Phrasal complements of *before* and *after*

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1 Introduction

The temporal connectives *before* and *after* can combine with complements of different semantic types. The examples in (1) illustrate this.

(1)   a.   Mary arrived before/after 6 o'clock.
        b.   Mary left before/after the meeting.
        c.   Mary arrived before/after John left.
        d.   Mary arrived before/after John.

In (1-a), the complement of *before/after* is an expression denoting a time, while it denotes an event in (1-b). *Before* and *after* can also take clausal complements, as in (1-c). Finally, (1-d) illustrates that what looks superficially like a DP denoting an individual can also serve as complement.

The literature on *before* and *after* has focused on cases like (1-b) and (1-c) (Pratt and Francez, 2001; von Stechow, 2002; Beaver and Condoravdi, 2003; Artstein, 2005). Instances of *before* and *after* like (1-d), where the complement is *prima facie* a DP denoting an individual, have received little attention. One of the few places where the construction is discussed is von Stechow and Beck (2007). This analysis is in the context of pluriactionality, in terms of events and not easily compared with the approach taken in this paper, which is in temporal terms.[1]

Such phrasal complements of *before/after* pose interesting challenges for the syntax/semantics interface. Their analysis is the main concern of this paper. The question, in particular, arises whether the complement in (1-d) is really just a DP, or whether it is underlyingly clausal and reduced by ellipsis. That is, whether (1-d) really corresponds to (2).

[1]Von Stechow and Beck (2007) analyse sentence (i-a) as (i-b), where pred(e) is the immediate predecessor of an event e.

(i)   a.   Min entered the room (immediately) after Katie.
        b. λe_v. Min enters the room in e & Katie enters the room in pred(e)
        c.   [[after Katie]] = $\lambda R_{e(vt)}.\lambda x_e.\lambda e_v.R(x)(e)$ & $R(\text{Katie})(\text{pred}(e))$

(2)   Mary arrived before/after John ~~arrived~~

If (2) is the correct analysis of (1-d), these cases of phrasal *before/after* can be reduced to clausal cases. If, on the other hand, it turns out that the complement of *before/after* is just a DP, a different analysis is required.

    It is interesting to note that other temporal connectives like *since* and *until* do not pattern with *before* and *after* in this respect. While both *since* and *until* can take times as well as events and clauses as complements, what looks like a bare DP is impossible.[2]

(3)   a.   Mary has been awake since 6 o'clock.
       b.   Mary has been awake since the accident.
       c.   Mary has been awake since John left.
       d. *Mary has been awake since John.

(4)   a.   Mary slept until 6 o'clock.
       b.   Mary slept until the meeting.
       c.   Mary slept until John left.
       d. *Mary slept until John.

    Similar issues do, however, arise in the domain of comparatives, where they have received a lot of interest (Hankamer, 1973; Bresnan, 1973; Hoeksema, 1983, 1984; Heim, 1985, a.o.).

(5)   a.   John is taller than Mary is.
       b.   John is taller than Mary.

For phrasal comparatives as (5-b), both reduction analyses, according to which they are underlyingly clausal and derived by some form of ellipsis, and direct analysis have been proposed. There evidence seems to be in favour of an analysis that assumes phrasal comparatives to be underlyingly clausal, at least in languages like English and German (see Lechner, 2001; Bhatt and Takahashi, 2007). Semantically, there is a connection between the temporal connectives *before* and *after* on the one hand, and comparatives on the other. Statements with *before* and *after* are semantically equivalent to comparatives involving the temporal adjective *early* and *late* as in the pairs in (6) and (7).

(6)   a.   Mary arrived before John.
       b.   Mary arrived earlier than John.

(7)   a.   Mary arrived after John.
       b.   Mary arrived later than John.

As times can be conceived as a particular sort of degrees (see von Stechow, 2009a), this equivalence between temporal comparatives and *before/after* follows.

    This paper addresses the question what the correct analysis of phrasal complements of *before/after* is. To this end, we discuss evidence, partly applying tests that have been discussed in the literature on phrasal comparatives. In contrast to compar-

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[2]Examples (3-d) and (4-d) are acceptable if the name *John* is used to refer to a time. For this interpretation, see (17). What is crucial is that these sentences do not have an an interpretation that would arguably involve ellipsis.

atives, however, the evidence suggests that the complement is just a DP. This necessitates a separate analysis for this instances of phrasal *before/after*. We propose such an analysis. Adopting this analysis has interesting consequences for the conception of the syntax/semantics-interface, as non-standard assumptions about the formation of LF have to be made.

The next section lays the ground for the discussion of the temporal connectives, and fills in some background on the interpretation of tense. In section 3, we present the analysis of Beaver and Condoravdi (2003), which works well for instances of *before/after* where the complement is a clause or an expression denoting a time or an event. Section 4 discusses empirical evidence that strongly suggests that DP complements of phrasal *before/after* are not elliptically reduced clauses. We present a matching analysis in 5 and discuss what assumptions it requires about the syntax/semantics-interface.

2   Background assumptions on tense interpretation

For the interpretation of tense, we use the system laid out in detail in von Stechow (2009b), simplifying it for the purpose at hand. Our main assumptions can be summarised as follows.

