On the Proper Treatment of Tense

Arnim von Stechow
Universität Tübingen

0. Introduction

This paper is mainly concerned with tense in embedded constructions. I believe that recent research – notably the work by Ogihara (1989) and Abusch (1993) – has contributed much to our better understanding of its semantics. The proposals made by the two authors are, however, still too simplistic in some regards. Among other things, they neglect the interplay of tense with temporal adverbs of quantification and with frame-setters. To get this composition right is a touchstone for every theory of tense and tense semanticists have been concerned with this problem from the beginning on, as witnessed by the analyses in Kratzer (1978), Bäuerle (1979), Dowty (1979/1982), to mention a few.

The claim I want to stress in this article is that in complements of attitudes, we can never have a "referential" tense, i.e., an absolute or anaphorical tense. Every tense occurring there will turn out to be a bound tense. I think this claim is implicit in Ogihara's (1989) analysis, and it is made explicit in Abusch's (1993) approach. The composition of bound tense with the two kinds of adverbs mentioned will require rather elaborate techniques and I am not sure whether I have been entirely successful, but I hope that the solution is basically correct.

1. The iconic tradition

Last year I had the honour of organizing a workshop on the syntax/semantic interface at the summer school in Copenhagen. Some speakers used the so-called Reichenbach theory and thought that the semantic contributions of tense could be made clear by drawing pictures in the style of Reichenbach's (1947) celebrated short passage on tense. And that would be all there is to do. Having been the organizer of the workshop, I didn't dare to criticize the method. But I feel that I have to do it at least once in my life: the method is not only imprecise, it sometimes gives us the wrong idea of what is going on. Here is a first application:

```
(1-1)   a. Vashek was funny
        b. -------------|---------|------------>
                       E,R        S
```

Sentence (1-1a) is represented by the diagram (1-1b), in which the vector represents the flow of time, S is the speech time, R is the reference time (whatever that may be) and E is the event time.

The pluperfect sentence (1-2a) is represented by the situation (1-2b).

```
(1-2)   a. Vashek had been funny
        b. -----|------|------|-------->
                E      R      S
```

The idea, of course, is that these situations directly reflect the semantics of the tenses which the verbs of the sentences have. Thus, the sentences may be analysed as (1-3)(a) and (b) respectively:

(1-3) a. PAST Vashek be funny
b. PAST PERF Vashek be funny

The diagrams tell us that PAST brings us from S to R and PERF brings us from R to E. Since (1-3a) has no PERFect operator, E and R coincide.

All this is nice and suggestive, but it is no semantics. One realizes that as soon as one tries to write that down. Any straightforward formalization is wrong, and there is, of course, a lot of literature trying to make the underlying intuitions precise.

Consider a quantificational approach which is developed in the writings of Arthur Prior and is used by Richard Montague. If we use two time parameters, the speech time S and the intensional time t, which can be shifted by tense operators, we can state the interpretation rules for PAST and PERF as (1-4)(a) and (b) respectively:

(1-4) **A quantificational approach**
a. $\| PAST\,\alpha \|^{S,t} = 1$ iff ∃t': t' < S & $\| \alpha \|^{S,t'} = 1$.
b. $\| PERF\,\alpha \|^{S,t} = 1$ iff ∃t': t' < t & $\| \alpha \|^{S,t'} = 1$.

The rules correctly capture that PAST is a deictic or absolute tense, whereas PERF depends on the intensional parameter only. Never mind how these sentential operators can be reconciled with the requirements of surface syntax, where tenses seem to be verb modifiers and not sentential adverbs: the problematic aspect of the formalizations is that tenses are interpreted as existential quantifiers. This creates problems as soon as we regard the interaction of tense with negation, as has been noticed by Partee (1973):

(1-5) I didn't turn the stove off

We can formalize this as (1-6a) or (1-6b), where the first expresses a state of affairs that is presumably false and the second one that is trivially true.

(1-6) a. ¬PAST I turn off the stove
b. PAST ¬ I turn off the stove

Neither can be correct.

Another problem, which is the starting point for Rainer Bäuerle's (1979) dissertation, has to do with the combination of tenses with temporal adverbs of quantification.

(1-7) Today, Vashek was always funny

Intuitively, it is quite clear what the truth conditions of (7) are, and they can be depicted by diagram (1-8):

(1-8)
```
                today
---?---|//////////|------?-----------|-------->
                 S
```

The slashed interval is the time of the funniness. Vashek's funniness might extend further into the past and into the future, but the sentence does not give us any information about that.

If we try to formalize this, we hit trouble. The quantifier *always* cannot have wider scope than PAST because that would amount to vacuous quantification. Therefore it must quantify over the time that has been shifted backwards by PAST. The semantics would then be something like (1-9):

(1-9) $\| \mathit{always}\ \alpha \|^{S,t} = 1$ iff $\forall t'$: If $t' \subseteq t$, then $\| \alpha \|^{S,t'} = 1$.

Thus, the formalization of our sentence would be (1-10a), whose truth conditions are stated under (1-10b). (1-10c) illustrates the scene described.

(1-10) a. today PAST always Vashek be funny
b. $\exists t'$: $t' \subseteq$ today & $t' < S$
& $\forall t^*$(If $t^* \subseteq t'$, then Vashek is funny at t^*)

```
                today
c.  ------|-?--////--?--|-----------------|--------->
                      S
```

Never mind how the frame-setter *today* and the tense are brought together: the formalization is too weak anyway. If there is an interval of today at which Vashek is always funny, this means that Vashek is funny at some interval of today. Thus, the semantics predicts that sentence (1-7) means the same as sentence (1-11), which is obviously wrong. We would immediately discover the difference if we negated the two.

(1-11) Today, Vashek was funny [≠ (1-7)]

An even more puzzling problem, pointed out to me by Irene Heim, arises with the present tense, which a straightforward quantificational theory would analyse as:

(1-12) $\| \mathit{PRES}\, \alpha \|^{S,t} = 1$ $\exists t'$: t' overlaps S & $\| \alpha \|^{S,t'} = 1$.

The theory predicts that (1-13a) means (1-13b). This, however, is too weak. Vashek does not bark only at one particular interval of today when the bell rings and which overlaps S. He barks at any belling-interval of today.

(1-13) a. Today, Vashek always barks when the bell rings
b. PREDICTED:

$$\left\| \mathit{today}\, \mathit{PRES}\, \mathit{always} \begin{bmatrix} \textit{when the bell rings,} \\ \textit{Vashek bark} \end{bmatrix} \right\|^{S,t} = 1 \text{ iff}$$

$\exists t'$: $t' \subseteq$ today & t' o S &
$\forall t^*$(If $t^* \subseteq t'$ & t^* o S & the bell rings at t^*, then Vashek barks at t^*)
c. WANTED:
$\forall t$(If $t \subseteq$ today & the bell rings at t, then Vashek barks at t)

("o" stands for the overlap relation.) The truth conditions are correctly described by the semiformal paraphrase (1-13c), in which the information conveyed by PRES has mysteriously disappeared.

Partee's (1973) conclusion is that a simple-minded quantificational approach is problematic: tenses are more like pronouns. There are a number of supporters of this view, among whom Enç (1987) is perhaps the best known.[1] Instead of discussing this rather intricate proposal, let us look at a simpler variant, which is considered in Heim (1994).

(1-14) **A referential approach**

a. $\| PRES_i \|^{S,g}$ is defined only if $g(i) o S$. When defined,

$\| PRES_i \|^{S,g} = g(i)$.

b. $\| PAST_i \|^{S,g}$ is defined only if $g(i) < S$. When defined,

$\| PAST_i \|^{S,g} = g(i)$.

If we try to apply this to example (1-13), we run into difficulties again. There are two options for interpreting *always*: the quantifier could quantify over present times. That would give us the meaning: "Vashek barks at every time which overlaps S and at which the bell rings". The second option is that *always* quantifies over subintervals of the time denoted by PRES. That would mean that Vashek barks at every subinterval of the present time at which the bell rings. Both interpretations are inadequate.

Reichenbachian diagrams don't give us a clue as to how we could overcome these problems. But there seems to be nothing wrong with them. Sometimes, however, the pictures really bewitch our thinking. Look at (1-15):

(1-15) a. Zuzana thinks that Vashek is asleep

One could try to represent this so-called simultaneous reading by means of icon (1-15b).

