TENSE, MODALS, AND ATTITUDES AS VERBAL QUANTIFIERS

ARNIM VON STECHOW, TÜBINGEN & KONSTANZ

Abstract

The talk addresses the syntax, semantics and morphology of tense. It builds mainly on work by Irene Heim. The main idea is that features of bound variables are transmitted under binding. Cf. (Heim, 1994), (Heim, 2001), (von Fintel and Heim, 2000), (Heim, 2005) among others. Tenses will be treated as generalised quantifiers that bind a temporal variable of a verb. A semantic tense has the interpretable feature [iN] for Present and [iP] for Past. The feature is transmitted under binding to the bound variable as the uninterpretable feature [uN]/[uP] and determines the temporal morphology of its verb under local agreement. Modals and attitudes are verbal quantifiers over worlds or world-times. They bind variables of verbs of subordinate clause (a prejacent or a complement). The temporal features of the verbal quantifiers are passed to the variables of the subordinate verbs thus giving raise to SOT-phenomena. Relative clauses under attitudes have an anaphoric tense **Tpro** (in analogy to Heim's **Wpro** in modal constructions) that is bound by stipulation. The temporal features are determined by the binding semantic tense.

I will present two implementations of the theory: one that binds tense in subordinates via Heim and Kratzers PRO. The other theory will treat modals and attitudes as verbal quantifiers generated in the position of the situation/world-argument. They are QR-ed for type reasons and thereby bind the situation variable. This theory requires to consider tenses as quantifiers over situations.

As to the framework used: A generative grammar that allows QR at some level of representation. Normally, QR is restricted to DPs. A QR-ed DP is adjoined to a constituent. Verbal quantifiers may consist of a subject plus a verb. The verb has to move to a head position. Hence a special type of QR is required. We will address the syntax of movement in more detail at the end.

The essential ideas are due all to Irene Heim (different papers and personal communication). My own contribution is the elaboration of some details concerning the auxiliary system and the elaboration of a unified account of tense, modality and attitudes in a situation framework. The remaining flaws are mine.

1. AN ACCOUNT WITH WORLDS AND TIMES

In the first section I will assume an intensional typed language based on the types e (individuals), t (truth-values), i (time intervals), and s(worlds).

1.1.Deictic tense

We start with tenses in matrix clauses.

(1) Mary is asleep

LF: **N** $[_{it}$ **PRO** $\lambda_2.[_t[_{(it)t}$ **be** $t_2]$ $[_{it}$ **PRO** λ_1**.Mary asleep** $t_1]]]$
λw.Mary is asleep in w at t_c

(2) Deictic Present: **N**, type i

$\lambda w.t_c$, type i, type i

This notation is short for $[\![\mathbf{N}]\!]^f = \lambda w.t_c$, type i. **N** reminds of "now".

(3) **PRO** cf. (Heim and Kratzer, 1998)

A semantically empty pronoun without type. PRO is a zero tense if generated at an i-position, it is a "zero world" if generated at an s-position, it is a "zero individual" if generated at an e-position. PRO has to be moved at LF and thereby creates a λ-operator.

We assume a PRO in DS whenever the logical type requires the formation of a λ-abstract over a variable.

(4) DS of We start with tenses in matrix clauses.

(1): $[_t$ **N** $[_t$ $[_{(it,t)}$ **be PRO**$][_t$ **Mary asleep PRO**$]]]$

The LF is generated from DS by PRO movement, which may be regarded as an instance of QR ("quantifier raising"). QR creates a λ-abstract binding its trace. Since PRO has no meaning, it is deleted at LF ("Full interpretation"), leaving the λ-operator.

(5) Adjectives: type i(et)

asleep$_{(it)t}$: λw. λt.λx. x is asleep in w at t

In this talk, the time argument is the first argument of a verb or adjective. Mostly it is taken to be the last one. The structures are better readable in the first way-

(6) Temporal auxiliaries, type i((it)t)

be/**have** : $\lambda w.\lambda t.\lambda P_{it}.P(t)$

Adjectives don't realize their time argument overtly. This is done by the temporal auxiliary **be**, which has a trivial semantics, viz. identity.

(7) a. Mary was asleep

N PRO λ_3[P t_3] PRO λ_2 [[be t_2] PRO λ_1[Mary asleep t_1]]
$\lambda w.(\exists t < t_c)$ Mary is asleep in w at t

b. Mary slept
N PRO λ_2[P t_2] PRO λ_1 [Mary sleep t_1]

(8) Past, type i((it)t) (Priorian Past)

P: $\lambda w.\lambda t.\lambda P_{it}.(\exists t' < t)\ P(t')$

Deictic Past is analysed as a the complex tense **P(N)**. For the examples, we could have defined a deictic Past **P*** as this is done mostly in the literature. We will see what the decomposition buys as soon as we embed tense under attitudes. I owe the idea to decompose Past as **P** applied to **N** to Irene Heim (p.c.).

(9) The future auxiliary **will**, type i(it,t)

$\lambda w.\lambda t.\lambda P_{it}.(\exists t' > t)\ P(t')$

(10) Mary will be asleep.

N PRO λ_3[will t_3] PRO λ_2 [[be t_2] PRO λ_1[Mary asleep t_1]]
$\lambda w.(\exists t > t_c)$ Mary is asleep in w at t

1.2.Morphology 1

Semantic tenses, i.e. **N** and **P**, have the feature [iN] or [iP], respectively. They transmit the features [uN]/[uP] to the traces they bind. The tense morphology of verbs has the feature [uN] for Present and [uP] for Past. The feature is licensed under agreement by the same feature at the trace in the time argument.

