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The dynamic semantics of aspectual adverbs

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1. Introduction

In ordinary English aspectual adverbs such as in French and English *encore*/*still*, *ne pas encore*/*not yet*, *déja*/*already*, and *enfin*/*finally* are used to create temporal coherence in local contexts, as well as to carry prosodic features that directly indicate the speaker's epistemic attitudes towards the course of events described. In multi-agent contexts factual information, or the content asserted by the speaker, is presented as descriptive information about part of the world to be incorporated into the common ground. But it may be questioned, accepted as true or rejected as unverifiable or even false by its recipient. However, subjective information about his attitudes about what is happening any speaker issues with first person authority. It is logically guaranteed to be veridical and directly referential, since it is caused by privileged access to the speakers private information state. Clauses with aspectual adverbs effectively combine factual and subjective information about what is happening. They constitute a good case study of how temporal information gets shared in the common ground by triangulation between communicating agents in the world.
Aspectual adverbs are often used in temporal reasoning, where premises affect the contextually determined reference time, shifting it at times to a later one during the interpretation of the premises. Syntactically, aspectual adverbs occur within INFL in IP clauses describing events, as in (1)-(4), and semantically they contribute new information about the onset or end of the described action relative to its contextually determined reference time.

(1) John is not yet asleep — Jean n'est pas encore endormi.
(2) John is already asleep — Jean est déja endormi.
(3) John is still asleep — Jean est encore endormi.
(4) John is not asleep anymore — Jean n'est plus endormi.

What exactly is the information the aspectual adverbs contribute in addition to the descriptive factual content of the clauses they occur in? From premises without aspectual adverbs presented in temporal sequence a conclusion may be validly inferred that does contain one, as in (5).

(5) a. When Mary arrived, John was asleep
Quand Marie arriva, Jean était endormi
b. John woke up
Jean se réveilla
c. Bill left
Bill partit
d. |= When Bill left, John was not asleep anymore
|=Quand Bill partit, Jean n'était plus endormi

Even though there are no aspectual adverbs in the premises in (5a-c), *not anymore* in (5d) supports a valid conclusion. When *still/encore* is added to the first premise in (5a), this conclusion remains valid, as in (6).

(6) a. When Mary arrived, John was still asleep
b. John woke up
c. Bill left
d. |= When Bill left, John was not asleep anymore

Adding *still* in (6a) does not affect the conclusion in (6d), so in this inference *still* seems *prima facie* not to contribute any useful information at all. But when *still* is used in English with marked high pitch, ordinarily indicative of new, focused content, it indicates subjective information regarding the speaker's assessment of the timing or duration of John's sleep.

(7) When Mary arrived, John was STILL asleep

Given the marked prosody in (7) anyone competent in English understands that the speaker had counterfactually expected, planned, hoped or perhaps feared that John would have woken up before Mary arrived. We use (7) to express some form of dissatisfaction or even irritation with the actual course of events where John's sleep endures. What the speaker is dissatisfied with systematically depends on the propositional content of the clause modified by the aspectual adverb. It is a matter of rhetorics or general pragmatics to determine in each context which attitude or emotive coloring of subjective information the speaker means to convey by the marked prosody, ranging from hope, plan, fear, to expectation or even trust. Of course, this leaves lots of room for misinterpretation and misunderstanding between communicating agents. In this paper the nature of the speaker's attitude remains undetermined, using ATT as a generic intensional relation of a speaker's attitude towards the factual descriptive content on which it is based.

2. Presuppositions of aspectual adverbs

The presuppositions of indicative clauses with aspectual adverbs are shared with its corresponding polarity question and VP-internally negated form. Proper answers to polarity questions must also share the presuppositions of the question. When the presupposition of the question is not accepted as common ground, another, meta-linguistic form of negation, i.e. denial (8d), must be used. In (8ab) *still* and *not anymore* are seen to share a presupposition, not shared by *already* in (8c), and denied by *not yet* in (8d).

