Sequence of Tense Revisited: Two Semantic Accounts of Tense in Intensional Contexts

Dorit Abusch

1. Introduction

In this paper I offer two theories of tense in intensional contexts, an extensional and an intensional one. The extensional theory, which I call the Independent Theory, maintains that tense has the same meaning in extensional and intensional contexts, so nothing special has to be said about the semantics of tense in embedded sentences. In section 2-4 I show how the independent theory analyzes past tense embedded under past tense attitude verbs, focusing on the interaction between the semantics of attitude and of tense. The independent theory embraces three simple assumptions: (i) All tenses are evaluated relative to the utterance time whether embedded or not; (ii) tenses (like pronouns) are referential expressions which can be anaphoric; and (iii) tenses (like NPs) can be interpreted de re, with a semantics as proposed by Lewis (1979) and Cresswell/von Stechow (1982). This account of embedded tense is attractive since we do not have to say anything special describing the behaviour of tense in intensional contexts: it follows simply from the semantics of tense and the semantics of attitudes.

However, data I present in section 6 indicate that the independent theory is not general enough. This motivates a semantically oriented sequence of tense (SQT) analysis in which tense is sensitive to intensional contexts. In section 10 I claim SQT cannot be described in purely syntactic terms, showing that (i) it is sensitive to the logical scope of operators; (ii) it is triggered by understood but not syntactically overt temporal parameters; and (iii) it is relevant only when tense is embedded in intensional contexts. In the intensional SQT-like mechanism which I propose past tense simultaneously constrains local and embedding temporal relations. The effect of this is that a SQT-past tense is never semantically empty.

The second set of data the independent theory cannot handle is the lack of the 'forward shifted reading' of past tense embedded under past tense intensional verbs. I attribute the absence of this reading to a constraint related to a branching future concept of modal temporal space. The upper limit constraint which I introduce is independently motivated by data having to do with the temporal perspective of modals such as might. These issues are discussed in sections 7-9.

In section 11, I examine present tense embedded in intensional past tense sentences, which has been described as having a double access reading. I show that this reading is predicted by the SQT mechanism which I introduced earlier, together with de re theory

and the upper limit constraint. In the last section I compare my intensional theory of SQT with Stowell's recent syntactic account of the data, pointing to where our views converge and where they diverge.

2. The Independent Theory of Embedded Tenses

Configurations involving a simple past tense verb embedded under a simple past attitude verb (past under past sentences) are ambiguous between a simultaneous reading for the past tenses, and a shifted backward reading. A good example of the latter is (1).

(1) The defendant Pst_2 was actually at home watching 'The Simpsons' at the time of the $crime_2$. But after hearing the testimony of the first eye-witness, the jurors clearly Pst_3 believed that he Pst_2 was in the laboratory building.

The terminology 'shifted backward reading' corresponds to the fact that the reference of the embedded past tense Pst_2 in the second sentence strictly precedes the time of the embedding verb believed. This yields a reading in which the time of the defendant being in the laboratory is prior to the jurors' believing time. As suggested by the indexing in (1), I think an account of this reading should assume a grammatical representation in which the embedded tense is anaphoric to the time introduced in the first sentence.[1] Since the time of the crime is prior to the jurors' believing time, the time of being in the laboratory, which is co-temporal with it, must also precede the believing time.
The other reading is the simultaneous one represented below:

(2) Mary Pst_2 believed it Pst_2 was raining.

In (2) the embedded past tense of was raining is anaphoric to the matrix past tense of believed. This results in a simultaneous reading where the raining is co-temporal with the believing.[2] The above two examples indicate that embedded tenses can be anaphoric to the matrix tense (as in (2) with the simultaneous reading) or to a tense in a pervious discourse (as in (1) with the backward shifted reading).

Such examples suggest an 'Independent Theory' of embedded tenses. The only restriction the independent theory puts on a past tense verb is that it should be evaluated at a time prior to the speech time, independently of whether it is in an embedded position or not.[3] The denotation of an embedded tense is therefore independent of syntactic configurations, in particular, of its embedding context. Obviously, this view differs from the notion that tenses are nested operators evaluated from embedded positions and up.

Another component of the independent theory is treating tenses as referential expressions with the potential of anaphoric readings, an idea originally developed in Partee (1973).

Assuming the above, the backward shifted and the simultaneous readings are predicted by the independent theory: in both (1) and (2) the embedded past tense is prior to the utterance time. And while in (2) it is anaphoric to its matrix tense, in (1) it is anaphoric to a tense in a previous sentence.

However, example (3) seems problematic for the independent theory:

(3) John Pst_1 found an ostrich in his apartment yesterday. Just before he Pst_2 opened the door, he Pst_3 thought that a burglar Pst_2 attacked him.

According to the independent theory, the embedded tense Pst_2, which denotes the time of the attack, may be co-indexed and as a consequence be anaphoric to the past tense in the previous sentence denoting the time of opening the door. Given this, John's original thought must have been:

(4) When I Tns_2 open the door, a burglar will $attack_2$ me.

Now, since the opening of the door is later than John's thinking, the burglar's attack (which is co-temporal with the opening) must also be later than the thinking. But the past under past sentence in (3), repeated below, lacks this 'forward shifted reading' in which the attack is later than the thinking:

(5) He Pst_3 thought that a burglar Pst_2 attacked him.

This seems to be a counterexample to the independent theory: the times denoted by both past tenses in (3) precedes the speech time, and the embedded past tense on <u>attacked</u> is anaphoric to the past tense on <u>opened</u> in the previous sentence. Nevertheless, the past under past sentence in (3) lacks the forward shifted reading.

Notice that the forward shifted reading in (3) can be derived by the independent theory with <u>would</u> in the embedded clause:

(6) John Pst_1 found an ostrich in his apartment yesterday. Just before he Pst_2 opened the door, he Pst_3 thought that a burglar Pst_3 would attack him.

The temporal relations in (6) are diagrammed in (6´):

(6´) -------|---------------------|------
think / will — open / attack

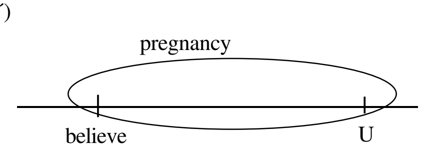
In (6), Pst_3 on <u>would</u> is anaphoric to Pst_3 on <u>thought</u> and they co-refer. The semantics of the future operator <u>will</u> requires the attack to be later than the reference of <u>will</u>, resulting in the attack being later than the thinking. Since the opening of the door is also later than the thinking, the attack may be co-temporal with the opening.

The forward shifted reading is also absent in examples of present tense embedded under past tense (present under past sentences):

(7) John believed that Mary is pregnant.

In (7) the pregnancy must include both the utterance time (U) and John's believing time, as illustrated below:

(7´)



In section (11) I will discuss in detail the semantics of present under past sentences. At this stage I only want to point at the parallelism with (3): the embedded present tense in (7) cannot be interpreted as later than the believing time, just like the embedded past tense in (3). In other words, present under past sentences, like past under past ones, cannot have the forward shifted reading.

3. <u>De Re Belief</u>

We saw that in examples (1)-(2) the tense in the belief context is anaphoric to a tense in an extensional position. So I have to say something about the interpretation of temporal anaphora into belief contexts. In fact, the problem is more general and concerns any pronominal element. Notice for instance that the pronoun <u>him</u> in the embedded sentence of (3) refers to <u>John</u>, which is outside the intensional context.

The issue of the interpretation of NPs in belief contexts was raised by Quine's Ortcutt example (1956; p. 185). Quine's example is of Ralph who believes of Ortcutt that he is a spy. In Quine's story Ralph has glimpsed Ortcutt in a brown hat and believes that the man glimpsed by him is a spy. On another occasion he glimpsed Ortcutt in a gray hat and believes that the man he has so glimpsed is not a spy. If the object of the belief is a proposition (a set of worlds), then Ralph must be accused of having contradictory beliefs, since the proposition that Ortcutt is a spy is logically incompatible with the proposition that Ortcutt is not a spy. But intuitively we do not ascribe contradictory beliefs to Ralph. Since Ralph may consistently believe that Ortcutt is a spy and that Ortcutt is not a spy, a theory of belief must be provided to account for such intuitions.

Two basic notions in Lewis' theory of de re attitudes give the right results for the Ortcutt story. The first is that of a centered world and the second of an acquaintance relation. A centered world (Quine 1969) is a pair of a world and a designated space-time point. According to Lewis, centered worlds are pairs of a world and a designated inhabitant.

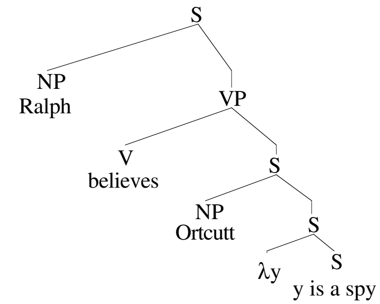
Once the notion of a centered world is introduced the object of the attitude is no longer a proposition (set of worlds), but rather a set of centered worlds. This is equivalent to a property of an individual. One example Lewis gives for preferring sets of centered worlds to propositions as objects of attitudes is the case of mad Heimson who falsely believes himself to be David Hume.[4] If the object of Heimson's belief is a proposition, the believed proposition is the empty one. This is so since there is no possible world where Heimson is Hume. The empty proposition is unfit to be believed.[5] Nevertheless, Heimson believes that he is Hume and this is so since Heimson self-ascribes the property of being Hume. Heimson and Hume have the same believed object – the property of being Hume. But Hume self-ascribes this property correctly, while Heimson, who believes just what Hume does, self-ascribes the very same property wrongly.

When we have a de re belief, the res must be presented to us in a certain way (see Kaplan 1969). Lewis names this a relation of acquaintance: 'I and the one of whom I have beliefs de re are so related that there is an extensive causal dependence of my state upon him'. In the Ortcutt example, Ortcutt was presented to Ralph first by being glimpsed in a gray hat. Following Lewis, I will call this relation which puts a person a in a cognitive contact with a res b in a world w 'the acquaintance relation'. As we said before, the notions of a centered world and an acquaintance relation play a central role in the semantics of belief sentences. We will now see how the puzzle of Ralph having consistent beliefs is resolved. Assume that (8)

(8) Ralph believes that Ortcutt is a spy.

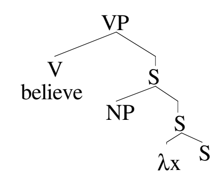
is represented by (8´), where the NP being interpreted de re has been scoped out of the complement S as suggested by Cresswell and von Stechow (1982):[6]

(8´)



To interpret (8) we must give VP's like that in (8´) a denotation. We will make use of Lewis' notion of an acquaintance relation and a centered world (which were primarily designed to take care of NP's interpreted de re in belief contexts) and incorporate into them a temporal component. This is somewhat relevant for the Quine's example and is crucial for the interpretation of tense in belief contexts. A centered world will now be a tuple of an individual (which we think of as a self), a time (which we think of as the self's now) and a world. We give the denotation of the VP in (8´´) in the semantic interpretive rule (9):

(8´´)



(9) Semantic rule for believe:

Where the abstract $\lambda x S$ denotes P, NP denotes y', and w_0 is the base world, the VP in (8´´) denotes the set of individuals $z_{subject}$ such that:

(i) $z_{subject}$ stands in the belief relation to the set of centered worlds $\{<x_{self}, t_{now}, w>|$ there is a unique individual y such that $R(x_{self}, t_{now}, y)$, and for that y $P(t_{now}, w, y)\}$.