(1-15) b.
```
                    E1, E2
---------------------|--------------------------->
                    R, S
PREDICTION: E1 = E2
```

E_1 represents the time of the thinking and E_2 is the time of Vashek's being asleep. Since all the parameters coincide, E_1 should be identical to E_2. This, however, is not so. We all are wrong about the time most of the time. Zuzana has her thought at 5 o'clock, but she believes it is 6 o'clock. She thinks: "It's 6 o'clock and I bet that that lazy fellow Vashek is still asleep". We can describe the content of her thought as "being temporally located at a time which is 6 o'clock and at which Vashek is asleep". In other words, the time of Vashek's sleeping in the belief worlds is 6 o'clock. Thus, E_1 = 5 o'clock and E_2 = 6 o'clock. So, obviously, $E_1 \neq E_2$. Or Zuzana might not have had any particular time in mind. She just thought: "Vashek is asleep right now". The content of the thinking may be described as "being at a time at which Vashek is asleep". This formulation makes it obvious once more that the time of the sleeping E_2 has nothing to do with the time of the thinking E_1.

Or consider (1-16a):

(1-16) a. Zuzana thought that Vashek was asleep

This sentence has three different Reichenbach diagrams, which we contract into one:

```
(1-16) b.             E2       E2       E2
          --------------|-------|---------|--------|---------->
                              E1, R                S
          PREDICTION: E2 < S
```

One might argue that the approach correctly predicts that the time of the sleeping in the belief worlds E_2 may be before, simultaneous to or after the time of the thinking E_1, a result compatible with our previous reflection. Still, the semantics of the embedded PAST tells us that E_2 is before S. And this is wrong again. The speech time is 5 o'clock. Zuzana had her thought at 4:45 and she thought that it was 5:15 and that Vashek was asleep. Thus, $E_2 > S$.

The consequence of this reflection is that the embedded tenses cannot be absolute tenses here. Since there is no relation between the time in the belief worlds and the time of the believing, the notion of relative tense doesn't make sense either if it is understood as expressing a relation between the evaluation time in the matrix clause and that in the subordinate clause. Thus, the traditional talk about *simultaneity*, *anteriority* or *back-shifting* and *posteriority* or *forward-shifting* has to be reinterpreted in a way that will become clear in the course of the discussion. All the more, it follows that there is no way of representing what is going on by means of Reichenbach diagrams.

2. Bound variable readings

Let us forget adverbs of quantification for a while and discuss embedded constructions. What is going on here? I think that Barbara Partee's conjecture that tenses might be something like pronouns carries some truth. Bound pronouns behave like bound variables and so do bound tenses.

This section will make it clear that the bound variable interpretation of embedded tense is a natural outcome of the semantics of attitudes. Bound variable tense will in fact be equivalent to tenselessness. I will give examples from the Latin Sequence of Tenses which show that embedded tensed forms must mean the same as their tenseless counterparts.

Let us start with a logical analysis of sentence (1-16a). I will use an extensional typed language in the style of Gallin (1975), which makes the intensional parameters world (= type s) and time (= type i) explicit. An approximate representation of the meaning of the sentence is:

(2-1) $$\exists t_1\Big[t_1 < t_0 \wedge think_{w_0 t_1}\Big(Zuzana, \lambda t_0 \lambda w_0\big[asleep_{w_0 t_0}(Vashek)\big]\Big)\Big]$$

The crucial property of the formula is that there is no past tense in the complement of *think*. (I am assuming a Priorian semantics for PAST here.) Furthermore, the time and the world variables of the predicate are λ-bound and, in fact, abstracted away: we could write the complement of *think* equally well as $asleep(Vashek)$, i.e., as a formula which leaves the world and time argument unsaturated. Therefore, there is no semantic relation between the time of the thinking and the time of the sleeping.

The formula as such does not tell us why there should be no tense in the complement. A meaning rule for *think* provides the explanation, for it reveals that "Zuzana thinks in w_0 at t_1" is a universal quantifier quantifying over world-time pairs:

(2-2) $\| think \|(P)(a)(t)(w) = 1$ iff for every w' and t' compatible with what a thinks in w at t, $P(t')(w') = 1$.

The rule assumes that *think* is of type $\langle\langle i,st\rangle\langle e,\langle i,st\rangle\rangle\rangle$. The rule can be paraphrased as "a thinks that she is in a world at a time such that P is true in that world at that time". If the time parameter were linked to the speech time, the speech time would be part of Zuzana's thought. In section 1 we argued that this cannot be the case. Our formalization correctly implies that the content of thought is in no way related to the time in the real world.

That there cannot be any tense information in embedded constructions is nicely illustrated by the Latin **consecutio temporum:**

(2-3) a. Scio quem Susanna amet
I know whom Sue love (subjunctive present)
a'. Scio Susannam te amare
I know Sue you love
b. Scio quem Susanna amaverit
I know whom Sue have loved (subjunctive perfect)
b'. Scio Susannam te amavisse
I know Sue you have loved (infinitive perfect)
c. Scio quem Susanna amatura sit
I know whom Sue loving-FUT be-SUBJ (subjunctive future)
c'. Scio Susannam te amaturam esse
I know Sue you lov-FUT be (infinitive future)

The equations listed under (2-4) show that the finite verb forms mean exactly the same as their non-finite counterparts, which we get from the finite ones by deleting the tense.

(2-4) Vstem + Pres + Subjunctive = Vstem
Vstem + Perf + Pres + Subjunctive = Vstem + Perf
Vstem + Future + Pres + Subjunctive = Vstem + Future

The synopsis suggests that the subjunctive is somehow responsible for the tense deletion. Later on, I will risk a speculation as to what analysis could be given of the subjunctive in order to obtain this result.

The discussion supports the hypothesis that *the complement of an attitude doesn't tolerate an absolute tense*.

3. The syntax of bound tense

If there cannot be absolute tense in certain intensional contexts but we nevertheless find tense morphology there (for the simple reason that every finite verb is tensed), we are left with two options. Either we delete the tense in these contexts or we interpret tense differently in transparent and opaque contexts. The result has to be a bound time variable in each case.

Among the approaches known to me, Ogihara (1989) is a deletion approach whereas Stowell (1993) is perhaps best understood as an approach of the other kind, although his system makes use of tense deletion in certain contexts as well, as we will see in section 5. Abusch (1993) tries to capture the bound readings by a complicated unified semantics, which I have discussed extensively elsewhere (cf. von Stechow 1994).

So, let us consider Ogihara's deletion approach first. It would be very simple if it were *just* deletion in embedded clauses. But things are more complicated because not just any combination of matrix tense and embedded tense is acceptable, as we all know. Ogihara's rule is this:

(3-1) (**Optional**) **Tense Deletion** (Ogihara 1989, p.109)

Delete a tense β if α and β are occurrences of the same tense morpheme and α is the local tense of β.

[local = next c-commanding]

Ogihara interprets deleted tense as relative present, an operation which has the effect that Ø-tense always denotes the local evaluation time. I will come back to the semantics in a moment. The rule applies at LF after Quantifier Raising. The effect of Tense Deletion is that a present morpheme may trigger the deletion of any subordinate present morpheme, provided no past morpheme intervenes. Similarly, a past morpheme may trigger the deletion of any subordinate past morpheme if no present morpheme intervenes.

Let us see the effect of the rule by applying it to some of the core data which motivated Ogihara's theory.[2]

(3-2) a. A week ago he <u>said</u> that in ten days he <u>would</u> buy a fish that <u>was</u> still alive
[<u>was</u> = bound variable]
b. He <u>will</u> buy a fish that <u>is</u> alive[3]
[<u>is</u> = bound variable]
c. He <u>will</u> buy a fish that <u>was</u> alive
[<u>was</u> = relative past]

The LFs explaining the data are roughly these, where I have indicated deleted tenses by the zero prefix:

(3-3) a. $PAST_1$ he say λ_0[that Ø-PAST WOLL λ_0[INF_0 he buy a fish that Ø-PAST be alive]]
b. $PRES_1$ WOLL λ_0[INF_0 he buy a fish that Ø-PRES be alive]
c. $PRES_1$ WOLL λ_0[INF_0 he buy a fish that $\exists_2$[$PAST_2$ be alive]]

The notation of the LF closely follows Heim (1994). In the article I will assume a TP dominating a VP. The subject is generated in SpecVP, the semantic tense

(PAST or PRES) is in SpecTP, and the tense morphology is in T, i.e., the TP-head. The AgrP is ignored throughout. SpecTP is an argument of the verb. Infinitive phrases INF-P or participle phrases PART-P contain a temporal argument in the specifier, the variable t_0. The representation of the morphology is omitted in the text.The LFs in this paper ignore the world parameter, which would have to be represented by the variable w_0 at the appropriate place. The formulas interpreting the LFs will, however, contain w_0 with the appropriate binding.