I am assuming the binding convention of Heim & Kratzer. A variable is semantically bound, if it is bound by the λ-operator. So the proper binder is the λ-operator. λ-abstracts are created by QR. The moved phrase is said to bind the variable/trace in a derived sense. In the structures considered here, the lambdas are created by PR0-movement. But it is not the PRO that counts as the relevant binder, but the verbal preceding it. In example (7) **[was t_2]** counts as the binder to **t_1**, **[P t_3]** binds **t_2** and so on.

(11) Mary was asleep

N PRO λ_3[P t_3] PRO λ_2 [[was t_2] PRO λ_1[Mary asleep t_1]]

iN iP uN uP uP uP

|_____| |……..|
|_____|_____|

____ stands for feature transmission under binding; …… stands for feature transmission

under agreement

The time argument of the adjective has the feature [uP]. Adjectives don't have temporal morphology. Therefore the feature is not realised there. But it may be passed to a subordinate verb. See below.

(12) Mary will be asleep.

N PRO_2[will t_2] PRO_1 [[be t_1] PRO_1[Mary asleep t_1]]

iN uN…uN uN uN

|_____|_____|_____|

I have abbreviated PRO λ_i as PRO_i.

Both **be** and **asleep** inherit a Present feature, which is not realised, because they are tenseless forms. We will see that this feature may be important. Note that **will** has no i-feature. It simply transmits the feature inherited from its time variables. We will say something about the treatment of morphological Future in languages such as French in the next section.

1.3.Tense under attitudes

Most accounts assume that there is no deictic tense under attitudes. Tense is not interpreted at all or interpreted as a relative tense: (von Stechow, 1984), (Ogihara, 1989), (Abusch, 1993), (von Stechow, 1995), (Kratzer, 1998), (Kusumoto, 1999), (Schlenker, 1999) among others. I will assume that this view is correct.

We can now analyze sequence of tense (SOT) constructions:

(13) John believed Mary was asleep (simultaneous)

N PRO_4 P t_4 **PRO_3 John believed t_3 PRO_2 [was t_2] PRO_1[Mary asleep t_1]**

$\lambda w.(\exists t < t_c)\ (\forall w't')\ [(w',t') \in Dox_{John}(w,t) \rightarrow$ Mary is asleep in w' at t']

(14) Attitude verbs

believe$_{(sit)(iet)}$: $\lambda w.\lambda t.\lambda p_{sit}.\lambda x.\ (\forall w',t')\ (w',t') \in Dox_x(w,t) \rightarrow p(w')(t')$

The notion "simultaneous" is to be taken *cum grano salis*. The doxastic alternatives of John are world-time pairs. So Mary sleeps at a time that John *takes* to be the actual time. But he may be wrong about the time.

The finite verb **was** semantically tenseless, i.e., its time variable is not bound by a semantic tense but by λ_2, which is generated by PRO-movement. PRO is base generated at the position t_2. At LF, PRO is deleted by Chomsky's principle of Full Interpretation.

Morphology 2

Verbs of attitude count as binders of the trace created by the PRO in the left periphery of their complement.

(15) **N PRO_4 P** t_4 **PRO_3 John believed t_3 PRO_2 [was t_2] PRO_1[Mary asleep t_1]**

iP uP uP

SOT-constructions show what (Zeijlstra, 2004) calls *Multiple Agree*: an interpretable features licenses more than one uninterpretable features in its licensing domain. Here Multiple Agree is licensed under variable binding.

The next example shows what we buy by the decomposition of Past: we can bind its time argument by PRO and thus obtain a Pluperfect reading for the embedded clause.

(16) John thought Mary was asleep (shifted)

N PRO_5 P t_5 PRO_4 John thought t_4 PRO_3 P t_3 **PRO_2 [was t_2] PRO_1[Mary asleep t_1]**

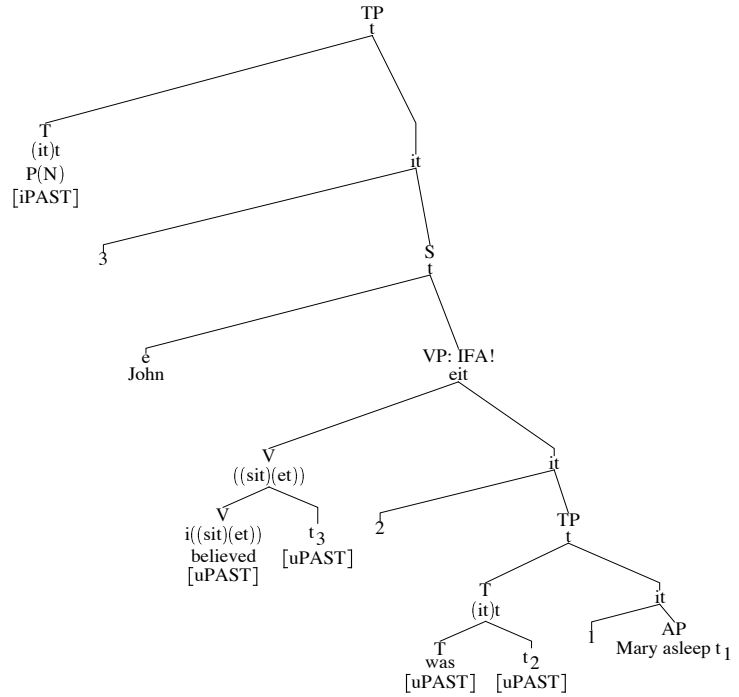
iP uP uP iP uP

$\lambda w.(\exists t < t_c)\ (\forall w',t')\ (w',t') \in Dox_{John}(w,t) \rightarrow (\exists t'' <\ t')$ Mary is asleep in w' at t'

We have two semantic Pasts in this example and therefore two binding chains. The time variable t_3 of the subordinate **P** is bound by **John believed**, which generates the shifted reading for the embedded clause.

