1. **Plot**

The talk gives a theory of the distribution and interpretation of tense in three constructions:
- simple relative clauses
- **before/after**-clauses
- complement clauses

in English, Russian and Japanese. English is a Sequence of Tense (SOT) language, Russian and Japanese are non-SOT languages. We defend the following principle:

\[ \text{(1) The SOT-parameter} \]

A language L is an SOT-language if and only if the verbal quantifiers of L transmit temporal features.

Verbal quantifiers are **will, budet,…** verbs of attitude **believe, say, dumat’, skazat’,…**

Subordinate tense will be represented by a bound variable **Tpro** in relative clauses and other temporal adjuncts, temporal **PRO** in complements. This variable will obtain its features from a higher tense under binding. The temporal morphology of a verb agrees with the temporal feature of the time variable of the verb. Quite generally, the temporal morphology of a verb is determined by a semantic tense.

Essential for the plot: Past is decomposed; formation of temporal abstracts by PRO-movement, *feature transmission under binding*. The seminal idea that features are transmitted via binding is found in (Heim, 1994b).

The handout makes very few references to the literature. Discussion of some of the relevant literature is found in (von Stechow, 2008).

2. **The Data**

Three different types of constructions: (i) Tense in relative clauses; (ii) tense in complement clauses, i.e., tense under attitudes; (iii) tense in adjunct clauses, notably **before/after**-clauses.

2.1. **Tense in Relative Clauses**

With a Past tense matrix verb, English and Russian relative clauses mostly behave in a similar way (different from Japanese).
**Present under Past: Simultaneous reading available?** (cf. (Kusumoto, 1999: chap. 2)

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<td>Relatives</td>
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(2)  

a. Mary talked to a boy who is crying. (morphology: Past + Pres)  
deictic, simultaneous*  
b. Маша встретила мальчика, который плачет. (morphology: Past + Pres)  
deictic, simultaneous*  
c. Taroo-wa [nai-te i-ru otoko]-o mi-ta (morphology: Past + Pres)  
Taro crying is man saw  
‘Taro saw a man who is crying’ (morphology: Past + Pres)  
simultaneous or deictic.

**Past under Past: simultaneous/independent available?**

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(3)  

a. Mary talked to a boy who was crying. (morphology: Past + Past)  
Independent, simultaneous  
b. Маша встретила мальчика, который плакал. (morphology: Past + Past)  
Independent, simultaneous  
c. 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’  
Shifted, *simultaneous/independent

**Present under Future: Simultaneous/independent reading available?**

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(4)  

a. Mary will buy a fish that is alive. (Ogihara, 1989)
ST = MT
b. Japanese: No morphological distinction between Present/Future
   lit. John buys a fish that is alive
   = John will buy a fish that is alive
   ST = MT
c. Masha kupit rybu kotoraja zhivet v Bergenskom akvariume
deictic

There are Russian examples that follow the Japanese pattern. 1
Add Past under Present Perfect: simultaneous reading available?
(5) John will say that he has bought a fish that was alive.
(at the time of the buying!)

2.2. Tense under Attitudes

1
(i) It was the very place for a homeless boy, who must die in the streets unless some one helped him. [Charles Dickens. Oliver Twist]

(i') Это было-past самое подходящее место для бездомного мальчика, которому придется-pf-pres умереть на улице, если никто ему не поможет-pf-pres.
(Russian National Corpus)

(ii) The effect of the brandy had long ago worn off, and the man bore in his brain along the marshy tract — which, when the rains came, would be quite impassable — the sound of the General Obregon's siren. [Graham Greene. The Power and the Glory]

(ii') Действие бренди теряло-ipf-past свою силу, и незнакомец уносил-ipf-past с собой в болотистые края, которые станут-pf-pres совсем непроходимыми в сезон дождей.
(Russian National Corpus)

To justify the Present in (i), we have to embed them under a covert attitude, e.g. “according to what he believed”. In (ii) we find a higher attitude.
(6) Present under Past
   a. #John believed Mary is sick.
      only double access (not treated)
   b. Taroo-wa [Hanako-ga byooki-da to] it-ta
      Taro Hanako sick-is said
      ‘Taroo said that Hanoko was sick’
      Simultaneous
   c. Vanja skazal chto Mash bolna.
      Vanja said that Masha (is) sick.
      Simultaneous

(7) Past under Past
   a. John believed that Mary was sick.
      Simultaneous
   b. Taroo-wa [Hanako ga byooki-da-ta to] it-ta
      Taro Hanako sick-was said
      ‘Taroo said that Hanako had been sick’
      anterior
   c. Vanja skazal chto Mash byla bolna.
      anterior

Present\Past: Simultaneous/independent reading available?

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Past\Past: Simultaneous/independent reading available?