The variable t_0 is called the **distinguished** (**time**) **variable** and plays a special role in our system. If it is free, it denotes the speech time. A general syntactic convention is that operators shifting the time always do that via λ~abstraction over t_0. This will have the effect that each occurrence of t_0 gives us the local evaluation time, i.e., the intensional time parameter of Montague's language IL. As will be seen in a moment, tenses may not be analysed as time shifters.

Henceforth, I will use a relational semantics for tense which is similar to the Priorian one but which doesn't necessarily quantify over the time. The advantage of such an approach is that it allows for temporal anaphora. $\text{PAST}_{i,0}$ says that t_i is before t_0. I will call t_i the **reference time** of PAST. t_0 is the local **evaluation time** of PAST. Since it is always denoted by the distinguished variable, the second index is redundant and can be omitted. Hence, I write PAST_i for $\text{PAST}_{i,0}$. Similar conventions apply to PRES. As for WOLL, the stem underlying the auxiliaries *will* and *would* , for the time being it is interpreted as an indefinite relative future with respect to some given evaluation time. The analogue holds for HAVE. This is the content of the following meaning rules.

(3-4) **Tense and temporal auxiliaries** (**preliminary version**)

a. Ø-PAST and Ø-PRES are translated by the distinguished variable t_0.

b. PAST_i and PRES_i are translated as $\lambda P\left[t_i < t_0 \wedge P(t_i)\right]$ and $\lambda P\left[t_i \; o \; t_0 \wedge P(t_i)\right]$, respectively.

c. WOLL and HAVE are translated as $\lambda t \lambda P \exists t'\left[t' > t \wedge P(t')\right]$ and $\lambda t \lambda P \exists t'\left[t' < t \wedge P(t')\right]$, respectively.

Condition (3-4a) is designed to capture Ogihara's interpretation of Ø-tense as a relative present: a Ø-tense is always c-commanded by an overt tense which applies to a λ_0-abstract. The effect of this is that t_0 is bound and denotes the reference time of the tense, i.e., the local evaluation time determined by the tense. The LFs can now be translated into the formulas (3-5)(a) to (c):[4]

(3-5) a. $$t_1 < t_0 \wedge say_{w_0 t_1}\left(\begin{array}{l} he, \\ \lambda t_0 \lambda w_0 \exists t\left[t > t_0 \wedge \exists x\left[\begin{array}{l} fish_{w_0 t_0}(x) \wedge alive_{w_0 t_0}(x) \\ \wedge \; buy_{w_0 t_0}(he, x) \end{array}\right]\right] \end{array}\right)$$

Bound variable past in relative clause

b. $$t_1 \; o \; t_0 \wedge \exists t\left(t > t_1 \wedge \exists x\left[fish_{w_0 t}(x) \wedge alive_{w_0 t} \wedge buy_{w_0 t}(he, x)\right]\right)$$

Bound variable present in relative clause

$$\text{c. } t_1 \, o \, t_0 \wedge \exists t \left[t > t_1 \wedge \exists x \begin{pmatrix} fish_{w_0 t}(x) \wedge \exists t_2 \left[t_2 < t \wedge alive_{w_0 t_2}(x) \right] \\ \wedge \, buy_{w_0 t}(he, x) \end{pmatrix} \right]$$

Relative past in relative clause

I think these results are satisfactory. Notice, however, that Ogihara's rule does not mention intensional contexts. Thus, we have to add a condition that Tense Deletion applies obligatorily there. Furthermore, Abusch (1993) argues that Tense Deletion cannot apply in extensional contexts at all but has to be restricted to intensional contexts:

(3-6) a. John met a woman being in the next room
b. *John met a woman who was in the next room now

She seems to think that the time variable of a verb with deleted tense may freely refer to any time whatsoever. For example (3-6b), the Ø-tense of *was* could refer to the utterance time t_0 according to Abusch. Thus, the two sentences would be synonymous, which they are not.

It should be clear from the semantics introduced that such a criticism doesn't apply to this example: Ø-tenses do not refer freely but denote the local evaluation time; hence their temporal reference is highly restricted. Look at an LF for (3-6b) where Tense Deletion can apply:

(3-6) c. $PAST_1$ λ_0[[a woman who Ø-PAST be in the next room now]$_3$
T_0 John meet t_3]

$$\text{d. } t_1 < t_0 \wedge \exists x \begin{bmatrix} woman(x) \wedge in\, the\ next\ room_{w_0 t_1}(x) \wedge t_1 \subseteq now \\ \wedge \, meet_{w_0 t_1}(John, x) \end{bmatrix}$$

The formula interpreting Ø-PAST as the local evaluation time is (3-6d). Clearly, it is contradictory because the local evaluation time cannot precede t_0 and be part of now, which is t_0. Thus, this example doesn't refute Ogihara's rule.

A closer inspection of the example shows the following: if we delete PAST, we have to bind it if we want Ø-PAST to be coreferential with the reference time denoted by the matrix PAST. This presupposes that the generalized quantifier $PAST_1$ can shift the local evaluation time t_0 *via* the abstractor λ_0. This is unobjectionable for this particular example but gives wrong results for cases like the following, which will be discussed in the next section.

(3-7) a. Bill had a student that ought to study more
b. $PAST_1$ λ_0[[a student that $ought_0$ to study more]$_2$ T_0 Bill have t_2]

In the next section we will see that *ought* has to be evaluated with respect to the local evaluation time t_0. If $PAST_1$ could shift t_0 to the past, the sentence could mean that the student was obliged to study more at the time at which Bill had him. Thus we have to bar the LF (3-7a). The convention that does the job could be this:

(3-8) **The QR convention:** The movement index created by QR is always different from the distinguished index 0.

The LF (3-7b) violates the condition because the movement index is 0 there. On the other hand, an admissible LF would be this:

(3-7) c. $PAST_1$ λ_2[[a student that $ought_0$ to study more]$_3$ T_2 Bill have t_3]

This correctly expresses that Bill's student has the obligation now. Returning to Abusch's example, let us apply the QR convention and let us suppose that we can apply Tense Deletion. We could derive the following LF then:

(3-6) e. $PAST_1$ λ_2[[a woman who Ø-PAST be in the next room now]$_3$
T_2 John meet t_3]

This LF would express an entirely consistent statement, namely that John met a woman who is in the next room now. In order to exclude the LF we can either say that a Ø-tense has to be λ-bound or that Tense Deletion doesn't apply in extensional contexts. Thus, Abusch is right in saying that we should not allow the application of Tense Deletion in certain extensional contexts. The proper LF for the sentence (3-6a) should therefore be one with two coindexed PASTs.

Another example showing that Ogihara's rule needs to be refined is this:

(3-9) a. He has bought a fish that is alive

b. $PRES_1$ HAVE λ_0[$PART_0$ he buy a fish that Ø-PRES be alive]

c. $t_1 \, o \, t_0 \wedge \exists t\Big(t < t_1 \wedge \exists x\Big[\, fish_{w_0 t}(x) \wedge alive_{w_0 t} \wedge buy_{w_0 t}(he, x)\Big]\Big)$

If PRES could be deleted here, we would expect the reading (3-9c) with a bound variable tense in the relative clause, which states that the fish was alive at the time of the buying. This reading is not attested. We could say that Tense Deletion cannot apply here because we have an extensional context. This, however, would not be entirely correct, because PAST can be deleted in this context as the following example shows:

(3-10) a. He has bought a fish that was alive

b. $PRES_1$ HAVE λ_0[$PART_0$ he buy a fish that Ø-PAST be alive]

It is pretty clear what is going on here: HAVE may trigger PAST-deletion but it blocks PRES-deletion. Thus, it plays a similar role as to PAST, but it cannot be deleted itself. Ogihara's rule has to be modified to capture these facts.

Before we try to state the rules which describe the distribution of bound tense in English, let us introduce some terminology. A tense is **absolute** or **deictic** if its evaluation argument denotes the time of utterance. In our system, the free variable t_0 does the job. We call a tense **bound in** α iff its arguments are bound in α. Bound Ø-tense is regarded as a special case thereof. A tense is **free in** α iff its arguments are not bound in α. Binding is to be understood in the sense of logic, i.e., a variable is bound by a quantifier or the λ-operator.