(8) a. Was John still asleep, when Mary arrived?
b. No, he was not asleep anymore.
c. * No, he was already asleep.
d. No, he had not even fallen asleep yet.

The interaction in (8) with internal and external negation shows that the four basic aspectual adverbs are clearly related by polarity in their temporal meaning. This relation is clarified below in the DRT-style of semantic representation.[1]
In a similar vein, presuppositions of aspectual adverbs in discourse cannot be accommodated, when the immediately preceding clause has contributed conflicting information. The accommodation of presupposition in a context that does not already entail it is hence a much more constrained process, if accommodation is considered as a general repair strategy.[2] If (9) is assumed to constitute coherent discourse, presented as continuous speech from a single source, the presupposition of falling or being asleep, i.e. being awake before, cannot be accommodated, since the context contains at the current reference time contradictory information that the referent is asleep.

(9) a. ?* John was already asleep. He fell asleep.
b. ?* John was not asleep anymore. He was asleep.

Had the aspectual adverbs not occurred in (9), the text could have been interpreted as a set of discontinuous clauses, possibly from different sources or uttered at various times. The aspectual adverbs contribute the information that the description of the course of events is produced by someone specific, representing a possibly biased perspective on what is happening. After updating the context with (9a) the information that John is asleep is current, so the presupposition of the second clause, i.e. that John was not sleeping in the given context, is inconsistent with it. Hence this presupposed information can not be accommodated at the current context, precluding the second clause from effecting a consistent and coherent update of the current information state.
When the initial context is updated by asserting the incompatible information, instead of presupposing it, the reference time is properly shifted, in order to coherently incorporate the content of the subsequent clauses, as in (10).

(10) a. John was already asleep. He woke up and fell asleep again.
b. John was not asleep anymore. He fell asleep again, so then he was asleep.

Assuming overall coherence of information, contributing information to the common ground by presupposition accommodation must hence be distinguished as updating process from asserting information, as in (9a/10a). Asserting information already presupposed by the preceding clause may create incoherence, as we see (9b/10b). A polarity conflict created by asserting information inconsistent with content of the preceding clause cannot be resolved by simply repairing the context, accommodating its presuppositions either by revising it or by shifting to a new, later reference time.

3. A DRT analysis of aspectual adverbs

Aspectual adverbs modify the factual content contained in the clause in their scope. E. g. *John was already asleep* entails that John fell asleep before, and *John is still not asleep* entails that John is not asleep yet, but falling asleep. It would be not just odd, but really misleading or perhaps predantic as

[1] Cf Smessaert and ter Meulen (2004) for a more detailed discussion on the presupposition of aspectual adverbs and comparison to other semantic accounts.
[2] Cf. Beaver (1997).

communicative act, to describe John as still not asleep, if he is actually jogging or cooking dinner, actions that are obviously incompatible with his falling asleep.
The DRT techniques of declaring reference markers and relating these in conditions with descriptive predicates produces the following representations for the four basic aspectual adverbs, linearly presented for easy exposition.[3]

(11) John is already asleep
$[r_0, r_1, e, j \mid sleep(e, j, +) \;\&\; e \supseteq r_0 \;\&\; r_0 = current \;\&$
$r_1 \supseteq START(sleep(e, j, +)) \;\&\; r_1 < r_0 \;\&\; SINCE(r_1, (sleep(e, j, +)))\ ]$

In (11) John's sleeping is anchored to the current reference time r_0 and its presupposition that he fell asleep earlier is added by representing the aspectual adverb with the corresponding aspectual verb. Ordinarily presuppositions are not automatically included in the DRS of a clause, although they may be added by presupposition accommodation or justification.[4] The presupposed event of falling asleep is telic , i.e. it does not contain sub-events which themselves are events of falling asleep. When the aspectual adverb is represented, it introduces a preceding reference time r_1, that includes this most recent occurrence of him falling asleep. The *SINCE* condition specifies that the onset of John's sleeping was not just any past event of him falling asleep, but the one after which he remained asleep up to now, i.e. the last time John fell asleep. The temporal DRS condition with *since* serves to bind John's falling asleep to his current state of being asleep.[5]
The other three aspectual adverbs are represented in (12)-(14), systematically using *SINCE/UNTIL* for binding the polarity transition to the current state and the temporal precedence order to reflect their polarity relations.

