# A Before-&-After Picture
# of *When-*, *Before-*, and *After*-Clauses

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## 1. The before-picture: Two problems in the interaction between Q-adverbs, *when-*, *before-*, and *after*-clauses, focus, and aspect

Rooth (1985) observes that the interpretation of a sentence like (1) depends on whether the main clause (matrix) or the subordinate *when*-clause is focused. Its two possible readings are illustrated in (2) and (3), respectively.

(1)     John usually shaves when he is in the shower.
(2)     John usually SHAves when he is in the shower.
        'Most times at which J. is in the shower are times at which he shaves.'
(3)     John usually shaves when he is in the SHOwer.
        'Most times at which J. shaves are times at which he is in the shower.'

Rooth (1985) proposes that association with focus is the mechanism by which these two readings are derived: Assuming that a Q-adverb is a relation between two temporal abstracts, the value of its first argument $C$ is derived through the focus structure. If the focus is on the matrix, as in (4), the nonfocused *when*-clause provides the value of $C$. Instead, if the focus is on the *when*-clause, as in (5), the value of $C$ is provided by the nonfocused matrix.

(4)     John usually SHAves when he is in the shower
        $\Rightarrow$ USUALLY $(C)$ $(\lambda t\ [shave(j)\ at\ t \wedge in\text{-}shower(j)\ at\ t \wedge pres(t)])$
        $\Rightarrow$ USUALLY $(\lambda t\ [in\text{-}shower(j)\ at\ t \wedge pres(t)])$ $(\lambda t\ [shave(j)\ at\ t \wedge pres(t)])$
                nonfocused `when`-clause

(5)     John usually shaves when he is in the SHOwer
        $\Rightarrow$ USUALLY $(C)$ $(\lambda t\ [shave(j)\ at\ t \wedge in\text{-}shower(j)\ at\ t \wedge pres(t)])$
        $\Rightarrow$ USUALLY $(\lambda t\ [shave(j)\ at\ t \wedge pres(t)])$ $(\lambda t\ [in\text{-}shower(j)\ at\ t \wedge pres(t)])$
                nonfocused `matrix`

### 1.1. Problem 1: The interaction of Q-adverbs with before- and after-clauses

Partee (1984) points out that an analysis which adopts Stump's (1985) interpretations of the connectives *when*, *before* and *after*, — and this is what Rooth (1985) does — automatically derives wrong truth conditions for (6).[1]

(6)     John usually SHAves before he takes a shower.

That is, if we integrate Stump's translation of *before* under (7) into Rooth's proposal we end up with (8), paraphrased in (9), as the interpretation of (6).

(7)     before $\Rightarrow \lambda P\ \lambda Q\ \lambda t\ \exists t'\ [t < t' \wedge P\ at\ t' \wedge Q\ at\ t]$

(8)     USUALLY $(\lambda t\ \exists t'\ [t < t' \wedge take\text{-}a\text{-}s.(j)\ at\ t' \wedge pres(t')])$ $(\lambda t\ [shave(j)\ at\ t \wedge$
                nonfocused *before*-clause                                    $pres(t)])$

(9)     'For most times t such that t is before a time t' at which J. takes a
        shower, J. shaves at t.'

However, the truth conditions under (8) do not capture the meaning of (6) correctly
because (8) requires that if $t'$ is a time of John taking a shower he must shave at
most times before $t'$. Rather, the meaning of (6) can be paraphrased as follows:

(10)    'For most times t such that J. takes a shower at t, there is a time t' before t
        and J. shaves at t'.'

If we compare this paraphrase with the incorrect one under (9), at first sight the
solution to Partee's problem seems to be a matter of relocating the temporal relation
contributed by the meaning of *before* into the scope of the Q-adverb. This is exactly
what de Swart (1991) proposes: The connective must contribute its temporal
relation to the matrix and, hence, its meaning automatically ends up in the scope of
a Q-adverb. We could incorporate de Swart's solution by assigning the connective
*before* the meaning under (11), in which *before* contributes the existential
quantification of the matrix's event time and not, as in Stump's — and also Rooth's
— (7), of the subordinate clause's event time.[2]

(11)    before $\Rightarrow \lambda P \lambda Q \lambda t \exists t'\ [t' < t \wedge P\ at\ t \wedge Q\ at\ t']$

If we integrate this novel meaning of *before* into Rooth's proposal, we arrive at the
reading paraphrased under (10): The Q-adverb's restrictor is provided by the
subordinate clause minus the relation contributed by *before*. This is shown in (12).

(12)    USUALLY $(\lambda t\ [take\text{-}a\text{-}s.(j)\ at\ t \wedge pres(t)])\ (\lambda t\ \exists t'\ [t' < t\ \wedge shave(j)\ at\ t'\ \wedge$
                nonfocused `before`-clause                                    $pres(t')])$
                without `before`

However, (12) predicts that (6) correctly describes a situation in which a sequence
of three times at which John shaves is followed by a sequence of three times at
which John takes a shower. This prediction runs counter to our intuition: (6) does
not seem to be correctly captured by an interpretation that allows for the possibility
that all the events of shaving precede all the events of showering.[3]
        In addition to this wrong prediction, we are also left with the question of
what happens if the *before*-clause is focused, that is, if according to Rooth the
matrix provides the restriction as in (13).

(13)    John usually shaves before he takes a SHOWer.

The correct meaning of (13), paraphrased in (14), illustrates that the temporal
relation expressed by the connective remains in the scope of the Q-adverb.

(14)    'For most times t such that John shaves at t, there is a t' and t is before t'
        and he takes a shower at t'.'

Sentence (13) should thus be assigned a logical form with the truth conditions in
(14). However, if we integrate the novel translation of *before* in (11) into Rooth's
proposal, we assign (15) as the interpretation of (13).

(15)    USUALLY $(\lambda t\ \exists t'\ [t' < t \wedge shave(j)\ at\ t' \wedge pres(t')])\ (\lambda t\ [take\text{-}a\text{-}s.(j)\ at\ t \wedge$
                nonfocused matrix with `before`                                    $pres(t)])$

The paraphrase of the interpretation derived in (15), namely (16), shows that *usually* quantifies over the times that lie after a shaving of John because — given (11) — the restrictor is provided by the matrix plus the temporal relation contributed by *before*. In other words, the integration of de Swart's solution into Rooth's analysis gives us back what her solution is supposed to solve: Partee's problem.

(16)     # 'For most times t such that t is after a time t' at which John shaves, he takes a shower at t."

Stump (1985) is aware of the fact that his interpretations of *before* and *after* are faced with Partee's problem. He suggests that the meaning of *before* in (7) — and similarly of *after* — be extended by the requirement that t and t' are temporally close. One way to spell out this proposal could be this: t and t' must not be intervened by any contextually relevant time interval. If we incorporate this requirement into Stump's translation of *before*, we get the translation in (17):

(17)     before $\Rightarrow \lambda P \, \lambda Q \, \lambda t \, \exists t' \, [t \angle t' \wedge P \, at \, t' \wedge Q \, at \, t]$
         where $t \angle t'$ holds iff there is no contextually relevant $t''$ such that $t < t'' < t'$

Integrating this alternative *before* into Rooth's proposal gives us (18) as the interpretation of (6):

(18)     USUALLY $(\lambda t \, \exists t' \, [t \angle t' \wedge \textit{take-a-s.}(j) \, at \, t' \wedge pres(t')]) \, (\lambda t \, [\textit{shave}(j) \, at \, t \, \wedge$
                          nonfocused `before`-clause                              $pres(t)])$

Like (8), (18) says that for most times t such that t is before a time t' at which John takes a shower, John shaves at t. But since there is not more than one contextually relevant time before t', namely t, (18) correctly interprets (6). Note also that (18) correctly predicts that (6) cannot describe a situation in which a sequence of three acts of shaving is followed by a sequence of three acts of showering. Partee (1984) rejects a contextually restricted definition of *before* like (17) since it would amount to treating *before* as *just before* and not as *sometime before*. In section 3, I show that her objection does not hold in my implementation of Stump's solution to Partee's problem.