Adopting the terminology of Abusch, let us call contexts in which we cannot have bound tenses **extensional contexts**. Second, there are contexts in which we can have bound tenses but which allow free tenses as well, for instance the contexts created by WOLL and HAVE. Let us call these contexts **weak**

intensional contexts. Third, there are the **strong intensional contexts** created by intensional predicates such as certain modals and verbs of attitude. In these contexts we cannot have free tenses. Henceforth, we will use the term **intensional context** in Abusch's sense, i.e., as a cover term for weak and strong intensional contexts.

If I haven't overlooked something, the rules which describe the distribution of different interpretations of tenses in English are these:

(3-11) **Tense Deletion in English** (**revised**)

a. No free tense in strong intensional contexts!

b. PAST may be deleted if it is c-commanded by PAST and is not in an extensional context.

c. PRES may be deleted if it is c-commanded by PRES , not c-commanded by PAST or HAVE, and is not in an extensional context.

If we compare this system with Ogihara's analysis, we discover important empirical differences. Ogihara treats PAST and HAVE exactly alike, namely as time-shifters which can bind temporal variables. This is Montague's analysis. Abusch's data clearly show that we have to distinguish between tenses and auxiliaries: the former are not able to bind time variables in their c-command domain. Thus, tenses behave more like names, whereas auxiliaries behave like quantifiers. In our formalism, this has to be stipulated, because tenses *could* bind time variables. The other difference is principle (3-11a), which I call **Abusch's constraint**. This is not a syntactic principle but follows from semantic considerations as has been mentioned.

The rule Tense Deletion accounts for bound variable tense, but not for bound tenses in general. We have to say something about **bound relative tenses**. Concerning bound relative PAST, I guess that it can occur in every tense deletion context. As for bound relative PRES, its distribution must be identical to the distribution of Ø-PRES, because the two nearly mean the same. The following example illustrates the point.

(3-12) a. Bill believed that Mary is pregnant

b. PAST_1 Bill believe [λ_0 that $\exists_2$[PRES_2 Mary be pregnant]]

The LF (3-12b) has a bound relative present in the *that*-clause. The sentence means that Bill believed that Mary was pregnant at a time overlapping his subjective now. The German counterpart of the sentence has that reading, but as a matter of fact the English sentence doesn't have it. Therefore, we have to restrict the occurrence of bound relative PRES for English. I will return to the question of what (3-12a) actually means in section 5.

4. Subjunctive forms

After having become acclimatized to the idea that finite forms may be interpreted as tenseless, i.e., as the bound distinguished variable t_0, in certain contexts, it shouldn't come as a surprise that certain finite forms are *always* tenseless. Abusch (1993) observes that a number of English modals have that property, for instance *ought* and *might*. I will argue that this holds for subjunctive forms in general and that the said modals are best analysed as frozen subjunctive forms. The semantic effect of the subjunctive will be that it selects Ø-tense, which is interpreted as the intensional parameter t_0.

Abusch (1993) gives the following examples, where the numbers in square brackets refer to her numbering.

(4-1) a. I ought to study more [A, 39]
b.*When he was in high school, John ought to study more [A, 40]
c. When he was in high school, John ought to have studied more [A, 41]

The comparison between (4-1b) and (4-1c) shows that semantically *ought* isn't a past form. The past role is played by *ought to have*. (4-1a) suggests that *ought* is a (semantic) present form, but the examples listed under (4-2) provide evidence that this cannot be correct either:

(4-2) a. John believed that he ought to study more [A, 45]
b. John believes that he ought to study more
c. He will always be a student that ought to work harder [Heim 1994, Fn. 22]

If *ought* were a present form, (4-2a) would be ungrammatical by the rules of the sequence of tenses. (4-2b) and (4-2c) show that *ought* can be embedded under present and future, too. If we assume that *ought* is semantically tenseless, *ought to study* corresponds to the Latin infinitive present and *ought to have studied* corresponds to the Latin infinitive perfect. These forms have a bound variable reading and the distribution follows from what we have said about bound tense if we assume that *ought* can occur in a non-embedded position as well. Non-finite forms cannot occur there. The data show that there is no semantic reason for that. Therefore, there must be matrix sentences without semantic tense as witnessed by (4-1a). This amounts to the same as if we had the present tense there.

This is the idea behind Abusch's analysis of the behaviour of these modals, which goes like this:

> "...the temporal parameter of *might* and *ought* is treated as an IL-evaluation time" (Abusch 1993, p. 23)

(IL is Richard Montague's language Intensional Logic.) What she means by this becomes clear if we have a look at the IL-formulas which formalize the sentences *John ought to study more* and *John ought to have studied more.*

(4-3) a. $[OUGHT \,{}^\wedge[study - more\ John]]$
b. $H[OUGHT \,{}^\wedge[study - more\ John]]$

H is Montague's PAST-operator. It expresses relative past: "there is a time before the evaluation time".[5] Montague treats H as a logical symbol. Therefore, we find no up operator $\wedge$ under H.

We represent the intensional parameters by w_0 and t_0 in the extensional language and thus obtain the following equivalent formulas, in which we use the auxiliary HAVE introduced in rule (3-4c) instead of Montague's H:

(4-4) a. $OUGHT_{w_0t_0}\left(\lambda t_0 \lambda w_0\left[study_{w_0t_0}(John)\right]\right)$

b. $HAVE_{t_0}\left(\lambda t_0\left[OUGHT_{w_0t_0}\left(\lambda t_0 \lambda w_0\left[study_{w_0t_0}(John)\right]\right)\right]\right)$

There is no semantic tense in these. Therefore, they can be embedded under an intensional predicate, and the intensional parameters are lambda-bound:

(4-5) a. John believed he ought to study more

b. $t_1 < t_0 \wedge believe_{w_0t_1}\begin{pmatrix} John, \\ \lambda t_0 \lambda w_0\left[OUGHT_{w_0t_0}\left(\lambda t_0 \lambda w_0\left[study_{w_0t_0}(John)\right]\right)\right] \end{pmatrix}$

As we have noted in the preceding section, Montague's analysis cannot be entirely correct because it yields the wrong reading for the sentence *Bill had a student that ought to study more*. We have to distinguish between HAVE and PAST. The former shifts the evaluation time t_0 but the latter doesn't.

The observations made carry over to subjunctive forms in general. We know from the Latin examples that they cannot be interpreted as free tenses. I think the same is true for the subjunctive forms of English as well. In most cases, the subjunctive is identical with the simple past, but the auxiliary *be* shows that the distinction still exists to some extent.

(4-6) If I <u>were</u>/?<u>was</u> not in Austin, I <u>would</u> be in Prague

The coexistence of the subjunctive and the indicative forms in this context shows to my mind that the latter is semantically a subjunctive. The data under (4-7) exhibit exactly the same grammaticality pattern as the examples (4-1). They show that the *would* in the consequent must be semantically tenseless and is perhaps best interpreted as a semantical subjunctive if the subjunctive is the operation deleting tense.

(4-7) a. If Bill <u>listened</u> to you, he <u>would</u> make fewer mistakes

b. *When Bill <u>was</u> in high school, he <u>would</u> make fewer mistakes if he listened to you

c. When Bill <u>was</u> in high school, he <u>would</u> <u>have</u> made fewer mistakes if he had listened to you

As before, we can embed (4-7a) under past, present or future, provided the matrix predicate creates an intensional context in the sense of Abusch.

(4-8) a. Mary <u>believed</u> that Bill <u>would</u> make fewer mistakes if he <u>listened</u> to you

b. Mary <u>believes</u> that Bill <u>would</u> make fewer mistakes if he <u>listened</u> to you

c. Vashek will always be a dog that would make fewer mistakes if he listened to Zuzana.

For convenience, I give an idea of what the LF for counterfactuals must be, here for a *could*-counterfactual.

(4-9) a. If Vashek listened to me, he could make fewer mistakes

b. $\lambda_{w_0 t_0}\left[listen_{w_0 t_0}(Vashek)\right] \Diamond \rightarrow_{w_0 t_0} \lambda_{w_0 t_0}\left[less_{w_0 t_0}(Vashek)\right]$

The symbolism is an extensional version of Lewis' (1973) theory of counterfactuals and is interpreted as indicated there.