(12) John is still asleep
$[r_0, r_1, e, j \mid sleep(e, j, +) \;\&\; e \supseteq r_0 \;\&\; r_0 = current \;\&$
$r_1 \supseteq END(sleep(e, j, +)) \;\&\; r_0 < r_1 \;\&\; UNTIL(r_1, (sleep(e, j, +)))\ ]$
(13) John is not yet asleep
$[r_0, r_1, e, j \mid (sleep(e, j, -) \;\&\; e \supseteq r_0 \;\&\; r_0 = current \;\&$
$r_1 \supseteq START(sleep(e, j, +)) \;\&\; r_0 < r_1 \;\&\; UNTIL(r_1, (sleep(e, j, -)))\ ]$
(14) John is not asleep anymore
$[r_0, r_1, e, j \mid (sleep(e, j, -) \;\&\; e \supseteq r_0 \;\&\; r_0 = current \;\&$
$r_1 \supseteq END(sleep(e, j, +)) \;\&\; r_1 < r_0 \;\&\; SINCE(r_1, (sleep(e, j, -)))\ ]$

The DRT-construction rules for these adverbs are specified in (15) in a simplified linear format, assuming a compositional VP semantics.

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[3] The reader unfamiliar with DRT semantics is referred to Kamp and Reyle (1993) or ter Meulen (2003) for an introduction.

[4] See Kamp (2003) for a comprehensive analysis of presupposition computation and justification in DRT.

[5] Cf. Kamp and Reyle (1993: 628–635) for a discussion of the semantics of *since* and *until* in temporal contexts.

(15) a. [$_{IP}$ x [$_{INFL}$ *already* [$_{VP}$ λy P (y)]]] => [r_0, r_1, e, x | P(e, x, +)) &
e ⊇ r_0 & r_1⊇ START(P(e, x, +)) & r_1< r_0 & SINCE(r_1, (P (e, x, +)))]
b. [$_{IP}$ x [$_{INFL}$ *still* [$_{VP}$ λy P (y)]]] => [r_0, r_1, e, x | P(e, x, +)) &
e ⊇ r_0 & r_1⊇ END(P(e, x, +)) & r_0< r_1 & UNTIL(r_1, (P (e, x, +)))]
c. [$_{IP}$ x [$_{INFL}$ *not yet* [$_{VP}$ λy P (y)]]] => [r_0, r_1, e, x | P(e, x, -)) &
e ⊇ r_0 & r_1⊇ START(P(e, x, +)) & r_0< r_1 & UNTIL(r_1, (P (e, x, -)))]
d. [$_{IP}$ x [$_{INFL}$ *not anymore* [$_{VP}$ λy P (y)]]] => [r_0, r_1, e, x | P(e, x, -)) &
e ⊇ r_0 & r_1⊇ END(P(e, x, +)) & r_1< r_0 & SINCE(r_1, (P (e, x, -)))]

Aspectual adverbs make it possible to describe an ongoing event statically, systematically placing it in the context of its future or past polarity transition. This constitutes an essentially indexical account of the English aspectual adverbs and forms the basis for the semantics of prosodically marked usage of aspectual adverbs presented in the next section.