### 1.2.  Problem 2: Not all matrices can provide the restriction of a Q-adverb's domain

Johnston (1994) leads us to a second problem for Rooth's proposal, namely an aspectual problem that arises if a nonfocused matrix is supposed to deliver the restriction of a Q-adverb. Johnston observes that only telic matrices can provide a Q-adverb's restriction and illustrates this with the following contrastive pair.

(20)     Marcia always writes a letter when she is at the CAfe.
         'For every time t such that M. writes a letter at t, she is at the cafe at t.'
(21)     Marcia is always at the cafe when she writes a LETter.
         # 'For every time t such that M. is at the cafe at t, she writes a letter at t.'

Only the telic matrix *Marcia writes a letter* in (20) but not the atelic matrix *Marcia is at the cafe* in (21) can be interpreted as the restriction of *always*.
         Johnston accounts for this discrepancy in the following way. If a Q-adverb's restriction is supposed to be given by the matrix, this restriction is determined through a semantic inheritance process which is based on Johnston's view that in the case of matrix restriction the Q-adverb takes the matrix's eventuality

as its domain.[4] For example, in the initial step of the semantic interpretation of (20) and (21), the Q-adverb binds the matrix's eventuality $e_2$ and the restrictor is empty (indicated as { }). This is shown in (22) for (20), and in (23) for (21).

(22)  always' $e_2$ { } [{$\lambda$i when'$_{e_1}$(at'(m, the cafe, $e_1$)) $\wedge$ i = f($e_1$)}
$\qquad\qquad\qquad\qquad\qquad\qquad$ [write'(m, a letter, $e_2$) $\wedge$ i $\supseteq$ f($e_2$)]]

(23)  always' $e_2$ { } [{ when'$_{e_1}$(write'(m, a letter, $e_1$)) $\wedge$ i = f($e_1$)}
$\qquad\qquad\qquad\qquad\qquad\qquad$ [at'(m, the cafe, $e_2$) $\wedge$ i $\subseteq$ f($e_2$)]]

According to Johnston, it is the binding relation between the Q-adverb and the matrix's eventuality which allows us to copy the matrix's descriptive content into the restrictor. This is shown in (24) for (22), and in (25) for (23).

(24)  always' $e_2$ {write'(m, a letter, $e_2$)} [{$\lambda$i when'$_{e_1}$(at'(m, the cafe, $e_1$))
$\qquad\qquad\qquad$ $\wedge$ i = f($e_1$)} [write'(m, a letter, $e_2$) $\wedge$ i $\supseteq$ f($e_2$)]]

(25)  always' $e_2$ {at'(m, the cafe, $e_2$)}[{when'$_{e_1}$(write'(m, a letter, $e_1$))
$\qquad\qquad\qquad\qquad$ $\wedge$ i = f($e_1$)} [at'(m, the cafe, $e_2$) $\wedge$ i $\subseteq$ f($e_2$)]]

(24) says that for every maximal eventuality of Marcia writing a letter $e_2$, there is an eventuality of Marcia being at the cafe $e_1$ whose runtime $i$ includes $f(e_2)$, the runtime of the letter-writing eventuality. This matches exactly (20)'s matrix restriction reading. Instead, (25) says that for every atelic eventuality of Marcia being at the cafe $e_2$ there is an eventuality of Marcia writing a letter $e_1$ whose runtime $i$ will be contained in $f(e_2)$, the runtime of Marcia being at the cafe. The reason why (25) — which corresponds with the nonexisting matrix reading of (21) — cannot be a correct interpretation of (21) is due to the subinterval property of atelic predicates (Bennett and Partee (1978)). From this property it follows that for each maximal eventuality of Marcia being at the cafe there will be an infinite number of atelic eventualities of Marcia being at the cafe. (25) thus means that each of that infinite number of presences at the cafe will contain an eventuality of Marcia writing a letter and according to Johnston this can never be the case.

$\qquad$ Although atelic predicates cannot provide the restriction of a Q-adverb's domain, atelic *when*-clauses can. An example is given in (26) (see also fn. 4).

(26)  Marcia is always writing a LETter when she is at the cafe.
$\qquad$ 'For every time t such that M. is at the cafe at t, she is writng a letter at t.'

Johnston argues that in (26) it is the contribution of *when* to ensure that the *when*-clause abstracts only over the runtimes of the maximal eventualities of the kind described by the clause with which *when* combines. In this way, the quantifier takes only the runtimes of the maximal eventualities of Marcia being at the cafe as its domain and not the runtimes of the infinite number of subeventualies of her being at the cafe. My problem with this account is that this crucial maximality aspect of *when* becomes fully redundant if we have a telic restrictive *when*-clause.
$\qquad$ A second problem I see in Johnston's account is that, even though (21) cannot get a matrix restriction interpretation, his theory is silent about the fact that this sentence is both a syntactically and semantically well-formed answer to the question *Marcia is always at the cafe when she writes WHAT?*
$\qquad$ Thirdly, the generalization that only telic matrices can provide a Q-adverb's restriction cannot be correct since none of the following telic matrices can.

(27)  Marcia is always writing a letter when she is at the CAfe.
$\qquad$ # 'For every time t such that M. is writing a letter at t, she is at the cafe at t.'

(28)    Marcia is always going to write a letter, when she is at the CAfe.
        # 'For every time t such that M. is going to w. a l. at t, she is at the c. at t.'
(29)    Marcia has always written a letter when she is at the CAfe.
        # 'For every time t such that M. has written a letter at t, she is at the c. at t.'

One may get around the problem raised by (27) and (28) by saying that all predicates with imperfective and prospective aspect are stative and, hence, atelic.[5] But this solution can certainly not cover the inability of the perfect matrix in (29) to provide the restriction of *always* since the traditional test to determine whether *has written a letter* is stative by combining it with a *for*-adverbial fails.

(30)    * Marcia has written a letter for an hour.

I will argue that the idea that only matrices that are unmistakably perfective in the sense of Klein (1994) can provide a Q-adverb's restriction is a more promising descriptive generalization of the aspect facts. Note also that (27) through (29) are well-formed sentences in the same sense as (21).

Finally, Johnston does not provide a uniform semantics of Q-adverbs since they either quantify over eventualites or over time intervals (see fn. 4).

## 1.3. Summary of the before-part of the picture

The conclusions we may draw from our discussion so far are the following.

First, Rooth proposes that the nonfocused material of a sentence provides the restriction of a Q-adverb. The focused material remains in the Q-adverb's scope. Regarding quantificational structures as tripartite structures, (R) shows that Rooth's Q-adverbs quantify over times, more particularly, over situation times.