In many other languages we find subjunctive forms at the place of the said English modals. Thus, it is tempting to regard these modals as frozen subjunctive forms. The hypothesis explaining the data would be that *subjunctive forms don't have a semantic tense.*

One of the roles of the subjunctive seems to be that it deprives finite forms of their semantic tense. We can express this in the following way:

(4-10) **Subjunctive**:
The subjunctive morpheme (SUBJ) selects Ø-tense.

Recall that Ø-tense is translated as t_0. Since the subjunctive typically occurs in dependent clauses, t_0 will mostly be bound if we make the assumption that complementizers like *if*, (non-relative) *that,* etc. contain the variable binders $\lambda t_0 \lambda w_0$ (*vide* Heim 1994 for this assumption). Ignoring the AgrP, the *if*-clause in sentence (4-9a) would have an LF like the following one:

(4-11) $[_{CP}\ \lambda_0$ if $[_{ModP}$ SUBJ $[_{TP}$ Ø-PAST $[_{VP}$ Vashek listen to me]]]]

To be sure, SUBJ is an abstract morpheme which is morphologically realized only occasionally in contemporary English.

5. The representation of double access

Let us take up the question of what sentence (3-12a), here repeated as (5-1a), means in English.

(5-1) a. Bill believed that Mary is pregnant

This is the notorious double access phenomenon, which has troubled semanticists since the time when it was introduced into the theoretical discussion by Carlota Smith (*vide* Smith 1978). Usually, it is said that the sentence is true if Bill believed that Mary was pregnant and the pregnancy extends to the present time. Yet, as Abusch (1993) notices, this is not correct. Bill might very well have believed something wrong. The truth conditions of (5-1a) are better described by saying that the sentence is true if Bill believed that Mary was pregnant and the state which caused his belief extends to the present time. This state might not be pregnancy at all; it could be Mary's state of having a big belly (from overeating).

Let us look at how Abusch (1993) derives that reading. We already know that PRES cannot be a part of the *that*-clause: PRES cannot be an absolute tense in view of Abusch's constraint, and it cannot be a bound tense according to the rules describing the distribution of bound tenses. Abusch's way out is to interpret PRES de re. Her LF is something like (5-1b).

(5-1) b. $PAST_1$ Bill believe-of $PRES_2$ $\lambda_3\lambda_0[T_3$ Mary be pregnant]

Here, *believe* has an additional time argument. In order to make that clear, I have represented the verb as $believe-of$. $PRES_2$ may be thought of as moved from its basic position to the res-position by "res-movement" (*vide* Heim 1994). We first note that (5-1b) is not in conflict with Abusch's constraint: $PRES_2$ is a free tense, but it is not in an intensional context. In the present theory the LF is, however, not well formed for type reasons: $PRES_2$ is of the quantifier type, whereas the res-position is of the individual type. It follows that $PRES_2$ cannot remain there but has to be scoped over the matrix tense. The result is the LF (5-1c), whose interpretation is (5-1d).

(5-1) c. $PRES_2$ $\lambda_4[PAST_1$ Bill believe-of t_4 $\lambda_3\lambda_0[T_3$ Mary be pregnant]]

d. $$t_2\ o\ t_0 \wedge t_1 < t_0 \wedge believe-of_{w_0 t_1}\Big(Bill, t_2, \lambda t_3 \lambda t_0 \lambda w_0\big[pregnant_{w_0 t_3}(Mary)\big]\Big)$$

A de-re-attitude is interpreted by means of the methods developed in David Lewis (1979). The subject of the attitude has to be acquainted with the res, here the time denoted by $PRES_2$, i.e. $g(t_2)$, via an appropriate description, which is integrated into the content of the attitude. Thus, the content of Bill's belief might be something like: "This state of Mary's which I observe is pregnancy". A meaning rule for de-re-belief might be something like this (cf. Heim 1994, 33):

(5-2) $\| believe-of \|^c(t_{res})(R)(x)(t)(w)$ is defined only if c supplies a suitable time-concept f_c such that $f_c(w,t) = t_{res}$.
Where defined, $\| believe-of \|^c(t_{res})(R)(x)(t)(w) = 1$ iff $R\big(f_c(w',t')\big)(t')(w') = 1$ for all w' and t' compatible with x beliefs in w at t.

As to the logical type of the symbol, since de-dicto-attitudes are of type $\langle\langle i,st\rangle\langle e,\langle i,st\rangle\rangle\rangle$, de-re-symbols are of type $\langle\langle i,\langle ii,st\rangle\rangle\langle e,\langle i,st\rangle\rangle\rangle$.

To appreciate the merits of Abusch's solution, we compare it with a recent analysis due to Tim Stowell (cf. Stowell 1993). Stowell distinguishes between past morphology - represented as *Past* - and the semantic operation PAST. Similarly for *Pres* and PRES. He says that past morphology, i.e. *Past*, is like a negative polarity item insofar as it must be in the scope of the semantic past operator PAST. Present morphology behaves like a positive polarity item with respect to PAST: it must not occur in the scope of PAST.

(5-3) **Stowell's (1993) tense polarity**

a. Past morphology can only appear in the scope of (semantic) PAST at LF.
b. Pres(ent) morphology must not appear in the scope of PAST at LF.

Thus, one semantic tense may license several tense morphologies without semantic tense. The idea is, of course, that a tense morphology without immediately adjacent semantic tense is not interpreted as semantic tense. Obviously, the principles are rather similar to the rule of Tense Deletion (3-11).

How is tense morphology without semantic tense interpreted? Stowell's semantic remarks are somewhat sketchy. From what I have understood, a Ø-tense can be regarded as a variable which is coindexed with the nearest c-commanding semantic tense.[6]

We are ready for Stowell's analysis of the double access phenomenon now. As before, the D-structure (5-4a) cannot be well formed, because *Pres* is in the scope of PAST.

(5-4) a. Bill PAST believe-Past that Mary PRES be-Pres pregnant

Therefore, Stowell scopes the embedded clause over the matrix clause and obtains the LF (5-4b).[7]

(5-4) b. [PRES_2 Mary be-Pres pregnant]$_3$
PAST_1 Bill believe-Past [Ø-PRES Mary be-Ø-Pres pregnant]$_3$

The scoping process leaves an identical copy with deleted PRES and, as Musan (1994) notices, *Pres* should be deleted as well. Otherwise the tense polarity condition (5-3b) would be violated. Stowell is not explicit on the principles which trigger these deletions. So let us assume that we delete everything which violates grammatical conditions of well-formedness. The next question concerns the interpretation of the scoping process. The standard interpretation by means of λ~abstraction is not possible because the copy left obviously cannot be interpreted as a bound variable. The only way to make sense of the LF which I can see is to interpret this scoping process as conjunction, though the details are not clear to me. Under these assumptions, the LF means this:

(5-4) c.
$$\begin{bmatrix} t_2 \, o \, t_0 \wedge pregnant_{w_0 t_2}(Mary) \wedge \\ t_1 < t_0 \wedge believe_{w_0 t_1}\Big(Bill, \lambda t_0 \lambda w_0\big[pregnant_{w_0 t_1}(Mary)\big]\Big) \end{bmatrix}$$

This reading is inadequate for several reasons. First, it does not guarantee that we are speaking about the same pregnancy. Stowell's LF means: "Mary is pregnant and Bill believed that Mary was pregnant at the time of the believing". Clearly, the pregnancies can be different ones. Second, the interpretation predicts that the complement of the sentence necessarily has a factive understanding. We have noticed that this need not be so. Bill might have a wrong belief about Mary's state. Third, we have a temporal anaphor in the intensional argument, a violation of Abusch's constraint. If this is the semantics for Stowell's analysis, then the proposal must be wrong.

A similar objection applies to Ençs (1987) solution of the phenomenon. Her LF is something like this:

(5-5) [$\text{COMP}_{0,k}$ $\text{PRES}_{0,k}$ Mary be pregnant]$_i$ $\text{PAST}_{j,k}$ Bill believe t_i

Again, I am not sure how the scoping of the CP is interpreted. If the interpretation is non-factive, the intended reading can be paraphrased as: "Bill believes at time t_j, $t_j < t_0$, that Mary is pregnant at time t_0, where t_j is included in t_0". Never mind how we obtain this interpretation from the LF, it cannot be correct anyway since the complement of attitude contains a free tense. The analysis is doomed to failure by Abusch's constraint.

