TEMPORAL REASONING WITH ASPECTUAL ADVERBS

ABSTRACT. Validity of dynamic temporal reasoning is semantically characterized for English and Dutch aspectual adverbs in Discourse Representation Theory. This dynamic perspective determines how the content needs to be revised and what information is preserved across updates, when the order of premises is considered relevant. Resetting contextual parameters relies on modelling the basic aspectual polarity transitions and temporal reasoning extensionally. For intensional aspectual adverbials the speaker’s attitudes regarding past alternatives to and possible continuations of the current state come into play. Additional considerations are offered for generalizing this system to the full logical space for linguistic universals, lexicalized quite differently in Dutch and English.

1. INTRODUCTION

Human reasoning about temporal relations between events is itself a cognitive process taking place in time. Not only does the time at which information is received often affect the conclusions we draw from it at a particular moment, processing the premises itself constitutes change of context and resets various temporal indexical parameters. Such forms of reasoning may be reported in natural language using aspectual adverbs, such as not yet, still or finally, which efficiently combine factual content with information about the speaker’s attitudes and presuppositions. To characterize the valid patterns of such situated reasoning in time about time, this paper proposes an analysis in Discourse Representation Theory

in which components of truth functional content are combined with information regarding the speaker’s attitudes towards possible past alternative courses of events and future continuations of the current state. Subjective evaluation of the speed and progress of changes that occur interact systematically with the actual polarity transitions, representing positive and negative phases of events. This account assigns a pivotal role to the perspective of the reasoner, herself situated at the current reference time, looking either back to what has happened or forward towards what may happen. This captures the essential situatedness of human temporal reasoning, which the Dynamic Aspect Trees of ter Meulen (1995) were designed to model for English aspectual verbs, aspectual classes and aspectual inflection of verbal predicates in discourse.

Adverbs are called aspectual when they carry information about the start or end of an event, which are themselves essentially polarity transitions, changing a negative state into a positive one or vice versa. We espouse the use of an event-based semantics, customary in DRT, from which an interval semantics may be derived, as used in van der Auwera (1993, 1998) and Löbner (1999).

A simple example of the kind of inference we are interested in is the following, intuitively obvious case of a valid temporal reasoning pattern, where the premises are presented in the order given.

(i) When Mary arrived, John was still asleep
(ii) John woke up
(iii) Bill arrived
(iv) ⊨ When Bill arrived, John was not asleep anymore

Presented first is the factual information in (i) that at the time of Mary’s arrival John was asleep. This information about John is revised upon adding the second premise in (ii), introducing a later reference time and resetting the polarity for John’s sleeping from positive (being asleep) to negative (not being asleep). In processing the premises in the given order, the premise in (iii) again introduces a later reference time of Bill’s arrival. This is the time at which the conclusion is drawn in (iv) that John is not asleep anymore. The aspectual adverbials in the first premise (i) and in the conclusion (iv), still and not anymore, contribute additional information with their presuppositions. The presupposition for still, for instance, will be characterized as relating to the 1/0 ending transition, relative to which the speaker herself is situated at an earlier point, looking towards it into the future. Even though still in (i) is not strictly necessary to infer the conclu-

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1 See Kamp and Reyle (1993) and Van Eijck and Kamp (1997) for an introduction to DRT.
sion in (iv), its presence contributes temporal coherence to the inference. From the premises (i), (ii) and (iii) we are not entitled to conclude, for instance, that John was already asleep when Bill arrived, because already, in contrast to not anymore in (iv), does not respect the presupposition of still.

The primary objective of this paper is to present a proper characterization of the reasoning patterns with aspectual adverbs which constitute valid inferences. A secondary objective is to indicate how natural languages may vary in the way they express the subjective speaker information and objective factual information in aspectual adverbs. In particular, English and Dutch, generally considered to be closely related Germanic languages, will be shown to adopt quite different strategies in expressing such aspectual information.

The italicised forms in (1) are assumed to constitute the core paradigm of extensional aspectual adverbials, where English and Dutch differ only slightly. The aspectual adverbials all modify descriptions of states, but those in (1a–b) relate to the beginning of the event (i.e., John’s falling asleep), whereas those in (1c–d) relate to its end (i.e., John’s waking up).

(1)a. E: John was not yet asleep.
   D: Jan slept nog niet/*niet al.
   John slept still not/*not yet.

b. E: John was already asleep.
   D: Jan slept al.
   John slept already.

Various labels have been used in the literature to refer to these four expressions: perspectivity particles (Van Baar 1990; Vandeweghe 1992), particles of change and continuation (Van Baar 1991; van der Auwera 1991), phasal adverbials (Löbner 1989/1990; van der Auwera 1998) or phasal polarity items (Van Baar 1997). Moreover, van der Auwera (1998, p. 35) introduces the label INCHOATIVE for al/already in (1b) whereas the other three elements are associated with the notion of CONTINUITY: nog/still in (1c) is CONTINUATIVE, niet meer/not anymore in (1d) is DISCONTINUATIVE and nog niet/not yet in (1a) is CONTINUATIVE NEGATIVE. This marked position of al/already within the system is supported by typological research showing that, if a language has a lexical gap for any of the four notions, it is invariably al/already which does not find expression (van der Auwera 1993, p. 615; 1998, pp. 35–37). Diachronically speaking, English, Dutch and German furthermore seem to have known a stage when there was no adverbial relating to the past onset, but there were lexemes available to express the three other meanings (van der Auwera 1998, p. 27). Although already/al is considered to fall outside the CONTINUITY paradigm of not yet/nog niet – still/nog – not anymore/niet meer in Smessaert (1997, 1999a, b), we opt to remain neutral on this issue in this paper, considering already/al to be lexically ambiguous between an extensional aspectual adverbial and an intensional one.
c. E: John was still asleep.
   D: Jan slipt nog.
      John slept still.

d. E: John was not asleep anymore.
   D: Jan slipt niet meer.
      John slept no more.

The aspectual adverbs in (2) and (3), with capitals indicating high pitch stress accents, induce additional semantic complexity, where English and Dutch diverge interestingly in lexicalization strategies.

(2)a. E: John was already asleep.
    D: Jan slipt al.
       John slept already.

b. E: John was finally asleep.
    D: Jan slipt eindelijk.
       John slept finally.

c. E: John was no longer asleep/already awake.
    D: Jan slipt al niet meer.
       John slept already not anymore.

d. E: John was finally awake.
    D: Jan slipt eindelijk niet meer.
       John slept finally not anymore.

(3)a. E: John was still asleep.
    D: Jan slipt NOG/nog steeds/nog altijd.
       John slept STILL/still always/still always.

b. E: John was still not asleep/awake.
    D: Jan slipt NOG/nog steeds/nog altijd niet.
       John slept STILL/still always/still always not.

In (2) and (3) we assume an implicit contextually determined reference point is given, analogous to the when-clause above in (i) When Mary arrived, John was still asleep. Although for both already/al in (2a) and finally/eindelijk in (2b) this reference point is located after John fell asleep, the former indicates that the speaker thought the actual course of events constituted relatively fast and easy progress, as opposed to the relatively slow and difficult progress in the latter. The same contrast in
speaker perception of the actual course of events is observed between no longer or alREADY not-P/ al niet meer in (2c) and finally not-P/eindelijk niet meer in (2d). These are the negative counterparts of (2a) and (2b) respectively, where the reference time is located after John’s waking up. This subjective dimension in (2c–d) is absent in the more elementary not anymore/niet meer in (1d). Similarly, STILL/NOG or nog steeds in (3a) and STILL not/NOG niet or nog steeds niet in (3b) differ from their elementary counterparts still/nog in (1c) and not yet/nog niet in (1a) by introducing the speaker’s perception of the lack of progress, i.e., a non-change, static situation.

As for the Dutch adverbial clusters al niet meer and eindelijk niet meer in (2c–d), it may be hard to find literal English adverbial equivalents, but one resorts to the antonym (asleep/awake) or to other syntactic categories such as aspectual auxiliary verbs. With the emphatic NOG and STILL in (3a), Dutch may, but English must resort to prosody in order to mark the additional information of the speaker’s attitude. In Dutch, this prosodic strategy is straightforwardly extended to the negative counterpart NOG niet in (3b). For English, however, the emphatic counterpart of not yet in (1a) is STILL not in (3b), which is not only prosodically marked, but also lexicalized with the corresponding internally negated dual. Dutch, as well as German, may alternatively express the attitude information overtly in a more compositional way by adding the virtually synonymous quantificational adverbs steeds or altijd (German immer) both to the positive nog in (3a) and to the negative nog niet in (3b). As observed in connection with (2c–d), English does not readily allow this strategy of adverbial composition to ??still always (not), but must resort to prosody. In Section 4 we will review how these intensional adverbs in Dutch – but again, not to the same extent in English – may furthermore combine with determiners

5 Apparentely, the English sentence in (2c) is much better when already is fronted but no longer is left in its original position, thus breaking up the adverbial cluster (van der Auwera 1998, p. 83). The alternative lexicalisation by means of waking up is in line with the general cross-linguistic observation that languages may adopt three alternative verbal strategies for expressing the basic notion of “continuity”, i.e., lexical verbs, (semi-)auxiliaries and verbal morphology (van der Auwera 1998, p. 30).

4 The same holds for German noch (Doherty 1973, p. 157; König 1977, p. 177; Mittwoch 1993, p. 77). Dutch and German furthermore allow this emphatic NOCH/NOG to occupy sentence-initial position (van der Auwera 1998, p. 86/103). For English STILL, however, such initial position seems to interfere with its so-called adversative or concessive nevertheless reading (König 1977, pp. 194–195).

5 English shares this extra complication – involving the order of the adverbial and the negation element – with the Scandinavian languages (van der Auwera 1998, p. 133, footnote 41). In Dutch niet al is highly marked, if not downright unacceptable, whereas nog niet is the preferred default option.
and other kinds of adverbs such as, never or rarely, and almost and just, indicating temporal distance to an envisaged future or realized past polarity transition. For ease of exposition, we will restrict the examples to English ones, whenever English and Dutch offer no interesting contrasts.

Our analysis is to account for valid and invalid reasoning patterns involving the aspectual adverbs in (2)–(3) in contexts where the temporal reference point may change during the interpretation of the premises. Consider the inference in (4), where the premises (4a, b, c) are presented in the order indicated, and (4d) is a valid conclusion (indicated by $\vdash$), but (4e) is invalid (indicated by $\not\vdash$).

(4)a. When Mary arrived, John was **STILL** not asleep.
  b. John fell asleep.
  c. Peter arrived.
  d. $\vdash$ When Peter arrived, John was **finally** asleep.
  e. $\not\vdash$ When Peter arrived, John was **already** asleep.

In dynamic semantics the information in (4b, c) changes the reference time created by (4a): some of the information is revised, whereas other information is not affected. The valid conclusion in (4d) preserves the subjective attitude information in (4a), whereas in (4e) it is contradicted. In other words, in a valid dynamic inference information concerning subjective attitudes is generally not affected, when new factual information is added and the context is changed.

In the second section of the paper the basic aspectual adverbials in (1) are analyzed, whereas the third section accounts for the more complex aspectual adverbials in (2)–(3). Both sections have a parallel internal structure. First of all, in order to model the presupposed polarity transitions of the aspectual adverbs we present a DRT account based on the various components of their meaning. Secondly, this account is used to characterize valid static temporal reasoning, i.e., inferences which concern one and the same reference time. Thirdly, valid dynamic temporal reasoning across different reference times, illustrated in (4), is explained in terms of operations on the richer DRSs, which preserve information about the speaker's attitudes and presuppositions, but revise the factual information.
2. THE BASIC ASPECTUAL ADVERBS

2.1. The DRT Analysis

Starting point of our analysis is the basic distinction between factual positive polarity in (5a) and negative polarity in (5b), represented in the discourse representation structure – or DRS\(^6\) – in (6a) and (6b) respectively.

(5)a. When Mary arrived, John was asleep.
   b. When Mary arrived, John was not asleep.

(6)a. \[
\begin{array}{|c|c|c|}
\hline
\text{arrive (e}_1, m) & r_0 < \text{now} & r_0 \supseteq e_1 \\
\text{sleep (e}_2, j) & e_2 \supseteq r_0 \\
\hline
\end{array}
\]

In (6a) the telic event of Mary’s arrival declares a new event reference marker \(e_1\) into the universe of the DRS (i.e., the top part of the box), which serves as a Davidsonian event argument in the predicate structure of the arrive-condition in the lower part of the box. The atelic event of John’s sleeping similarly introduces a new event reference marker \(e_2\) into the DRS, which serves as argument in the sleep-condition.\(^7\) The telic arriving and atelic sleeping, which both precede the speech time (‘now’) as their corresponding clauses are past tense, are anchored to the reference time \(r_0\). Telic events are always included in the reference time, but atelic events and states include it. Accordingly, \(r_0\) includes Mary’s arrival and is included in John’s sleeping.

The only condition affected by the factual polarity reversal in (5b) is the sleeping of John, which is now negative. This is represented in the DRS in (6b) by negating the nuclear condition, which is true in a model when the corresponding relation does not hold between the referents of its arguments.