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- Japanese and Russian treat complements alike.

2 (Ogihara, 1995: p. 122)
• English and Russian treat relatives alike.

2.3.  

Tense in Temporal Adverbial Clauses (before/after-clauses)

Again, the most interesting data come from future constructions. (Ogihara, 1996: 5.5) quoting (Stump, 1985) provides the following paradigm.

(4)  

\textit{after/before} under Future in English

\begin{itemize}
    \item a. John \textbf{will} enter the room before Mary \textit{leaves}.
    \item b. John \textbf{will} enter the room after Mary \textit{has left}.
    \item c. John \textbf{will} enter the room after Mary \textit{leaves}.
    \item d. *John \textbf{will} enter the room after Mary \textit{will leave}.
    \item e. *John \textbf{will} enter the room before Mary \textit{will leave}.
\end{itemize}

(5) Mary \textit{left} before/after John \textit{arrived}.  (morphology: Past + Past)

(8)  

\begin{itemize}
    \item a. Taroo-wa [ Hanako-ni au mae-ni] denwa-o si-ta.  
        \textit{lit. He called her before he sees her}  
        ‘Taro called Hanako before he saw her.’
    \item b. Taroo-wa [ Hanako-ni at-ta ato-de] denwa-o si-ta.  
        \textit{lit. He called her after he met her}  
        ‘Taro called Hanako after he had seen her.’
    \item c. Taroo-wa [ Hanako-ni au mae-ni] denwa-o su-ru.  
        \textit{lit. Taro calls Hanako before he sees her}  
        ‘Taro will call Hanako before he sees her.’
    \item d. Taroo-wa [ Hanako-ni at-ta ato-de] denwa-o su-ru.  
        \textit{lit. He will call her after he saw her}  
        ‘Taro will call Hanako after he sees her.’
\end{itemize}

• Under \textit{before} we always find Present, even under MT = Past.

The Russian paradigm
3. TEMPORAL STRUCTURE OF SIMPLE SENTENCES

(8) a. John called.
   b. Mary is happy.

(9) Tenses
   a. Present, type i: \( F(\text{N}) = s^* \).
   b. Past, type i(it,t): \( F(\text{P}) = \lambda t.\lambda P_{it}.(\exists t')[t' < t & P(t')] \) (Heim, 1997)

- \( P \) is a relative tense. The argument of \( P \) is always \( \text{N} \) in matrix clauses. In subordinate clauses, \( P \) can have a time variable \( t \) as argument that is bound by a higher tense or locally bound by a \( \lambda \)-operator.

Past is indefinite. For the Partee Problem, see the appendix.

(10) a. \( F(\text{John}_e) = \text{John} \)
    b. \( F(\text{called}_{(et)}) = \lambda t.\lambda x.x \text{ calls at } t. \)

- \text{called} has a tenseless semantics! The morphology is checked by a semantic tense.
- The time argument is the first by convention.
- At DS the time argument is filled by the semantically empty pronoun \( \text{PRO} \), which is moved for type reasons at LF (PRO-theory of (Heim and Kratzer, 1998))

(11) Derivation of (8a)
DS: [TP [t P N] [vp John [called PRO]]]

PRO-movement (with subsequent PRO deletion)

LF: N PRO λ₀ [TP [t P t₀] PRO λ₁ [vp John [called t₁]]]
= (∃t < s*) John calls at t

(9) The temporal auxiliary be: type i(it,t)
F(is) = λt.λPₙ. P(t)

(10) Analysis of (8b)
DS: [TP P N [VP [V is PRO] [AP Mary happy PRO]]]

PRO movement (with subsequent PRO deletion)
LF: [TP P N λ₁ [VP [V is t₁] λ₂ [AP Mary happy t₂]]]
= (∃t < s*) Mary is happy at t

(11) John had called.

(12) have/had: type i(it,t) feature iP

λt.λPₙ.(∃t’)[t’ < t & P(t’)]

(Extended Now meaning for have-pres ignored.)

(13) [it₄ P N] [λ₁ [[had t₁][λ₂ [John [called t₂]]]]]
= (∃t₁)[t₁ < s* & (∃t₂ < t₁)[John calls at t₂]]

The future auxiliary will is the mirror image of have:

(14) will: type i(it,t)

λt.λPₙ.(∃t’)[t’ > t & P(t’)]

(15) John will call.

N [λ₁ [[will t₁][λ₂ [John [call t₂]]]]]
= (∃t’)[t’ > s* & John calls at t’]

4. FEATURE THEORY

(Zeijlstra, 2004) and others: There are two sorts of features, interpretable ones [iF] and uninterpretable ones [uF]. Interpretable feature check an uninterpretable ones.