(R)     Q-ADVERB $t$ [ nonfocused material($t$) ] [ focused material($t$) ]

We have pointed out that Rooth's proposal leads to Partee's problem if *before* or *after* belongs to the nonfocused material and therefore ends up in the restriction of the quantifier. A solution in the sense of de Swart (1991) was shown to be not helpful. Moreover, Rooth's approach to so-called matrix restriction does not account for the fact that atelic matrices cannot restrict a Q-adverb's domain.

Secondly, according to Johnston (1994) subordinate clause restriction leads to quantification over time intervals whilst matrix restriction is a matter of quantification over eventualities. This distinction could be captured in the tripartite structures under (J1) and (J2), respectively.

(J1)    Q-ADV $t$ [ (a)telic *when/before/after*-clause($t$) ] $\exists e$ [ ... (A)TELIC($e,t$) ... ]
(J2)    Q-ADV $e$ [ telic matrix($e$) ] $\lambda t$ [ ... TELIC($e,t$) $\wedge$ *when/before/after*-clause($t$) ]

(J1) and (J2) also capture that *when*-, *before*-, and *after*-clauses describe time intervals. Moreover, (J2) illustrates that if the Q-adverb quantifies over eventualities, the Q-adverb's restriction can only be provided by a telic matrix. However, we have shown that telic matrices with imperfective, prospective, or perfect aspect cannot restrict a Q-adverb either.

I will present a uniform semantics of Q-adverbs in which they always quantify over topic times (see Klein (1994)), together with a uniform semantics of *when-*, *before-*, and *after*-clauses in which these clauses are predicates of contextually unique topic times. As a consequence, Partee's problem vanishes.

Moreover, my solution to Johnston's aspect problem is based on the view that retrieving a Q-adverb's domain restriction is a matter of accommodating backgrounded material into the restrictor (Geurts and van der Sandt (1997)). The fact that a contextual restriction of a Q-adverb can be retrieved only from perfective backgrounded matrices is explained as the consequence of the fact that only the relation expressed by their perfective aspect (Klein (1994)) is compatible with the relation expressed by *when*.

Section 2 integrates Klein's (1994) theory of time in a discourse semantic framework. This provides the background of the after-picture made in section 3.

## 2. A discourse semantic version of Klein (1994)

### 2.1. The basic notions

Klein (1994) distinguishes three temporal parameters: The time of utterance, the time of situation, and the topic time. Whereas the time of situation is the time at which an eventuality described by a sentence occurs, the topic time is the time the sentence talks about. The topic time is thus by definition part of a sentence's presupposed material (i.e., of its topic or background). As an illustration, the scheme in (32) shows that the topic time of (31) is a time span which includes the situation time at which John shaves and which lies before the time of speech.

(31)    John shaved.
(32)    _____{J. shave}_____ time of utt._____ ⟶
            [          topic time        ]

How does Klein's topic time differ from Reichenbach's (1947) notion of reference time? As Kamp and Reyle point out, Reichenbach's notion of reference time has both an anaphoric component, which lies in its role as temporal antecedent or "reference point" (Rpt), and a mediating role, which lies in its contribution as "temporal perspective point" (TPpt) in Kamp and Reyle's interpretation of tense. They define tense as a pair of relations, whose first element is the relation between the TPpt and the time of utterance and whose second element is the relation between the eventuality described and the TPpt. In contrast to the Rpt, Klein's topic time *is* the temporal anaphoric component of an utterance, that is, it is the temporal component which needs an antecedent. In contrast to the TPpt, the topic time is a parameter which contributes to a relational definition of tense *and* to a relational definition of aspect.

In Klein's approach, tense expresses the relation between the topic time and the time of utterance and not, as often assumed, between the time of situation and the time of utterance. The relation expressed by the three tenses PRESENT, PAST and FUTURE are captured in the schema under (33):

(33)    PRESENT : $t_{top} \supseteq t_{utt}$          PAST : $t_{top} < t_{utt}$          FUTURE : $t_{top} > t_{utt}$

Yet another novelty in Klein's approach is that aspect contributes a temporal relation as well, namely, the relation between the topic time and the time of situation. (34) represents the relations expressed by the four grammatical aspects, that is, PERFECTIVE, IMPERFECTIVE, PERFECT and PROSPECTIVE.

(34)    PERFECTIVE : $t_{top} \supseteq t_{sit}$          PROSPECTIVE : $t_{top} < t_{sit}$
        IMPERFECTIVE : $t_{top} \subset t_{sit}$          PERFECT : $t_{top} > t_{sit}$

To formally capture the discourse semantic meaning of an utterance's topic time, I regard a DRT framework in the spirit of Kamp (1981) and Kamp and Reyle (1993) as the most appropriate tool. I make use of the DRT version presented in Geurts and van der Sandt (1997) who enrich this representational theory of meaning with van der Sandt's (1992) binding theory for the anaphoric resolution of presuppositions. In particular, I adopt Geurts and van der Sandt's (1997) Background Presupposition Rule (BPR). This rule states that whenever $\varphi$ is backgrounded, the presupposition is triggered that $\varphi^*$ holds, where $\varphi^*$ is the existential instantiation of $\varphi$. For example, if we focus *John* in *John shaved*, it follows from the BPR that the backgrounded *shaved* presupposes the following:

(35)     'There is an x and x shaved.'

This rule will be extremely useful for analyzing the semantics of focused versus backgrounded *when-*, *before-*, and *after-*clauses.

### 2.2. A DRT with topic times

In the light of example (31), I illustrate how Klein's notion of topic time together with his definitions of tense and aspect as temporal relations can be integrated into a DRT framework. I assume that the syntactic structure of (31) is (36), where *PIVE* stands for PERFECTIVE:

(36)     [$_{\text{TenseP}}$ *PAST$_i$* [$_{\text{AspP}}$ *PIVE$_i$* [$_{\text{VP}}$ John shave$_k$-Asp-Tense ]]]

The aspect and tense morphology on the verb are regarded as linguistic markers of the presence of a syntactic aspect and tense projection, respectively. A full sentence is regarded as a tense phrase (TenseP). The head of the VP bears the situation time index $k$; the heads of the AspP and the TenseP bear the topic time index $i$.

Building up the DRS based on (36), the DRS assigned to the VP shows that the situation time is introduced at the VP level by assigning the variable $t_{sit}$ to $k$.

(37)     [ $t_{sit}$ : j shave at *tsit* ]$_{\text{VP}}$

Note that Geurts and van der Sandt's (1997) notation, which I adopt here, represents a DRS as the pair "[ DRefs : conditions(DRefs) ]" consisting of a set of discourse referents DRefs and the conditions holding of these referents. This is exactly Kamp's (1981) original definition of a DRS.

Given the definition of perfective aspect in (34) and of past tense in (33), and by successively assigning the topic time variable $t_{top}$ to the index $i$ on heads of the AspP and the TenseP, we get the following DRSs of the AspP and the TenseP.[6]

(38)     [ $t_{sit}$, $\underline{t_{top}}$ : j shave at $t_{sit}$, $\underline{t_{top}} \supseteq t_{sit}$ ]$_{\text{AspP}}$
(39)     [ $t_{sit}$, $\underline{t_{top}}$ : j shave at $t_{sit}$, $\underline{t_{top}} \supseteq t_{sit}$, $\underline{t_{top}} <$ t$_{\text{utt}}$ ]$_{\text{TenseP}}$

(39) leaves us with a topic time which, like a discourse referent introduced by a pronoun, needs to be equated with an accessible discourse referent. Geurts and van der Sandt make the fact that an anaphoric element has not been resolved yet visible by underlining it. Their binding theory gives us two options for the resolution of $t_{top}$: Either $t_{top}$ is bound to an accessible temporal antecedent, or $t_{top}$ is accommodated to the highest possible site by which it creates its own antecedent. After the topic time is bound, the TenseP is fully embedded into a temporal context.

