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A Constraint-Based Grammar of Dutch Temporal Connectives

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A Constraint-Based Grammar of Dutch Temporal Connectives

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Abstract:

This paper formalises the essence of Oversteegen's work on Dutch temporal connectives in a HPSG variant of constraint-based grammar. It does so by developing typed feature structure representations of tense and aspect, proposing a way to combine them into lexical representations of verbs, and developing a method of checking consistency of all temporal information in a connective-subsentence-main sentence configuration. Checking consistency is done by combining the representations of the core meanings within a context feature. Deriving the temporal relations holding between the denoted events depends on the aspectual types of sub- and main clause. By notating the various possibilities in disjuncts, constrained by event type, the actual relations are derived. Also steps are taken to account for some rhetorical relations such as consequentiality and causation.

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1 Introduction

1.1 General Introduction

This paper formalises the essence of Oversteegen's work on Dutch temporal connectives (see [5], [4]) in a HPSG variant of constraint-based grammar. It does so by developing typed feature structure representations of tense and aspect, proposing a way to combine them into lexical representations of verbs, and developing a method of checking consistency of all temporal information in a connective-subsentence-main sentence configuration. Checking consistency is done by combining the representations of Oversteegens's core meanings (definitions in terms of evaluation points on the S-track) within a context feature. Deriving the temporal relations holding between the events (intervals on the E-track) denoted depends on the aspectual types of sub- and main clause. By notating the various possibilities in disjuncts, constrained by event type, the actual relations are derived. Also steps are taken to account for some rhetorical relations such as consequentiality and causation. Consequentiality is connected to an analysis of the stative interpretation of the Perfect tense.

All concepts are applied to most of the Dutch connectives discussed in [5]: temporal, consequential, and narrative *toen*, temporal *terwijl*, and temporal as well as conditional *voordat*. Their rhetorical, non-temporal properties are discussed only partially in comparison to the treatment in [5]. The reason for this is that, while temporal relations are treated extensively here, the rhetorical ones require additional formal concepts; see for more about them (for English connectives) in the related deliverable R2.3.3. *Sinds*, *totdat*, and *nadat* are left out of account here (but their English counterparts are treated in R2.3.3. The descriptions of at least their temporal properties can easily be derived from the other analyses in paper.[1]

1.2 Basic concepts

In Oversteegen's Two-track Theory of Time (TTT, see Dandelion deliverable R1.3.2a) speech points are referred to in three different manners: as the *actual* Point of Speech S, which in the Present tense acts as a Point of Evaluation; as an *imaginary* Point of Speech S' preceding or following the actual one, which in e.g. the Past tense acts as a Point of Evaluation; and as a *imaginary* Point of Speech $\diamond S$, which is a potential Point of Evaluation which does not depend on tense but on the time and the type of the event. I will refer to the first one by Speech Point (attribute name: SPEECH), to the second one by Evaluation Point (attribute name: EVAL), and to the third one by Image Point (attribute name: IMAGE). Identity of their values is expressed by structure-sharing, and temporal relations between their values are expressed within feature structures of types like *before*, *during*, *meets*, *equal*, and *overlap* (introduced by Allen in [1]).

Besides these three attributes, being *S-track* concepts, there is an EVENT attribute representing the *E-track*, also with a type *list*, of which temporal relations to the S-Points can be

[1]Thanks to Janet Hitzeman, Leonoor Oversteegen, and Reinhard Muskens for helpful comments and discussion.

expressed with temporal features also (for simplicity I assume that clauses refer to a single event). The idea is that the events on the E-track are conceptualised as dense lists; so the type *during* can also hold between a discrete list ("on the S-track") and its dense superlist ("on the E-track"), for example.

The type of SPEECH is a point, but since the temporal relations generally hold between lists, I assign to it rather the type of a singleton list $singleton - list$ (a subtype of $list$). The type of IMAGE is $list$, because it originates, so to speak, from a E-track to S-track mapping, a function from the event interval onto a list of points: a $singleton - list$ in case of the Convergence mapping (expressing the speaker's perspective of a terminative event), and a *properlist* - another subtype of $list$, expressing a list with more than one element - in case of the Injection mapping (expressing the speaker's perspective of a process or a state). As a consequence, the type of EVAL has to be *list* also, because its value has to be unifiable with the value of IMAGE; for instance in case of the Simple Past (see R1.3.2a, p.15).

In addition, we will use three subtypes of $properlist$, namely $process$, $state$, and $terminative-event$. They will only be needed as values of the EVENT attribute; the values of the various S-track attributes are actually restricted to more general list (proper or singleton) types. (This is perhaps no definitive solution; another possibility, which more distinguishes aspectual from interval information, would be to give EVENT the same three types without *properlist* being a supertype, and declare a feature INTERVAL for them with as subtypes *properlist* and $singleton - list$.)

I have followed the methodology of characterising the meanings of the usual tenses in terms of compositions of atomic contributions corresponding to Present, Past, Perfect, Future, and a "new tense" Simple. The reason for the latter is that it allows for the following clear picture: Present and Past relate the Evaluation Point(s) EVAL to the Speech Point SPEECH; Perfect, Future, and Simple relate EVAL to the EVENT - and thus also to its Image Point(s) IMAGE. Following the methodology mentioned, in case of the (simple) Present and Past the latter relation cannot be represented within their *own* atomic contribution because the result would not be unifiable with atomic Perfect or Future information anymore. So what is normally called Present and Simple Past will be expressed by the composition of the sign for Simple below with the signs for Present and Past respectively.

The temporal relations are expressed as values of an attribute TCOND. I will notate the five tense atoms as macros with as arguments variables reoccurring within their definitions.

present(1,2)=

$$ {}_{verb}\left[\begin{array}{ll} \text{EVAL} & \boxed{1}\ \textit{list} \\ \text{SPEECH} & \boxed{2}\ \textit{sing-list} \\ \text{TCOND} & \left\{ {}_{dur}\left[\begin{array}{ll} \text{ARG1} & \boxed{2} \\ \text{ARG2} & \boxed{1} \end{array}\right] \right\} \end{array}\right] $$

past(1,2)=

$${}_{\textit{verb}}\left[\begin{array}{ll} \text{EVAL} & \boxed{\textit{1}}\ \textit{list} \\ \text{SPEECH} & \boxed{\textit{2}}\ \textit{sing-list} \\ \text{TCOND} & \left\{ {}_{\textit{bef}}\left[\begin{array}{ll}\text{ARG1} & \boxed{\textit{1}}\\ \text{ARG2} & \boxed{\textit{2}}\end{array}\right]\right\}\end{array}\right]$$

perfect(1,2,3)=

$${}_{\textit{verb}}\left[\begin{array}{ll} \text{EVENT} & \boxed{\textit{2}}\ \textit{properlist} \\ \text{EVAL} & \boxed{\textit{1}}\ \textit{list} \\ \text{IMAGE} & \boxed{\textit{3}}\ \textit{list} \\ \text{TCOND} & \left\{ {}_{\textit{bef}}\left[\begin{array}{ll}\text{ARG1} & \boxed{\textit{2}}\\ \text{ARG2} & \boxed{\textit{1}}\end{array}\right], {}_{\textit{dur}}\left[\begin{array}{ll}\text{ARG1} & \boxed{\textit{3}}\\ \text{ARG2} & \boxed{\textit{2}}\end{array}\right]\right\}\end{array}\right]$$

