TENSE: INTRO

1. QUESTIONS (FROM HEIM)

What are sentence meanings, given that truth-value varies with utterance time?

- Tense morphemes, temporal auxiliaries: what do they mean?
- Lexical entries for verbs: where and how does time come in? Different answers for different classes of verbs?
- Non-verbal predicates (nouns, adjectives, prepositions): same questions as for verbs
- Temporal adverbs and adverbials: What kinds are there? What do they mean? What is their internal structure/composition?
- Temporal adverbials: Where do they fit in the structure, what do they contribute?
- Combinations of tense morphemes/temporal auxiliaries in the same clause: syntactic or semantic constraints on possible combinations
- Embedded tenses: are they syntactically and semantically like unembedded ones?
    - What is the relation between semantic tense and tense morphology?

2. EXAMPLES

<u>Present tense</u>

(1) a. Maria schläft.
    b. ?Mary sleeps.
    c. Mary is asleep.

(2) a. Maria ruft an.
    b.*Mary calls.
    c. Mary is calling.
    d. Maria ist am anrufen.

(3) a. *Mary comes tomorrow.

b. Mary will come tomorrow.

c. [OK]Maria kommt morgen.

The distribution of English Present is more restricted than that of German Present. It combines on only with stative VPs; it cannot be combined with future adverbs.

(4) *John is asleep yesterday.

*John called tomorrow.

The Present is not combinable with past adverbs. The Past is not combinable with future adverbs.

<u>The Present Perfect</u>

(5) a. Mary called yesterday.

b. *Mary has called yesterday.

[OK]Maria hat gestern angerufen.

c. Mary called Monday.

d. *Mary has called Monday.

e. Mary has called on a Monday.

d. Mary had called at six.

The Engl. Present Perfect is not compatible with definite past adverbs.

(6) a. Since yesterday 3/many students have called.

b. *Since yesterday John/this student/every student has called.

The Perfect adverbial **since α** is not compatible with definite terms or every-DPs. The Present Perfect is analysed in (Dowty, 1979), chapter 7.

<u>Tense and Negation</u>

(7) I didn't turn off the stove.

≠ There is no time in the past at which I turned off the stove.

≠ There is a time in the past at which I didn't turn of the stove.

(Partee, 1973) claims that this example shows that the Past cannot be the existential quantifier "there is a time before the speech time". It rather must be a free variable denoting a particular time in the past (The Partee-Problem). The claim can be refuted. In fact, the first paraphrase is (almost) correct. The interpretation of Past is the standard semantics and due to (Prior, 1967).

<u>Interaction of tense with quantification</u>

(8) John called yesterday

= There is past time in yesterday at which John called

(9) John called exactly once yesterday.

≠ There is a past time t in yesterday such that there is exactly one time t' in t such that John called at t'.

= There is exactly one time past time t in yesterday s.t. John called at t.

(Bäuerle and von Stechow, 1980) claimed that this example speaks against an analysis of past tense as existential quantifier. This claim can be refuted (complicated).

(10) John polished every boot.

≠ There is a past time at which John polished every boot.

= For every boot there is a past time at which John polished it.

The example of (Cresswell, 1979) shows that quantificational DPs can/must out-scope semantic tense.

(11) Mary called every Sunday.

≠ There is a past time that is in every Sunday and Mary called at that time.

≠ For every Sunday there is a past time at which Mary called.

= There is a past time such that Mary called on every Sunday of that time.

or perhaps:

= For every Sunday in the past there is a past time at which Mary called.

This example is due to Ogihara (where?). An analysis is due to (von Stechow, 2002).

<u>Temporal adjunct clauses</u>

(12) Mary came after every boy had left.

= Mary came after the <u>earliest</u> time t s.t. for every boy x there is a time t' before t s.t. x leaves at t.

(13) Mary left before every boy had arrived.

Similarly

The idea to introduce operators like EARLIEST, LATEST is due to (Beaver and Condoravdi, 2004).

<u>Sequence of tense</u>

(14) John believed that Mary was sick.

≠ John believed that Mary is sick before s*

= John believed: “Mary is sick now”. (Simultaneous)

= John believed: “Mary was sick”. (Shifted)

(15) ?John believed that Mary is sick.

= John believed: “Mary is sick” & Mary was sick at the time of the believing and she still is sick (Double Access)

(16) Russian/Japanese:

John believed Mary is sick (Simultaneous)

John believed Mary was sick (Shifted)

3. Temporal Structure of Simple Sentences

Prerequisites: (Heim and Kratzer, 1998) with modifications.

We will follow Heim’s lecture notes: (Heim, 1997)

3.1. Simple Past

(17) Present: **N** “now”, type i

⟦**N**⟧ = s* “speech time”

(18) Past: **P**, type i(it,t)

⟦**P**⟧ = $\lambda t.\lambda P_{it}.(\exists t')[t'$ is before t & P(t’)]

“is before” will be written as “<”. **P** is a relative Priorian Past: “There is a time before t”. Heim assumes a free variable for the temporal argument of **P** and assumes that free temporal variables denote the speech time s*. We assume (in agreement with recent ideas of Heim) that the first argument of **P** in matrix clauses denotes the Present **N**. This will be important.

(19) **called**: type i(et)

⟦**call**⟧ = λt.λx.x calls at time t.

Tensed forms will be interpreted tenseless!

(20) **John**: type e

⟦**John**⟧ = John

(21) John called

LF: **$[_{it,t}$ P N] [λt_1. [John [call t_1]]]**

The semantic Past $[_{it,t}$ P N] is base generated at the i-position of the verb. It is QR-ed for type reasons producing an interpretable LF.

Computation of the meaning:

$[\![\ [_{it,t} \mathbf{P\ N}]\ [\boldsymbol{\lambda} \mathbf{t_1}.\ [\mathbf{John}\ [\mathbf{call}\ \mathbf{t_1}]]]\ ]\!]^g$

$= [\![[_{it,t} \mathbf{P\ N}]]\!]^g ([\![\boldsymbol{\lambda} \mathbf{t_1}.\ [\mathbf{John}\ [\mathbf{call}\ \mathbf{t_1}]]]\!]^g)$ Functional Application [= FA]

$= [\![[_{it,t} \mathbf{P\ N}]]\!]^g (\lambda t.\text{John calls at } t)$ Evaluation of the λ-abstract (2 steps!)

$= [\![\mathbf{P}]\!]([\![\mathbf{N}]\!])(\lambda t.\text{John calls at } t)$ FA

$= (\lambda t.\lambda P_{it}.(\exists t')[t' < t\ \&\ P(t')](s^*))(\lambda t.\text{John calls at } t)$ Meaning of **P** and **N**

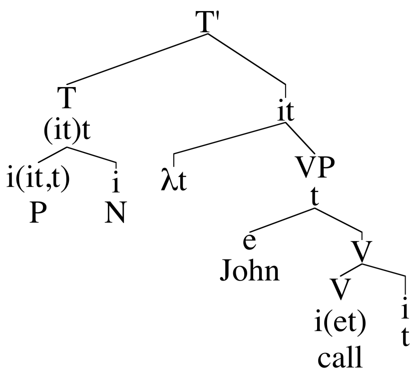
$= \lambda P_{it}.(\exists t')[t' < s^*\ \&\ P(t')](\lambda t.\text{John calls at } t)$ λ-conversion

$= (\exists t')[t' < s^*\ \&\ \text{John calls at } t']$ λ-conversion

Question: What is the relation between semantic Past and the temporal morphology of the verb. We will answer that later.

Syntax:

(22) John called



The Past tense is a quantifier, but it is interpreted in the head position of TP. At SS, the subject is moved to [Spec,TP] for Case reasons. [P N] requires an argument of type it. We assume that a semantically empty pronoun PRO is generated at the temporal argument position and moved at LF for type reasons creating a temporal λ-abstract.

4. TEMPORAL AUXILIARIES

(23) John had called.

(24) **have**: type i(it,t)

$\lambda t.\lambda P_{it}.(\exists t')[t' < t\ \&\ P(t')]$

have has the same meaning as Past (**P**)!

(25) $[_{it,t} \mathbf{P\ N}]\ [\boldsymbol{\lambda} \mathbf{t_1}\ [[\mathbf{have}\ \mathbf{t_1}][\ \boldsymbol{\lambda} \mathbf{t_2}\ [\mathbf{John}\ [\mathbf{call}\ \mathbf{t_2}]]]]]$

$= (\exists t_1)[t_1 < s^* \ \& \ (\exists t_2 < t_1)[\text{John calls at } t_2]]$

Again **[have t_1]** is a quantifier, but it is generated in the head of the AuxP.

The future auxiliary is the mirror image of have:

(26) **will**: type i(it,t)

$\lambda t.\lambda P_{it}.(\exists t')[t' > t \ \& \ P(t')]$

">" stands for "is after".

(27) John will call.

N [λt_1 [[will t_1][λt_2 [John [call t_2]]]]]

$= (\exists t')[t' > s^* \ \& \ \text{John calls at } t']$

(28) Mary was asleep.

Heim assumes "was" as semantically empty and deletes the verb at LF. We can interpret the verb semantically by assuming that it "passes" the time of the matrix tense to the embedded VP:

(29) The temporal auxiliary **be**: type i(it,t)

$[\![\textbf{be}]\!] = \lambda t.\lambda P_{it}.P(t)$

(30) $[\![\textbf{asleep}]\!] = \lambda t.\lambda x.x \text{ is asleep at time t.}$

(31) **[$_{it,t}$ P N] [λt_1 [[be t_1][λt_2 [Mary [asleep t_2]]]]]**

$= (\exists t_1)[t_1 < s^* \ \& \ \text{Mary is asleep at } t_1]$

There is another auxiliary **be**, which expresses the Progressive:

(32) John is calling Mary.

The Progressive is a modal operator. It is analysed in (Dowty, 1979), chapter 3.

5. Syntax and Morphology

We distinguish between semantic Tense and morphological tense. In English we have present and past morphology of verbal forms. Present forms of a verb a have the feature [uN] "uninterpretable Present/Now". The semantic Present **N** has the feature [iN] "interpretable Present/Now". Past forms of a verb have the feature [uP] "uninterpretable Past", The semantic Past tense **P** has the feature [iP].

(33) Some verb forms with spell out:

Present: **call/calls** [uN]

Past: **called** [uP]

Past Participle: **called** (no temporal feature)

Infinitive: **call** (no temporal feature)

Meaning of all these: λt.λx.x calls at time t

Attention: Present and past forms of a verb mean the same. The temporal feature is not interpreted! That's why it is called "uninterpretable". The forms have other features, e.g. Person. Since the u-features uniquely determine the morphological spell-out, we represent the different verb forms at LF simply tenseless as **call**.

(34) Forms of the auxiliary **be**

Present forms: **am, are, is, are** [uN]

Past forms: **was, were, was, were** [uP]

Infnitive: **be**

Meaning of all these: $\lambda t.\lambda P_{it}.P(t)$

The correct tense morphology is controlled/checked by semantic tenses under binding.

(35) Feature transmission under semantic binding.

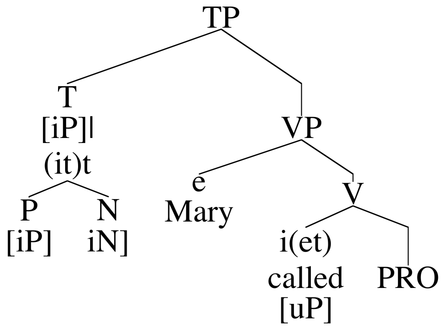
A semantic tense **P** or **N** transmits a feature [uP]/[uN] to the time variable it binds. If the variable is an argument of a tensed verb form, the feature has to agree with the tense feature of the verb.

The idea that features are transmitted under semantic binding is due to Irene Heim. There are a couple of papers. The present system is due to personal communication.

We assume the conventions for semantic binding out-lined in (Heim and Kratzer, 1998). In particular, a phrase or operator α may bind a variable via a λ-operator. To generate the necessary λ-operators, we assume that cases-less argument positions are filled with the semantically empty pronoun PRO, which must be moved ("QR-ed") thus creating a λ-abstract. Being semantically empty, PRO is deleted after movement. Case positions may be filled with the semantically empty operator WH, the relative pronoun. It is moved and creates a λ-abstract as well.

(36) Mary called.

DS:



(The subject **Mary** is moved to [Spec,TP] for case reasons at SS. This will be ignored.) The tree assumes the following convention for feature percolation:

(37) Percolation of tense features

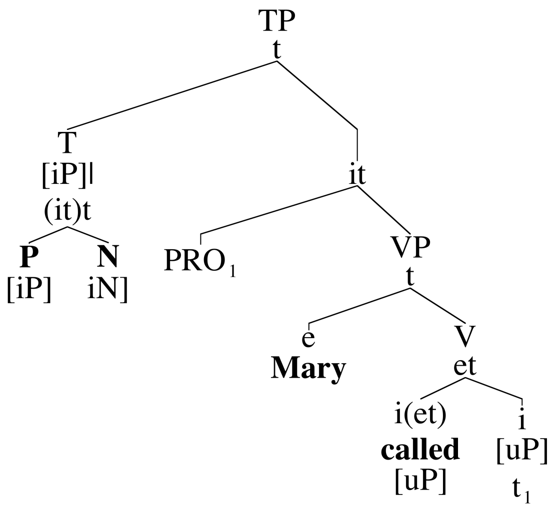
a. Features percolate along the head line.

b. The feature of a temporal variable either agrees with the inherent feature of the head or it is transmitted to the head (and percolates to the phrase).

Since the semantic Past is the head of the semantic tense [P N], the feature [iP] percolates to the phrase [P N].