(6)b. \[
\begin{array}{|c|c|c|}
\hline
\text{arrive (e}_1, m) & r_0 < \text{now} & r_0 \supseteq e_1 \\
\text{~sleep (e}_2, j) & e_2 \supseteq r_0 \\
\hline
\end{array}
\]

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\(^6\) van Eijck and Kamp (1997) presents a concise introduction to the concepts and use of reference markers or discourse referents in Discourse Representation Theory (DRT).

\(^7\) The event of John’s sleeping could also be considered a state, but for the present purposes it is simply treated as eventive. The individual constants ‘j’ and ‘m’ in the universe of the DRS is shorthand for the standard approach to proper names in terms of external anchors \(u_j\) and identity conditions \(u_j = b\) (van Eijck and Kamp 1997, p. 191/220).
Factual polarity reversal obviously plays a central role in the four basic aspectual adverbs in (1), here repeated in (7), again assuming an implicit reference time of Mary’s arrival.

(7)a. John was not yet asleep.
   b. John was already asleep.
   c. John was still asleep.
   d. John was not asleep anymore.

With already in (7b) and still in (7c) the factual polarity is positive, i.e., the reference time is located inside the sleeping-event. With not yet in (7a) and not anymore in (7d) the factual polarity of this sleeping event is negative, i.e., the reference time is located before or after the sleeping-event, respectively.

For not yet in (7a) and already in (7b) John’s falling asleep is respectively anticipated or realized. In the preliminary DRS in (8a), to be refined later, this polarity transition from negative to positive is represented by means of an END operator applied to the negative phase and in (8b) by means of a START operator applied to the positive phase. In (8a) END takes the event e 2 of John’s not sleeping as its argument and returns the punctual subevent corresponding to its termination. The reference time r 1 which includes this telic event is preceded by the current reference time r 0 of Mary’s arrival, in the case of not yet of (8a). In (8b) START takes the event e 2 of John’s sleeping as its argument and returns the punctual subevent corresponding to its onset. It is included in the reference time r 1, which precedes the current reference time r 0 of Mary’s arrival for already in (8b). Of course, ending a waking phase is tantamount to starting a sleeping phase, so both not yet and already concern the same 0/1 transition of the relevant action.

(8)a. When Mary arrived, John was not yet asleep.

| e 1, e 2, r 0, r 1, m, j, now │
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>arrive (e 1, m)    │ r 0 &lt; now</td>
<td></td>
</tr>
<tr>
<td>~sleep (e 2, j)    │ e 2 ⊇ r 0</td>
<td></td>
</tr>
<tr>
<td>r 1 ⊇ END(~sleep(e 2, j)) │</td>
<td></td>
</tr>
<tr>
<td>r 0 &lt; r 1         │ r 1 &lt; now</td>
<td></td>
</tr>
</tbody>
</table>
| UNTIL (r 1, ~sleep(e 2, j)) ⊇ r 0 │
In (8) John’s falling asleep is either future with respect to Mary’s arrival, i.e., \( r_0 < r_1 \) as in (8a), or past, i.e., \( r_1 < r_0 \) as in (8b). This amounts to a simplified Priorean representation of the future versus past, which fails to capture their essential asymmetry in a branching conception of time. Only past events are realized, and hence their polarity transition is publicly available and located in the common ground as in (8b). The SINCE-clause ensures that John’s falling asleep actually started the current phase of his sleeping, instead of some arbitrary earlier one.\(^8\) Future events are better considered modal, as ways in which the speaker may envisage the current state to continue, hence quantifying universally over its possible continuations, restricted to ones the speaker envisages at the current reference time. To capture this asymmetry between the realized factual past and the envisaged modal future, we propose to analyze the aspectual adverbs involving future polarity transitions as requiring a strong three place modal operator \( \text{CON} \), which takes the speaker \( sp \) as first argument, the current reference time \( r_0 \) as second argument and a DRS as third argument. \( \text{CON} \) quantifies over all continuations of the current reference time envisaged by the speaker, which for \text{not yet sleeping} must end in John’s sleeping. To ensure that any speaker envisaged endpoint is actually ending the current phase of John’s not-sleeping, rather than some arbitrary future phase of John being awake, the UNTIL clause requires that John remains awake/not-asleep up to this END transition. This is represented explicitly in (8c), which replaces (8a).

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\(^8\) Cf. Löbner (1999, p. 59) obtaining this binding by his notion of “admissible interval”.

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<table>
<thead>
<tr>
<th>( e_1, e_2, r_0, r_1, m, j, \text{now} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>arrive ( (e_1, m) ) ( r_0 &lt; \text{now} ) ( r_0 \supseteq e_1 )</td>
</tr>
<tr>
<td>sleep ( (e_2, j) ) ( e_2 \supseteq r_0 )</td>
</tr>
<tr>
<td>( r_1 \supseteq \text{START}(\text{sleep}(e_2, j)) )</td>
</tr>
<tr>
<td>( r_1 &lt; r_0 ) ( r_1 &lt; \text{now} )</td>
</tr>
<tr>
<td>SINCE ( (r_1, \text{sleep}(e_2, j)) \supseteq r_0 )</td>
</tr>
</tbody>
</table>
When Mary arrived, John was not yet asleep.

\[
\begin{array}{c|c|c}
\text{e}_1, \text{e}_2, \text{r}_0, \text{m}, \text{j, now, sp} & \text{arrive (e}_1, \text{m}) & \text{r}_0 < \text{now} \\
& \sim \text{sleep (e}_2, \text{j}) & \text{e}_2 \supseteq \text{r}_0 \\
\hline
\text{CON (sp, r}_0, & \text{r}_1 \supseteq \text{END(\sim \text{sleep (e}_2, \text{j})}) \\
& \text{r}_0 < \text{r}_1 & \text{UNTIL(r}_1, (\sim \text{sleep(e}_2, \text{j}))) \supseteq \text{r}_0
\end{array}
\]

The difference between (8a) and (8c) not only concerns the use of the CON operator, quantifying over all continuations, but also the reference marker \(r_1\) anchoring the endpoint of John being awake. The latter was introduced in the top DRS in (8a), but is subordinate to CON in (8c). Only reference markers belonging to the main DRS universe get an existential interpretation.\(^9\) The semantics of CON, specified in the appendix, ensures that the reference markers declared in its DRS, as its third argument, are universally quantified. For the prosodically marked aspectual adverbs \textit{STILL (not)} that also involve a future transition the DRSs embedded under CON must be more complex, inducing universal/existential structure, as explained below.

The speaker is of course part of the immediately available situation of use, hence the corresponding reference marker sp is declared in the domain of the main DRS in (8c).

A similar difference arises between \textit{still} in (9a), which looks forward to all possible continuations of the current reference time ending in John’s waking up and \textit{not anymore} in (9b) where such an event has actually occurred. Therefore, the \(r_1\) in (9a) again belongs to the universe of the DRS subordinate to CON, whereas in (9b) it gets interpreted existentially as a member of the main DRS universe:

\(^9\) This is a consequence of the semantics: a DRS is true in a model if it is possible to assign referents to the reference markers in the DRS universe which satisfy its conditions in the model (van Eijck and Kamp 1997, p. 186).
An important difference between (8a–b) and (9a–b) concerns the nature of the polarity transition involved: John’s waking up is a transition from positive being asleep to negative not being asleep or being awake. This terminative transition is represented in (9a) by means of the END operator, which yields the terminal subevent of John’s sleeping, located after the reference time of Mary’s arrival. For (9b) the transition is past and hence realized, which is represented by START of John’s not sleeping anchored on \( r_1 \), publicly accessible in the top DRS, but located before the reference time of Mary’s arrival with not anymore.

2.2. Combinatorial Constraints

The four DRSs in (8)–(9) differ along three dimensions, referred to as polarity dimensions, since they relate to negation or more generally to an opposition between positive and negative values. In mapping these three dimensions into their combinatorial space, it is obvious that not all logical possibilities are realized. The constraints on the lexicalizations turn out to be attributable to presuppositions, as explained below. The basic
opposition in (10) concerns the actual polarity of the condition involving John’s sleeping.

(10) polarity dimension A = Actual Polarity

| A = 1 | positive polarity | sleep (e, j) |
| A = 0 | negative polarity | ∼sleep (e, j) |

With already in (8b) and still in (9a) this A dimension is positive, since the reference time is located inside a positive sleeping-event. This is not the case for not yet in (8a) and not anymore in (9b), which have a negative A dimension. The second polarity dimension B is encoded in the two aspectual operators involving opposite polarity transitions of the event. The START operator, which is monotone increasing since, once you have started a subevent e₁ of e, and if e₁ is a temporal part of e₂, you must have started e₂, corresponds to a positive B-value in (11). The END operator, which is decreasing since ending any subevent e₁ of e, where e₂ is a temporal part of e₁, requires that e₂ is ended, yields a negative B-value.

(11) polarity dimension B = Presupposition

| B = 1 | transition from negative to positive polarity |
| END(∼sleep (e, j)) = START(sleep (e,j)) |
| B = 0 | transition from positive to negative polarity |
| END(sleep (e, j)) = START(∼sleep (e,j)) |

B is positive for not yet in (8a) and already in (8b), but negative for still in (9a) and not anymore in (9b). Although the literature basically agrees in considering the difference between the former two expressions and the latter two as a difference in presuppositions, there is far less unanimity as to the precise nature of these presuppositions. Two strategies can be distinguished, namely an ADDITIVE and a SEQUENTIAL strategy. The additive strategy relates the presupposition to the polarity of the state immediately preceding the temporal reference point: not yet and already both presuppose a negative preceding state, whereas still and not anymore both presuppose a positive preceding state. On the sequential strategy the presupposition reflects the two ways in which two states of opposite polarity can be ordered into a linear sequence: not yet and already both presuppose a negative-to-positive sequence, whereas still and not anymore
both presuppose a positive-to-negative sequence.\footnote{Both the seminal analysis of Doherty (1973, pp. 154–155) in terms of “series” and the duality approach of Löbner (1999, pp. 53–54/59) in terms of “admissible intervals” adopt a rich notion of presupposition which combines the additive and the sequential strategies. The additive strategy is predominant with van der Auwera (1993, p. 624/626; 1998, p. 42) and König (1977, pp. 192–193), the latter relegating the sequential view to the domain of generalized conversational implicature. Mittwoch’s analysis (1993, p. 76) could be called semi-additive – in that not yet and already are not taken to presuppose a negative preceding state, but still and no longer do both presuppose a positive preceding state – while Michaelis’ analysis of already (1996, p. 485) could be called non-additive. Vandeweghe’s notion of presupposition, by contrast, is predominantly sequential (1992, pp. 93–95).} The notion of presupposition adopted in (11) is basically sequential, but more dynamic than other sequential approaches in focusing on the polarity transition. Furthermore, the well-known problem of incompatibility between already and predicates such as young (excluding anterior opposite states), or between still and predicates such as old (excluding posterior opposite states), can straightforwardly be accounted for in terms of selection restrictions on the event argument of the START and END operators.\footnote{See Doherty (1973, p. 155), who talks about ‘initial states’ versus ‘final states’, or Löbner (1989, pp. 181–182; 1999, p. 51), who refers to ‘irreversible states’. Combinations such as German schon immer (König, 1977, p. 182) or its Dutch counterpart altijd al (‘always already’) as well as Mittwoch’s famous naturalization example – He is already American, for he was born there – discussed in Löbner (1989, p. 183), van der Auwera (1993, p. 622), Mittwoch (1993, p. 74) and Michaelis (1996, p. 481) demonstrate that this notion of irreversibility need not be lexically determined, but may also be induced by the context.}

The linear ordering between these polarity transitions and the reference time constitutes the third polarity dimension of perspective in (12), where $r_1$ is a reference marker anchoring the aspectual operators START and END. With the positive conditions, this C-dimension is retrospective – i.e., looking back upon a realized transition in the past with the START and SINCE operators. With the complex CON conditions the C-dimension is prospective – i.e., looking forward to possible transitions in the future with the END and UNTIL operators:

\[
\text{polarity dimension } C = \text{ PERSPECTIVITY}
\]

\[
\begin{align*}
C = 1 & \quad \text{retrospective} & r_1 < r_0 \\
C = 0 & \quad \text{prospective} & \text{CON (sp, } r_0, \begin{array}{c} r_1 \\ r_0 < r_1 \end{array} )
\end{align*}
\]

The retrospective adverbs already in (8b) and not anymore in (9b) get a positive C-polarity. The prospective ones not yet in (8a) and still in (9a), in contrast, get a negative C-polarity. The monotonicity properties of START
and END, discussed above, assure their proper interaction with this C-dimension. These different polarity assignments are summarized in the 3D polarity system in (13).

\[(13)\]

<table>
<thead>
<tr>
<th>THREE-DIMENSIONAL POLARITY SYSTEM</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>(6a) John is asleep</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(6b) John is not asleep</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(8a) John is not yet asleep</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>(8b) John is already asleep</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>(9a) John is still asleep</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(9b) John is not asleep anymore</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

One advantage of this 3D calculus is its independence of the syntactic categories in which aspectual information is expressed, which may vary considerably across different languages, as we have observed for English and Dutch, otherwise so closely related. The composition of the paraphrases of not yet asleep as will start sleeping, or that of not asleep anymore as having ended sleeping is straightforwardly associated with these three polarity dimensions, as in (14a, b):

\[(14)\]

