On the Compositionality of Tense: Merging Reichenbach and Prior

Henk J. Verkuyl∗
Utrecht Institute of Linguistics OTS, Utrecht University

Abstract. Tense systems as proposed by Reichenbach and Prior can be improved by changing their matrix $3 \times 3$-design into a binary-set up. In fact, the improvement took already place in Te Winkel (1866), because the Dutch grammarian L.A. te Winkel presented a $2 \times 2 \times 2$-tense system for the eight Dutch tense forms with Reichenbachian reference points. An improvement of Reichenbach’s system in terms of a system of binary oppositions will also bring about an improvement of Prior’s system. In fact, the binary approach implies a merger of Reichenbach’s and Prior’s insights into how tense operates in natural language. It leads quite naturally to a compositional treatment of tense in the sense that presence or absence of language forms determines the presence or absence of tense operators making up the system. The binary system produces eight tense forms for English and Dutch, but it also accounts for tense systems having far more indicative forms, such as French.

Keywords: tense, Imparfait, Passé Simple, perfect, compositionality

1. Introduction

This paper aims at showing that there is a way to improve on the description of the English tense system in Reichenbach (1947) by changing its matrix $3 \times 3$-design into a $2 \times 2 \times 2$-set up. In fact, the improvement took already place in Te Winkel (1866), because the Dutch grammarian L.A. te Winkel presented a tense system with Reichenbachian reference points in a binary set up using three binary oppositions to characterize the eight forms. The Dutch tense system is historically related to the English system, both languages belonging to the West-Germanic language family, so Te Winkel’s insights carry over to English which I shall use for the explanation of his system. It will be shown that an improvement of Reichenbach’s system along the lines pegged out by Te Winkel will also bring about an improvement of Prior’s system. In fact, the binary approach will bring about a natural merger of Reichenbach’s and Prior’s insights into how tense operates in natural language.1

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1 Another Dutch grammarian, R.A. Kollewijn, proposed a dynamic Priorian system that can be shown to cover the empirical domain more properly than its successor Prior (1967) originating sixty years later. However, Kollewijn (1892) suffers from the same drawback as the systems proposed by Reichenbach and Prior—the acceptance of a tripartition into Past,

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To my knowledge, it has escaped the entire tense community that there is a fundamental issue connected with the choice between a quadratic ($3^2$) system and a cubic ($2^3$) system as applied to Germanic tense systems. Essential to Te Winkel’s approach turns out to be not the cubic system that operates in Dutch, but rather the possibility to define a tense system with binary dimensions in a compositional way. The popularity of Reichenbach’s matrix prevents people from seeing that his system suffers from the primacy of ontological decisions about time structure. A binary system such as Te Winkel’s departs from the language side and tries to connect temporal structure in the domain of interpretation on the basis of information encoded in the language. In other words, it can be shown now that for languages like Dutch, English, and also for French, a binary system is completely compositional, whereas Reichenbach’s system fails to have this property.

As a starter we begin by observing that compositionality can be made dependent on the presence or absence of certain linguistic forms. In other words, with a complex English tense form as in *She would have gone*, the presence of three forms, i.e. one abstract tense form *PAST*, and two auxiliaries *will* and *have*, corresponds with the presence of three semantic pieces of information two of which are absent in *She went*. In a language having eight forms the analysis amounts to a cubic system ($2 \times 2 \times 2$), but it will be shown that the system can be extended so as to capture all the indicative tense forms of French.

The result of adopting a binary strategy is that Reichenbach and Prior can be brought more closely together. The first step to show this is to re-capture Reichenbach’s configurations in a binary system. They will come out quite naturally including the one tense form missing in his own system. The configurations that arise can be taken more dynamically than they are in Reichenbach’s system. In this way, we can capture Kamp’s famous example *A child was born which will rule the world* in an entirely natural way, that is, without having to appeal to a Now-operator from the outside: it is automatically present in the system itself. The binary approach also explains the well-known ambiguity of the Pluperfect containing temporal adverbials as well as the modal and temporal use of tenses expressing posteriority. The system turns out to have a Priorean interpretation at points where Reichen-
bach’s system is unnatural and to improve on Prior by having available an operator which is lacking in Prior’s system.

It is on these points that the present paper will focus, the general conclusion being that both Reichenbach and Prior were harmed by their choice for a fundamental tripartition into past, present and future. It will be shown that a system in which the past and the present are taken as being opposed in the same dimension, and in which future is analyzed more neutrally as posteriority with respect to a point in the past or the present solves the problems haunting both Reichenbach and Prior.3

It is necessary to give Reichenbach’s system, because at several places in the present paper it will be referred to. I assume sufficient familiarity with it to understand the configurations that are yielded by the system in which binary relations hold between E and R and between R and S. Reichenbach’s 3x3-approach yields the matrix in Table I. As said, there is one tense form missing: the English *Mary would have written the letter* cannot be described by the system. Another problem is that there are three cells containing *will write* in *Mary will write the letter*. Furthermore, there is the problem of allotopy: there are three configurations in the cell for Anterior Future and three configurations in the cell for the Posterior Past. I refer to Verkuyl and Loux-Schuringa (1985) for the details.

2. Te Winkel’s 2 × 2 × 2-system

Te Winkel proposed a system in which three oppositions play a role:

1. Present vs. Past
2. Synchronous vs. Posterior
3. Action in Progress (Incompleted) vs. Completed Action

I will first comment upon what Te Winkel said of each of the three dimensions that form the tense system and then try and formalize his ideas in terms of currently available semantic tools. The three steps presume a procedure in which the oppositions can be cast in terms of operations. Every tense form is composed on the basis of a choice made at each of the three steps. For example, the Simple Present is built up from Present, Synchronous and Incompleted, the Pluperfect from Past, Synchronous and Completed, the Posterior Future from Present, Posterior and Incompleted, etc.

3 It is necessary to lay down some conventions on the use of terms. I will use lower case letters to speak about past, present and future as temporal notions outside the language and capital letters in Past, Present and Future to refer informally to linguistic forms pertaining to these temporal entities.
Table 1. Reichenbach’s matrix

<table>
<thead>
<tr>
<th></th>
<th>Past</th>
<th>Present</th>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R &lt; S</td>
<td>R, S</td>
<td>S &lt; R</td>
</tr>
</tbody>
</table>

Anterior E < R

<table>
<thead>
<tr>
<th></th>
<th>Anterior Past (Past Perfect)</th>
<th>Anterior Present (Present Perfect)</th>
<th>Anterior Future (Future Perfect)</th>
</tr>
</thead>
</table>

had written has written will have written

Simple E,R

<table>
<thead>
<tr>
<th></th>
<th>Simple Past (Past Perfect)</th>
<th>Simple Present (Present Perfect)</th>
<th>Simple Future (Future Perfect)</th>
</tr>
</thead>
</table>

wrote writes will write

Posterior R < E

<table>
<thead>
<tr>
<th></th>
<th>Posterior Past (Past Future)</th>
<th>Posterior Present (Present Future)</th>
<th>Posterior Future (Future Future)</th>
</tr>
</thead>
</table>

would write will write will write

2.1. Present vs. Past

About the first opposition, Te Winkel writes:

In thinking one starts from one of two points in time: either from the present or from the past. In the former case everything is seen as it appears at the moment at which one is thinking; in the latter case as it appeared at the moment at which one is thinking (in the past). (1866:68)

If we label the utterance time as \( n \), the quotation can be interpreted as connecting the Present tense with a point that is identical to or overlapping with \( n \) and connecting the Past tense with a point that is anterior to \( n \).\(^4\) In present-day terms, this can be accounted for by assuming that in the syntax of sentences expressing a Present tense or a Past tense there are operators, \( \text{PRES} \) and \( \text{PAST} \) respectively, that can be interpreted semantically as connecting the information expressed by a tenseless structure either with a point in the present or

\(^4\) To facilitate the comparison with the representations in Kamp and Reyle (1993), I use \( n \) for the utterance time in discourse.
with a point in the past. In Dutch and in English it is possible to associate the two operators with overt tense morphemes.

Semantically, the first dimension of Te Winkel’s system can be understood on the basis of a structure $S' = \text{PRES}(S)$ or $S' = \text{PAST}(S)$, where the two tense-operators are taken to be of type $\langle\langle i, t \rangle, t \rangle$. In other words, PRES and PAST are seen as operators taking a tenseless $S$—or, in terms of Galton (1984), the event-radical $S$—to form a tensed sentence $S'$. I will come back to this point later on because this interpretation of Te Winkel’s system turns out to become important in analyzing some of the shortcomings of Prior’s tense system.

For the present exposition it suffices to represent the tenseless sentence $S$ (1a) as (1b),

$$\begin{align*}
(1) & \quad \text{a. Mary write the letter} \\
& \quad \text{b. } \lambda i. \text{Write}(i)(b)(m)
\end{align*}$$

which makes it of type $\langle i, t \rangle$, the type standing for a set of indices making the predication true.\(^5\) I will use the term index in order to stay neutral with respect to a choice between instants, intervals or events. Te Winkel speaks about points in time, but he leaves in the dark whether or not the utterance time is to be taken as a point or an interval. As to my scepticism to take $i$ as an event, I may refer to Verkuyl (1999b).\(^7\) By its Curry-notation, the formula has a Montagovian format; the NP the letter is simply represented by $b$ and Mary as $m$.