4. Prosodically Marked Aspectual Adverbs

English aspectual adverbs prosodically marked by a high pitch indicate that the described, current course of events varies from what the speaker had envisaged it to be like. The exact nature of the epistemic attitude of the speaker may vary greatly from one context to another, and is apt to lead to misunderstandings by the recipient. To abstract from all such intricacies, we use here the generic attitude ATT, systematically relating the speaker (sp) to the onset or termination of the described event.
Marked prosody cannot naturally be expressed with high pitch on *not yet*, but English has an extensionally equivalent lexicalization, that does accept this prosody in *STILL not*. There may be an interesting phonological explanation why *not yet* does not provide a suitable lexical structure to carry such marked prosody, perhaps requiring internal negation to avoid placing high pitch on it. An answer to this issue would lead us much beyond the scope of the current paper, but clearly complements this semantic account of prosodically marking in dynamic information structure. Accordingly in (16) the prosodically marked *STILL not* creates a contrast between the actual course of events, and what the speaker subjectively had envisaged it to be. It indicates that the actual course of events is slow in the eyes of the speaker, i.e. in his subjectively preferred course of events John would actually be asleep. His falling asleep should have occurred already, switching UNTIL to its counterpart SINCE to create the desired temporal binding.

(16) John is STILL not asleep
[$_{IP}$ *John* [$_{INFL}$ *STILL not* [$_{VP}$ λy *sleep* (y)]]] =>
[r_0, r_1, e, x | sleep(e, x, -)) & e ⊇ r_0 & r_1⊇ START(sleep(e, x, +)) & r_0< r_1 & UNTIL(r_1, (sleep (e, x, -))) & ATT (sp, [- | r_1 < r_0 & SINCE(r_1, (sleep (e, j, +)))])]

Now it is easy to see what the semantic representation of other prosodically marked forms of the aspectual adverbs should be. Again, English has no prosodic marking for *not anymore*, as it uses *no LONGer* to express the contrastive speaker information. The positive phase adverbs *already* and *still* are easily used with marked prosody.

(17) John is STILL asleep

$[_{IP}$ *John* $[_{INFL}$ *STILL* $[_{VP}$ λy *sleep* (y)]]] =>

$[r_0, r_1, e, x \mid sleep(e, x, +)) \& e \supseteq r_0 \& r_1 \supseteq END(sleep(e, x, +)) \& r_0 < r_1$

$\&$ UNTIL(r_1, (sleep (e, x, +))) & ATT (sp, [- | $r_1 < r_0$ & SINCE(r_1, (sleep (e, j, -)))])]

(18) John is no LONGer asleep

$[_{IP}$ *John* $[_{INFL}$ *no LONGer* $[_{VP}$ λy *sleep* (y)]]] =>

$[r_0, r_1, e, x \mid sleep(e, x, -)) \& e \supseteq r_0 \& r_1 \supseteq END(sleep(e, x, +)) \& r_1 < r_0$

& SINCE(r_1, (sleep (e, x, -))) & ATT (sp, [- | $r_0 < r_1$ & UNTIL(r_1, (sleep (e, j, +)))])]

(19) John is alREADY asleep

$[_{IP}$ *John* $[_{INFL}$ *alREADY* $[_{VP}$ λy *sleep* (y)]]] =>

$[r_0, r_1, e, x \mid sleep(e, x, +)) \& e \supseteq r_0 \& r_1 \supseteq START(P(e, x, +)) \& r_1 < r_0$

& SINCE(r_1, (P (e, x, +))) & ATT (sp, [- | $r_0 < r_1$ & UNTIL(r_1, (sleep (e, j, -)))])]

The contrasts induced by the prosodically marked aspectual adverbs always concern the timing of the polarity transition from a negative phase (not sleeping) to a positive phase (sleeping) and the speed with which the current course of events develops. Using *alREADY* and *no LONGER* the speaker registers her surprise at how early the polarity transition took place. With *STILL* and *STILL not* she indicates that she had preferred the transition to have taken place, registering hence her negative evaluation or disappointment at its being late. It is remarkable how much information is added to the meaning of the original basic four aspectual adverbs in a highly effective and efficient way by prosodically marking the corresponding aspectual adverbs in English.

5. Presuppositions, polarity transitions and temporal reasoning

The four basic DRSs in (11)-(14) 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 becomes obvious that not all logical possibilities are realized. The logical constraints on lexicalizations turn out to be attributable to presuppositions. The basic opposition in (20) concerns the actual polarity of the condition involving John's sleeping at the current reference time.