future(1,2,3)=

$${}_{\textit{verb}}\left[\begin{array}{ll} \text{EVENT} & \boxed{\textit{2}}\ \textit{properlist} \\ \text{EVAL} & \boxed{\textit{1}}\ \textit{list} \\ \text{IMAGE} & \boxed{\textit{3}}\ \textit{list} \\ \text{TCOND} & \left\{ {}_{\textit{bef}}\left[\begin{array}{ll}\text{ARG1} & \boxed{\textit{1}}\\ \text{ARG2} & \boxed{\textit{2}}\end{array}\right], {}_{\textit{dur}}\left[\begin{array}{ll}\text{ARG1} & \boxed{\textit{3}}\\ \text{ARG2} & \boxed{\textit{2}}\end{array}\right]\right\}\end{array}\right]$$

simple(1,2)=

$${}_{\textit{verb}}\left[\begin{array}{ll} \text{EVENT} & \boxed{\textit{2}}\ \textit{properlist} \\ \text{EVAL} & \boxed{\textit{1}}\ \textit{list} \\ \text{IMAGE} & \boxed{\textit{1}}\ \textit{list} \\ \text{TCOND} & \left\{ {}_{\textit{dur}}\left[\begin{array}{ll}\text{ARG1} & \boxed{\textit{1}}\\ \text{ARG2} & \boxed{\textit{2}}\end{array}\right]\right\}\end{array}\right]$$

In order to model the Convergence and Injection mappings also with respect to the event types, we let the latter constrain the types of IMAGE as follows. (IMAGE being an S-track feature, only *properlist* and $singleton - list$ are distinguished; it is senseless to use more specific EVENT types *process* and the like as IMAGE values.)

Processes:

$$\left[\begin{array}{ll}\text{EVENT} & \textit{process}\\ \text{IMAGE} & \textit{properlist}\end{array}\right]_{\textit{verb}}$$

States:

$$\left[\begin{array}{ll}\text{EVENT} & \textit{state}\\ \text{IMAGE} & \textit{properlist}\end{array}\right]_{\textit{verb}}$$

Terminative events:

$$\left[\begin{array}{ll}\text{EVENT} & \textit{terminative-event}\\ \text{IMAGE} & \textit{singleton-list}\end{array}\right]_{\textit{verb}}$$

Now pieces of complex information can be composed as combinations of the "atomic" representations given, the mode of composition being: unification in the case of non-set-valued features, and union in the case of set-valued features. For instance, a Simple Past Process is represented by the composition of Simple, Past, and Process:

$$\left[\begin{array}{ll}\text{EVENT} & \boxed{3}\ \textit{process}\\ \text{EVAL} & \boxed{2}\ \textit{list}\\ \text{SPEECH} & \boxed{1}\ \textit{singleton-list}\\ \text{IMAGE} & \boxed{2}\ \textit{properlist}\\ \text{TCOND} & \left\{\left[\begin{array}{ll}\text{ARG1} & \boxed{2}\\ \text{ARG2} & \boxed{1}\end{array}\right]_{\textit{bef}}, \left[\begin{array}{ll}\text{ARG1} & \boxed{2}\\ \text{ARG2} & \boxed{3}\end{array}\right]_{\textit{dur}}\right\}\end{array}\right]_{\textit{verb}}$$

As another example, here is the composition of Perfect, Present, and Terminative Event:

$$\left[\begin{array}{ll}\text{EVENT} & \boxed{6}\ \textit{terminative-event}\\ \text{EVAL} & \boxed{4}\ \textit{list}\\ \text{SPEECH} & \boxed{1}\ \textit{singleton-list}\\ \text{IMAGE} & \boxed{5}\ \textit{singleton-list}\\ \text{TCOND} & \left\{\left[\begin{array}{ll}\text{ARG1} & \boxed{1}\\ \text{ARG2} & \boxed{4}\end{array}\right]_{\textit{dur}}, \left[\begin{array}{ll}\text{ARG1} & \boxed{6}\\ \text{ARG2} & \boxed{4}\end{array}\right]_{\textit{bef}}, \left[\begin{array}{ll}\text{ARG1} & \boxed{5}\\ \text{ARG2} & \boxed{6}\end{array}\right]_{\textit{dur}}\right\}\end{array}\right]_{\textit{verb}}$$

Finally, a remark about the interaction of the EVENT tense features with the CONTENT value of verbs. In the cases discussed the EVENT value is structure-shared with the value of PSOA-INDEX, which acts as the event variable associated to the state of affairs (type *psoa*) the CONTENT value consists in. So this is something which has to be expressed in the complete sign of a verb (I will give an example in the next section). There are exceptions however: verbs in some Perfect tense. For these have besides the interpretation given also another one, the state interpretation. According to this the state obtaining *after* the EVENT is relevant, so that the PSOA-INDEX of their CONTENT is structure-shared with this state. I will turn to this phenomenon now.

2 The State Interpretation of the Perfect

As explained in R1.3.2a, p.12, the representation of the Perfect above expresses only one of the two possibilities in Dutch: some time in the past there was a certain event. But there is another interpretation: at the current moment there is a state of an event having occurred. For the present work this interpretation is especially important because if temporal connectives are combined with particular tense combinations (see R1.3.2a, p.21) the perfect tenses get this very interpretation.

So in this case the described event is actually a *state* immediately following the event (usually of type $terminative-event$) located at the time the normally interpreted perfect tense would point to. This can partially be encoded as

perfect(1,2,3,4)=

$$\left[\begin{array}{ll}
\text{EVENT} & \boxed{2}\ \textit{properlist} \\
\text{EVAL} & \boxed{1}\ \textit{list} \\
\text{IMAGE} & \boxed{3}\ \textit{list} \\
\text{TCOND} & \left\{\begin{array}{l} {}_{bef}\begin{bmatrix}\text{ARG1} & \boxed{2} \\ \text{ARG2} & \boxed{1}\end{bmatrix}, {}_{dur}\begin{bmatrix}\text{ARG1} & \boxed{3} \\ \text{ARG2} & \boxed{2}\end{bmatrix}, \\ {}_{meets}\begin{bmatrix}\text{ARG1} & \boxed{2} \\ \text{ARG2} & \boxed{4}\end{bmatrix}, {}_{dur}\begin{bmatrix}\text{ARG1} & \boxed{1} \\ \text{ARG2} & \boxed{4}\end{bmatrix}\end{array}\right\} \\
\text{RCOND} & \left\{ {}_{cons}\begin{bmatrix}\text{ARG1} & \boxed{2} & \\ \text{ARG2} & \boxed{4} & \textit{state}\end{bmatrix}\right\}
\end{array}\right]_{verb}$$

This differs from the Perfect specification given earlier in the presence of additional elements of the set of conditions. First, a state $\boxed{4}$ is assumed to stand in the rhetorical relation of consequence (*cons*) of the original event $\boxed{2}$, and to follow (*meet*) it immediately. I will express this within a feature RCOND for the conditions involvinf rhetorical relations. Note that the location of the IMAGE value, needed if the sentence is a main clause, is still during this original event and not on the result state. Finally, this state $\boxed{4}$ is located during the evaluation point $\boxed{1}$, in accordance with the characterisation in R1.3.2a, p.12.