(ii) in w_0, $z_{subject}$ bears the relation R to y'.

The definition is relative to a given acquaintance relation R.

We add to the Ortcutt story the temporal specification that Ralph glimpsed Ortcutt on the first occasion at a time separated by two days from now. The acquaintance relation must therefore be:

(10) R_1: $\lambda x_{self}\, \lambda t_{now}\, \lambda b$ [x_{self} glimpsed b in a brown hat two days before t_{now}].

Condition (9i) is satisfied by virtue of what we take the belief relation to be: in each of Ralph's centered belief worlds $<x_{self}, t_{now}, w>$ there is a unique person that x_{self} glimpsed in a brown hat two days before t_{now}, and furthermore that person is a spy in w. This is how we model Ralph's belief that the guy in the brown hat is a spy, using Lewis' de re theory. Condition (9ii) is satisfied since Ralph ($z_{subject}$) really did see Ortcutt (the referent of the NP) in a brown hat two days before now (the believing time), so in the base world w_0 Ralph is related to Ortcutt by R_1. Sentence (11) is also true, given a different acquaintance relation:

(11) Ralph believes that Ortcutt is not a spy.

We assume that Ralph glimpsed Ortcutt in the second occasion in a gray hat five hours before now. The acquaintance relation R_2 is therefore:

(12) R_2: $\lambda x_{self}\, \lambda t_{now}\, \lambda b$[$x_{self}$ glimpsed b in a gray hat five hours before t_{now}].

The first condition is satisfied: each of Ralph's centered belief worlds $<x_{self}, t_{now}, w>$ is such that there is a unique person that x_{self} saw in a gray hat five hours before t_{now}, and furthermore that person is not a spy in w. This is how we model Ralph's believing that the guy in the gray hat is not a spy. Condition (9ii) is also satisfied: Ralph is related to

Ortcutt by R_2 in w_0 since Ralph did see Ortcutt in the gray hat five hours before now. Thus equipped with a semantics of de re belief, we can analyze the reports about Ralph's beliefs as described in (8) and (11) as consistent.

4. Anaphora across Attitude Contexts

The role of the acquaintance relation is quite general. Specifically, it is required whenever we have anaphora into a belief context. Actually we can simplify Quine's story dropping mistaken beliefs:

(13) Yesterday, Ralph_1 saw a man at the beach_2 . He_1 believes he_2 is a spy.

The pronoun he_2 in the belief context is anaphoric to a man at the beach_2 outside it. As a consequence of the anaphoric relation the proposition denoted by the syntactic complement of believe is a singular proposition about the person who was actually at the beach. It is implausible to say that this is the actual proposition believed by Ralph because Ralph presumably does not have complete knowledge about the person who was actually at the beach yesterday (c.f. Lewis' 1979 section XIII). In Ralph's centered belief worlds the person who is a spy is the person the self glimpsed. In some cases, this might be the actual man at the beach, in other cases not. This motivates introducing an acquaintance relation as in the more complicated example of Quine.

As in Lewis' account of the Ortcutt example, I maintain the pronoun he_2 in the reported belief is used de re. The acquaintance relation suggested by the first sentence in (13) is:

(14) R_3: $\lambda x_{self}\, \lambda t_{now}\, \lambda y$[$x_{self}$ glimpsed y on the beach one day before t_{now}].

Given the semantics of belief we saw before, in each of Ralph's centered belief worlds w there is a unique y such that Ralph glimpsed y one day before t_{now}, and y is a spy in w. Furthermore, in the real world Ralph bears the acquaintance relation R_3 to the reference of he_2, namely to the actual man who was yesterday on the beach.[7] We see that when he_2 is used de re, it takes its denotation in the real world, and the entity in the belief world which is required to be a spy is not necessarily the same entity. Rather it is picked out by an acquaintance relation. Thus a theory of de re interpretation solves the problems with modeling belief created by a theory of anaphora.

Sentence (1) repeated below is a similar example with tenses:

(1) The defendant Pst_2 was actually at home watching 'The Simpsons' at the time of the crime$_2$. But after hearing the testimony of the first eye-witness, the jurors clearly Pst_3 believed that he Pst_2 was in the laboratory building.

The acquaintance relation in (1) is a causal one. The jurors are acquainted with the events which constitute the crime only indirectly, through the evidence of the witness who actually saw them. The acquaintance relation is causal since certain events caused the witness to describe them, and this description caused the jurors to maintain certain beliefs about the time of the crime. The acquaintance relation is described below:

(15) R_4: $\lambda x_{self}\, \lambda t_{now}\, \lambda w \lambda t$: [t is the unique time when the eye witness (who x_{self} heard testify in w shortly before t_{now}) experienced such-and such events, and $t<t_{now}$].

In line with the independent theory of tense, the embedded Pst_2 on <u>was</u> can be co-indexed with the time of the crime and thus be interpreted as co-temporal with it. But the jurors might not be able to pick out the time of the crime absolutely correctly. In each of their belief worlds there is a time at which the crime occurs. How is it that this time can be co-temporal with the time of the crime, as indicated by the co-indexing?

Just like in example (13) with the pronominal anaphora, I claim that de re belief theory gives the right interpretation to the embedded sentence in (1). When the embedded Pst_2 in (1) is interpreted de re, it denotes the time at which the crime occurred in the real world. But this time does not figure directly in the condition on the centered belief worlds of the jurors. Rather, its place is taken by a time picked out by the relation (15).

We see that the thesis that tenses are anaphoric together with de re belief theory gives the correct interpretation for the pronominal and temporal examples (1) and (13). I want to generalize this thesis and claim that whenever we have anaphora across attitude contexts, de re interpretation of the anaphoric element is forced. Applying this principle to tenses, it amounts to saying that whenever a tense is embedded in an intensional position, and is anaphoric to some other element in extensional position, it must be interpreted de re.

So far we saw that anaphora together with de re belief accounts for the backward shifted reading of past under past sentences as in (1). What about the simultaneous reading of past under past? The thesis that anaphoric tenses embedded under intensional contexts are interpreted de re not only takes care of the simultaneous reading of past under

past sentences, but does so with no further stipulations about this particular construction. As I have already said in section 2, the sentence

(2) Mary Pst_2 believed that it Pst_2 was raining.

has the simultaneous reading in which Mary believed at some past time that it was raining at that time. Assuming past tense is a semantic operator shifting evaluation time, the simultaneous reading of (2) should obtain only with present tense complements. This is so since the present tense rule introduces a time overlapping the evaluation time which in (2) is introduced by the higher past verb. To obtain the simultaneous reading for (2), SQT-theory assumes the existence of a morphological SQT-rule responsible for the shift of present tense morphology into past tense in the complements of matrix clauses which have past tense morphology.

However, with de re theory at hand we can account for the simultaneous reading without a SQT-rule. In line with the independent theory, Pst_2 of the embedded <u>was</u> can be anaphoric to the tense on <u>believed</u>. With such an anaphoric relation, we must assume a de re interpretation of the anaphoric element. What is the acquaintance relation in this case? It is simply identity with the now of the believer. This means that in all of Mary's belief worlds the time of the raining is co-temporal with her now. Since we can be acquainted with current times, R_5 is a suitable acquaintance relation.[8]

(16) R_5: $\lambda x_{self}\, \lambda t_{now}\, \lambda t[t = t_{now}]$

Applying the semantics of de re belief to (2), we get the following:

(17) (i) In each of $z_{subject's}$ centered belief worlds $<x_{self}, t_{now}, w>$ there is a unique t standing in the relation R to $<x_{self}, t_{now}, w>$, and in each case it rains at that time t in w.

(ii) In w_0, $z_{subject}$ at the believing time bears the relation R to the reference of Pst_2.

Condition (17i) is satisfied since in all of Mary's centered belief worlds w there is a unique time t identical to t_{now}, and in each case it is raining in w at t. Condition (17ii) is also satisfied since at the believing time Mary bears the acquaintance relation to the reference of Pst_2 in the base world. This is so since the acquaintance relation is temporal identity, and the reference of Pst_2 is the believing time.

Notice how this analysis explains what the past tense is doing on the embedded verb. Once it is interpreted de re, it is in an extensional position and the past tense has the straightforward interpretation of precedence to the speech time in the base world. Notice also that our grammatical analysis of the simultaneous reading and the shifted backward reading are really the same. The difference amounts just to a different choice of antecedent for the embedded past tense. This looks like an optimal solution.

The second sentence of (3) repeated below also involves temporal anaphora outside an attitude context. Since Pst_2 on attacked is anaphoric to Pst_2 on opened, which is in an extensional position, the former must be interpreted de re:

(3) John Pst_1 found an ostrich in his apartment yesterday. Just before he Pst_2 opened the door, he Pst_3 thought that a burglar Pst_2 attacked him.

But we already saw that the time of the attack cannot be interpreted as later than the time of the thinking (although the opening of the door is later than the thinking). How does our thesis that anaphoric tenses in attitude contexts are interpreted de re explain the lack of the forward shifted reading in (3)?

The acquaintance relation in (3) is to a time later than John's now, at which he has just opened the door:

(18) R_6: $\lambda x_{self}\, \lambda t_{now}\, \lambda t$[t is a time slightly after t_{now} at which x_{self} has just opened the door]

Applying the semantics of de re belief to (3) results in:

(19) (i) In each of John centered belief worlds (relative to w_0 and John's believing time), there is a unique time t which stands in the relation R to $<x_{self}, t_{now}, w>$ and at that time t in w, x_{self} is attacked by a burglar.
(ii) In w_0, $z_{subject}$ at the believing time bears the relation R to the reference of Pst_2.

The first condition is satisfied since in all of John's belief worlds there is a unique time in the future at which John opens the door and at that time he is attacked. Condition (19ii) is also satisfied since in w_0 John at the believing time bears R to the reference of Pst_2 which is the time of opening the door.

Since the above conditions are satisfied, the problem might lie in the acquaintance relation R_6. The acquaintance relations R_4 and R_5 involved in the interpretation of the

backward shifted and simultaneous readings of (1)-(2) are a perceptual relation and a causal relation to some time in the present or in the past. The acquaintance relation R_6 involved in the interpretation of the forward shifted reading in (3) introduces a future time: the opening of the door is later than the believer's now. But neither does the believer perceive this time, nor does he stand in a causal relation to it. This is perhaps why (3) is ruled out – the acquaintance relation involved is simply an unsuitable one.

A parallel example can be provided with pronouns. A lottery has been held. Mary believes that whoever the winner is, that person is happy. In the actual world Bill is the winner. Given these circumstances, we can not report Mary's belief with (20), claiming Bill is used de re:

(20) Mary believes that Bill is happy.