We use the semantic type i for times, in addition to the usual types e (entities), v (events) and t (truth values). Times are points or intervals on the time scale ordered by the 'earlier than'-relation $<$. For any two time points (moments) m and m', it holds that either $m < m'$ or $m' < m$ (also written as $m > m'$), or $m = m'$. The $<$-relation is extended in a natural way to intervals: The interval t is before the interval t' ($t < t'$) iff each moment in t is before any moment in t'.

Verbs, and more generally expressions that are temporally located, have a temporal argument. We assume that this is the innermost argument, as shown in (8) for the verb *arrive*.

(8)   [[arrive$_{i(et)}$]] = $\lambda t_i . \lambda x_e . x$ arrives at time t

Temporal arguments are passed up in the syntactic structure by λ-binding until they are bound by a tense operator.[3] We furthermore assume that tense morphology on verbs is not interpreted, but points to covert semantic tense operators. Technically, this can be implemented via pairs of uninterpretable and interpretable features. A verb with past morphology, for instance, bears an uninterpretable PAST-feature [uPAST] which has to be checked against a corresponding interpretable PAST-feature [iPAST] on a covert PAST-operator located in T^0. For illustration, the syntactic structure of sentence (9-a) is given as (9-b).[4] From this, the LF (9-c) is derived.

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[3]For concreteness, we assume that λ-operators are generated by PRO-movement in the style of Heim and Kratzer (1998). The temporal argument is base-generated as the pronoun PRO, which is semantically empty and doesn't have a semantic type. PRO has to be moved for type reasons and is subsequently deleted at LF. Crucially, PRO-movement creates a λ-abstract of type it. We will generally gloss over the details of the derivation of λ-operators.

[4]We neglect the movement of the subject to Spec,TP and other kinds of movement for syntactic reasons which can be assumed to be reconstructed at the level of LF.

(9) a. Mary arrived

  b. $[_{TP} PAST_{[iPAST]} [Mary arrived_{[uPAST]}]]$

  c. $[_{(it)t} PAST [\lambda t_1 [Mary [arrive(t_1)]]]]$

We assume an indefinite semantics of tense (cf. Prior, 1967). The temporal operator PAST, when evaluated at the speech time s*, asserts the existence of a time preceding s* of which the temporal property denoted by the complement holds, cf. (10). This leads to the truth conditions (11) for (9).

(10) $[[PAST]]^{s*} = \lambda P_{it}.(\exists t < s^*)P(t)$

(11) $[[(9\text{-c})]]^{s*} = (\exists t < s^*)$ Mary arrives at t

3 Temporal and clausal arguments of *before* and *after*

Beaver and Condoravdi (2003) propose a semantic analysis of *before* and *after* as relations between times. The only difference between *before* and *after* concerns the temporal relation employed in their semantics. While *before* denotes the $<$-relation, *after* corresponds to $>$. The meaning rules are given in (12).[5]

(12) a. $[[before]] = \lambda t_i.\lambda t'_i.\lambda P_{it}.P(t) \& t' < t$

  b. $[[after]] = \lambda t_i.\lambda t'_i.\lambda P_{it}.P(t) \& t' > t$

This semantics of *before* and *after* is very appealing, as it is simple and corresponds to the meaning these temporal connectives have intuitively.

Although Beaver and Condoravdi (2003) are concerned with clausal complements of *before*/*after*, the simplest cases are ones where the complement is an expression denoting a time, such as *6 pm*. As the complement is of the right type, viz. i, it can directly serve as the first argument of *before*/*after*. The second argument is the temporal argument which all temporally located expressions have and which is to be bound by the matrix tense. The semantic derivation is illustrated in (13).

(13) a. Mary arrived after 6 pm.

  b. $[PAST [\lambda t_2 [[t_2 after 6 pm] [\lambda t_1 [Mary arrive(t_1)]]]]]$

  c. $(\exists t < s^*)$ Mary arrives at t & $t > 6$ pm

According to the truth conditions in (13-c), the sentence is true in a scenario as the one depicted in (14).

(14)
  6 pm   arrival(m) s^*
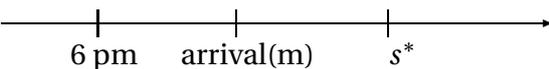
If the complement of *before*/*after* is a DP denoting an event, e.g. *the meeting*, the type shifter τ can be used, which associates an event with its running time. With this, the semantic derivation is also straightforward, as shown in (15).

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[5]The temporal connectives could even have the simple type $i(it)$, i.e. *before* and *after* could express $<$ and $>$ directly. The VP would then be analysed as $[[\lambda t_2 t_2 after 6 pm][\lambda t_1 Mary arrive(t_1)]]$, where the adjunct combines with the VP via Predicate modification. PAST would then simultaneously bind t_2 and t_1.