(a) not yet P \hspace{1cm} b. not P anymore

| will \hspace{1cm} start P \hspace{1cm} not P now | (C = 0) \hspace{1cm} (B = 1) \hspace{1cm} (A = 0) | have \hspace{1cm} ended P \hspace{1cm} not P now | (C = 1) \hspace{1cm} (B = 0) \hspace{1cm} (A = 0) |

An important observation in connection with the polarity system in (13) is that, although the interaction of three binary parameters yields a complete space of eight logical possibilities \((2^3)\), only four of them are actually realized. Since the three ABC dimensions are not logically independent, the assignment of a value to one parameter imposes constraints on the assignment of values to the others. For instance, the combination of prospective and a START-presupposition constrains the combination with the A-polarity: e.g., in order to start P \((B = 1)\) in the near future \((C = 0)\) you must not now be engaged in it \((A = 0)\). Referring to the polarity combina-
tions 11 and 00 as CONVERGENT, and to 10 and 01 as DIVERGENT, these constraints can be formulated as the equivalences in (15):

\[(15)a. \ (AB \ are \ convergent) \iff (C = 1)\]
\[b. \ (AC \ are \ convergent) \iff (B = 1)\]
\[c. \ (BC \ are \ convergent) \iff (A = 1)\]

These equivalences reveal a certain redundancy in the 3D polarity system of (13), as two binary parameters would suffice to distinguish four expressions.\(^{12}\) However, explicitly representing the three dimensions is essential to show all combinatorial possibilities of family resemblances (van der Auwera 1998, p. 42). It provides a logical foundation for predicting their value: given the polarity of any combination of two parameters, the value of the third parameter is predicted. With the more complex adverbials in Section 3 the C-parameter will turn out to be pivotal in our analysis in order to capture the essential situatedness of temporal reasoning.\(^{13}\)

2.3. Static Temporal Reasoning

Representing the meaning of aspectual adverbials in DRT allows a straightforward and intuitively appealing account of temporal inferences. Some simple static inferences, concerning one and the same information state,

\(^{12}\) Similar observations are made by Löbner (1990, pp. 134–135), Vandeweghe (1992, p. 101) and van der Auwera (1998, p. 42). Löbner relates the values assigned to the three parameters to the concept of markedness, with − standing for unmarked and + for marked. The result is a systematic reversal of the value assignments: our positive polarity (1) corresponds to his unmarked case (−), whereas our negative polarity (0) corresponds to his marked case (+).

\(^{13}\) Vandeweghe (1992, p. 100ff) assigns a similar weight to the perspective parameter C. Löbner (1990, pp. 134–135) takes a different view: the contrast between retrospective and prospective does not readily fit his markedness-perspective and is hence discarded altogether. In Löbner (1999) the difference between retrospective already and not anymore on the one hand, and prospective not yet and still on the other hand, is formulated both in terms of “relatively advanced” versus “relatively delayed” states of affairs (p. 69) and in terms of conversational implicatures of “recent change” as opposed to “imminent change” (p. 60/76). However, the prospective-retrospective opposition as such does not play an explanatory role in his duality analysis, as his account concerns primarily truth-conditional semantics and not the dynamic inferences we are interested in. Nevertheless, we basically subscribe to the importance of duality relations and to Löbner’s view that “the truth conditions of a natural language sentence are not fully understood as long as it is not assessed what the propositional negation of the sentence is. (...) Since in most cases they [i.e., the particles] cannot be negated by the standard means of adding not to the sentence in the appropriate position, the question is not trivial here” (Löbner 1999, p. 105).
are given in (16), where the aspecual adverb is eliminated for a simple polarity to remain in the conclusion.

(16)a. When Mary arrived, John was not yet asleep  
    $\models$  When Mary arrived, John was not asleep
b. When Mary arrived, John was already asleep  
    $\models$  When Mary arrived, John was asleep
c. When Mary arrived, John was still asleep  
    $\models$  When Mary arrived, John was asleep
d. When Mary arrived, John was no longer asleep  
    $\models$  When Mary arrived, John was not asleep

All the static inferences in (16) are just simple cases of conjunction reduction, as the elementary condition of sleeping or being awake holds at the current reference time. In terms of the 3D polarity system of (13) – merely shorthand for the explicit DRS conditions – the validity of the inferences in (16) obviously depends on preserving the A-polarity.\footnote{The rule involved could be called Aspectual Adverb Elimination. In this connection, König (1977, p. 181) refers to the aspecual adverbs as being “implicative”.

15 This relation is crucial in the duality-framework of Löbner (1989, 1990, 1999). Objections to his position that al (already) and nog (still) are duals, like the existential and universal quantifiers of predicate logic, have been raised by van der Auwera (1993), Mittwoch (1993), De Mey (1994) and Smessaert (1997).}

A second type of static temporal reasoning is based on the observation that the Dutch adverbs nog and nog niet, unlike their English counterparts still and not yet, are clearly formally related by negation, variously referred to as the INTERNAL or SUBNEGATION of the aspecual adverb.\footnote{This relation is crucial in the duality-framework of Löbner (1989, 1990, 1999).} In both languages, however, the substitution of one adverb by its subnegation can be neutralized if the lexical verbal predicate, e.g., slapen/be asleep in (16), is simultaneously substituted by its polar antonym wakker zijn/be awake, yielding not just a unidirectional entailment, but an equivalence relation as in (17) (Doherty 1973, p. 156; König 1977, p. 193; Löbner 1999, p. 56):

(17)a. When Mary arrived, John was not yet asleep  
    $\iff$  When Mary arrived, John was still awake
b. When Mary arrived, John was not yet awake  
    $\iff$  When Mary arrived, John was still asleep
Compare the DRS for *not yet asleep* in (8c) – repeated below as (18a) – which represents the left-hand side of the equivalence in (17a) with that of *still awake* in (18b), representing the right-hand side of (17a):

(18)a. ‘*not yet asleep*’

\[
\begin{array}{c|c|c}
\text{e}_1, \text{e}_2, \text{r}_0, \text{m}, \text{j}, \text{now, sp} & \text{r}_0 \geq \text{e}_1 & \text{e}_2 \geq \text{r}_0 \\
\hline
\text{arrive} (\text{e}_1, \text{m}) & \text{r}_0 < \text{now} & \hline \\
\sim \text{sleep} (\text{e}_2, \text{j}) & \hline \\
\hline
\text{CON} (\text{sp, r}_0, \text{r}_1) & \hline \\
\text{r}_1 \geq \text{END} (\sim \text{sleep} (\text{e}_2, \text{j})) & \text{r}_0 < \text{r}_1 \\
\text{UNTIL} (\text{r}_1, (\sim \text{sleep} (\text{e}_2, \text{j}))) \geq \text{r}_0 \\
\end{array}
\]

b. ‘*still awake*’

\[
\begin{array}{c|c|c}
\text{e}_1, \text{e}_2, \text{r}_0, \text{m}, \text{j}, \text{now, sp} & \text{r}_0 \geq \text{e}_1 & \text{e}_2 \geq \text{r}_0 \\
\hline
\text{arrive} (\text{e}_1, \text{m}) & \text{r}_0 < \text{now} & \hline \\
\text{awake} (\text{e}_2, \text{j}) & \hline \\
\hline
\text{CON} (\text{sp, r}_0, \text{r}_1) & \hline \\
\text{r}_1 \geq \text{END} (\text{awake} (\text{e}_2, \text{j})) & \text{r}_0 < \text{r}_1 \\
\text{UNTIL} (\text{r}_1, (\text{awake} (\text{e}_2, \text{j}))) \geq \text{r}_0 \\
\end{array}
\]

First of all, any actual event \( e_2 \) satisfying the negative \( \sim \text{sleep}(e_2, j) \) condition of (18a) automatically satisfies the corresponding positive \( \text{awake}(e_2, j) \) condition of (18b) and vice versa. Secondly, any hypothetical event qualifying as the END of the \( \sim \text{sleep}(e_2, j) \) in the embedded DRS in (18a) simultaneously qualifies as the END of the \( \text{awake}(e_2, j) \) in the embedded DRS in (18b) and the other way around. This is due to the fact that the anticipated polarity transition in (17a), i.e., the punctual event of John’s falling asleep, allows two perfectly equivalent representations, namely as ‘end not-sleeping’ in (18a) or as ‘end being awake’ in (18b). Conversely, the equivalence in (17b) is accounted for by systematically switching \( \text{sleep} \) and \( \text{awake} \) in the DRS conditions of (18a) and (18b): the possible event of John’s waking up thus is simultaneously coreferred to as END sleeping and END being not-awake.

Again reverting to the 3D polarity system, the negative C-value is fixed with *not yet* and *still* in (17) since they are both prospective, while their A- and B-values – i.e., the actual polarity and the presupposition – are
reversed: from 010 for *not yet* to 100 for *still*. This AB polarity reversal associated with the internal negation on the adverbs is neutralized by the substitution of the antonymous verbal predicates, yielding the equivalences in (17).

On the standard view, the relation of internal negation not only holds between *still* and *not yet*, but also between *already* and *not anymore*. Strictly speaking, the equivalences in (19) could be considered the retrospective counterparts of (17):

(19)a. When Mary arrived, John was *already* asleep
   \[\iff\] When Mary arrived, John was *not awake* anymore

b. When Mary arrived, John was *already* awake
   \[\iff\] When Mary arrived, John was *not asleep* anymore

However, the left-to-right implication from *already* to *not anymore* in (19) is more natural than the right-to-left implication from *not anymore* to *already*. As was briefly mentioned in connection with (2)–(3), this may be attributed to the fact that *already* adds a subjective dimension which is absent from *not anymore*. Dropping this additional information in the rightward implication in (19) is fine, but having to add it in the leftward direction is more problematic.\(^{16}\)

2.4. Dynamic Temporal Reasoning

Dynamic temporal reasoning differs from its static form in crucially requiring the update in information states to trigger transitions of the reference time, while preserving consistency in interpreting the premises in their order of presentation. Consider again the intuitively valid dynamic inference in (20), discussed at the beginning of Section 1:

(20)a. When Mary arrived, John was *still* asleep.

b. John woke up.

c. Peter arrived.

d. \(\models\) When Peter arrived, John was *not asleep* anymore.

The general pattern of this dynamic type of reasoning has an aspectual adverb in its first premise describing two events at the first current reference time. The second premise provides the information that a polarity

16 In Section 3 *al/already* is argued to be the internal negation of the more complex adverbial cluster *al niet meer?/already no longer*. As pointed out by Vandeweghe (1992, pp. 104–105), the negative sentences with the simpler *niet meer/not anymore* are equivalent to positive sentences with the antonymous predicate but without *al/already*. 
transition took place at a second, later reference time, reset to be the current one. The current reference time is reset a second time in interpreting the third premise. The conclusion then contains a different aspectual adverb, describing the resulting relation between the events. In order to account for the validity of (20) we need to distinguish information which is modified from one time to the next from information which remains stable through updates. Starting point is the DRS for (20a), which was given in (9a) and is repeated below as (21a). This DRS provides the context in which the second premise in (20b) is interpreted, yielding the intermediate (and preliminary) DRS in (21b):

(21)a. When Mary arrived, John was still asleep

\[
\begin{array}{|c|c|c|}
\hline
\text{Arrive (e1, m)} & r_0 < \text{now} & \text{r}_0 \supseteq \text{e}_1 \\
\text{Sleep (e2, j)} & \ & \text{e}_2 \supseteq \text{r}_0 \\
\hline
\text{CON (sp, r0, r1)} & \text{r}_1 \supseteq \text{END (sleep (e2, j))} & \text{r}_0 < \text{r}_1 \supseteq \text{UNTIL (r1, (sleep(e2, j)) \supseteq \text{r}_0} \\
\hline
\end{array}
\]

b. 

\[
\begin{array}{|c|c|c|}
\hline
\text{Arrive (e1, m)} & r_0 < \text{now} & \text{r}_0 \supseteq \text{e}_1 \\
\text{Sleep (e2, j)} & \ & \text{e}_2 \supseteq \text{r}_0 \\
\hline
\text{CON (sp, r0, r1)} & \text{r}_1 \supseteq \text{END (sleep (e2, j))} & \text{r}_0 < \text{r}_1 \supseteq \text{UNTIL (r1, (sleep(e2, j)) \supseteq \text{r}_0} \\
\hline
\text{r}_2 \supseteq \text{END (sleep (e2, j))} & \text{r}_0 < \text{r}_2 & \text{r}_2 = \text{current} \\
\text{r}_2 < \text{now} & \ & \text{r}_2 < \text{now} \\
\hline
\end{array}
\]

The interpretation of (20b) introduces a new reference time r2 into the universe of the main DRS in (21b) together with the condition that it includes the end of John’s sleeping (van Eijck and Kamp 1997, p. 228). More importantly, (20b) resets the current reference time from the given r0 to a new one, r2. This resetting is realized in two steps in (21b): as we just remarked, the reference time r2 is first set to include John’s waking up, and
secondly it is temporally located after the time of Mary’s arrival, which was
the previous current reference time, thus reflecting the progression forward
along the linear time axis. Now the reference time r₁, the one the presup-
position of still introduced in the scope of CON, may be identified with
r₂, representing the update of the speakers’ view that John actually woke
up, as she had envisaged. This identification of reference times declared
in domains of different DRSs, representing public and private information,
constitutes an operation on DRSs which may be considered a simple form
of belief revision. Such connections between DRT and theories of belief
revision, however fruitful they might be, will not be pursued any further in
this paper.