In English, finite verb forms have uninterpretable temporal features. 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].

(16) Some verb forms with spell out:
Present: **call/calls** [uN]

Past: **called** [uP]

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

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

**Meaning of all these:** \( \lambda t. \lambda x. x \text{ calls at time } t \)

(17) **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. (Heim, 1994b), (Heim, 2005).

We assume the conventions for semantic binding outlined in (Heim and Kratzer, 1998). In particular, a phrase or operator \( \alpha \) may bind a variable via a \( \lambda \)-operator. \( \lambda \)-abstracts are created by PRO- or WH-movement.

(18) Mary called. (DS) (not interpretable)

(19) **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].

(20) **The LF** (interpretable)
5. **ANALYSIS: TENSE IN RELATIVE CLAUSES**

(9) **Basic assumption:** The highest semantic tense of a relative clause is the pronoun $T_{pro}$, which is obligatorily bound by a higher tense.

This idea is implicit in Kusumoto’s dissertation.³ The present formulation is due to Irene Heim (p.c). $T_{pro}$ can be read as “time pronoun”. This reminds of (Partee, 1973) who proposed that tenses should be pronouns in general (we differentiate between matrix clauses (tense is an operator), complements (tense is PRO or TPro) and adjuncts (tense is Tpro). Recall that von Fintel & Heim also know of a $W_{pro}$ (“world pronoun”); cf. (von Fintel and Heim, 2000).

5.1. **English relatives**

(10) Mary will buy a fish that is alive. (Ogihara, 1989)

a. $ST = MT$ (simultaneous)

b. $ST = s^*$ (deictic)

(29) Simultaneous

$N \lambda_1 \text{will}(t_1) \lambda_2 M. \text{buy}(t_2) \text{a fish } W_H^3 T_{pro_2} \lambda_4 \text{is}(t_4) \lambda_5 x_3 \text{alive}(t_5)$

³ Cf. (Kusumoto, 1999: chap.2).

1. K. doesn’t use $N$. She has a distinguished variable $t^*$, which denotes $s^*$ in the matrix, which is anaphoric in relatives and bound by a predicate of attitude in complements.

2. The temporal arguments of finite verbs are variables that carry a presupposition: $\text{past}_t$ denotes a past time. In addition we have a relative Past.
will is a verbal quantifier. It transmits its temporal feature to the variables it binds, i.e. $t_2$ and $\text{Tpro}_2$. More accurately will has two features uN, the inherent and the transmitted one.

The deictic reading of (27) requires binding of $\text{Tpro}$ to the matrix $N$:

\[(30)\]  
\[N \lambda_1 \text{will}(t_1) \lambda_2 \text{M. buy}(t_2) \text{a fish WH3 Tpro}_1 \lambda_4 \text{is}(t_4) \lambda_5 x_3 \text{alive}(t_5) \]
\[iN \quad \text{uN} \]
\[= (\exists t > s^*)(\exists x)[\text{fish}(x) \& \text{alive}(x,s^*) \& \text{buy}(\text{Mary},x,t)]\]

The semantics is different, and $\text{Tpro}_1$ gets its feature directly from $N$.

For Past under Past constructions, the literature assumes three readings:

\[(31)\] Mary talked to a boy who was crying.

Simultaneous, anterior, independent

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. Obviously, this interpretation could deal with the two remaining cases in (31) 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:

\[(32)\] John thought that he would buy a fish that was still alive. (Ogihara)

5.2. Russian Relatives

Russian relatives are analysed like the English ones with the exception that Present under Future has to be deictic.

(11) Analysis of Russian

0. The verbal quantifiers of Russian don’t transmit temporal features.

1. Perfective Present expresses semantic Future F:

\[[F] = \lambda t. \lambda P. (\exists t')(t' > t \& P(t'))\]

2. The analysis of tense under attitudes will require a relative PRESENT, which is locally bound by PRO and hence never occurs in relative clauses. See below.

3. Tensed participles are interpreted like relatives.
(12) Маша купит рыбу, которая живёт в Бергенском аквариуме.

Deictic

Why is the bound reading (event in the future), i.e. the Japanese interpretation, not possible?

(13) \( N \lambda_1 F(t_1) \lambda_2 \ldots \text{buy-fut}(t_2) \ldots \text{WH} \ Tpro_{1/2} \lambda_3 \ldots \text{lives}(t_3) \ldots \)

\[ \begin{array}{ccc}
iN & iF & uN & iN \\
\end{array} \]

- If Tpro is bound by N, it correctly inherits uN and transmits uN to lives.
- If Tpro is bound by F, it has the feature uF, which is in conflict with the present morphology of lives.

Present \textit{budet}

(14) Ol’ga \textit{budet zamuzhem za vrachom kotoryj zhivet v Murmanske}.