A note to semantic composition. We work with abstraction and Functional Application (FA). But the application of **believe** to the complement requires Intensional Functional Application (IFA): cf. (Heim and Kratzer, 1998: chap. 12)

(17) John believed Mary was asleep (simultaneous)



- The PROs are deleted.

Here is the generation of the shifted reading with embedded Pluperfect:

(18) John believed that Mary had been asleep

…**that PRO$_3$ [had t$_3$ λ$_2$ [been t$_2$ λ$_1$ [Mary asleep t$_1$]]]**

uP uP

iP uP

λw.λt.(∃t' < t) Mary is asleep in w at t'

The perfect auxiliary **been** is a semantic Past and introduces a new binding chain. This generates the shifted reading.

(19) Perfect Auxiliaries:

a. **been**$_{i(it,t)}$: λw. λt.λP$_{it}$. (∃t' < t) P(t') (like **P**)

b. **been**$_{i(it,t)}$: λw. λt.λP$_{it}$. (∃t' >< t) P(t') Extended Now Perfect (XN-Perfect)

t' >< t means that t' abuts t from the left. Under Present, **been** always expresses an XN-Perfect in English; cf. (Dowty, 1979: chap. 7)

(20) Mary has been asleep

λw.(∃t >< t$_c$) Mary is asleep in w at t

The next examples show that tenseless forms (infinitives, participles, adjectives) transmit

their tense feature to the variable they bind.

(21) John will say that Mary is asleep

N PRO λ_1 **will** t_1 PRO λ_2 John <u>say</u> t_2 PRO λ_3 **is** t_3 PRO λ_4 Mary asleep t_4
iN uN uN uN

The Present feature is transmitted through the infinitive. The morphology of **will** and **is** agrees with the present feature transmitted by the matrix Present. This is a case of Multiple Agree; cf. (Zeijlstra, 2004).

The synthetic future in Romance has to be treated along the same lines, as the following example suggests[1]:

(22) Jean dira que Marie est malade. (simultaneous)

The embedded verb has Present morphology that is determined by the matrix verb, which has future morphology. This shows that an analysis that assumes a covert Future operator F with the feature [iF] cannot be correct. The verb **dira** would then have the feature [uF], and this feature would be passed to the embedded verb yielding the following structure:

(23) *N PRO_1 F t_1 PRO_2 Jean dira t_2 PRO_3 que sera t_3 PRO_4 Marie malade t_4
iF uF uF!

The prediction of such an account of synthetic future would be that the sentence

(24) Jean dira que Marie sera malade

has a simultaneous interpretation. Since this is not so, this approach is not correct and we have to decompose the verb morphology to make it similar to English:

(25) N PRO_1 [**–a** t_1] PRO_2 Jean **dir-** t_2 PRO_3 que est t_3 PRO_4 Marie malade t_4
iN uN uN uN

The suffix **–a** has the same analysis as English **will**. The stem **dir-** is a tenseless form and hence doesn't realise the uN feature. The stem and the suffix must be brought together at PF by head movement.

(26) John was aware that Mary was sick.

N λ_5 **P** t_5 λ_4 **was** t_4 λ_3 John <u>aware</u> t_3 PRO λ_2 **was** t_2 λ_1 Mary sick t_1
iP uP uP uP

The Past feature is transmitted trough the adjective.

(27) John had said that Mary was sick.

[1] This is the answer to Orin Percus' questions on the treatment of morphological Future.

N λ_5 **P** t_5 λ_4 **had** t_4 λ_3 John <u>said</u> t_3 PRO λ_2 **was** t_2 λ_1 Mary sick t_1
iP uP uP uP

The Past feature is transmitted trough the participle.

1.4.Tense in relative clauses

(28) The tense in relative clauses is a temporal pronoun **Tpro** that has to be bound by stipulation.

This similar to the account in (Kusumoto, 1999). Kusumoto assumes in addition deictic tenses in relative clauses. (Partee, 1973) is the source for the idea that tenses can be pronouns. Not all occurrences of tenses can be pronouns. The Past must have at least one relative interpretation to get the shifted reading.

(29) John knew a woman who was sick.

a. Simultaneous
N PRO_1 P t_1 PRO_2 John knew t_2 a woman who$_x$ $Tpro_2$ PRO_3 was t_3 x sick
iP uP uP uP
"sick at the time of the knowing"

b. Backward shift
N PRO_1 P t_1 PRO_2 John knew t_2 a woman who$_x$ $Tpro_2$ PRO_3 P t_3 PRO_4 was t_4 x sick
iP uP uP iP uP
"sick before the time of the knowing"

c. Indipendent
N PRO_1 P t_1 PRO_2 John knew t_2 a woman who$_x$ $Tpro_1$ PRO_3 P t_3 PRO_4 was t_4 x sick
iN uN iP uP
"sick before the speech time"

d. Forward shift
N PRO_1 P t_1 PRO_2 John knew t_2 a woman who$_x$ $Tpro_1$ PRO_3 is t_3 x sick
iN uN uN
"sick at the speech time"

1.5.Double Access

(30) John said that Mary is sick

N PRO_1 P t_2 PRO_2 John said t_2 PRO_3 Mary **is** t_2 sick
iP uP uP!