Adding the content of the third premise to the DRS (21b), results in
another resetting of the current reference time to r₃, after r₂, but still in the
past of the speech time.

\[
\begin{array}{c|ccc}
 & e₁, e₂, e₃, r₀, r₂, r₃, m, j, p, now, sp & \\
arrive (e₁, m) & r₀ < now & r₀ ≥ e₁ & \\
sleep (e₂, j) & e₂ ≥ r₀ & \\
\hline
\text{CON (sp, r₀,} & \\
\hline
r₁ & r₁ ≥ END(sleep (e₂, j)) & r₀ < r₁ & UNTIL(r₁, (sleep(e₂, j))) ≥ r₀ & \\
\hline
r₂ ≥ END(sleep (e₂, j)) & r₀ < r₂ & r₂ < now & \\
arrive (e₃, p) & r₃ < now & r₃ ≥ e₃ & \\
r₃ = current & r₂ < r₃ & \\
\end{array}
\]

In (21c) the e₃ reference marker incorporates the past event of Peter’s ar-
riaval into the context. The resetting of the reference time is again captured
in terms of two conditions: first r₃ is set to include Peter’s arrival and then
it is located after the given reference time r₂ which includes John’s waking
up.

Finally, drawing the conclusion in (20d) boils down to the construc-
tion of the DRS of (21d), using only the available reference markers and
logical operations on the given conditions. It only expands the DRS in
(21c) by the interpretation of not anymore, the logical identification of

\[\]
the end of John’s sleeping with his starting to be awake, and verification that John remained awake since, including the time Peter arrived, which happens to be the current reference time. These conditions correspond to the DRS for not anymore in (9b), so the conclusion in (21d) does not add any genuinely new information, nor requires any new reference markers to be declared. The validity of inference patterns depends on whether every situation satisfying the DRS for the premises necessarily satisfies the DRS for the conclusion as well. The identification of starting a negative phase with ending a positive one is the only one tense logical operation on DRSs needed to support such forms of temporal reasoning with simple aspectual adverbs.

\[
\text{(21d). } \begin{array}{|c|c|c|c|}
\hline
& e_1, e_2, e_3, r_0, r_2, r_3, m, j, p, \text{ now, sp} \\
\hline
\text{arrive (} e_1, m \text{)} & r_0 < \text{now} & r_0 \supseteq e_1 \\
\text{sleep (} e_2, j \text{)} & e_2 \supseteq r_0 \\
\hline
\text{CON (sp, } r_0, \\
\text{ } r_1 \\
\text{ )} & r_1 \supseteq \text{END(sleep (} e_2, j \text{))} \\
\text{} & r_0 < r_1 \\
\text{UNTIL(r}_1, (\text{sleep}(e_2, j))) \supseteq r_0 \\
\hline
\text{r}_2 \supseteq \text{END(sleep (} e_2, j \text{))} & r_0 < r_2 & r_2 < \text{now} \\
\text{arrive (} e_3, p \text{)} & r_3 < \text{now} & r_3 \supseteq e_3 \\
\text{r}_3 = \text{current} & r_2 < r_3 \\
\text{END(sleep}(e_2, j)) = \text{START(} \neg \text{sleep}(e_2, j) \text{))} &  \\
\text{SINCE(r}_2, (\neg \text{sleep}(e_2, j))) \supseteq r_3 \\
\hline
\end{array}
\]

This form of temporal reasoning may also be accounted for in terms of the 3D polarity calculus, clarifying which parameters reverse their polarity from still in (20a)–(21a) to not anymore in (20d)–(21d). The second premise in (20b), introducing an actual polarity transition, obviously switches C from 0 (prospective) to 1 (retrospective), modelling the passage of time by relegating what was once considered future to the past. The constraints in (15) predict that as soon as the value for one parameter is reversed, the value of one (and only one) of the other two parameters must be reversed as well, if the inference is to be valid. In this case, the reversal of the dynamic C-parameter causes the reversal of the A-parameter for the actual polarity from positive to negative. The value of the presuppositional B-parameter, however, must be kept constant, as factual changes in the world should not affect presuppositions. The temporal inference in (20),
whose validity relies on reversing the A- and C-values, while preserving the B-value, is schematically represented in (22):

\[
\begin{array}{ccc}
 & A & B & C \\
(22)a. & still asleep & 1 & 0 & 0 \\
b. & wake up & 0/1 \\
c. & not asleep anymore & 0 & 0 & 1 \\
\end{array}
\]

Assuming a shifting of reference times from Mary’s to Peter’s arrival, similar to that in (20), the examples in (23) illustrate the other two logical possibilities of changing two values, while preserving the third in temporal reasoning, both yielding invalid patterns that do not preserve the presupposition in B:

\[
\begin{array}{ccc}
 & A & B & C \\
(23)a. & John was not yet asleep & 0 & 1 & 0 \\
b. & John fell asleep & 0/1 \\
c. & \neg John was still asleep & 1 & 0 & 0 \\
d. & \neg John was not asleep anymore & 0 & 0 & 1 \\
\end{array}
\]

Although in (23c) the A-value of the factual polarity is reversed with still, the prospective negative C-value is not changed accordingly. Instead, the presuppositional B-transition of starting is replaced by that of ending, as if jumping forward too far inside the event, creating an invalid inference. An even bigger leap forward occurs in (23d): although the C-value is switched to the retrospective positive one, the actual polarity in A is not, while the B-parameter is switched from starting to ending. As a consequence, two polarity transitions are packaged into one step, resulting in an invalid inference. The other valid inferences based on the two premises in (23a–b) are given in (24).

\[
\begin{array}{ccc}
 & A & B & C \\
(24)a. & John was not yet asleep & 0 & 1 & 0 \\
b. & John fell asleep & 0/1 \\
c. & \models John was already asleep & 1 & 1 & 1 \\
d. & \models John was not awake anymore & 0 & 0 & 1 \\
\end{array}
\]

Strictly speaking the inference in (24c) runs perfectly parallel to that in (20)–(22): A and C are reversed, whereas B remains constant. However, the question mark with already reveals that the situation may not be quite
as symmetric as suggested. As discussed in connection with static temporal reasoning, more in particular with the equivalences in (19), the subjective evaluation of fast and easy progress associated with already (dealt with in detail in the next section) seems to interfere. This is not the case in (24d), where the dynamic reversal of the AC-values from (24a) to (24c) is followed by the static START P = START \sim(\sim P) reversal of the AB-values, while substituting the antonymous verbal predicate. In other words, in going from not yet P in (24a) to not \sim P anymore in (24d), switching the BC-values and substituting the antonym yields a perfectly valid dynamic inference, as the subjective information plays no role in it. However, when more sensitive notions of topic continuity or coherence are taken into account, it matters whether the glass is half full or half empty. In capturing coherence of context, this BC reversal with antonym substitution may no longer be considered an acceptable inference.

3. ATTITUDES IN ASPECTUAL ADVERBS

3.1. Speaker and Common Ground Information in DRT

The basic analysis presented in Section 2 would assign the adverbs not yet and still not in (25) an identical DRS, just as the two adverbs not anymore and no longer in (26).

(25)a. John was not yet asleep.
    b. John was still not asleep.

(26)a. Jan was not asleep anymore.
    b. Jan was no longer asleep.

Unlike the adverbs not yet in (25a), and not anymore in (26a), still not in (25b) and no longer in (26b) may carry marked high pitch stress intonation in English, indicative of the speaker’s counterfactual attitudes toward the continuation or past of the current course of event. The exact phonetic and phonological features of such intonational contours need to be characterized in other studies. For our present purposes it suffices to indicate the high pitch prosody with capitals. Informally, anyone capable of using such prosody effectively, intends to communicate his frustration about the slow speed of what is happening with STILL not, while no LONGER may be used to express the speaker’s relief at the fast and easy progress. Although Dutch nog niet also has a prosodically marked counterpart NOG niet, Dutch often expresses such additional speaker information in aspectual
adverbs compositionally. The Dutch nog altijd niet ('still always not') or its virtual synonym nog steeds niet correspond to the English STILL not, whereas al niet meer ('already not anymore') best translates no LONGER.

Of course, speakers always have the option to describe their own epistemic attitudes in full clauses, for instance, stating that they anticipate that John, who is now asleep, will wake up, but should have been awake by now in their own eyes. Obviously, this mix of factual information in the common ground related to speaker’s epistemic attitudes or subjective timing is much more effectively expressed in aspectual adverbs with marked prosody.

Although these differences have not gone unnoticed in the existing literature, at least two types of problems seem to arise with the available analyses. First of all, the differences between the basic adverbs and the ones with attitude information are often either underestimated or overestimated. Secondly, the fundamental parallel in (25) and (26) in terms of the subjective, private information of the speaker regarding the progress is in general not reflected in the analysis. In van der Auwera (1993, pp. 628–629; 1998, pp. 43–45) no LONGER/al niet meer has an extra condition of contiguity to the point of change, which is lacking in not anymore/niet meer. Nevertheless, the former is basically considered as an “emphatic use” of the latter, i.e., as an alternative that either modifies or at least stylistically emphasizes the meaning, thus giving it “an inchoative nuance” (1998, pp. 82–83). Similarly, the composition in Dutch of altijd ('always') with nog ('still') merely serves as a modification, which stresses the continuation (1998, p. 85). In sum, although van der Auwera treats the differences in (25) and (26) on a par, they are not considered to be semantically fundamental. Löbner and Mittwoch take the opposite view by assigning different presuppositions to (the German counterparts of) not yet and STILL not in (25a–b). By referring to the negative state preceding the temporal reference point, both analyses invoke the so-called additive strategy for presuppositions, discussed in connection with (11) above, but they do so in different ways. For Mittwoch (1993, pp. 76–77) not yet does not presuppose a preceding negative state, whereas STILL not does. In Löbner’s account, by contrast, both adverbs share this presupposition, but in the case of STILL not the preceding negative state is furthermore characterized as having started long before the temporal reference point (1999, pp. 82–83), whereas no such temporal distance is involved in not yet (1999, pp. 53–54). The Löbner/Mittwoch approach not only differs from that of van der Auwera in assigning manifestly different semantic representations

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18 Still these so-called ‘emphatic uses’, which do not really get an independent semantic representation, play an important role in van der Auwera’s typological definition of ‘degree of Standard Average European’ (1998, pp. 82–90).
to the basic adverb in (25a) as opposed to the more complex one in (25b), but also in assigning an unequal status to the contrasts in (25) and (26). Mittwoch (1993) does not handle expressions such as *no LONGER/al niet meer* in (26b) explicitly, whereas Löbner treats it as logically equivalent to *not anymore* in (26a), but differing pragmatically by combining the so-called pragmatic narrowing of its two components, namely *al/already* and *niet meer/not anymore* (1999, p. 77).

The analysis we propose in this paper for the adverbs with speaker’s attitude information takes an intermediate position in between van der Auwera’s (somewhat underestimating) ‘emphatic uses’ approach and Löbner’s (somewhat overestimating) presuppositional approach and furthermore captures the fundamental similarity between the oppositions in (25) and (26) in the DRS representations. Our account moreover straightforwardly generalizes to the adverb *finally/eindelijk*, which also involves the speaker’s perception of progress.\(^\text{19}\) Consider the six adverbs in (27) with their basic ABC-polarity assignment:\(^\text{20}\)

\[
(27) \quad \text{ABC} \quad \text{ABC}
\]
\[
a. \quad 111 \quad \text{alREADY/al} \quad 001 \quad \text{no LONGER/al niet meer}
\]
\[
b. \quad 111 \quad \text{finally/eindelijk} \quad 001 \quad \text{finally not/eindelijk niet meer}
\]
\[
c. \quad 010 \quad \text{STILL not/ nog altijd niet} \quad 100 \quad \text{STILL/nog altijd}
\]

The prosodically marked *alREADY* in (27a) indicates not only that the onset is past, hence the current phase is positive, just as its prosodically neutral counterpart does, but it adds the information that the speaker expresses an attitude of surprise or relief at the fast and easy progress of the current course of events. It is not always possible to determine precisely which epistemic attitude the speaker intends to convey by the high pitch prosody, as it may depend on the desirability of the action affected. But it is always understood to indicate the positive subjective evaluation of the speed of the current course of events. Analogously, *no LONGER* indicates that the termination is past and hence the current phase is negative, just as its prosodically neutral counterpart *not anymore* does, but it adds the subjective information that the speed of the current course of events is in some way regarded positively. The speaker had counterfactually envisaged the onset or the termination, respectively, to happen later, after the current reference time. Using ALT as operator ranging over the speaker’s alternative or preferred ordering of reference times, this counterfactual location of

\(^{19}\) This is what van der Auwera calls the pre-duality idea that “no account of *already* is complete that does not relate it to the meaning of *finally*” (1993, p. 650).