The temporal relations for this interpretation seem rightly represented now; what is needed in addition however is to ensure that the CONTENT of such a stative perfect sentence is a result state, as in example (1), not the original event, as in example (2):

(1) Hij heeft de deur gisteren geschilderd.

He has painted the door yesterday.

(2) Hij heeft de deur nu geschilderd.

He has painted the door now.

So let us consider the SYNSEM | LOCAL value for 'heeft geschilderd' ("has painted"), given below first in the terminative interpretation, and then in the stative one.

The local SYNSEM value of a non-stative Perfect

$$
{}_{local}\begin{bmatrix}
\text{CATEGORY} & \begin{bmatrix}
\text{HEAD} & {}_{verb}\begin{bmatrix}
\text{EVENT} & \boxed{6}\ \textit{terminative-event} \\
\text{EVAL} & \boxed{4}\ \textit{list} \\
\text{SPEECH} & \boxed{1}\ \textit{singleton-list} \\
\text{IMAGE} & \boxed{5}\ \textit{singleton-list} \\
\text{TCOND} & \boxed{10}\left\{ \begin{array}{l}
{}_{dur}\begin{bmatrix} \text{ARG1} & \boxed{1} \\ \text{ARG2} & \boxed{4} \end{bmatrix}, \ {}_{bef}\begin{bmatrix} \text{ARG1} & \boxed{6} \\ \text{ARG2} & \boxed{4} \end{bmatrix}, \\
{}_{dur}\begin{bmatrix} \text{ARG1} & \boxed{5} \\ \text{ARG2} & \boxed{6} \end{bmatrix}
\end{array} \right\}
\end{bmatrix} \\
\text{SUBJ} & \langle \textit{NP}\ \boxed{7} \rangle \\
\text{COMPS} & \langle \textit{NP}\ \boxed{8} \rangle
\end{bmatrix} \\
\text{CONTENT} & \left\langle {}_{paint}\begin{bmatrix} \text{PSOA-INDEX} & \boxed{6} \\ \text{ARG1} & \boxed{7} \\ \text{ARG2} & \boxed{8} \end{bmatrix} \right\rangle \\
\text{TEMP-RELNS} & \boxed{10}
\end{bmatrix}
$$

The meanings of the two readings (the second one is on the next page) differ not only in that they carry diverging values of the TEMP-RELNS attribute, but also in their having different CONTENT values: according to the first one the paint-relation between the two individuals $\boxed{7}$ and $\boxed{8}$ (standing for the INDEX values of the respective NPs) is conceived of as a terminative event $\boxed{6}$, according to the second one it is conceived of as a state $\boxed{9}$ immediately following $\boxed{6}$. Moreover, the fact that the latter is a consequence of the former is inherited there by an attribute RHET-RELNS for the rhetorical relations. Besides *cons*, typically for the relation between a terminative event and its consequent state, another one which I will use is *causes*, for the relation between two events which is more one of intended causation.

The local SYNSEM value of a stative Perfect

$$
{}_{\textit{local}}\left[\begin{array}{ll}
\text{CATEGORY} & \left[\begin{array}{ll}
\text{HEAD} & {}_{\textit{verb}}\left[\begin{array}{ll}
\text{EVENT} & \boxed{6}\ \textit{terminative-event} \\
\text{EVAL} & \boxed{4}\ \textit{list} \\
\text{SPEECH} & \boxed{1}\ \textit{singleton-list} \\
\text{IMAGE} & \boxed{5}\ \textit{singleton-list} \\
\text{TCOND} & \boxed{10}\left\{\begin{array}{l}
{}_{\textit{dur}}\left[\begin{array}{ll}\text{ARG1} & \boxed{1} \\ \text{ARG2} & \boxed{4}\end{array}\right],\ {}_{\textit{bef}}\left[\begin{array}{ll}\text{ARG1} & \boxed{6} \\ \text{ARG2} & \boxed{4}\end{array}\right], \\
{}_{\textit{dur}}\left[\begin{array}{ll}\text{ARG1} & \boxed{5} \\ \text{ARG2} & \boxed{6}\end{array}\right],\ {}_{\textit{meets}}\left[\begin{array}{ll}\text{ARG1} & \boxed{6} \\ \text{ARG2} & \boxed{9}\end{array}\right], \\
{}_{\textit{dur}}\left[\begin{array}{ll}\text{ARG1} & \boxed{4} \\ \text{ARG2} & \boxed{9}\end{array}\right]
\end{array}\right\} \\
\text{RCOND} & \boxed{11}\left\{ {}_{\textit{cons}}\left[\begin{array}{ll}\text{ARG1} & \boxed{6} \\ \text{ARG2} & \boxed{9}\end{array}\right]\right\}
\end{array}\right] \\
\text{SUBJ} & \langle\ NP\ \boxed{7}\ \rangle \\
\text{COMPS} & \langle\ NP\ \boxed{8}\ \rangle
\end{array}\right] \\
\text{CONTENT} & \left\langle\ {}_{\textit{paint}}\left[\begin{array}{ll}\text{PSOA-INDEX} & \boxed{9}\ \textit{state} \\ \text{ARG1} & \boxed{7} \\ \text{ARG2} & \boxed{8}\end{array}\right]\right\rangle \\
\text{TEMP-RELNS} & \boxed{10} \\
\text{RHET-RELNS} & \boxed{11}
\end{array}\right]
$$

Officially, we follow Pollard and Sag in that the general type of the CONTENT of verbs and sentences is (a list of) *psoa*, defined for QUANTS and NUCLEUS; and, as in the Discourse LRE work (see [3]), moreover defined for PSOA-INDEX which is structure-shared with the EVENT value. This leads to representations in which the PSOA-INDEX values of the CONTENT reoccur as ARG values of the TEMP-RELNS. However, since we ignore in this study internal NP structure, we will restrict the CONTENT in our examples actually to quantifier-free psoa's; the type *qfpsoa* being the supertype of all relations, in turn defined for a fixed number of arguments as well as for our PSOA-INDEX feature.

As is clear, the TEMP-RELNS of simple sentences like these ones are structure-shared by the COND value, which is in turn simply inherited from the verb (be it a complex one here: auxiliary plus main verb). As such, the temporal relations of simple sentences may be viewed as expressing, just like the CONTENT feature, a part of their assertional meaning.

As to this, we will conjecture in the later sections on the temporal connectives that the picture for complex sentences composed by temporal connectives has to be rather different: there, following the theory of TTT, the *asserted temporal relations* TEMP-RELNS are a function of (at least) both the temporal contribution of the connective itself, and the event types of the constituting clauses; in contrast, the TEMP-RELNS originally asserted by the constituting clauses are required to be consistent with the *presupposed temporal relations* of the temporal connectives, something which will be notated in a CONTEXT feature.

For example, in a number of connective-subclause-main clause configurations (see R1.3.2a, p.21) the interpretation of the perfect is restricted to the state reading intuitively; and indeed the non-state readings here can in our HPSG reconstruction of TTT be shown to be inconsistent with the contextual conditions of the connectives (see section 4).