## 2.3. When-, before-, and after-clauses

Following Johnston (1994), I interpret *when-*, *before-*, and *after*-clauses as properties of a time interval, more particularly, as predicates holding of the topic time. Focus and syntactic position serve as indicators of whether the predicate contributed by a temporal subordinate clause does or does not belong to the background of an utterance. For instance, if a *when*-clause is not focused and thus backgrounded, as in (40), its descriptive content belongs to the presupposed material of a sentence. In contrast, if a *when*-clause is focused, as in (41), the topic time description it contributes belongs to the asserted material of the sentence.

(40)    John SHAved when he took a shower.
(41)    John shaved when he took a SHOwer.

The fact that in (40) *when he took a shower* is backgrounded and in (41) *John shaved* corresponds with the fact that (40) is an answer to the question *What did John do when he took a shower?* whilst (41) is an answer to the question *When did John shave?*[7] In the syntax, this distinction is made transparent by locating the nonfocused *when*-clause in the specifier position of the TenseP (Spec-TenseP) and the focused clause in Spec-VP.[8] In both cases, the subordinate clause is coindexed with the topic time index $i$, as shown in (42) and (43).

(42)    [$_{TenseP}$ (when$_l$ he took$_l$ a shower)$_i$ $PAST_i$ [$_{AspP}$ $PIVE_i$ [$_{VP}$ John shave$_k$ ]]]
(43)    [$_{TenseP}$ $PAST_i$ [$_{AspP}$ $PIVE_i$ [$_{VP}$ (when$_l$ he took$_l$ a shower)$_i$ John shave$_k$ ]]]

These transparent syntactic structures deliver an appropriate input to the DRS construction of (40) and (41). In (44), which is (40)'s initial step in the construction of its DRS, the *when*-clause belongs to the underlined background. (45), which is (41)'s initial DRS, captures that the matrix is backgrounded.

(44)    [ $t_{sit}$, $\underline{t_{top}}$ : j shave at $t_{sit}$, $\underline{when_l\text{-J.-took}_l\text{-a-s.}(t_{top})}$, $t_{top} \supseteq t_{sit}$, $t_{top} < t_{utt}$ ]
(45)    [ $\underline{t_{sit}}$, $\underline{t_{top}}$ : $\underline{j\ shave\ at\ t_{sit}}$, $when_l\text{-J.-took}_l\text{-a-s.}(\underline{t_{top}})$, $\underline{t_{top} \supseteq t_{sit}}$, $\underline{t_{top} \leq t_{utt}}$ ]

(44) and (45) each contain an unreduced DRS condition, namely the topic time predicate contributed by the respective *when*-clauses. These conditions make visible yet another crucial semantic aspect of temporal connectives, namely the fact that a subordinate clause's situation time is presupposed to exist (Heinemäki (1978)). This aspect I capture by underlining the temporal index on the connective, namely $\underline{l}$, and by coindexing *when* with the situation time of the clausal complement. The underlining of the index indicates that *when* turns the subordinate clause's asserted situation time into a presupposed situation time. Furthermore, assuming that the connective *when* expresses inclusion between the topic time and the situation time of *when*'s clausal complement, and interpreting aspect and tense of this clausal complement as proposed before, we expand the respective unreduced DRS conditions in (44) and in (45) as follows:

(46)    [ $t_{sit}$, $\underline{t_{top}}$, $t_{sit}'$ , $\underline{t_{top}'}$ : j shave at $t_{sit}$, $t_{top} \supseteq t_{sit}$, $t_{top} < t_{utt}$,
            $\underline{t_{top}' \supseteq t_{sit}'}$, $\underline{j\ take\ a\ shower\ at\ t_{sit}'}$, $\underline{t_{top}' \supseteq t_{sit}'}$, $\underline{t_{top}' \leq t_{utt}}$ ]
(47)    [ $\underline{t_{sit}}$, $\underline{t_{top}}$, $t_{sit}'$ , $\underline{t_{top}'}$ : $\underline{j\ shave\ at\ t_{sit}}$, $\underline{t_{top} \supseteq t_{sit}}$, $\underline{t_{top} < t_{utt}}$,
            $\underline{t_{top} \supseteq t_{sit}'}$, j take a shower at $\underline{t_{sit}'}$, $\underline{t_{top}' \supseteq t_{sit}'}$, $\underline{t_{top}' < t_{utt}}$ ]

In (46) and (47), the situation time variable $t_{sit}'$ has been assigned to the syntactic index $l$. The presuppositions associated with the DRSs (46) and (47) are given in

(48) and (49), respectively, and these paraphrases correspond with the presuppositions of (40) and (41).

(48)    'There was a $t_{top}$ which includes a $t_{sit}$' at which John takes a shower.'
(49)    'There was a $t_{top}$ which includes a $t_{sit}$ at which John shaves.'

Note that in (48) the presupposed inclusion relation is contributed by the connective *when*, whereas in (49) it is contributed by the perfective aspect of *shaved*. This point will be crucial in our solution to Johnston's aspect problem below.

A major advantage of interpreting *when*-clauses as topic time predicates is that it leaves open the exact relation between the situation time of the matrix and the situation time of the subordinate clause. In the literature, it has often been pointed out that *when* does not only allow for coincidence between these two situation times but also for precedence and posteriority. This is shown in the following examples taken from Partee (1984) and Heinemäki (1978), respectively:

(50)    a.   When Smith spoke, Jones introduced him.
        b.   When John wrecked the car, Bill fixed it.

The present account of *when* does not determine the relation between the situation times involved and as such it leaves this issue underdetermined.

Turning now to the interpretation of the connectives *before* and *after*, the intended readings of (51) and (52) make overt that a *before/after*-clause identifies the topic time as a unique pretime/posttime of the subordinate clause's situation time.[9]

(51)    John SHAved before/after he took a shower.
        'There was a topic time t, namely the pretime/posttime of the sit. time t' at which J. took a shower, and t includes a sit. time t" at which he shaves.'
(52)    John shaved before/after he took a SHOwer.
        'There was a topic time t, namely the time including a sit. time t" at which J. shaves, and t is the pretime/posttime of the sit. time at which he took a s.'

To capture this uniqueness aspect in the meaning of *before* and *after*, I make use of the proximity condition of the kind expressed in (17) by saying that *before* and *after* hold between a topic time $t$ and a situation time $t'$ iff no contextually relevant topic time $t''$ intervenes between $t$ and $t'$. This meaning aspect will turn out to be relevant when we arrive at our solution to Partee's problem in the next section.[10] Note in this respect that *before* and *after* do not mean *just before* and *just after* in any literal sense. That is, from our interpretation of *before* and *after* it does not follow that (53a) means (53b). The examples were given to me by S. Zucchi.

(53)    a.   Alexander of Macedon died after his father Philip died. (true)
        b.   Alexander of Macedon died just after his father Philip died. (false)

(53a) means that the topic time within which Alexander's dying is located is some time interval after the time at which his father died. Given that by the definition of *after* no contextually relevant time must intervene between the topic time of (53a) and Philip's death, this topic time is interpreted as a particular time after Philip's death. What the particle *just* in (53b) seems to add is that for the interpretation of a *just after*-clause we need a notion of proximity which is stricter than contextual proximity. One way to integrate this idea of stricter proximity is by requiring that the first element of the matrix's topic time interval coincides with the final element

of the situation time interval of the *just after*-clause. This still allows for posteriority between the matrix's situation time and the subordinate clause's situation time.