The present morphology of is cannot be licensed under agreement with t_2! Binding of t_2 by the matrix **N** or inserting a new **N** in the complement doesn't make sense semantically.

According to (Abusch, 1997), (Ogihara, 1996) ,(Kratzer, 1998), (Kusumoto, 1999) a de re construction.

(31) John said of the present the property that Mary is sick.

N λ_1 P t_1 λ_2 John said t_2 N λ_3 Mary is t_3 sick

iN uN

The second **N** is an argument of the "saying de re". Somehow it qualifies as a binder of the time argument of the embedded clause. You may think of the embedded stuff as a structured proposition in the sense of (von Stechow, 1984).

(32) *saying de re*

say$_{i(i((sit)(et)))}$: λw.λt.λt'.λP_{sit}.λx.x says in w at time t of time t' the property P.

2. THE THEORY OF VERBAL QUANTIFIERS

2.1.Heim's idea

A reflection on our LFs: A moved PRO is nothing but a λ-operator. Tenses bind temporal traces. **N** has the type i and could be base generated at the position of its trace. If it binds the time variable of **P** it can be reconstructed and yield **P(N)**. **P(N)** has the quantifier type (it)t. Therefore we may think that it is base generated at the time position of the verb and QR-ed at LF.

(33) Mary is asleep

LF: **N PRO λ_2 [$_t$ [be t_2] PRO λ_1[$_{it}$ Mary asleep t_1]]**
Old DS: [**N [$_t$ [$_{(it,t)}$ be PRO][$_{it}$ Mary asleep PRO]]]**
New DS: **Mary asleep [be N]**

(34) Mary was asleep.

LF: **N PRO λ_2[P t_2] PRO λ_1 [[be t_1] PRO λ_1[Mary asleep t_1]]**
Old DS: **N [P PRO] [[be PRO][Mary asleep PRO]]**
New DS: **[Mary asleep[[be [P N]]]]**

Tenses and temporal auxiliaries are thus temporal quantifiers generated at argument position and QR-ed at SS/LF.

- This move automatically generates the relevant binding chain(s).

Modals are verbal quantifiers: **can** is an existential quantifier over worlds, **must** is a universal quantifier over worlds. Similarly, **John believes** is a universal quantifier over worlds. Quantifiers over individuals have the type (et)t and must be QRed at LF for type reasons. Ignoring tense, verbal quantifiers have the type (st)t. (Heim, 2001) has the idea to

base generate verbal quantifiers at the position of the world argument. Then they are subjected to QR for type reasons. Here are two examples:

(35) It must rain

DS: rain (must(PRO)(Acc))
=> QR
must(PRO)(Acc) λ_1. rain(w_1)
=> QR
LF: PRO **λ_2.must(t_2)(R) λ_1. rain(t_1)**

We assume an extensional language with world variables. The traces are interpreted as world variables.

(36) **rain**$_{st}$: λw.it rains in w

must$_{s(R(pt))}$: λw.λAcc.λp.($\forall$w' $\in$ Acc(w))p(w')
R:= s(st), p = st
Acc is a variable ranging over accessibility relations.

The approach extends to attitudes, tense still ignored:

(37) John thinks it rains

DS: it rains(John thinks(PRO))
=> QR
John thinks(PRO) λ_1. it rains(t_1)
=>QR
LF: **PRO λ_2.John thinks(t_2) λ_1. it rains(t_1)**

2.2.Tense and modality as verbal quantifiers

The program is to treat tenses, modals and attitudes uniformly as verbal quantifiers. Here is a first analysis:

(38) Ede had to work (hard).

DS: Ede work(have(P(N(PRO)))(R))
=> QR
have(P(N(PRO))(R)) λ_1.Ede work t_1
=> QR
P(N(PRO)) λ_2 have(t_2)(R) λ_1.Ede work t_1
=> QR
N(PRO) λ_3 P(t_3) λ_2 have(t_2)(R) λ_1 Ede work t_1
=> QR
LF: **PRO λ_4 N(t_4) λ_3 P(t_3) λ_2 have(t_2)(R) λ_1 Ede work t_1**

We explain the variable under **N** in a moment.

Interpretation wanted:

(39) λw.($\exists$t < t_c)($\forall$w' $\in$ R(w) Ede works in w' at time t.

Problem: How could the LF express this proposition? The reading shows that we have to distinguish between worlds and times. A framework that assumes only world variables for verbs cannot get time and modality correctly.[2]

Proposal: We assume a situation theory in the sense of (Kratzer, 1989) or (Elbourne, 2005). Verbs, modals and tenses have a situation argument. A situation s uniquely determines a time t(s), a world w(s) and a place p(s). Modals shift the world of the situation while leaving the time intact, tenses shift the time of the situation while leaving the world intact, attitudes shift the world and the time of a situation.

