also that *Zij hoopt dat Jan vreedzaam stierf* is odd as contrasted with *Zij hoopt dat Jan vreedzaam gestorven is*.

The present discussion leads to the conclusion that a direct connection between k_1 and k_0 is not really necessary given the fact that the match between i_1 and i_0 enables us to interpret the two temporal structures as being sufficiently connected. Perhaps, it will turn out to be necessary after all to make a provision along the lines discussed in § 3.2.1 allowing a main verb to require that the k_1 -index of the embedded verb is ordered with respect to k_0 , but on the other hand one may argue that the difference between *that*-complements and infinitival complements is to be characterized in terms of a different role for lexical semantics: in *that*-complements the main verb cannot exercise the influence that it has in bare infinitival complements.

On the basis of the above considerations, the *that*-complementizer could be characterized as taking a t and yielding an $\langle i, t \rangle$, by λ -abstraction. I will formulate the rule bringing this about as a rewrite instruction:

(23) Rewrite: $\exists i\phi[i]$ as $\lambda i\phi[i]$

This transforms Figure 1 into Figure 6. Note that in the present analysis the

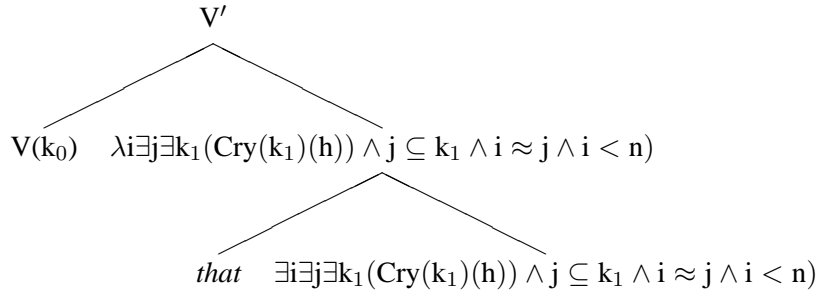


Figure 6. After λ -abstraction

possibility for a *that*-complement to provide for a more independent tense structure than the bare infinitival complements is accounted for by the fact that it is only the i -index that is used to make the connection. It is an empirical question to find out whether this idea can be maintained or not, but as far as I can see now the data point into the right direction. Much depends on a more detailed and more extended research into the data available.

4. Conclusion

The present analysis investigates ways of dealing formally with the difference between two sort of complements. Three elements of the analysis are important:

- The analysis is based on PRES and PAST as the only genuine tenses to be distinguished type-logically from posterior and anterior forms. This made it possible to compare Reichenbach's 3×3 -system and a Te Winkelian $2 \times 2 \times 2$ -system. It turns out to be the case that the absence of PRES and PAST in infinitival complements are exactly the only factors that make a distinction with *that*-complements;
- The index information on the main verb in bare infinitival complements is necessarily related to the index information on the subordinate verb. This form of lexical semantic information is absent in *that*-complementation

- The *that*-complementizer abstracts over the subordinate PRES or PAST tense in order to connect the subordinate to the main temporal structure. In this way language users can construe the resulting complex temporal structure even though it is encapsulated in the internal argument of the main verb.

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