The acquaintance relation R_7 involved in this story is to some y who is the winner in Mary's belief worlds.

(21) R_7: $\lambda x_{self}\, \lambda t_{now}\, \lambda t\, \lambda w$[y is a winner in w at t]

Just like R_6, R_7 does not seem to be a suitable acquaintance relation. Recall that R_1, R_2 and R_3 all involve a perceptual relation of glimpsing which holds between the believer and some y on the beach. But acquaintance relations need not be perceptual. They can be causal or may involve other direct or indirect contacts between the believer and his object of belief (cf. Lewis 1979). However, R_6 and R_7 do not involve such contacts. This is perhaps why de re interpretation of the past tense on was in (3) and Bill in (20) is impossible.

I just said that the forward shifted reading in (3) is not available because R_6 is not a suitable acquaintance relation. However, (22) seems to be a counterexample to my hypothesis:

(22) John Pst_1 found an Ostrich in his apartment yesterday.
Just before he Pst_3 opened the door, he Pst_2 thought that a burglar Pst_2 would attack him $then_3$.

The example has a reading where the attack is later than the thinking. The time adverbial $then_3$ is anaphoric to Pst_3, whose reference is the time of opening the door. Since $then_3$ is in an intensional position, it must be interpreted de re. But the acquaintance relation associated with then is presumably R_6. This is inconsistent with my claim that the forward shifted reading in (3) is missing due to the fact that R_6 is not a suitable acquaintance relation.

Notice that in (22) not only then but also the tense on would is interpreted de re.[9] I already examined a configuration with would embedded under past tense. The tense on would is identified with the thinking time, and then, which modifies attack, is anaphorically identified with the opening time.

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(22´)   ------|--------------------|-----
             think                 then
              will                 open
                                   attack
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A similar counterexample is available with pronouns. A pronoun in an attitude context can be co-referential with an NP outside it, in spite of the unsuitable acquaintance relation R_7. The new situation is as follows: Mary does not know who the winner in the lottery is, but thinks that whoever he is, he is a regular guy. Mary's thought is described in (23):

(23) The winner is a regular guy.

We can describe her belief with (24):

(24) Before she found out who the winner was, she thought he was a regular guy. In fact, he was Bill, an employee of the State Lottery.

Again, a proper name cannot be used de re in this situation:

(25) Before she found out who the winner was, she thought Bill was a regular guy.

The same contrast we just saw between he and Bill also exists for then and in August. Here is the temporal analogy. Mary thinks: 'I will be home whenever John comes'. In the real world John comes home in August. Given this, while then in (26) can be interpreted as co-temporal with the time of John's coming home, the same sentence with in August does not have this interpretation.

(26) Before she found out when John was coming, she was sure she would be at home then/ in August.

To summarize this section, I said pronominal elements in intensional positions are interpreted de re when anaphoric to antecedents in extensional positions. I claimed this thesis accounts for the interpretation of tenses in embedded contexts. I also said that when a suitable acquaintance relation is missing, de re interpretation of the anaphoric element is impossible. So when was in (1) and Bill in (20) and (25) cannot be used de re, the lack of the forward shifted reading is predicted. I would have concluded at this point if not the counterexamples (22) and (24): in the same examples where I claimed there is no suitable acquaintance relation, he and then may relate to elements outside the belief context. This is puzzling.

5. Pronouns Interpreted de dicto

My hypothesis that anaphoric tenses in attitude contexts are interpreted de re assumes an analysis of these elements as individual variables. More specifically, I would give tenses a DRT-style analysis with all the assumptions which follow from this framework. While DRT theory treats anaphoric elements (not c-commanded by their antecedent) as donkey-bound variables, the E-type analysis of pronouns views them as semantically equivalent to definite descriptions. Some representatives of the E-type approaches are Cooper (1979), Evans (1980) and Heim (1990). In (27), for instance, the antecedent is not definite and does not have scope over the pronoun:

(27) Mary has a cat. It is in the kitchen.

According to Heim's version of E-type theory (Heim 1990), which I state here quite informally, it in (27) is semantically a definite description obtained by copying the antecedent NP and its scope. As a result, it is replaced by the definite description 'the cat that Mary has'. Constructing the definite description in logical form yields something like:

(28) Mary has a cat. The cat that Mary has is in the kitchen.

When the antecedent of the pronoun is a definite (a name, a definite description, a pronoun), the pronoun is simply replaced by a copy of the antecedent. Evans names a pronoun obtained in this way a 'pronoun of laziness'. Pronouns c-commanded by their antecedents are treated by both E-type and DRT theories as bound variables.

How is the analysis of pronouns as definite descriptions related to the temporal data we have encountered? We saw in the previous section that then in (22) and he in (24) can be anaphoric to elements outside belief in spite of the lack of a suitable acquaintance relation. This puzzling behaviour is resolved once we assume that then and he in these examples are pronouns of laziness interpreted de dicto. When we substitute the definite description for the pronoun, we can account for its anaphoric reading without de re theory. To make this more explicit, I repeat the temporal example below:

(29) Just before he Pst_3 opened the door, he Pst_2 thought that a burglar Pst_2 would attack him $then_3$.

The antecedent for then is supplied by the before-clause, roughly as follows:

(30) Just before he Pst_3 opened the door, he Pst_2 thought that a burglar Pst_2 would attack him at the time when he opened the door.

Here I assume the complement of before is a definite description equivalent to the time when he opened the door. What I suggest here is that the time adverbial then may get a different interpretation from that of anaphoric tenses. While tenses in attitude contexts anaphoric to tenses in extensional positions are always variables interpreted de re, in the same configurations time adverbials like then may be pronouns of laziness interpreted de dicto. This new hypothesis resolves the difficulty raised by (22), leaving my original proposal for the interpretation of anaphoric tenses in belief contexts intact.

What is the impact of this hypothesis on the interpretation of the embedded tenses in the examples we saw? The past tense in the backward shifted reading is a variable interpreted de re. The same is true for the simultaneous reading where the past tense is in the scope of the antecedent. Finally, my hypothesis that the anaphoric past tense is a variable interpreted de re is consistent with the lack of the forward shifted reading in example (22). Since a variable does not provide a description, we need the relation supplied by the acquaintance relation in order to substitute an individual for the variable. The forward shifted reading for the past tense is blocked, because forward-oriented relations are not the right kind of relations.

Notice that the property in the definite description content of an E-type pronoun is somehow similar to the acquaintance relation provided by R. As a consequence the believed proposition (or rather, property) ends up being rather similar under the two analyses. The difference is that a de dicto interpretation of a pronoun of laziness allows for a less restricted descriptive content in the definite description. This is why the pronoun then can be used in a situation where an anaphoric past tense could not be used.

It is now clear how to proceed with example (24) with the anaphoric pronoun. As I claimed above, since a suitable acquaintance relation is not available in this case, the pronoun he cannot be interpreted de re. But when we assume that he in (24) is a pronoun of laziness interpreted de dicto, its anaphoric behaviour stops being mysterious. Substituting the definite description supplied by the antecedent for the pronoun, we end up with something which looks right:

(31) Before she knew who the winner was, she thought the winner was a regular guy.

To conclude, I argue here that anaphoric pronouns across belief contexts are ambiguous between two interpretations: the one is of donkey-bound variables interpreted de re, and the other of pronouns of laziness interpreted de dicto. I maintain the same for the time adverbial then. On the other hand, anaphoric tenses across attitudes are more restricted in their interpretation – they are always variables interpreted de re.

The appeal of the theory I described in section 2-4 lies in the simplicity of its assumptions: the first was that the semantics of tenses in embedded contexts is the same as in matrix sentences. This implies that tenses are always interpreted relative to the utterance time, independently of the syntactic configuration they occur in. This is an extensional analysis of tense. The second assumption was that tenses, like pronouns, are referential expressions which can be anaphoric. I called these two assumptions the independent theory of tense. My third assumption was that temporal elements, like pronominal ones, can be interpreted de re. De re theory was originally introduced in philosophy of language and semantics to account for examples with nominal elements in belief contexts. Since various people have convincingly pointed out analogical behaviour patterns shared between nominal and temporal anaphora (Partee (1973,1984), Kamp (1979, 1981), Hinrichs (1986)), the assumption that temporal anaphora across belief should also have de re interpretation is natural. The originality of my proposal lies in combining the three assumptions, those of the independent theory and that of de re theory, to predict the interpretation of tenses in embedded discourse. The appeal of this thesis, as I have already said, is its simplicity. We do not need to stipulate anything additional about the semantics of embedded tenses. It follows directly from the semantics of tense and belief.

6. Attitudes with Internal Anaphora

There are some problems with the thesis I outlined in sections 2-4. One is raised by example (32):

(32) Last Monday John Pst$_2$ believed that he Pst$_3$ was in Paris on Tuesday$_3$.

The past tense on was in (32) cannot denote a time later than the believing time. Similarly, on Tuesday which is co-indexed with it, cannot be interpreted as the Tuesday following last Monday, but instead must be one of the previous Tuesdays. But in principle, time adverbials like on Tuesday can refer to future times as demonstrated by the direct discourse (33):

(33) I will be in Paris on Tuesday.

In (33) the time of being in Paris is co-temporal with some Tuesday later than the speech time. Now, since the independent theory assumes anaphoricity of tenses, the tense on was in (32) can be anaphoric and thus co-temporal with the time adverbial on Tuesday. And since on Tuesday may denote a future time, the anaphoric past tense was should also be able to receive this future interpretation. But we just said that (32) lacks the forward shifted reading. My thesis cannot account for the lack of the forward shifted reading here, since the anaphora is between temporal elements inside the belief context. In such cases, I cannot make use of acquaintance relations, and in particular, of constraints on them.

I still might try to account for (32) by pushing de re theory as far as possible, claiming on Tuesday is interpreted de re. The idea is that John might be acquainted with Tuesday in a different way than that introduced by the expression on Tuesday. John might have an acquaintance relation to some particular future time which he is familiar with through some other description. Since I said that an acquaintance with future times might not constitute a suitable acquaintance relation, this perhaps explains the lack of the forward shifted reading in (32).

Unfortunately, this explanation is not complete, since we cannot apply it to the interpretation of (32) where on Tuesday is part of John's attitude rather than ascribed to him by the speaker. De re theory cannot account for the lack of the forward shifted reading in this case. (34) demonstrates this point more strikingly:

(34) John Pst$_2$ believed he Pst$_3$ was in Paris at some time$_3$.

(34) has the backward shifted reading where at some time has narrow scope relative to believe. This amount to "John believed that at some time or other preceding his believing time he was in Paris". But the corresponding forward shifted reading where at some time has narrow scope relative to believe is not available in (34). We cannot use de re theory to explain the lack of this narrow scope forward shifted reading, since this approach would not help with a representation where some time has minimal scope.