Olga will (be) married with a doctor who lives in Murmansk

Deictic

\( N \lambda_1 \text{budet}(t_1) \lambda_2 \text{Ol’ga zamuzhem}(t_2) \text{za vrachom WH}_3 Tpro_{1/2} \lambda_4 t_3 \text{zhivet}(t_4) \)

\[ \begin{array}{ccc}
iN & uN & \text{no T-feature!} & uN & uN \\
\end{array} \]

- If Tpro is bound by N, it correctly inherits the feature uN and we have the deictic reading.
- If Tpro is bound by \textit{budet}, it has no temporal feature (SOT-parameter) and uN of lives cannot be checked. We cannot wrap Tpro into \textbf{PRES}_{R}, which would check lives, because \textbf{PRES}_{R} must have \textit{PRO} as argument. Another option would be that Tpro comes with a temporal feature from the lexicon.

Though a forward shifted reading for Fut\Fut is preferred, there is the deictic reading as well.

(15) Череz два года она \textit{vyjdet zamuzh} za человека, который завтра будет у нас в гостях.

Deictic

‘Within two years she will marry a man that will be our guest tomorrow’

\textbf{Insertion of covert Past}

A complication for Russian arises from the fact that we can always insert a relative past under Past or Future to obtain a semantic Pluperfect or Future Perfect; cf. (Paslawska and von Stechow, 2003), (Grønn, 2003). \textit{This insertion does not block or affect feature transmission from above} (“counter cyclic insertion”).
Innokentij in-advance knew, how in-morning during breakfast they with pleasure
сообщат-pf-pres, что им обоим снился-ipf-past один и тот же сон ...
will-tell, that they both dreamt one and the same dream …)

- Одинаковых снов не бывает-ipf-pres! - сказать-pf-pres им отец,
identical dreams not happen - will-tell them father,
который уже вернется-pf-pres с ночной дежурства
who already will-(have)-returned from night work
и будет завтракать-ipf-in infinitive вместе с ними.
and BUDET eat-breakfast together with them

‘Innokentij knew in advance how tomorrow morning during breakfast they would
tell with great pleasure that they both had the same dream … Identical dreams do
not happen, their father, who will eat breakfast together with them after having
returned from night work, will tell them.’

A note on tensed participles in Russian

Tensed participles behave like relative clauses and are therefore analysed similarly. See e.g.
a present participle under Future:

lit. Alla will meet with students living-pres on the second floor
deictic

Тproi has to be bound by a higher N to get the morphology right. With past participles we
expect shifted or deictic readings.
5.3. Japanese Relatives

(18) **Tense in Japanese Relatives** (Heim, 1997)

0. Verbal quantifiers (attitudes) don’t transmit temporal features (SOT-parameter).

1. Present expresses a relative non-Past.

\[ \text{[PRES} \text{]} = \lambda w. \lambda t. \lambda P (t_0 \cdot (\exists t') (\neg t' < t \& P(t'))) \]

Unlike in Russian, **PRES** can have **Tpro** as argument.

2. **P**, like English

   - Variation arises from the different semantics of **Pres**.

(19) **Pres\Fut(=PRES)**

a. simultaneous

Taro will see a man who is crying

\[ N \lambda_0 \text{PRES}_1 (t_0) \lambda t_1 \text{Taro sees}(t_1) \text{a man who}_{x} \text{Tpro}_1 \lambda_2 \text{is}(t_2) \lambda_3 \text{x crying}(t_3) \]

\[ iN \quad uN \quad uN \quad uN \]

\[ = (\exists t < s^*) \text{Taro sees a man at t who is crying at t) } \]

**Tpro** is bound by **PRES**.

(20) **Pres\Past**

a. simultaneous

\[ N \lambda_0 \text{P}(t_0) \lambda t_1 \text{Taro saw}(t_1) \text{a man who}_{x} \text{Tpro}_1 \lambda_2 \text{PRES}(t_2) \lambda_3 \text{x crying}(t_3) \]

\[ iP \quad uP \quad uP \quad iN \quad uN \]

\[ = (\exists t < s^*) \text{Taro sees at t a man who is crying at a time not before t. } \]

**Tpro** is bound by **P**.

b. deictic

\[ N \lambda_3 \text{P} t_3 \lambda t_1 \text{Taro saw}(t_1) \text{a man who}_{x} \text{PRES}(Tpro_3) \lambda_2 \text{is}(t_2) \lambda_3 \text{x crying}(t_3) \]

**Tpro** is bound by **N**.

(21) **Past\Past**
6. Analysis: Before/After-Clauses

We assume a boring analysis for after/before following (von Stechow, 2002) and (Beaver and Condoravdi, 2004): the prepositions are relations between two times t and t’ and mean that t is after/before t’. The intended interpretation of the next sentence is indicated.