The tenseless information structure $S$ corresponds quite closely to what Te Winkel describes as the content of a thought: it is a predication that has not yet been actualized in real time: it has to be taken at the abstract level of a virtual event. It is only by PRES or PAST that “everything” appears, as Te Winkel put it.

The two tense-operators of the first opposition in the system can now be defined as in (2):

$$\begin{align*}
(2) & \quad \text{a. PRES} := \lambda \phi \exists i[\phi[i] \land i < n] \\
& \quad \text{b. PAST} := \lambda \phi \exists i[\phi[i] \land i \circ n]
\end{align*}$$

\(^5\) So, I will not go into the question of whether Tense is an operator on the VP or on V. This question is not relevant for the present issue. In taking Tense as an operator on a tenseless construction, I follow Te Winkel (1866), Verkuyl (1972; 1993) and Kamp and Reyle (1993), among others, but evidently not Prior (1967).

\(^6\) Please note the difference between writing $i$ (in formulas) or $i$ (in the running text) as an index and $i$ as the indication of a type. In general, the easiest way to interpret $i$ is to see it as an integer standing for something actual in real time.

\(^7\) My scepticism concerns the ontological implications of the notion of event. It is misleading to call tenseless semantic objects events if one wants to reserve the term ‘event’ for something that occurs in real time. Rather than speaking about proto-events, I prefer to use numbers (with their pleasant properties) to provide for the extra-argument. Those who stick to event semantics may read (1b) in the Davidsonian way.
The notation $\phi[i]$ expresses that $i$ is present somewhere in the structure of the tenseless $\phi$. Definition (2a) takes \textit{PRES} as the set of all predications such that $i$ in the real time of the eventuality indexed as $i$ overlaps ($\circ$) with the utterance time $n$, whereas \textit{PAST} locates $i$ earlier than $n$. Definition (2a) takes the weakest option considered above: overlap rather than identity. On the basis of what Te Winkel says, I am inclined to take identity as the proper relation, but for the exposition of the system overlap will do. I will come back to this issue in § 5.2.

The two definitions appear to characterize Te Winkel’s opposition between two poles of the first dimension correctly on the assumption that a predication corresponding to what he calls a thought, can be interpreted as an event if actualization takes place by the application of tense. This is not an unreasonable assumption given the fact that from Te Winkel’s examples the tenseless predication ‘Mary write the letter’ is the only thing that could give rise to what he calls a thought. On this view, \textit{PRES} and \textit{PAST} provide a mapping between an abstract semantic object and its actualization in real time. In other words, the operators \textit{PAST} or \textit{PRES} tie a thought (a predication) to real time by introducing a index $i$ which by its relation to real time can be temporally interpreted as before $n$ or at the same time as $n$.

On the basis of the definitions in (1b) and (2b), one obtains the derivation (3b) for sentence (3a).

\begin{enumerate}
\item[(3)]
  \begin{enumerate}
  \item\textit{Mary schreef de brief}
  Mary wrote the letter
  \item\textit{PAST(Mary write the letter)} $\rightsquigarrow$
  $\lambda\phi\exists i[\phi[i] \land i < n](\lambda i'.\text{Write}(i')(b)(m))$
  $= \exists i[\lambda i'.\text{Write}(i')(b)(m)[i] \land i < n]$
  $= \exists i[\text{Write}(i)(b)(m) \land i < n]$
  \end{enumerate}
\end{enumerate}

This says that there is an $i$ in the past of $n$ at which it was the case that Mary wrote the letter. The \textit{PRES}-operator yields:

\begin{enumerate}
\item[(4)]
  \begin{enumerate}
  \item\textit{Mary schrijft de brief}
  Mary writes the letter (reportive use)
  \item$\exists i[\text{Write}(i)(b)(m) \land i \circ n]$
  \end{enumerate}
\end{enumerate}

The two tenses are represented in the two diagrams of Figure 1. $E$ subscripted with $i$ means that the actualization of $E$ in real time—the running time of $E$ on the time axis, if we follow Krifka (1989)’ terminology—is determined by the index $i$ which, in the case of Past, is located before $n$ and in the case of Present overlaps with $n$.

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8 For a formal description of the relation between in $i$ and real time in Verkuyl (1993), pp. 318–327.
On the compositionality of tense

Figure 1. Past and Present

The Past Tense representation in the last line of (3) reveals a problem with Kamp & Reyle’s box providing the tense of Mary wrote the letter (1993:516).

The \(<\)-relation holds here between \(n\) and the event \(e\). This means that they are to be taken as belonging to the same “plane of comparison”. In other words, if \(n\) is located in real time, so is \(e\). But this means that, in the box, the Present and Past tenses are not treated as an operator connecting tenseless information with real time.

2.2. Posteriority

The second dimension of the tense system is described by Te Winkel as follows:

An action is either synchronous or posterior with respect to each of the two points in time mentioned. The forms of the verb indicate these different relations: Hij belooft (he promises)[synchr.] dat hij het doen zal (that he will do it)[posterior with respect to a present point in time]; Hij beloofde (he promised)[past] dat hij het doen zou (that he would do it)[posterior with respect to a point of time in the past]. (1866:68-9)

The idea here is that the posterior verb form introduces an index positioned after the point introduced by the Present tense of the main verb beloven (promise) or after the point introduced by its Past tense. There are two ways of treating this opposition in the second dimension of the cubic system. The first one is parsimonious in the sense that it only introduces an operator POST and not an operator SYNCHR because the idea could be that operators are only necessary when there is some overt form to carry them. The second one is more opulent by introducing two operators for each of the opposite plane irrespective of the question of whether both are “visible” in surface structure. I will first follow the parsimonious option because it shows beautifully how compositional Te Winkel’s system can be taken.
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The operator POST, standing for the Dutch verb _zullen_, or for the English verbs _will_ and _shall_, can be defined as in (6).

(6) \[ \text{POST} := \lambda \phi \lambda i \exists j[\phi[j] \land i < j] \]

This operator yields the set of all \( i \) such that \( i \) is located before the event time \( j \). The definition does justice to Te Winkel’s description of posteriority, the leading idea being that the sense of future should not be associated uniquely with the utterance time but also with times located in the past and introduced by the PAST-operator.

On the basis of definition (6) and the definitions given above we can now derive sentences like (7).

(7) a. Marie zal de brief schrijven
   Mary will write the letter

b. Marie zou de brief schrijven
   Mary would write the letter

For (7b) this leads to a derivation resulting in (8).

(8) \[ \text{POST}(\text{Mary write the letter}) \Rightarrow \lambda \phi \lambda i \exists j[\phi[j] \land i < j](\lambda i'.\text{Write}(i')(b)(m)) \]
   \[= \lambda i \exists j[\lambda i'.\text{Write}(i')(b)(m)[j] \land i < j] \]
   \[= \lambda i \exists j[\text{Write}(j)(b)(m) \land i < j] \]
   \[\text{PAST}(\text{POST})(\text{Mary write the letter}) \Rightarrow \lambda \phi \exists i[\phi[i] \land i < n](\lambda i'.\exists j[\text{Write}(j)(b)(m) \land i' < j]) \]
   \[= \exists i[\lambda i'.\exists j[\text{Write}(j)(b)(m) \land i' < j][i] \land i < n] \]
   \[= \exists i \exists j[\text{Write}(j)(b)(m) \land i < j \land i < n] \]

The present posterior form is (9).

(9) \[ \exists i \exists j[\text{Write}(j)(b)(m) \land i < j \land i \circ n] \]

The two forms produced lead to Figure 2. Figure 2a covers the three allotopic

\[ \begin{array}{c}
\text{E}_j \quad \ldots \quad \text{E}_i \\
\downarrow \quad \quad \quad \quad \quad \downarrow \\
\quad \quad \quad \quad \quad n \\
\end{array} \quad \begin{array}{c}
\text{E}_j \\
\downarrow \\
\quad \quad \quad \quad \quad n \\
\end{array} \]

a: Posterior Future \quad b: Present Future

Figure 2. Posterior and Present Future

configurations R - E - S, R - S,E and R - S - E. Verkuyl and Loux-Schuringa (1985) called them allotopic in order to underscore that they are basically
three variants of one logical possibility of the system, in this case due to the fact that E is simply later than R and may be located before, simultaneous to or after S, there being no direct information about the relation between S and E. This is expressed in the configuration of Figure 2a without the necessity to refer to three configurations. A compositional treatment based on binary oppositions relates \( n \) to \( i \) by Past and it relates \( i \) to the event-index \( j \).