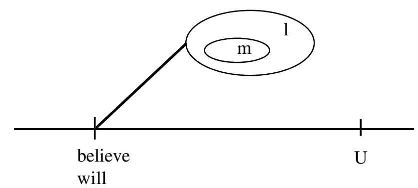
A second objection also calls for an account independent of de re theory. Consider (35)-(36):

(35) Sue Pst$_3$ believed that she Pst$_3$ would marry$_2$ a man who Pst$_2$ loved her.

(36) Sue Pst$_3$ expected to marry$_2$ a man who Pst$_2$ loved her.

The temporal relations in (35) are diagrammed below:

(35´)



Due to the semantics of would, the marrying time is interpreted as later than the believing time, and is undetermined relative to U. The problem is that the loving in (35) has the salient interpretation as simultaneous with the marrying, although loved is marked with past tense morphology. The point is that I cannot account for the simultaneous reading of loved as I did before:

(37) Mary Pst$_2$ believed that it Pst$_2$ was raining.

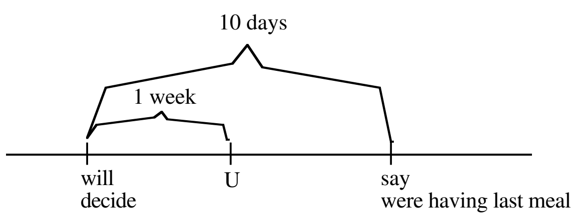
The difference between (37) and (35) is that while in (35) the anaphoricity between marry and the tense on loved is internal to believed, the anaphora in (37) is across the belief context. Thus, de re theory, which accounted for the simultaneous reading in (37), cannot apply to (35)-(36).

A similar example was used in Abusch (1988) growing out of a discussion by Kamp and Rohrer (1984) of French data:[10]

(38) John Pst_3 decided a week ago that in ten days at breakfast he Pst_3 would say_4 to his mother that they Pst_4 were having their last meal together.

The salient interpretation of (38) is that the meal time is simultaneous with John's saying time, as indicated by the indexing. The temporal relations are displayed below:

(38´)



The decision is one week before U and the time of saying and having the meal is three days after U. The problem here again is with the past tense morphology on were having. It does not help to say that the tense on were is interpreted de re, since as indicated by the above diagram, the were having time does not precede any time alluded to in the sentence, and in particular, it does not precede U.[11] This example is more convincing than (35) since due to the time adverbials, its temporal ordering is determined.

Examples (35)-(36) and (38) constitute strong evidence for a SQT theory and against the extensional theory I outlined in 2-4. According to SQT theory, were having in (38) inherits its morphological past tense from the embedding would, which in turn inherits its past tense morphology from the embedding verb decided. Semantically speaking, the two tenses morphologically marked as past are actually present tenses, which accounts for their simultaneous reading.

To summarize, in this section we met two kinds of data which my extensional theory, which combines assumptions from the semantics of tense and belief, fails to account for. These are:

(i) The lack of the forward shifted reading in examples (32) and (34) where the temporal anaphora is internal to the belief.

(ii) The presence of past tense morphology on a verb whose denotation does not express precedence relative to any time alluded to in the sentence, in particular U (example (38)).

7. The Case of Modals

In this section and the next one I try to resolve the first of the two problems my extensional theory fails to account for, i.e., the lack of the forward shifted reading in (32) and (34). With this goal in mind, I want to look at independent evidence from the behaviour of modals showing that something special goes on in intensional contexts.

When he was a teenager, John did not study enough. If we had asked him about it at the time, he would have said

(39) I ought to study more.

Here ought expresses a modality relative to what was appropriate or advisable for him at the time. If we want to describe this situation now, we cannot simply say

(40) #When he was in high school, John ought to study more.

What goes wrong here, I conjecture, is that there is a temporal parameter in ought which is identified with the utterance time, so that (40) describes a present necessity rather than a past one. To describe a past necessity, we have to use one of the options in (41).

(41) a. When he was in high school, John ought to have studied more.
b. ? When he was in high school, given what is appropriate for a high school student, John had to study more.

A similar point can be made about the temporal parameter implicit in the modal might. Suppose John married a woman with some financial prospects. At the time, he would have said:

(42) My wife might become rich.

The modality here is an epistemic one, with the temporal perspective of the marrying time: given what John knew about his wife, it was possible for her to become rich later on. If we want to describe this situation now, we cannot say:

(43) John married a woman who might become rich.

This is true even if we give more explicit clues to the epistemic modality, by inserting something like "given what he knew about her at the time". Again, I think the reason is that might in (43) is understood as describing a possibility from the point of view of the utterance time. To describe the past possibility, we have to say:

(44) John married a woman who might have become rich.

At this point, there is a temptation to say that the might and ought have defective morphological paradigms – they only have present tense forms. Consider however the behaviour of these forms when embedded under believed.

(45) a. John believed that he ought to study more.
b. John believed that his bride might become rich.

Here the implicit temporal parameter of the modality is obligatorily the believing time. Or rather, it is the now of John's centered belief worlds. The possible events of the wife becoming rich are ordered after the nows of John's epistemic alternatives, not after the utterance time or some counterpart to it. We see that in extensional contexts, the temporal parameter of such modals is obligatorily the utterance time. In belief contexts, this parameter is identified with the believer's now.[12]

8. The IL Theory or Temporal Reference

There is a way in which the behaviour of might and ought is exactly what one would expect if one believed in Montague's intensional logic as a formalism for describing the semantics of English. The semantics for IL, together with the way Montague applied it, provides an automatic way of matching up temporal and modal parameters– the so called evaluation time and evaluation world– throughout an extensional context. These parameters are then bound by an up operator (^) in the intensional argument of an operator such as believe. For instance, suppose we have two occurrences of ought or might which are not separated by any intensional operators. Say they are conjuncts.

(46) ought $(\phi_1) \wedge$ might(ϕ_2)

The semantics of IL ensures that the same temporal parameter – the evaluation time – is passed to the two verbs. In a top-level context this is equated with the utterance time.

Now let us see what happens in an intensional context. An up operator is prefixed to the argument of believe:

(47) believe (j, ^might (ϕ))

Semantically, this acts as a lambda binding the evaluation time and evaluation world. In another notation, we could write:

(48) $\text{believe}_{w_1,t_1}$ (j, $\lambda w_2\, \lambda t_2\, \text{might}_{w_2,t_2}\, (\phi)$)

Here w_2 and t_2 are the evaluation parameter for might which become bound in the intensional context.

In describing the semantics of (48), we have to say what we are taking the belief relation to be. Given the discussion in section 2-4, an obvious possibility is to identify t_2 with the now of the believer. Putting it another way, the intensional argument in (48) is exactly the property which is required by Lewis' semantics for belief, except that an abstraction for the self of the believer is missing. The point is now that this IL machinery provides a neat account of the data regarding the temporal parameter implicit in might and ought. In an extensional context, this temporal parameter is identified with the utterance time, as in (39) and (42). In the argument of believe, it is bound by an up operator, and is semantically interpreted as the now of the believer, as in (45).

This observation pushes in the opposite direction from what I said in sections 2-4. While I did not discuss the IL theory of temporal reference there, I was implicitly rejecting it, since I proposed a theory where tenses were independently referring elements which did not interact in any special way with intensional operators. The difference is evident in my treatment of the simultaneous reading of past under past. I said that in the representation (49), the second occurrence of Pst_2 was interpreted in the same way as the first one, as a referring element in an extensional position.

(49) John Pst_2 believed that it Pst_2 was raining.

Now, since I used Lewis' semantics for belief, I did assume that the semantics involved reference to the now of the believer. The difference lies in the fact that (49) includes no parameter in the complement sentence which directly names the now of the believer. Rather, this was introduced in the semantics of de re belief as a counterpart of the reference of the embedded Pst_2.

If this kind of analysis was in general correct, it would show that the IL system – at least the temporal part – was at best irrelevant. If we did insert an up operator in intensional contexts, its temporal part would be vacuous, since there are no evaluation time parameters to bind in an representation such as (49).

At this point, it is of interest to see where my analysis of the simultaneous reading breaks down when applied to might and ought. Consider again example (45):

(45) a. John believed that he ought to study more.
b. John believed that his bride might become rich.

We assume that might and ought have discrete temporal parameters. Suppose these parameters are interpreted de re, and thus scoped out to an extensional position. In this case the temporal parameter of might and ought would be the utterance time judging by the examples (39)-(42). But in (45a)-(45b) the reference of the temporal parameters is to possibilities and obligations at the believing time and not at U. I cannot replicate my analysis of Pst\Pst sentences with such examples.

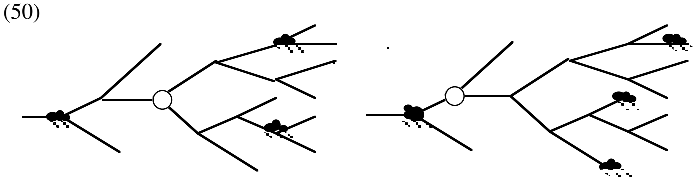
These observations explain my earlier remark that it is wrong to think of might and ought as having a present tense temporal parameter. For if so, we could not account for their behaviour in (45) when embedded under believe. I have suggested that it is more insightful to treat the temporal parameter of might and ought as an IL-evaluation time.

9. The Upper Limit for Reference

I have just said that the IL analysis of temporal reference, which keeps track of a local evaluation time, has something to recommend it. Earlier, I discussed the problem of shifted forward readings, and said that an account based on restrictions on acquaintance relations was not general enough, since it cannot predict the lack of the forward shifted reading in examples like (32) and (34) where the temporal anaphora is between two intensional positions.

However, I find part of this account worth preserving. Generalizing what I said in section 4, let us speculate that forward reference with tenses was impossible because future times are not sufficiently determined from the perspective of the now of an intensional context. There is a relation between this idea and branching future models where modal space is represented as a tree or forest:

(50)



Epistemic alternatives are points in this tree, say the circles above. From the perspective of one of these circles, the past is determinate. For instance, starting at one of these circles we can search backwards for the last occurrence of a thunderstorm in Stuttgart. But looking in the other direction, we cannot find a unique next thunderstorm, because the possibilities branch apart. To talk about the future, we have to quantify over the branches by using modals or a similar operator. This ties in with the observation that there is no future tense in English, just future-oriented modals. The suggestion then is that there is a constraint on the reference of tense nodes in intensional contexts, having to do with the nature of modal space. We can use the backward-shifted belief report (51a) because the past is determinate from the point of view of one of John's alternatives. We cannot use the forward shifted report in (51b), because the future is indeterminate.

(51) (a) Mary believed that John was afraid during the last thunderstorm.
(b) Mary believed that John was afraid during the next thunderstorm.

Let us say, then, that the now of an epistemic alternative is an upper limit for the reference of tenses. Given that the now of a belief alternative is equated with the local evaluation time of the complement of believe, we can restate this by saying that the local evaluation time is an upper limit for the reference of tenses. I call this constraint on the reference of tenses the upper limit constraint (ULC). The lack of the forward shifted reading in (51b) is due to the ULC.[13]

10. An Intensional theory of Transmitted Temporal Relations

The upper limit on tense reference solves only half of the problem of tense in intensional contexts. The remaining problem is exemplified by the example repeated below:

(52) John Pst_3 decided a week ago that in ten days at breakfast he Pst_3 would say_2 to his mother that they Pst_2 were having their last meal together.