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

= (∃t > s*) John enters at t & t < the earliest time t’ s.t. t’ > t* & Mary leaves at t’.

Being adjuncts, the highest semantic tense of the adjunct should be Tpro.

We will disregard non-veridical readings under before. In order to map the adjunct clause to a time we need the following coercion operator due to (Beaver and Condoravdi, 2004).

(23) Coercion from it to i.

[[EARLIESTC]] = λP.∀t.∃t’ P(t) & t < t’ & (∀t’ P(t’)) → ¬ t’ < t

6.1. English Adjuncts

(24) Past\Past

John came before Mary left.

= (∃t1 < s*) John comes at t1 & t1 = the earliest t in C and < s* s.t. Mary leaves at t.

The idea to analyse the adjunct clause as a relative clause is due to (Heim, 1997). at means
= or \(\subseteq\). (The contextual restriction of the EARLIEST operator by \(C\) is necessary. Because might be older than John and have left many times before John entered.)

The problematic case is Present\Future. The straightforward analysis doesn’t work:

\[(34) \text{ Present\Future} \]
\[\text{John will come before Mary leaves} \]
\[N \lambda_1 \text{ will}(t_1) \lambda_2 \text{John come}(t_2) \text{ t2 before EARL}_C W H_3 \text{Tpro}_1 \lambda t_4 \text{ t4 at t3 Mary leaves}(t_4) \]
\[= (\exists t_2 > s^*) \text{John comes at } t_2 \& t_2 < \text{the earliest } t_3: t_3 \text{ in } C \& t_3 = t_2 \& \text{Mary leaves at } t_3. \]

This entails that \(t_2 < t_2!\) Binding \(\text{Tpro}_1\) to \(N\) would entail that \(s^* < s^*\).

Remedy: Insert a covert Future in the adjunct clause.\(^4\)

\[(25) \]
\[N \lambda_1 \text{ will}(t_1) \lambda_2 \text{John come}(t_2) \text{ t2 before EARL}_C W H_2 \text{Tpro}_1 \lambda_3 F(t_3) \lambda t_4 \text{ at t2 Mary leaves}(t_4) \]
\[= (\exists t_2 > s^*) \text{John comes at } t_2 \& t_2 < \text{the earliest } t_3: t_3 \text{ in } C \& t_3 > s^* \& \text{Mary leaves at } t_3. \]

If this is really ungrammatical and we have to insert a covert Future for some reason even in this sentence, then we have an explanation for the unacceptability:

\[(26) \]
\[\text{*John will enter the room before/after Mary will leave.} \]

According to this semantics, the leaving of Mary should occur at the first moment after \(s^*\), which is impossible.\(^5\)

\(^4\) Presumably, Stump has this reading in mind, when he rejects the sentence.
6.2. **Russian adjuncts**

Russian adjunct clauses live in the best possible world. The tense of the adjunct is the same as that of the main clause.

(35) The Russian paradigm

a. Ваня ушел после/ до того как ушла Маша. (morphology: Past + Past)
   lit. Ivan left after/before Masha left.

b. Ваня уйдет после/ до того как уйдет Маша. (morphology: Pf-pres + Pf-pres)
   lit. Ivan will leave after/before Masha will leave.

**Analysis of Russian adjuncts**

Adjunct tenses are bound by the matrix N (viz. PRO under embeddings).

Analysis:

(36) \[ N \lambda_1 P(t_1) \lambda_2 Ваня ушел(t_2) t_2 после/ до того как EARL WH_2 P(Tpro_1) \lambda_3 ушла(t_3) Маша. \]

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

(37) \[ N \lambda_1 F(t_1) \lambda_2 Ваня уйдет(t_2) t_2 после/ до того как EARL WH_2 F(Tpro_1) уйдет Маша. \]

= (\exists t > s^*) ....
6.3. Japanese Adjuncts

Recall that Japanese adjuncts always have Present under before.

(28) Japanese paradigm (following (Ogihara, 1996: 180))

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’

(29) Analysis of Japanese Adjuncts (Heim, lecture notes p.21)

Tpro of the adjunct is bound by the matrix tense.

Recall that PRESJ is a relative non-Past.

We give the LF for sentence Recall that Japanese adjuncts always have Present under before.

(28a):

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

P(t0) λt1 [t1 before [EARL WH2 PRES(t1) λt3 t3 AT t2 λt3 he meets(t3) her ]]

iPRES uPRES

λt1 he called(t1) her

= (∃t1)[t1 < s* & t1 < the earliest t2(∃t3)[¬t3 < t1 & t3 at t2 & he meet her at t3]
   & he calls her at t1]

= (∃t1)[t1 < s* & t1 < the earliest t2 [¬t2 < t1 & he meet her at t2]
   & he calls her at t1]

The stipulation that the embedded tense must be bound by the matrix tense immediately explains the ungrammaticality of Recall that Japanese adjuncts always have Present under before.