(40) Tenses in situation semantics, type s((st)t)

a. Present
N : $\lambda s.\lambda p_{st}.t(s) = t_c$ & p(s)
b. Past
P : $\lambda s.\lambda p_{st}.$ $(\exists s')[s' < s$ & $p(s')]$
where $s' < s$:iff $w(s') = w(s)$ & $t(s') < t(s)$; w(s) means "the world of s"

- The first argument of the Present is a situation. **N** says that the time of this situation is the context time t_c.
- Past brings us to an earlier situation in the same world. The first argument of **P** is a situation!

(41) Modals in situation semantics: type s(R(pt)) (as above)

must, **have to**: $\lambda s.\lambda R.\lambda p.(\forall s')\ s' \in R(s)$ & $t(s') = t(s) \rightarrow p(s')$
Similarly for possibilities.

- The accessible situations are at the time of the local evaluation situation. Temporal control.

Truth condition of the LF in (38):

(42) Ede had to work (hard)

PRO λ_4 Nt_4 λ_3 P t_3 λ_2 have t_2 Acc λ_1 Ede work t_1
$\lambda s.(t(s) = t_c$ & $(\exists s')[w(s') = w(s)$ & $t(s') < t(s)$ & $(\forall s'')[s'' \in Acc(s')$ & $t(s'') = t(s')$
$\rightarrow$ Ede works in s'']]

Our language is extensional and has situation variables (type s) in the syntax. So (von Fintel and Heim, 2000)'s analysis of the Janet Fodors "specific de dicto" reading of the following sentence may be implemented:

[2] This was the reason I didn't choose this approach in (von Stechow, 2003); I should have known better, because in my lecture notes I had been using for years a situational approach to tense in the style given below.

(43) A friend of mine must win

The problematic reading is that I want that one of my actual friends wins, no matter which one. Here the indefinite term **a friend of mine** is in the scope of the modal, but the word variable of **a friend of mine** is bound form outside. H & v.F. assume a pronoun **Wpro** of type s that must be bound (like the **Tpro** in relative clauses).

(44) The specific de re reading

LF: PRO λ_1 [N t_1] λ_2 [must t_2 R] λ_3 a [friend **Wpro**$_1$] win t_3
|_____|_____|

DS: a [friend **Wpro**$_1$] win (must ((N PRO) R))

(45) **friend of mine**, type s(et)

$\lambda s.\lambda x.x$ is a friend of mine in s

- The s-argument of nouns is filled by a **Wpro**.

The theory predicts two specific de re readings under past modals:

(46) Einer meiner Freunde musste gewinnen.

LF1: PRO λ_1 [N t_1] λ_2 [P t_2] λ_3 [must t_3 R] λ_4 a [friend **Wpro**$_1$] win t_4
|_____|_____|

"One of my present friends had to win"

LF2: PRO λ_1 [N t_1] λ_2 [P t_2] λ_3 [must t_3 R] λ_4 a [friend **Wpro**$_2$] win t_4
|_____|

"One of my then friends had to win"

2.3.Attitudes as verbal quantifiers

For the time being, assume that the subject of an attitude is plugged in before the object. Thus Subject + Verb has the type of a generalized quantifier.

(47) **think** in situation semantics, type s(e(st,t))

$\lambda s.\lambda x.\lambda p_{st}.(\forall s' \in Dox_x(s))p(s')$

This move subsumes attitudes under verbal quantifiers. Here is the analysis of an SOT paradigm.

(48) John thought that Mary was asleep

a. simultaneous

PRO λ_1 N t_1 λ_2 P t_2 λ_3 John thought t_3 λ_4 was t_4 λ_5 Mary asleep t_5
|_____|_____|

iP uP uP

$\lambda s_1.t(s_1) = t_c$ & $(\exists s_2)[s_2 < s_1$ & $(\forall s_3 \in Dox_{John}(s_2))$ Mary is asleep in s_3]

b. backwards shifted

PRO λ_6 N t_6 λ_5 P t_5 λ_4 John thought t_4 λ_3 P t_3 **λ_2 [was t_2] λ_1[Mary asleep t_1]**

iP uP iP uP

DS: **Mary asleep (was P(John thought P (N (PRO))))**

2.4.De se readings

(49) Heimson believed he was David Hume.

Heimson doesn't believe that Heimson is David Hume. He rather believes: "I am David Hume." Cf. (Lewis, 1979). This is a "de se reading".

(50) LF: **PRO λ_6 N t_6 λ_5 P t_5 λ_4 Heimson believed t_4 [$_{s(et)}$ λ_1 [$_{et}$ HE λ_2 t_2 [was t_1] D.H.]]**

$\lambda s.(\exists s' < s)\ (\forall s',y)((s',y) \in Dox_{Heimson}(s) \rightarrow y = \text{David Hume})$

DS: **HE [was(Heimson believed(P(N(PRO)))) D.H.**

(51) De se pronouns

HE is a semantically vacuous pronoun. It agrees with the features of the verbal quantifier that binds it.

Like **PRO**, a de se pronoun only creates a λ-operator.

(52) De se **believe**, type s(e(set,t))

$\lambda s.\lambda x.\lambda P_{set}.(\forall s',y)((s',y) \in Dox_x(s) \rightarrow P(s')(y))$

The difference to propositional believe is that the alternatives are not simply situations but individual-situation pairs. Note that the time of the alternatives is left unspecified. I might be the same as the time of the local evaluation time, but if the subject is wrong of his time, it is a different time. Presumably, all doxastic alternatives are at the same time. So the rule should be more complicated.