\(^{20}\) For convenience’s sake, the Dutch prosodic variants *NOG* and *NOG niet* discussed in (3) will not be mentioned explicitly anymore since they convey exactly the same evaluative meaning as the *nog altijd* forms.
the reference time which anchors the transition is captured in the DRS in (28a). It constitutes an expansion of the DRS for *already* in (8b), ensuring again with the SINCE-clause that the right transition of falling asleep is bound to the current state as its onset.

(28)a. When Mary arrived, John was already asleep.

<table>
<thead>
<tr>
<th>e₁, e₂, r₀, r₁, m, j, now</th>
</tr>
</thead>
<tbody>
<tr>
<td>arrive (e₁, m) r₀ &lt; now  r₀ ⊇ e₁</td>
</tr>
<tr>
<td>sleep (e₂, j) e₂ ⊇ r₀</td>
</tr>
<tr>
<td>r₁ ≥ START(sleep(e₂, j))</td>
</tr>
<tr>
<td>r₁ &lt; r₀ r₁ &lt; now</td>
</tr>
<tr>
<td>SINCE(r₁, (sleep(e₂, j))) ⊇ r₀</td>
</tr>
</tbody>
</table>

ALT (sp, r₀, r₀ < r₁ UNTIL(r₁, (∼sleep(e₂, j))) ⊇ r₀ )

The same DRS structure will account for the negative phase *no longer* adverb, which indicates that the speaker had envisaged the start of the negative phase to have been located after the current reference time, as in (28b), expanding on the DRS for the basic *not anymore* in (9b).

(28)b. When Mary arrived, John was no longer asleep.

<table>
<thead>
<tr>
<th>e₁, e₂, r₀, r₁, m, j, now</th>
</tr>
</thead>
<tbody>
<tr>
<td>arrive (e₁, m) r₀ &lt; now  r₀ ⊇ e₁</td>
</tr>
<tr>
<td>∼sleep (e₂, j) e₂ ⊇ r₀</td>
</tr>
<tr>
<td>r₁ ≥ START(∼sleep(e₂, j))</td>
</tr>
<tr>
<td>r₁ &lt; r₀ r₁ &lt; now</td>
</tr>
<tr>
<td>SINCE(r₁, (∼sleep(e₂, j))) ⊇ r₀</td>
</tr>
</tbody>
</table>

ALT (sp, r₀, r₀ < r₁ UNTIL(r₁, (sleep(e₂, j))) ⊇ r₀ )

The speaker dependent subjective information is captured in this DRT account by contrasting the actual temporal relation between reference times, where r₁ precedes r₀ in the main DRS structure, to the alternative one the speaker had envisaged, where r₁ follows r₀ in the embedded DRS structure. The marked prosody hence indicates a semantic temporal contrast, which qualifies as a case of contrastive stress.
If the basic adverb not yet indicates that the speaker envisions the current negative phase to end, as the DRS in (8c) captured, the speaker exploits the prosodically marked STILL not in (27c) to indicate her frustration at the slow progress in getting to that polarity transition. No matter when this transition is actually reached, the speaker will find it late. In other words, the speaker will regard every envisaged reference time which includes the transition to a positive phase as later than it should have been. Had the world run its course according to her subjective timing, the transition to a positive phase would have been realized already, i.e., it would have preceded the current reference time. High pitch STILL (not) in (27c) also expands the DRS for their corresponding basic adverbs not yet in (8c) and still in (9a) by adding to the subDRS in the scope of CON a subordinate DRS which includes in the scope of ALT the counterfactual temporal relation between the reference times, as in (28c).21

(28c) When Mary arrived, John was STILL (not) asleep.

The remaining adverbs finally/eindelijk and finally neg-P/eindelijk niet meer in (27b) present an intermediate view in evaluating the speed of the current course of events. Finally conveys that there was steady progress towards the past onset, but it was judged to be late anyway. The speaker had envisaged the event to have started earlier than it actually did. With finally neg-P we indicate that the past termination was reached late, even though there was steady progress towards it. The speaker had envisaged the event to have ended earlier than it actually did. A contrast is hence created between a realized past polarity transition and the time the speaker had envisaged it to happen, which in both cases should have been earlier. This interpretation is represented in the DRS in (28d) by declaring a third reference time, r₂, in the domain of the DRS within the scope of ALT, which serves in the comparison to the one anchoring the realized transition

21 Clearly, STILL and STILL not are related by internal negation. To economize on space, the DRS in (28c) represents both, by bracketing the negation symbol. Note that STILL not requires the SINCE clause in the subordinate ALT DRS in the scope of CON to include sleep (e₂, j), whereas STILL requires ~ sleep (e₂, j) there.
in the main DRS, constituting the common ground. DRSs with three declared reference times may be considered measurably more complex than the ones in (28a–c) where only two reference times play a role, even though two intensional operators CON and ALT were used in the conditions. Such issues of cognitive complexity in terms of DRS architecture must be deferred to future, experimental investigations of human information processing with aspectual adverbs.

(28)d. When Mary arrived, John was finally asleep/no longer asleep (i.e., awake).

\[
\begin{array}{|c|c|}
\hline
e_1, e_2, r_0, r_1, m, j, \text{ now} \\
\hline
\text{arrive} (e_1, m) & r_0 < \text{now} \\
\text{∼sleep} (e_2, j) & e_2 \supseteq r_0 \\
\hline
r_1 \supseteq \text{START}((\sim)\text{sleep}(e_2, j)) & e_2 \supseteq r_0 \\
r_1 < r_0 & r_1 < \text{now} \\
\hline
\text{SINCE}(r_1, ((\sim)\text{sleep}(e_2, j))) \supseteq r_0 & r_2 < r_1 \\
\hline
\end{array}
\]

Returning to the simplified polarity calculus presented in Section 2 for the basic aspectual adverbs, we can incorporate the more complex adverbs with attitude information by expanding it from three to five polarity dimensions. Two more logically independent, but interacting polarity dimensions (i.e., binary oppositions) are defined in (29): D representing the subjectively perceived SPEED and E representing the subjectively judged PROGRESS:

(29) polarity dimension D: EVALUATION OF SPEED
D = 1 the speaker evaluates the course of events as fast
D = 0 the speaker evaluates the course of events as slow
polarity dimension E: JUDGEMENT OF PROGRESS
E = 1 the speaker evaluates the course of events as progressing
E = 0 the speaker evaluates the course of events as stalling

At both extremes of the ‘scale of progress’ the two evaluative dimensions converge: with STILL (not) nog altijd (niet) in (27c) what is happening is
perceived as slow and stalling, whereas with no LONGER/al (niet meer) in (27a) the speaker expresses her judgement of fast and steady progress. The intermediate position of finally (neg) P/eindelijk (niet meer) in (27b), by contrast, exhibits an evaluative discrepancy between making progress, but being slow nevertheless. The interaction of polarity properties of the adverbs in (27) is rendered in a 5D system in (30), integrating the 3D account of the basic aspectual adverbs.

(30)

<table>
<thead>
<tr>
<th>FIVE-DIMENSIONAL POLARITY SYSTEM</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>John is asleep</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>John is not asleep</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>John is not yet asleep (Dutch: nog niet)</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>John is already asleep (Dutch: al)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>John is still asleep (Dutch: nog)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>John is not asleep anymore (Dutch: niet meer)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>John is STILL not asleep (Dutch: nog altijd niet)</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>John is finally asleep (Dutch: eindelijk)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>John is already asleep (Dutch: al)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>John is STILL asleep (Dutch: nog altijd)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>John is finally not asleep/wake (Dutch: eindelijk niet meer)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>John is no LONGER asleep (Dutch: al niet meer)</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

It should be noted that D and E concern non-factual, speaker dependent, subjective polarities, in contrast to the ABC dimensions which represent actual ones, although the future, as continuations of the current state, is already considered modal. To illustrate the 5D assignments of 01000 to STILL no/hog altijd niet and 00111 to no LONGER/al niet meer their paraphrases are decomposed in (31a–b):
Notice that the combination of positive D and negative E is absent from (30), as fast stalling is clearly materially, and hence tense logically impossible. This combinatorial constraint can be formulated as the implication in (32):

$$(32) \quad [E = 0] \Rightarrow [D = 0]$$

If there is no progress then there cannot possibly be any speed either, or by contraposition, if there is speed there must be progress. The speaker may judge an event as changing slowly and stalling without indicating its causes or reasons. This is why the subjective D and E dimensions are somewhat indeterminate in their intended interpretation, even though their logical interactions with the ABC polarities, which interest us here, are fully determinate and transparent. Some actions, like reading, require controlled effort from their agents, others, like sleeping, do not. Sometimes external forces may limit the speed of change by interfering with the control of the agent, as in John was STILL not here. In other clauses, referents of arguments with thematic roles other than agents may be considered the cause of slow change or lack of progress, as in John is STILL reading this long novel. Sorting out exactly how the speaker intends to attribute causal forces to interactions is not a task that properly belongs to the semantics of natural language. Complex pragmatic issues interfere and obviously also psychological perceptions of what is happening. Our present concern is restricted to the logical aspects of temporal inference, hence an account of such issues, however interesting, would lead us too far astray.

By design the 5D-polarity system in (30) exhibits a steady increase in subjectivity from A to E. By determining the speaker position – i.e., the temporal perspective – the central C parameter in a sense bridges the common ground AB dimensions of assertion and presupposition to its left and the subjective DE dimensions of speaker judgements to its right. As the equivalences in (15a) express, the polarity assigned to C constrains the possible values of A and B. At first sight, similar constraints seem to hold between C on the one hand and the subjective D and E values on the
other hand. More in particular, the 5D polarity assignments in (30) obey the equivalence in (33a) and the entailment in (33b).

\[(33)\]
\[
a. \quad [E = 1] \iff [C = 1] \\
b. \quad [D = 1] \implies [C = 1]
\]

According to (33a), a realized, past transition is required for the subjective assessment of progress. By virtue of the implication in (33b), the subjective judgement of speed also requires a realized transition, for which a reference marker is declared in the common ground or main DRS domain. But obviously not every available past transition is judged for speed. Although for all six 5D adverbs listed in (30) both constraints in (33) hold, these do not express the same logical impossibility captured in (32). As will be discussed in more detail in section four, the adverb *almost/bijna* combines both with the retrospective *already/al* and *finally/eindelijk* and with the prospective *STILL/nog altijd*. In considering a wider range of aspectual expressions, where temporal distance between a reference time and the current one may play a role, the C dimension of temporal perspective and the E dimension of progress turn out to be logically independent.

As was pointed out in connection with (25), Löbner characterizes the presupposed preceding state of *STILL (not)nog altijd (niet)* as having started long before the current reference time (1999, pp. 82–83). Exactly the same presupposition is assigned to *finally (neg)eindelijk (niet meer)*, thus yielding the four members of a duality group, with *STILL not/nog altijd niet* and *finally/eindelijk presupposing an extended negative anterior state, and *STILL/nog altijd and finally neg/eindelijk niet meer* presupposing an extended positive anterior state. This presuppositional connection is argued for by Löbner (1999, p. 81) on the basis of question-answer pairs such as (34).

\[(34)\]
\[
a. \quad A: \text{Is she finally gone?} \quad B: \text{No, she is STILL not gone.} \\
b. \quad A: \text{Is she STILL not gone?} \quad B: \text{Oh yes, she is finally gone.}
\]

In both dialogues the answer of speaker B is obviously highly cooperative in that she adopts the same negative evaluative attitude towards the course of events as speaker A. This need not be the case, however. In (34a) speaker B’s answer could just as well contain the basic adverb *not yet*, which does

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22 The analysis of French *(ne) ... enfin (plus)* (‘finally no longer’) and *(ne) ... toujours (pas)* (‘still not’) in Muller (1975), discussed in König (1977, pp. 176–178) and Vandeweghe (1992, p. 88), also formulates the evaluative similarities involved in terms of presuppositions.
not express any speaker information. In the case of (34b), B might also have answered “Oh yes, she is already gone for quite some time”, which conveys exactly the opposite, i.e., positive evaluation. If two speakers disagree about the truth-value of asserted, factual information, they do not presuppose it, for presuppositions cannot be so simply disputed, since they are part of the common ground. The evaluation of the speed, subjective as it may be, should hence be considered part of what is under discussion, i.e., part of the asserted information. Although presupposition and evaluation are related in both being stative background information, we prefer to keep them separate in designing the underlying 5D polarity system for dynamic inference patterns. In doing so, we basically recapture the idea of Doherty that “an evaluation is something else than a presupposition or an assertion. The speaker does not claim to express facts by it, he rather gives his opinion on facts” (1973, p. 157).