Figure 2b creates a present posterior configuration: it covers the Reichenbachian S,R - E configuration. Yet, there is a crucial difference between Reichenbach and Te Winkel here: Reichenbach has three (non-allotopic) forms for the future tense: S,R - E, S - R - E and S - R,E. These forms are not allotopic because they are logical possibilities of the matrix system: S,R - E is based on S,R and R < E, S - R - E on S < R and R < E and S - R,E on S < R and R,E. These variants of the simple future are not possible in Te Winkel’s system, so here we have a concrete difference between the \( 3 \times 3 \)- and the \( 2 \times 2 \times 2 \)-approach. To my knowledge there is no convincing evidence that one can differentiate between sentences on the basis of a choice between S,R - E, S - R - E and S - R,E expressed by one and the same tense form. Te Winkel’s construction of the tense system seems more appropriate: it creates posteriority with respect to one point of reference with respect to which the event time is located. We will return to this question in \( \S \) 4 in order to see whether adverbial modification may change the picture.

At this point it should be noted that in a lot of sentences expressing past posteriority, in particular those who report about what really happened, the range of \( E_j \) should be restricted to the interval \( [i,n] \), as in Toen werd er een kind geboren dat de wereld zou regeren (Then a child was born that would rule the world). Only the modal use of zullen (will) as in She told me that she would come may bring about an interpretation in which the event is located after the utterance time. In particular, the use of Dutch adverbials like morgen (tomorrow) extend the range of \( j \), but without adverbial modification there are pragmatic principles restricting \( j \). The principles that govern the choice between genuine temporal and modal interpretation are still unclear. A sentence like She had told me that she would come tends to put \( j \) before the utterance time, but it can be followed both by . . . and I think she will show up tomorrow and by . . . but she never showed up. The binary tense system developed so far can handle these cases without being able to explain them on the basis of the machinery proposed. But to my knowledge no tense system is able to explain the difference between modal and temporal posteriority, probably because this difference can only be explained on the basis of contextual or explicit modification.

There are reasons to assume that R - S - E is empirically not correct so that the dotted line in Figure 2a is cut off at the point of speech. This topic will come back below in the other two posterior forms.
2.3. Anteriority

The third opposition of planes in the cube is described by Te Winkel as follows:

An action expressed by a verb is thought of as going on as an action in progress, or as having been done, as a completed action. An action is really the ever-continuing transition from an action in progress to a completed action. A verb captures an action either in the middle of this transition or at the other end, where it has become a totally completed action. (1866: )

As so many grammarians do, Te Winkel focusses here on the prototypical verb meaning, which is a meaning assigned to action verbs, thus ignoring states and processes or events where no agent can be held responsible for the “action”. Taking that into account and assuming that the division will hold for stative verbs too, we may observe that the distinction closely resembles the well-known distinction between imperfective and perfective aspect. From the point of view of locating eventualities the opposition amounts to the reverse of the couple synchronous vs. posterior. So, we shall define an operator \( \text{PERF} \) of anteriority as in (10).

\[
\text{PERF} := \lambda \phi \lambda i \exists k [\phi[k] \land k < i]
\]

As in the case of posteriority, the operator \( \text{PERF} \) is visible in the form of an auxiliary: \textit{hebben} in Dutch and \textit{have} in English.\(^{10}\) Along the same lines as demonstrated above we can now properly derive the tensed sentences in (11).

(11) a. Mary heeft de brief geschreven
Mary has written the letter

b. Mary had de brief geschreven
Mary had written the letter

For (11b) the derivation leads to:

\[
\text{PERF(Mary write the letter)} \rightarrow
\lambda \phi \lambda i \exists k [\phi[k] \land k < i](i')(b)(m))
= \lambda i \exists [\lambda i'. \text{Write}((i')(b)(m)[k] \land k < i)]
= \lambda i \exists [\text{Write}(k)(b)(m) \land k < i]
\]

\[
\text{PAST(PERF)(Mary write the letter)} \rightarrow
\lambda \phi \exists i [\phi[i] \land i < n](\lambda i' \exists k[\text{Write}(k)(b)(m) \land k < i')]}
= \exists i [\lambda i' \exists k[\text{Write}(k)(b)(m) \land k < i'][i] \land i < n]
= \exists i [\text{Write}(k)(b)(m) \land k < i \land i < n]
\]

\(^{10}\) In Dutch the auxiliary \textit{zijn} can also be used as a perfect auxiliary as in \textit{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 \textit{hebben} (have) as prototypical for the perfect auxiliaries.
The present anterior form is (13).

\[ \exists i \exists k \left[ \text{Write}(k)(b)(m) \land k < i \land i \circ n \right] \]

(13) The corresponding diagrams are given in Figure 3. They can be taken as

\[ E_k \]

\[ \begin{array}{c}
  \downarrow \\
  n \end{array} \]

\[ \!
  \downarrow \\
  j
\]

a: Past Perfect

\[ E_k \]

\[ \begin{array}{c}
  \downarrow \\
  n \end{array} \]

\[ \!
  \downarrow \\
  j
\]

b: Present Perfect

Figure 3. Past and Present Perfect

expressing the same as the Reichenbachian configurations E - R,S for the Present Perfect and E - R - S for the Past Perfect. One may even argue that Te Winkel is to be regarded as the inventor of Reichenbach’s famous analysis of the Present Perfect. In § 4, we will see that in a binary system the well-known problem for Reichenbach with respect to the ambiguity of the Past Perfect does not show up. In § 5, the obvious problem of explaining the well-known differences between the Dutch and the English Present Perfect will be discussed and extended so as to cover the French data as well.

2.4. POSTERIORITY AND ANTERIORITY

So far we have given six of the eight tense forms possible in a \(2 \times 2 \times 2\) - system. The remaining two are exemplified in (14).

(14) a. Marie zal de brief geschreven hebben
   Mary will have written the letter

b. Marie zou de brief geschreven hebben
   Mary would have written the letter

The sentence based on \( \text{PRES(POST)(PERF)}((1a)) \) can be derived as in (15)

(15) \( \text{PERF(Mary write the letter)} \) \( \leadsto \ldots \)

\[ = \lambda i \exists k [\text{Write}(k)(b)(m) \land k < i] \]

\[ \text{POST(\text{PERF})(Mary write the letter)} \] \( \leadsto \)

\[ \lambda \phi \lambda i' \exists j [\phi[j] \land i' < j] (\lambda i \exists k [\text{Write}(k)(b)(m) \land k < i]) \]

\[ = \lambda i' \exists j [\lambda i \exists k [\text{Write}(k)(b)(m) \land k < i][j] \land i' < j] \]

\[ = \lambda i' \exists j \exists k [\text{Write}(k)(b)(m) \land k < j \land i' < j] \]

\[ \text{PRES(\text{POST)}(\text{PERF})(Mary write the letter)} \] \( \leadsto \)

\[ \lambda \phi \exists i [\phi[i] \land i \circ n] (\lambda i' \exists j \exists k [\text{Write}(k)(b)(m) \land k < j \land i' < j]) \]

\[ = \exists i [\lambda i' \exists j \exists k [\text{Write}(k)(b)(m) \land k < j \land i' < j||i] \land i \circ n] \]

\[ = \exists i \exists j \exists k [\text{Write}(k)(b)(m) \land k < j \land i < j \land i \circ n] \]
The corresponding Past form is (16).

\[ \exists i \exists j \exists k \exists k.(\text{Write}(k)(b)(m) \land k < j \land i < j \land i < n) \]

In Figure 4a allotopy returns as the result of the relation between \( i \) and \( j \) being independent of the relation between \( j \) and \( k \). The same applies to Figure 4b. A comforting sign of the power of the binary system is that there is a complete parallel between (a) and (b) in Figure 4. There could be some debate about the question of whether the dots in Figure 4b may cross the line of the \( n \)-index. The French translation of (14a) Marie aura écrit la lettre à huit heures warrants that at \( n \) the letter has not been completed yet. The discussion has no bearing on the tense system presented here, because different (pragmatic, Gricean) principles are involved to exclude or allow a crossing.

2.5. TAKING STOCK

The syntactic base for this system could be a structure such as given in Figure 5, interpreted from bottom to top.\(^{11}\) As observed, \( S' \) differs typologically from \( S \). This means that \( \text{PERF} \) and \( \text{POST} \) are taken as optional \( S \)-modifiers.

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\(^{11}\) Pace the availability of a refined categorial machinery to describe complex verbal clusters in a flexible way, as developed in Moortgat (1999), the stable structure in Figure 5 will suffice here to explain the semantics involved properly.
Taking Figure 5 as the basis for interpretation has the obvious drawback of making it necessary to stipulate that anteriority precede posteriority in a derivation. The pain from such a stipulation could be removed, at least partly, by the observation that in Dutch there are sentences like (17) as an alternative to (14b).

(17) Marie had de brief zullen schrijven
lit. Mary had the letter shall write

From the point of view of POST and PERF being operators of the same type one might be happy to find this interchange, even though (14b) is the more accepted form. It suggests an equivalence.

However, it should also be observed that (18a) leads to (18b), or—replacing $j$ by $k$ and $k$ by $j$ in order to bring the formula closer to the last line of (15)—to (18c).