(53) **be**, type s(e(et))

$\lambda s.\lambda x.\lambda y.y$ is x (Identity)

Identity is a "transcendental", the relation does not depend on the situation parameter.

(54) At 5 John thought it was 6.

PRO λ_1 N t_1 λ_2 P t_2 λ_3 [t_3 **at 5**] λ_4 **John believed t_4 λ_5 [was t_5] 6]**

$\lambda s.(\exists s' < s)[t(s') = 5 \ \& \ (\forall s'' \in Dox_{John}(s')\ t(s'') = 6]$

(55) a. **be**, type s(it)

$\lambda s.\lambda t.t(s) = t$

b. **at 5**, type s(st,t)

$\lambda s.\lambda p_{st}.t(s)$ is 5

2.5.Non-SOT languages

E.g. Japanese and Russian.

1. They have a relative Present (**PRES**). (Ogihara, 1996)

2. The time variable of verbs is locally bound by a semantic tense. (Kusumoto, 1999)? check!

Imagine the following sentences to be Japanese. Corresponding examples are found in the literature.

(56) Taro said Mariko is sick. (simultaneous)

PRO λ_1 P t_1 λ_2 Taro said t_2 λ_3 PRES t_3 λ_4 is t_4 λ_5 Mariko sick t_5

|_____| |_____|

iP uP iPRES uPRES

$\lambda s.(\exists s' < s)(\forall s'' \in SAY_{Taro}(s'))(\exists s''' = s'' \ \&$ Mariko is sick in $s''')$

(57) Japanese tenses

a. **N** and **P**, as in English
b. Relative Present **PRES**, type s(st,t)
$\lambda s.\lambda p_{st}.(\exists s')[s' = s \ \& \ p(s')]$,

- PRES has no semantic impact. The only function of this tense is to license the features of the verb whose time variable it binds.

(58) Taro said Mariko was sick (only shifted)

PRO λ_0 P t_0 λ_1 t_1 λ_2 Taro said t_2 λ_3 P t_3 λ_4 was t_4 λ_5 Mariko sick t_5

The simultaneous reading is not possible, because the time variable of **was** would not be locally bound by a semantic tense:

(59) **PRO λ_0 P t_0 λ_1 t_1 λ_2 Taru said t_2 λ_4 was t_4 λ_5 Mariko sick t_5** ***** simultaneous

|_____|__xxx_____|

t_4 is not locally bound by P

Double Past in Russian: In Russian, past morphology may express a Pluperfect, i.e. a double Past. Cf. (Paslawska and von Stechow, 2003), (Grønn, 2003).

This is in agreement with local binding of the time variable of verbs.

(60) V vosem' chasov Alla uzhe vyshla

at eight o'clock Alla already leave-pf-past
'A eight Alla had already left'
PRO λt N t λ_0 P t_0 λ_1 t_1 λ_2 t_2 at 8 λt_3 P t_3 λ_4 Alla left t_4

|_____|

P-iteration seems to be allowed only in languages with impoverished tense morphology, i.e., they don't have a way to express the Pluperfect overtly.

2.6. Tense in Relative Clauses

The treatment is the same as before. The only difference is that we may consider tenses (and even Tpro) as verbal quantifiers that are generated in argument position:

(61) John knew a woman who was sick.

a. Simultaneous
N λ_1 P t_1 λ_2 John knew t_2 a woman who$_x$ Tpro$_2$ λ_3 was t_3 λ_4 x sick t_4
iP uP uP uP
"sick at the time of the knowing"
DS: **John knew P(N) a woman [who sick[was Tpro$_2$]]]**

b. Backward shift
N λ_1 P t_1 λ_2 John knew t_2 a woman who$_x$ Tpro$_2$ λ_3 P t_3 λ_4 was t_4 λ_5 x sick t_5
iP uP uP iP uP
"sick before the time of the knowing"

c. Indipendent
N λ_1 P t_1 λ_2 John knew t_2 a woman who$_x$ Tpro$_1$ λ_3 P t_3 λ_4 was t_4 λ_5 x sick t_5
iN uN iP uP
"sick before the speech time"

d. Forward shift
N λ_1 P t_1 λ_2 John knew t_2 a woman who$_x$ Tpro$_1$ λ_3 is t_3 λ_4 x sick t_4
iN uN uN

For Non-SOT-languages, a complication arises. In Japanese, Present under Past in Relatives may have a simultaneous interpretation. In Russian, this is not possible; cf. (Kusumoto, 1999: chap. 2)

(62) Mariko talked to a man who is crying like a baby.

Japanese: simultaneous: o.k.
Russian: simultaneous: *

- Tentative proposal: In Japanese, relative clauses may contain a relative PRES. In Russian, PRES is only possible under attitudes.

(63) **N λ_1 P t_1 λ_2 Mariko talked t_2 to a man who$_x$ PRES t_2 λ_3 is t_3 λ_4 x crying t_4**

2.7.Syntax and Morphology

The syntax for verbal quantifiers may look adventurous in view of the unconventional DS. But the SS looks quite familiar. We show how a tree is generated via the rules *External Merge* (= Phrase structure rule) and *Internal Merge* (Movement). We will assume a more conventiale logical type for attitudes: the object slot is saturated before the subject slot.