To close this section, a word about further syntactic specification. First, the two local SYNSEM values given represent attributes of a complex phrase 'heeft geschilderd' and as such they are assumed to be composed of two lexical specifications: one associated to the auxiliary and one associated to the main verb. For the main verb the essence just lies in the type of the CONTENT relation together with the order of the arguments, standing for indices inherited from the noun phrases subcategorised for. For the auxiliary the essence is given in either the macro definition perfect/3 above or perfect/4, plus the corresponding specification of what value the PSOA-INDEX will take. The two choices for the perfect are assumed to be related by a general lexical rule.

3 Checking Consistency of Temporal Relations

The next step is of course the incorporation into grammar, including in particular a representation of TTT's constraints on temporal connectives. Thus the sign for *toen* would have to include features like the following.

Conditions on Tense of Sub- and Main Clause for *toen*:

$$\begin{bmatrix} \textsc{subcat} & \langle verb \begin{bmatrix} \textsc{speech} & \boxed{1} \\ \textsc{eval} & \boxed{2} \end{bmatrix} \rangle \\ \textsc{mod} & verb \begin{bmatrix} \textsc{speech} & \boxed{1} \\ \textsc{image} & \boxed{5} \end{bmatrix} \\ \textsc{tcond} & \{ dur \begin{bmatrix} \textsc{arg1} & \boxed{7} \\ \textsc{arg2} & \boxed{2} \end{bmatrix}, dur \begin{bmatrix} \textsc{arg1} & \boxed{7} \\ \textsc{arg2} & \boxed{5} \end{bmatrix} \} \end{bmatrix}$$

This preliminary sketch expresses that the list of evaluation points of the subsentence subcategorised for includes at least one element which also belongs to the list of image points of the main sentence to be modified.

As an example, take

(3) Toen het regende ben ik nat geworden.

When it rained I have got wet.

A parse of this instantiates the CATEGORY | HEAD value of the argument of the subcat list to the sign given for a Simple Past Process; and the CATEGORY | HEAD value of MOD to the sign given for a Perfect Present Terminative event (in the non-stative variant). In my choice of the variables within the three respective signs (for SPE and PPTe at the end of section 1, and for '*toen*' above) I have anticipated on the result, so that it is easy to check that the union of all temporal conditions becomes:

$$bef \begin{bmatrix} \textsc{arg1} & \boxed{2} \\ \textsc{arg2} & \boxed{1} \end{bmatrix}, bef \begin{bmatrix} \textsc{arg1} & \boxed{6} \\ \textsc{arg2} & \boxed{4} \end{bmatrix}, dur \begin{bmatrix} \textsc{arg1} & \boxed{2} \\ \textsc{arg2} & \boxed{3} \end{bmatrix}, dur \begin{bmatrix} \textsc{arg1} & \boxed{2} \\ \textsc{arg2} & \boxed{3} \end{bmatrix}$$

$$dur \begin{bmatrix} \textsc{arg1} & \boxed{1} \\ \textsc{arg2} & \boxed{4} \end{bmatrix}, dur \begin{bmatrix} \textsc{arg1} & \boxed{5} \\ \textsc{arg2} & \boxed{6} \end{bmatrix}, dur \begin{bmatrix} \textsc{arg1} & \boxed{7} \\ \textsc{arg2} & \boxed{2} \end{bmatrix}, dur \begin{bmatrix} \textsc{arg1} & \boxed{7} \\ \textsc{arg2} & \boxed{5} \end{bmatrix}$$

Checking compatibility of such conditions can be done as follows. The *before* and *meets* conditions yielded within the analysis of a text are translated into linear lists which are required to be compatible. The translation rule takes into account transitivity with respect to the *during* and *equal* relations, so that e.g. if A precedes B and C is during B, A also precedes C. Also a fifth temporal relation *overlap* will be used in the examples of the next sections, but this is not taken into account explicitly in the translation step, since it is expressable in terms of *during*:

$$\left\{ {}_{overlap}\begin{bmatrix} \text{ARG1} & \boxed{\mathit{1}} \\ \text{ARG2} & \boxed{\mathit{2}} \end{bmatrix} \right\} = \left\{ {}_{during}\begin{bmatrix} \text{ARG1} & \boxed{\mathit{3}} \\ \text{ARG2} & \boxed{\mathit{1}} \end{bmatrix}, {}_{during}\begin{bmatrix} \text{ARG1} & \boxed{\mathit{3}} \\ \text{ARG2} & \boxed{\mathit{2}} \end{bmatrix} \right\}$$

Translation of *before* and *meets* structures into lists of sets.

In the following definitions ';' stands for immediate precedence and ',' for merely precedence.

$$before\begin{bmatrix} \text{ARG1}\ \boxed{1} \\ \text{ARG2}\ \boxed{2} \end{bmatrix}^{\dagger} = [S_1, S_2], \text{ where } S_{n,n\in\{1,2\}} \text{ is the smallest set such that}$$

1. $\boxed{\text{n}} \in S_n$
2. $\forall x(\exists y \in S_n(during\begin{bmatrix} \text{ARG1}\ x \\ \text{ARG2}\ y \end{bmatrix}) \rightarrow x \in S_n)$
3. $\forall x(\exists y \in S_n(equal\begin{bmatrix} \text{ARG1}\ x \\ \text{ARG2}\ y \end{bmatrix} \vee equal\begin{bmatrix} \text{ARG1}\ y \\ \text{ARG2}\ x \end{bmatrix}) \rightarrow x \in S_n)$

$$meets\begin{bmatrix} \text{ARG1}\ \boxed{1} \\ \text{ARG2}\ \boxed{2} \end{bmatrix}^{\dagger} = [S_1; S_2], \text{ with the same conditions on } S_{n,n\in\{1,2\}}.$$

In our example,

$$before\begin{bmatrix} \text{ARG1}\ \boxed{2} \\ \text{ARG2}\ \boxed{1} \end{bmatrix}^{\dagger} = [\{\boxed{2}, \boxed{7}\}, \{\boxed{1}\}]$$

$$before\begin{bmatrix} \text{ARG1}\ \boxed{6} \\ \text{ARG2}\ \boxed{4} \end{bmatrix}^{\dagger} = [\{\boxed{6}, \boxed{5}, \boxed{7}\}, \{\boxed{4}, \boxed{1}\}]$$

In addition a notion of consistency of sets of list (of both kinds) needs to be defined. I will not give such a definition here. Intuitively it is often easy to see the (in)consistency however: for instance, the two lists of this example are consistent, since they assert the same about their common subelements: namely that $\boxed{7}$ precedes $\boxed{1}$. It becomes a bit harder when the incosistency arises partially from the types of the ARG features themselves; for example, it cannot be the case that if C is a $singleton - list$, A is before B and C is both during A and during B.

4 Temporal connectives as heads of adverbial clauses

The representations in this section illustrate what would essentially have to be specified lexically if we view temporal connectives as the heads of phrasal adjuncts. It expresses for *toen* that this has a single saturated verbal (so sentential) complement COMPS; for which INV - is specified because verbs are final in Dutch subclauses, following the ideas of Pollard and Rentier, compare [2]. (Note that this elaboration follows the revised version of HPSG ([6],Ch. 9) according to which the SUBCAT list is divided into a COMPS and a SUBJ list.) With this clausal complement, the connective MODifies a main clause (for Dutch specified by INV +) by Schema 5 for Head Adjunct structures.