The tree is not interpretable because PRO has no meaning and no type. Therefore, PRO has to be QR-ed (PRO-movement) creating a λ-bound trace. This creates the interpretable tree:

(38) The LF

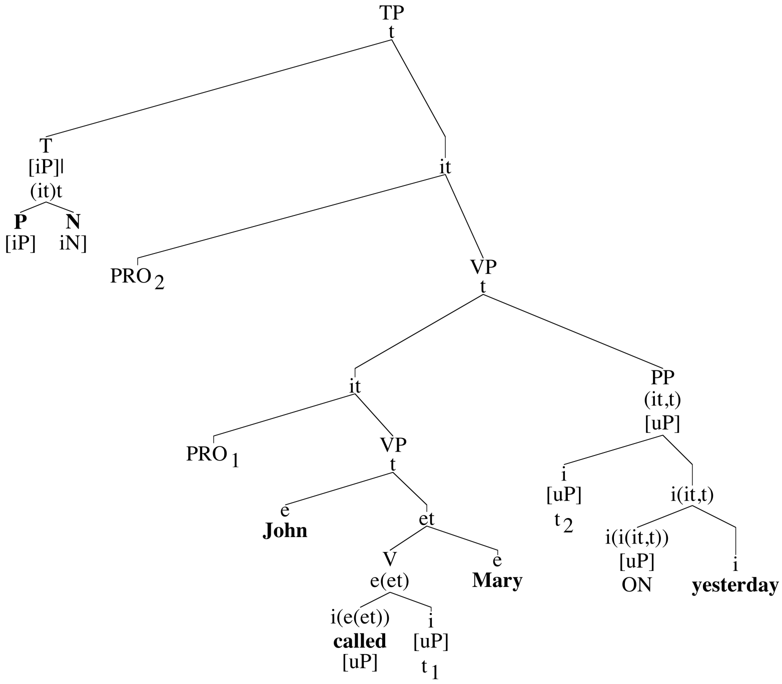


PRO_1 is the λ-operator λ_1. By means of this operator, [P N] transmits the feature [uP] to the bound variable t_1. [uP] agrees with the internal feature [uP] of **called**.

Since temporal features are not important for interpretation, we omit them in our LFs. Similarly we ignore the different morphology of verb forms and write the verb in the infinitive. The feature mechanisms is, however, important for understanding the relation between morphological and semantic tense. Semantic tense is a covert operator, which is made visible by the verbal morphology.

(39) John will call Mary tomorrow.

LF:



[PN] binds the trace t_2, the "subject" of 'ON **yesterday**' and transmits the feature [uP]. The feature is transmitted to the head ON and percolates to the PP. The PP transmits [uP] to the trace t_1, which it binds via the λ-operator PRO_1. There [uP] agrees with the inherent feature [uP] of **called**. ON doesn't have an inherent tense feature, but it may carry one for transmission. When we come to tenses that occur in a subordinate construction, we will see that non-finite forms transmit tense features.

6. REMARKS TO THE PARTEE-PROBLEM

Recall that Partee's analysis of *I didn't turn off the stove* is this:

(40) **not I turn-off the stove($PAST_5$)**

$PAST_5$ is a temporal variable of type i, which has a presuppositional semantics (the formulation is due to (Heim, 1994)):

(41) Referential Past

$[\![$ **PAST**$_i$ $]\!]^g$ = g(i), provided g(i) < s*; if the latter is not the case, the variable doesn't denote anything.

Now, what is the meaning of the verb **turn off**? Turning off the stove is a very short event that takes a moment. It is clear that $PAST_5$ cannot denote a particular moment. Which moment should that be? So $PAST_5$ rather refers to a stretch of time, say the two hours before my leaving. Say that this is the interval (10 am, 12 am). So we must say what "I turn off the stove" means when evaluated with respect to this interval, which we call t. Obviously the action cannot take place *at* t, because the length of the action is not 2 hours. So the action must take place *in* t. So the only reasonable lexical entry is this:

(42) **turn-off** in Partee's account: type i(e(et))

$[\![$ **turn-off** $]\!]$ = λt.λx.λy.(∃t')[t' is <u>in</u> t & y turns of x <u>at</u> t']

= λt.λx.λy.y turns of x <u>at</u> t]

This formulation makes clear that the lexical entry contains an existential quantification over times, which is in the scope of the negation. In fact, the lexical entry contains a covert aspectual operator, viz. the Perfective. See below. According to this analysis, the sentence means correctly:

(43) ¬(∃t' ⊆ g(5)) I turn off the stove at t', where g(5) < s* & g(5) = (10 am, 12 am)

This makes the analysis rather similar to the indefinite analysis defended by Heim, which assumes a contextually restricted Past:

(44) Contextually restricted Past: type (it, i(it,t))

$[\![$ **P** $]\!]$ = λC. λt.λQ.(∃t')[C(t') & t' < s* & Q(t')]

The analysis of the Partee sentence is then:

(45) **not [P_C N] λt. I [turn-off(t) the stove]**

If g(C) = {t | t ⊆ (10 am, 12 am)}, the LF means:

¬(∃t < s*) t ⊆ (10 am, 12 am) & I turn off the stove at t

This is almost the same truth-condition as before. The only difference is that the past time quantified over is presupposed in the first account but introduced by an existential quantifier in the second approach. The second approach contains a "definite part" as well, viz. the times in C. The first approach contains an indefinite part as well, but it is contained in the lexical entry.

7. A NOTE ON LEXICAL ENTRIES

Following (Vendler, 1957) most linguists distinguish between four *Aktionsarten*. In general, an Aktionsart is expressed by the VP.

1. *Accomplishments*. These are actions that start at a particular time and have an end after a while. An accomplishment is *quantized* ("gequantelt"), cf. (Krifka, 1989). This means the following: If the accomplishment P_{it} is true of an interval t, there is not proper subinterval t' of which P is true.

The tenseless VP **John walk from the Post Office to the station** expresses an accomplishment. It is true of the interval t (or at t!) if John starts his walk at the Post Office and he ends the walk at the station. Similarly, the VP "x polish y" is true of t if x starts polishing y at the beginning of t and if y is polished at the end of t.

2. *Achievements* are quantized as well, but they are true only of moments, i.e. very short intervals: **John find a dollar**.

3. *States* are typically expressed by adjectives. They have the subinterval property, i.e. if the state P is true of t, P is true of any subinterval t' of t. **Mary be drunk** is a state.

4. *Activities* don't have the subinterval property but they are cumulative in the following sense: If t_1 and t_2 are abutting times, i.e. they touch each other in one point, and P is true of t_1 and P is true of t_2, then P is true of $t_1 \cup t_2$. **John walk** is an activity (though **John walk from the Post Office to the Station** is an accomplishment).

To do the lexical entries properly, we need events. For instance, the meaning of **from the Post Office** cannot be described in temporal terms. The PP is a property of events and means something like λe.e starts at the Post Office. The Accomplishment in 1 is something like the following property of events:

(46) λe.e starts at the Post Office & e is a walking by John & e ends at the station.

Now, a particular instance e of that property takes exactly one time denoted as τ(e). Let us call the property in (46) E. Then a more proper analysis of the sentence

(47) John walked from the Post Office to the station

is something like this:

(48) $[P_C\ N]\ \lambda t\ (\exists e)[E(e)\ \&\ \tau(e) \subseteq t]$

The operator that localises events in time is the Perfective Operator:

(49) The Perfective Operator: type (vt,it), v the type of events

$[\![\mathbf{PF}]\!] = \lambda E_{vt}.\lambda t.(\exists e)[E(e)\ \&\ \tau(e) \subseteq t]$

Heims lecture notes don't introduce aspect operators (the Progressive is another one). In fact, we can go a long way ignoring aspect. The analysis in (48) exhibits similarities with Partee's entry for "turn off": the description of the proper action "x turn-off y" is the Property E. Since E is quantized, no subevent e' of the E-instance e has the property E. An event e that has the property E determines exactly one time. Therefore, the accomplishment is true of t or at t. If we say that the accomplishment is true in t', we always mean that t' is a superinterval of t. The outcome of all this is that every definition of a temporal property P says that P is true of t or holds at t. If a lexical definition says that a property holds in t we must always assume some aspectual operator that is built in.

For the time being: All our lexical entries will be "perfective", i.e. interpreted at a time t. The Progressive can be derived from these entries. As to VPs: we will assume that perfective VPs may have have (a derived) in – analysis.

(50) Perfective VP:

⟦ **Mary arrive** ⟧ = λt. Mary arrive at t (or λt.Mary arrive in t)

Stative XP:

⟦ **Mary sick** ⟧ = λt. Mary is sick at t (not in !)

Back to the Partee-Problem. Can **in**-entries solve the Partee-Problem without having the negation above Tense? The relevant LF would be this:

(51) I didn't turn off the stove this morning

$PAST_i$ λt [t in this morning] λt ¬ I turn off (t) the stove

= $PAST_i$ in this morning & ¬ I turn off the stove in $PAST_i$.

= $PAST_i$ in this morning & ¬ (∃t ⊆ $PAST_i$) I turn off the stove AT t.

This is too weak, because it does not entail that $PAST_i$ = this morning. Could we say that the invisible preposition preceding **this morning** is not **in** but rather at (i.e. =)? Look at this one:

(52) I didn't turn off the stove today.

≠ $PAST_i$ λt t = today λt ¬ I turn off(t) the stove

This implies that the entire **today** is before the speech time. But only part of it is before s*. So this is no good solution. Conclusion: **in**-entries don't solve the Partee-Problem in the sense that **not** may have narrow scope with respect to Tense.

8. TEMPORAL ADVERBIALS

(53) Mary called on my birthday.

We will assume that temporal adverbials/PPs have the same logical type as the auxiliaries, i.e. i(it,t). Syntactically they are adjuncts.

(54) ⟦ **on my birthday** ⟧ = $\lambda t.\lambda P_{it}.t$ is on my birthday & P(t)

(55) Mary called on my birthday.

[$_{it,t}$ P N] [λ_2 [[[on my birthday] t_2] [λt_1 [Mary [call t_1]]]]]

$(\exists t_2)[t_2 < s^*$ & t_2 is on my birthday & Mary calls at t_2]

Note that [**PN**] doesn't directly bind the time variable t_1 of the verb in the syntax. The binding is mediated by the intersective semantics of the "quantifier" **[[on my birthday] t_2].** If we want binding of t_1 in the syntax, we have to analyse the PP as type t and use Predicate modification:

(56) **[$_{it,t}$ P N] [λ_1 [[[on my birthday] t_1] [Mary [call t_1]]]]**

(57) An alternative analysis of "on my birthday":

⟦ **[on my birthday]$_{it}$** ⟧ = $\lambda t.t$ is on my birthday

The relevant version of **Predicate Modification** is:

(58) Let α be a tree of type t with daughters β and γ of type t. Then

[[α]] = 1 iff ⟦ β ⟧ = 1 = ⟦ γ ⟧.

(59) Temporal Ps, type i(i(it,t)) quantifier format

a. ⟦ **on/in** ⟧ = $\lambda t.\lambda t'.\lambda P_{it}.t'$ is on/in t & P(t'), **on/in** = $\subseteq$

b. ⟦ **at** ⟧ = $\lambda t.\lambda t'.\lambda P_{it}.t'$ is at t & P(t'), **at** = =

Alternatively temporal prepositions are simply relations between two times, i.e., they have the type i(it).

In interaction with the Perfect auxiliary temporal PPs may create an ambiguitiy:

(60) Mary had left at six

a. **[P N] λt [t at six] λt [have (t)] λt Mary left(t)**

$(\exists t < s^*)$ t at 6 o'clock & $(\exists t' < t)$ Mary leaves at t'

b. **[P N] λt [have (t)] λt [t at six] λt Mary left(t)**

$(\exists t < s^*)(\exists t' < t)$ t' at 6 o'clock & Mary leaves at t'

(a) is a Past-time or reference time modification: the leaving is before six. (b) is a Perfect-time or event-time modificaton, the leaving is at six.

Observation by Hornstein/Klein/Thompson:

Speech time modification is not allowed.

(61) John leaves at six

$*N\ \lambda t$ [t at six] λt John leave(t)

The sentence can only have a scheduled reading, i.e. future reading.

(62) John left at six

$*$ N λt [t at six] λt [P t] λt John leave(t)Tense and Quantification

- Klein: a definite time cannot be specified (pragmatic constraint).

What about German Present?

(63) Marie kommt um 6?

Let us assume that German Present morphology always licenses the insertion of a covert FUT-operator, which has the meaning of **will**. The sentence may have the LF:

(64) **[FUT N] λt 1 at 6 λt Mary arrive(t)**

9. TENSE AND QUANTIFICATION

9.1. On the Bäuerle-von Stechow Problem

This problem has caused much trouble and has lead many people away from the quantificational analysis of tense. Here is a more compositional version of Heim's solution of the problem.

(65) a. Yesterday, Mary called exactly once/one time.

b. Yesterday, Mary called exactly 3 times.

The comparison shows that *once* = *at one time*.

Recall that we cannot analyse (a) as:

(66) [P N] λt in yesterday (t) λt. at exactly one time(t) λt. Mary call(t)

$= (\exists t)[t < s^* \ \&\ t \subseteq$ yesterday $\&\ (\exists! t')[t' \subseteq t\ \&$ Mary calls at t']]

$(\exists! t')$…t'… means "There is exactly one time satisfying …t'…. .

(Bäuerle and von Stechow, 1980) conclude that Past is a predicate meaning $\lambda t.t < s^*$. "Mary called" means $\lambda t.t < s^*$ & Mary calls at t. The quantification is provided by adverbials such as "exactly once". The default case is existential generalisation. Many people have taken up this proposal, e.g. (Musan, 2002, von Stechow, 1995) and occasionally Ogihara.