(28a’): suppose we replace the embedded tense in (30) by P. Then we obtain:

(31) P N λt1 [t1 before [EARLIEST WH2 P(t3) λt3 t3 at t2 λt4 he meet(t4) her ]]
\( \lambda t_5 \text{ he call}(t_5) \text{ her} \)

\[
= (\exists t_1)[t_1 < s^* \land t_1 < \text{the earliest } t_2 \land t_2 < t_1 \land \text{he meet her at } t_2]
\land \text{he calls her at } t_1]
\]

This condition is inconsistent because it basically stipulates that \( t_1 < t_1 \).

7. **ANALYSIS: TENSE UNDER ATTITUDES**

The analysis of attitudes requires an intensional framework; see appendix. The change doesn’t affect the previous LFs. In order to avoid temporal paradoxes analysed in (von Stechow, 1981), (von Stechow, 1995), (Heim, 1994a) among others, attitudes cannot be simply quantifiers over worlds. They quantify over world times (and individuals, neglected here). Hence complements must be properties of time, type i(st). The properties are generated by assuming PRO (or TPRO) as the highest semantic tense (“zero-tense”). PRO is moved and creates a temporal abstract; cf. (Kratzer, 1998).

(32) a. At 5 o’clock Mary thought it was 6 o’clock. (sequence of tense, "simultaneity")

   b. В пять часов Маша думала, что (уже) шесть часов. (non-sequence of tense, relative present)\(^6\)

7.1. **English attitudes**

(33) Tense in clausal complements

1. Attitude verbs are (verbal) temporal quantifiers that transmit their temporal features. SOT-parameter.

2. The highest semantic tense of a complement is temporal \( \text{PRO} \). \( \text{PRO} \) has to be moved for type reasons and thus creates a temporal abstract. Follows from the logical type of the attitude verb; cf. (Kratzer, 1998).

(34) Quantifier over worlds and times (style of (Lewis, 1979))

\(^6\) Past + Past morphology as in English is possible also in Russian, in what looks like a SOT-construction:

(i) В пять часов Маша думала, что было (уже) шесть часов.
believe, type (s(it))(i.et)
F(believe) = λw.λP_{sit}λt.λy.((∀w')(∀t')[(w',t') is compatible with everything y
believes of (w,t) in w at time t → p(w')(t')]}

(35) past\Past (simultaneous)

\[ P N \lambda_{1} t_{1} at 5 o’clock Mary thought(t_{1}) PRO \lambda_{4} t_{4} \lambda_{2} was(t_{2}) \lambda_{3} t_{3} at 6 o’clock \]
\[ = \lambda w. (\exists t_{1} < s^{\ast}) [t_{1} = 5 o’clock \& ((\forall w’,t’) \in Dox_{Mary}(w,t)) t’ = 6 o’clock] \]

• The temporal variable of subordinate was inherits its feature from the matrix \( P \) via
feature transmission through thought.

(36) Past\Past (anterior)

Mary thought Bill left.

\[ P N \lambda_{1} Mary thought(t_{1}) PRO \lambda_{2} P(t_{2}) \lambda_{3} Bill left(t_{3}) \]
\[ = \lambda w. (\exists t_{1} < s^{\ast}) Mary thinks in w at t_{1} [\lambda w’,\lambda t_{2}.(\exists t_{3} < t_{2}) Bill leaves in w’ at t_{3}] \]

• The complement contains an own relative Past that checks the uP of left. Hence the
shifted interpretation.

Ogihara’s evidence that Past in relatives must be bound sometimes.

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

\[ P N \lambda_{1} John thought(t_{1}) PRO \lambda_{2} would(t_{2}) \lambda_{3} he buy(t_{3}) a fish WH_{4} T_{pro3} \]
\[ = \lambda_{5} was(t_{5}) \lambda_{6} t_{4} alive(t_{6}) \]

• The variable of was in the relative inherits its feature from matrix \( P \) via binding. Note
that the binding chain goes through the infinitive buy, which has no inherent temporal
feature.

7.2. Russian Attitudes

Analysis of Russian
0. The Russian verbal quantifiers *budet* and verbs of attitudes do not transmit temporal feature. (SOT-parameter)

1. Russian has a relative Present, whose argument is by stipulation PRO.

\[ [[ \text{PRES}_R ]] = \lambda t. \lambda P. \exists t'[ t' = t & P(t')] \], feature iN; Cf. (Ogihara, 1995) with modification mentioned.