(15)   a.   Mary arrived after the meeting.
          b.   [PAST [λt_2 [[t_2 after τ(the meeting)] [λt_1 [Mary arrive(t_1)]]]]]
          c.   ($\exists t < s^*$) Mary arrives at t & $t > \tau$(the meeting)

(16)

$$\vdash \overline{\text{meeting}} \mid \quad \underset{\text{arrival(m)}}{\mid} \qquad \underset{s^*}{\mid} \longrightarrow$$

More challenging are cases where the complement DP is quantified, as in *after every meeting*, or ones involving cascades of temporally locating expressions like *after every meeting on a Monday*, but we don't discuss these here.

    There are also cases, where DPs that intrinsically denote individuals are used to refer to times. (17) is an example.

(17)   The reputation of the USA was ruined after George W. Bush..

Here the name *George W. Bush* refers to the time of the presidency of the person.

    For clausal complements of *before/after*, as in (18), deriving a time as the denotation of the complement clause requires more elaborate assumptions about the syntax/semantics interface.

(18)   Mary arrived before John left.

Following Heim (1997), we assume that temporal adverbial clauses are interpreted akin to relative clauses, such that *before John left* is equivalent to *before the time at which John left*. To this end, we assume that the clause contains a covert *at*-phrase, where t *at* t' means that $t = t'$. The inner argument of AT is wh-extracted to form a relative clause ('at which John left'). This results in the LF (19) for the temporal clause in (18).

(19)   WH$_2$ PAST λt_3 [[t_3 AT t_2] λt_1 [John leave(t_1)]]]

In order to serve as the argument of *before*, this set of times at which John left has to be coerced into a single time. Beaver and Condoravdi (2003) argue that this is done by a covert coercion operator EARLIEST, defined in (20).[6]

(20)   [[EARLIEST]] = $\lambda P_{it}.(\iota t)P(t)$ & $(\forall t')P(t') \rightarrow t < t'$
          (abbreviated as: the earliest t such that $P(t)$)

Combining all these assumptions, we get the LF (21-a) for sentence (18). The truth conditions (21-b) expressed by this LF correspond to *Mary arrived before the earliest time at which John left* and are true in a scenario such as (22).

(21)   a.   [PAST [λt_4 [t_4 before [EARLIEST WH$_2$ PAST λt_3 [[t_3 AT t_2] λt_1 [John leave(t_1)]]]]
              [λt_5 [Mary arrive(t_5)]]]]
         b.   ($\exists t < s^*$) Mary arrives at t & $t <$ the earliest t' s.t. $t' < s^*$ & John leaves at t'

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[6]EARLIEST has to be restricted to contextually relevant intervals. This is necessary to prevent sentences like (i) from being tautological. (i) doesn't refer to the first time the sun set ever, i.e. the first day of the world, but rather to the day relevant in the context.

(i)   Mary went to bed after the sun set.

Temporal operators in general have to be restricted to contextually relevant intervals. We neglect this issue here.

(22)

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      |           |           |
——————+———————————+———————————+——————————————►
   arrival(m)   leaving(j)    s*
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Summarising this section, we can state that Beaver and Condoravdi (2003) offer an analysis for *before* and *after* that successfully deals with cases where these expressions take clausal complements, and also certain instances of phrasal complements, namely ones that denote times or events. This leaves phrasal complements denoting an individual as in (23).

(23)   Bill left before Mary.

If such examples are really underlyingly clausal, Beaver and Condoravdi's analysis covers them as well. But if the complement is really just the visible DP, their analysis doesn't apply and a different semantics for these cases is required. In the next section, we consider empirical evidence bearing on the syntactic and semantic status of these phrasal complements of *before* and *after*.

4   Empirical evidence

4.1   Lexical distinction

As a first kind of evidence, we observe that some languages use different lexical items for *before* and *after*, depending on whether they take a clausal or a phrasal complement. In German, for example, the clausal variants are *bevor* and *nachdem*, cf. (24-a), while the phrasal variants are *vor* and *nach*. The phrasal variant doesn't distinguish the semantic status of the complement, i.e. whether it denotes an individual as in (24-b), or a time or an event as in (24-c).

(24)   a.   Peter trank den Whiskey bevor / nachdem er das Bier getrunken hatte.
            Peter drank the whiskey before / after   he the beer drunk   had
       b.   Peter trank den Whiskey vor   / nach dem Bier.
            Peter drank the whiskey before / after the   beer / six o'clock / the dinner
       c.   Peter trank den Whiskey vor   / nach sechs Uhr   / dem Abendessen.
            Peter drank the whiskey before / after six   o'clock / the   dinner

The contrast in the choice of lexical item makes it implausible that (24-b) is derived from (24-a) by ellipsis reduction. If (24-b) was an elliptical form of (24-a), this shouldn't affect the form of the temporal connective.

Note that the lexical distinction German makes doesn't, in fact, provide an argument against the analysis of Beaver and Condoravdi (2003), according to which the clausal case (24-a) is parallel to phrasal cases like (24-c). The conjunction *nachdem* is morphologically made up of *nach* ('after') and the dative form of the definite article. So this fact from German could be taken as evidence for the presence of a definiteness operator like EARLIEST.

4.2   Restrictions on category and number of complements

Further indication that DP complements of *before/after* are not elliptical clauses comes from restrictions on the category and number of the remnants of the alleged reduction. Phrasal complements of *before* and *after* are invariably DPs. PPs or adverbials can't serve as complements of phrasal *before/after*.