(18) a. \(\text{PRES(\text{PERF})(\text{POST})(Mary write the letter)}\)

b. \(\exists i \exists j \exists k [\text{Write}(j)(b)(m) \land k < j \land k < i \land i \circ n]\)

c. \(\exists i \exists j \exists k [\text{Write}(k)(b)(m) \land j < k \land j < i \land i \circ n]\)

Both configurations fail to put the index expressing posteriority after the point of utterance \(n\). This means that there is no equivalence between the \(\ldots (\text{POST})(\text{PERF})\)-representation in (15) and the two \(\ldots (\text{PERF})(\text{POST})\)-representations in (18). It follows, that there is a structural need to have POST in a more prominent position than PERF. This is accounted for in Te Winkel’s organisation of the three oppositions.

One of the interesting features of the binary system is that the first opposition is primordial. The unique status of the first dimension can be traced back to Te Winkel’s own wording “In thinking one starts from one of two points in time: either from the present or from the past.” The crucial term used here is ‘start from’. The natural way to express that one starts in the present is by connecting \(i\) with \(n\). Starting in the past is expressed by putting \(i\) at some point before \(n\). This point, call it \(n’\), is in all sorts of ways similar to \(n\).\(^{12}\) Not only by the fact that the phrase “starts from it” suggests that Past and Present have things in common, but also by looking at the Figures so far, one can clearly see that the \(i,j,k\)-configurations headed by \(\text{PRES}\) are identical to the \(i,j,k\)-configurations headed by \(\text{PAST}\), except for their origin, i.e. the place they “start from”. In order to underscore this similarity I will add \(n’\) to Figure 7 which closes off the present paper by collecting all the configurations discussed so far or to be discussed below. By putting \(n’\) into

\(^{12}\) Although there are clear differences as to the formalism involved as well as contentual differences, the interpretation of Te Winkel’s first dimension in terms of a virtual point of speech in the past is compatible with the so-called two-track approach advocated in Oversteegen (1989).
the Past-diagrams the correspondences between the Present- and the Past-configurations are made visible to a degree that enables us also to see more sorts of correspondence between the different tense forms, as I will point out in more detail below.

The remarks made in the preceding paragraph underlining the unique position of the Present tense and the Past tense can be confronted with perspectives from the logical side. Johan van Benthem (pers. comm.) suggested that PRES could be analyzed as NOW(O) and PAST as NOW(PERF), where NOW is defined as $\lambda \phi \exists i [\phi[i] \land i = n]$ actualizing the information connected with $i$ in real time, and $O$ as $\lambda i' \exists i [\phi[i] \land i \circ i']$. These definitions would lead to the same formulas as given at the end of the derivations above, but the difference would be that the NOW-operator fully expresses the actualisation of the event in real time by providing a temporal location for the tenseless semantic object connected with the index $i$, whereas O and the other operators are tenseless. The obvious advantage is that the system as a whole is made more elegant but, as far as I can see, the linguistic price to be paid is high: it takes away the advantage of considering PRES and PAST as primitives. For example, we shall see below that both the English and French system are characterized by a main division between PRES-forms and PAST-forms, which means that with a logically more fine-grained analysis this opposition has to be phrased as an opposition between NOW(O) and NOW(PERF), i.e. as an opposition between two pairs of operators. As the suggested refinement does not play a role in decisions to be made, I will continue the analysis of the binary system with PRES and PAST as operators.

Concluding this section, I think it is fair to state that the choice for a bipartition between Past and Present rather than for the now more trendy tripartition into Past, Present and Future leads to a well-motivated system with as many logical possibilities as there are forms. It provides all the virtues of Reichenbach’s system evading its drawbacks, so we do not have to “throw away” Reichenbach. One can simply note that in a binary system the points that relate to one another work together in a better way.

3. Reanalyzing Prior

In this section, I would like to show that a binary system as applied to Germanic languages such as Dutch and English is, in fact, very useful for connecting the virtues of Reichenbach’s approach with those of Prior’s system. Three points that are relevant to the present discussion will be discussed.
3.1. **PAST AND FUTURE**

Assuming some familiarity with Prior’s system, the comparison with the binary system described above will be restricted to the operators \( P \) (Past) and \( F \) (Future). Let me compare the two systems by giving a table for English with respect to the sentence that appeared in all examples so far.

<table>
<thead>
<tr>
<th>Operator</th>
<th>Prior Tense forms</th>
<th>Te Winkel Tense forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>( p )</td>
<td>Mary writes the letter</td>
<td>PRES((p))</td>
</tr>
<tr>
<td>( Fp )</td>
<td>Mary will write the letter</td>
<td>PRES((\text{POST})(p))</td>
</tr>
<tr>
<td>( Pp )</td>
<td>Mary has written the letter</td>
<td>PRES((\text{PERF})(p))</td>
</tr>
<tr>
<td>( FPPp )</td>
<td>Mary will have written the letter</td>
<td>PRES((\text{POST})(\text{PERF})(p))</td>
</tr>
<tr>
<td>( Pp )</td>
<td>Mary wrote the letter</td>
<td>PAST((p))</td>
</tr>
<tr>
<td>( PFp )</td>
<td>Mary would write the letter</td>
<td>PAST((\text{POST})(p))</td>
</tr>
<tr>
<td>( PPPp )</td>
<td>Mary had written the letter</td>
<td>PAST((\text{PERF})(p))</td>
</tr>
<tr>
<td>( FPPp )</td>
<td>Mary would have written the letter</td>
<td>PAST((\text{POST})(\text{PERF})(p))</td>
</tr>
</tbody>
</table>

At first sight, the lower part of Table II suggests that Prior and Te Winkel have developed the same sort of machinery for the past tense forms. However, the suggestion raised by \( \text{PAST} = P, \text{POST} = F \) and \( \text{PERF} = P \) is misleading. In the binary system sketched above \( \text{PRES} \) and \( \text{PAST} \) have a different status from \( \text{POST} \) and \( \text{PERF} \): they are always in front position and their type-logical status differs from the other two operators. In sentences like *Mary had written the letter* the tense form *had* is to be analyzed as \( \text{PAST}+\text{have} \). For Prior this translates as \( PP \), for Te Winkel as \( \text{PAST}+\text{PERF} \). Te Winkel is more adequate in differentiating between the two operators. Prior’s system turns out to be misleading, in the sense that \( P \) does not pertain to something constant.

Two remarks are appropriate here. The first is that Prior made the (wrong) decision to take \( p \) as a tensed sentence, which forced him to define \( F \) and \( P \) as operators on tensed sentences. In a binary system, \( p \) is taken as tenseless and the only operators to get tense are \( \text{PRES} \) and \( \text{PAST} \), whereas \( \text{POST} \) and \( \text{PERF} \) are operators taking tenseless propositions having tenseless propositions as their output. Table II shows that where Prior has the problem of analyzing both Simple Past and Present Perfect as \( Pp \), the binary system yields a proper distinction between the Imperfect form, which is a \( \text{PAST}(p) \)-configuration, and the Perfect form which is a \( \text{PRES}(\text{PERF})(p) \)-configuration.

The second is that Prior’s dynamic approach is neither bound to a tripartition into Past, Present and Future nor to the absence of a Present-operator. It is

---

13 So, the operators \( H \) and \( W \) will not be discussed here.
the feature of dynamicity that makes Prior interesting for linguists rather than his ontology. The pictures shown above indicate that it is possible to interpret the index-system based on Te Winkel binary approach more dynamically than Reichenbach’s system: in a composite structure one may “go back” from $n$ to $i$ and then the next shift follows to $j$ or $k$. This explains the presence of arrows in the configurations shown so far. Note that if the right column in Table II is indeed an improvement on Prior, it follows that Te Winkel serves as medium between Prior and Reichenbach, because this column also can be seen as an improvement on Reichenbach.

3.2. QUANTIFICATION AND REFERENCE

In the formal semantic literature there are well-established objections against Prior’s system in respect of its application to natural language, as in Galton (1984), in Kamp and Reyle (1993):486–504, Landman (1991):121–221, among others. One of the problems for Prior’s tense system is its inability to treat indices as points of reference, which play a role in the construction of discourse structure, the leading idea being its strictly quantificational approach. This is also visible in the representations in the preceding sections. In that sense, Te Winkel has been taken more Priorean than Reichenbachian.

Now, Blackburn (1994) has extended the Priorean tense system with the possibility of introducing reference points. For example, rather than analyzing the Past Tense as $P\phi$ it is possible to take it as $P(i \land \phi)$, where $i$ is a so-called nominal element providing a sort of proper name for an index that is unique in the model. In this way, the system is extended with a referential capacity that compensates the shortcomings of a purely quantificational system maintaining its advantages. I think that Blackburn’s wish to extend Prior’s system is certainly fruitful, but his proposal includes the two problems just mentioned: (a) the tripartition, and (b) the treatment of the Present tense without an operator. The latter problem shows up in the lack of a nominal $i$ in the Present Perfect, the Present and the Simple Future.