None of these objections applies to Abusch's solution. Therefore, I take it her approach is more successful than its rivals.

6. Tense and temporal adverbs of quantification

Let us come back to the problem of combining tense with (temporal) adverbs of quantification. I think the key for a correct treatment is still Kratzer's (1978) **definite theory of tense**, according to which PAST denotes the maximal time stretch before the speech time. In extensional terms, Kratzer's semantics may be stated as follows:

(6-1) $\| PAST \|(P)(t) = 1$ iff $(P)(t') = 1$, where t' is the maximal subinterval of t which is before t_0.

If t is today, then PAST(P)(t) is true iff P is true of the time within today which is before the speech time. The adverb *always* quantifies over every subinterval of that time. This account gives us the correct truth-conditions.

I would like to incorporate this semantics into the relational approach I was using in the previous sections. This is not entirely straightforward because the temporal parameters play different roles in Kratzer's and our systems. The variable t in Kratzer's rule is the intensional parameter and corresponds to our evaluation time. At the same time, t plays the role of what Bäuerle (1979) calls *Betrachtzeit*, "temporal frame", which is the time determined by frame-setters like *today*. It corresponds to our reference time. t_0 is the unshiftable time of utterance. In our system, the local evaluation time is expressed by the shiftable parameter t_0. Since the reference time is the maximal time before t_0 within Bäuerle's temporal frame, we have to introduce a further temporal parameter for the frame, which we may call **frame time**. This parameter can be shifted by a frame-setter like *today*. The logical forms for PAST and PRES are now these:

(6-2) **Tenses (official version)**

a. $PAST_{(j)i}$ is translated as $\lambda P\left[PAST(t_0)(t_j)(t_i) \wedge P(t_i)\right]$.

$\|PAST\|(k)(j)(i) = 1$ iff i = the maximal t, such that t $\subseteq$ j and t is before k.

b. $PRES_{(j)i}$ is translated as $\lambda P\left[PRES(t_0)(t_j)(t_i) \wedge P(t_i)\right]$.

$\| PRES \|(k)(j)(i) = 1$ iff i = the maximal t, such that t $\subseteq$ j and t overlaps k.

To illustrate the terminology once more: t_i denotes the reference time, t_j the frame time, and t_0 denotes the local evaluation time. We can now represent Partee's sentence (1-5) as:

(6-3) PAST$_{(1)2}$ λ_3[not T$_3$ I turn off the stove]

$$PAST(t_0)(t_1)(t_2) \wedge \neg\left[turn-off_{w_0 t_2}(I,s)\right]$$

$$\text{iff } t_2 = MAX_t\left[t \subseteq t_1 \wedge t < t_0\right] \wedge \neg\left[turn-off_{w_0 t_2}(I,s)\right]$$

In this case, both the frame time t_1 and the evaluation time t_2 have to be determined by the context, i.e., by a contextually given variable assignment g_c. The situation changes with an overt frame-setter like *yesterday*: then, the most natural reading of the sentence is that I didn't turn off the stove for the whole of yesterday:

(6-4) Yesterday λ_1[PAST$_{(1)2}$ λ_3[not T$_3$ I turn off the stove]]

$$t_2 = MAX_t\left[t \subseteq yesterday \wedge t < t_0\right] \wedge \neg\left[turn-off_{w_0 t_2}(I,s)\right]$$

$$\text{iff } \neg\left[turn-off_{w_0 yesterday}(I,s)\right]$$

We are finally ready for an analysis of the puzzling sentence (1-13a). Consider the simpler variant (6-5a) first, where the adverb of quantification is not overtly restricted:

(6-5) a. Today, Vashek is always funny

b. Today λ_1[PRES$_{(1)2}$ λ_3[always$_{(3)}$ Vashek be funny]]

$$t_2 = MAX_t\left[t \subseteq today \wedge t \circ t_0\right] \wedge \forall t\left[t \subseteq t_2 \rightarrow funny_{w_0 t}(Vashek)\right]$$

Here, 0 is the frame variable of the quantifier *always*, whose meaning is:

(6-6) *always* is a symbol of type $\langle i,\langle\langle i,t\rangle,t\rangle\rangle$.

$\|always\|(t)(P) = 1$ iff for each t': if t' is a subinterval of t, then $P(t') = 1$.

Next, consider (1-13a), here repeated as (6-7a). We want this to express the reading represented by the formula (6-7b):

(6-7) a. Today, Vashek always barks when the bell rings

b. $$\begin{bmatrix} t_2 = MAX_t\left[t \subseteq today \wedge t \circ t_0\right] \\ \wedge \forall t\left[t \subseteq t_2 \wedge ring_{w_0 t}(the\ bell) \rightarrow bark_{w_0 t}(Vashek)\right] \end{bmatrix}$$

The formula illustrates what we have observed in section 1: the *when*-clause must not contain an absolute present; otherwise we would obtain a wrong reading, for in the absolute interpretation *always* cannot bind a variable in the antecedent and the sentence is therefore out. Hence, this occurrence of the present morpheme must express a bound variable reading. Since the PRES in the *when*-clause can undergo Tense Deletion, we can generate an appropriate LF:

(6-7) c. today λ_1[PRES$_{(1)2}$ λ_3[ALWAYS$_{(3)}$

λ_0[when$_0$ λ_0[Ø-PRES the bell ring]] Vashek bark]]

The formula shows that we are assuming that $ALWAYS_{(3)}$ creates a tense deletion context. As for the conjunction *when*, I will assume a very trivial semantics, namely "being a time at which":

(6-8) $when$ is of type $\langle i, \langle\langle i,t\rangle, t\rangle\rangle$. $\| when \|(t)(P) = 1$ iff $P(t) = 1$.

Thus, λ_0[$when_0$ λ_0[Ø-PRES the bell ring]] expresses the property "being a time at which the bell rings". ALWAYS is a two-place quantifier which takes a restricting clause in addition to the frame variable:

(6-9) $ALWAYS$ is of type $\langle i, \langle\langle i,t\rangle, \langle\langle i,t\rangle, t\rangle\rangle\rangle$.

$\| ALWAYS \|(t)(P)(Q) = 1$ iff for every t': if t' is a subinterval of t and $P(t') = 1$, then $Q(t') = 1$.

Obviously, *always* and ALWAYS are instances of a more general schema, but I am neglecting this issue. Given all this, we can translate the LF (6-7c) into a logical formula which expresses the desired reading:

(6-7) d. $$\lambda t_1 \left[\begin{array}{l} PRES(t_0)(t_1)(t_2) \\ \wedge\ ALWAYS(t_2) \left(\begin{array}{l} \lambda t_0 \left[when(t_0)\left(\lambda t_0 . ring_{w_0 t_0}(the\ bell)\right)\right], \\ \lambda t_0 \left[bark_{w_0 t_0}(Vashek) \right] \end{array} \right) \end{array} \right] (today)$$

The reader may convince himself that this is equivalent to (6-7b). I expect the approach to be applicable to constructions with *after* and *before*: as well:

(6-10) a. Vashek is always happy immediately after a walk
b. Vashek is always very impatient before we go out for a walk
c. This afternoon, Vashek ran away before anyone could catch him

We have to say that "t after/before P" means that t is a time after/before a time which is P. This meaning is very weak. Therefore, we mostly have to assume additional modifiers like *immediately* or *five minutes* which qualify the distance between t and the next P-time. Some of these may be invisible at the surface. *Before*-adverbials bring further complications, since the complement may be modalized and license negative polarity items. It is rather obvious that this has to do with a merely possible future as opposed to a real future. This belongs to the complex of "prospective" aspect, a topic not treated in this paper.

In section 3, I analysed the auxiliary stem WOLL as "there is a time after". The following sentences show that this is not general enough.

(6-11) a. Zuzana said that Vashek would always be funny
b. Zuzana said that Vashek would always be a dog that would make fewer mistakes if he listened to Vladimir

To obtain the correct readings, $WOLL_{(j)i}$ must give us the maximal subinterval i of j which is after 0:

(6-12) $\|WOLL\|(k)(j)(i) = 1$ iff i is the maximal time t such that t is a subinterval of j and t is after k.