(25)   a.   *Tom lived in Scotland after in the US.
       b.   *John drove fast after slowly.

This restriction is unexpected under a reduction analysis. It doesn't show up in comparative complements, either, as the examples in (26) illustrate.

(26)   a.   Tom lived longer in Scotland than in the US.
       b.   More cars drove fast than slowly.

   Furthermore, the remnant can only consist of one constituent, never two or more, cf. (27). This also contrast with comparatives, as shown in (28).

(27)   a.   *Mary drank the beer after Peter the whiskey.
       b.   *Austen wrote Sense and Sensibility before Brontë Jane Eyre.

(28)   a.   Mary drank the beer quicker than Peter the whiskey.
       b.   Austen wrote Sense and Sensibility earlier than Brontë Jane Eyre.

4.3   Case matching

Complement DPs of phrasal *before/after* appear invariably in the oblique case, independently of the case of its correlate in the matrix, cf. (29-a). In elliptical clausal complements in contrast, the case of the remnant corresponds to the case of the correlate, cf. (29-b).

(29)   a.   Kim left before/after me/ *I.
       b.   Kim left before/after I did.

   Case assignment on pronouns in English doesn't, however, constitute a conclusive argument. Similar data for comparatives, cf. (30), have been discussed in the literature on phrasal comparatives, without a conclusive result.

(30)   a.   John is older than me/ *I.
       b.   John is older than I am.

More telling in the case of comparatives are data from languages that also have case marking on full DPs, such as German. Here the case of the DP embedded under *als* ('than') matches the case of the correlate in the matrix, and different case marking yields different interpretations, as the following examples from Heim (1985) illustrate.

(31)   a.   Ich   habe dir   bessere   Schlagzeuger als   der   Karlheinz
            I.NOM have you.DAT better.ACC drummers   than the.NOM Karlheinz
            vorgestellt.
            introduced

   'I have introduced better drummers to you than Karlheinz (has).'

  b. Ich habe dir bessere Schlagzeuger als dem Karlheinz
    I.NOM have you.DAT better.ACC drummers   than the.DAT Karlheinz
    vorgestellt.
    introduced
    'I have introduced better drummers to you than (to) Karlheinz.'

  c. Ich habe dir bessere Schlagzeuger als Bassisten
    I.NOM have you.DAT better.ACC drummers   than bassists.ACC
    vorgestellt.
    introduced
    'I have introduced better drummers to you than bassists.'

In contrast to complements of comparatives, DPs embedded under *vor* ('before') and *nach* ('after') in German always bear dative case, independently of the function and the case of the correlate in the matrix. This is illustrated in (32). Consequently, examples with ditransitive verbs are three-ways ambiguous, as any of the arguments of the verb can be the correlate – if pragmatically plausible. (33) is such an example.

(32) a. Der Pfarrer trank den Whiskey nach dem Bürgermeister.
    the.NOM priest drank the.ACC whiskey after the.DAT mayor
    'The priest drank the whiskey after the mayor.'

  b. Der Pfarrer trank den Whiskey nach dem Bier.
    the.NOM cowboy drank the.ACC whiskey after the.DAT beer
    'The priest drank the whiskey after the beer.'

(33) Er stellte   seine Verlobte seinen Eltern nach seiner Sekretärin vor.
   he introduced his.ACC fiancée his.DAT parents after his.DAT secretary PART
   'He introduced his fiancée to his parents after he introduced his fiancée to his secretary.'
   'He introduced his fiancée to his parents after he introduced his secretary to his parents.'
   'He introduced his fiancée to his parents after his secretary introduced his fiancée to his parents.'

These data suggest that *vor* ('before') and *nach* ('after') are prepositions assigning dative case to their DP complements.

4.4 Binding effects

In addition to the morphological facts discussed in the previous subsections, more elaborate tests can be applied to draw conclusions on the syntactic status of phrasal complements of *before/after*. One such test, which has been used by Lechner (2004) for phrasal comparatives, concerns binding effects. Lechner notes that direct and reduction analyses make different predictions for the binding possibilities of the comparative complements. In the case of *before/after*, the predictions are as follows:

(34) a. Prediction by the direct analysis: The binding properties of DP complements of phrasal *before/after* are the same as the binding properties of DP

complements of other prepositions.

b. Prediction by the reduction analysis: Binding properties of the remnant are determined by c-command relations in the matrix; the remnant is c-commanded by everything that c-commands the correlate.

So what are the empirical observations regarding binding properties of the complements of phrasal *before/after*? As discussed by Lechner (2004), clearest evidence comes from Principle C effects. We first consider cases where the reduction analysis predicts a Principle C violation. (35) is a case in point, under the intended interpretation with the subject (*Mary*) as correlate, i.e. meaning Mary saw Peter's sister before Peter saw Peter's sister.[7]

(35)   ?Mary saw Peter$_i$'s sister before him$_i$.

Under the reduction analysis, (35) is an elliptical version of (36). There the unreduced complement clause violates Principle C, as the R-expression *Peter* is c-commanded by the coreferential pronoun *he*.