(Heim, 1997) defends the indefinite Past theory. We follow her.

9.2. DP Quantifiers

(Cresswell, 1979) observes that quantifiers must have wide scope with respect to tense. ("Cresswell's generalisation")

(67) John polished every boot.

$\neq$ ($\exists$t < s*) John polished every boot at t.

= For every boot x ($\exists$t < s*) John polished x at t.

The first reading means that John polished every boot at the same past time. In the second, the boots can be polished at different times. Therefore the LF must be:

(68) **every boot λ1 [P N] λi John polish(i) t_1**

With a temporal adverb:

(69) Yesterday John polished every boot.

every boot λ1 [P N] λi yesterday(i) λi' John polish(i') t_1

$(\forall x)[boot(x) \rightarrow (\exists t < s^*)[t \subseteq yesterday$ & John polishes x at t]]

We assumed the **at**-entry for polish. If we assume the **in**-entry, every boot can have narrow scope with respect to Tense:

(70) **[P N] λi yesterday(i) λi' every boot λ1 John polish(i') t_1**

$(\exists t \subseteq yesterday)(\exists t < s^*)(\forall x)[boot(x) \rightarrow (\exists t' \subseteq t)$[John polishes x at t']]

- It is however not possible to solve the Partee-Problem by means of **in**-entries and giving every boot narrow scope with respect to Tense.

Basically the same method must apply to plural DPs with numeral attributes:

(71) 3 students called.

---------a-----b-------c--------s*

There is a group x of 3 student & for each y in x ($\exists$t)[t < s* & y called at t]

(72) ⟦**3 students**⟧ = $\lambda P.(\exists x)[students(x) \& |x| = 3 \& P(x)]$

⟦**DIST**⟧ = $\lambda P_{et}.\lambda x.(\forall y \in x)\ P(y)$

DIST is a distributor. It modifies a predicate of groups and says that the predicate applies to a group if it applies to each member of it. DIST is used in plural semantics.

(73) **[3 students] DIST λx [P N] λi x call(i)**

The decomposition of the DP:

(74) **∃ 3 (many) students**

$= \lambda P_{et}.(\exists x)[\ |x| \geq 3\ \&\ students(x)\ \&\ P(x)\ ]$

(75) Meanings for generating the DP

a. $[\![\ \exists_{(et)(et,t)}\ ]\!] = \lambda P_{et}.\lambda Q_{et}.(\exists x)[P(x)\ \&\ Q(x)]$ covert existential quantifier

b. $[\![\ \mathbf{3}_n\ ]\!] = 3$, where n is the type of numbers

c. $[\![\ \mathbf{many}_{n(et)}\ ]\!] = \lambda n.\lambda x.\ |\ x\ | \geq n$, $|\ x\ |$ stand for the cardinality of the group x

d. $[\![\ \mathbf{students}_{et}\ ]\!] = \lambda x.x$ is a group of students

Now consider:

(76) At least/exactly/at most 3 students called yesterday.

At least n/exactly n/at most n are numeric quantifiers, i.e., they have the type n(nt,t). We assume the following meanings:

(77) a. $[\![\ \mathbf{at\ least}\ ]\!] = \lambda n.\lambda P_{nt}.\max k.\ P(k) \geq n$

d. $[\![\ \mathbf{exactly}\ ]\!] = \lambda n.\lambda P_{nt}.\ \max k.\ P(k) = n$

e. $[\![\ \mathbf{at\ most}\ ]\!] = \lambda n.\lambda P_{nt}.\ \max k.\ P(k) \leq n$

Consider:

(78) Exactly 3 students called yesterday.

Assuming Cresswell's generalisation, the DP has wide scope with respect to Past. This leaves two options: (a) we can interpret **exactly 3** in the scope of the covert article ∃ or (b) we can give it wide scope with respect to ∃. Only (b) is correct.

(79) Option (a)

[∃ λx exactly 3 λn x n-many students] DIST λy [P N] λt yesterday(t) λt y call(t)

$= (\exists x)[\ \max k\ [students(x)\ \&\ |\ x\ | \geq k] = 3\ \&\ (\forall y \in x)(\exists t < s^*)\ t \subseteq yesterday\ \&\ x$ called at t]

This is compatible with the fact that more than 3 students called, therefore not the correct reading ("van Benthem's problem").

(80) Option (b)

exactly 3 λn [∃ λx n λn x n-many students] DIST λy [P N] λt yesterday(t) λt' y call(t)

$= \max n\ [(\exists x)[students(x)\ \&\ |\ x\ | \geq n\ \&\ (\forall y \in x)(\exists t < s^*)\ t \subseteq yesterday\ \&$ x called at t]] = 3

This is correct. Exactly three students called yesterday, though each might have called more than once. The relevant generalisation seems to be:

- Numerical quantifiers take scope over the DP that contains them.

9.3. Adverbs of quantification

The Bäuerle-Stechow Problem is solved along the lines of the last section.

(81) Mary called exactly once yesterday

= Mary called at exactly one time yesterday.

(82) John called at most twice yesterday

= John called at at most 2 times yesterday.

(83) **at most 2 λn $\exists$ n-many times DIST λt_1 [P N] λt_2 yesterday(t_2) λt_3 [t_3 at t_1] λ_4 John call (t_4)**

$= \max n[(\exists T)[\text{times}(T) \ \& \ |T| \geq n \ \& \ \forall t_1[t_1 \in T \rightarrow (\exists t_2 < s^*)[t_2 \subseteq \text{yesterday} \ \& \ t_2 \text{ at } t_1 \ \& \ \text{John calls at } t_2]]]] \leq 2$

This means that there are at most 2 calling events within yesterday. Again we can show that we obtain too weak a reading if we interpret **at most 2** inside its DP (homework).

The analysis given in Heim's lecture notes, #20 on p. 11 assumes a DP **[exactly one in yesterday]** for **[exactly once yesterday]**. For German, this is not plausible:

(84) Er hat gestern genau einmal angerufen.

The relative scope of quantifiers in the middle field corresponds to the surface. This shows that "genau einmal" = "zu genau einer Zeit" is in the scope of "gestern" and not an adjunct to "Zeit" = "time". But the idea for the analysis is the same.

Ogihara (where?) thinks that the PP hosting "at most 2 times" is not **at** but rather **in**. He considers "exactly once". Suppose this is analysed as "in exactly one time". In our theory this would be:

(85) # **exactly 1 λn $\exists$ n-many times DIST λt_1 [P N] λt_2 yesterday(t_2) λt_3 [t_3 <u>in</u> t_1] λ_4 John call (t_4)**

$\max n.(\exists T)[\text{times}(T) \ \& \ |T| \geq n \ \& \ (\forall t \in T)(\exists t' < s^*)[\ t' \text{ in yesterday} \ \& \ t' \text{ in } t \ \& \ \text{John calls at } t'\ ]] = 1$

This can never be satisfied, as the following picture illustrates.

----{--------[--/////---]--------}---------s*------→

{…} denotes yesterday. […] is supposed to denote the only interval that properly contains the event time ////. But then there are many (perhaps infinitely many) subintervals of […] that also properly contain ////. So there cannot be just one […]. So the PP hosting "exactly one time" must be **at**.

What about Heim's sentence (25) on page 12 of her notes?

(86) He called on exactly one weekend.

Recall that Heim's scenario assumes that he called twice on the relevant weekend. Is this in conflict with our analysis? No. Here is the LF:

(87) DS: [P N] λt [t at $\exists_C$ exactly 1 (many) weekends] λt he call(t)

LF: **exactly 1 λn.$\exists_C$ n many weekends] DIST λy[P N] λt [t on y] λt he call(t)]**

max n.(∃X)[C(X) & | X | ≥ n & weekends(X) & (∀y ∈ X)(∃ t < s*) t on y & he calls at t] = 1

g(C) = {X | weekends(X) & (∀y ∈ X) y ⊆ last summer}

The LF is obtained by first QR-ing "exactly one many weekends" over the tense. Since this is a plural DP, DIST is inserted between the DP and the VP. Then "exactly one" is QR-ed. We have to restrict the weekends to the relevant ones, here those of last summer. Otherwise the LF cannot be satisfied. **on** means the same as in, i.e. ⊂. Yet, the construction is different. In the last example the question was whether "exactly once" meant "at exactly one time" or "in exactly one time". Since the latter gives rise to an inconsistency, it means the former.

10. Asymmetric Quantifiers

The following sentence is due to Ogihara's SALT paper #4.

(88) John worked on every Sunday.

≠ a. (∃t < s*) every Sundax λx t on x & John works at t

"There is a past time that is on every Sunday…"

≠ b. every Sunday λx (∃t < s*) t on x & John works at t

"Every Sunday contains a time before the speech time…"

Heim's suggestion: "Sunday" has to be restricted to the Past. She doesn't know why this is so. Recall that quantifiers have a domain restriction. Since an unrestricted **every** makes no sense, we interpret its domain variable C as the times before now: g(C) = {t | t < s*}. So the LF for (88) is:

(89) **every_C Sunday λx [P N] λt t on x λt John work(t)**

(∀x)[x in C & Sunday(x) → (∃t)[t < s* & t on x & John works at t]]

(von Stechow, 2002) proposes that Past restricts "Sunday" as an adjunct, i.e. he assumes an

NP of the form “Sunday in [P N]”. The LF assumed by him is this:

(90) **[PN] λt every Sunday in t λx [$_{PP}$ ∃ on x] λt John work(t)**

= (∃t < s*)(∀x)[x is a Sunday in t → (∃t’ on x) John works at t’]

There are two problems with the proposal: (a) We have to assume a covert existential quantifier as the subject of the **on**-PP. Up to now we had no evidence for this quantifier. (b) The connection between the semantic tense and the time variable of the verb via a binding chain is lost. We need that chain, however, to account for the morphology of the verb as we shall see. (Ogihara, 2006) follows (von Stechow, 2002) in assuming that “Sunday” is restricted by a temporal adjunct. He assumes a meaning “Sunday in the past” with **the past** = {t | t ≤ s*}. In addition he assumes that temporal PPs have ∃ as subject. Thus, his LF (see p. 242) is:

(91) **every Sunday in the past λx [$_{PP}$ ∃ on x] λt John work(t)**

= (∀x)[Sunday x & τ(x) ≤ s* → (∃t on x) John works at t]

Note that the LF contains no semantic tense. Ogihara observes that explicitly. This is a consequence of having ∃ as the subject of the **on**-PP. This is not good.

We will assume the following generalisation:

- Every tensed verb is c-commanded by at least one semantic tense.

Note that the restriction of Sunday could be more simply done by a covert adjective **past$_{it}$** which means λt.t < s*. A further LF would then be:

(92) **every past Sunday λx PN λt t on x λt John work(t)**

(∀x)[τ(x) < s* & Sunday(x) → (∃t < s*)[t on x & John works at t]]

I will assume that (89) or (92) are the correct analyses.

(von Stechow, 2002) investigates nested temporal PPs, i.e. cascades of temporal PPs.

(93) Fritz rief in keiner Woche an jedem Tag an.

¬(∃x)[C(x) & week(x) & (∀y)[day(y) & y in x → (∃t < s*)[t on y & call(Fritz,t)]]]

The LF proposed by von Stechow (with the modifications introduced here) is this:

(94) **(in) keiner$_C$ Woche λx (an) jedem [Tag in x] λy [P N] λt t an y λt Fritz anruf(t)**

¬(∃x)[C(x) & week(x) & (∀y)[day(y) & y in x → (∃t < s*)[t on y & Fritz calls at t]]]

The DS is:

(95) P N λt [t [an jedem [Tag in keiner Woche]]] λt Fritz anruf(t)

First the DP **jedem [Tag in keiner Woche]]** is QR-ed and the preposition **an** is pied-piped, i.e., interpreted in situ. Then the DP keiner Woche is QR-ed and the preposition in is pied-piped. This yields the interpretable LF in (94).

Heim asks why the following sentence is good. She shows that we don't obtain the correct reading how ever we interpret the Present.

(96) John works on every Sunday.

I think that the sentence contains a covert habituality operator: "John has the habit to work on every Sunday". It is possible to have such a habit at a time point, viz. s*. We have to work that out however.

11. A NOTE ON THE LOGICAL TYPE OF TPPS

Temporal prepositions have the type i(it) or i(i,(it,t)). People have worried how this is compatible with the type of **Sunday** or **meeting**, which seem to be sets of individuals, i.e. they are of type et. There are several ways of dealing with that.

1. These nouns are sets of times, i.e. they have the type it. In that case, we have no problem. Quantifies like **every** must have several type, of course. There is a variant of type (it)(it,t). For the simple type of **on** we assume a DS $[\mathbf{on}_{i(it)}\ [\mathbf{every}_{(it)(it,t)}\ \mathbf{Sunday}_{it}]\ ]$.

2. The nouns have the type et, and temporal prepositions are ambiguous. Each preposition has two variants (i(it)) and (e(it)), analogously for the quantifier type.
The semantic entries are these:

(97) a. $[\![\mathbf{on}_{i(it)}]\!] = \lambda t.\lambda t'.\ t' \subseteq t$

b. $[\![\mathbf{on}_{e(it)}]\!] = \lambda x.\lambda t'.\ t' \subseteq \tau(x)$, where $\tau(x)$ is the time of x.

The individuals that can be objects of **on** must be events, i.e., things that uniquely determine a time. If you want, you can introduce a special type v for events. That is the strategy used in (Pratt and Francez, 2001).

3. You can use the function τ of type ei (or vi) as a type shifter.

(98) The projection function τ, type ei

$[\![\tau]\!] = \lambda x.$the time of x

You assume temporal prepositions to be of type i(it) (or the more complicated quantifier type) and accommodate the type at LF.