By the Semantics Principle, the content of a head adjunct structure is the content of the adjunct daughter, which is the content of its head, the temporal connective. I modify this in that I take 'content' in this formulation to refer to both CONTENT, the non-temporal content, TEMP-RELNS, the temporal relations between events occurring within CONTENT, and RHET-RELNS, their rhetorical relations. It is also an option to give the latter two features as values of CONTENT of course; one reason to prefer the current notation is perspicuity of the total representations.

The CONTENT of the whole is often identical to the CONTENT of the main clause, since the CONTENT of the sub clause is often presupposed; which will be expressed by giving it as an element of the set-value of a CONTEXT | PRESUPPOSITION feature. This is only a preliminary step though; the intended procedural interpretation of it is that the CONTENT value of a parsed sentence added to its CONTEXT | PRESUPPOSITION value yields the CONTEXT | PRESUPPOSITION value of the sentence to be parsed next. If, like in the example of section 4.1.1, a PRES value is assigned an element which was not added to this set earlier, presupposition failure should be signalled. See for steps towards a DRT elaboration of the general idea Deliverable R2.3.3.

The union of all temporal conditions, contributed by both clauses as well as the connective itself, I have given here as a set-value of CONTEXT | TCOND. This is the one of which semantic consistency would have to be checked by definite clause attachments in the way proposed earlier.

Returning to the selection restrictions on tense, a constant feature of the connective representations is: of the main clause, the SPEECH and IMAGE points are required to comply with a certain CONDition, and of the subclause the SPEECH (token-identical with the other one) and EVAL points. Further, reference is made to a CONTENT of both clauses, which is partially specified for a PSOA-INDEX. Remember that its value is normally inherited from the EVENT of the respective clause; only in the case of the stative Perfect it is the state following the EVENT.

4.1 *Toen*

4.1.1 a. Purely temporal

$$
\left[\begin{array}{ll}
\text{CATEGORY} & \left[\begin{array}{ll}
\text{HEAD} & {}_{\textit{adj}}\left[\begin{array}{ll}
\text{MOD} & \left[\begin{array}{ll}
\text{HEAD} & {}_{\textit{verb}}\left[\begin{array}{ll}
\text{SPEECH} & \boxed{1} \\
\text{IMAGE} & \boxed{5} \\
\text{TCOND} & \boxed{10} \\
\text{INV} & +
\end{array}\right] \\
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle \\
\text{CONTENT} & \left\langle \boxed{6}\left[\text{PSOA-INDEX}\ \ \boxed{8}\right]\right\rangle
\end{array}\right] \\
\text{PRD} & -
\end{array}\right] \\
\text{COMPS} & \left\langle \left[\begin{array}{ll}
\text{HEAD} & {}_{\textit{verb}}\left[\begin{array}{ll}
\text{SPEECH} & \boxed{1} \\
\text{EVAL} & \boxed{2} \\
\text{TCOND} & \boxed{11} \\
\text{INV} & -
\end{array}\right] \\
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle \\
\text{CONTENT} & \left\langle \boxed{3}\left[\text{PSOA-INDEX}\ \ \boxed{9}\right]\right\rangle
\end{array}\right] \right\rangle
\end{array}\right] \\
\text{CONTENT} & \left\langle \boxed{6} \right\rangle \\
\text{TEMP-RELNS} & \left\{\begin{array}{ll}
{}_{\textit{(1)eq}}\left[\begin{array}{lll}
\text{ARG1} & \boxed{8} & \textit{t-ev} \\
\text{ARG2} & \boxed{9} & \textit{t-ev}
\end{array}\right] \vee &
{}_{\textit{(4)dur}}\left[\begin{array}{lll}
\text{ARG1} & \boxed{8} & \textit{t-ev} \\
\text{ARG2} & \boxed{9} & \textit{pr}\vee\textit{st}
\end{array}\right] \vee \\
{}_{\textit{(5)dur}}\left[\begin{array}{lll}
\text{ARG1} & \boxed{9} & \textit{t-ev} \\
\text{ARG2} & \boxed{8} & \textit{pr}\vee\textit{st}
\end{array}\right] \vee &
{}_{\textit{(2,6)ov}}\left[\begin{array}{lll}
\text{ARG1} & \boxed{8} & \textit{pr}\vee\textit{st} \\
\text{ARG2} & \boxed{9} & \textit{pr}\vee\textit{st}
\end{array}\right]
\end{array}\right\} \\
\text{CONTEXT} & \left[\begin{array}{ll}
\text{TCOND} & \boxed{10} \cup \boxed{11} \left\{ \ldots\ {}_{\textit{bef}}\left[\begin{array}{ll}
\text{ARG1} & \boxed{2} \\
\text{ARG2} & \boxed{1}
\end{array}\right] \ldots \right\} \cup \\
 & \left\{ {}_{\textit{dur}}\left[\begin{array}{ll}
\text{ARG1} & \boxed{7} \\
\text{ARG2} & \boxed{2}
\end{array}\right], {}_{\textit{dur}}\left[\begin{array}{ll}
\text{ARG1} & \boxed{7} \\
\text{ARG2} & \boxed{5}
\end{array}\right] \right\} \\
\text{PRES} & \left\{ \ldots \boxed{3} \ldots \right\}
\end{array}\right]
\end{array}\right]
$$

The numbers before the types of the temporal relations refer to the paths in R1.3.2a, p.68. I will clarify most features one by one.

SUBJ <>, COMPS <> : main and sub clause are saturated verbs, i.e. sentences.

CONTENT < $\boxed{\mathbf{6}}$ > : the asserted content of the complex sentence is the asserted content of the main clause.

CONTEXT | PRES{...$\boxed{\mathbf{3}}$...} : part of the presupposed content of the complex sentence is the asserted content of the subclause.

CONTEXT | COND... : that *toen* generally subcategorises for a subsentence with a past tense is expressed here by the fact that its temporal conditions $\boxed{11}$ include the AVM expressing that $\boxed{2}$ precedes $\boxed{1}$; moreover this is added to the whole "consistency test" expressed by the conditions together: $\boxed{10}$ united with $\boxed{11}$ united with a set of two conditions expressing Oversteegens general definition of purely temporal *toen*:

$$\exists x \in \diamond S_m \exists y \in S^{max}{}_s : x = y$$

This definition is in terms of S-track concepts. It allows for various temporal relations between the events on the E-track:

TEMP-RELNS : the possibilities depend on their event type in such a way that actually only one relation is yielded. So this value is a singleton which is specified as a disjunction of four possibilities; which one is retained depends on the types of $\boxed{8}$ and $\boxed{9}$ inherited from the two verbs modified and subcategorised for.

- Path (1) : coextension of terminative (punctiliar) events.
- Path (2): coextension of processes or states, which is not distinguishable from path (6), at least not on the basis of event type.
- Paths (4) and (5): a process or state including a terminative event.
- Path (6): overlapping of processes or states.

Now this purely temporal *toen* presupposes knowledge with respect to the location of the evaluation of the subsentence event, whereas the consequential variety does not. The reason is simply that the purely temporal interpretation will only be informative if this presupposition is satisfied. This can be the case by information from the preceding context, information in the subsentence itself or information inferable from real world knowledge (see R1.3.2a, p.27). Currently it is difficult to model all this; not only a framework for incorporating the dynamic notion of context change need to be set up (but see R2.3.3), also inferences depending on lexical-semantic knowledge cannot be adressed here.