(36)   *Mary saw Peter$_i$'s sister before he$_i$ saw Peter$_i$'s sister.

Although (35) might not be perfect, it is decidedly better than the ungrammatical (36), indicating that the phrasal variant (35) doesn't have the same clausal structure underlyingly. The direct analysis, in contrast, predicts that (35) is parallel to other cases of PP-internal pronouns like (37).

(37)   ?Mary visited Peter$_i$'s sister without him$_i$.

Similar binding facts also hold for German, as the grammaticality contrast between (38) and (39) illustrates.

(38)   Maria meldete   den   Peter$_i$ vor   ihm$_i$ an.
         Maria signed-up the.ACC Peter before him.DAT PART
         Intended reading: Maria signed up Peter before Peter signed up himself.

(39)   *Maria meldete   den   Peter$_i$ an, bevor er$_i$ den   Peter$_i$ anmeldete.
         Maria signed-up the.ACC Peter PART before he the.ACC Peter signed-up
         Intended reading: Maria signed up Peter before Peter signed up himself.

There are also inverse cases where an R-expression, which is coreferential with a pronoun in the matrix, occurs in the DP-complement of *before/after*. In this constellation, a Principle C violation obtains, cf. (40).

(40)   *Mary saw him$_i$ before Peter$_i$'s sister.

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[7]As the correlate can be the subject or the object, (35) can also express a reading equivalent to (i), in which case the sentence is unobjectionable.

(i)   Mary saw Peter$_i$'s sister before she saw him$_i$

What is relevant is that the sentence can also express the subject correlate reading. The ? in (35) refers to the sentence under this reading.

The ungrammaticality of (40) isn't predicted by the reduction analysis. Under the intended reading that Mary saw Peter before Peter's sister saw Peter, (40) should be equivalent to the clausal version (41-a). As the R-expression is free in its binding domain, the *before*-clause, (41-a) is grammatical.

(41)   a.   Mary saw him$_i$ before Peter$_i$'s sister saw him$_i$.
        b.   Mary saw him$_i$ before Peter$_i$'s sister did.

Thus, the reduction analysis doesn't account for the ungrammaticality of (40). There is also a clear contrast between (40) and the elliptical version (41-b) of (41-a), which is unexpected under the assumption that (40) is an even more reduced elliptical version of the clausal variant.

     The direct analysis, in contrast, makes the correct prediction. Assuming that the direct object c-commands the *before*-PP, (40) represents a violation of Principle C. In any case, (40) is predicted to be parallel to analogous sentences with other prepositions like (42), which is borne out.

(42)   *Mary visited him$_i$ without Peter$_i$'s sister.

Again, the facts carry over to German.

(43)   a. *Maria sah ihn$_i$ vor   Peters$_i$ Schwester.
          Maria saw him before Peter's sister
          Intended reading: Maria saw Peter before Peter's sister saw Peter.
       b.   Maria sah ihn$_i$ bevor Peters$_i$ Schwester ihn$_i$ sah.
          Maria saw him before Peter's sister   him saw

     Summarising the binding data, we observe that the binding properties of the DP complement of phrasal *before/after* are determined by surface syntax, not by c-command relations between the correlate and other matrix elements. This is compatible with the direct analysis, but not with the reduction analysis.
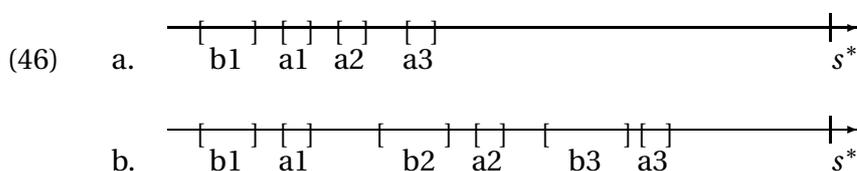
4.5   Quantificational arguments

Another type of data that might allow conclusions on the syntactic status of the complement of phrasal *before/after* concern the scope possibilities of quantificational complements. If phrasal *before* and *after* are prepositions, one would expect quantificational complements to interact freely with quantifiers in the matrix. If, in contrast, the complement is underlyingly clausal, the expectation would be that quantifier scope being generally clause bounded, quantificational remnants can't take scope outside the complement clause. This argument is, however, not as straightforward as one would wish. In the realm of comparatives, certain quantificational elements embedded in comparative clauses seem to defy clause boundedness (see a.o. Schwarzschild and Wilkinson, 2002; Beck, 2010). It has also been observed that quantifiers can take scope outside of a temporal adjunct clause in English (Artstein, 2005). Sentence (44) for instance has a reading with *each executive* taking scope above the matrix subject *a secretary* and is true in a situation where each resignation of an executive is followed by the crying of a different secretary, e.g. the resigned executive's secretary.

(44)   A secretary cried after each executive resigned.

However, as Artstein (2005) notes, the situation is different in German, where quantifiers can't take scope outside of a temporal adjunct clauses. Sentence (45), for instance, only has a specific reading, according to which one book is read before the reading of all articles.[8] The unspecific reading, where the reading of each article is preceded by the reading of a potentially different book is not available. Thus, (45) can describe the situation depicted in (46-a), but not in (46-b).