Whereas Löbner defines the close semantic connection between finally (neg)eindelijk (niet meer) and STILL (not)nog altijd (niet) in terms of presupposition, van der Auwera does so in terms of counterfactuality: with both pairs of expressions “the real (in the case of finally) or anticipated real change (in the case of still not) is evaluated as late, as posterior to the counterfactual change” (1993, p. 625; 1998, p. 47). This lateness as compared to a conceivable alternative course of events is of course perfectly compatible with the negative value assigned to finally (neg)eindelijk (niet meer) and STILL (not)nog altijd (niet) for the evaluative D-parameter of speed in (28) and (30): evaluating the actual course of events as slow requires a comparison to counterfactual alternative scenarios in which things change faster. Conversely, the positive D-value for having speed assigned to already (neg)al (niet meer) in (30) corresponds to van der Auwera’s characterization that “relative to the counterfactual turning point, the real turning point is early” (1993, p. 621; 1998, p. 47). In other words, when evaluating the progress of what is happening, fast not only correlates with easy but also with early, whereas slow not only correlates with difficult, but also with late.23 The so-called double alternative hypothesis of van der Auwera – which combines a factual alternative with a counterfactual one24 – clearly holds for the six 5D adverbs in (30). We disagree, how-

---

23 van der Auwera (1993, p. 623) himself explicitly mentions the relationship between his counterfactual readings and the “evaluative” readings in the pre-duality work of Doherty (1973) and König (1977). Obviously, this type of relationship holds even stronger for the present “post-duality” proposal in which the concept of evaluation is spelled out in much greater detail.

24 His distinction between posterior and anterior time spheres for the factual alternative (1998, p. 42) corresponds to the prospective versus retrospective C polarity dimension in (12).
ever, with van der Auwera’s claim that both alternatives are also semantic components of the basic aspectual adverbs, but that there may be contexts in which either one is prominent (1993, pp. 623–624; 1998, p. 40). His analysis of \textit{STILL not/nog altijd niet}, for instance, as merely “specialized for” or “singling out” (1993, p. 625) the counterfactual scenario already part of the semantic representation of \textit{not yet/nog niet} in our view considerably underestimates the semantic contribution of the notion of evaluation. Translating the present proposal into van der Auwera’s terms, the basic adverbs – with their 3D polarity representation and explicit DRS semantics – would only operate with factual alternatives. However, as soon as subjective attitudes of the speaker play a role – be it marked prosodically or lexically – richer DRSs and a 5D system is required to account for the counterfactual alternatives.\footnote{In this connection, van der Auwera’s claim that \textit{already} differs from \textit{finally} in that the discontinuation of the negative state is either neutral or early, but not late (1998, p. 47) can be reinterpreted as reflecting the lexical ambiguity of \textit{already} as either a basic 3D adverbial (on the neutral reading) or a 5D evaluative adverbial (on the early reading), the latter being predominant most of the time. \textit{Finally}, by contrast, unambiguously requires a 5D evaluative reading.}

The fundamental similarity and complementarity between \textit{finally/eindelijk} and \textit{already/al} constituted an important argument in van der Auwera’s (1991, 1993) criticism of the duality relationship posited by Löbner between \textit{already} and \textit{still}. Both Vandeweghe (1992, pp. 88–92) and Löbner (1999, pp. 79–80) counter this criticism by stressing that \textit{finally/eindelijk} has the extra modal, expressive or non-propositional meaning component of ‘undesirability’, which is lacking from either \textit{already/niet meer} or \textit{STILL (not)nog altijd (niet)}. Before we can argue that this special status of \textit{finally/eindelijk} is due to its intermediate position on the evaluative scale, it should be pointed out explicitly that the notion of (speaker) expectation plays no role as such in the subjective DE polarity dimensions defined in (29). Although aspectual adverbs time and again give rise to paraphrases in the sense of “later/slower versus earlier/faster than expected”,\footnote{See e.g., Doherty (1973, p. 157), König (1977, pp. 189–190) and van der Auwera (1998, p. 85).} Löbner (1989, p. 176) and Declerck (1994, p. 313) have argued that such timing expectations are not part of the semantics of these expressions. And indeed, the positive evaluation with \textit{already/niet meer} in (35) and the negative evaluation with \textit{STILL (not)nog altijd (niet)} in (36) are perfectly compatible either with...
situations conforming to expectations or with situations thwarting those expectations.27

(35)a. When Mary arrived, John was already asleep, as I/she had expected.
b. When Mary arrived, John was already asleep, contrary to what I/she had expected.

(36)a. When Mary arrived, John was still (not) asleep, as I/she had expected.
b. When Mary arrived, John was still (not) asleep, contrary to what I/she had expected.

Conformity to expectations may give rise to positive attitudes, whereas thwarted expectations may give rise to negative attitudes. As in (35)–(36), however, these different mental states – expressed by means of the positive and negative propositional attitude verbs be glad and regret in (37)–(38) – are equally compatible with positive and negative aspectual evaluation:

(37)a. I/Mary was glad that John was already awake, when she arrived.
b. I/Mary regretted that John was already awake, when she arrived.

(38)a. I/Mary was glad that John was still (not) asleep, when she arrived.
b. I/Mary regretted that John was still (not) asleep, when she arrived.

Now consider the behaviour of finally (neg) both with respect to the different expectations in (39) – the counterparts of (35)–(36) – and the different propositional attitudes in (40) – the counterparts of (37)–(38).

(39)a. When Mary arrived, John was finally asleep/awake, as I/she had expected.
b. ??When Mary arrived, John was finally asleep/awake, contrary to what I/she had expected.

27 As is expressed by the alternative subjects in the expect-clause, the expectations may be attributed to the speaker, to a participant in the described events or to any collective.
Vandeweghe (1992, p. 90) discussed the incompatibility of regret with finally in (40b) as opposed to its acceptability with already in (37b). Löbner (1999, pp. 79–82) extended his observation to a similar opposition between finally (neg) and still (not) in (38b). Interestingly, this intrinsic tension between a negative attitude and finally in (40b) also shows up with the thwarted expectations in (39b). Our DRT account makes explicit why this is so. The third reference time declared under the scope of ALT in (28d) precedes the reference time of the actual past transition, indicating that the speaker had preferred it to have occurred earlier. It should be safe to assume that ordinarily one prefers to have the world change according to one’s own timing, because anyone likes to feel in control. Clearly one must be prone either to severe mental temporal derangements or to megalomania, if one indicates to know that John fell asleep in (39b), but not to have allowed for the possibility that it would happen later than the time one had in mind for it. A human being cannot expect the world to change according to his own preferred schedule, although most of us will try to make parts of it conform to our own timing preferences, if we can. For (40b), if one prefers for John to be asleep and is waiting for him to fall asleep, one cannot regret it, once he does fall asleep.

Apparently, thwarted expectations and negative attitude act upon this material correlation between speed and progress, informally represented in the 5D system in (41), where {00} and {11} stand for the subjective D and E-parameters, i.e., indicating slow stalling and fast progress respectively.

(41)a. You expected {11} but in reality you get {00}, which you regret for pleasurable actions.

b. You expected {00} but in reality you get {11}, which you regret for unpleasurable actions.

From a subjective point of view the {11} of already/al and no longer/al niet meer in (41b) and the {00} of still (not)nog altijd niet) in (41a) make these each another’s negations. Given the constraint in (31), excluding fast stalling {10}, there is no negation of the {01} slow progress of the finally (neg)eindelijk (niet meer) assignment, as stated in (42) marked with * for unacceptability.
(42)a. *You expected {10} but in reality you get {01}, which you regret for unpleasurable actions.
b. *You expected {01} but in reality you get {10}, which you regret for pleasurable actions.

In other words, the (negative) propositional attitude and the (thwarted) expectations which are EXTERNAL to the doubly positive alREADY/al and no LONGER/al niet meer and the doubly negative STILL (not)/hog altijd (niet) are INTERNAL to the evaluative semantics of finally (neg)eindelijk (niet meer) which needs to reconcile the opposing tendencies of wanted progress (E = 1) versus unwanted delay (D = 0). As the problematic examples in (39b) and (40b) demonstrate, this internal discrepancy cannot be acted upon externally anymore. In those marginal cases where alREADY/al and finally/eindelijk occur in the same sentence, it is systematically the unwanted delay reading of the latter which overrules the former’s positive D-value for speed.28

3.2. Static Temporal Reasoning

As demonstrated for the basic aspectual adverbials in section 2, the DRT representation of their meaning allows a straightforward account of temporal inferences. With the static inferences, which concern a single reference time, the most trivial valid examples either report an atomic DRS condition as conclusion or combine several conditions into a more complex conclusion with relational temporal adverbs. The examples in (43) are the counterparts of the basic inferences in (16), constituting cases of adverb elimination to exhibit the positive or negative phase of the underlying event.

(43)a. At that time John was STILL awake/not asleep
    |= At that time John was awake/not asleep
b. At that time John was already/finally asleep
    |= At that time John was asleep
c. At that time John was STILL asleep
    |= At that time John was asleep
d. At that time John was no LONGER asleep
    |= At that time John was not asleep

In terms of the 5D polarity system validity of static inferences may be characterized simply as given any polarity assignment \( f \) to ABCDE, it entails \( f(ABC) \) and \( f(A) \). In other words, eliminating the subjective parameters DE, but preserving the ABC values yields a valid inference, as illustrated in (44).29

(44)a. At that time John was \textit{STILL} not asleep.
\( \models \) At that time John was \textit{not yet} asleep.

b. At that time John was \textit{STILL} asleep.
\( \models \) At that time John was \textit{still} asleep.

c. At that time John was \textit{finally no longer} asleep/\textit{finally awake}.
\( \models \) At that time John was \textit{not asleep anymore}.

As pointed out in (19) and (24) above, the status of \textit{already/al} as a basic aspectual adverbial is questionable. This may be supported by the fact that the inference in (45a) is valid in DRT, since the DRS (8b) clearly is a subDRS of the DRS (28a). Hence inferences are trivial, but valid, if merely prosodic contours are disregarded. The inference in (45b) is also valid in DRT, as DRS (28d) contains the subDRS (8b) for the basic, prosodically neutral \textit{already}. In both cases the positive ABC values are clearly preserved.30 Nevertheless, an evaluation conflict seems to arise in (45b) as far as the speed with which the event is perceived to develop is concerned.

(45)a. At that time John was \textit{alREADY} asleep.
\( \models \) At that time John was \textit{already} asleep.

b. At that time John was \textit{finally} asleep.
\( \not \models \) At that time John was \textit{already} asleep.

In connection with (17) we saw that valid inferences may exploit the internal negation between \textit{nog/still} and \textit{nog niet/not yet}, based on the temporal logical equivalence of the end of a negative state and the start of a positive one, i.e., reversing AB, but preserving C. This naturally extends to the domain of evaluation adverbials, such as \textit{nog altijd/STILL} and \textit{nog altijd niet/STILL not}, when the values for AB are switched, but those for CDE are preserved.31 Consider the equivalences in (46) where the antonym

29 In Löbner (1999, p. 83) the entailments involving negative and mixed evaluative adverbials are accounted for by the underlying entailment relation between the presupposition of the evaluation adverbial and that of the corresponding basic adverbial.

30 It is precisely the problematic inference in (45b) which constituted a crucial argument in van der Auwera’s criticism of Löbner’s duality account.

31 In Löbner (1999, p. 83) this relation again gives rise to a duality square.
Predicate substitution incorporates the internal negation on the adverbs, which generally is the preferred mode of expression in English, unlike Dutch.

(46)a. At that time John was *finally not* awake anymore
    \[\iff \text{At that time John was *finally* asleep}\]

b. At that time John was *already not* awake anymore
    \[\iff \text{At that time John was *already* asleep}\]

c. At that time John was *STILL not* awake
    \[\iff \text{At that time John was *STILL* asleep}\]

The equivalences based on internal negation interact with the unidirectional entailment from subjective to basic adverbs in (44) in two different ways. This is characterized in (47) by a complex entailment lattice from *STILL not awake* to *still asleep*.

(47)

On the left side in (47) the equivalence precedes the entailment: first end/start substitution, i.e., AB reversal in the 5D case, as in (46c), then conjunction reduction, i.e., ABC preservation in reducing to the 3D case, as in (44b). Conversely, on the right side in (47), the entailment precedes the equivalence: the step from evaluation to basic adverb, conjunction reduction applies, i.e., ABC is preserved, as in (44a), before end/start substitution applied, i.e., AB is reversed in the 3D case as in (17b).
3.3. *Dynamic Temporal Reasoning*

Changing the context during temporal reasoning requires understanding what information is modified or updated in going from one reference time to the next, and what information is unaffected or immune for such dynamic updates. Consider again the valid inference pattern in (4), repeated in (48), where the first premise contains a prosodically marked adverb, the second and third premise shift the reference time, and the conclusion describes the resulting state with another evaluation adverbial.

(48)  

(a) When Mary arrived, John was *STILL not* asleep.  
(b) John fell asleep.  
(c) Peter arrived.  
(d) ⊨ When Peter arrived, John was *finally* asleep.