4.1.2 b. Consequential

Although one can collapse any two HPSG representations into one by using disjunction (see for instance the single representation for 'when' in R2.3.3), I will give here for readability a separate representation for consequential *toen*. This is the variant which shares with the purely temporal version the fact that the CONTENT of the subsentence is presupposed; but it differs in that the *location* of the subsentence evaluation point needs not to be derivable.

Apart from the latter, we can give a representation which adequately gives its content, as well as its asserted and presupposed temporal relations. Moreover, we can show that a consequential interpretation is sometimes forced by a combination of tenses, which simply excludes a temporal interpretation: in the case of *toen* the combination of a Simple Past in the subsentence with a Past Perfect in the main clause. An example is

(4) Toen Nikki thuiskwam had haar vader een enorm feestmaal aangericht.

When Nikki came home her father had prepared a big feast.

Earlier we noted Oversteegen's claim that this tense combination (among others) requires a stative reading of the perfect. So the only reading of a sentence with this combination is the one with a consequential *toen*-clause and a stative Past Perfect.

Now let us propose a representation of consequential *toen*. There is no longer a common evaluation point of main and subclause, as required by the definition (CONTEXT | TCOND) of purely temporal *toen*. This is obvious from a simpler sentence (two times Simple Past) like

(5) Toen Mireille Miguel op het feestje tegenkwam, wilde ze meteen naar huis.

When Mireille ran into Miguel at the party, she wanted to leave immediately.

This example by the way shows that the restriction of the subsentence event to processes and states (R1.3.2a, p.31) is not correct. Instead the interpretation can be consequential because the temporal part of the definition is rather

$$\exists y \in {S^{max}}_s \forall x \in \diamond S_m : y < x$$

that is, it locates the image points of the main sentence in the future of at least some evaluation points of the subsentence events (compare R1.3.2a, p.31). It seems that the precedence does not have to be immediate (so a $before$ instead of a *meets* suffices) because after all the IMAGE value of the second (main sentence) event can be a singleton list, temporally located somewhere in the middle during the event; an immediate precedence of the two lists of evaluation points would, unjustified, imply in this case a necessary overlap of the corresponding events.

Moreover, there has to be a consequentiality relation between the events. I will notate this extra condition as an element of the feature RHET-RELNS, and presume that the type *temps-relns* can be specified not only to really temporal subtypes such as *before* and *during*, but also to a type *causes*. The proposal as to the E-track is that consequential *toen* locates the resulting main sentence event after the causal subsentence event.

The local SYNSEM value of consequential *toen*

$$
\begin{bmatrix}
\text{CATEGORY} & \begin{bmatrix}
\text{HEAD} & {}_{adj}\begin{bmatrix}
\text{MOD} & \begin{bmatrix}
\text{HEAD} & {}_{verb}\begin{bmatrix} \text{SPEECH} & \boxed{1} \\ \text{IMAGE} & \boxed{5} \\ \text{TCOND} & \boxed{10} \\ \text{RCOND} & \boxed{13} \\ \text{INV} & + \end{bmatrix} \\
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle \\
\text{CONTENT} & \langle \boxed{6} \begin{bmatrix} \text{PSOA-INDEX} & \boxed{\mathit{8}} \end{bmatrix} \rangle
\end{bmatrix} \\
\text{PRD} & -
\end{bmatrix} \\
\text{COMPS} & \left\langle \begin{bmatrix}
\text{HEAD} & {}_{verb}\begin{bmatrix} \text{SPEECH} & \boxed{1} \\ \text{EVAL} & \boxed{2} \\ \text{TCOND} & \boxed{11} \\ \text{RCOND} & \boxed{14} \\ \text{INV} & - \end{bmatrix} \\
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle \\
\text{CONTENT} & \langle \boxed{3} \begin{bmatrix} \text{PSOA-INDEX} & \boxed{\mathit{9}} \end{bmatrix} \rangle
\end{bmatrix} \right\rangle
\end{bmatrix} \\
\text{CONTENT} & \langle \boxed{6} \rangle \\
\text{TEMP-RELNS} & \left\{ {}_{dur}\begin{bmatrix} \text{ARG1} & \boxed{12} \\ \text{ARG2} & \boxed{9} \end{bmatrix}, {}_{bef}\begin{bmatrix} \text{ARG1} & \boxed{12} \\ \text{ARG2} & \boxed{8} \end{bmatrix} \right\} \\
\text{RHET-RELNS} & \boxed{\mathit{13}} \cup \boxed{\mathit{14}} \cup \left\{ {}_{causes}\begin{bmatrix} \text{ARG1} & \boxed{9} \\ \text{ARG2} & \boxed{8} \end{bmatrix} \right\} \\
\text{CONTEXT} & \begin{bmatrix}
\text{TCOND} & \boxed{10} \cup \boxed{11} \left\{ \ldots {}_{bef}\begin{bmatrix} \text{ARG1} & \boxed{2} \\ \text{ARG2} & \boxed{1} \end{bmatrix} \ldots \right\} \cup \\
 & \left\{ {}_{dur}\begin{bmatrix} \text{ARG1} & \boxed{7} \\ \text{ARG2} & \boxed{2} \end{bmatrix}, {}_{bef}\begin{bmatrix} \text{ARG1} & \boxed{7} \\ \text{ARG2} & \boxed{5} \end{bmatrix} \right\} \\
\text{PRES} & \{ \ldots \boxed{3} \ldots \}
\end{bmatrix}
\end{bmatrix}
$$

In the system on p.68 of R1.3.2a this corresponds to path (7). A difference on the properties there (p.70) is that the subsentence event is not required to be a process or state; a terminative event is possible too.

Let us first return to our example:

(6) Toen Mireille Miguel op het feestje tegenkwam, wilde ze meteen naar huis.

When Mireille ran into Miguel at the party, she wanted to leave immediately.

The consequential reading of this is present if the context is such that the subsentence cannot be used to determine the evaluation time of the main sentence. For this example the following features are derived from our representations of consequential *toen* and of the Simple Past (as to the CONTENT it is a simplified representation, with its notation of complex phrases in the form of single types) :

$$\begin{bmatrix} \text{CONTENT} & \left\langle {}_{\textit{want-to-leave}}\begin{bmatrix} \text{PSOA-INDEX} & \boxed{8} \\ \text{ARG1} & \textit{mireille} \end{bmatrix} \right\rangle \\ \text{CONTEXT}|\text{PRES} & \left\{ \ldots \; {}_{\textit{run-into}}\begin{bmatrix} \text{PSOA-INDEX} & \boxed{9} \\ \text{ARG1} & \textit{mireille} \\ \text{ARG2} & \textit{miguel} \end{bmatrix} \ldots \right\} \\ \text{TEMP-RELNS} & \left\{ {}_{\textit{dur}}\begin{bmatrix} \text{ARG1} & \boxed{12} \\ \text{ARG2} & \boxed{9} \end{bmatrix}, {}_{\textit{bef}}\begin{bmatrix} \text{ARG1} & \boxed{12} \\ \text{ARG2} & \boxed{8} \end{bmatrix} \right\} \\ \text{RHET-RELNS} & \left\{ {}_{\textit{causes}}\begin{bmatrix} \text{ARG1} & \boxed{9} \\ \text{ARG2} & \boxed{8} \end{bmatrix} \right\} \end{bmatrix}$$

This says that some (not precisely specified) time after the beginning of the terminative event of Mireille's running into Miguel, she wanted to leave as a consequence thereof.