In my view, it is possible to use a simple Montagovian technique to do what Blackburn did in his way. For the analysis of *Mary is ill* Montague (sometimes) used the format $\exists x[\text{Ill}(x) \land x = m]$. In the same way, one of the quantifiers in the eight tense formulas given above can be treated like that in order to provide for a contextually and uniquely defined point of reference. For example, if the speaker and hearer have identified a certain point $a$ in the future about which they talk if (7a) *Mary will write the letter* is said, it is possible to analyze the last line of the derivation in (8) as:

$$\exists i \exists j[\text{Write}(j)(b)(m) \land j = a \land i < j \land i \circ n]$$

In this way, the referential force of the system receives a natural interpretation. I will continue to simply give the existential quantifiers as before, assuming that the context provides the appropriate values that can be connected
to tense elements by the simple predicate-logical technique demonstrated in (19). § 4 will discuss an alternative or complementary device of introducing nominal elements, namely adverbial modification.

3.3. THE NOW-OPERATOR

In Kamp (1971) the famous Now-operator \( N \) was introduced in order to deal with the difference between sentences like (20a) and (20b) left unexplained in Prior’s system.

(20) a. A child was born which would rule the world
    b. A child was born which will rule the world

In the Priorian system (20a) would be analyzed as in (21):

\[
P(\exists x(\text{Child}(x) \land \text{Born}(x) \land F(\text{Rule-the-world}(x))))
\]

Its interpretation ‘In the past there was a time \( t \) at which a child was born and with respect to \( t \) there is a later point of time \( t’ \) at which \( x \) ruled the world’ appears to do justice to what is expressed in (20a). However, the only possibility for Kamp to obtain a proper representation for (20b) within the Priorian framework was to add an operator in the following way:

\[
P(\exists x(\text{Child}(x) \land \text{Born}(x) \land \text{NF}(\text{Rule-the-world}(x))))
\]

The operator \( N \) is defined so as to relate \( F \) to the utterance time rather than to the \( P \)-operator in the scope of which it would have to stand without \( N \), as in (21). There is something artificial in (22): the whole formula remains in the scope of \( P \). This is obviously due to the need to maintain anaphoric reference in the scope of the existential quantifier binding the object variable \( x \).

On the assumption that conjunction is the way to connect the main clause \( A \text{ child} \text{ was born} \) and the restrictive clause \( \text{which \ will/would rule the world} \), each of the complex sentences in (20) can be analyzed as a conjunction of two propositions on an equal footing provided that some temporal index of the first proposition is related to an index of the second one. This is a reasonable assumption given the fact that the relative clause also requires an anaphoric relation between the NP \( a \text{ child} \) and \( \text{which} \): the two eventualities are in some way connected because the same entity is involved in the two predications. Let us abbreviate the predication \( A \text{ child} \text{ be born} \) as \( B(c_1) \) and the predication \( \text{which rule the world} \) as \( \text{RW}(c_1) \). Then we obtain on the basis of the binary system discussed above, the following result.

\[
\exists i_1[B(i_1)(c_1) \land i_1 < n] \land \exists i_2[j[RW(j)(c_1) \land i_2 < j \land i_2 < n]
\]

The obvious indices that are to be related are \( i_1 \) and \( i_2 \). Both are introduced by the Past tense, so the question arises of how they relate to one another.
In view of what has been said about anaphoric ties between the main clause and the restrictive clause, it is arguable to assume a relation \( i_1 = i_2 \), which reduces the formula in (23b) to (24).

\[(24) \exists i \exists j [B(i)(c_1) \land RW(j)(c_1) \land i < j < n]\]

The assumption is plausible because the first occurrence of \( \textsc{past} \) brings us to a point in the past of the utterance time giving information about an event in which \( c_1 \) is involved. In (25a) \( i_1 \) is located in the past of the ruling of the world (which is before \( n \)) and the emperor’s death.

\[(25) \begin{align*}
a. & \quad \text{An emperor died who had ruled the world} \\
& \exists i_1 \exists i_2 \exists k [D(i_1)(c_1) \land RW(k)(c_1) \land k < i_2 \land i_1 = i_2 \land i_1 < n] \\
b. & \quad \exists i \exists k [D(i)(c_1) \land RW(k)(c_1) \land k < i < n] \\
c. & \quad \exists i \exists k [D(i)(c_1) \land RW(k)(c_1) \land k < i < n]
\end{align*}\]

Indeed, there is again the need to identify \( i_2 \) and \( i_1 \). The \( i \) of the dying time can be used as the point \( i \) before which the event time \( k \) of the RW-predication is located. In this sense the Pluperfect is construed from the utterance time \( n \) simply making use of the presence of a point of reference in the structure required by the tense form. In general, there seems to be a principle saying that \( \textsc{past}_1 \ldots \textsc{past}_2 \) gives \( i_1 = i_2 \), whereas \( \textsc{past}_1 \ldots \textsc{past}_2 \) require \( i_2 < i_1 \) and \( i_1 < i_2 \), respectively. The existence of such a principle seems to derive from the wish to keep “things simple”: the use of the same \( i \) in the main clause and the subordinate clause warrants the permanence of a viewpoint in the construal of the way in which different events are to be related.

It is illuminating to give the diagrams of (24) and (25) because they reveal an important feature of the system where it deviates quite clearly from choices made by Kamp & Reyle. The idea that becomes visible is that the index introduced by the highest tense operator, in this case \( \textsc{past} \) plays a decisive role in connecting the temporal structure of the first sentence to that of the second sentence. Note that *He had ruled the world* in Figure 6b receives its past perfect structure as if the sentence was said independently from the other one: it has a \( k < i < n \)-structure just like the single clause in (12) diagrammed in Figure 3. So it seems as if the two “first level”-operators \( \textsc{pres} \) and \( \textsc{past} \) play an important role in the construction of discourse structure. We will come back to this point later on.

![Figure 6. Configurations in complex sentences](image-url)
We can now turn to the case for which Kamp 1970 had to introduce the Now-operator:

(26) a. A child was born who will rule the world
b. $\exists i_1 [B(i_1)(c_1) \land i_1 < n] \land \exists i_2 \exists j [RW(j)(c_1) \land i_2 < j \land i_2 \circ n]$
c. $\exists i_1 \exists i_2 \exists j [B(i_1)(c_1) \land RW(j)(c_1) \land i_1 < n \circ i_2 < j]$

There is no reduction here, because the tense-operators of the main clause and the restrictive clause differ. The system as presented can easily account for the appropriate information without having to appeal to an extra-operator.

It is quite easy to put the information of (26c) into a DRS-box which basically gives the same information as the formula in (26).

\[
\begin{array}{cccccc}
 n & i_1 & i_2 & j & x \\
i_1: & \text{Be-Born}(x) \\
 i_2 \circ n & j: & \text{Rule-World}(x)
\end{array}
\]

(27)

Note that $i_1 < i_2$ follows automatically. This is because PAST puts $i_1$ in the past and PRES locates $i_2$ at the utterance time. In (23) and (24) $i_1$ and $i_2$ fall together. This is an interesting point: contrary to what Kamp & Reyle maintain, the eventuality itself does not play a role in the structuring of discourse structure. The picture is somewhat blurred by the use of the Simple Past, but take analogous sentences with a clear Past Perfect like (28)

(28) a. A guest had arrived who would disturb the meeting
b. $\exists i_1 \exists k [A(k)(g_1) \land k < i_1 \land i_1 < n] \land \exists i_2 \exists j [DM(j)(g_1) \land i_2 < j \land i_2 \circ n]$
c. $\exists i \exists j \exists k [A(k)(g_1) \land DM(j)(g_1) \land k < i < j < n]$

In these cases, it is arguable that it is the index $i_1$ rather than $k$ that plays a role in the construction of the temporal discourse structure. One of the arguments is that in sentences like No guest had arrived who would disturb the meeting. In this case there is no arrival event but there is an index $i_1$ available.\(^{14}\)

The relative ease with which (26) can be derived in a binary tense system indicates that its three dimensions provide the operator $N$ automatically: it was the decision to divide time into three compartments that caused the trouble for Prior. And for Kamp.\(^{15}\)

\(^{14}\) One may argue that $j < n$ should be changed in the light of the analysis of past posteriority in (8) but as observed there are some reasons to restrict the location of $j$ to the interval $[i,n]$, so $\leq$ seems to be the best we can make of it in (28c), given what the sentence expresses.

\(^{15}\) Kamp’s operator $N$ would also be necessary for A child was born which rules (is ruling) the world, which would amount to: $P(p_1 \land Np_2)$. This shows that $p$ taken apart, i.e. without
4. Adverbial modification

In Jespersen 1924 it was observed that the Pluperfect in English sentences containing temporal adverbials like five o’clock, now, yesterday, etc. is ambiguous.

(29) Mary had left at five o’clock

Sentence (29) may pertain to a situation in which Mary’s departure was at five o’clock but also to a situation in which Mary had gone before five o’clock. In the latter case five o’clock denotes a sort of point at which it was noticed that Mary’s leaving had already taken place.