## 3. The After-Picture: Q-adverbs and the restriction of their domain

We are now in a position to shoot our after-picture which will show how the present perspective helps us in solving the problems that arise with restricting the domain of a Q-adverb as sketched in section 1. It also allows us to draw a novel distinction between restrictive and nonrestrictive temporal subordinate clauses.

### 3.1. The domain of Q-adverbs

Since the domain of a quantifier is arguably presupposed, I assume that a Q-adverb quantifies over the topic time of an utterance which is always a part of this utterance's background. With this assumption, *John always SHAved* means that all contextually relevant topic times in the past include a situation time at which John shaves. (54), the DRS standing for the meaning of *always*, illustrates that a Q-adverb creates a duplex condition thereby binding the topic time of a TenseP and taking this TenseP in its scope.

(54)    [ $t_{top}$ : when$_k$-C$_k$($t_{top}$) ] < always $t_{top}$ > [ : TenseP($t_{top}$) ]

(54) also shows that the domain of *always* can be restricted by a contextually determined *when*-clause when$_k$-C$_k$. Applying (54) to *John SHAved* (see (39)) yields (55), the DRS of *John always SHAved*:

(55)    [ $t_{top}$ : when$_k$-C$_k$($t_{top}$) ]<always $t_{top}$>[ $t_{sit}$ : j s. at $t_{sit}$, $t_{top} \supseteq t_{sit}$, $t_{top} <$ t$_{utt}$ ]

(55) says that each topic time which is restricted by a contextually relevant predicate *when$_k$-C$_k$* includes a situation time at which John shaves and precedes the time of speech. Note that in (55) the Q-adverb's domain is not restricted. The way in which a value of $C_k$ can be retrieved from the linguistic context is our next topic. Note also that below we will find cases in which in addition to the topic time other temporal parameters can belong to the background. These additional parameters will be existentially bound in the restrictor since, unlike the topic time, they are not bound by *always* (see Kamp and Reyle (1993): 420-425).

### 3.2. Restricting the domain of Q-adverbs: A solution to the aspect problem

Retrieving the restriction of a Q-adverb's domain leads us back to Rooth's pair of examples (2) and (3), repeated here as (57) and (58):

(57)    John usually SHAves when he is in the shower.
(58)    John usually shaves when he is in the SHOwer.

We will begin with the interpretation of (57), the case in which the matrix is focused. The syntactic structure assigned to (57) is (59).

(59)    [ usually$_i$ [$_{TenseP}$ (when$_l$ he is$_l$ in the s.)$_i$ *PRES$_i$* [$_{AspP}$ *PIVE$_i$* [$_{VP}$ J. s.$_k$ ]]]]

In (59), the quantifier *usually* is adjoined to the TenseP and together with the *when*-clause it bears the topic time index $i$. This syntactic information serves as the input for the construction of (57)'s initial DRS given in (60).

(60)    [ $t_{top}$ : when$_\underline{k}$-C$_k$($t_{top}$) ] < usually $t_{top}$ > [ $t_{sit}$ : j shave at $t_{sit}$, $t_{top} \supseteq t_{sit}$,
$t_{top} \supseteq$ t$_{utt}$, when$_\underline{l}$ he is$_\underline{l}$ in the shower($t_{top}$) ]

The complete TenseP first lands in the scope of *usually*. The *when*-clause in Spec-TenseP is identified as backgrounded material. Since the *when*-clause is a predicate of $t_{top}$, the *when*-clause's content cannot be accommodated higher than at the site at which this topic time is bound. Hence, it is accommodated into the restrictor, as shown in (61):

(61)    [ $t_{top}$ : when$_\underline{k}$-C$_k$($t_{top}$), when$_\underline{l}$ he is$_l$ in the shower($t_{top}$) ] < usually $t_{top}$ >
[ $t_{sit}$ : j shave at $t_{sit}$, $t_{top} \supseteq t_{sit}$, $t_{top} \supseteq$ t$_{utt}$ ]

Because we have an overt topic time predicate in (61), there is no urge to retrieve a contextual value of $C_k$. Hence, (61) is equivalent with (62) and a final construction step expands the unreduced *when*-clause as in (63):[11]

(62)    [ $t_{top}$ : when$_\underline{l}$ he is$_l$ in the shower($t_{top}$) ] < usually $t_{top}$ >
[ $t_{sit}$ : j shave at $t_{sit}$, $t_{top} \supseteq t_{sit}$, $t_{top} \supseteq$ t$_{utt}$ ]
(63)    [ $t_{top}$, $t_{top}'$, $t_{sit}'$ : $t_{top} \supseteq t_{sit}'$, j be in the s. at $t_{sit}'$, $t_{top}' \subset t_{sit}'$, $t_{top}' <$ t$_{utt}$ ]
< usually $t_{top}$ > [ $t_{sit}$ : j shave at $t_{sit}$, $t_{top} \supseteq t_{sit}$, $t_{top} \supseteq$ t$_{utt}$ ]

It is thus the resolution of the backgrounded *when*-clause which automatically provides a domain restriction. Note that in (63) $t_{sit}'$ has been assigned to $l$ and that $t_{sit}'$ is existentially bound in the restrictor. Note also that aspect, that is, the relation expressed by the perfective matrix ($t_{top} \supseteq t_{sit}$), contributes the crucial domain-scope relator.

Now we turn to the interpretation of Rooth's example (58) whose *when*-clause is focused. (64) is (58)'s syntactic structure and this structure is the input to the construction of its intitial DRS, namely (65).

(64)    [ usually$_i$ [$_{TenseP}$ *PRES$_i$* [$_{ASPP}$ *PIVE$_i$* [$_{VP}$ (when$_l$ he is$_l$ in the s.)$_i$ J. s.$_k$ ]]]]
(65)    [ $t_{top}$ : when$_\underline{k}$-C$_k$($t_{top}$) ] < usually $t_{top}$ > [ $t_{sit}$ : j shave at $t_{sit}$, $t_{top} \supseteq t_{sit}$,
$t_{top} \supseteq$ t$_{utt}$, when$_\underline{l}$ he is$_l$ in the shower($t_{top}$) ]

Given that in (64) the *when*-clause is in Spec-VP, (65) makes overt that this *when*-clause contributes a topic time predicate that is not backgrounded. But how do we derive the restriction of a Q-adverb if the background does not contain an overt topic time predicate? If we follow Rooth, the restriction must be provided by the nonfocused matrix. In the present proposal, this means that the matrix provides the value of $C_k$. However, Johnston argues that Rooth's association with focus mechanism is too strong since an atelic matrix cannot restrict a Q-adverb's domain (see (20) vs. (21)). According to Johnston, telicity is the clue to find the value of $C_k$. However, I pointed out in section 1.2 that Johnston's generalization in terms of telicity is not adequate because telic matrices with imperfective, prospective, or perfect aspect cannot deliver a Q-adverb's domain restriction either (see (27) through (29)). Hence, Johnston's association with lexical aspect is too strong as well. So the question we are left with is: When can a matrix provide the restriction of a Q-adverb? My answer is that a backgrounded matrix can do so iff this matrix

expresses the perfective aspect relation. The reason is that only this aspectual relation does not contradict the meaning of *when$_k$*. Here is why.