(45)   Peter las   ein Buch bevor er jeden Artikel las.
        Peter read a   book before he every article read
        'Peter read a book before he read every article.'

(46)   a.

              b1   a1 a2   a3 s^*

        b.

              b1   a1   b2   a2   b3   a3 s^*

The behaviour of quantifiers embedded in *before/after*-clauses contrasts with quantificational complements of phrasal *before/after* in German. In (47), the quantifier *jeder Artikel* ('every article') can take wide scope over the matrix object *ein Buch* ('a book'), and (47) can be used in the scenario (46-b).

(47)   Peter las   ein Buch vor   jedem Artikel.
        Peter read a   book before every   article
        'Peter read a book before every article.'

Even though in German, the scope of quantifiers embedded in temporal clauses is clause bounded, quantificational complements of phrasal *before/after* can take scope over matrix elements. This, too, suggests that DP complements aren't remnants of ellipsis reduction of a clausal complement.

4.6   Summary of empirical evidence

All kinds of empirical evidence we considered are in favour of the direct analysis. We conclude that the DP complement of phrasal *before/after* is syntactically a DP and semantically an individual. Consequently, the semantics of Beaver and Condoravdi (2003) for *before/after* doesn't extend to cases where the complement is a DP denoting an individual. This phrasal *before/after* requires a separate analysis. In the next section, we propose a matching analysis.

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[8]As *after*-clauses in German generally require use of the pluperfect, which introduces another temporal quantifier, we discuss an example with *before*, which allows simple tenses in complement clauses, rather than the sentence corresponding to Artstein's original example (44).

5 Analysis

5.1 Semantics

The semantics of phrasal *before/after* has to mimic the semantics of clausal *before/after*. What *before* and *after* set into relation are times at which a certain temporal property holds of different individuals, e.g. (48) compares the time of Mary's arrival to the time of John's arrival.

(48)   Mary arrived after John.

If the temporal property isn't present in the structure of the complement, and according to the empirical evidence discussed in the previous section it isn't, it nevertheless has to be represented in the semantics. We prose a semantics for phrasal *before/after* which closely follows Heim's (1985) direct analysis of phrasal comparatives.

(49)   a. $[[\,\text{before}\,]] = \lambda x_e.\lambda t_i.\lambda R_{e(it)}.\lambda y_e.R(y)(t)\ \&\ t < \textsc{earliest}\,(\lambda t.R(x)(t'))$
        b. $[[\,\text{after}\,]] = \lambda x_e.\lambda t_i.\lambda R_{e(it)}.\lambda y_e.R(y)(t)\ \&\ t > \textsc{earliest}\,(\lambda t.R(x)(t'))$

According to this meaning rule, phrasal *before/after* takes four arguments. The innermost is the individual denoted by the complement DP. The second argument slot is occupied by the temporal argument of the *before/after*-phrase. The third argument is a relation between individuals and times (type $(e(it))$). In the meaning rule, this relation R is applied both to the complement and the correlate. The individual corresponding to the correlate is the last argument.

For illustration, we show how the semantics in (49) derives the correct meaning for sentence (48). The relation between individuals and times in this case is $\lambda x_e.\lambda t_i.x$ arrives at t. This can be derived from the VP by λ-abstracting over the subject and the temporal argument of the verb, as shown in the LF (50). (The issue of LF formation is discussed in more detail in the next subsection).

(50)
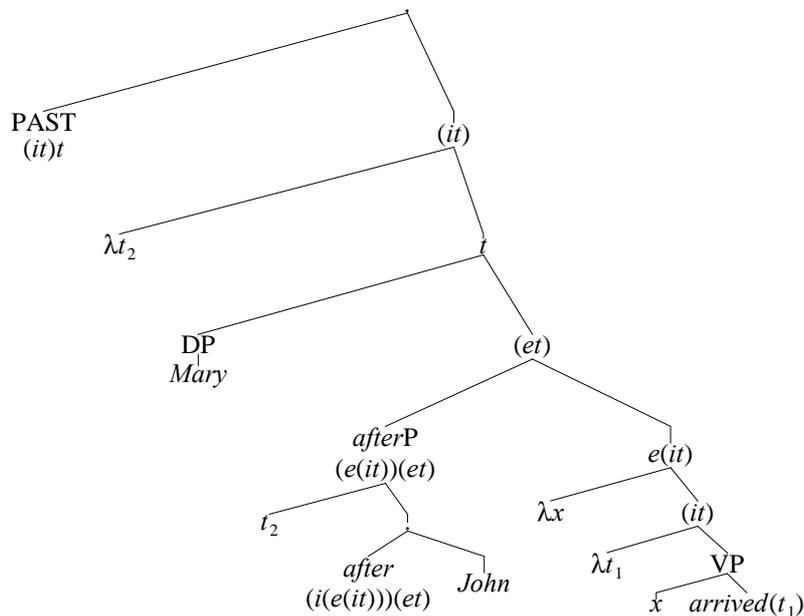
Applying the meaning rule in (49), the LF (50) expresses the truth conditions (51), which correctly reflect the intuitive meaning of this sentence.