(20) polarity dimension A = ACTUAL POLARITY

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

For *already* in (15a) and *still* in (15b) this A dimension is positive, since the reference time is located inside a positive phase of the sleeping-event. The other two adverbs *not yet* in (15c) and *not anymore* in (15d) have a negative A dimension.

The second polarity dimension B encodes the two aspectual operators involving opposite polarity transitions of the event. The START operator is monotone increasing since, once you have started a subevent e_1 as temporal part of e_2, you must have started e_2, corresponding to a positive B-value in (21). The END operator is monotone decreasing, since in ending e_1 any subevent e_2 that is a temporal part of e_1 is ended, yielding a negative B-value.

(21) polarity dimension B = PRESUPPOSED TRANSITION
B = 1 transition from negative to positive polarity START(P(e))
END(~sleep (e, j)) = START(sleep (e,j))
B = 0 transition from positive to negative polarity END (P(e))
END(sleep (e, j)) = START(~sleep (e,j))

B is positive for *not yet* and *already*, but negative for *still* and *not anymore*.
The linear order between these polarity transitions and the reference time constitutes the third polarity dimension of perspective in (22), 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. the information is provided by the speaker looking back upon a realized transition in the past with the START and SINCE operators. With the other conditions the C-dimension is prospective -- i.e. looking forward to possible transitions in the future with the END and UNTIL operators:

(22) polarity dimension C = PERSPECTIVITY
C = 1 retrospective $r_1 < r_0$
C = 0 prospective $r_0 < r_1$

The retrospective adverbs *already* and *not anymore* get a positive C-polarity. The prospective ones *not yet* and *still* 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 (23).

(23)

	THREE-DIMENSIONAL POLARITY SYSTEM	A	B	C
	John is asleep	1	-	-
	John is not asleep	0	-	-
	John is *not yet* asleep	0	1	0
	John is *already* asleep	1	1	1
	John is *still* asleep	1	0	0
	John is *not* asleep *anymore*	0	0	1

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. 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 (24a, b).

(24) a. *not yet P*
will (C=0)
start P (B=1)
not P now (A=0)

b. *not P anymore*
have (C=1)
ended P (B=0)
not P now (A=0)

An important observation in connection with the polarity system in (23) 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 lexicalized. 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 combinations 11 and 00 as CONVERGENT, and to 10 and 01 as DIVERGENT, these constraints can be formulated as the equivalences in (25):

(25) 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 (23), as two binary parameters would suffice to distinguish four expressions. However, explicitly representing the three dimensions is essential to show all combinatorial possibilities and to provide 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 prosodically marked adverbials the C-parameter will turn out to be pivotal to capture the essential situatedness of temporal reasoning·

Some forms of temporal reasoning may be accounted for in terms of the 3D polarity calculus, clarifying which parameters reverse their polarity from *still* to *not anymore*. The second premise in (6b), introducing an actual polarity transition, obviously switches C from 0 (prospective) to 1 (retrospective), modeling the passage of time by relegating what was once considered future to the past, i.e. introducing a new, later current reference time into the DRS. The constraints in (25) 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 valid. In this case, the reversal of the dynamic C-parameter reverses the A-parameter for the actual polarity from positive to negative. The value of the presupposition B-parameter must be preserved, as factual changes in the world should not affect presuppositions. The temporal inference whose validity relies on reversing the A- and C-values, while preserving the B-value, is schematically represented in (26).

			A	B	C
(26)	a.	*still* asleep	1	0	0
	b.	wake up			0/1
	c.	*not* asleep *anymore*	0	0	1

Shifting reference times from Mary's arrival to Bill's departure, the examples in (27) 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.

			A	B	C
(27)	a.	John was *not yet* asleep	0	1	0
	b.	John fell asleep			0/1
	c.	$\not\models$ John was *still* asleep	1	0	0
	d.	$\not\models$ John was *not* asleep *anymore*	0	0	1

Although in (27c) the A-value of the factual polarity is reversed with *still*, the prospective negative C-value is not changed accordingly. Instead, the presupposed polarity transition in B of starting is replaced by ending, as it were jumping forward too far inside the event. This creates temporal incoherence, resulting in an invalid inference.