Using the same abbreviation conventions as before, the LF for (6-11a) is (6-11a$_1$) and (6-11a$_2$) is the interpretation:

(6-11) a$_1$. PAST$_{(2)1}$ λ3∃$_{(3)4}$[Zuzana say
λ0∃5[Ø-PAST WOLL$_{(6)5}$ λ0[always$_{(0)}$ Vashek be funny]]]

a$_2$.

$$\left[\begin{array}{l} t_1 = MAX_t[t \subseteq t_2 \wedge t < t_0] \\ \wedge \exists t_4 \left[\begin{array}{l} t_4 \subseteq t_1 \\ \wedge\, say_{w_0 t_4}\left(Zuzana, \lambda t_0 \lambda w_0 \exists t_5 \left[\begin{array}{l} t_5 = MAX_t[t \subseteq t_6 \wedge t > t_0] \\ \wedge \forall t[t \subseteq t_5 \rightarrow funny_{w_0 t}(Vashek)]\end{array}\right]\right)\end{array}\right]\end{array}\right]$$

∃$_{(3)4}$ is the invisible adverb of quantification "at some time t$_4$ which is a subinterval of the frame time t$_3$". Bäuerle (1979) introduced such invisible temporal adverbs of quantification. The frame variables 2 and 6 are left free and get their value from the context. A good value for 6 would be the entire time.

I have analysed WOLL entirely parallel to tenses, i.e., I am assuming that auxiliaries have a referential argument, here 5. (The auxiliary HAVE has an analogue semantics, of course.) This requires the closure of the variable by a quantifier, here the invisible existential quantifier.

Sentence (6-11b) can be analysed along the same lines. The result will be a rather complicated LF, whose elaboration I leave to the reader.

7. Bound variable tense and frame-setting temporal adverbs

Frame-setting adverbs like *today*, *yesterday* or *on Monday* provide some evidence that our analysis of "bound variable tense" as a bound variable is too simple. Presumably we have to choose the *relative present* instead.

Recall that the strongest principle defended in this paper is Abusch's constraint, i.e., the claim that there cannot be an absolute tense in a strong intensional context. One would like to deduce this principle from a more general principle such as:

(7-1) No direct reference in strong intensional contexts![8]

Direct reference is understood in the sense of Kaplan (1977) as covering deictics and bound individual variables. This rather sweeping claim is at variance with a huge amount of theoretic literature on deictics in intensional contexts, notably with what has been said on double indexing (e.g. Kamp 1971). Nevertheless, I guess that the principle is correct for the reason that we must know the essence of a thing in order to have it as a part of the content of an attitude (*vide*, e.g., Lewis 1979).

The principle entails that many standard analyses have to be revised. Consider for instance the following contrast noted in Klein (1994, p. 173).

(7-2) a. *Arnim seems to sleep yesterday
b. Arnim seems to have slept yesterday

If principle (7-1) were not valid, (7-2a) would be acceptable and express a proposition like: "In every world w and every time t which are compatible with everything which seems to be the case in the real world w_0 at the present time t_0, Arnim sleeps at w on the day before the day containing t_0". Klein's solution is that the matrix verb projects its evaluation time (his "topic time") into the embedded infinitival. Then the non-finite verb is evaluated at the present time and we obtain a conflict with the meaning of *yesterday*.

This rather obvious solution is not compatible with principle (7-1), and it contradicts the observation made in section 1 that there is no connection between the evaluation time of the matrix verb and the evaluation time of the embedded verb in an intensional context. We therefore have to find another explanation for the contrast. I would like to indicate a possible solution by discussing a somewhat different example involving the future which shows a similar contrast:

(7-3) a. *Three days ago Sue believed that she was sick today
b. Three days ago Sue believed that she would be sick today

Three days ago Sue said to herself: "In three days I will be sick". She did not have a particular day in mind because she did not even know which day it was. Nevertheless, we describe her attitude by means of (7-3b). Let us complicate things slightly: I uttered (7-3b) on Monday, and today is Tuesday. In this scenario, I can describe Sue's attitude by means of (7-4)(a) or (b):

(7-4) a. Four days ago Sue believed that she would be sick (*was sick) yesterday
b. Four days ago Sue believed that she would be sick (*was sick) on Monday

Thus, the *that*-clauses in (7-3b) and (7-4)(a) and (b) all describe Sue's content of belief: "In three days I will be sick". How could that be? None of the clauses contains the temporal description *in three days*. We find *today*, *yesterday* and *on Monday* instead. These are obviously *our* way of describing Sue's "in three days".

The only method I am aware of which can cope with these findings is a de re analysis: Sue believed of today/yesterday/Monday under the description "three days after the day at which I am" that she would be sick.

Thus, the relevant LF for (7-3b) is perhaps (7-3b_1), and the formula interpreting it is below:

(7-3) b_1. $PAST_{(2)1}$ Sue believe-of today
$\lambda 3 \lambda 0[t3\ \lambda 4 \exists 5[$Ø-PAST $WOLL_{(4)5}\ \lambda 0[INF_0$ she be sick$]]]$

$$PAST(t_0)(t_2)(t_1) \wedge believe-of_{w_0 t_1}\left(\begin{array}{l} Sue, today, \\ \lambda t_3 \lambda t_0 \lambda w_0 \exists t_5 \left[\begin{array}{l} WOLL(t_0)(t_3)(t_5) \\ \wedge\ sick_{w_0 t_5}(she) \end{array}\right] \end{array}\right)$$

The formula is true if there is a relation of acquaintance R which uniquely connects Sue in w_0 at t_0 with today and Sue believes of being R-related to a unique time at which she will be sick. In this particular case, R is the function "three days after the time at which I am", i.e., R(t) is the third day after the day containing t. In the scenario assumed for (7-3b1), $R(g(t_1)) = \|today\|$, because $\|today\|$ is the third day after the day containing $g(t_1)$. Let us abbreviate R(t) as "3rd-after(t)". Then the content of belief can be represented by the formula:

(7-3) b2. $\lambda t_0 \lambda w_0 \exists t_5 \begin{bmatrix} WOLL(t_0)(3rd - after(t_0))(t_5) \\ \wedge\ sick_{w_0 t_5}(she) \end{bmatrix}$

The formula expresses the property of being sick on the third day after the subjective now. This is the correct result.[9]

Next, let us turn to sentence (7-3a). Here we have the problem that we don't know what the LF should be because the frame-setter *today* has to bind a frame variable, but there is none if we interpret the bound PAST as a bound variable *simpliciter*. The assumption that the temporal abstract applies to the frame-setter in this case does not help either, because we obtain a consistent content of belief in such a case. Thus, if we assumed that (7-3a) had the LF (7-3a1), the content of belief would be (7-3a2):

(7-3) a1. PAST(2)1 Sue believe-of today λ3λ0[t3 λ0[Ø-PAST she be sick]]
a2. $\lambda t_0 \lambda w_0 \left[sick_{w_0\, 3rd - after(t_0)}(she) \right]$

The only way out of the dilemma which I can imagine is to say that bound variable tense expresses a *bound relative present* (cf. von Stechow 1991). If this is correct, the proper LF for (7-3a) is (7-3a3), where Ø-PAST(4)5 is interpreted as if it were PRES(4)5.

(7-3) a3. PAST(2)1 Sue believe-of today λ3λ0[t3 λ4∃5[Ø-PAST(4)5 she be sick]]

If we evaluate the formula translating this LF with respect to the aforementioned function R, we obtain:

(7-3) a4. $\begin{bmatrix} t_1 = MAX_t[t < t_0 \wedge t \subseteq t_2] \\ \wedge\ believe_{w_0 t_1} \begin{pmatrix} Sue, \\ \lambda t_0 \lambda w_0 \exists t_5 \begin{bmatrix} t_5 = MAX_t(t\ o\ t_0 \wedge t \subseteq 3rd - after(t_0)) \\ \wedge\ sick_{w_0 t_5}(she) \end{bmatrix} \end{pmatrix} \end{bmatrix}$

Clearly the restriction for the bound present $t\ o\ t_0 \wedge t \subseteq 3rd - after(t_0)$ is inconsistent, and this explains the oddness of the example.

We could use the notation PRES(4)5 instead of Ø-PAST(4)5 if we wanted. This might, however, give the wrong impression that this bound relative present is the translation of a surface present. This is not so. A surface present in that position cannot be interpreted as a bound relative present. My notation is reminiscent of this somewhat paradoxical situation, which is typical for English.