(51)   ($\exists t < s^*$) Mary arrives at t & $t >$ the earliest t' s.t. John arrives at t'

(52)   arrival(j) arrival(m) s^*
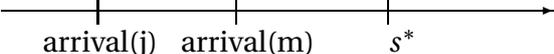
Note that in the meaning rule for phrasal *before*/*after*, the EARLIEST operator is incorporated. While Beaver and Condoravdi's (2003) analysis of clausal complements remains neutral whether EARLIEST is specified in the lexical meaning of the connectives or in the process of compositional build-up through type shifting operations, the later option isn't available for phrasal *before*/*after*.

Employing EARLIEST, our analysis inherits certain aspects of Beaver and Condoravdi's. The first concerns non-veridical readings of *before*, where the temporal clause isn't implicated to become true. (53-a) is such an example. Non-veridical readings are also possible for phrasal *before*. (53-b), for instance, doesn't imply that Jones closed the contract.

(53)   a.   Mozart died before he finished the Requiem.
        b.   Smith closed the contract before Jones.

Beaver and Condoravdi (2003) account for non-veridical readings of *before* by using a branching time framework. In the case of *before*, the earliest instantiation of the complement clause isn't necessarily on the branch which represents the actual continuation of the world. It is sufficient if the complement clause is instantiated on a branch representing a plausible alternative continuation at the time of the matrix clause. As the truth conditions resulting under our semantics of phrasal *before* are identical to Beaver and Condoravdi's for clausal cases, their explanation carries over.

Another asymmetry between *before* and *after* concerns the licensing of negative polarity items (NPIs) in their complements. NPIs can occur in clausal complements of *before*, cf. (54-a), and as DP complements, cf. (54-b), but they are generally excluded in the complement of *after*, cf. (55).

(54)   a.   Mary left before anyone noticed her.
        b.   Mary arrived before any of her friends.

(55)   a.   *Mary left after she ate anything.
        b.   *Mary left after anyone else.

Beaver and Condoravdi (2003) explain the licensing of NPIs in *before*-clauses with the EARLIEST operator: if a time t precedes the earliest time which instantiates a temporal property P, t precedes every time instantiating P. The same doesn't hold for *after*: if a time t follows the earliest time which instantiates a temporal property P, it doesn't follow that t precedes every time instantiating P. Thus, the complement of *before* constitutes a downward entailing environment in which NPIs are licensed, whereas the complement of *after* doesn't.

Accommodating the licensing of NPIs by phrasal *before* in our analysis requires certain additional assumptions. If we try to analyse sentence (54-b) with the meaning rule (49-a) we do neither account for the licensing of the NPI nor do we get the right truth

conditions. This is due to the fact that in the meaning rule (49-a) the first argument is specified to be an individual. A quantificational DP like *any of her friends* in this position thus has to be QR-ed, yielding an LF like (56-a). It expresses the truth conditions in (56-b), which are fulfilled in the scenario (57). In other words, Mary wasn't the last to arrive. This is in fact not a reading (54-b) intuitively has.

(56)   a.   [PAST λt_2 [anyone λx [[t_2 before x] $\lambda t_1 \lambda y$ [y arrive(t_1)]]]]]
       b.   ($\exists t < s^*$) Mary arrives at t & ($\exists x$)x is a friend of Mary & $t <$ the earliest t'
            s.t. x arrives at t'

(57)   arrival(f1) arrival(f2) arrival(m) arrival(f3) s^*
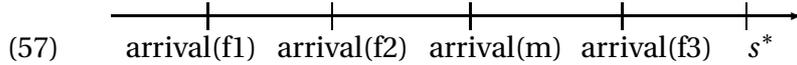
In fact, the reading in (56) is excluded, because the NPI *any of her friends* takes scope outside of the *before*-phrase and thus isn't interpreted in a downward entailing environment. In order for the NPI to be interpretable below *before*, we need a type-shifted version (58), where the first argument is of the quantifier type.

(58) $[[\text{before}_2]] = \lambda \mathcal{Q}_{(et)t}.\lambda t_i.\lambda R_{e(it)}.\lambda y_e.R(y)(t) \& t < \text{EARLIEST}(\lambda t.\mathcal{Q}(\lambda z.R(z)(t')))$

Applying this meaning rule, *any of her friends* is interpreted in the scope of *before* and the correct truth conditions (59-b) are derived, according to which Mary is the first to arrive.

(59)   a.   [PAST λt_2 [[t_2 before$_2$ anyone] $\lambda t_1 \lambda y$ [y arrive(t_1)]]]]]
       b.   ($\exists t < s^*$) Mary arrives at t & $t <$ the earliest t' s.t. ($\exists x$)x is a friend of Mary
            & x arrives at t'

(60)   arrival(m) arrival(f1) arrival(f2) arrival(f3) s^*
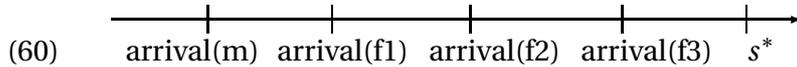
5.2   Derivation of LF

The meaning rule we prose for phrasal *before/after* after requires that it applies to the following four arguments in order: (i) an individual (the DP complement), (ii) a time (the time argument), (iii) a relation between individuals and times, and (iv) another individual (the correlate). The first two arguments are realised in the *before/after*-phrase. The remaining two arguments are external to this phrase and have to be built up in the derivation of LF. How this is achieved is not a trivial question. Deriving the relation between individuals and times, in particular, proves challenging.