(38) Present\Past (simultaneous)

a. Ваня сказал, что Маша в опере.

lit. John said that Mary is in the opera.

\[
\begin{align*}
\text{N} & \lambda_1 P(t_1) \lambda_2 \text{Ivan said}(t_2) \text{ PRO } \lambda_3 \text{PRES}_R(t_3) \lambda_4 \text{is}(t_4) \lambda_5 \text{Mary in}(t_5) \text{ opera } \\
& \text{iP} \quad \text{uP} \\
& \lambda w. (\exists t_1 < s^*) \text{Ivan says in w at t}_1 [\lambda w'. \lambda t_2. (\exists t_3 = t_2) \text{Mary be in the opera in w' at t}_3]
\end{align*}
\]

(39) Past\Past (anterior)

Ваня сказал, что Маша была в опере.

lit. Ivan said that Mary was in the opera.

\[
\begin{align*}
\text{N} & \lambda_1 P(t_1) \lambda_2 \text{Ivan said}(t_2) \text{ PRO } \lambda_3 P(t_3) \lambda_4 \text{was}(t_4) \lambda_5 \text{be}(t_5) \lambda_6 \text{Mary in}(t_6) \text{ opera } \\
& \text{iP} \quad \text{uP} \\
& \lambda w. (\exists t_1 < s^*) \text{Ivan says in w at t}_1 [\lambda w'. \lambda t_2. (\exists t_3 < t_2) \text{Mary be in the opera in w' at t}_3]
\end{align*}
\]

Impact of the SOT-parameter: If verbs of attitude did transmit their features to the complement, we could have the simultaneous reading as in English.

(40) lit. Ivan said that Mary was in the opera.

\[
\begin{align*}
\text{N} & \lambda_1 P(t_1) \lambda_2 \text{Ivan said}(t_2) \text{ PRO } \lambda_3 \text{Mary was}(t_3) \text{ in opera } \\
& \text{iN} \quad \text{uN} \quad \text{uN} \\
& \underbrace{}_{\text{Violiation of SOT-parameter}} \quad \lambda w. (\exists t_1 < s^*) \text{Ivan says in w at t}_1 [\lambda w'. \lambda t_2. \text{Mary be in the opera in w' at t}_2]
\end{align*}
\]

8. SUMMARY

1. The temporal features of finite verbs are licensed by semantic binding through semantic tense.

2. Tense agreement has several analyses:

   a) Non local agreement is mediated via Tpro, which is obligatorily bound by a higher tense (relative clauses). (Related to Principle B)
b) Local agreement is licensed by a verbal quantifier, e.g. a verb of attitude. It is mediated by (temporal) PRO.

3. Variation in tense distribution between languages has the following sources:
   a) The SOT-parameter
   b) Difference in interpretation of semantic tenses (e.g. relative PRES in Japanese and Russian)

A remark on aspect: Aspect operators are below tense operators. They don’t block feature transmission. Aspect is ignored here.

9. **APPENDIX 1: EXTENSIONAL LF LANGUAGE**

The *types* of L are: \(e\) (entities), \(i\) (time intervals), \(m\) (moments), \(s\) (worlds) and \(t\) (truth-values). The functional types are generated by the following rule: if \(a\) and \(b\) are types, then \((ab)\) is a type. Outermost bracket are usually omitted.

**Syntax of L**

1. If \(\alpha\) is a lexical entry or a variable of type \(a\), then \(\alpha\) is an expression of type \(a\).  
   (“Lexicon”)

2. If \(\alpha\) is an expression of type \((ab)\) and \(\beta\) is an expression of type \(a\), then \([\alpha\beta]\) is an expression of type \(b\). (“functor-argument”)

3. If \(\alpha\) and \(\beta\) are expressions of type \((at)\), then \([\alpha\beta]\) is an expression of type \((at)\).  
   (“predicate modification”)

4. If \(\alpha\) is an expression of type \(a\) and \(x\) is a variable of type \(b\), then \([\lambda x\alpha]\) is an expression of type \((ba)\). (“abstraction”)

\(\mathcal{M} = (M, T, E, \{0,1\}, s^*, F)\), where \(M\) is the set of moments, \(T\) is the set of time intervals based on \(M\), \(E\) is the set of entities, \(\{0,1\}\) is the set of truth-values, and \(s^*\) is the speech time. \(F\) is a function that interprets the lexicon with appropriate meanings. Semantic domains: \(D_m = M\), \(D_i = T\), \(D_e = E\), \(D_t = \{0,1\}\), and \(D_{(ab)}\) = the (possibly partial) functions from \(D_a\) into \(D_b\). A condition for the interpretation of the lexicon is that \(F(\alpha) \in D_a\) if \(\alpha\) is a lexicon entry of type \(a\).