Here are the three LFs for

(99) Maribel worked on a Sunday.

1. **$[_{it,t}$ a Sunday$_{it}]$ λt' P N λt t on t' λt Maribel work(t)**

2. **$[_{et,t}$ a Sunday$_{et}]$ λx P N λt t on x λt Maribel work(t)**

3. **$[_{et,t}$ a Sunday$_{et}]$ λx P N λt t on τ(x) λt Maribel work(t)**

The LFs assume prepositions of the quantifier type.

Homework. Indicate the logical type for the prepositions in these LFs. Write the meaning rules. Convince yourself that the LFs mean the same.

12. THE TEMPORAL PREPOSITIONS **AFTER, BEFORE, WHEN**

*12.1. The meanings of **before** and **after***

(100) Mary arrived after/before 6.

(101) Mary arrived after/before John left/had left.

(102) Mary arrived after/before John.

Working hypothesis **after/before** mean the same in these constructions.
(100) is the most transparent construction. We read off the meaning from that construction. (102) appears to be simple. But this may be deceiving.

We will take up **when** later.

(103) **after/before** : type i(i,(it,t))

a. ⟦ **after** ⟧ = $\lambda t.\lambda t'.\lambda P_{it}.t' > t$ & $P(t')$

b. ⟦ **before** ⟧ = $\lambda t.\lambda t'.\lambda P_{it}.t' < t$ & $P(t')$

(104) Mary arrived after 6.

[P N] λt t after/before 6 λt Mary arrive(t)

(∃t)[t < s* & t > (<) 6 o'clock & Mary arrives at t]

-------6----/////-----s*-→

or

------/////---6------s*-→

12.2. Temporal adjuncts in English: the SOT rule

12.2.1. After-adjuncts

"after John left/had left" = after the time at which John left/had left. What is "the time…"? Even if we restrict the definite article to relevant time (say the times in this afternoon) there are many times after the leaving of John. So we need an additional operator. (Beaver and Condoravdi, 2004) propose the operator "the earliest". "after John left/had left" therefore means "after the earliest time at which John left/had left". The operator has to be contextually restricted, because the complement of **after** does not denote the earliest P-time of all the times.

(105) EARLIEST: type (it)((it)i)

$[\![$EARLIEST$]\!] = \lambda C.\lambda P_{it}$.the earliest time t in C such that P.

= the t, such that $C(t)$ & $P(t)$ & $(\forall t')[C(t')$ & $P(t') \rightarrow t < t']$

(106) after John left

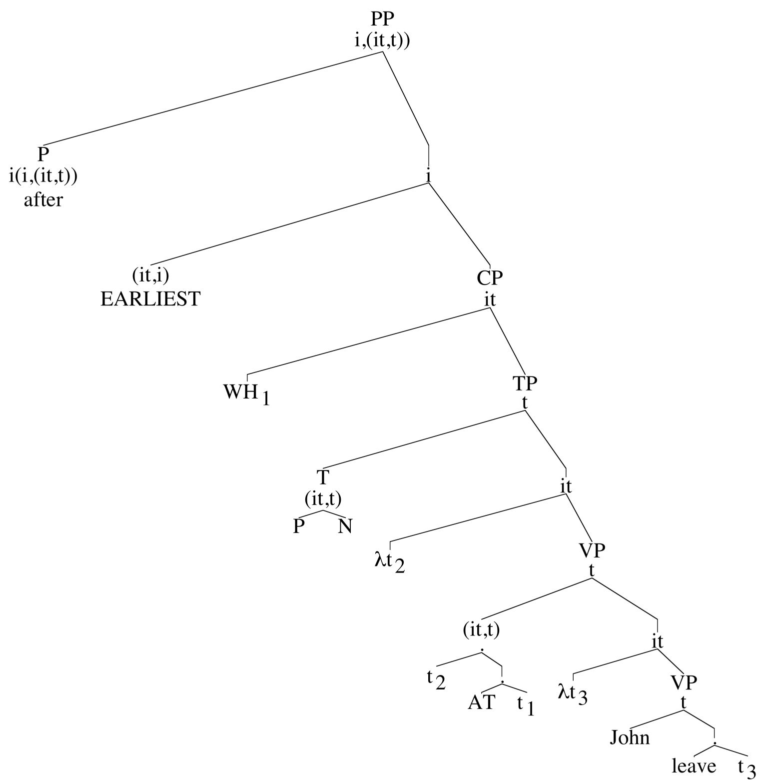
after EARLIEST$_C$ WH$_1$ [P N] λt t AT t$_1$ λt John leaves(t)

= λt.t after the earliest t' in g(C) s.t. ($\exists$t'') t'' < s* & t'' at t' & John leaves at t''

= λt.t after the earliest t' in g(C) s.t. t' < s* & John leaves at t'

WH is the relative pronoun, i.e., a semantically empty pronoun that has to be WH-moved for type reasons creating the λ-operator λ_1. g(C) may be the set of times contained in this morning. Here is the tree for the adjunct clause:

(107) after John left



Analysis of (101):

(108) Mary arrived after John left.

[P N] λt after EARLIEST$_C$ WH$_1$ [P N] λt t AT t$_1$ λt John leaves(t) λt Mary arrive(t)

= (∃t)[t < s* & t > [the earliest t' in C s.t. (∃t'' < s*) t'' at t' & John leaves at t''] & Mary arrives at t]

= (∃t)[t < s* & t > [the earliest t' in C s.t. t' < s* & John leaves at t'] & Mary arrives at t]

(von Stechow, 2002: sect.7) makes the complement of **after** definite by means of the operator **min** t…t… "the smallest time t such that…". If we constrain the operator correctly, this comes much to the same. The main idea is that the complement of tPs is definite and not indefinite as in previous analyses, e.g. Heinämäki.

We get in trouble if we want to analyse the following sentence by this method.

(109) Mary arrived after every boy left.

[P N] λt t after EARLIEST$_C$ WH$_1$ every boy λx [P N] λt t AT t$_1$ λt x leaves(t) λt Mary arrive(t)

= (∃t)[t < s* & t > [the earliest t' in C s.t. (∀x)[boy(x) → (∃t'' < s*) t'' at t' & x leaves at t''] & Mary arrives at t]]

= (∃t)[t < s* & t > [the earliest t' in C s.t. (∀x)[boy(x) → t' < s* & x leaves at t'] & Mary arrives at t]]

The transition to the last line is justified because t'' at t' iff t'' = t'. This means that every boy left at the same time, not what we are after. We want:

(110) …after the earliest $t_1[t_1 < s^* \& (\forall x)[boy(x) \rightarrow (\exists t_2)[t_2 < t_1 \& x \text{ leaves at } t_2]]]$

This looks like a pluperfect construction. Indeed: In German the complement of **after** has to be in the perfect or pluperfect:

(111) Maria kam nachdem jeder Junge *ging/^{OK}gegangen war.

In German it is impossible to construct **after** + Simple Past. We have to use the Pluperfect construction.

(112) after every boy had left

after EARLIEST WH$_1$ [PN] λt t AT t$_1$ λt every boy λx. have(t) λt x left(t)

= the meaning given in (110)

(113) Mary arrived after John had left.

'Mary arrived after the earliest time which is before a time before the speech time and John leaves at that time.'

(114) *Mary arrived after no boy had left

A welcome prediction of the account is the oddness of this sentence. Presumably the complement of **after** should denote a time just after the leaving of some boy. In von Stechows's analysis the complement would even be undefined. In any case the semantics predicts that we don't quite know what this means.

What is worrying is the semantic tense in the adjunct clause. It predicts that the following sentence is normal:

(115) Mary will arrive after John left

$(\exists t > s^*)$ t is after the earliest t' s.t. $(\exists t'' < s^*)$ t'' at t' & John left at t''. (bad)

There is nothing wrong with the interpretation, but the sentence doesn't mean that.

- Perhaps the time argument of P in the adjunct clause is not filled by **N**, but it is bound by the matrix tense? More appropriately, by the event time of the matrix clause.

12.2.2. before adjuncts

Before-clauses are constructed exactly parallel to **after**-clauses. There are two peculiarities to be mentioned.

(116) Mozart died before he finished the Requiem.

≠ Mozart died before the earliest time at which he finished the Requiem.

The semantics of **before** given so far is extensional. So this analysis cannot grasp the intended meaning. We have to modalise the complement.

(117) a. Mozart died before he COULD finish the Requiem.

b. Mozart died before the earliest time at which he would have finished the requiem in the normal course of events.

(Beaver and Condoravdi, 2004) give an analysis along the lines of (b). Since modalisation complicates the issues, we ignore the construction here.

Another feature of **before**-clauses is that they license NPIs in the complement.

(118) Mary left before any boy arrived.

NPIs are licensed in DE-context. **before** creates such a context:

(119) Cleo left before David sang ➔ Cleo left before David sang loudly

After doesn't create a DE-context:

(120) Cleo left after David sang =/=> Cleo left after David sang loudly

"Sang" is interpreted as "started singing".

Before-clauses make it very clear that deictic tenses alone in adjunct clause won't do.

(121) *Mary will arrive after John left

($\exists$t > s*) t is after the earliest t' s.t. ($\exists$t'' < t) John leaves at t''. (bad)

The sentence doesn't express this reading.

12.2.3. The SOT-Rule

Heim will follow (Ogihara, 1996: sect. 5.5) by assuming a Sequence of Tense (SOT) Rule. See below. Before we take this up we consider **before**.

(Ogihara, 1996: 5.5) quotes examples from (Stump, 1985).

(122) English Paradigm

a. John will enter the room before Mary leaves.
b. John will enter the room after Mary has left.
c. John will enter the room after Mary leaves.
d. *John will enter the room after Mary will leave.
e. *John will enter the room before Mary will leave.

Account of English following (Heim, 1997) (Ogihara remains inclusive).

1. English has an optional SOT rule, which deletes PAST (= **P**) in the scope of PAST and PRES (= **N**) in the scope of PRES.
2. Undeleted PRES in English always counts from the speech time.
3. Since English Present doesn't allow futurate readings, some instances of Japanese PRES must be rendered by **will** in English.

(123) **SOT rule**

Delete Present under Present, Past under Past. (Semantic Tenses!)

"under" means c-commanded by. The subordinate tense is deleted, the superordinate tense stays.

- We can't simply delete the semantic tense because that would create a complement of type it. When we QR the relative operator WH, this creates a complement of type i(it). But the operator EARLIEST wants a complement of type it.

(124) **Tense Deletion** means the replacement of the semantic tense by the existential quantifier ∃ of type (it)t. More precisely: N is replaced by **∃** and **[PN]** is replaced by **∃**, too.

Consider (125a) first. Suppose we do not apply the SOT-rule, i.e., we have a deictic Present in the adjunct.

(125) John will enter the room before Mary leaves.

N λt will(t) λt. t before [EARL WH_1 N λt t at t_1 M. leaves(t)] λtJohn enter(t)

= (∃t > s*) J. enters at t & t < the earliest t': t' = s* & M. leaves at t'.

This doesn't make sense, because the entering is in the future but the leaving is at the speech time s*. Since the embedded **N** is in the scope of the matrix **N**, we can apply the SOT-rule and replace the lower N by ∃. We obtain:

(126) **N λt will(t) λt. t before [EARL WH_1 ∃ λt t at t_1 M. leaves(t)] λtJohn enter(t)**

= (∃t > s*) J. enters at t & t before the earliest t' s.t. Mary leaves at t'.

Provided the leaving is in the future, this reading makes sense.

(127) John will enter the room after Mary has left.

As before, a deictic present in the adjunct doesn't make sense. We therefore delete the lower Present:

(128) **N λt will(t) λt. t after [EARL WH_1 ∃ λt t at t_1 λt. have(t) λt M. leaves(t)] λtJohn enter(t)**

= (∃t > s*) John enters the room & t is before the earliest t' s.t. (∃t'' < t') Mary leaves at t''.

Provided the quantification over the times in the subordinate clause is about future times, this makes sense.

(122c) is analysed parallel to (122a).

(122d/e) are ungrammatical according to Stump-Ogihara:

(129) *John will enter the room before Mary will leave

The account given above predicts that the sentence is okay for a deictic Present in the adjunct. Consider (e):

(130) **N λt will(t) λt. t before [EARL WH_1 N λt. will(t) λt t at t_1 λt M. leaves(t)] λtJohn enter(t)**

= (∃t > s*) John enter(t) & t > the earliest t' > s*.Mary leave at t']

This makes sense.

If we apply the SOT-rule for (e), we obtain an odd result:

(131) **N λt will(t) λt. t before [EARL WH_1 ∃ λt. will(t) λt t at t_1 λt M. leaves(t)] λtJohn enter(t)**

= (∃t > s*) John enters the room at t & t before the earliest t' (∃t'') t'' > t' & Mary leaves at ''

Suppose the existential quantifier in the adjunct speaks about future time. Then the earliest time satisfying the adjunct condition is the speech time. So this sentence could never be true. For sentence (d) we obtain:

(132) **N λt will(t) λt. t after [EARL WH_1 ∃ λt. will(t) λt t at t_1 λt M. leaves(t)] λtJohn enter(t)**

= (∃t > s*) John enters the room at t & t after the earliest t' (∃t'') t'' > t' & Mary leaves at ''

This means that Mary has to enter at the speech time, which is not meant either.

- The result of the discussion is that we could explain the data under the assumption that the SOT-rule were obligatory in this construction.

We still generate the odd sentence:

(133) *John will enter the room after Mary left.

We could block this by stipulating that we *never* have a semantic tense in adjunct clauses. Then the SOT-rule would apply obligatorily. But it cannot apply in (133). So the construction is ruled out.