So far, we have considered a case where the correlate is the subject. To see what the derivation of an appropriate LF involves, consider an example with an object correlate like (61).

(61)   George drank the whiskey after the beer.

In this case, the relation between individuals and times our semantics requires corresponds to $\lambda x_e.\lambda t_i.x$ George drinks x at t. This relation doesn't correspond to the meaning of any phrase, and thus has to be derived in the syntax/semantics interface. We show step by step how the derivation proceeds.

In the first step of the derivation of the LF, a temporal abstract of VP is created, resulting in (62).

(62) λt_i [George drank(t_1) the whiskey]

This creation of a temporal property isn't special, as our assumptions on the syntax/semantics interface require it in general for the interpretation of tense. However, to be able to serve as the relation argument of phrasal *before*/*after*, the temporal property has to be λ-abstracted even further to yield a relation of type $e(it)$. Such a relation can be derived by QR of the correlate DP *the whiskey*, as shown in (63).

(63)
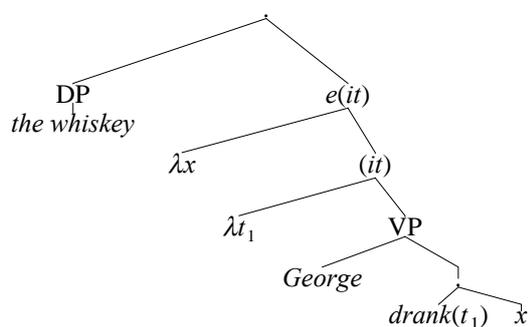
Now, crucially, the relation of type $e(it)$ derived by QR has to be available for combination with the *after*-phrase. For this, the *after*-phrase has to be merged in between the QR-ed correlate and the derived predicate, as shown in (64).

(64)
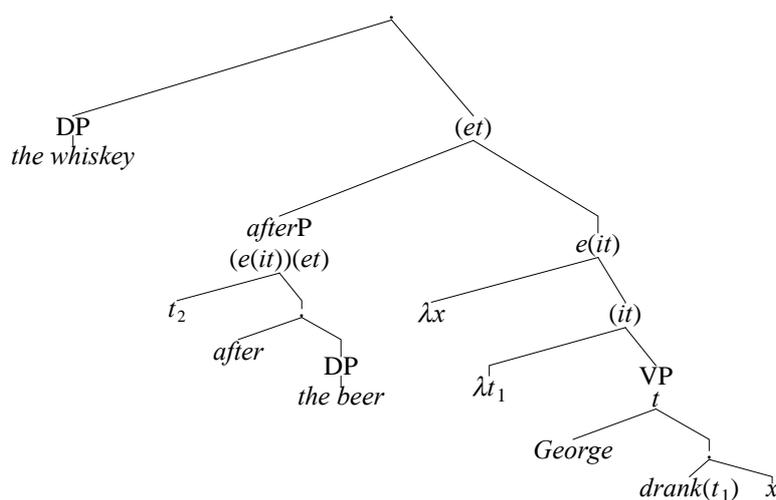
The tree in (64) represents an instance of Countercyclic Merge, as the *after*-phrase is merged after QR of the correlate has taken place creating the derived predicate. Countercyclic Merge has been argued to be needed in the analysis of other kinds of adjuncts as well (Lebeaux, 1991; Nissenbaum, 1998), so it might be that adjuncts in general are merged countercyclicly.

In the final step, the temporal argument of *after* is bound by the matrix tense, as shown in (65). This LF expresses the truth conditions in (65) covering the intuitive

meaning.

(65)   [PAST [λt_2 [[the whiskey] [[t_2 after the beer] [$\lambda x \lambda t_1$ [George drank(t_1) x]]]]]]

(66)   ($\exists t < s^*$) George drinks the whiskey at t & t < the earliest t' s.t. George drinks the beer at t'

We see that our analysis of phrasal *before/after* derives the correct meaning for cases with object correlates. However, it has to be assumed that *before/after*-phrases are merged countercyclicly.

6 Conclusions

In this paper, we discussed cases where the complement of *before/after* is superficially a DP denoting an individual. We discussed a row of empirical evidence bearing on the question whether such complements are underlyingly clausal or whether the DP visible is all there is in the syntax and semantics. The evidence considered strongly suggests that the complement of phrasal *before/after* is just a DP. To accommodate this for the semantics, we proposed an analysis of phrasal *before/after* which takes a DP as argument and otherwise mimics Beaver and Condoravdi's semantics of clausal *before/after*. Our analysis has interesting consequences for the conception of the syntax/semantics-interface, as it requires that *before/after*-phrases are merged countercyclicly. Hence, the investigation of phrasal *before/after* provides a further argument for the assumption that adjuncts are merged countercyclicly.

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