Since in (65) the backgrounded matrix contains occurrences of the topic time variable $t_{top}$, we accommodate this matrix at the site at which $t_{top}$ is bound, which in this case is the restrictor. More particularly, the matrix substitutes the clausal variable $C_k$, the matrix's situation time $t_{sit}$ is assigned to the index $k$, and $t_{sit}$ is existentially bound in the restrictor. All three steps are illustrated in (66):

(66)    [ $t_{top}$ $t_{sit}$ : when$_{tsit}$-j shave at $t_{sit}(t_{top})$, $t_{top} \supseteq t_{sit}$, $t_{top} \supseteq t_{utt}$ ] < usually $t_{top}$ >
                                    [ : when$_l$ he is$_l$ in the shower($t_{top}$) ]

As a next step, we expand the contextually retrieved *when*-clause in the restrictor as well as the overt *when*-clause in the scope by which it becomes explicit that the presupposed situation time $t_{sit}'$ assigned to $l$ is locally accommodated in the scope. Moreover, the relation contributed by *when$_l$* is the crucial domain-scope relator in the quantificational structure ($t_{top} \supseteq t_{sit}'$).

(67)    [ $t_{top}$, $t_{sit}$ : $t_{top} \supseteq t_{sit}$, j shave at $t_{sit}$, $t_{top} \supseteq t_{sit}$, $t_{top} \supseteq t_{utt}$ ] < usually $t_{top}$ >
        [ $t_{sit}'$, $t_{top}'$ : $t_{top} \supseteq t_{sit}'$, j be in the shower at $t_{sit}'$, $t_{top}' \subset t_{sit}'$, $t_{top}' < t_{utt}$ ]

What is important in (67) is that in the restrictor the condition contributed by perfective aspect, namely $t_{top} \supseteq t_{sit}$, is identical with the semantic contribution of *when$_{tsit}$*, that is, $t_{top} \supseteq t_{sit}$. (67) is thus equivalent with (68):

(68)    [ $t_{top}$, $t_{sit}$ : j shave at $t_{sit}$, $t_{top} \supseteq t_{sit}$, $t_{top} \supseteq t_{utt}$ ] < usually $t_{top}$ >
        [ $t_{sit}'$, $t_{top}'$ : $t_{top} \supseteq t_{sit}'$, j be in the shower at $t_{sit}'$, $t_{top}' \subset t_{sit}'$, $t_{top}' < t_{utt}$ ]

(68) correctly captures the truth conditions of (58) by saying that for every topic time $t_{top}$ such that it includes a situation time $t_{sit}$ at which John shaves, there is another situation time $t_{sit}'$ in this topic time at which he takes a shower.

A backgrounded matrix provides a predicate of the topic time if and only if its aspect is perfective, that is, denotes inclusion ($\supseteq$) between $t_{top}$ and $t_{sit}$. If a backgrounded matrix comes in the imperfective, which means that the relation between $t_{top}$ and $t_{sit}$ is the proper subset relation ($\subset$), its accommodation leads to a contradiction in the contextually retrieved *when*-clause. To illustrate this, we turn to (27), repeated here as (69), and we suppose that the initial DRS of (69) is (70).

(69)    Marcia is always writing a letter when she is at the CAfe.
(70)    [ $t_{top}$ : when$_k$-$C_k(t_{top})$ ] < always $t_{top}$ > [ $t_{sit}$ : m write a l. at $t_{sit}$, $t_{top} \subset t_{sit}$,
                                    $t_{top} \supseteq t_{utt}$, when$_l$ she is$_l$ at the cafe($t_{top}$) ]

Accommodating the backgrounded matrix into the restrictor gives us (71).

(71)    [ $t_{top}$ $t_{sit}$ : when$_{tsit}$-m write a letter at $t_{sit}(t_{top})$, $t_{top} \subset t_{sit}$, $t_{top} \supseteq t_{utt}$ ]
                            < always $t_{top}$ > [ : when$_l$ she is$_l$ at the cafe($t_{top}$) ]

If we expand the contextually derived *when*-clause as in (72), we see that the restrictor contains a contradiction: The information contributed by the matrix's imperfective aspect says that $t_{top} \subset t_{sit}$ whilst the connective *when$_{tsit}$* says the opposite, namely, $t_{top} \supseteq t_{sit}$.

(72)    [ $t_{top}$, $t_{sit}$ : $t_{top} \supseteq t_{sit}$, m write a letter at $t_{sit}$, $t_{top} \subset t_{sit}$, $t_{top} \supseteq t_{utt}$ ]
                            < always $t_{top}$ > [ : when$_l$ she is$_l$ at the cafe($t_{top}$) ]

Still, (69) is an interpretable sentence but only as an answer to the question *Marcia is always writing a letter when she is WHERE?* In other words, the *when*-clause is a second mentioned topic time predicate of which one component, namely the location of the subordinate eventuality, was not understood when the *when*-clause was mentioned first.[12] (69) thus triggers the presupposition under (73), which shows that the quantificational structure as a whole belongs to the background:

(73)    $[ x : [ t_{top}\ t_{sit}' : \text{when}_{tsit'}$ she is at $x$ at $t_{sit}'(t_{top}) ] < \text{always } t_{top} >$
$[ t_{sit} : \text{m write a letter at } t_{sit},\ t_{top} \subseteq t_{sit},\ t_{top} \supseteq t_{utt} ] ]$

The focus on *the CAfe* in (69) indicates that the speaker wants to complete an already backgrounded predicate of the topic time, namely *when$_{tsit'}$ she is at $x$ at $t_{sit}'(t_{top})$*.

A matrix with prospective aspect or a matrix with perfect aspect cannot provide the contextual restriction of a topic time either: Neither in (28) nor in (29) — here repeated as (74) and (75) — is the matrix able to contribute the restriction of the domain of *always* and can the matrices be used to retrieve a topic time predicate.

(74)    Marcia is always going to write a letter when she is at the CAfe.
(75)    Marcia has always written a letter when she is at the CAfe.

Suppose that the initial DRSs of these examples are as follows.

(76)    $[ t_{top} : \text{when}_k\text{-}C_k(t_{top}) ] < \text{always } t_{top} > [ \underline{t_{sit}} : \underline{\text{m write a letter at } t_{sit}},$
$\underline{t_{top} < t_{sit}},\ \underline{t_{top} \supseteq t_{utt}},\ \text{when}_l$ she is$_l$ at the cafe$(t_{top}) ]$
(77)    $[ t_{top} : \text{when}_k\text{-}C_k(t_{top}) ] < \text{always } t_{top} > [ \underline{t_{sit}} : \underline{\text{m write a letter at } t_{sit}},$
$\underline{t_{top} > t_{sit}},\ \underline{t_{top} \supseteq t_{utt}},\ \text{when}_l$ she is$_l$ at the cafe$(t_{top}) ]$

(76) shows that in the case of prospective aspect the topic time precedes the matrix's situation time ($t_{top} < t_{sit}$). (77) shows that in the case of perfect aspect the topic time follows the matrix's situation time ($t_{top} > t_{sit}$). If we accommodate the backgrounded matrices into the restriction and use them as the value of $C_k$ and expand the contextually derived *when*-clauses, the resulting DRSs (78) and (79) make visible that these derived topic time predicates contain contradictory information: Whereas *when$_k$* contributes the condition $t_{top} \supseteq t_{sit}$, prospective and perfect aspect contribute the conditions $t_{top} < t_{sit}$ and $t_{top} > t_{sit}$, respectively.