We still have potential problems with embedded quantifiers:

(134) a. John will enter the room before every girl leaves.
b. John entered enter the room before every girl left.

(135) Prediction for (a):
…before the earliest time t: every girl leaves at t (i.e. at the same time!)

(136) Prediction for (b):

i. tense deletion:

…before the earliest time t: every girl leaves at t (i.e. at the same time!)

ii. deictic interpretation:

…before the earliest time t: $(\forall x)[girl(x) \rightarrow t < s^* \ \&\ x$ leaves at t]

or

…before the earliest time t: $t < s^* \ \&\ (\forall x)[girl(x) \rightarrow x$ leaves at t]

We obtain the first (odd) variant of ii by scoping **every girl** over **PN**. The second variant is obtained by scoping **every girl** under **PN**. Both variants entail a leaving at the same time.

A reasonable reading either requires an embedded Perfect (**have**), or we must have a perfective operator near the verb, i.e. the "in"-interpretation for "leaves", i.e, "x leaves in t" is interpreted as $(\exists t' \subseteq t)$x leaves at t'. This would get the distribution of **every girl** to different event times right.

Heim's summary of the predictions:

„It seems that we should then expect the following paradigm in English. (Where two possible forms are predicted, this is because of the optionality of SOT.)"

(30') He <u>called</u> her before he <u>would meet</u> her.
'he called her before he met her'

(31') (a) He <u>called</u> her after he <u>had met</u> her.
(b) He <u>called</u> her after he <u>met</u> her.
'he called her after he met her'

(32') He <u>will call</u> her before he <u>will meet</u> her.
'he will call her before he meets her'

(33') (a) He <u>will call</u> her after he <u>has met</u> her.
(b) He <u>will call</u> her after he <u>met</u> her.
'he will call her after he meets her'

12.3. Temporal adjuncts in Japanese

Data from (Ogihara, 1996: 180)

(137) a. Taroo-wa [Hanako-ni au mae-ni]

Taro-TOP Hanako-DAT meet-PRES before

denwa-o si-ta.

phone-ACC do-PAST

lit. He called her before he sees her

'Taro called Hanako before he saw her.'

b. Taroo-wa [Hanako-ni at-ta ato-de]

Taro-TOP Hanako-DAT meet-PAST after

denwa-o si-ta.

phone-ACC do-PAST

lit. He called her after he met her

'Taro called Hanako after he had seen her.'

c. Taroo-wa [Hanako-ni au mae-ni]

Taro-TOP Hanako-DAT meet-PRES before

denwa-o su-ru.

phone-ACC do-PRES

'Taro will call Hanako before he sees her.'

d. Taroo-wa [Hanako-ni at-ta ato-de]

Taro-TOP Hanako-DAT meet-PAST after

denwa-o su-ru.

phone-ACC do-PRES

lit. He will call her after he saw her

'Taro will call Hanako after he sees her.'

Repetition of the Paradigm

(138) a. lit. He called her before he sees her.

'He called her before he saw her'

a'. *He called her before he saw her

b. lit. He called her after he met her

c. lit. He calls her before he sees her.

'He will call her before he sees her'

c'. *He calls her before he saw her.

d. lit. He calls her after he saw her

'He will call her after he meets her'

We get the Japanese facts with two assumptions (Heim, lecture notes p.21)

1. Japanese Present means non-past, i.e., a disjunction of a relative Engl. Present and Future.

2. The time argument of the embedded tense is always bound by the matrix tense. (The time argument of a matrix tense will always be **N**.)

(139) Japanese Present, type i(it,t)

$[\![$ PRES $]\!] = \lambda t.\lambda P_{it}.(\exists t')\ \neg t' < t\ \&\ P(t')$

We give the LF for sentence (138a):

(140) lit. He called her before he sees her

P N λt_1 [t_1 before [EARLIEST WH$_2$ PRES(t_1) λt_3 t_3 at t_2 λt_4 he meet(t_4) her]]

λt_5 he call(t_5) her

$= (\exists t_1)[t_1 < s^*\ \&\ t_1 <$ the earliest $t_2(\exists t_3)[\neg t_3 < t_1\ \&\ t_3$ at t_2 & he meet her at t_3]

& he calls her at t_1]

$= (\exists t_1)[t_1 < s^*\ \&\ t_1 <$ the earliest t_2 $[\neg t_2 < t_1$ & he meet her at t_2]

& he calls her at t_1]

The stipulation that the embedded tense must be bound by the matrix tense immediately explains the ungrammaticality of (138a').

Suppose we replace the embedded tense in
(140) by P(AST). Then we obtain:

(141) **P N λt_1 [t_1 before [EARLIEST WH$_2$ P(t_1) λt_3 t_3 at t_2 λt_4 he meet(t_4) her]]**

λt_5 he call(t_5) her

$= (\exists t_1)[t_1 < s^*\ \&\ t_1 <$ the earliest t_2 $[t_2 < t_1$ & he meet her at t_2]

& he calls her at t_1]

This condition is inconsistent because it basically stipulates that $t_1 < t_1$.

Here is the analysis of (138d)

(142) lit. He calls her after he saw her.

PRES N λt_1 [t_1 after [EARLIEST WH$_2$ $\underline{P(t_1)}$ λt_3 t_3 at t_2 λt_4 he meet(t_4) her]]

λt_5 he call(t_5) her

= $(\exists t_1)[\neg t_1 < s^* \ \&\ t_1 >$ $\underline{\text{the earliest } t_2 [t_2 < t_1}$ & he meet her at t_2]

& he calls her at t_1]

Homework: Give the LF for (138c) and the truth-condition it expresses. Explain the oddness of (138c').

12.4. Temporal adjuncts in Russian

Past sentences (data from Alla Paslawska)

(143) Владимир покинул зал, после того как ушла каждая девушка.
Wladimir leave-pf-past room after that (gen) how leave-pf-past every girl
'W. left the room after every girl had left'

(144) Владимир покинет зал, после того как *ушла/уйдет каждая девушка.
Wladimir leave-pres-pf room, after that (gen) leave-pres-pf every girl
,W. will leave the room after every girl has left'

Future sentences (data from Georgij Nowssjelow)

(145) Джон покинет зал до того, как уйдут все девушки
John leave-Perf/Pres room before that as go-Perf/Pres-Pl all girl- Pl/ Nom

(146) Джон покинет зал после того, как уйдут все девушки
John leave-Perf/Pres room after that as go-Perf/Pres-Pl all girl- Pl/ Nom

Perfective-Present forms are interpreted as Future in Russian.

(147) The Russian paradigm

a. Ivan <u>left</u> after/before Masha <u>left.</u>

b. Ivan <u>will leave</u> after/before Masha <u>will leave</u>.

In Russian, the temporal adjunct has the same tense as that in the main clause. What is surprising is the combination Future….**after** Future…

The Russian data are obtained by the following assumptions.

1. Present perfective forms are bound by semantic Future.

2. Embedded tenses are interpreted deictically.

(148) Future

$[\![\mathbf{F}]\!] = \lambda t.\lambda P_{it}.(\exists t' > t)\ P(t')$

Analysis:

(149) **P N λt Ivan leave(t) t before/after EARL WH$_1$ P N λt' t' at t$_1$ λt Masha leave(t)**

$= (\exists t < s^*)$ Ivan leaves at t & t $</>$ the earliest t': $t' < s^*$ & M. leaves at t'

(150) **F N λt Ivan leave(t) t before/after EARL WH$_1$ F N λt' t' at t$_1$ λt Masha leave(t)**

$= (\exists t > s^*)$ Ivan leaves at t & t $</>$ the earliest t': $t' > s^*$ & M. leaves at t'

While this works fine for adjuncts with a definite subject, we hit trouble for adjuncts that contain quantifiers such as every girl. the semantics predicts tha But (Grønn, 2003) and (Paslawska and von Stechow, 2003) have argued on independent grounds that the following principle is true for Russian:

3. We can always insert a covert relative Past, i.t. a bound **P** under a semantic tense.

We can use this covert tense to obtain a different event time subjects such as **every girl**.

(151) Ivan <u>will leave</u> before every girl <u>will leave</u>.

F N λt I. leave(t) t before

EARL WH$_1$ F N λt' t' at t$_1$ λt every girl λx <u>P(t)</u> λt. x leave(t)

$= (\exists t > s^*)$ Ivan leaves at t & t > the earliest t': $t' > s^*$ & $(\forall x)[girl(x) \rightarrow (\exists t'' < t')$ x leaves at t']

'Ivan will leave before the earliest moment at which every girl will have left'

12.5. On the restriction of embedded tenses

Recall from the Partee-Problem that all tenses that are introduced by quantifier are restricted by the domain variable of the quantifier. Now how should we restrict embedded tenses?

(152) Mary came before John left.

a) ----------m---------j--------s*-----→

b) *--------m---------s*---------j-------→

The sentence describes scenario (a) but not (b). Similarly for the following example:

(153) Mary will come after John has left.

a) ------------------s*-------j----m-→

b) *-------j----------s*-------m------→

It has been observed in literature (Higginbotham, Hornstein?) that a similar situation arises with the Future Perfect.

(154) At six, John will have left

a) --------s*---------j----6-----→

b) *------j----------s*----6-----→

The unobserved readings can be excluded by the following strategy:

(155) Restriction for embedded tenses

An embedded tense takes the content of the next superordinate tense as its restriction with the following provisos:

a) The superordinate tense must be compatible with the tense in question.
b) In temporal adjuncts, the restriction is added to the domain variable of EARLIEST; the restriction is passed to the next embedded tense.

Look first at the LF for (154):

(156) **N λt WILL$_{C1}$(t) λt t at 6 λt have$_{C2}$(t) λt john left(t)**

g(C1) = {t | t a time}

g(C2) = {t | t > s*}

= (∃t)[t > s* & t = 6 & (∃t')[t' > s* & t' < 6 & John leaves at t']]

We cannot restrict the Future **will** by **N**, because this restriction would be in conflict with the meaning of the Future. But we can restrict the meaning of the Perfect **have** by the meaning of the Future, i.e., have quantifies over future times. The restriction "t' > s*" rules out the scenario (154b).

Next we take up (152). We have to restrict the domain variable of EARLIEST by the matrix Past:

(157) **P N λt [t before EARLIEST$_C$ WH$_1$ ∃ λt t at t$_1$ λt John leave(t)] λt Mary come(t)**

g(C) = {t | t < s*}

This correctly rules out scenario (152b).

Finally, let us take up (153).

(158) **N λt will(t) λt [t after EARLIEST$_C$ WH$_1$ ∃ λt t at t$_1$ λt have$_C$(t) λt John left(t)] λt Mary come(t)**

g(C) = {t | t > s*}

Again, this rules out the unwarranted reading (153b).

The procedure looks so systematic that we may guess that a superordinate tense somehow binds the restriction of the subordinate tense. Luisa Marti has done some work on similar mechanism. It remains to be seen whether her method applies to subordinate tense. For the time being, we leave this question open and assume the procedure outlined here.

12.6. when,during,while

when seems to mean the same as **at**, viz. identity, but it is a subordinating conjunction, i.e., a preposition that takes a CP as complement. **during** and **while** mean "in", i.e. ⊆. **during** can take names of time spans as complements (*during the summer*), it is more or less synonymous with **in**. (**on** means the same but is restricted to days.) **while** also means "in", but it is a subordinating conjunction.

(159) a. **during**: takes DPs as arguments

$[\![\mathbf{during}_{i(i,(it,t))}]\!] = \lambda t.\lambda t'.\lambda P_{it}.t' \subseteq t \ \& \ P(t')$

b. **while**: takes CPs as arguments

same meaning

(160) Boris slept during every lecture.

every lecture λx P N λt t during x λt Boris sleep(t)

$(\forall x)[\text{lecture}(x) \rightarrow (\exists t < s^*)\ t \subseteq \tau(x)\ \&\ \text{Boris sleeps at } t]$

The following examples are taken from (Pratt and Francez, 2001).[1]

(161) Every student slept during some meeting.

[1] The semantic theory of this paper is summarised in (von Stechow, 2002). Pratt-Francez is virtually ununderstandable because of the many type-lifts, all packed into special syntactic rules. The paper has the merit that the complements of temporal conjunctions are for the first time interpreted as definite quantifiers (though of the Russellian sort, which motivates an additional type lifting, if you don't want to have QR in the syntax).

a. **every student λx some meeting λy P N λt t during y λt x sleep(t)**

$(\forall x)[student(x) \rightarrow (\exists y)[meeting(y) \& (\exists t < s^*)\ t \subseteq \tau(y) \& x \text{ sleeps at } t]]$

b. **some meeting λy every student λx P N λt t during y λt x sleep(t)**

In (a) we could have **some meeting** in the scope of **[P N]** without changing the meaning. In (b), this is not possible.

(162) Mary arrived while John was asleep.

'Mary arrived at some past time that falls into some time at which John sleeps'

Here, the complement of the tP **while** (= **during**, **in**) is an existential quantifier of type (it)t. Recall that the CP, which makes up the temporal adjunct clause, is a relative clause of type it. Therefore, we need a covert existential quantifier **A** of type (it)(it,t).

(163) The covert indefinite determiner **A**

$[\![\mathbf{A}]\!] = \lambda P_{it}.\lambda Q_{it}.(\exists t)\ P(t) \& Q(t)$

Here is the analysis of (162):

(164) **PN λt [A WH$_1$ ~~[P N]~~ ∃ λt t at t$_1$ λt be(t) λt J. asleep(t)] λt' t while t' λt M. arrive(t)**

$= (\exists t < s^*)(\exists t')[\text{John is asleep at } t' \& t \subseteq t' \& \text{Mary arrives at } t]$

The derivation goes as follows. The temporal adjunct is construed as in the previous sections. Then the SOT-rule applies, i.e., the subordinate **PN** is replaced by ∃. The logical operation converting the adjunct into a generalised quantifier is not EARLIEST but the covert determiner **A**. In the next step the thus formed generalised quantifier is QR-ed, yielding the LF.