An even bigger leap forward occurs in (27d); 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 temporal incoherence and an invalid inference. The other valid inferences based on the two premises in (6a-b) are given in (28).

			A	B	C
(28)	a.	John was *not yet* asleep	0	1	0
	b.	John fell asleep			0/1
	c.	|= John was ?*already* asleep	1	1	1
	d.	|= John was *not* awake *anymore*	0	0	1

In the inference in (28c) 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 the analysis of prosodically marked aspectual adverbs, the subjective evaluation of fast and easy progress so readily associated with *already* seems to interfere in our intuitions, even in the prosodically neutral case. This is not the case in (28d), where the dynamic reversal of the AC-values from (28a) to (28c) is followed by the static START P = START ~(~P) reversal of the AB-values, while substituting the antonymous verbal predicate. In other words, in going from *not yet* P in (28a) to *not ~P anymore* in (28d), 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 notion of coherence is 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.

Given the simplified polarity calculus for the basic aspectual adverbs, we can incorporate the prosodically marked adverbs providing 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)* what is happening is perceived as slow and stalling, whereas *no LONGER* the speaker expresses her judgment of fast and steady progress. The intermediate position is lexicalized in English by *finally (neg) P,* indicating a subjectively perceived discrepancy between making progress, but slowly. The interaction of polarity properties of all adverbs is rendered in a 5D system in (30), integrating the 3D account of the basic aspectual adverbs.

(30)

FIVE-DIMENSIONAL POLARITY SYSTEM	A	B	C	D	E
John is asleep	1	-	-	-	-
John is not asleep	0	-	-	-	-
John is *not yet* asleep	0	1	0	-	-
John is *already* asleep	1	1	1	-	-
John is *still* asleep	1	0	0	-	-
John is *not* asleep *anymore*	0	0	1	-	-
John is *STILL not* asleep	0	1	0	0	0
John is *finally* asleep	1	1	1	0	1
John is *alREADY* asleep	1	1	1	1	1
John is *STILL* asleep	1	0	0	0	0
John is *finally* not asleep/awake	0	0	1	0	1
John is *no LONGER* asleep	0	0	1	1	1

It should be noted that D and E concern non-factual, speaker dependent, subjective polarities, in contrast to the ABC dimensions that represent actual ones. To illustrate the 5D assignments of 01000 to *STILL not* and 00111 to *no LONGER* their paraphrases are decomposed in (31a-b):

(31)

a. *STILL not P*		b. *no LONGER P*	
not P now	A=0	not P now	A=0
end not P	B=1	start not P	B=0
possible future	C=0	actual past	C=1
slow	D=0	fast	D=1
stalling	E=0	progress	E=1

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) $[E = 0] \Rightarrow [D = 0]$

If there is no progress, then there cannot possibly be any speed either, or, by contraposition, if there is speed there must be some 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 a sustained and controlled effort from their agents. Other actions, like *sleeping*, supposedly 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 and what causal forces may affect it. Our present concern is restricted to the logical aspects of temporal reasoning, 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 factual AB dimensions of assertion and presupposition to its left and the subjective DE dimensions of speaker judgments to its right. As the equivalences in (25a) 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. $[E = 1] \Leftrightarrow [C = 1]$
b. $[D = 1] \Rightarrow [C = 1]$

According to (33a), a realized, past transition is required for the subjective assessment of progress. By virtue of the implication in (33b), the subjective judgment 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 in (30) both constraints in (33) hold, these do not express the same logical impossibility captured in (32).
As final consideration of how aspectual adverbs serve in adjusting context in a multi-agent setting, let's briefly look at the way the counterfactual epistemic states are used in planning contexts. Suppose (34a) is uttered in a situation where agents already share the information that they are to have dinner at 9, and that John is supposed to be asleep before dinner, hence he will not participate in the dinner.