It follows that we have to replace all the occurrences of bound variable tense by the more complicated symbol expressing bound relative present. For instance, the revised LF for (7-3b) is:

(7-3) b3. PAST(2)1 Sue believe-of today

$\lambda_3\lambda_0$[t3 $\lambda_4\exists_5\exists_6$[Ø-PAST(0)5 WOLL(4)6 λ_0[INF0 she be sick]]]

To convince yourself that this gives us the same result as before, consider the translation of $\lambda_0\exists_5$[Ø-PAST(0)5...]. It is $\lambda t_0 \lambda w_0 \exists t_5 \left[t_5 = MAX_t \left(t \; o \; t_0 \wedge t \subseteq t_0 \right) ... \right]$. This is equivalent to $\lambda t_0 \lambda w_0 [... t_0 ...]$. Thus, this version of bound present encodes the bound variable reading.

Finally, let us return to Klein's examples (7-2). We can get the contrast only if we assume that the embedded infinitival contains a relative present. The most natural place for the localization of this information is presumably the INFL-node *to*. Thus, an LF for the unacceptable (7-2a) is:

(7-2) a1. PRES(2)1 seem-of yesterday

$\lambda_3\lambda_0$[t3 $\lambda_4\exists_5$[to-PRES(4)5 Arnim sleep]]

Let us assume that the relation of acquaintance for the impersonal attitude "seem" is "the day which is before the day of the utterance". We abbreviate this as "1st before(t_0)". Then PRES(4)5 expresses the information $t_5 = MAX_t \left[t \; o \; t_0 \wedge t \subseteq 1st - before(t_0) \right]$. This is inconsistent and therefore explains the oddness of (7-2a).

Endnotes

[1]For a recent discussion of the merits and problematic aspects of Enç's theory, *vide* Zeller (1994, 3.3).

[2]As far as I know, examples of this kind were first noted by Lee Baker. In Baker (1989/95), chapter 17, we find the example (76a) *Phyllis wanted to tell Arthur that [John <u>didn't</u> think that he <u>would</u> ever find out whether anyone <u>knew</u> when his baggage <u>would</u> arrive]*. The rule which accounts for the "unexpected" dependent past forms is the Past Harmony Rule on page 546 of the second edition. Ogihara's Tense Deletion may be regarded as a formalization of this rule.

[3]Dowty (1982) discusses the structurally identical *John <u>will</u> find a unicorn that <u>is</u> walking*.

[4]Ogihara interprets Ø-tense as the relative present , which is the identical function in his system. This has the effect that a statement of the form $\exists$t[PRES(t) & AT(t, α)] means the same as the tenseless statement α.

[5]Note, incidentally, that the formulas show that the English surface syntax is idiosyncratic here. *Ought* should be embedded under *have*, as it is in German or Italian. Thus, this construction cannot be interpreted compositionally.

[6]For a careful exegesis of Stowell's work, *vide* Zeller (1994).

[7]Stowell's LF is actually more complicated, namely something like: *H_0 e_0 Mary be pregnant [$\exists e_i$ PRO_0 PAST e_i Bill believe [H_i e_i Mary be pregnant]]*. From what I have understood this can be paraphrased as "At the present time e_0 we have a state

of Mary's pregnancy and there is an event/state e_i which is before e_0 which is a belief of Bill that a state of Mary's pregnancy holds at the time of e_i".

[8]There are several passages in Abusch (1993) which suggest that she has this generalization in mind.

[9]To my mind, this and the related examples show that Abusch's (1993) claim that one cannot be acquainted with a future time for epistemological reasons cannot be correct.

References

Abusch, D. (1993). “Sequence of Tense Revisited: Two Semantic Accounts of Tense in Intensional Contexts.” Manuscript.

Baker, C. L. (1989/95). English Syntax. Cambridge, Massachusetts, MIT Press.

Bäuerle, R. (1979). Temporale Deixis – Temporale Frage. Tübingen, Narr.

Dowty, D. (1979). Word Meaning and Montague Grammar. Dordrecht, Reidel.

Dowty, D. (1982). “Tenses, Time Adverbs, and Compositional Semantic Theory.” Linguistics and Philosophy **5**: 23-55.

Enç, M. (1987). “Anchoring Conditions for Tense.” Linguistic Inquiry **18**: 633-657.

Gallin, D. (1975). Intensional and Higher-Order Modal Logic. Amsterdam, North-Holland.

Heim, I. (1994). “Comments on Abusch's Theory of Tense.” Manuscript, MIT.

Kamp, H. (1971). “Formal Properties of "now".” Theoria **37**: 227-273.

Kaplan, D. (1977). Demonstratives. An Essay on the Semantics, Logic, Metaphysics, and Epistemology of Demonstratives and Other Indexicals. University of California, Los Angeles, Ms.

Klein, W. (1994). Time in Language. London and New York, Routledge.

Kratzer, A. (1978). Semantik der Rede. Kontexttheorie - Modale - Konditionale. Kronberg/Ts., Scriptor.

Kühner, R. & Stegmann, C. (1982). Ausführliche Grammatik der Lateinischen Sprache. Zweiter Teil: Satzlehre. Darmstadt, Wissenschaftliche Buchgemeinschaft.

Lewis, D. (1973). Counterfactuals. Cambridge, Massachusetts, Harvard University Press.

Lewis, D. (1979). “Attitudes De Dicto and De Se.” The Philosophical Review **88**: 13-43.

Montague, R. (1974). Formal Philosophy. Selected Papers of Richard Montague. New Haven/London, Yale University Press.

Musan, R. (1994). "Temporal Interpretation of NPs. Chapter IV: On PPs as NP-internal Temporal Modifiers". Manuscript, MIT.

Ogihara, T. (1989). Temporal Reference in English and Japanese. PhD dissertation. University of Texas, Austin.

Partee, B. (1973). “Some Analogies between Tenses and Pronouns in English.” Journal of Philosophy **70**: 601-609.

Prior, A. (1967). Past, Present, and Future. Oxford, Oxford University Press.

Reichenbach, H. (1947). Elements of Symbolic Logic. Berkeley, University of California Press.

Smith, C. (1978). “The Syntax and Interpretation of Temporal Expressions in English.” Linguistics and Philosophy **2.1**: 43-100.

Stechow, A. v. (1991). "Intensionale Semantik - eingeführt anhand der Temporalität." Universität Konstanz. Arbeitspapiere der Fachgruppe Sprachwissenschaft.

Stechow, A. v. (1994). Tense in Intensional Context. Semantics in Natural Language, Blaubeuren, Seminar für Sprachwissenschaft, Universität Tübingen.

Stowell, T. (1993). “Syntax of Tense.” Manuscript, MIT.

Zeller, J. (1994). Die Syntax des Tempus. Opladen, Westdeutscher Verlag.

[1]For a recent discussion of the merits and problematic aspects of Enç's theory, *vide* Zeller (1994, 3.3).

[2]As far as I know, examples of this kind have been noted first by Lee Baker. In Baker (1989/95), chapter 17, we find the example (76a) *Phillys wanted to tell Arthur that [John <u>didn't</u> think that he <u>would</u> ever find out whether anyone <u>knew</u> when his baggage <u>would</u> arrive]*. The rule which accounts for the "unexpected" dependent past forms is the Past Harmony Rule on page 546 of the second edition. Ogihara's Tense Deletion may be regarded as a formalization of the rule.

[3]Dowty (1982) discusses the structurally identical *John <u>will</u> find a unicorn that <u>is</u> walking*.

[4]Ogihara interprets Ø-tense as the relative present , which is the identical function in his system. This has the effect that a statement of the form $\exists$t[PRES(t) & AT(t, α)] means the same as the tenseless statement α. Our translation obtains exactly the same effect.

[5]Note incidentally that the formulas show that the English surface syntax is idiosyncratic here. *Ought* should be embedded under *have*, as it is in German or Italian. Thus, this construction cannot be interpreted compositionally.

[6] For a careful exegesis of Stowell's work, *vide* Zeller (1994).

[7]Stowell's LF is actually more complicated, namely something like: *H_0 e_0 Mary be pregnant [$\exists e_i$ PRO_0 PAST e_i Bill believe [H_i e_i Mary be pregnant]]*.. From what I have understood this can be paraphrased as "At the present time e_0 we have a state of Mary's pregnancy and there is an event/stade e_i which is before e_0 which is a belief of Bill that a state of Mary's pregnancy holds at the time of e_i."

[8] There are several passages in Abusch (1993) which suggest that she has this generalization in mind.

[9] To my mind, this and the related examples show that Abusch's (1993) that one cannot be acquainted with a future time for epistological easons cannot be correct.