In the DRS in (49), first (48a) introduces the CON operator, quantifying universally over the continuations the speaker envisages of the current reference time $r_0$, at which Mary arrived and John was not asleep. All these continuations are regarded by the speaker as ending at $r_1$ in John’s falling asleep, but whenever he actually does, the speaker will consider it late, for he had preferred for John to have fallen asleep already before $r_0$. When (48b) is asserted, the reference time $r_2$ is introduced in the main DRS representing the public common ground, which instantiates the left DRS under CON, specifying that the current situation changed conform to what the speaker had envisaged. Of course, with classical Modus Ponens, one can now derive that the speaker considered John to have fallen asleep late. The third premise in (48c) shifts the current reference time to $r_3$, the time of Peter’s arrival and the time at which the conclusion in (48d) is drawn. Verifying that *finally* in (48d) does not introduce any new reference times.
consists in observing simply that in the main DRS \( r_0 < r_1 = r_2 < r_3 = \) current, and all the requisite conditions obtain at \( r_3 \), but the speaker had preferred with his ALT instead that \( r_1 = r_2 < r_0 < r_3 \). The classical notion of logical consequence as defined in Kamp and Reyle (1993) accounts for the validity of such dynamic forms of temporal reasoning.

In terms of the 5D polarity system of the adverbs involved, (48) can schematically be represented as (50).

\[
\begin{align*}
A & B & C & D & E \\
(50)a. & \text{John was still not asleep} & 0 & 1 & 0 & 0 & 0 \\
b. & \text{John was finally asleep} & 1 & 1 & 1 & 0 & 1
\end{align*}
\]

As with the dynamic inferences in (20) and (24), the polarity transition in (48b) switches \( C \) from 0, i.e., prospective, in (50a) to 1, i.e., retrospective, in (50b). The reversal of the dynamic \( C \)-parameter then not only triggers the switch of the static \( A \)-parameter for the actual polarity (as in the basic inferences), but also that of the \( E \)-parameter evaluating progress: the \( C \) polarity transition induces at least some progress. In addition to the presupposed starting or ending on the \( B \) dimension, the evaluation of speed on the \( D \) dimension also must be preserved across reference times. If the course of events was perceived as slow up to the polarity transition, that perception cannot all of a sudden be reversed because it happened. These validity conditions are characterized in the 5D system in (51).

\[
\begin{align*}
\text{(51) A dynamic evaluation inference is valid if and only if} \\
1. & \text{the } C \text{-value is switched from } 0 \text{ to } 1: \\
\text{C} = & \text{temporal perspective} \\
2. & \text{the } A \text{- and } E \text{-values are reversed:} \\
\text{A} = & \text{actual polarity} \\
\text{E} = & \text{evaluation of progress} \\
3. & \text{the } B \text{- and } D \text{-values are preserved:} \\
\text{B} = & \text{presupposed transition} \\
\text{D} = & \text{evaluation of speed}
\end{align*}
\]

In other words, established presuppositions and attitudes are generally not affected when new factual information about the progress of a course of events becomes available in a valid dynamic inference. Now consider the invalid inference pattern in (52) with its 5D polarity representation.
First of all, the pattern in (52) differs from (48)–(49) in relating to the polarity transition of ending \( B = 0 \) instead of starting. In line with the first two steps of (51), the second premise in (52b) switches the C-value from 0 to 1 and reverses the A and E values accordingly. However, in the invalid conclusion of (52d), the D parameter for the evaluation of speed is unduly changed along with the E parameter, as if the mere occurrence of a factual polarity transition obliterates the earlier evaluation of slowness.

In its DRS representation, the conclusion would introduce a new reference time under CON to model the time the speaker envisaged John’s waking up as preceded by the reference time introduced by (52b), contrary to its actually preceding the current reference time, at which Peter arrived.

As with the basic inferences in (24d) the mechanisms of dynamic and static temporal reasoning can be integrated straightforwardly. The basic dynamic pattern of (49) can get a number of static extensions, as illustrated in (53).
The chain of valid temporal reasoning demonstrates that the conclusion of the dynamic inference in (53c) can function as the top of a lattice structure, such as (47), which represents the valid static reasoning patterns. The evaluation construction in (53d) then represents the intermediate node on the left side, where the dynamic reversal of ACE is followed by end/start substitution (i.e., the static reversal of AB while substituting the contradictory predicate). The basic construction in (53d'), on the other hand, corresponds to the intermediate node on the right side: after the dynamic ACE-reversal one reduces from the 5D evaluative system to the 3D basic system, preserving ABC. Finally, the basic expression in (53e) constitutes the bottom of the lattice structure. It is either the result of reducing the 5D evaluation adverbial in (53d) to a 3D adverbial, or else the result of reversing AB and the predicate of the 3D adverbial in (53d').

4. THE INTERACTION OF QUANTIFICATION AND SUBJECTIVE ATTITUDES

Various constraints have already been formulated to characterize which of all combinatorial possibilities in the logical space for aspectual information are realized in ordinary language. We have discussed some ways in which English and Dutch vary in effectively coding factual temporal information in combination with subjective speaker attitudes on timing. The five dimensional polarity system was designed to provide an easily surveyable map of this tense logical territory, generalizing to a more abstract level what the DRT tools make explicit at the level of truth-functional semantics. In this section we probe deeper into the variability between English and Dutch, showing a larger compositional ease of expression in the temporal adverbs of Dutch.

First of all, the equivalences in (15) captured the fact that only four out of the eight logically possible combinations of ABC values are actually realized with the basic aspectual adverbs, for presuppositions and actual polarities are obviously dependent parameters. Secondly, the entailment in (32) – stating that if there is speed, there must be progress – accounts for the fact that only three out of four combinatorial possibilities of subjective DE-values are realized. Although the combination of the logical possibilities into a four-by-three matrix in principle yields twelve positions, only six adverbs have been discussed so far. Consider the table in (54) which shows the four ABC combinations (and their corresponding basic adverb) on the
vertical axis, and the three evaluative DE constellations on the horizontal axis.

(54)

<table>
<thead>
<tr>
<th>Basic adverb</th>
<th>ABC</th>
<th>slow stalling DE = 00</th>
<th>slow progress DE = 01</th>
<th>fast progress DE = 11</th>
</tr>
</thead>
<tbody>
<tr>
<td>not yet</td>
<td>010</td>
<td>STILL not</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>?already</td>
<td>111</td>
<td>---</td>
<td>finally</td>
<td>already</td>
</tr>
<tr>
<td>still</td>
<td>100</td>
<td>STILL</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>not anymore</td>
<td>001</td>
<td>---</td>
<td>finally neg</td>
<td>already neg</td>
</tr>
</tbody>
</table>

As expressed in the equivalence in (33a), the six empty cells in (54) were explained by the fact that judging progress (E = 1) requires hindsight (C = 1), so if C = 0, DE must be assigned negative polarities. Since progress can be either slow or fast, the overall distribution in (54) is asymmetrical: there are fewer realized cells on the prospective first and third rows, where C = 0, than on the retrospective second and fourth rows, where C = 1.³² Now consider the following entailment relations in (55).

(55)a. At that time John was almost asleep

\[ \models \text{At that time John was not yet asleep} \]

b. At that time John was almost not asleep anymore/almost awake

\[ \models \text{At that time John was still asleep} \]

Since almost in (55a) conveys that John is very close to falling asleep, but not quite there yet, he is not yet asleep. Similarly, for its internal negation in (55b), John is very close to waking up, but not quite there yet, and therefore he is still asleep. Since aspectual adverbs and degree predicates are semantically closely related, this characterisation of almost as “not (quite) but very close” corresponds to the so-called extensional definition proposed by Rapp and von Stechow (1999) for those forms of almost (and German fast) which modify degrees.³³ In terms of the ABC

³² Van Baar (1997, pp. 33–34) and van der Auwera (1998, p. 49) formulate this asymmetry in terms of the number of scenarios available for a given expression. Since they consider our basic and evaluative reading as different scenarios of the same adverb, retrospective elements have three scenarios – namely a neutral, a fast and a slow one – whereas prospective elements only have two scenarios, i.e., a neutral and a slow one.

³³ For Rapp and von Stechow (1999, p. 161) the extensional interpretation of the sentence Manfred is almost 6 feet tall as “the degree of Manfred’s tallness is very near to 6 feet, but it is not equal to 6 feet” is equivalent to the modal or possible worlds interpretation according to which “our world is very similar to a world where Manfred is 6 feet tall, though he is not 6 feet tall”.


polarity dimensions of the basic adverbs, the composition with almost in (55b) reverses A and C from 001 for not anymore to 100 of still. Similarly, A and C are reversed from 111 for the implicit basic already in (55a) to 010 of not yet. The entailments in (56) demonstrate that, whereas English does not readily allow adverbial composition, the Dutch bijna (‘almost’) may modify the retrospective al (niet meer) (‘already not anymore’) and eindelijk (niet meer) (‘finally not anymore’).

(56)

a. Toen sliep Jan al bijna. (‘already almost asleep’)
   Toen sliep Jan eindelijk bijna bijna eindelijk. (‘finally almost finally asleep’)
   ⊨ Toen sliep Jan nog niet. (‘not yet asleep’)

b. Toen sliep Jan al bijna niet meer
   (‘already almost not asleep anymore’ = already almost awake)
   Toen sliep Jan eindelijk bijna niet meer.
   (‘finally almost not asleep anymore’ = finally almost awake)
   ⊨ Toen sliep Jan nog. (‘still asleep’)

Although the reversal of A and C triggered by the composition with bijna (‘almost’) turns retrospective into prospective both with the polarity transition of starting in (56a) and that of finishing in (56b), the evaluation of progress is retained. The al bijna niet meer composition precisely expresses what van der Auwera considers to be impossible:

(57)  “for ‘still’ a counterfactual scenario with a turning point that is late relative to the one of the factual state line makes no sense, for the latter is not only not real – it is only potential – it is not even projected to any particular point in the future” (van der Auwera 1998, p. 49)

If the counterfactual transition is later than the actual one, the course of events is evaluated as fast, which is clearly the case for al bijna niet meer. Although prospective, and hence only modal, it does project the transition onto a point in the very near future, or even in the process of realization.

---

34 The precise relationship between almost $P$ and not $P$ – as translated in our reversal of the A-value for actual polarity – has been a matter of debate. In his influential “radical pragmatics” account, for instance, Sadock (1981) provides various arguments in favour of viewing not $P$ as a generalized conversational implicature of almost $P$. As he admits himself however, one problem with this view is that the implicature is “not terribly cancelable” (1981, p. 264).
Adding the four evaluation adverbials with *bijna* (‘almost’) to the table in (54) yields the following result in (58).

(58)

<table>
<thead>
<tr>
<th>basic adverb</th>
<th>ABC</th>
<th>DE = 00</th>
<th>DE = 01</th>
<th>DE = 11</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>not yet</em></td>
<td>010</td>
<td><strong>STILL not</strong></td>
<td><strong>finally almost</strong></td>
<td><strong>already almost</strong></td>
</tr>
<tr>
<td><em>already</em></td>
<td>111</td>
<td>--</td>
<td><strong>finally</strong></td>
<td><strong>already</strong></td>
</tr>
<tr>
<td><em>still</em></td>
<td>100</td>
<td><strong>STILL</strong></td>
<td><strong>finally almost neg P</strong></td>
<td><strong>already almost neg P</strong></td>
</tr>
<tr>
<td><em>not anymore</em></td>
<td>001</td>
<td>--</td>
<td><strong>finally neg P</strong></td>
<td><strong>already neg P</strong></td>
</tr>
</tbody>
</table>

Strictly speaking, the four *almost* adverbials in (58) involve a third evaluative parameter: in addition to the evaluation of speed (D) and progress (E), the EVALUATION OF TEMPORAL DISTANCE plays a role as well. As the adverbs in (55) furthermore demonstrate, this distance parameter also combines with the basic adverbs, independently of any evaluation of speed and progress.35

The overall distribution in (58) is still asymmetrical like that of (54), but in this case the prospective adverbs on rows one and three outweigh the retrospective ones on rows two and four. Hence the question arises how the two remaining gaps in (58) may be realized. From the scalar examples in (59) it can be inferred that combining *bijna* (‘almost’) with *nog altijd niet* (‘STILL not’) or *nog altijd* (‘STILL’) is not excluded in principle. It is actually realized rather naturally in Dutch adverbial composition as in (59).

(59)a. Ik heb nog altijd bijna niemand opgebeld.
     ‘I STILL have called hardly anybody.’

b. Ik bewaar nog altijd bijna de helft van mijn koekjes.
     ‘I STILL have almost half of my biscuit’

35 Smessaert (1999a, chapter 4) describes eight adverbials of so-called aspectual quantification, which evaluate the duration or distance between the temporal reference point and the polarity transition of starting or finishing as either short or long. With a temporal reference point that is located before the beginning of an event, for instance, the basic adverbial *nog niet* (‘not yet’) has quantificational counterparts in the form of *nog lang niet* (still long not, ‘not yet by far’) and *nog net niet* (still just not, ‘not yet but about to’), the latter being the compositional equivalent of the *bijna* in (55a). A detailed account of this third evaluative dimension falls outside the scope of this paper, however.
In (59a) the transition is on an upward monotonicity scale from “still nobody” to “just a few”, whereas in (59b) the transition is on a downward monotonicity scale from “still more than half” to “just less than half”. In both cases the impact of crossing the critical point on the scale is minimalized: in spite of the hindsight, the sense of stalling remains. A similar combination of hindsight and stalling seems much more problematic in the realm of simple temporality, as in (60).