Here is a short remark about **when**. The simplest way to analyse it is to say that it means the same as **at**. There are many examples suggesting that it means "immediately after":

(165) Mary left when Bill arrived.

(166) Mary left when Bill was preparing dinner.

The sentences are taken from (Kamp and Reyle, 1993: p.652 ff.). In the first sentence, the leaving is upon Bill's arriving, while we have simultaneity in the second sentence. Kamp & Reyle observe that we have simultaneity if the subordinate clause is stative, while the event time of the main clause is after that of the subordinate if both sentences are perfective. To account for these facts we need an additional operation that shifts the event time of the main clause. We leave the nature of this complication open and assume that **when** means simultaneity, i.e., **at**. Note that **while** behaves differently. The subordinate clause always seems to require a state.

Pres\Future shows the expected SOT-behavior, i.e., the Present is vacuous:

(167) Fred will leave when Mary arrives. (Kamp and Reyle, 1993: 652)

Differently from **after/before**, the following sentence is perfectly OK:

(168) Mary arrived while no boy was asleep.

*12.7. Phrasal **after/before***

(169) Mary came after/before George.

(170) George drank the schnapps after the beer.

(171) Randi's son was born after Mary's.

after and **before** require a time (or an event) as object. Phrasal **after** takes an individual as object. One could try to analyse the construction as elliptic according to the following lines:

(172) a. Mary came after George ~~came~~.

b. George drank the schnapps after ~~George drunk~~ the wine.

c. Randi's son was born after Mary's ~~son was born~~.

For German, this account is not vary attractive for the fact that the preposition nach 'after' invariably governs the dative:

(173) a. <u>Die</u> Marie ist nach <u>dem</u> Schorsch gekommen.

b. <u>Der</u> Schorsch hat den Schnaps nach <u>dem</u> Wein getrunken.

c. <u>Der</u> Sohn von Randi ist nach <u>dem</u> Sohn von der Marie geboren.

Doris Penka proposes a direct analysis, which is analogous to the phrasal comparative of Heim (1985).

(174) Phrasal **after**

after type e(i((i(et),et)))

$[\![\textbf{after}]\!] = \lambda x.\lambda t.\lambda R_{i(et)}.\ \lambda y.t > \text{EARLIEST}\ (\lambda t'.R(t')(x))\ \&\ R(t)(y)$

(175) a. Mary came after George.

b. [**PN** λt **Mary** [[λt λx [x **came**(t)]] [t **after George**]]]

c. (∃t < s*) Mary comes at t & t is after the earliest t' s.t. George comes at t'

(176) a. George drank the schnapps after the beer.

b. [**PN** λt **the schnapps** [[λt λx [**George drank**(t) x]] [t **after the beer**]]]

c. (∃t < s*) George drinks the beer at t & t is after the earliest t’ s.t. George drinks the schnapps at t’

There seems no way to generate the LF via conventional QR. We need PRO-movement: Here is the derivation of the LF in (176)

[**PN the schnapps**[[**George drank**(PRO) PRO] [PRO **after the beer**]]]

Since [PRO **after the beer**] requires an argument of type i(et), we have to create it by movement. We QR the two PROs in the VP:

[**PN the schnapps** [[~~PRO~~ λt. ~~PRO~~ λx [**George drank**(t) x] [PRO **after the beer**]]]

In the next step we QR the PRO of the PP under **PN**:

[**PN** ~~PRO~~ λt_2 **the schnapps** [λt_1.λx [**George drank**(t_1) x] [t_2 **after the beer**]]]

The unconventional step is that the object **the schnapps** cannot be base generated. Intuitively, it binds the “trace” x. But there is no obvious formal link to x. An appropriate “binding theory” remains to be spelled out.

Prediction of the account: quantificational DPs as complements of *after* always take wide scope.

(177) a. Mary came after every boy.

b. [**PN** λt **every boy** λx **Mary** [[λt λy [y **came**(t)]] [t **after** y]]]

= (∃t < s*) (∀x)[boy(x) → Mary comes at t & t is after the earliest t’ s.t. x comes at t’]

that means either all boys came at the same time or there is a coming of Mary after each one coming; better:

d. **every boy** λx [**PN** λt **Mary** [[λt λy [y **came**(t)]] [t **after** y]]]

= (∀x)[boy(x) → (∃t < s*) Mary comes at t & t is after the earliest t’ s.t. x comes at t’]

12.8. *before/after in the literature*

The uniform treatment of **before** and **after** is due to Heim’s lecture notes, (Beaver and Condoravdi, 2004), (von Stechow, 2002) Compare this to earlier treatments by Anscombe and Heinämäki to see the progress. The earlier approaches are discussed in (Beaver and Condoravdi, 2004). The progress with respect to Heim is the introduction of operators like EARLIEST or MIN.

The standard analysis of **before** and **after** is due to (Anscombe, 1964). The words are quantifiers, i.e. relations between sets of times

(27) A before B iff $(\exists t \in A)\ (\forall t' \in B)\ t < t'$
A after B iff $(\exists t \in A, t' \in B)\ t > t'$

Crucially, while Anscombe's analysis of *before* involves universal qu

The semantics is taken from (Beaver and Condoravdi, 2004). In our framework, these quantifiers would have the type (it)(it,t):

(178) Anscombe restated

a. ⟦**before**⟧ = $\lambda P_{it}.\lambda Q_{it}.(\exists t)[Q(t) \& (\forall t')[P(t') \rightarrow t < t']]$

b. ⟦**after**⟧ = $\lambda P_{it}.\lambda Q_{it}.(\exists t)(\exists t')[Q(t) \& P(t') \& t > t']]$

Anscombe is not concerned with semantic tense. Our semantics of tenses is not compatible with this approach because **P** and **N** require an argument of type it. So let us assume the following tenses:

(179) Tenses for Anscombe: type (it)(it).

a. PRES = $\lambda P_{it}.\lambda t.t = s^* \& P(t)$

b. PAST = $\lambda P_{it}.\lambda t.t < s^* \& P(t)$

Here is the analysis of a sentence in the PAST.

(180) John arrived after Mary arrived.

[after PAST λt.Mary arrive(t)] [PAST λt.John arrive(t)]

= $(\exists t)(\exists t')[t < s^* \&$ J. arrives at t $\& t' < s^* \&$ M. arrive at t' $\& t > t']$

A sentence in the future will require the SOT-rule, i.e. tense-deletion. This time we can simply delete the embedded tense without accommodating the type:

(181) John will arrive before Mary arrives.

[before ~~PRES~~ λt.Mary arrive(t)] [PRES λt will(t) λt.John arrive(t)]

= $(\exists t = s^*)(\exists t' > t)$[J. arrives at t' & $(\forall t'')$[M. arrives at t'' $\rightarrow t' > t'']]$

= $(\exists t > s^*)$[J. arrives at t & $(\forall t')$[M. arrives at t' $\rightarrow t > t']]$

Criticism of the approach:

1. There is no unified semantics of **before**/**after**. Most serious objection.

2. What about sentence such as **John came after/before 6** ?

Beaver & Condoravdi point out that the following sentence is predicted to be true:

at some point, (32) is predicted true.

(32) David ate lots of ketchup before he made a clean sweep of all the gold medals in the Sydney Olympics.

The point is that this sentence is predicted to be true under Anscombe's semantics, if David never even took part in the Olympic Games, as long as he ate lots of ketchup.

3. Measure phrases for the distance cannot be integrated into Anscombe's account:

(182) David entered the room two minutes before Cleo arrived.

On the other hand, the measure phrase can easily integrated into the previous theory. Here is the idea:

(183) $[\![\textbf{2 minutes}]\!]$(after/before) = $\lambda t.\lambda t'.\lambda P_{it}.t$ after/before t' & $|t - t'|$ = 2 minutes & $P(t')$

4. An even more worrying objection (not made by Beaver & Condoravdi) is that **before/after**-adjuncts may restrict adverbs of quantification:

(184) a. John always took a brandy before he went to the lecture.
b. John always took a shower after he went to the lecture.

The structure of these must be something like this:

Wanted structure: **[ALWAYS before/after-**clause**]** main clause

ALWAYS is a two-place operator relating sets of times. But Anscombe has the following structure:

Anscombe: ALWAYS [[**before/after** subordinate clause] main clause]

So ALWAYS should be of type tt. But then the adjunct cannot restrict the adverb anymore.

<u>Summary</u>: The merit of Anscombe is that the account of **before** can explain the occurrence of NPIs in the **before** complement. This is the reason why everyone before Beaver & Condoravdi (or von Stechow) accepted this analysis (Higginbotham, Zwarts, Ogihara and many others).

(Heinämäki, 1974) basically follows Anscombe. The difference is that she works with intervals whereas Anscombe has time points. H. has no semantic tense either.

Heinämäki (1974:49,72) gives the following definitions (where I(B) is the initial point at which B is true, and we omit her references to tense information):

(35) A BEFORE B is true if and only if
(i) A is true at some interval,
(ii) B is true at some interval, and
(iii) $tr(\mathrm{A}) < \mathrm{I(B)}$

A AFTER B is true if and only if
(i) A is true at some interval J,
(ii) B is true at some interval, and
(iii) there is J' such that $J' \subseteq J$ and $J' > tr(\mathrm{B})$

The general definitions Heinämäki uses relating sentences to intervals at which they are true seem to allow that if a sentence holds at an interval, then it also holds at all subintervals of the interval. However, the intention of the definitions seems to be that a sentence is true only at maximal (continuous) intervals, such that it is not true at subintervals of those intervals. This assumption is also implicit in the definitions of *tr* and I.

Beaver & Condoravdi immediately discuss the predictions of the approach. They say that it is basically the same as Anscombe's proposal. tr(A) is the temporal reference point of A. It is used for anchoring the semantic tense. Heinämaki defines tr as follows:

(185) Heinämäki's temporal reference point

tr(A) is the beginning of the interval A if A is not an accomplishment

tr(A) is the end of A if A is an accomplishment

(186) Heinämäki's I-operator ("beginning of")

I(A) is the first point of A.

There is a confusion between intervals and Aktionsarten here. A VP-meaning A is a *set* of intervals. VP-meanings have the type it. A VP meaning has neither a beginning nor an end. An interval t instantiating a VP-meaning has a beginning and an end. We correct this:

(187) Heinämäki's temporal reference point revised: type (it)(ii)

$[\![\mathbf{tr}]\!] = \lambda P_{it}.\lambda t{:}P(t).\mathrm{beg}(t)$, if P is not an accomplishment; end(t) if P is an accomplishment.

P(t) is a presupposition.

(188) Heinämäki's I-operator restated: type (it)(ii)

$[\![\mathbf{I}]\!] = \lambda P_{it}.\lambda t{:}P(t).\mathrm{beg}(t)$

(189) Heinämäki's **before/after**-meanings restated; type (it)(it,t)

a. $[\![\textbf{before}]\!] = \lambda B_{it}.\lambda A_{it}.(\exists t)(\exists t')[A(t) \& B(t') \& tr(A)(t) < I(B)(t')]$

b. $[\![\textbf{after}]\!] = \lambda B_{it}.\lambda A_{it}.(\exists t)(\exists t')[A(t) \& B(t') \& (\exists t'')[t'' \subseteq t \& t'' > tr(B)(t')]]$

Beaver & Condoravdi claim that these meanings by and large make the same predictions as Anscombe's. If true (I am not sure [AvS]), this requires a more careful investigation of the meaning of **before**.

Be that as it may. It follows from the logical type of the prepositions that we can make exactly the same objections we brought forward against Anscombe.

12.9. Adverbs of quantification restricted by adjunct clauses

(190) a. John always took a brandy before he went to the lecture.

b. John always took a shower after he went to the lecture.

The problem with these sentences is that a straightforward analysis of **always** (and **sometimes**, **often**…) makes the meaning too strong. A straightforward analysis for (a) would give this:

(191) $(\exists t < s^*)(\forall t' \subseteq t)[t' <$ the earliest time $t''[t'' < s^*$ & J. goes to the lecture at $t''] \rightarrow$ John takes a brandy at $t']$

Suppose t = last year and John's lecture is each Monday at 10 AM. Then the sentence intuitively reports 52 (or so) brandy takings. But under (191) it reports innumerably many brandy times. We have to restrict the quantification on the subintervals before the lecture to the *immediately preceding* time. The same holds for **after**. It is not clear what "immediately before/after" should mean in a continuous time structure. We ignore this problem and simply presume that the notion makes sense somehow. IMMEDIATELY is a modifier of **before/after**:

(192) $[\![$IMMEDIATELY$]\!]([\![\textbf{before}]\!]/[\![\textbf{after}]\!]) = \lambda t.\lambda t'.\lambda P_{it}.t' <(>) t \;\&\; |\, t - t' \,|$ is as short as it can be & $P(t')$

For simplicity, assume that intervals that stand in the immediately before or after relation are "abutting".

(193) $[\![\textbf{always}_{i(it\,(it,t))}]\!] = \lambda t.\lambda P_{it}.\lambda Q_{it}.(\forall t')[t' \subseteq t \& P(t') \rightarrow Q(t')]$

The analysis (190a) is now:

(194) **P N λt. [[always(t) λt.t [IMM before] EARL WH$_1$ P N λt t at t$_1$ λt J. goes.t.l.(t)] λt J. takes.b (t)]**

= $(\exists t < s^*)(\forall t')[t' \subseteq t$ & t' immediately before earliest $t'' < s^*$: J. goes to the lecture at $t'' \rightarrow$ John takes a brandy at t']

The operator IMMEDIATELY is a special case. The important thing is that we need an adverb that fixes the distance between the two times, e.g. **two minutes before** etc. It is not clear which distance the silent modifier delivers. If I remember well, Bernard Schwarz addresses this problem somewhere and speaks of an "appropriate" relation between the two times. The context has to deliver the relation, i.e. the distance.