For sentences with a stative Past Perfect main clause, like

(7) Toen Nikki thuiskwam had haar vader een enorm feestmaal aangericht.

When Nikki came home her father had prepaired a big feast.

things are more complex, compare the representation on the next page. It says that some time after the beginning of the terminative event of Nikki's coming home, the state existed of her father having prepaired a big feast, a state caused (*causes*) by Nikki's coming home. Moreover, the analysis expresses - compare the representation of the stative perfect in section 2 - that immediately before (*meets*) the beginning of this state (and possibly overlapping a bit of Nikki's coming home), the terminative event of which it is a consequence (*cons*), i.e. of prepairing the feast, occurred.

$$
\left[\begin{array}{ll}
\text{CONTENT} & \left\langle {}_{\textit{prepair}}\begin{bmatrix}\text{PSOA-INDEX} & \boxed{8}\ \textit{state}\\ \text{ARG1} & \textit{her-father}\\ \text{ARG2} & \textit{a-big-feast}\end{bmatrix}\right\rangle \\
\text{CONTEXT}|\text{PRES} & \left\{\ldots\ {}_{\textit{came-home}}\begin{bmatrix}\text{PSOA-INDEX} & \boxed{9}\ \textit{term-ev}\\ \text{ARG1} & \textit{nikki}\end{bmatrix}\ldots\right\} \\
\text{TEMP-RELNS} & \left\{ {}_{\textit{dur}}\begin{bmatrix}\text{ARG1} & \boxed{12}\\ \text{ARG2} & \boxed{9}\end{bmatrix}, {}_{\textit{bef}}\begin{bmatrix}\text{ARG1} & \boxed{12}\\ \text{ARG2} & \boxed{8}\end{bmatrix}\right\} \\
\text{RHET-RELNS} & \left\{ {}_{\textit{causes}}\begin{bmatrix}\text{ARG1} & \boxed{9}\\ \text{ARG2} & \boxed{8}\end{bmatrix}, {}_{\textit{cons}}\begin{bmatrix}\text{ARG1} & \boxed{6}\\ \text{ARG2} & \boxed{8}\end{bmatrix}\right\} \\
\text{CONTEXT}|\text{TCOND} & \left\{\ldots\ {}_{\textit{meets}}\begin{bmatrix}\text{ARG1} & \boxed{6}\ \textit{term-ev}\\ \text{ARG2} & \boxed{8}\end{bmatrix}\ldots\right\}
\end{array}\right]
$$

4.1.3 c. Narrative

Narrative *toen* differs from the other two in that the content of the subsentence event is not presupposed, but new; obviously in connection to this, the subsentence can syntactically only *follow* the main sentence. Further it differs in that the evaluation points of the subsentence are located immediately *after* the image points of the main sentence. As to aspect, it is usually the case that the main sentence denotes a state or process, and the subsentence a terminative event. Moreover, the latter usually causes the main sentence event to stop abruptly.

An example is with this connective is

(8) Ajax zou ongetwijfeld kampioen worden toen Feyenoord een onverwacht doelpunt maakte.

Ajax was undoubtedly going to be the champion when Feyenoord scored unexpectedly.

We can express most of these features within the following local SYNSEM value.

The local SYNSEM value of narrative *toen*

$$
\begin{bmatrix}
\text{CATEGORY} & \begin{bmatrix}
\text{HEAD} & {}_{adj}\begin{bmatrix}
\text{MOD} & \begin{bmatrix}
\text{HEAD} & {}_{verb}\begin{bmatrix} \text{SPEECH} & \boxed{1} \\ \text{IMAGE} & \boxed{5} \\ \text{TCOND} & \boxed{10} \\ \text{RCOND} & \boxed{12} \\ \text{INV} & + \end{bmatrix} \\
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle \\
\text{CONTENT} & \langle \boxed{6} \begin{bmatrix} \text{PSOA-INDEX} & \boxed{8} \end{bmatrix} \rangle
\end{bmatrix} \\
\text{PRD} & -
\end{bmatrix} \\
\text{COMPS} & \left\langle \begin{bmatrix}
\text{HEAD} & {}_{verb}\begin{bmatrix} \text{SPEECH} & \boxed{1} \\ \text{EVAL} & \boxed{2} \\ \text{TCOND} & \boxed{11} \\ \text{RCOND} & \boxed{13} \\ \text{INV} & - \end{bmatrix} \\
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle \\
\text{CONTENT} & \langle \boxed{3} \begin{bmatrix} \text{PSOA-INDEX} & \boxed{9} \end{bmatrix} \rangle
\end{bmatrix} \right\rangle
\end{bmatrix} \\
\text{CONTENT} & \langle \boxed{6}, \boxed{3} \rangle \\
\text{TEMP-RELNS} & \left\{ {}_{meets}\begin{bmatrix} \text{ARG1} & \boxed{8}\ proc \vee state \\ \text{ARG2} & \boxed{9}\ term\text{-}ev \end{bmatrix} \right\} \\
\text{RHET-RELNS} & \boxed{12} \cup \boxed{13} \cup \left\{ {}_{stops}\begin{bmatrix} \text{ARG1} & \boxed{9} \\ \text{ARG2} & \boxed{8} \end{bmatrix} \right\} \\
\text{CONTEXT} & \begin{bmatrix}
\text{TCOND} & \boxed{10} \cup \boxed{11} \left\{ \cdots {}_{bef}\begin{bmatrix} \text{ARG1} & \boxed{2} \\ \text{ARG2} & \boxed{1} \end{bmatrix} \cdots \right\} \cup \\
 & \left\{ {}_{meets}\begin{bmatrix} \text{ARG1} & \boxed{5} \\ \text{ARG2} & \boxed{2} \end{bmatrix} \right\}
\end{bmatrix}
\end{bmatrix}
$$

4.2 *Terwijl*

The local SYNSEM value of narrative *toen*

In complex sentences formed by *terwijl* the main sentence event is located during the subsentence event, the content of which is presupposed. Its definition expresses that the evaluation points of the subsentence include the image points of the main sentence:

$$\forall x \in \diamond S_m \exists y \in S^{max} : x = y$$

$$
\begin{bmatrix}
\text{CATEGORY} & \begin{bmatrix}
\text{HEAD} & {}_{adj}\begin{bmatrix}
\text{MOD} & \begin{bmatrix}
\text{HEAD} & {}_{verb}\begin{bmatrix} \text{SPEECH} & \boxed{1} \\ \text{IMAGE} & \boxed{5} \\ \text{TCOND} & \boxed{10} \\ \text{INV} & + \end{bmatrix} \\
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle \\
\text{CONT} & \langle \boxed{6} \begin{bmatrix} \text{PSOA-INDEX} & \boxed{8} \end{bmatrix} \rangle
\end{bmatrix} \\
\text{PRD} & -
\end{bmatrix} \\
\text{COMPS} & \langle \begin{bmatrix}
\text{HEAD} & {}_{verb}\begin{bmatrix} \text{SPEECH} & \boxed{1} \\ \text{EVAL} & \boxed{2} \\ \text{TCOND} & \boxed{11} \\ \text{INV} & - \end{bmatrix} \\
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle \\
\text{CONT} & \langle \boxed{3} \begin{bmatrix} \text{PSOA-INDEX} & \boxed{9} \end{bmatrix} \rangle
\end{bmatrix} \rangle
\end{bmatrix} \\
\text{CONTENT} & \langle \boxed{6} \rangle \\
\text{TEMP-RELNS} & \left\{ {}_{(2)eq}\begin{bmatrix} \text{ARG1} & \boxed{8} & t\text{-}ev \\ \text{ARG2} & \boxed{9} & t\text{-}ev \end{bmatrix} \vee {}_{(2,4)dur}\begin{bmatrix} \text{ARG1} & \boxed{8} & \\ \text{ARG2} & \boxed{9} & proc \vee state \end{bmatrix} \right\} \\
\text{CONTEXT} & \begin{bmatrix}
\text{TCOND} & \left\{ {}_{dur}\begin{bmatrix} \text{ARG1} & \boxed{5} \\ \text{ARG2} & \boxed{2} \end{bmatrix} \right\} \cup \boxed{10} \cup \boxed{11} \\
\text{PRES} & \{ \ldots \boxed{3} \ldots \}
\end{bmatrix}
\end{bmatrix}
$$

The definition suggests that for comparable events (two processes or states, or two terminative events) there is a possible interpretation: namely the one where the events are coextensive (the disjuncts within the TEMP-RELNS, both complying with path (2), R2.1.3a,p.68). Besides the possibility of two processes or states, the second disjunct allows path (4), the combination with a terminative event of comparable length, as in

(9) De auto wachtte om de hoek terwijl Bill de deur openmaakte.

The car was waiting around the corner while Bill opened the door.

Moreover, this combination of event types is possible when the terminative event is iterated. An example is

(10) Minte gooide haar bal tegen de muur terwijl Peter ziek in bed lag.

Minte bounced her ball against the wall while Peter was down with the flu.

In this case R1.3.2a predicts coextension (p.68, path (3)) but this seems to strong a conclusion - the reason why I have classified path (3) under my disjunct for path (2,4). The requirement of comparability of length, fulfilled by iteration terminative events or otherwise, is not expressed here.

Apart from these purely temporal basic interpretations, Oversteegen also discusses non-temporal aspects of this connective, without assigning separate paths to them in the system (p.68) however. The extra conditions for them, listed on p.48, require additional concepts inour framework.

4.3 *Voordat*

4.3.1 a. Purely temporal

The representation given below for this connective describes the purely temporal interpretation, a relation between at least one image point of the main sentence and all evaluation points of the subsentence event:

$$\exists x \in \diamond S_m \forall y \in S^{max} : x < y$$

If the main sentence event is a terminative one, this precedes the other event; if it is a process or state, at least a part precedes the other one, and possibly another part overlaps. This is what is expressed in the representation on the next page. Moreover, there is the general condition, not expressed in it, that the point of speech must not be located between main sentence image points and subsentence evaluation points.

Combining this representation with our analyses of the Perfect tenses, the result is yielded that in the '*voordat* Past Perfect - Simple Past' and '*voordat* Past Perfect - Past Perfect' combinations, only a stative interpretation of the Perfect tenses will lead to a parse. This is in accordance with Oversteegen's observations as to, for example

(11) Voordat Peter haar taartje had gestolen at Nikki er al een.

Before Peter had taken her piece of cake, Nikki already had one.

(12) Marc had een zeilboot gebouwd voordat hij een roman geschreven had.

Marc had built a sailboot before had written a novel.

$$
\begin{bmatrix}
\text{CATEGORY} & \begin{bmatrix}
\text{HEAD} & {}_{adj}\begin{bmatrix}
\text{MOD} & \begin{bmatrix}
\text{HEAD} & {}_{verb}\begin{bmatrix} \text{SPEECH} & \boxed{1} \\ \text{IMAGE} & \boxed{5} \\ \text{TCOND} & \boxed{10} \\ \text{INV} & + \end{bmatrix} \\
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle \\
\text{CONT} & \langle \boxed{6} \begin{bmatrix}\text{PSOA-INDEX} & \boxed{8}\end{bmatrix} \rangle
\end{bmatrix} \\
\text{PRD} & -
\end{bmatrix} \\
\text{COMPS} & \langle \begin{bmatrix}
\text{HEAD} & {}_{verb}\begin{bmatrix} \text{SPEECH} & \boxed{1} \\ \text{EVAL} & \boxed{2} \\ \text{TCOND} & \boxed{11} \\ \text{INV} & - \end{bmatrix} \\
\text{SUBJ} & \langle\ \rangle \\
\text{COMPS} & \langle\ \rangle \\
\text{CONT} & \langle \boxed{3} \begin{bmatrix}\text{PSOA-INDEX} & \boxed{9}\end{bmatrix}\rangle
\end{bmatrix} \rangle
\end{bmatrix} \\
\text{CONTENT} & \langle \boxed{6} \rangle \\
\text{TEMP-RELNS} & \left\{ {}_{(17)bef}\begin{bmatrix}\text{ARG1} & \boxed{8}\ t\text{-}ev \\ \text{ARG2} & \boxed{9}\end{bmatrix} \right\} \vee \left\{ {}_{(18)dur}\begin{bmatrix}\text{ARG1} & \boxed{12} \\ \text{ARG2} & \boxed{8}\, pr \vee st\end{bmatrix}, {}_{bef}\begin{bmatrix}\text{ARG1} & \boxed{12} \\ \text{ARG2} & \boxed{9}\end{bmatrix}\right\} \\
\text{CONTEXT} & \begin{bmatrix}
\text{TCOND} & \left\{ {}_{dur}\begin{bmatrix}\text{ARG1} & \boxed{7} \\ \text{ARG2} & \boxed{5}\end{bmatrix}, {}_{bef}\begin{bmatrix}\text{ARG1} & \boxed{7} \\ \text{ARG2} & \boxed{2}\end{bmatrix} \right\} \cup \boxed{10} \cup \boxed{11} \\
\text{PRES} & \{ \ldots \boxed{3} \ldots \}
\end{bmatrix}
\end{bmatrix}
$$

4.3.2 b. Consequential

Besides the purely temporal cases Oversteegen describes three other variants refinements (paths (13), (14), (15)), of which the first one, occasional-positive, has a mixed temporal-conditional interpretation. It is present in a sentence like

(13) We moesten een nieuwe accu installeren voordat de auto startte.

We had to install a new battery before the car started.

Here the main sentence event acts as a condition on the subsentence event. Apart from the fact that this variant is constrained by the presence of a "deontic marker" (in the example 'moesten', *had to*), it can be described by adding to the temporal representation above the following rhetorical relation:

$$\left[\text{RHET-RELNS} \quad \left[\begin{array}{ll}\text{ARG1} & \boxed{8} \\ \text{ARG2} & \boxed{9}\end{array}\right]_{causes}\right]$$

For the other two variants of *voordat*, the definition given in CONTEXT | COND remains the same; they differ however in requiring more subtle epistemic concepts (see [5], p.56) instead of simply presupposing the subsentence event, as the first two did.

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