We saw that the account of sequence of tense from sections 2-4 (using de re interpretation) was applicable to the second occurrence of Pst, but not to the third. The de re interpretation strategy worked by putting a past node into a position where its interpretation could be taken to be temporal precedence. But in (52), the contemplated meal (i.e. the event associated with the third past tense node) does not precede any time evoked in the sentence. In particular, it does not precede the utterance time.

This example suggests the need for a sequence of tense solution– one in which the third Pst node in (52) does not have the obvious interpretation, but is somehow licensed by the presence of an embedding past tense node. There are several reasons to believe that sequence of tense should not be formulated in a purely syntactic way. First, as discussed in Abusch (1988) it is sensitive to the logical scope of operators. Consider a reading of (53) where the NP the topic that the participants were most interested in has narrowest possible scope.

(53) Five days ago, John promised to talk during a seminar a week later
about the topic that the participants were most interested in.

On that reading were can be understood as referring to the time of the seminar, and John has made a very open ended promise– he will talk about whatever the people who show up happen to be interested in. This is the sequence of tense reading parallel to the reading of (52) I discussed; note that the temporal adverbs give the information that the seminar follows the utterance time. On a reading where the noun phrase headed by the topic has widest scope – where John has (more sensibly) made a promise to talk about a specific topic – were cannot be understood as referring to the seminar time, but rather must be co-temporal with the promise time or precede it. This shows that SQT is sensitive to the logical scope of operators, and cannot be described in terms of surface syntax.[14]

Along the same lines, there is no extensional analog of (52). Consider for instance the example below:

(54) Last week John met a woman who was in the next room (now).

Suppose that sequence of tense could eliminate the semantic content of the tense on was. Then (54) should have a reading where was refers to the utterance time. However, this reading can only be expressed by a woman who is in the next room. This shows SQT only operates in intensional contexts.

Finally, Irene Heim has given examples, discussed in Ogihara (1989), that sequence of tense can be triggered without a higher tense operator being syntactically present. For

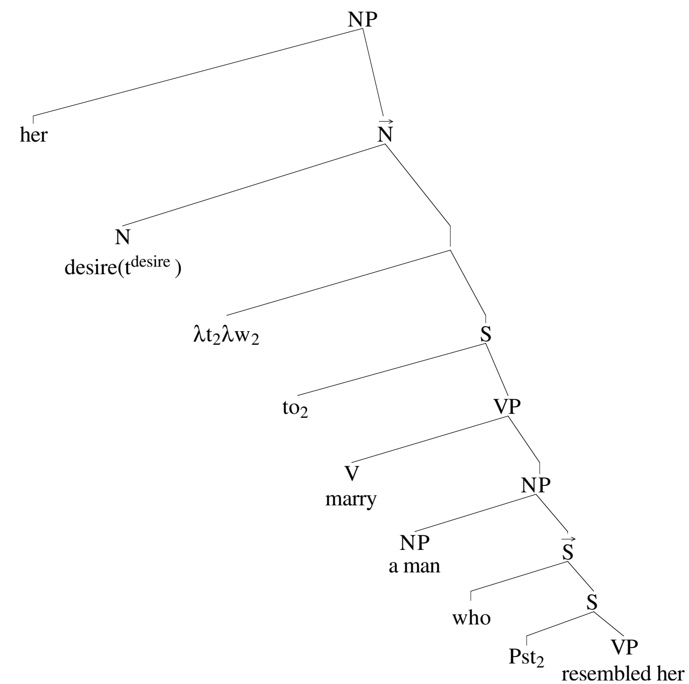
instance, understanding Mary's desire in (55) as being a past desire is sufficient to license sequence of tense on resembled.

(55) I know that Mary was a strange child.
But her desire to marry a man who resembled her is really bizarre.

Nominals describing psychological states have temporal parameters with an obvious motivation in lexical semantics: people have different psychological states at different times. In (55), the discourse context suggests that the temporal parameter for Mary's desire is a past time. Apparently, selecting such an understanding of the temporal parameter in desire is sufficient to license sequence of tense in its complement.

This example shows that a SQT past tense need not be semantically vacuous: in (55) the past tense gives information about the location of the temporal parameter of the embedding operator. Consider the following representation:

(55´)



t^{desire} is the temporal parameter of the embedding nominal. Let $R^{resemble}$ be a relation relating the reference of Pst_2 to its local evaluation time, (which is t_2) and let R^{desire} be a relation relating t^{desire} to its local evaluation time (which is U).

The past tense in (55´) does not have a local interpretation of temporal precedence, as dictated by the fact that it is coindexed with its local evaluation time. To characterize the information contributed by this tense, we have to treat it as providing information not simply about the local relation $R^{resembled}$, but about the set of relations $\{R^{desire}, R^{resembled}\}$: at least one of these relations must be the temporal precedence relation. Given the indexing, $R^{resembled}$ cannot be temporal precedence, so it must be R^{desire} which satisfies this condition.

In order to state this, we must keep track of enough information to allow Pst_2 to place a constraint on R^{desire}. Let us say that

(i) All operators with intensional arguments (whether they are verbal or nominal) introduce a relation variable relating their local temporal parameter to their local evaluation time. In our example, R^{desire} relates t^{desire} to U, so that $R^{desire}(t^{desire}, U)$ is a constraint at the level of <u>desire</u>.

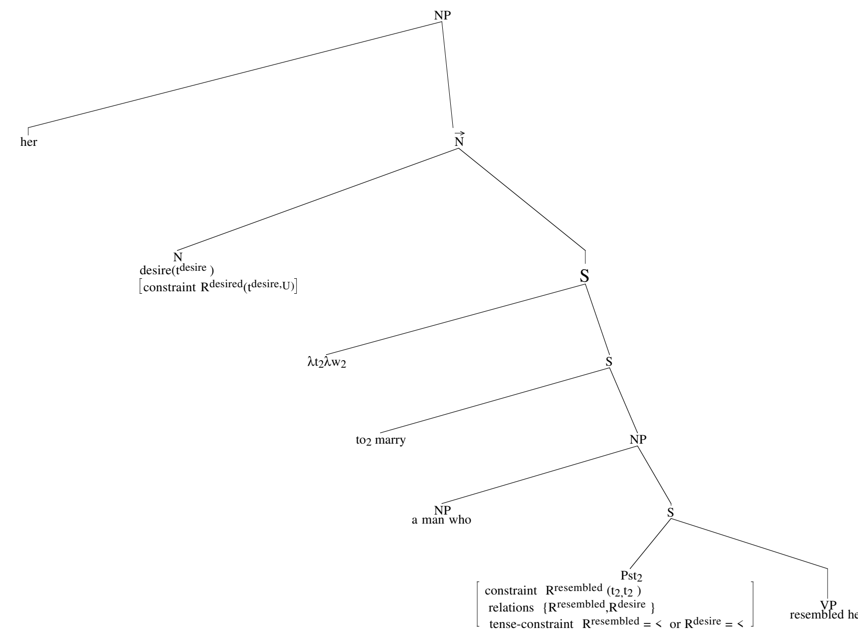
(ii) Such relations (R^{desire} in our case) are transmitted by a feature passing mechanism to the intensional arguments.

(iii) The semantics of past tense is a constraint on a set of such transmitted temporal relations, along with the local relation: at least one of these must be the temporal precedence relation.

Since we have seen that SQT is sensitive to the scope of operators, this information has to be transmitted at a level where scope has been represented, such as logical form.

A semantic tree with annotated temporal relations is given below:

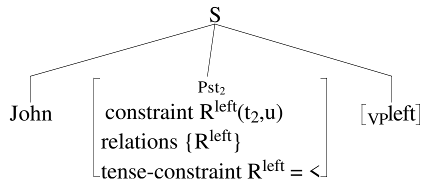
(55´´)



All the relevant information is written under the embedded tense Pst_2. The local temporal relation is $R^{resembled}$, which relates t_2 to the local evaluation time t_2 (which is bound by λ at the level of the argument of the verb <u>desire</u>). The set of temporal relations constrained by Pst_2 includes the transmitted relation R^{desire} in addition to $R^{resembled}$. The constraint coming from the past tense PST_2 is that at least one of them is temporal precedence. Since the arguments of $R^{resembled}$ are cotemporal, it must be R^{desire} which expresses temporal precedence relative to its local evaluation time U.

In the case of a tense in an extensional position we have the default of the normal semantics of past tense: the set of transmitted temporal relations for a tense in an extensional position is empty, and so the local relation must satisfy the constraint. In the example below this is the relation between t_2 and the local evaluation time U.

(56) John left.

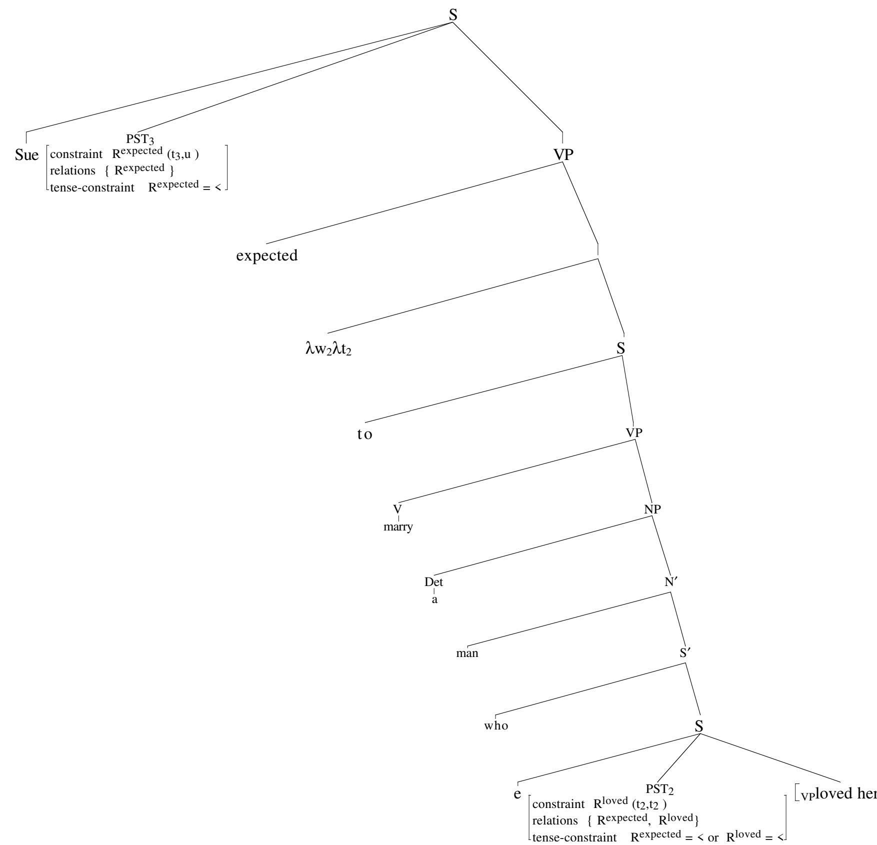


In section 6 I mentioned example (36). Parallel to the reading of (35) which I discussed, Pst_3 on loved is understood as co-temporal with marry, although loved has past tense morphology.