(34) a. John is ALREADY asleep, so let's have dinner at 8.
b. Let's have dinner at 8. John is already asleep.

In (34a) John fell asleep earlier than the speaker had expected, indicated by *ALREADY*. Since he fell asleep before 8, the original plan to have dinner at 9 is adjusted to have dinner earlier. From (34b), reversing the order of the two clauses, in the context containing the plan to have dinner at 8, asserted by the first clause, *already* may lose its subjective counterfactual temporal meaning. Instead, (34b) indicates that one of the first conditions necessary to fulfill the plan to have dinner at 8, i.e. that John be asleep, has been satisfied earlier than expected. Elaborating the DRT account with such interactive planning information and information shared as common ground to which agents all have equal access would be a first enrichment of the semantic representations required for (34). Such research awaits a future occasion.

6. Temporal reasoning: Semantics or Pragmatics?

Stalnaker (1999: 153-155) discussed two different ways to demarcate semantics from pragmatics, reflecting a difference in the role the notion of context plays in the explanation of the linguistic facts. On the one hand, a fact is considered pragmatic if it is independent from the truth conditional content and appeals to principles, maxims and inference rules other than logical deduction. Meaning

determines certain aspects of the interpretation of a speech act, and the context determines other aspects of its interpretation. On the other hand, a fact is characterized as semantic if it is based on rules any competent speaker of the language must know to communicate effectively. Information is pragmatic when it relies on knowing certain factual circumstances under which the speech act was performed or knowledge of the world that may be used in determining what was said.

It should be evident that the DRT account of aspectual adverbs offered in this paper is semantic on both counts, for aspectual adverbs determine factual truth conditional content and epistemic attitudes of the speaker. It is semantic since it determines temporal content, relative to contextual information about reference times, independent of matters of fact or common sense knowledge, hence part of our linguistic competence. What remains for genuine pragmatics is to determine the epistemic attitude the speaker wants to express by using marked prosody on an aspectual adverb. Perhaps a more detailed account of such issues relating to rhetorical relations arising in discourse needs a phonologically more sophisticated analysis of the nature of the intonational contour used.

Another issue worthy of further investigation is to analyze the different strategies natural languages may use to lexicalize the logical space of the five dimensions. In Dutch, as opposed to English, 5D aspectual adverbs may be lexicalized differently from 3 D adverbs. For instance, the English prosodically neutral *still* is expressed with *nog*, but its prosodically marked counterpart is compositionally expressed by *nog steeds* or *nog altijd* (*still always*). In Dutch there appears to be a preference to express the 5D adverbs by lexical composition over the prosodic marking, so characteristic of English. In French, *still* is expressed as *encore*, but the counterpart of the prosodically marked *STILL* is *toujours*, which is ambiguous as it also covers the regular quantificational adverb *always*. Perhaps prosody marks the difference between its use as the 5D aspectual adverb and its use as regular quantificational adverb. Other languages may express the logical oppositions in morphological markers, or perhaps in word order differences, as we detect in German, where *Jan schläft noch inmer* is the unmarked order, meaning John is still asleep, but *Jan schläft immer noch* is marked, indicating the speakers frustration that he is not yet awake. A proper logic of temporal reasoning in natural languages captures the linguistic variability of aspectual distinctions, while characterizing validity of dynamic temporal reasoning at a more abstract, universal level. In this account of the dynamic semantics of aspectual adverbs a story, assumed to constitute coherent discourse, constitutes the premises from which the conclusion is drawn. The interpretation of the premises is itself modeled as a dynamic process in which the reference time is shifted to later ones, when updates with dynamic information require it. The construction rules for the DRSs are semantic in nature and the standard logical notion of entailment in DRT serves to characterize validity without any appeal to notoriously problematic notions such as a 'normal' course of events or 'normal possible world' or to common sense about what the world is like or how causal connections arise, as in default logics (cf. Lascarides and Asher, 1993).

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