This observation has been used as an argument against Reichenbach’s system in Bertinetto (1986) (cf. also Hornstein (1977)) the problem being according to Bertinetto that in a Reichenbachian structure E - R - S, there is no room for two different points at which five o’clock could be located. This is because in Reichenbach’s system temporal adverbials cannot modify E: they modify R. One cannot simply change this restriction, because it is used to account for the fact that one can say in English Mary walked yesterday but not Mary has walked yesterday. In the former case—E,R - S pattern—yesterday is connected with R in the past of S. In the latter case one has E - R,S and so it is clear why in the Present Perfect there is no room for yesterday: R is located in S. The same applies to John has left at five o’clock: the R of five o’clock cannot be located in S. So, here a severe problem arises for Reichenbach.

This problem is absent in a binary system on the reasonable assumption that temporal adverbials identify the indices in the system. Kamp & Reyle (1993:511) write Sunday(t) for the period denoted by the NP Sunday. Assuming the correctness of taking Sunday(t) as a period, we will write for convenience Sunday(k) for k ⊆ Sunday(t). For (29) this extension of Te Winkel’s system would give (30).

(30) a. Mary had left at five o’clock (departure time: 5.00 pm)
   \[ \exists i \exists k [L(k)(m) \land k < i \land 5 \text{ o’clock}(k) \land i < n] \]

b. Mary had left at five o’clock (departure time: < 5.00 pm)
   \[ \exists i \exists k [L(k)(m) \land k < i \land 5 \text{ o’clock}(i) \land i < n] \]

This appears to be an adequate solution for Reichenbach’s problem with the Pluperfect. This solution is simply due to the fact that a binary system contains more indices to operate with and in this particular case this feature of a cubic system is of help.

16 Or \( k \in \text{Sunday}(t) \), dependent on the appropriate type-logical choice.
Returning now to Blackburn’s extension of Prior’s system as discussed above, one can easily see that an explicit identification by tense is not really necessary due to the presence of the appropriate adverbials. That is, in (19) the unique time index \( a \) was introduced there contextually due to the lack of an overt adverbial in (7a). So, rather than introducing \( a \) in the Montagovian way sketched above, it is possible to think of introducing a contextual adverbial \( A \) as shown in (31).

\[
(31) \quad \exists i \exists j[\text{Write}(j)(b)(m) \land A(j) \land i < j \land i \circ n]
\]

Here it is \( A \) which restricts the quantificational range of the existential quantifier to a contextually uniquely defined position in the temporal structure expressed by the sentence as a whole.

As to the ambiguity in (30), we should be able to do more than simply account for it in terms of (30a) and (30b). The same sort of ambiguity is predicted for the Present Future Perfect, the Past Future, the Past Perfect and the Past Future Perfect. Its absence is predicted for the other four tenses. The former set is characterized by the presence of the relation \( i < n \) except for the Simple Past, the latter set by the presence of the relation \( i \circ n \) except for the Present Future Perfect. The Simple Past escapes the ambiguity because there are too few indices, the Present Future Perfect can be ambiguous because it is the only Present tense form having two extra indices apart from \( i \) and \( j \). Let us put this to test.

The Present is the most simple case. It easily passes the test. As expected the Simple Future does not yield the ambiguity under analysis. For example, in *Ik zal je om vijf uur bellen* (I will call you at five o’clock) the adverbial cannot be associated with \( n \): it must be connected to the index \( j \), so the formula contains *5 o’clock* and \( i \circ n < j \).

The Present Perfect is a \( i \circ n \)-case with only one extra index and consequently the ambiguity under discussion should not show up. To my knowledge, it does not show up except for one use of the Present Perfect that can be only discussed after the inspection of the remaining tense forms because in that particular use posteriority is involved.

The Present Future Perfect is a \( i \circ n \)-case, but in the formula there are two more indices \( j \) and \( k \), so one should expect ambiguity here. Indeed, sentences like (32) allow for two interpretations on the basis of two different locations for the modification:

\[
(32) \quad \text{Mary zal om vijf uur gebeld hebben}
\]

Mary will have called at five o’clock

On the first interpretation *five o’clock* modifies the event time \( k \), as in (33a).

\[
(33) \quad \begin{align*}
\text{a. } & \exists i \exists j \exists k [C(k)(m) \land k < j \land 5 \text{ o’clock}(k) \land i < j \land i \circ n] \\
\text{b. } & \exists i \exists j \exists k [C(k)(m) \land k < j \land 5 \text{ o’clock}(j) \land i < j \land i \circ n]
\end{align*}
\]
However, there is also an interpretation in which (32) expresses that by 5 o’clock Mary will have called. This is an interpretation which definitely has a heavier modal load in the sense that the speaker takes 5 o’clock as the ultimate limit for Mary to have called. This interpretation becomes more visible in (34).

(34) Mary zal om vijf uur zeker hebben gebeld
Mary will certainly have called at (by) five o’clock

or by using adverbials like al (already), or simply by putting the adverbial in (32) in front position.

Another example to convince those who have to get accustomed to the 5 o’clock(j)-interpretation, is sentence (35) said at the evening before.

(35) Marie zal om 5 uur hebben getraind en om 6 uur hebben ontbeten
Mary will have trained at 5 a.m. and have breakfasted at 6 a.m.

Here the 5 o’clock(j) and the 6 o’clock(j)-interpretations are even more prominent than the 5 o’clock(k) and the 6 o’clock(k)-interpretations. These cases suffice to show that the prediction comes out true in the Present Future Perfect, as expected by the presence of available indices.

The Simple Past cannot show the ambiguity under analysis due to the absence of sufficient indices: $i$ is the only one available. The Past Future, however, is a tense structure containing $i < n$ and $i < j$, so there should be an ambiguity of the kind discussed above for the Pluperfect: $i$ and $j$ can be modified. Indeed, there is such an ambiguity although by the very nature of posteriority it has a somewhat different flavour than in the anteriority cases. Consider sentence (36).

(36) Marie zou om vijf uur weggaan
Mary would leave at five o’clock

On one interpretation, it is said that according to the speaker things were arranged such that at five o’clock of some natural day the departure of Mary would take place. On the second less visible interpretation, the sentence expresses that to the speaker’s knowledge it was sure at five o’clock that Mary would leave. Five o’clock is the latest time at which it was known to the speaker that Mary would leave. On this interpretation it is not excluded that later information tells us that at seven o’clock it was decided that Mary would stay after all. The two interpretations are kept apart in (37).

(37) a. $\exists i \exists j [L(j)(m) \land i < j \land 5 \text{ o’clock(j)} \land i < n]$
b. $\exists i \exists j [L(j)(m) \land i < j \land 5 \text{ o’clock(i)} \land i < n]$

It is not unreasonable to observe that the prediction comes out true.
As to the Past Future Perfect, the favorite interpretation of sentences like (38) favours the 5 o’clock\(k\)-interpretation.

(38) Marie zou om vijf uur hebben gebeld
Mary would have called at five o’clock

However, the second interpretation is certainly not excluded, although there are more natural ways to express its content:

(39) Marie zou vóór vijf uur hebben gebeld
Mary would have called before five o’clock

Nevertheless, there are contexts in which the 5 o’clock\(k\)-interpretation is visible as in (40).

(40) Marie zou net als gisteren en eergisteren om vijf uur hebben getraind en om zes uur hebben gegeten, ware het niet dat het zo hard regende en stormde zodat zij besloot in bed te blijven liggen.
Mary would just like yesterday and the day before have trained at 5 a.m. and have had breakfast at 6 p.m., if it wouldn’t have rained and stormed so much, so that she decided to stay in bed

Note that this second interpretation systematically informs a hearer about what information is available to the speaker about the event described. Sentences like (41) and (42) are quite acceptable in normal speech.

(41) a. Zondag zou zij nog zijn gekomen, maar nu weet ik niet meer of ze überhaupt nog wel komt
Sunday (it looked as if ) she would have come, but now
I no longer know whether she will be there at all

b. Gisteren zou hij hebben gebeld, maar misschien heeft hij nu wel besloten te faxen.
Yesterday he would have called but maybe he has now decided to send a fax

The point at issue can be strengthened considerably in the light of the well-known phenomenon that the present tense can be used to express a sense of posteriority. A plausible way to explain that sentences like (43) means that Mary will call at five o’clock is to assume that POST may appear covertly after PRES in this case.

(43) a. Marie belt om vijf uur
lit: Mary calls at five o’clock

b. PRES\(\text{POST}(\phi)\)

c. \(\exists i \exists j [\text{C}(j)(m) \land i < j \land 5 \text{ o’clock}(j) \land i \circ n]\)
Here again the binary system shows its predictive power, because (43a) is one of the two cases where this insertion of the POST-operator is possible, the other case being sentences like (44).

(44) Marie heeft om vijf uur gebeld
    lit: Mary has called at five o’clock

Apart from its “normal” present perfect interpretation, this sentence can be used to express posteriority, for example in a situation in which the speaker reassures the hearer that Mary will have called before five o’clock. It is important to note that PAST(φ) also has this possibility, as in Jan zei dat hij kwam (lit: John said that he came) which is a acceptable variant of Jan zei dat hij zou komen. Note that the system predicts this possibility correctly, whereas in Reichenbach’s system it would not follow from anything.