(60)a. *Toen sliep Jan nog altijd bijna niet.
   (‘STILL almost not asleep’)

   b. *Toen sliep Jan nog altijd bijna.
   (‘STILL almost asleep’)

The intrinsically prospective nature of bijna (‘almost’) naturally combines with retrospective al and eindelijk in (56) by switching the latter’s positive C value to a negative one. The problematic combinations in (60) reflect a conflict between two prospective elements. In polarity terms, the unmarked case is the one in (56) where the negative bijna operates on the positive al and eindelijk. Applying a negative operator to a negative argument as in (60) does not straightforwardly yield a positive, i.e., retrospective result, and, at least in Dutch or English, it does not simply constitute a case of negative concord either.

More in general, the extension of the original 5D system in (54) with the bijna expressions in (58) has revealed that the C dimension of perspective and the E dimension of progress are to a large extent logically independent. In other words, the strong equivalence in (33a), repeated below as (61a), which characterizes (54), needs to be replaced with the much weaker unidirectional entailment in (61b):

(61)a. [E = 1] <=> [C = 1]

   b. [E = 0] => [C = 0]

The entailment in (61b) explains the problems observed in (60) and hence the two gaps in (58): stalling (E = 0) is incompatible with hindsight (C = 1). To conclude, let us briefly consider how bijna expressions behave in valid patterns of dynamic temporal reasoning, as in (62).

(62)a. Toen Marie aankwam, sliep Jan al bijna niet meer.
   When Mary arrived, John was already almost awake.
b. Jan werd wakker en Peter kwam aan.
John woke up and Peter arrived.
c. ⊨ Toen Peter aankwam, sliep Jan *al niet meer*.
When Peter arrived, John was *already* awake.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>(63)a.</td>
<td>al bijna niet meer/already almost</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>(63)b.</td>
<td>al niet meer/already negP</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

(64)a. Toen Marie aankwam, sliep Jan *eindelijk bijna*.
When Mary arrived, John was *finally almost* asleep.
b. Jan viel in slaap en Peter kwam aan.
John fell asleep and Peter arrived.
c. ⊨ Toen Peter aankwam, sliep Jan *eindelijk*.
When Peter arrived, John was *finally* asleep.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>(65)a.</td>
<td>eindelijk bijna/finally almost</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>(65)b.</td>
<td>eindelijk/finally</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

With the dynamic inferences, the contribution of the polarity transition and the shift of reference time in (62b) and (66b) also entails reversing the A and C polarities. In other words, the contribution of *bijna/almost* is neutralized by the polarity transition, so the valid inference patterns in (64)–(65) could be considered instances of *almost*-elimination. The inferences in (62)–(63) and (64)–(65) furthermore demonstrate that if the E = 1 to start with, it cannot be reversed. This leads to the following slight modification of the original characterization of validity in (51).

(66) A dynamic evaluation inference is valid if and only if

1. C is switched from 0 to 1  \(C = \text{perspective}\)
2. a. A is reversed  \(A = \text{factual polarity}\)
   b. if E = 0, it is set to 1  \(E = \text{evaluation of progress}\)
3. B and D are preserved  \(B = \text{presupposition}\)
   \(D = \text{evaluation of speed}\)

Informally speaking, the modification in the second part of (66) means that slow stalling \{00\} is turned into slow progress \{01\}, but that slow progress \{01\} remains slow, and fast progress \{11\} remains fast.
In this paper two classes of adverbial expressions were assigned a semantic representation: the basic aspectual adverbs - *not yet*, *already*, *still* and *not anymore* – and the more complex ones with subjective timing interpretation – such as *STILL not* or *finally*. Dutch was shown to admit a more compositional adverb semantics in comparison to English, which often seeks recourse to prosody, antonyms or aspectual auxiliaries.

The DRT semantics captured their meaning in terms of START, END, CON and ALT operators, the first two extensional polarity transitions and the other two quantifying respectively over all continuations of the specified reference time, as envisaged by the speaker, or the speaker preferred alternative temporal ordering of the reference times declared by the content of the clause interpreted. Adding the tense logical substitution rule of \( \text{START } P \iff \text{END } \neg P \), the classical notion of logical consequence in DRT provided the proper characterization of both static and dynamic patterns of temporal reasoning. A polarity system was proposed, generalizing the basic distinction between actual positive and negative polarity, where the basic adverbs were represented in a 3D format. The evaluation adverbs required a 5D representation to capture their subjective speaker timing and evaluative attitudes. For the basic adverbs in section two, the ABC polarity dimensions were shorthand notation for the various conditions constituting the DRS representation of a given sentence. Dynamic temporal reasoning was modelled as a stepwise updating of the DRSs, adding new conditions as information comes in, but also by removing or adjusting conditions that are overruled by that incoming information, suggestive of the general mechanism of belief revision.

This analysis was then explicitly contrasted with the presuppositional account of Löbner (1999) and the counterfactual account of van der Auwera (1993, 1998). The special status of *eindelijk/finally* was attributed to its intermediate evaluation of slow progress. Static temporal inference, concerning a single information state, was characterized as valid iff it reduces the 5D assignment to its 3D component, or its A polarity. In addition, internal negation reverses polarity in AB and substitutes the polar antonym of the verbal predicate. The unidirectional inferences and the equivalences were composed into a lattice structure of valid static temporal inferences. Dynamic temporal reasoning required separating the information to be preserved in an update, when the reference time is moved forward, from static information, including epistemic or affective attitudes, not affected in shifting the reference time. In the 5D polarity system, valid dynamic reasoning requires preserving the presupposed polarity transition.
in B (starting/ending), as well as the subjective evaluation of speed in D. Finally, it was demonstrated how static and dynamic temporal reasoning interact with other adverbs in complex, but valid inference patterns.

APPENDIX

The detailed construction rules for the aspectual adverbs are specified here for the interested reader, familiar with the DRT construction rules in Kamp and Reyle (1993) and their semantics by verifying embeddings into models.

The classical treatment of negation in DRT constructs a subDRS in the scope of negation, with the associated embeddings verifying it just in case none can be extended to an embedding which verifies the conditions in the subDRS. This accounts nicely for the fact that indefinites in the scope of negation are inaccessible for anaphora. In our paper NP anaphora have been disregarded, while our focus has been on temporal reference and quantification. In English especially there seems to be wide preference to express polarity reversals with polar antonyms, which incorporate the predicate negation. Although this is not the place to explore the behavior of indefinites under incorporated negation, the semantics of the negated atomic conditions used in our DRSs is the simplest case of the classical DRT account of negation, where all reference markers occurring in its conditions are declared in the current DRS and negation does not create a subordinate DRS, but merely adds a negative atomic condition to the DRS itself. This condition is true in a model just in case the referents assigned to the reference markers are not in the extension of the predicate.

Two operators CON and ALT have been defined in the paper, for which only an informal semantics was presented. Their semantics is made explicit as follows:

Given a model $M$, and DRS $K$, and an assignment $f$ such that $f(sp) =$ speaker of $M$ and $f(r_0)$ is the current reference time in $M$, then $f(CON(sp, r_0, K))$ is true in $M$ iff the speaker envisages $r_0$ to change into a state at which all conditions of $K$ are verified by any extension of $f$.

Given a model $M$, and DRS $K$, and an assignment $f$ such that $f(sp) =$ speaker of $M$ and $f(r_0)$ is the current reference time in $M$, then $f(ALT(sp, r_0, K))$ is true in $M$ iff the speaker had preferred the conditions in $K$ to be verified by any extension of $f$; over the conditions $f$ actually does verify.

The DRT-construction rules for the aspectual adverbs are given in a simplified format, where labelled brackets provide the minimal parse, and the declared reference markers are listed first in square brackets ($= = \ldots$
empty domain), separated by | from the conditions representing the truth functional content of the interpreted clauses.

(i) **DRS construction rules for the basic aspectual adverbs**

a. [IP x [INFL not yet [VP λ y P(y)]]] ⇒ [r₀, e, x, sp |¬P(e, x) & e ⊇ r₀ & CON(sp, r₀, [r₁ | [r₁ ⊇ END(~P(e, x))] & r₀ < r₁ & UNTIL(r₁, ~P(e, x)) ⊇ r₀)]]

b. [IP x [INFL already [VP λ y P(y)]]] ⇒ [r₀, r₁, e, x |P(e, x) & e ⊇ r₀ & r₁ ⊇ START(P(e, x)) & r₁ < r₀ & SINCE(r₁, P(e, x)) ⊇ r₀]

c. [IP x [INFL still [VP λ y P(y)]]] ⇒ [r₀, e, x, sp |P(e, x) & e ⊇ r₀ & CON(sp, r₀, [r₁ | [r₁ ⊇ END(P(e, x)) & r₀ < r₁ & UNTIL(r₁, P(e, x)) ⊇ r₀)]]

d. [IP x [INFL not [VP λ y P(y)] anymore]] ⇒ [r₀, r₁, e, x |¬P(e, x) & e ⊇ r₀ & r₁ ⊇ START(~P(e, x)) & r₁ < r₀ & SINCE(r₁, ~P(e, x)) ⊇ r₀]

(ii) **DRS construction rules for the evaluative aspectual adverbs**

a. [IP x [INFL STILL not [VP λ y P(y)]]] ⇒ [r₀, e, x, sp |¬P(e, x) & e ⊇ r₀ & CON(sp, r₀, [r₁ | [r₁ ⊇ END(~P(e, x))] & r₀ < r₁ & UNTIL(r₁, ~P(e, x)) ⊇ r₀] ⇒ ALT(sp, r₀, [¬ | [r₀ ⊆ r₁ & UNTIL(r₁, ~P(e, x)) ⊇ r₀)]]

b. [IP x [INFL already [VP λ y P(y)]]] ⇒ [r₀, r₁, e, x, sp |P(e, x) & e ⊇ r₀ & r₁ ⊇ START(P(e, x)) & r₁ < r₀ & SINCE(r₁, P(e, x)) ⊇ r₀]

c. [IP x [INFL finally [VP λ y P(y)]]] ⇒ [r₀, r₁, e, x, sp |P(e, x) & e ⊇ r₀ & r₁ ⊇ START(P(e, x)) & r₁ < r₀ & SINCE(r₁, P(e, x)) ⊇ r₀ & ALT(sp, r₀, [¬ | [r₀ ⊆ r₁ & UNTIL(r₁, P(e, x)) ⊇ r₀)]]

d. [IP x [INFL STILL [VP λ y P(y)]]] ⇒ [r₀, e, x, sp |P(e, x) & e ⊇ r₀ & CON(sp, r₀, [r₁ | [r₁ ⊇ END(P(e, x)) & r₀ < r₁ & UNTIL(r₁, P(e, x)) ⊇ r₀]) ⇒ ALT(sp, r₀, [¬ | [r₁ ⊆ r₀ & SINCE(r₁, ~P(e, x)) ⊇ r₀)]]

e. [IP x [INFL no LONGER [VP λ y P(y)]]] ⇒ [r₀, r₁, e, x, sp |¬P(e, x) & e ⊇ r₀ & r₁ ⊇ START(~P(e, x)) & r₁ < r₀ & SINCE(r₁, ~P(e, x)) ⊇ r₀ & ALT(sp, r₀, [¬ | [r₀ ⊆ r₁ & UNTIL(r₁, P(e, x)) ⊇ r₀)]]

f. [IP x [INFL finally not [VP λ y P(y)] anymore]] ⇒ [r₀, r₁, e, x, sp |¬P(e, x) & e ⊇ r₀ & r₁ ⊇ START(~P(e, x)) & r₁ < r₀ & SINCE(r₁, ~P(e, x)) ⊇ r₀ & ALT(sp, r₀, [¬ | [r₂ ⊆ r₁ & SINCE(r₂, ~P(e, x)) ⊇ r₀)]]}
In DRT the notion of logical consequence relates two DRSs, requiring that a DRS $K'$ is a logical consequence of DRS $K$ representing the premises iff any verifying embedding into the underlying models of the conditions in $K$ can be extended to a verifying embedding of the conditions in $K'$ (i.e., there is no model in which to make the premises true and the conclusion false).

A DRS is pure just in case all reference markers used in its conditions are declared at that level or at a higher one. The conclusion cannot add any new reference markers in other words, doing justice to the static nature of drawing a conclusion from given information.

(iii) **DRT Definition of logical consequence**

Let $K, K'$ be pure (…) DRSs. Thus $K'$ is a logical consequence of $K$ ($K \models K'$) iff the following condition holds:

Suppose $M$ is a model and $f$ is a function from $U_K \cup \text{Fr}(K) \cup \text{Fr}(K')$ into $U_M$, such that $M \models f K$. Then there is a function $g \supseteq U_K$ such that $M \models g K'$ (Kamp and Reyle 1993, p. 305.).

The only tense logical substitution rule needed to characterize logical validity of static and dynamic temporal inference is the equivalence of ending a negative state and starting a positive one, or vice versa, as stated in the meaning postulate in (iv).

(iv) For all $P, x, e$: $\text{START}(P(e, x)) \iff \text{END}(\sim P(e, x))$

The valid patterns of temporal reasoning are based on the fact that any DRS entails its subDRSs, so any prosodically marked DRS entails its basic counterpart. They both entail the basic positive or negative condition at the current reference time, which is the first condition constructed in all representations.

**REFERENCES**


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