We now define the function \([\cdot\cdot]\)\(^{\mathcal{M},g}\) that interprets each expression of L. The function depends on the model \(\mathcal{M}\) and a variable assignment \(g\).

**Interpretation of L**

1. a. If \(\alpha\) is a lexical entry of type \(a\), then \([\alpha]\)\(^{\mathcal{M},g}\) = \(F(\alpha)\). ("Lexicon")
b. If x is a variable of type a, then $[[x]]^{a,g} = g(x)$  (“Variable”)

2. If $\alpha$ is of type ab and $\beta$ is of type a, then $[[\alpha\beta]]^{a,g} = [[\alpha]]^{a, g} \cdot [[\beta]]^{a, g}$
   (“Functional Application”, FA)

3. If $\alpha$ and $\beta$ are of type at, then $[[\alpha\beta]]^{a,g} = \lambda x_a. [[\alpha]]^{a, g}(x) \& [[\beta]]^{a, g}(x)$
   (“Predicate Modification”, PM)

4. If x is a variable of type a and $\alpha$ is an expression of type b, then
   $[[\lambda x.\alpha]]^{a,g} = \lambda u \in D_a. [[\alpha]]^{a, g(x/u)}$
   (“Abstraction”, $\lambda$)

$g[x/u]$ is defined like g with the (possible) exception that $g[x/u](x) = u$. As a special case of PM we will assume that $\alpha$ and $\beta$ are of type t. Then $[[\alpha\beta]]^{a,g} = 1$ iff $[[\alpha]]^{a, g} = 1 = [[\beta]]^{a, g}$.

10. **APPENDIX 2: INTENSIONAL LF LANGUAGE**

We introduce an intensional $\lambda$-language. “Intensional” means that expressions of type a express meanings of type (sa), i.e., a-intensions.

Some revised lexical entries:

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

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

c. $F(N_i) = \lambda w. s^*$

d. $F(P_{\text{det},(t,t)}) = \lambda w. \lambda t. \lambda P_{\text{det}}(\exists t' < t) P(t')$

The only innovation is Heim & Kratzer’s rule Intensional Functional Application (IFA).

Recursive definition of the interpretation function $[[\cdot]]_{F,g}$
1. Let $\alpha$ be a lexical entry of type $a$. Then $[[\alpha]]^{y}\mathcal{g} = F(\alpha)$.

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

3. FA: Let $\alpha$ have type $b$ and daughters $\beta$ of type $ab$ and $\gamma$ of type $a$.

4. IFA: Let $\alpha$ have type $b$ and daughters $\beta$ of type $(sa)b$ and $\gamma$ of type $a$.

5. PM: Let $\alpha$ have type $a$ and daughters $\beta$ and $\gamma$ of the same type.

6. Abstraction: Let $x$ be a variable of type $a$ and let $\alpha$ be an expression of type $b$.

11. **APPENDIX 3: RESTRICTING TENSE**

(21) I didn’t turn off the stove.  
= I didn’t turn off the stove at a particular time in the past

(22) Tomorrow, John will have left.
= There is a time after $s^*$ in tomorrow which is after John’s leaving time in tomorrow.

Our indefinite Past is an existential quantifier and comes with a domain restriction. So the refined lexical entry is this:

(23) Contextually restricted Past: type $(it, i(it, t))$  
(Musan, 2002)

$$[[P]] = \lambda C. \lambda t. \lambda Q. (\exists t') [C(t') \& t' < t \& Q(t')]$$

The analysis of the Partee sentence is then:

(24) The Partee Problem

$$\text{not } [P_{C N}] \lambda t. I [\text{turn-off}(t) \text{ the stove}]$$

If $g(C) = \{t \mid t \subseteq [11 \text{ a.m.}, 12 \text{ a.m.}]\}$, the LF means:

$$\neg (\exists t < s^*) t \subseteq [11 \text{ a.m.}, 12 \text{ a.m.}] \& I \text{ turn off the stove at t}$$

(25) John will have left at six.

We obtain the correct result if we assume the following pragmatic principle:
(26) An embedded tense or temporal auxiliary adds the “content” of the next superordinate tense to its restriction provided the superordinate tense is compatible with the tense in question.

(27) $N\lambda t\text{ WILL}_{C1}(t)\lambda t\text{ have}_{C2}(t)\lambda t\text{ john left}(t)$

\[
g(C1) = \{t \mid t \text{ a time}\} \\
g(C2) = \{t \mid t > s^*\} \\
= (\exists t)[t > s^* \& (\exists t')[t' > s^* \& t' < t \& \text{ John leaves at } t']]$$

**LITERATURE**


Heim, Irene. 1994a. Comments on Abusch’s theory of tense: Manuscript, MIT.