5. Breaking away from the cube

5.1. Introduction

The preceding section ended with discussing the presence of covert operators. It is time now to discuss the merits and the drawbacks of the binary system presented above in terms of an evaluation of its main ingredients, in particular its operators. Furthermore, we should be able to escape from the Germanic format predicting eight tense forms into a more general concept of a binary system that should be able to cover different varieties of tense systems. I will begin by considering the system as discussed above from the point of view of providing each of the three dimensions with two operators, one present and visible in the linguistic forms expressing tense, the other covert its existence being justified by the presence of the overt form. We have to see what this strategy can bring us.

5.2. Blowing up the three oppositions

The eight Dutch tense forms are correctly described by a binary system along the lines sketched above. All forms are accounted for and there are no logical possibilities that suffer from being variants of existing other forms. The system provides a lot of parallel structure lacking in Reichenbach’s and in Prior’s system. For convenience, the resulting forms are put together in the upper part of Table III. As noted earlier there is a way to interpret Te Winkel’s system more opulently in the sense that each of the poles in the three oppositions may be attributed its own operator to obtain the relevant information. The intuition behind this would be that in this way all eight tenses are treated in the same way. Such an approach would amount to the lower part of Table III. The two
Table III. Two ways of representing the eight tense forms

The eight tense forms as discussed

<table>
<thead>
<tr>
<th>Operators</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRES</td>
<td>∃i[Write(i)(b)(m) ∧ i &lt; n]</td>
</tr>
<tr>
<td>PRES(POST)</td>
<td>∃i∃j[Write(j)(b)(m) ∧ i &lt; j ∧ i &lt; n]</td>
</tr>
<tr>
<td>PRES(PERF)</td>
<td>∃i∃k[Write(k)(b)(m) ∧ k &lt; i ∧ i &lt; n]</td>
</tr>
<tr>
<td>PRES(POST)(PERF)</td>
<td>∃i∃j∃k[Write(k)(b)(m) ∧ k &lt; j ∧ i &lt; j ∧ i &lt; n]</td>
</tr>
</tbody>
</table>

PAST

<table>
<thead>
<tr>
<th>Operators</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAST(POST)</td>
<td>∃i[Write(i)(b)(m) ∧ i &lt; n]</td>
</tr>
<tr>
<td>PAST(PERF)</td>
<td>∃i∃j[Write(j)(b)(m) ∧ i &lt; j ∧ i &lt; n]</td>
</tr>
<tr>
<td>PAST(POST)(PERF)</td>
<td>∃i∃j∃k[Write(k)(b)(m) ∧ k &lt; i ∧ i &lt; n]</td>
</tr>
<tr>
<td>PAST(POST)(PERF)</td>
<td>∃i∃j∃k[Write(k)(b)(m) ∧ k &lt; j ∧ i &lt; j ∧ i &lt; n]</td>
</tr>
</tbody>
</table>

The opulent way

<table>
<thead>
<tr>
<th>Operators</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRES(SYN)(IMP)</td>
<td>∃i∃j∃k[Write(k)(b)(m) ∧ j ⊑ k ∧ i = j ∧ i &lt; n]</td>
</tr>
<tr>
<td>PRES(POST)(IMP)</td>
<td>∃i∃j∃k[Write(k)(b)(m) ∧ j ⊑ k ∧ i &lt; j ∧ i &lt; n]</td>
</tr>
<tr>
<td>PRES(SYN)(PERF)</td>
<td>∃i∃j∃k[Write(k)(b)(m) ∧ k &lt; j ∧ i = j ∧ i &lt; n]</td>
</tr>
<tr>
<td>PRES(POST)(PERF)</td>
<td>∃i∃j∃k[Write(k)(b)(m) ∧ k &lt; j ∧ i &lt; j ∧ i &lt; n]</td>
</tr>
</tbody>
</table>

PAST(IMP)

<table>
<thead>
<tr>
<th>Operators</th>
<th>Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAST(IMP)</td>
<td>∃i∃j∃k[Write(k)(b)(m) ∧ j ⊑ k ∧ i = j &lt; n]</td>
</tr>
<tr>
<td>PAST(IMP)</td>
<td>∃i∃j∃k[Write(k)(b)(m) ∧ j ⊑ k ∧ i &lt; j &lt; n]</td>
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</tr>
<tr>
<td>PAST(IMP)</td>
<td>∃i∃j∃k[Write(k)(b)(m) ∧ k &lt; j ∧ i &lt; j &lt; n]</td>
</tr>
</tbody>
</table>

extra operators SYN and IMP necessary to complete the four given above are defined in (45).

(45) a. SYN := λϕλί′∃j[ϕ[j] ∧ i′ = j]  
b. IMP := λϕλί′∃k[ϕ[k] ∧ i′ ⊑ k]

The SYN-operator seems to be completely redundant, so missing it would make no difference. This does not hold for the IMP-operator. In the case of IMP, the appropriate way of capturing the notion of imperfect is inclusion (⊆). If one takes j⊆k as expressing some uncertainty about whether or not an event in the past is still going on, one creates the possibility to use the IMP-operator as invoking an interpretation coming close to what is expressed by the Imparfait in French, namely a certain indeterminacy as to whether or not the event has found its completion, whereas j = k would explicitly express
completedness. Let us repeat here the derivation in (3) but now including the \( \text{IMP} \)-operator:

\[
\text{IMP}(\text{Mary write the letter}) \sim \\
\lambda \phi \lambda i' \exists i[\phi[i] \land i' \sqsubseteq i](\lambda i''.\text{Write}(i'')(b)(m)) \\
= \lambda i' \exists i[\lambda i''.\text{Write}(i'')(b)(m)[i] \land i' \sqsubseteq i] \\
= \lambda i' \exists i[\text{Write}(i)(b)(m) \land i' \sqsubseteq i] \\
\text{PAST}(\text{IMP})(\text{Mary write the letter}) \sim \\
\lambda \phi \exists i[\phi[i] \land i < n](\lambda i' \exists k[\text{Write}(k)(b)(m) \land i' \sqsubseteq k]) \\
= \exists i[\lambda i' \exists k[\text{Write}(k)(b)(m) \land i' \sqsubseteq k][i] \land i < n] \\
= \exists i \exists k[\text{Write}(k)(b)(m) \land i \sqsubseteq k \land i < n]
\]

It will be clear that the last line of the derivation in (46) differs considerably from the last line of the derivation in (3) given in (47).

\[
\exists i[\text{Write}(i)(b)(m) \land i < n]
\]

A derivation including \( \text{IMP} \) contains the information that the speaker of the sentence \textit{Mary wrote the letter} wants to keep open the possibility that the event described may still go on at \( n \), whereas (47) locates the event before the point of speech. So, there is a difference involved.

In Dutch the sentence \textit{Marie wandelde} (Mary walked) seems to express what Te Winkel must have had in mind: Mary may still be walking but not necessarily so. The idea expressed in the binary system including \( \text{IMP} \) is that the point of reference is located somewhere in the event expressed by the predication. In this sense, Dutch differs from English in which \textit{Mary walked} is considered as pertaining to an event in the past. It would be unacceptable to find out that Mary would be still walking at \( n \). The French Imparfait is more close to the Dutch form. So, the next step is to consider the English Past tense as resulting from dropping the \( \text{IMP} \)-operator or having it but using the \( = \)-part of the information as its default.

More in general it is important to see that the indices connected with tenseless semantic objects—Galton’s event radicals—have attractive properties. They have nothing to do with aspecual properties such as terminativity (or telicity) and durativity (or atelicity). It is a quite well-accepted view nowadays that the choice of the language material provided by the speaker of (3a) \textit{Mary wrote the letter} brings about a terminative interpretation which means that the event spoken about is taken as bounded, completed. In the same way, a durative sentence like \textit{Mary wrote letters} is said to pertain to an unbounded event. The corresponding event radicals \textit{Mary write the letter} and \textit{Mary write letters} are terminative and durative, respectively, due to the fact that all relevant aspecual information is provided for at the tenseless level. An operator
like IMP does not change the nature of its input, it produces an output which says something about the indices, not about the input event-radical itself. It says that speakers of the French sentence *Mary écrivait la lettre* analyzed as (46) cannot commit themselves fully to the actualization of the event as related to the index $k$. The commitment is restricted to a subindex $i$.\(^{17}\)

### 5.3. The richness of the French tense system

A problem with the binary system restricted to three oppositions as discussed above is that it can only deal with eight tense forms. French has considerably more forms, as shown in Table IV. Some grammars consider forms like *écrit* as falling outside the indicative domain, but other grammars recognize the temporal use of *écrit* and *aurait écrit*. I will follow the latter as most grammarians beyond the level of introductory and practical grammars do recognize between eleven and fourteen indicative tense forms.

Table IV can be taken as showing that the Passé Simple, the Passé Antérieur and the Passé Surcomposé, the Plus-que-Parfait Surcomposé and two Posterior Surcomposé forms fall outside the range of Te Winkel’s three oppositions. They do not have correspondents in the more restricted Germanic system. This means that we have to show that the binary system as restricted

\(^{17}\) For more information about this line of thought, see the analysis of the Progressive Form in Verkuyl (1993) and Verkuyl (1999a).
to just eight forms can be extended in a natural way without loosing its internal coherence and consistency. However, before showing that, it is necessary to raise the question of whether one may speak about a correspondence between the French and the English forms if for eight tenses corresponding forms are found in the columns.