The meaning of **always** is standard and occurs in many papers.

Adverbs like **always** are focussing. (Rooth, 1985) gives the following examples:

(195) a. In St. Petersburg officers always escorted <u>ballerinas</u>.
'If officers escorted anyone, they escorted ballerinas'
b. In St. Petersburg <u>officers</u> always escorted ballerinas.
' If someone escorted ballerinas, they were officers'

The difference in meaning should come about by interplay of the meaning of **always** with focus semantics. We cannot go into focus semantics here. It should not touch the essentials of our analysis.

13. TENSE IN RELATIVE CLAUSES

13.1. English

<u>Past\Past</u>

(196) Mary talked to a boy who was crying.
a. ST = NT (simultaneous)
b. ST < MT (shifted, anterior)
c. ST > MT (independent, posterior)

MT: The event time of the matrix

ST: The event time of the subordinate (relative) clause

An example with prevailing (c) reading:

(197) Hillary married a man who became the president.

Pres\Past

(198) Mary talked to a boy who is crying.

ST = s* (deictic)

Tense\will

(199) Mary will buy a fish that is alive.

a. ST = MT (simultaneous)

b. ST = s* (deictic)

Mary will buy a fish that has been alive.

ST < MT (shifted)

ST < s* (deictic, Perfect)

Mary will buy a fish that was alive

ST < s* (deictic)

?? ST < MT > s* (shifted).

The simultaneous and the shifted reading require the application of the SOT-rule, i.e. tense deletion. The temporal variable of the finite verb has to be bound.

(200) *Tense deletion in relative clauses*

Past\Past or Pres\Pres can be deleted. One semantic tense (**N** or **PN**) in the subordinate clause is replaced by a temporal variable **Tpro**, which is obligatorily bound.

- The English facts can be described by the assumption that the relative clause either contains a deictic tense or a **Tpro** obligatorily bound by a matrix tense.

(201) The independent reading.

P N λ_1 Mary talk(t_1) to [a boy WH_2 P N λ_2 was(t_2) λt_3 t_2 crying(t_3)]

$= (\exists t_1 < s^*)(\exists x)[boy(x)$ & M. talks to x at t_1 & $\underline{(\exists t_2)[t_2 < s^*}$ & x cries at t_2]]

(The LF neglects the QR-ing of the object.) Matrix and relative clause contain a deictic Past.

(202) The simultaneous reading

SS: **P N λ_1 Mary talk(t_1) to [a boy WH_x ~~P N~~ λ_2 was(t_2) λt_3 x crying(t_3)]**

Tense deletion: replace subordinate Tense **PN** by **$Tpro_1$**.

P N λ_1 Mary talk(t_1) to [a boy WH_x $\underline{Tpro_1}$ λ_2 was(t_2) λt_3 x crying(t_3)]

iP uP uP uP

$(\exists t_1 < s^*)(\exists x)[boy(x)$ & M. talks to x at t_1 & x cries at $\underline{t_1}$]]

We cannot bind **Tpro** to **N** because then we couldn't license the feature **uP** of **was**.

(203) The shifted reading

Source:

P N λ_1 Mary talk(t_1) to [a boy WH$_2$ P ~~N~~ λ_2 was(t_2) λt_3 t_2 crying(t_3)]

Tense deletion: replace subordinate **N** by **Tpro$_1$**.

P N λ_1 Mary talk(t_1) to [a boy WH$_2$ [P Tpro$_1$] λ_3 was(t_3) λt_4 t_2 crying(t_4)]

iP uP iP uP

= $(\exists t_1 < s^*)(\exists x)[boy(x)$ & M. talks to x at t_1 & $\underline{(\exists t_2)[t_2 < t_1}$ & x cries at $t_2]]$

Here, **Tpro$_1$** is an argument of the embedded semantic Past. There are two semantic Pasts in the sentence. The lower is bound by the matrix Past.

(204) Present under Future

Mary will buy a fish that is alive.

N λt_1 will(t_1) λt_2 buy(t_2) a fish WH$_x$ Tpro$_2$ λt_3 is(t_3) λt_4 x alive(t_4)

(simultaneous)

N λt_1 will(t_1) λt_2 buy(t_2) a fish WH$_x$ Tpro$_1$ λt_3 is(t_3) λt_4 x alive(t_4)

(deictic)

Homework: Discuss Perfect\Future and Past\Future.

The forward shifted reading is prominent in the following sentence, which is due to Ogihara:

(205) Hillary married a man who became the president.

The simultaneous reading is obtained by having a **Tpro** (and no **P**) in the relative clause, where **Tpro** is bound to the matrix Past. The backward shifted reading is obtained by a semantic Past in the relative, which is bound to the matrix Past, and the independent reading has an embedded Past bound to **N**. The latter reading is a deictic reading, and the forward shifting is a purely pragmatic thing. Obviously, this interpretation could deal with the two remaining cases in (199) as well. So Past under Past doesn't give us convincing data that require bound tense in the relative clause. We could have a deictic Past in all these cases. But attitudes will give us data that can only be dealt with within the binding approach:

(206) John thought that he would buy a fish that <u>was</u> still alive. (Ogihara)

The event time of the relative clause certainly isn't before the speech time. Thus a referential analysis is impossible. Let us look to tense under attitudes then.

13.2. Japanese

(Ogihara, 1996: p. 153ff.)

(207) Taroo-wa [nai-te i-ru otoko]-o mi-ta

Taro crying is man saw

'Taro saw a man who was crying' (simultaneous)

(208) Taroo-wa [nai-te i-ta otoko-o] mi-ta

Taro crying was man saw (shifted: ST < MT)

'Taro saw a man who had been crying'

(209) Taroo-wa [eki-de kinoo nai-te i-ta otoko]-o mise-de mi-ta

Taro [at the station yesterday crying was man] the day before yesterday at the store saw (independent: ST > MT)

'The day before yesterday Taro saw at the store the man who was crying at the station yesterday'

(210) [Asia-no siai-de kat-ta hito-wa] kin-medaru-o morai-masu

tomorrows match-at won person gold-medal gets (ST < MT)

'The person who wins tomorrow's match will get a gold medal'

The Japanese facts follow from the assumptions given.

1. The Present expresses a relative non-Past.
2. The subordinate tense is bound by a matrix tense.

(211) Pres\Past (simultaneous)

P N λt_1 Taro see(t_1) a man who PRES(t_1) crying

= ($\exists t_1 < s^*$) Taro sees at t_1 a man who is crying at t_1

There is the deictic reading as well.

More accurately, the sentence should mean "saw a man who was or would be crying", because PRES expresses a Non-past.

(212) Past\Past (shifted)

P N λt_1 Taro see(t_1) a man who P (t_1) crying

= ($\exists t_1 < s^*$) Taro sees at t_1 a man who ($\exists t_2 < t_1$) is crying at t_2

(213) Past\Past (independent: ST > MT)

N λt_0 P t_0 λt_1 $t_1 \subseteq$ yesterday-1 & Taro see(t_1) a man who P (t_0) crying & $t_0 \subseteq$ yesterday

= $(\exists t_1 < s^*)$ $t_1 \subseteq$ yesterday-1 & Taro sees at t_1 a man who $(\exists t_2 < s^*)$ $t_2 \subseteq$ yesterday & crying at t_2

Here the embedded Past is bound by the matrix N.

(214) Past\Fut (shifted)

Taro will see a man that was crying

PRES N λt_1 Taro see(t_1) a man who P(t_1) crying

= $(\exists t_1 > s^*)$ Taro sees at t_1 a man who $(\exists t_2 < t_1)$ is crying at t_2

(215) Past\Fut (independent)

N λt_0 PRES t_0 λt_1 Taro see(t_1) a man who P(t_0) crying

= $(\exists t_1 > s^*)$ Taro sees at t_1 a man who $(\exists t_2 < s^*)$ is crying at t_2

Our analysis basically follows (Kusumoto, 1999: chap.2). The differences are:

1. K. doesn't use **N**. She has a distinguished variable t*, which denotes s* in the matrix and **Tpro** in a subordinate construction. In intensional contexts, t* can be bound by a predicate of attitude.

2. The temporal arguments of finite verbs are variables that carry a presupposition: **past**$_i$ denotes a past time.

Apart from these differences, Kusumoto's system is the same as ours.

Homework: Find data for this independent reading. I haven't found examples in the literature.

13.3. Russian

(216) a. Masha videla cheloveka kotoryj plachet.

Masha <u>saw</u> a man who <u>is</u> crying. (deictic: ST = s*)

Example from (Kusumoto, 1999: Chap. 2). The discussion of the Russian data is not complete. Recall our analysis of Russian:

1. Perfective Present expresses a Future.

2. Subordinate tense in adjuncts is interpreted deictically.

3. You can insert a covert Past under any semantic tense.

(217) Prediction for Russian

a. Masha <u>saw</u> a man who <u>was</u> crying (shifted: ST < MT, independent)

b. Masha will buy a fish that will be alive.

(independent)

(shifted: ST < MT)

c. Masha will buy a fish that was alive.

(deictic: "ST < s*")

LFs: Homework!

14. TENSE UNDER ATTITUDES

To deal with attitudes we have to enrich our semantic framework in a way that it can deal with attitudes. For this purpose we introduce an intensional λ-language. "Intensional" means that expressions of type a express meanings of type (sa), i.e., a-intensions. Recall that s is the type of possible worlds W, D_{sa} is the set of (partial) functions from W into D_a. In particular, each lexical entry will denote and intension. So the former lexical entries have to be revised to take care of the world argument. Here are some examples:

(218) Some revised lexical entries:

a. $F(\mathbf{John}_e) = \lambda w.John$

b. $F(\mathbf{called}_{i(et)}) = \lambda w.\lambda t.\lambda x.x$ calls in w at t.

c. $F(\mathbf{N}_i) = \lambda w.s^*$

d. $F(\mathbf{P}_{i(it,t)}) = \lambda w.\lambda t.\lambda P_{it}.(\exists t' < t)P(t')$

Apart fromThe interpretation of the language $[\![\,.\,]\!]^{\mathfrak{w},g}$ is as before. The only innovation is Heim & Kratzer's rule Intensional Functional Application (IFA).

(14-219)Recursive definition of the interpretation function $[\![\,.\,]\!]_{F,g}$

1. Let α be a lexical entry of type a. Then $[\![\alpha]\!]^{\mathfrak{w},g} = F(\alpha)$.

2. Let x be a variable of type a. Then $[\![x]\!]^{\mathfrak{w},g} = \lambda w.g(x)$, g(x) in D_a.

3. **FA**: Let α have type b and daughters β of type ab and γ of type a.

$[\![\alpha]\!]^{\mathfrak{w},g} = [\![\beta]\!]^{\mathfrak{w},g}(w)([\![\gamma]\!]^{\mathfrak{w},g}(w))$

4. **IFA**: Let α have type b and daughters β of type (sa)b and γ of type a.

$[\![\alpha]\!]^{\mathfrak{w},g} = \lambda w.\ [\![\beta]\!]^{\mathfrak{w},g}(w)([\![\gamma]\!]^{\mathfrak{w},g})$

5. **PM**: Let α have type a and daughters β and γ of the same type.

$[\![\alpha]\!]^{\mathfrak{w},g} = \lambda w.\lambda x.[\![\beta]\!]^{\mathfrak{w},g}(w)\ \&\ [\![\gamma]\!]^{\mathfrak{w},g}(w)$

6. **Abstraction**: Let x be a variable of type a and let α be an expression of type b.

$[\![\lambda x\ \alpha]\!]^{\mathfrak{w},g} = \lambda w.\lambda u \in D_a.[\![\alpha]\!]^{g[x/u]}(w)$

The standard way of defining complements of predicates of attitudes is to say that they are simply propositions, i.e. sets of worlds. For instance, the sentence *It is raining* (Progressive ignored) would mean [λw.it rains in w at s*]. A straight forward semantics of attitudes in the style of (Hintikka, 1969) would be this:

(220) *believe*, type (st)(i,et)

F(**believe**) = $\lambda w.\lambda p_{st}.\lambda t.\lambda x.(\forall w')$[w' is compatible with everything x believes of w in w at time t → p(w')]

John believes it is raining could then be analysed as:

(221) **N λt John believes(t) [N λt is(t) λt raining(t)]** (to be revised)

= λw. (∀w')[w' is compatible with everything John believes of w in w at time s* → it is raining in w' at s*]

Since the sentential complement is of type t whereas **believes** requires a complement of type st, we have to use IFA for the semantic composition. The example embeds a tensed proposition with deictic Present. Now it has been known at least since (Prior, 1967) that tense under attitudes cannot have a deictic interpretation. The sentence *John believed that it was raining* it used to report a belief of John that he would have worded as: "It <u>is</u> raining". In other words, an embedded Past is used to express a "subjective now". In order to express this, the embedded Tense has to be bound. Using the strategy we know from the interpretation of relative clauses, we may assume a **Tpro** in the embedded clause and bind it to the matrix Past:

(222) John believed it was raining (to be revised)

P N λ_1 John believed(t_1) $Tpro_1$ λt_2 was(t_2) λ_3 raining(t_3)

= $\lambda w.(\exists t_1 < s^*)$ John believes in w at t_1 λw'.it is raining in w' at t_1

This analysis correctly accounts for the licensing of the embedded past tense morphology, because the matrix Past transmits its [uP]-feature to **was** via the binding chain. And the semantics looks reasonable. An anaphoric of this kind has been proposed by (Gennari, 2003) among others.