(36) Sue Pst_3 expected to $marry_2$ a man who Pst_2 loved her.

As I argued for (35), this example too cannot be handled by de re theory, since both loved and marry are in the same intensional context. I believe such examples constitute clear evidence for the intensional analysis of SQT which I presented. My analysis assigns (36) the following temporal relations:

(36´)



Expected is an intensional operator, so it introduces the relation $R^{expected}$ and transmits it to its argument. The tense constraint coming from Pst_3 is that $R^{expected}=<$. The set of temporal relations constrained by Pst_2 on loved is $\{R^{expected}, R^{loved}\}$. $R^{expected}$ is the transmitted relation and R^{loved} is the local relation. If we look at R^{loved} we see it does not have an interpretation of temporal precedence because t_2 fills both arguments of R^{loved}. However, since we already have the information $R^{expected}=<$, the tense-constraint is satisfied.

Notice that under a different co-indexing, the loving time can precede its local evaluation time. (57) is such an example:

(57) Sue Pst_2 expected to_3 marry a man who Pst_4 loved her [when they met]$_4$

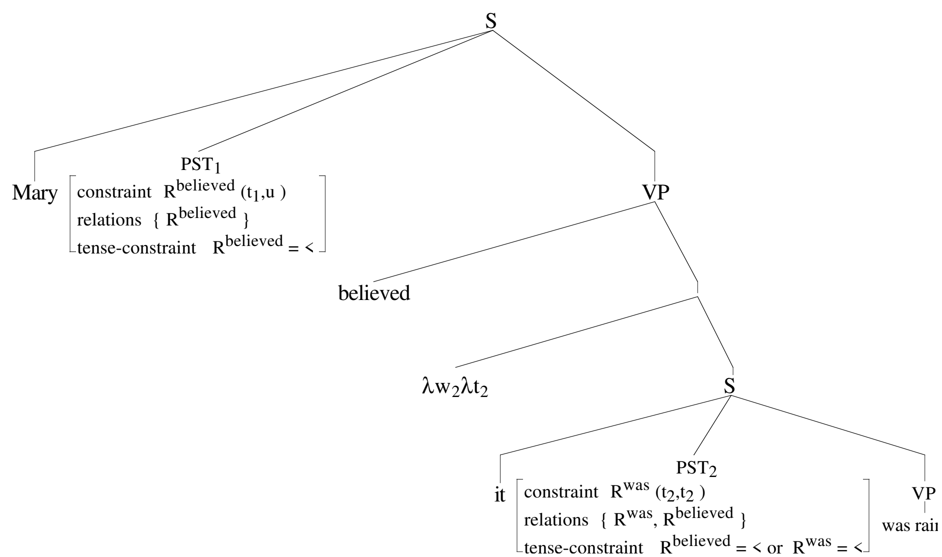
Here, since the meeting precedes the marrying, so must the loving.

My intensional analysis of SQT also handles the simultaneous reading of Pst\Pst. Consider again my earlier example (2)

(2´) Mary Pst_2 believed that it Pst_2 was raining.

The relevant tree for (2), with the set of transmitted temporal relations, is drawn below:

(2´)



$\lambda w_2 \lambda t_2$ is the up operator introduce by believed. Let us assume that it is possible for the embedded tense to be co-indexed with λt_2. Since t_2 is the local evaluation time, we obtain the constraint $R^{was}(t_2,t_2)$. This excludes Pst_2 being locally licensed. Instead, Pst_2 is non-

locally licensed by virtue of the fact that $R^{believed}$ is the relation <. We see that Pst_2 on was raining reflects the fact that the tense of its embedding verb expresses pastness.

Remember that this reading could also be derived by the independent theory. In section 4 I said that Pst_2 on was raining, which is in intensional position, is anaphoric to the tense on believed, which is in extensional position. This configuration forces a de re interpretation of the tense on was raining. The time of the raining in the belief worlds is co-temporal with the believer's now. In the real world, the reference of Pst_2 on was raining precedes U. This allows us to maintain that in intensional positions past tense has the same meaning as in extensional ones, namely precedence to U. I said before that one nice consequence of using de re theory for the analysis of examples like (2) is that we do not need to stipulate anything additional to the semantics of tense and belief. But we saw we need the intensional account for cases of anaphora internal to belief. If we cannot do without it, we might as well employ it to account for the simultaneous reading of Pst\Pst.

The difference between the interpretation of the embedded tense in the two alternative accounts of (2) is clear: in de re theory, past tense retains its standard interpretation in which it expresses pastness relative to its evaluation time, which is U. This is true for both extensional and intensional contexts. In the intensional analysis, past tense is not always licensed by the local eventuality preceding something else. Instead, it can be licensed by the temporal parameter of one of the embedding intensional operators preceding its local evaluation time.

What about the lack of the forward shifted reading of Pst\Pst sentences? Consider

(58) John Pst_2 believed that it Pst_2 was raining.

The forward shifted reading of (58) can be derived by neither the extensional nor the intensional analysis. According to the intensional account, when the embedded tense node is in the scope of the higher one, it is subject to the upper limit constraint which excludes the forward shifted reading. In the extensional analysis, when was is interpreted de re, it is scoped to an extensional position and leaves behind a trace which is subject to the upper limit constraint. This scoping is represented in (58´):

(58´) believe (j, Pst_2, <λt_2 [it was Tns_2 raining]>.

The upper limit constraint guarantees the trace Tns_2 cannot be interpreted as later than its local evaluation time t_2.

11. <u>The Present Tense in Intensional Contexts</u>

What about the semantics of the present tense? The obvious semantic rule is the complement of the one for past tense: no element of the set of temporal relations is the "<" relation. I will understand this in the following way: each of the relations should be a temporal relation which entails "¬<", the negation of the temporal precedence relation. Since we already have a constraint that the reference of tense nodes cannot follow the local evaluation time, for tense nodes this will amount to the relation of temporal overlap. So a present tense in an extensional position will be constrained to overlap the utterance time, as in standard accounts.

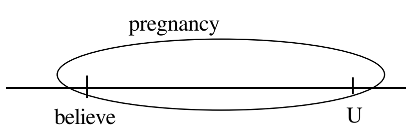
However, the interpretation of present tense is more complicated in intensional contexts. When the present tense is embedded under an intensional past verb it appears to have a quite intricate interpretation.

Consider (59) mentioned before,

(59) John believed that Mary is pregnant.

The rough intuition about this example is that Mary's pregnancy seems not only to overlap John's believing time, which is in the past, but to include both John's believing time and the utterance time. This is illustrated in (59´):

(59´)



I call this reading the double access reading (DAR) of a present tense complement of a past tense verb (Present under Past sentences Prs\Pst).

However, our rough intuition is not quite right. First, the complement is not required to be actually true at the believing time or the utterance time. Suppose Mary has gained a lot of weight over the last few months, and that two weeks ago at lunch John announced that the explanation was a pregnancy. In saying (60)

(60) John said two weeks ago that Mary is pregnant but actually she has just been overeating for the last three months.

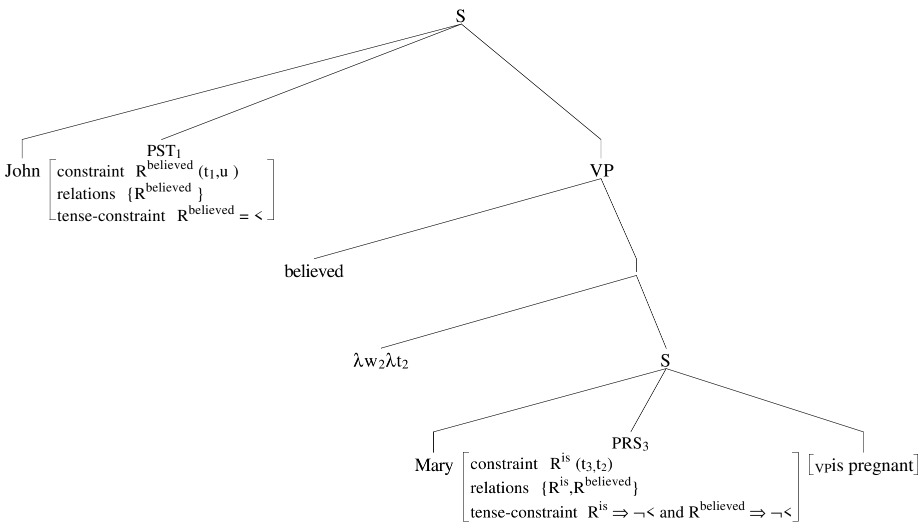
The speaker is reporting John's claim, but explicitly denying that it is correct. According to the speaker, there certainly is no actual pregnancy overlapping the time of John's statement and the current utterance time. This shows that the picture (59') need not depict the world as described by the speaker.

There is also the problem with saying it describes the world according to John. When he made his assertion, John was not making a prediction about the future time when (60) is uttered- he was just saying how he thought things were at his time. He may ask the speaker not to misrepresent his believed proposition and use past instead of present tense in the complement.

What seems to licence the Prs\Pst in this example is that the speaker is interested in the explanation for Mary's symptoms in an interval spanning the two times. In fact, (59) seems inappropriate if Mary's symptoms, her big belly, and so forth, do not persist at the utterance time. In this sense, the present tense imposes a condition on the base world, even though the condition is not one requiring that Mary be pregnant at the interval depicted in (59'). This poses a puzzle for the syntax/semantics interface since semantic material in a complement S standartly contributes to the proposition which is the semantic argument of the verb. In the rest of this section I show how the mechanisms of transmitted temporal relations and de re interpretation actually predict the DAR in (59), i.e., the reading where in the base world Mary's symptoms overlap both the believing and the utterance time. My analysis also settles the puzzles raised above.