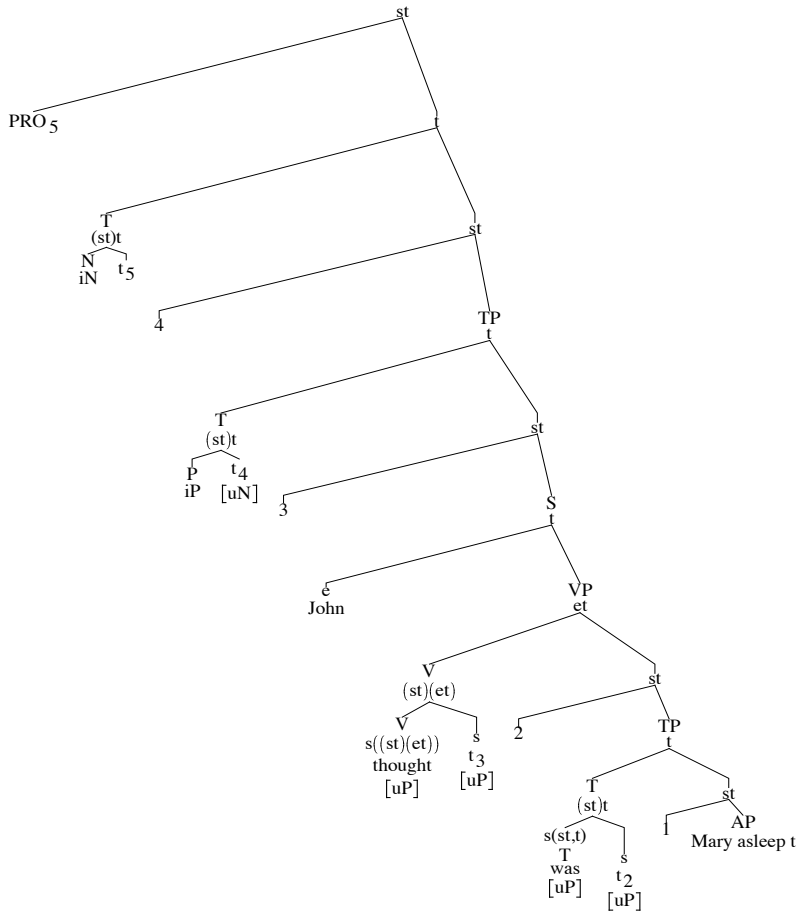
(64) John thought that Mary was asleep

simultaneous reading
PRO λ_5 N t_5 λ_4 P t_4 λ_3 John thought t_3 λ_2 was t_2 λ_1 Mary asleep t_1

DS: generated by External Merge (EM):
Mary asleep (was (thought P (N (PRO))))
=> Internal Merge (IM), head movement
$[_{TP}$ $[_V$ was (thought P (N (PRO)))] λ_1 $[_{AP}$ Mary asleep $t_1]]$
=> EM with **that**
$[_{CP}$ that $[_{TP}$ [was (thought P (N (PRO)))] λ_1 $[_{AP}$ Mary asleep $t_1]]]$
=> IM, head movement
$[_{VP}$ thought (P (N (PRO)))$_3$ $[_{CP}$ that $[_{TP}$ [was $t_3]_1$ $[_{AP}$ Mary asleep $t_1]]]]
=> EM with **John**
$[_{VP}$ John $[_{V'}$ thought (P (N (PRO)))$_3$ $[_{CP}$ that $[_{TP}$ [was $t_3]_1$ $[_{AP}$ Mary asleep $t_1]]]]]
=> IM, head movement
$[_{TP}$ P (N (PRO))$_4$ $[_{VP}$ John $[_{V'}$ [thought $t_4]_3$ $[_{CP}$ that $[_{TP}$ [was $t_3]_1$ $[_{AP}$ Mary asleep $t_1]]]]]]
=> IM, head movement
$[_{TP}$ [N (PRO)]$_5$ $[_{TP}$ [P t_5]$_4$ $[_{VP}$ John $[_{V'}$ [thought $t_4]_3$ $[_{CP}$ that $[_{TP}$ [was $t_3]_1$ $[_{AP}$ Mary asleep $t_1]]]]]]
=> IM, PRO movement
PRO$_6$ $[_{TP}$ [N $t_6]_5$ $[_{TP}$ [P t_5]$_4$ $[_{VP}$ John $[_{V'}$ [thought $t_4]_3$ $[_{CP}$ that $[_{TP}$ [was $t_3]_1$ $[_{AP}$ Mary asleep $t_1]]]]]]

The result is a familiar tree:

(65) John thought that Mary was asleep



Trees of this sort may be thought as s-structures. They contain all the information we need for phonetic interpretation and for semantic interpretation.

2.8.Movement across the board

Orin Percus asked how the second theory could treat conjunctions under attitudes.

(66) John thinks [it must be raining and it might have been cold]

This structure can be derived by an appropriate ATB-movement. The derivation has been pointed out by M. Romero in discussion. Here it is.