(78)    $[ t_{top}, t_{sit} : t_{top} \supseteq t_{sit},\ \text{m write a letter at } t_{sit},\ t_{top} < t_{sit},\ t_{top} \supseteq t_{utt} ]$
$< \text{always } t_{top} > [ : \text{when}_l$ she is$_l$ at the cafe$(t_{top}) ]$
(79)    $[ t_{top}, t_{sit} : t_{top} \supseteq t_{sit},\ \text{m write a letter at } t_{sit},\ t_{top} > t_{sit},\ t_{top} \supseteq t_{utt} ]$
$< \text{always } t_{top} > [ : \text{when}_l$ she is$_l$ at the cafe$(t_{top}) ]$

This result answers the question of why prospective and perfect matrices cannot restrict the quantifier: In the restrictor, the aspect relations contributed by these matrices contradict the meaning of *when*. Again, the only way to interpret (74) and (75) is by understanding the *when*-clauses as second mentioned topic time predicates in which the location of the eventuality described is focused.

Finally, the atelic matrix in Johnston's example (21), repeated here as (80), cannot provide the restriction of a Q-adverb's domain for the same reason as the imperfective matrix in (69) cannot.

(80)    Marcia is always at the cafe when she writes a LETter.

As pointed out in fn. 11, the perfective form of the verb *to be* is ambiguous between a perfective and an imperfective interpretation. The presence of the *when-*clause in (80) forces us to interpret the verb *is* as expressing imperfective aspect. If we assume that the imperfective matrix *is at the cafe* delivers the restriction of the domain of *always*, the contextually derived *when-*clause contains a contradiction, as shown in the following DRS of (80):

(81)    [ $t_{top}$, $t_{sit}$ : $t_{top} \supseteq t_{sit}$, m be at the cafe at $t_{sit}$, $t_{top} \subset t_{sit}$, $t_{top} \supseteq t_{utt}$ ]
        $<$ always $t_{top}$ $>$ [ : when$_l$ she writes$_l$ a letter($t_{top}$) ]

The only way to interpret (80) is by understanding the overt *when-*clause as a second mentioned topic time predicate in which only the object argument of the eventuality in the *when-*clause is focused. (80) is thus a possible answer to *Marcia is always at the cafe when she writes WHAT?*

In sum, a backgrounded matrix can deliver the complement of a contextually derived *when-*clause iff this matrix's aspect is compatible with the relation contributed by the embedding *when$_k$*. As we have seen, only perfective aspect is.

### 3.3. Q-adverbs and before- and after-clauses: A solution to Partee's problem

In this section, we move to the other major problem addressed in this paper, namely, Partee's problem. In section 1.1, we have seen that integrating de Swart's solution into Rooth's association with focus mechanism is deemed to fail: It recreates Partee's problem.

From the analysis of temporal subordinate clauses in section 2.3, it follows that like in Stump (1985), but unlike in de Swart (1991), *before* and *after* contribute their meaning to the meaning of the clause they structurally belong to, namely, to the subordinate clause. Given that we have adopted a version of Stump's repair of Partee's problem, i.e., by imposing a proximity condition on the topic time described by a *before-* or *after-*clause (see (17) and section 2.3), we will not run into Partee's problem if a nonfocused *before-* or *after-*clause restricts a Q-adverb's domain. We illustrate this by means of (82):

(82)    John usually SHAves before he takes a shower.

The initial DRS of (82) in (83) illustrates that *usually* is quantifying over topic times, which are accurately described by the backgrounded *before-*clause. By accommodating this clause we get a restrictor for free, as shown in (84).

(83)    [ $t_{top}$ : when$_k$-C$_k$($t_{top}$) ] $<$ usually $t_{top}$ $>$ [ $t_{sit}$: j shave at $t_{sit}$, $t_{top} \supseteq t_{sit}$,
                    $t_{top} \supseteq t_{utt}$, before$_l$ he takes$_l$ a shower($t_{top}$) ]
(84)    [ $t_{top}$ : before$_l$ he takes$_l$ a shower($t_{top}$) ] $<$ usually $t_{top}$ $>$ [ $t_{sit}$ : j shave at $t_{sit}$,
                    $t_{top} \supseteq t_{sit}$, $t_{top} \supseteq t_{utt}$ ]

Expanding the *before-*clause as in (85) makes clear that Partee's problem does not arise since we interpret *before* in such a way that it guarantees that we are only quantifying over unique pretimes.

(85)    [ $t_{top}$, $t_{sit}'$, $t_{top}'$ : $t_{top} \angle t_{sit}'$, j take a shower at $t_{sit}'$, $t_{top}' \supseteq t_{sit}'$, $t_{top}' \supseteq t_{utt}$ ]
        $<$ usually $t_{top}$ $>$ [ $t_{sit}$ : j shave at $t_{sit}$, $t_{top} \supseteq t_{sit}$, $t_{top} \supseteq t_{utt}$ ]

(85) says that each pretime of John taking a shower contains a situation time at which John shaves. Since there is not more than one contextually relevant pretime

for each situation time of the *before*-clause, (85) correctly interprets (82). A relocation of the meaning of *before* as proposed in de Swart (1991) is therefore not needed. Moreover, (85) correctly captures that (82) does not describe a situation in which a sequence of three shavings is followed by a sequence of three showerings.

### 3.4. Restrictive versus nonrestrictive when-clauses

The view that temporal subordinate clauses are descriptions of times allows us to draw a further distinction in the class of *when-*, *before-*, and *after*-clauses, namely, a distinction between restrictive and nonrestrictive subordinate clauses. The semantic literature largely follows Lewis (1975) in regarding *when*-clauses as restrictors of Q-adverbs. We have seen that this is not necessarily the case. In particular, *when*-clauses that are not backgrounded remain in the scope of a quantifier. In closing this paper, I point out yet another appearance of *when*-clauses in which they do not restrict the domain of a Q-adverb, and I illustrate this by the ambiguity of (86) and (87).

(86)    A couple of times when John was in the shower, he shaved.
     i.   'Some of the times at which J. was in the shower, he shaved.'
     ii.  'Some times, and these were all times J. was in the s., he shaved.'

(87)    Once when I arrived in Nijmegen, I wished I lived in a sunny place.
     i.   'One of the times I arrived in N., I wished I lived in a sunny place.'
     ii.  'One time, and this was a time I arrived in N., I wished I lived
        in a sunny place.'

In (86i), the *when*-clause restricts *a couple of times* but in (86ii) it is understood more like its apposition. The same can be said about the interaction of the *when*-clause with *once* in (87). Note that the two readings correspond to a difference in intonational contour. This is illustrated for (86i) in (88), and for (86ii) in (89).

(88)    A couple of times when John was in the shower, he shaved.
(89)    A couple of times, when John was in the shower, he shaved.

The intonational potential of *when*-clauses reminds of the "comma intonation" test to distinguish restrictive relatives from nonrestrictive ones (see McCawley (1988)).

(90)    At the party, Margret met five men who were lawyers.
(91)    At the party, Margret met five men, who were lawyers.

This intonational correspondence with modifying clauses in the nominal domain suggests the existence of a restrictive versus nonrestrictive distinction in the class of temporal subordinate clauses.