In the previous section I outlined how temporal relations are transmitted to the argument of intensional verbs. When this mechanism is applied to sentence (59), it introduces the constraints in representation (61):

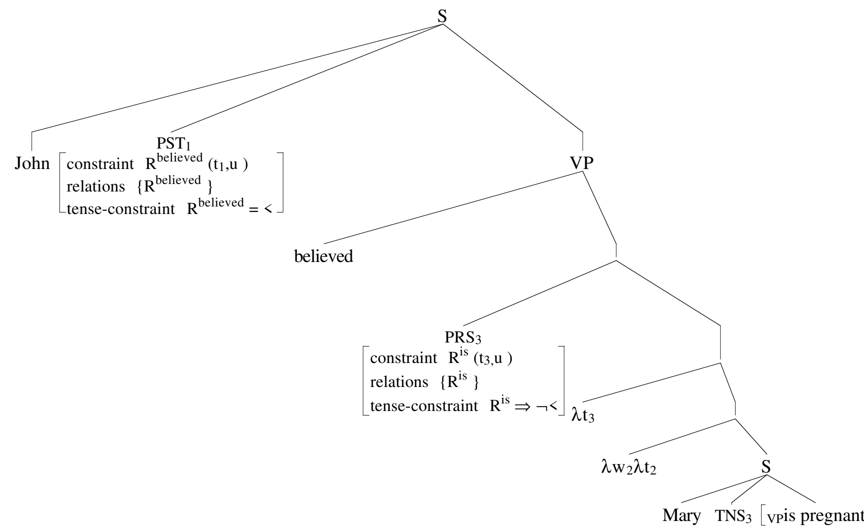
(61)



The tense constraint introduced by PRS_3 in (61) is that both $R^{believed}$ and R^{is} imply "$\neg<$". The tense constraint coming from PST_1 is that $R^{believed}$ is $<$. The representation in (61) therefore involves contradictory constraints on the relation $R^{believed}$, one contributed by the higher tense and one by the embedded one. The theory therefore entails that a present tense cannot be embedded inside the intensional argument of a past tense verb. While false as a statement about surface syntax, I believe this is the right conclusion as a description of a more logical level. In Abusch (1991) I said that in such Prs\Pst structures the present tense was interpreted de re, and thus in an extensional position. I argued that this provided the best account of the rather peculiar semantics of Prs\Pst examples. In the rest of this section I want to further pursue this line of thought.

In (62), PRS_3 is scoped out to an extensional position outside the intensional argument of believe (which is $\lambda w_2 \lambda t_2 S$) leaving behind a trace TNS_3.

(62)



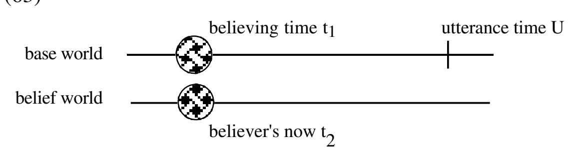
Scoping PRS_3 to an extensional position changes things in two ways:

(i) The local evaluation time of PRS_3 is U instead of t_2.

(ii) $R^{believed}$ is no longer in the set of relations constrained by PRS_3, so the contradictory condition on $R^{believed}$ is eliminated.

The intuition about Prs\Pst sentences is that the embedded tense overlaps both the utterance time and the believing time. In (62), Prs_3 is constructed to overlap the utterance time, but this representation does not make it clear it also overlaps the believing time. To show how this comes about, I will look at relations between temporal parameters in (62):

(63)

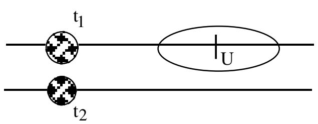


In the base world we have the believing time t_1 (corresponding to Pst_1 in (62)) and the utterance time U. In the belief world we have the believer's now t_2 (corresponding to λt_2

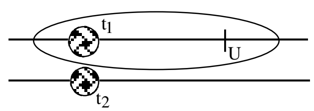
in (62)). The balls in the two worlds, the believing time t_1 and the believer's now t_2, are counterparts.

We now look at the information contributed by present tense. PRS_3 is present tense, and in this case the associated temporal constraint amounts to overlapping the utterance time. This means that it might or might not overlap the believing time. This leaves two possibilities for the reference of PRS_3, represented below by the open ellipse. In (64a) PRS_3 overlaps just the utterance time and in (64b) it overlaps both the utterance and the believing time.

(64) a.

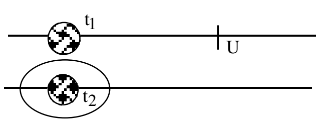


b.

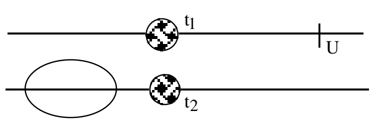


The trace TNS_3 left behind is a free variable and therefore bare of temporal properties. This means it is unspecific as to whether it denotes a present or a past time. However, since it is a tense node, it is subject to the upper limit constraint, which is a general constraint on tense. The ULC prevents TNS_3 from referring to a time later than its local evaluation time t_2. So the reference of Tns_3 might either overlap or precede t_2, as illustrated in (65a) and (65b):

(65) a.



b.



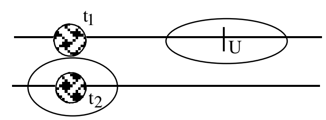
This leaves two possibilities for the reference of TNS_3 in the belief world as diagrammed above.

So we have two possibilities for the reference of PRS_3 (these in (64a) and (64b))) and two possibilities for the reference of TNS_3 (these in (65a) and (65b)). Taken together, 2×2 gives us four possible combinations for the reference of PRS_3 and TNS_3.

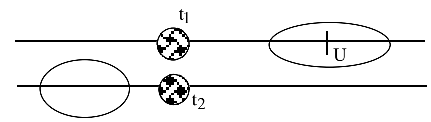
The idea is that the counterpart relation invoked by de re construal eliminates some of the four combinations, by requiring that the actual and the belief worlds be temporally

isomorphic. The believing time t_1 is a counterpart of the believer's now t_2, and PRS_3 is a counterpart of TNS_3. With a reasonable acquaintance relation, when PRS_3 overlaps the believing time t_1 in the actual world, its counterpart TNS_3 should overlap the believer's now t_2 in a belief world. When PRS_3 precedes the believing time t_1 in the actual world, its counterpart TNS_3 should precede the believer's now t_2 in the belief world. This eliminates the following combinations.

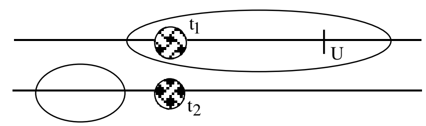
(66) a.



b.

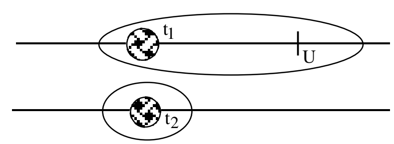


c.



What is wrong with each of them is that the open ellipse looks different in the base and belief worlds from the perspective of the balls (the believing time t_1 and the believer's time t_2). In other words, the belief and the base worlds are not temporally isomorphic as required by an appropriate acquaintance relation. The remaining possibility is the one in (66d):

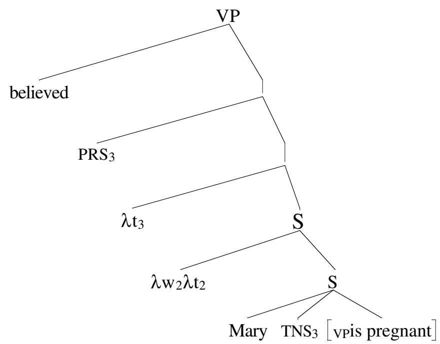
d.



This is the double access reading where the reference of the present tense PRS_3 in the base world overlaps the believing time and the utterance time.

Now I want to apply this to example (59), using a specific acquaintance relation. In (67) I represent its VP, with the present tense in extensional position interpreted de re:

(67)



I use the same formalization as in section 4 where I discussed the extensional analysis of Pst\Pst . The denotation of the VP is given in (68), where Q is the denotation of the abstract $\lambda t_3 S$:

(68) Set of individuals $z_{subject}$ such that

(i) $z_{subject}$ stands in the belief relation to the set of centered worlds $\{<x_{self}, t_2, w_2>|$ there is a unique time t such that $R(x_{self}, t_2, t)$, and $Q(t_2, w_2, t)\}$

(ii) in w_0, $z_{subject}$ at the evaluation time t_1 (i.e. $z_{subject's}$ believing time) bears the relation R to the referent of PRS_3.

I will apply this definition to the pregnancy example. I said before following my (1991) paper that a reasonable acquaintance relation for (59) is one picking out the maximal interval overlapping the reference time at which Mary has a big belly. This acquaintance relation is given in (69):

(69) R_8: $\lambda x_{self}\, \lambda t_2\, \lambda t$ [t overlaps t_2 and t is the maximal interval at which Mary has a big belly].

For condition (68i) to be true, John is supposed to stand in the belief relation to the set of centered worlds given in (70):

(70) $\{<\lambda x_{self}\, \lambda t_2\, w_2> |$ there is a unique time t such that t is the maximal interval overlapping t_2 such that Mary has a big belly in w_2 at t_2 and further, at this time t_2 in w_2, Mary is pregnant$\}$.

Given what we take the belief relation to be, this would be true if each of John's centered belief worlds $<x_{self}, t_2, w_2>$ fits the condition above. Given John's belief, this is pretty plausible: in each centered belief world Mary is pregnant and consequently has a big belly at t_2, and at the maximal interval throughout which she has the symptom, she is also pregnant. In the different centered belief worlds of John the maximal interval may be different. In some of John centered belief worlds it may not reach up to the utterance time, and in others the maximal interval overlaps the utterance time and may extend beyond it. The length of the maximal interval may vary from one belief world to another, and all these intervals are consistent with John's beliefs. We see that condition (68i) is satisfied. Condition (68ii) is also satisfied. This is so since in the base world PRS_3 denotes the maximal interval overlapping t_1 at which she has a big belly. And by virtue of the information coming from the present tense morphology, this interval overlap U as well.

To summarize, what I claim here is that the double access reading is derived in the following way:

(i) The semantics of tense forces de re construal of present tense. This is so since the contradictory information on $R^{believed}$ in (61) shows PRS_3 is scoped out to an extensional position.

(ii) When we have de re construal, the semantics gives us the double access reading. This follows from the constraints on present tense (PRS_3) and the trace behind. Together with the counterpart relations enforced by de re theory it yields the desired double access reading for Prs\Pst sentences.

Two earlier analysis of Prs\Pst have suggested that the present tense is interpreted de re in Lewis' and Cresswell/von Stechow's technical sense (Abusch 1991) or scoped out of the embedded sentence via the ordinary scope mechanism (Ogihara 1989). These proposals are from my point of view on the right track. However I think they both contain undesirable stipulations, and therefore do not quite succeed in deriving the semantics of Prs\Pst from independently motivated principles. In my earlier paper, I assumed exactly the scheme of de re interpretation and the logical forms reviewed above, and my discussion here of plausible acquaintance relations for Prs\Pst sentences is borrowed from that paper. However, I said there that the fact that the reference of the scoped present tense node in (62) overlaps both the believing time and the utterance time follows directly from the semantic interpretive rule for the present tense, something which now strikes me as implausible and stipulative. In the present analysis, as just reviewed, the reference of this node follows from an interaction of independently motivated considerations, namely the semantics of present tense, the semantics of de re interpretation, and the upper limit constraint on the reference of tense nodes. All of these were motivated by considerations independent of the Prs\Pst configuration and its peculiar semantics.