DS: it raining(be(must(John thinks(N(PRO)))))

and it cold(be(might(John thinks(N(PRO)))))

=> QR

be(must(John thinks(N(PRO)))) λ_1 it raining(s_1)

and been(have(might(John thinks(N(PRO)))))λ_1 it cold(s_1)

=> QR

be(must(John thinks(N(PRO)))) λ_1 it raining(s_1)

and have(might(John thinks(N(PRO)))) λ_2 been(s_2)λ_1 it cold(s_1)

=> QR

must(John thinks(N(PRO))) λ_2 be(s_2) λ_1 it raining(s_1)

and might(John thinks(N(PRO))) λ_3 have(s_3) λ_2 been(s_2)λ_1 it cold(s_1)

=> **QR across the board**

John thinks(N(PRO)) λ_4[must(s_4) λ_2 be(s_2) λ_1 it raining(s_1)

and might(s_4) λ_3 have(s_3) λ_2 been(s_2)λ_1 it cold(s_1)]

=> QR

N(PRO) λ_5 John thinks(s_4) λ_4[must(s_4) λ_2 be(s_2) λ_1 it raining(s_1)

and might(s_4) λ_3 have(s_3) λ_2 been(s_2)λ_1 it cold(s_1)]

=> QR

PRO λ_6 N(s_6) λ_5 John thinks(s_4) λ_4[must(s_4) λ_2 be(s_2) λ_1 it raining(s_1)

and might(s_4) λ_3 have(s_3) λ_2 been(s_2)λ_1 it cold(s_1)]

The essential step is the movement across the board. But this we need in any theory of conjunction. So these structures don't pose a problem for the second theory.

3. CONCLUSION

The systems proposed strike me as simpler and more elegant than the other proposes I know. Multiple Agree of tense features is reduced to feature transmission under semantic binding. The second system is conceptually rather appealing, because the binding chain is reduced completely to an iterative application of QR, a semantic motivation.

There are open ends. I have to see how and whether the temporal adverbials can be integrated in the theory. The other thing to consider is the integration of aspect. Furthermore I ignored difficult issues in situation semantics, i.e., truth in a situation, minimal satisfaction and the like. For the time being, the first theory variant is the safer one, but the second one is the more challenging and appealing one.

4. LITERATURE

Abusch, D. 1997. Sequence of Tense and Temporal de re. *Linguistics and Philosophy* 20(1):1-50.

Abusch, Dorit. 1993. Two Theories of Tense in Intensional Contexts. Paper presented at *Proceedings of the 9th Amsterdam Colloquium.*

Dowty, David. 1979. *Word Meaning and Montague Grammar: the semantics of verbs and times in generative semantics and in Montague's PTQ*: Synthese Language Library. Dordrecht: Reidel.

Elbourne, Paul D. 2005. *Situations and Individuals*. Cambridge, Massachusetts/London, England: The MIT Prress.

Grønn, Atle. 2003. The Semantics and Pragmatics of the Russian Factual Imperfective, Faculty of Arts, University of Oslo: Doctor Artium Thesis.

Heim, Irene. 1994. Puzzling reflexive pronouns in de se reports: Handout from Bielefeld conference.

Heim, Irene, and Kratzer, Angelika. 1998. *Semantics in Generative Grammar*: Blackwell Textbooks in Linguistics. Oxford/Malden, MA: Blackwell.

Heim, Irene. 2001. Features of pronouns in semantics and morphology. Ms. Universität Tübingen.

Heim, Irene. 2005. Feature on bound pronouns. Ms. Cambridge/Mass.

Kratzer, A. 1989. An investigation of the lumps of thought. *Linguistics and Philosophy* 12:607-653.

Kratzer, Angelika. 1998. More Structural Analogies Between Pronouns and Tenses. In *SALT VIII*, eds. D. Strolovitch and A. Lawson. Cambridge, Mass.: Ithaca: CLC-Publications.

Kusumoto, Kiyomi. 1999. Tense in embedded contexts, Department of Linguistics, University of Massachusetts at Amherst: Ph.D. dissertation.

Lewis, David. 1979. Attitudes De Dicto and De Se. *The Philosophical Review* 88:513-543.

Ogihara, T. 1996. *Tense, Attitudes, and Scope*. Dordrecht: Kluwer.

Ogihara, Toshiyuki. 1989. Temporal Reference in English and Japanese: University of Texas at Austin.

Partee, Barbara. 1973. Some Structural Analogies between Tenses and Pronouns in English. *Journal of Philosophy* 70:601-609.

Paslawska, Alla, and von Stechow, Arnim. 2003. Perfect Readings in Russian. In *Perfect Explorations*, ed. Rathert Alexiadou, von Stechow. Berlin: Mouton de Guyter.

Schlenker, Philippe. 1999. Propositional Attitudes and Indexicality: A Cross-Categorial Approach, MIT: Ph.D Dissertation.

von Fintel, Kai, and Heim, Irene. 2000. Notes on Intensional Semantics. Ms. Cambridge, Mass.

von Stechow, Arnim. 1984. Structured Propositions and Essential Indexicals. In *Varieties of Formal Semantics. Proceedings of the 4th Amsterdam Colloquium, September 1982*, eds. Fred Landman and Frank Feldman, 385-404. Dordrecht: Foris Publications.

von Stechow, Arnim. 1995. On the Proper Treatment of Tense. In *SALT V*, eds. Teresa Galloway and Mandy Simons, 25: Cornell University.

von Stechow, Arnim. 2003. Feature Deletion under Semantic Binding: Tense, Person, and Mood under Verbal Quantifiers. In *NELS 33*, eds. Makoto Kadowaki and Shigeto Kawahara, 397-403. Amherst Massuchusetts: GLSA.

Zeijlstra, Hedde. 2004. *Sentential Negation and Negative Concord*. Utrecht: LOT.