It has been know for a long time that this cannot be the whole story ((von Stechow, 1984), (Abusch, 1994), (Heim, 1994), (von Stechow, 1995) among others). The analysis assumes that the subject knows precisely the time at which he is, but we are mostly wrong about the time. Consider the following sentence still assuming the anaphoric approach:

(223) At 5 o' clock Mary thought it was 6 o'clock.

P N λ_1 t_1 at 5 o' clock Mary thought(t_1) Tpro$_1$ λ_2 was(t_2) λ_3 t_3 at 6 o'clock

= $\lambda w.(\exists t_1 < s^*)\ t_1 = 5$ o'clock & Mary thinks in w at t_1 $\lambda w'.t_1 = 6$ o'clock.

According to this analysis, the content of Mary's belief is the proposition that 5 o'clock is 6 o' clock, a blatant contradiction. Intuitively, however, there is nothing wrong with Mary's belief, she simply believes that the time at which she located is 6 o' clock.

A solution of the problem following (Lewis, 1979) is this: despite the morphological appearance, the complement of the attitude predicate is not a temporally independent proposition of type st but a temporally dependent proposition of type s(it), i.e. a property of times. In other words, the clausal complement of the sentence in (223) is the proposition that the time t_1 is 6 o' clock but the property of being at 6 o'clock. We obtain this property by abstracting **Tpro$_1$** away. The semantics of the verb of attitudes has to be revised accordingly.

(224) *believe*, type (s(it))(i,et) (style of (Lewis, 1979))

F(**believe**) = $\lambda w.\lambda P_{s(it.)}\lambda t.\lambda y.(\forall w')(\forall t')[(w',t')$ is compatible with everything y believes of (w,t) in w at time t $\rightarrow p(w')(t')]$

((w,t) may be thought as that part of the world history w that is at time t. The antecedent of the conditional is abbreviated as $(w',t') \in Dox_y(w,t)$.) The revised LF for the sentence in (223) is the following:

(225) **P N λ_1 t_1 at 5 o' clock Mary thought(t_1) ~~PRO~~ λ_4 t_4 λ_2 was(t_2) λ_3 t_3 at 6 o'clock**

iP uP uP uP

= $\lambda w.(\exists t_1 < s^*)[t_1 = 5$ o'clock & $((\forall w',t') \in Dox_{Mary}(w,t_1))\ t' = 6$ o'clock]

In other words, Mary locates her time at 6 o'clock, and she does that at 5 o'clock.

The LF for the complement is created by starting with a temporal PRO at the Tense position. Since PRO is semantically void it, has to be moved for type reasons and creates a complement of the correct type. This is precisely the analysis proposed by (Kratzer, 1998). If we look at the LF, we see that the verb of attitude now qualifies as a binder of the embedded temporal variable t_4 and therefore also of the temporal variable of **was**. Thus there is a binding chain form the matrix Past up to **was**.

A semantic Past under an attitude can have a shifted reading. We obtain this by assuming a locally bound **P** in the complement:

(226) Mary thought Bill left. (shifted)

P N λ_1 Mary thought(t_1) λ_2 P(t_2) λ_3 Bill left(t_3)

$= \lambda w.(\exists t_1 < s^*)$ Mary thinks in w at t_1 $[\lambda w'.\lambda t_2.(\exists t_3 < t_2)$ Bill leaves in w' at $t_3]$

The temporal behaviour of complement clauses can be described as follows:

(227) Tense in clausal complements

The semantic tense of a complement is either the semantically empty **PRO** or **P**(**PRO**). **PRO** has to be moved for type reasons and thus creates a temporal abstract.

We are now in a position to deal with Ogihara's sentence (228):

(228) John thought that he would buy a fish that was still alive. (Ogihara)

P N λ_0 J. thought(t_0) λ_1 t_1 λ_2 would(t_2) λ_3 he buy(t_3) a fish WH$_4$ Tpro$_3$ λ_5

iP uP uP uP uP

was(t_5) λ_6 x_4 alive(t_6)

uP

$= \lambda w.(\exists t_0 < s^*)$ J. thinks$(w,t_0,[\lambda w'.\lambda t_1.(\exists t_3 > t_1)(\exists x)[fish(x,w')$ & $alive(x,w',t_3)$ & $buy(J.,x,w',t_3)]])$

Note that the **Tpro$_3$** in the relative clause is bound buy the future **would**, the past form of **will**. This accounts for the fact that the temporal variable **t_5** of **was** denotes a time after the subjective now of John. This is the crucial fact for the theory of tenses in relative clauses: we said that the semantic tense in relative clauses is a **Tpro** that is obligatorily bound. While the previous examples of a past tense in relative clauses could be treated as deictic tenses, this example has to be treated as a bound tense.

Notes to the literature: Temporal **PRO** is what (Kratzer, 1998) calls a zero tense. She writes it as Ø and the variable crated by movement as $Ø_i$. For reasons of uniformity, Kratzer wants to have all tenses as pronouns, i.e. she assumes a referential semantics for Past . We have seen that an embedded Past can have a shifted reading. To get this, Kratzer assumes that the past tense is ambiguous between a referential Past and a Perfect, i.e. our **P** or **have**. Thus an indefinite analysis of the Past is needed in this theory as well. (Ogihara, 1989) deals with Tense under attitudes by a rule of tense deletion:

Japanese and Russian are Non-SOT-languages. The data behave as in the following pardigm:

(229) Attitudes in Japanese and Russian

a. John believes Mary is sick.

b. John will say that Mary is sick. (simultaneous)

c. John said that Mary is sick. (simultaneous)

'John said that Mary was sick'

d. John said that Mary was sick. (shifted)

'John said that Mary had been sick'

We obtain these by the assumption that Tense in Non-SOT-languages is locally bound as the logical type of the verb of attitude requires. Recall that PRES in Japanese is a relative Non-Past. Here is the analysis of Japanese examples:

(230) John will say that Mary is sick Japanese

N λ_1 PRES(t_1) λ_2 John say(t_2) λ_3 PRES(t_3) λ_4 is(t_4) λ_5 Mary sick(t_5)

(231) John said that Mary is sick. Japanese (simultaneous)

N λ_1 P(t_1) λ_2 John say(t_2) λ_3 t_3 λ_4 is(t_4) λ_5 Mary sick(t_5)

(232) John said that Mary was sick. (shifted)

N λ_1 P(t_1) λ_2 John say(t_2) λ_3 P(t_3) λ_4 was(t_4) λ_5 Mary sick(t_5)

Never mind that Japanese doesn't have auxiliaries. The analysis is done under the fiction that the Japanese syntax is like the English one.

Russian is similar to Japanese, but there are some differences. Russian has a Future realised as present+perfective (or *byt'* + Inifinitive). The present morphology in the embedded clause is either licencensed by the matrix Present or by an additional relative Present in the complement. We assume the former option:

(233) John will say that Mary is sick Russian (simultaneous)

N λ_1 FUT(t_1) λ_2 John say(t_2) λ_3 t_3 λ_4 is(t_4) λ_5 Mary sick(t_5)

(234) John said that Mary is sick. Russian (simultaneous)

N λ_1 P(t_1) λ_2 John say(t_2) λ_3 t_3 λ_4 is(t_4) λ_5 Mary sick(t_5)

(235) John said that Mary was sick. (shifted)

N λ_1 P(t_1) λ_2 John say(t_2) λ_3 P(t_3) λ_4 was(t_4) λ_5 Mary sick(t_5)

Homework. a. Indicate the truth-conditions for the Russian or the Japanese examples.

b. Find Japanese and English examples, either from the literature (Ogihara, Kusumoto) or by asking informants.

15. Our Meaning Rules

(17) Present: **N** "now", type i

⟦**N** ⟧ = s* "speech time"

(18) Past: **P**, type i(it,t)

⟦**P**⟧ = $\lambda t.\lambda P_{it}.(\exists t')[t'$ is before t & $P(t')]$

(19) **called**: type i(et)

⟦**call**⟧ = λt.λx.x calls at time t.

(20) **John**: type e

⟦**John**⟧ = John

(24) **have**: type i(it,t)

$\lambda t.\lambda P_{it}.(\exists t')[t' < t \ \& \ P(t')]$

(26) **will**: type i(it,t)

$\lambda t.\lambda P_{it}.(\exists t')[t' > t \ \& \ P(t')]$

(29) The temporal auxiliary **be**: type i(it,t)

⟦**be**⟧ = $\lambda t.\lambda P_{it}.P(t)$

(30) ⟦**asleep**⟧ = λt.λx.x is asleep at time t.

(41) Referential Past:

⟦$\mathbf{PAST_i}$⟧^{g} = g(i), provided g(i) < s*; if the latter is not the case, the variable doesn't denote anything.

(49) The Perfective Operator: type (vt,it), v the type of events

⟦**PF**⟧ = $\lambda E_{vt}.\lambda t.(\exists e)[E(e) \ \& \ \tau(e) \subseteq t]$

(59) Temporal Ps, type i(i(it,t)) quantifier format

a. ⟦**on/in**⟧ = $\lambda t.\lambda t'.\lambda P_{it}.t'$ is on/in t & P(t'), **on/in** = ⊆

b. ⟦**at**⟧ = $\lambda t.\lambda t'.\lambda P_{it}.t'$ is at t & P(t'), **at** = =

(98) The projection function τ, type ei

⟦τ⟧ = λx.the time of x

(103) **after/before** : type i(i,(it,t))

a. ⟦**after**⟧ = $\lambda t.\lambda t'.\lambda P_{it}.t' > t \ \& \ P(t')$

b. ⟦**before**⟧ = $\lambda t.\lambda t'.\lambda P_{it}.t' < t \ \& \ P(t')$

(105) EARLIEST: type (it)((it)i)

$[\![\text{EARLIEST}]\!] = \lambda C.\lambda P_{it}.$the earliest time t in C such that P.

= the t, such that $C(t)$ & $P(t)$ & $(\forall t')[C(t')$ & $P(t') \rightarrow t < t']$

(139) Japanese Present, type i(it,t)

$[\![\text{PRES}]\!] = \lambda t.\lambda P_{it}.(\exists t')\ t' = t$ & $P(t')$

(159) a. **during**: takes DPs as arguments

$[\![\textbf{during}_{i(i,(it,t))}]\!] = \lambda t.\lambda t'.\lambda P_{it}.t' \subseteq t$ & $P(t')$

b. **while**: takes CPs as arguments

same meaning

(163) The covert indefinite determiner **A**

$[\![\textbf{A}]\!] = \lambda P_{it}.\lambda Q_{it}.(\exists t)\ P(t)$ & $Q(t)$

(174) Phrasal **after**

after type e(i((i(et),et)))

$[\![\textbf{after}]\!] = \lambda x.\lambda t.\lambda R_{i(et)}.\ \lambda y.t >$ EARLIEST $(\lambda t'.R(t')(x))$ & $R(t)(y)$

16. EXERCISES

<u>Exercises on sections 3 and 4</u>

For the sentences

(236) a. John arrived.

b. John will arrive.

c. John will have arrived.

(i) give the tree corresponding to the Logical Form (LF);
(ii) state the lexical entries of the words and operators involved;
(iii) calculate the meaning of the sentence: for each (non-terminal) node of the tree, state the semantic rule applied at that node and the meaning of the node;
(iv) describe a simple situation in which the sentence is true (this is best done by drawing a time line on which events (e.g. John's arrival) are temporally located).

<u>Exercises on section 8</u>

For the sentence

(237) John arrived on Monday.

(i) give the tree corresponding to the LF;

(ii) state the lexical entry of **on Monday;**

(iii) calculate the meaning of the sentence: for each (non-terminal) node of the tree, state the semantic rule applied at that node and the meaning of the node,

first assuming that **on Monday** is a temporal quantifier (i.e. of type i(it,t)), and then assuming that **on Monday** is a temporal property (i.e. of type (it)).

Excercises to section 12

12.1.

(238) John slept after a meeting.

(i) Give a tree for the logical form.

(ii) Calculate the meaning step by step.

(iii) Sketch a scenario that makes the sentence true.

(239) John didn't sleep before each meeting.

Do the same things as before. Ignore "do support", i.e. analyse the sentence as **John not slept before each meeting** assuming the deep structure (i.e. the structure before QR) **not John slept before each meeting**. Recall that you have to QR **each meeting** over the semantic tense.

12.3. Give the LFs for two of the sentences in (134) under the respective reading paraphrased in in (135). Compute the meaning for one of these.

12.4. Give the LFs for the remaining Japanese examples in section 12.3.

12.5. Discuss the Russian data in section 12.4. Gather further material and formulate a hypothesis.

12.6. Calculate the truth-condition for the LF (161b).

12.7. (240) Every student didn't sleep during some meeting.

Which are possible readings for this sentence? Give the corresponding LF (or LFs).

12.8. Give the LF for sentence (167) and calculate the truth-conditions.

12.9. Give an LF for sentence (168) and calculate the truth-conditions.

12.10. Consider the following sentence:

(241) Mary kissed John during every meeting on a Monday.

The sentence has two different readings: (a) the meetings are on the same Monday; (b) the meetings are on different Mondays. First state the truth-conditions for the readings. Then give LFs. Hint: Recall that there is the rule of Predicate Modification, which combines a PP with an NP by means of intersection.

12.11. Give the LF and calculate the truth conditions for the sentence

(171) Randi's son was born after Mary's.

Hint: Assume that this is an instance of NP-ellipsis, i.e. that at LF the noun **son** is also present in the complement of **after.**

12.12. Try to give an analysis of the following sentence using Anscombe's semantics for **after.**

(242) John arrived after six o'clock.

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