     Yet another test for distinguishing restrictive from nonrestrictive relative clauses described in McCawley (1988) points towards the same suggestion. Unlike restrictive relative clauses, nonrestrictive relative clauses cannot combine with a genuine quantifier. The contrast between (92) and (93) illustrates this test.

(92)    Everyone who is a lawyer, likes arguing.
(93)    * Everyone, who is a lawyer, likes arguing.

Like their nominal counterparts, genuine Q-adverbs cannot combine with nonrestrictive *when*-clauses either. A case in point is *usually*.

(94)    Usually when I arrived in Nijmegen, I wished I lived in a sunny place.
(95)    * Usually, when I arrived in Nijmegen, I wished I lived in a sunny place.[13]

Doron (1993) addresses two distinctive properties of nonrestrictive nominal clauses, namely, maximality and uniqueness. Maximality captures the fact that for instance in (91) the men Margret meets at the party and the lawyers are identical: Except for lawyers, Margret doesn't meet any other men. This is not the case in (90), where the relative clause is restrictive: Most likely, Margret has met other men which weren't lawyers. Interestingly, maximality is also triggered by the nonrestrictive *when*-clause in (89): John shaved a couple of times and all those times were times at which he was in the shower. In contrast, the restrictive *when*-clause in (88) clearly does not yield a maximality effect.

Doron uses the contrast between (96) and (97) to illustrate uniqueness as the second distinctive property of nonrestrictive nominal clauses.

(96)    There is a doctor in Manchester, a Welsh woman.
(97)    There is a doctor in Manchester who is a Welsh woman.

The presence of the nonrestrictive clause *a Welsh woman* in (96) gives rise to the interpretation that there is only one doctor in Manchester, namely one who is both Welsh and female. In contrast, the restrictive clause in (97) does not give rise to this uniqueness effect. Similarly, under its nonrestrictive reading the *when*-clause in (87) gives rise to a uniqueness effect: There was only one arrival in Nijmegen and at that time I wished I lived in a sunny place. On its restrictive interpretation, there may have been many arrivals and only at one occasion my desire arose.

From the fact that *when*-clauses and relative clauses behave the same way under particular tests, and from the fact that some *when*-clauses demonstrate the same distinctive properties as nonrestrictive relative clauses, I conclude that the restrictive/nonrestrictive distinction must be adopted for temporal subordinate clauses as well. However, this is only possible if they are regarded as predicates of time intervals. This is exactly what the present proposal does. Moreover, the ambiguity of (86) and (87), and the ungrammaticality of (95) show that one of the useful consequences of drawing the restrictive/nonrestrictive distinction in the class of *when*-clauses is that it gives us a means of distinguishing indefinite temporal adverbials (e.g. *a couple of times*, *once*) from genuine Q-adverbs (e.g. *usually*).

## 4.    Conclusion: The complete before-&-after picture

In this paper, I presented a uniform semantics of temporal Q-adverbs: They bind topic times. *When-*, *before-*, and *after*-clauses have been analyzed as predicates of the matrix's topic time that are backgrounded or not. A Q-adverb's domain can be restricted by accommodating a backgrounded *when-*, *before-*, or *after*-clause into the restrictor. If no such clause is available, the domain restriction of a Q-adverb's can be retrieved from the backgrounded matrix iff this matrix's aspect is perfective in the sense of Klein (1994).

First, these provisions lead to a straightforward solution of Johnston's aspect problem: Whether a Q-adverb's domain can be restricted by means of a backgrounded matrix or not depends on whether the relation this matrix's aspect contributes is compatible with restrictive *when*. Secondly, Partee's problem vanishes because of the fact that *before* and *after* are defined in terms of Stump's contextual proximity. Finally, adopting the restrictive/nonrestrictive distinction for

temporal subordinate clauses widens our understanding of what are the common characteristics of the nominal and the verbal domain (see Bach et al. (1995)).

## Endnotes

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[1] More precisely, Stump assigns *when, before,* and *after* in episodic sentences meanings that are distinct from the meanings assigned to these connectives in quantified sentences. Rooth gives a uniform semantics of the temporal connectives which is based on Stump's episodic connectives and that is how Rooth inherits Partee's problem. Note also that Stump was aware of this problem. I will outline his solution below.

[2] In de Swart's analysis, Q-adverbs quantify over events and not over event times. This is not relevant here since it is the spirit of her solution which counts.

[3] Johnston (1994) makes a similar observation. I discuss his solution, which is also argued to solve Partee's problem, in fn. 10.

[4] In the case of *when*-clause restriction, a Q-adverb directly quantifies over the time intervals described by the *when*-clause. An illustration is Johnston's example (i).
(i)      Marcia always writes a LETter when she is at the cafe.
         "For every time t such that Marcia is at the cafe at t, she writes a letter at t."

[5] In fact, Johnston (1997) accounts for why imperfective matrices cannot restrict a Q-adverb's domain by extending his 1994 account for atelic matrices to matrices with imperfective aspect. Still, an account based on the subinterval property of atelic eventualities can never be extended towards perfect telic matrices (see (29)).

[6] The time of utterance $t_{utt}$ and names are treated as constants.

[7] Focus on the adverbial can also indicate a case of so-called second mentioning. In this case, (41) is an answer to the question *John shaved when he did WHAT?* The *when*-clause is then a second mentioned constituent and it is both presupposed that John shaved and that meanwhile he did something else.

[8] According to Johnston the availability of two syntactic sites for temporal adverbials "does not have significant consequences for the interpretation of episodic uses of *when,* ... [Johnston (1994): 28]." In my approach, it does since the syntactic position triggers whether the temporal adverbial belongs to the background or not, irrespective of whether a Q-adverb is present or not. In this way, we capture that only focused *when*-clauses can answer a *when*-question.

[9] I only discuss factual *before*. For nonfactual *before*, see Ogihara (1995).

[10] Johnston wants to solve Partee's problem in terms of uniqueness as well. He requires that the right boundary of the time interval described by a *before*-clause, the so-called foremath, precedes the initial time point of the runtime of the eventuality of the *before*-clause. The foremath's left boundary must be right after the final point of the runtime an eventuality that is of the same type as the one in the *before*-clause. However, given that time is dense there will always be a time interval between two intervals that precede or follow each other. Therefore, it cannot follow from Johnston's proposal that the foremath of an eventuality is unique.

[11] According to Klein (1994), the perfective form of the verb *to be* is semantically ambiguous between imperfective and perfective aspect. As Klein points out, *Burton was in Mecca* can either mean that for a particular topic time in the past it holds that Burton is in Mecca ($t_{top} \subset t_{sit}$), or that in a very large topic time interval, e.g. the whole past, there is a situation time at which Burton is in Mecca ($t_{top} \supseteq t_{sit}$). The

perfective interpretation captures the mere fact that Burton was in Mecca (the Hadji reading). If we combine *Burton was in Mecca* with a *when*-clause, as in (i), *was* receives only the imperfective interpretation since the subordinate clause makes automatically clear that (i) can impossibly talk about the whoile past.

(i)      Burton was in Mecca when we tried to reach him.

Following Klein, I let the verb *is* in (57) contribute imperfective aspect in (63).

[12] Of course, such an interpretation is also available for (58).

[13] The *when*-clause in (95) can be interpreted episodically, namely as a predicate of a particular time interval in the past. *Usually* can then be understood as quantifying over the posttime of the arrival in the *when*-clause. In this case, the *when*-clause is not in the scope of the Q-adverb and, hence, not structurally combined with it.


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