The most obvious problem is that the notion of correspondence cannot be taken in a strict sense: there are clear differences between the use of the English present tense *writes* and its French counterpart *écrit*. On the other hand, the Dutch present tense *schrijft* and the reportive English *writes* come pretty close to having exactly the same use as the French *écrit*, which shows that the differences between the Germanic and Romance tense systems can be described on the basis of a common underground. It would also not be unreasonable to relate the English *wrote* to the French tense form *écrivait* on the basis of connecting *had written* to *avait écrit*. All four share Past and Synchronous. If one would deny to the Imparfait a position in the restricted system on the ground of its forming an aspectual opposition to the Passé Simple, then the same should hold for *avait écrit*, which is generally fully accepted as a Plus-que-parfait, whereas it is also the Imparfait form of the auxiliary verb *avoir*. In other words, we underscore the correspondence between the English Imperfect wrote and the French Imparfait on the basis of their position in the system of oppositions, explaining their different uses in terms of choices with respect to IMP and PERF. The inclusion of the four corresponding tenses in Table IV treated so far extends to the other four tenses. In Figure 7 below all French tense forms are given and so one can easily compare the position of each tense form in the system as a whole.

So, it may be concluded that there are no reasons to think that the eight French tense forms which have a correspondent in the English system should not be given the analyses in Table IV, the deviations between English and French being explained along the lines suggested above. In other words, we may now focus on the remaining forms just given. In Figure 7 presented at the end of the present paper fourteen forms of the Table IV are pictured.

The reason why the cube is so successful for the treatment of Germanic tense systems is that it reflects the compositionally formed construction of the resulting eight tenses: it can account for the presence of two auxiliary verbs plus the “real” primary tenses PRES and PAST. This leads to first assigning the PERF-meaning to the tenseless predication, then (if a posterior form is present) to POST and then to one of the two main tenses, PAST or PRES. So, we could try and find out what happens in the case of the Passé Surcomposé. The technical problem to be solved for the analysis of sentences like 48 is to deal with two PERF-forms.

(48) a. Marie a eu écrit la lettre
    b. PRES(PERF)(PERF)(Write(b))(m)
The same possibility to use the 
que-parfait Surcomposé, which for
Surcomposé is not really a problem. Neither is the derivation of the Plus-
que-parfait in (50a) and the use of the Passé Surcomposé and the Passé Com-
There is a parallelism between the use of the Plus-que-parfait and the Im-
(50)

a. Dès que j’avais terminé mes cours, je partais en vacances
b. Dès que j’ai eu terminé mes cours, je suis parti en vacances

There is a parallelism between the use of the Plus-que-parfait and the Imparfait in (50a) and the use of the Passé Surcomposé and the Passé Composé in (50b). So, it turns out that the compositional derivation of the Passé Surcomposé is not really a problem. Neither is the derivation of the Plusque-parfait Surcomposé, which for Marie avait eu écrire la lettre would have
PAST(PRES(PRES(PRES(Marie écrire la lettre) \sim
\lambda i \exists k' \exists [Write(k)(b)(m) \land k < k' \land k' < i']\land i \circ n]

(51) = \exists k [Write(k)(b)(m) \land k < k' \land k' < i \land i < n]

The same possibility to use the PERF-operator twice is found in the future sur-
composé forms. So, one has PRES(PRES(PRES(PRES(Marie écrire la lettre and PAST(PAST(PAST(PRES(Marie aura eu écrire la lettre, respectively. I shall ignore these two forms because their treatment follows from (49) and (51).

Turning now to the Passé Simple and the Passé Antérieur, it is important to
observe that the Passé Simple is closely related to the Passé Composé. In fact,
the latter form has taken over the duties of the former in the spoken language.
It is often considered as a literary form. However, the Passé Simple deviates
from the Passé Composé in an important respect: it is not directly anchored
to the point of speech. Formally, this is because the Passé Composé is ana-
yzed as belong to the Present tenses. So, there should be a crucial difference
between the two, the more so because the Passé Simple is not banned from
the spoken language. A possible solution is to analyze the Passé Simple as
made up from the \textsc{past}-operator and an operator $\text{Anch}_c$ which takes to the tenseless predication, as shown in (52).

(52) a. Marie écrivit la lettre
   b. $\textsc{past}(\text{Anch}_c)(\text{Write}(b)(m))$

Consider the following derivation:

(53) $\text{ANCH}_c \leadsto \lambda \phi \exists k[\phi[k] \land A(k,j)]$

$\text{ANCH}_c(\text{Marie écrire la lettre}) \leadsto$

$\lambda \phi \exists k[\phi[k] \land A(k,j)](\lambda i'.\text{Write}(i')(b)(m))$

$= \lambda j \exists k[\lambda i'.\text{Write}(i')(b)(m)[k] \land A(k,j)]$

$= \lambda j \exists k[\text{Write}(k)(b)(m) \land A(k,j)]$

$\textsc{past}(\text{ANCH}_c)(\text{Marie écrire la lettre}) \leadsto$

$\lambda \exists i[\phi[i] \land i < n](\lambda j \exists k[\text{Write}(k)(b)(m) \land A(k,j)])$

$= \exists i[\lambda j \exists k[\text{Write}(k)(b)(m) \land A(k,j)][i] \land i < n]$

$= \exists \exists k[\text{Write}(k)(b)(m) \land A(k,i) \land i < n]$

The operator $\text{ANCH}_c$ introduces a separate domain containing an anchor point with respect to which the predication is interpreted. Important is to see that the role of $n$ as a natural anchor point is suppressed: it is as if the speaker “moves mentally” to the anchor point introduced by $\text{ANCH}_c$. This is due to the fact that $\text{ANCH}_c$ introduces an $A$-relation between the index $j$ and the index $k$. This $A$-relation is contextually determined, so it may be an adverbial used in a preceding sentence, it may be an index introduced by the predication in a subordinate clause or some contextually understood anchor point. The suggestion of “long ago” or “distant from now” is obtained because the domain introduced by $A$ is by itself preceding the moment of speech.”

(54) a. Napoleon mourut à Sainte-Hélène en 1821
   b. Je me trouvai l’autre jour dans un endroit très agréable
   c. En attendant Jean, Marie fit sa toile
   d. . . .

In (54c) the time stretch to which $\text{En attendant Jean}$ relates is contextually identifiable as a stretch introduced earlier in the text. In all these cases the Anchor point is located in a stretch of time separated from the point of speech which is overruled by the contextual (discourse) nature of the index $j$. One could think here of an index introduced in the way $n$ is introduced: as a name, say $n’$. In that case, the existential quantifier introduces $i$ which is identified as being identical to $n’$.

As to the Passé Antérieur the following derivation yields the proper configuration (56) on the basis of the syntactic configuration in (55c).

(55) a. Marie eut écrit la lettre
   b. $\textsc{past}(\text{Anch}_c)(\text{PERF}(\text{Write}(b)(m)))$
could even say that 5a is the Present of the Passé Antérieur, except for the characterizations in a fully compositional way. The binary oppositions making up a tense system make it possible to being applied where they should. This shows up in the area of compositionality between Past, Present and Future prevents linguistic considerations from being applied where they should. This shows up in the area of compositionality: the binary oppositions making up a tense system make it possible to characterize the tense forms in a fully compositional way.

More in general, I would like to conclude that a binary set up of the tense systems in Germanic and Romance languages appears to provide correct descriptions of the temporal configurations involved. Moreover, I think that Te Winkel’s approach has shown to be more fruitful than Reichenbach’s and Prior’s approaches. This is because the ontologically motivated tripartition between Past, Present and Future prevents linguistic considerations from being applied where they should. This shows up in the area of compositionality: the binary oppositions making up a tense system make it possible to characterize the tense forms in a fully compositional way.

The formulas that have been produced on the basis of considerations that emerge from the wish to generate the French tenses compositionally seem to reveal a system that shows remarkable features. First of all, it is possible to divide tenses with a Present from tenses with a Past in such a way as to obtain a striking parallelism between pairs of tenses. This is shown in Figure 7. It contains seven rows. The purpose of presenting Figure 7 is to show the remarkable parallelisms between tenses and parts of tenses. First of all, 6b and 7b are identical except for the extra point k‘ in the Passé Antérieur, but the latter also shows a striking similarity to the Passé Surcomposé in 5a. One could even say that 5a is the Present of the Passé Antérieur, except for the Anchoring structure occurring in 6b and 5b. The relation between 2a and 5a is also remarkably parallel to the relation between 6b and 7b. Furthermore, the Passé Simple is closely related to the Plus-que-parfait if one abstracts away from the A-structure in 5b. The same applies to the relation between the Plus-que-Parfait Surcomposé in 5b and the Passé Antérieur in 7b. And so on. These are really fascinating relations that should also be checked out empirically in more detail, as e.g. in Verkuyl and Vet (2001).

6. Conclusion
Figure 7. The French indicative tenses
References