A similar point can be made about Ogihara's analysis. He proposes a logical form in which the embedded tense node (in Ogihara's notation, an Aux node) is copied and adjoined to the matrix S (Ogihara 1989:p327):

(k) $[_S[_{\text{Aux }k}$ Pres$][_S$ John Past say that Mary $[_{\text{Aux }ek}$ Pres] be pregnant]]

Assuming a morphological present in the embedded position is motivated by the desire to derive the double-access semantics (with the reference of the present tense overlapping both the utterance time in the base world, and the evaluation time in a belief world) directly from rules of semantic interpretation. Since there are two coindexed present tenses in LF, one in matrix position and one in the embedded position, overlap with both the utterance time and the embedded evaluation time (i.e. the believer's now) can be read directly off the logical form, given that Ogihara gives present tense a semantics of overlap with the local evaluation time (or rather, the semantics of present tense is that the reference of the tense node contains local evaluation time, Ogihara (1989:p 334)).

The question for someone advocating this analysis has to answer is why scoping in this case leaves a copy rather than a trace. In all other cases I know of, scoping puts the content of the scoped phrase in a higher position, with simply a bound variable – syntactically a trace – in the embedded position. This is the semantics of quantifier scope, and in the case of Cresswell and von Stechow's logical forms for de re interpretation, getting the content of the phrase interpreted de re not to contribute to the believed proposition is part of the motivation for the logical form.

Independently, it is not clear to me what in Ogihara's analysis forces the present tense to take wide scope. If Ogihara's semantics of present tense is simply that local evaluation time is contained in the reference of the tense, a logical form for Prs\Pst where the embedded tense is not scoped would have a simultaneous reading, like the simultaneous reading of Pst\Pst. Since there is no such reading, some way of ruling out this logical form is required.

12. Stowell's Temporal Polarity Theory

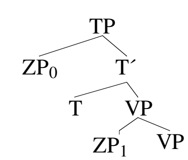
In recent work, Tim Stowell has discussed an account of sequence of tense which has a lot in common with the proposal made here, both in terms of motivating phenomena and analysis (Stowell ms.). His proposal is in many respects more syntactically oriented than mine, the idea being to relate certain aspects of temporal interpretation to analogous phenomena in the nominal domain, in particular control PRO, and to link the theory of temporal parameters and relations to a more general account of the syntax-semantics map in an X-bar theoretic scheme. This project is one with which I am very sympathetic, and below I will outline a correspondence between Stowell's representational approach and my theory, a correspondence which I find remarkable, given that they were independently developed. Stowell's account of sequence of tense, like mine, allows for non-local licensing of past tense morphology by higher temporal relations. In his metaphor, the distribution of overt past tense morphology is analogous to that of negative polarity items: just as a negative polarity item must be in the scope of a semantically negative trigger, overt tense morphology must be in the scope of a pastness operator, which turns out, at least in English, to be a covert operator. Specifically, the constraint is this:

(71) In LF, an overt past tense morpheme (written past) must be c-commanded by a temporal operator expressing temporal priority, written Past.

Since c-command is an unbounded relation, past tense morphology can be non-locally licensed. The similarity to my proposal is obvious. However, I will argue that the conventional syntactic relation of c-command does not get at the right generalization, in that it misses the role of intensionality.

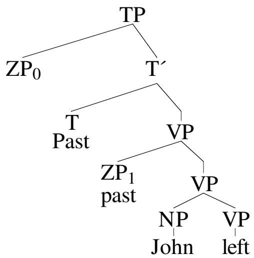
Simplifying things slightly, Stowell's account is based on a syntactic TP (tense phrase) with the following geometry:

(72)



The tense node T denotes, in my terms, a relation between local evaluation time and eventuality time; ZP_0 denotes the local evaluation time and ZP_1 corresponds to the eventuality argument of the verb. Under these assumptions, the structure of (56) is:

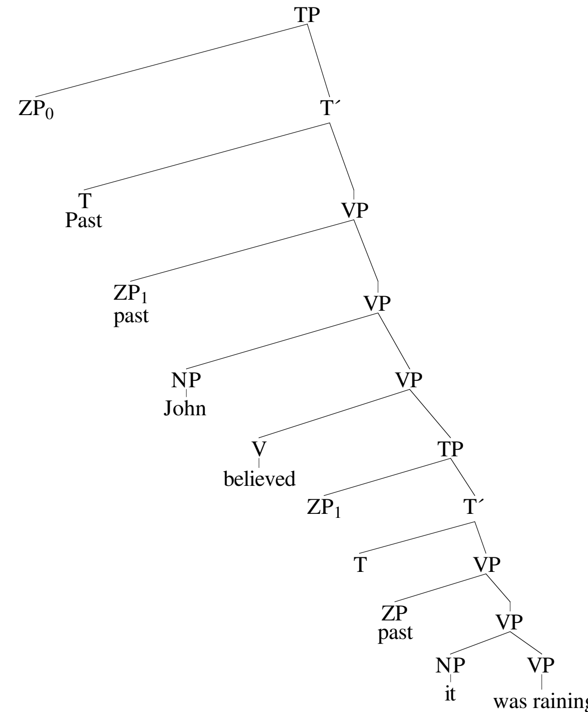
(73)



ZP_1 is the overt tense morpheme, denoting the leaving time or eventuality. The upper levels of the tree contribute the information $t_1 < t_0$, which is what we want, assuming as Stowell does that the specifier of TP in an unembedded context is identified with the utterance time so that t_0 is the utterance time. The novel aspect here is that the node contributing the temporal precedence relation, namely Past, is a covert operator, and is viewed as freely inserted. The overt tense node past is licensed by virtue of being c-commanded by Past in LF.

A simultaneous reading of (2) has the following analysis:

(74)



The main point is that the embedded tense node past is non-locally licensed by the c-commanding node Past, so that no local licensing relation need be present. This leaves a number of options open for the embedded T and [$_{ZP}$ past] nodes, but Stowell would have no reason to be unhappy with my suggestion that the embedded overt tense [$_{ZP}$ past] is coindexed with its local evaluation parameter ZP_1, and that the embedded T contributes an essentially unconstrained temporal relation variable.

Something needs to be said about the embedded local evaluation parameter ZP_1. In Stowell's representation, it is coindexed with the believing time, rather than being bound by lambda at the level of the argument of believe, as in my representation. Stowell aims to enforce this coindexing with control theory, on the model of control PRO configurations:

(75) $John_4$ hopes [PRO_4 to leave]

The representation (74) does not directly represent the now of the believer as a temporal parameter bound by the lambda at the level of the argument of believe. But Stowell's analogy to control makes sense semantically, given that control PRO is interpreted as a de se pronoun, a pronoun of self-reference. That is, in (75), the person who leaves in a centered world where John's hope is fulfilled is the self of that world. Presumably, an account of the syntax-semantics interface which gives PRO_4 in (75) a de se interpretation would generalize to give the embedded PRO-like evaluation time parameter in (74) an interpretation as the now of the believer.

Returning to the analysis of the embedded tense in (74), the tense polarity constraint (71) gives the same result as my formulation stated in terms of temporal relations transmitted to intensional arguments by feature passing. Notice, though, that a c-command constraint enforced at LF does not give intensional arguments any special status. If what I said in section 10 is correct, genuine sequence of tense arises only in intensional contexts. Consider an extensional context, with an embedded relative clause:

(76) a. Sue married a man who was in love with her best friend.
b. Sue married a man who is in love with her best friend.

The observation about (76a) is that it has no reading equivalent to (76b), with the loving taking place at the utterance time. Because the point is so obvious, it might be surprising that any theory runs the risk of deriving this reading. But in fact, I think many theories of sequence of tense do. Within a theory employing the temporal polarity constraint (71), we have to check whether any logical forms along the following lines are possible, with the embedded morphological past tense past licensed by the matrix operator Past.

(77) [ZP_0 Past $past_1$ Sue married [a man who [$past_0$ was in love with her best friend]]]

As in the simple structure (73), the matrix evaluation time ZP_0 denotes the utterance time and the matrix eventuality time $past_1$ precedes the utterance time. Since the embedded morphological past tense is c-commanded by the matrix operator Past, it meets the polarity constraint (71). It follows that it need not be licensed by a local Past operator. This has the effect of making its reference quite free, and above I have coindexed it with ZP_0, the utterance time.

In order to see whether there is a genuine problem here, we have to consider the indexing of the embedded spec of TP in (77), i.e. the embedded evaluation time parameter. Here is a version of the representation with this node included:

(78) [ZP_0 Past $past_1$ Sue married [a man who [ZP_k T $past_0$ was in love with her best friend]]]

What we have to play with is the index k of the local evaluation time ZP_k, and the temporal relation expressed by T, the embedded head of TP. Let us consider two options for k, the utterance time index 0, and the marrying time index 1. If k is 0, the evaluation time for the embedded sentence is the utterance time, and we could take the relation expressed by T to be identity, since T is a relation between eventuality time and local evaluation time, which would be identified if k is 0. This is a representation for the unobserved reading of (76a) where the time of being in love is the utterance time rather than the marrying time or some other past time.

If k is 1, the evaluation time for the embedded sentence is the marrying time. In this case, there is a good prospect for ruling out the representation. In particular, we could appeal to the upper limit constraint on the reference of tenses, as in my theory. If k is 1, the reference of $past_0$, namely the utterance time, follows the local evaluation time for $past_0$, namely the marrying time. So, perhaps the solution to the problem posed by (76a) is that the evaluation time for the embedded TP is forced to be the marrying time in any LF configuration where Past c-commands the embedded past. Within Stowell's program, this might be a consequence of control theory. Unfortunately, the data regarding the temporal perspective of certain modals discussed in section 7 provides evidence against allowing evaluation time to be shifted in extensional contexts. If we assumed a version of (78) where k is 1, there should also be representations along the following lines:

(80) [ZP_0 Past $past_1$ Sue married [a man who [ZP_1 T might become rich]]]

But this would --- at least given my assumptions from section 7 --- be a representation for a reading where the temporal perspective of might is the marrying time, something which is not possible in this extensional context.

My conclusion is that evaluation times are never shifted in extensional contexts, and as a result the index k in (78) would have to be 0. This means that to rule out the representation (78) – a representation where the embedded node past denotes the utterance time – we have to appeal to something other than an inappropriate relation to local evaluation time. My hypothesis is that the embedded past is not commanded by a licensing element in the relevant sense. In my proposal, the set of potentially licensing temporal relations in (78) would consist just of the local relation expressed by T. The reason the matrix relation Past is not a potentially licensing relation is that the embedded past node is not inside an intensional argument of married.

I emphasize that the point of interest in the argument I have just made is not whether we should think of the licensing relation as a structural relation in LF, but the content of that relation. Presumably, if intensional arguments were structurally marked in LF, we could reformulate my constraint --- which in the approach I outlined was implemented by feature passing --- as a command-like constraint.

13. Concluding Remarks

Although the independent theory seems quite attractive as a theory of tense, we saw that it is not general enough. I said its appeal lies in its assumptions, which do not go beyond what we already know about the theory of tense and attitudes. The data I introduced calls for a SQT-like analysis sensitive to intensional contexts, where temporal relations are transmitted by a feature passing mechanism to intensional arguments. This together with a generalization of the standard interpretation of tense (past and present tense) gives embedded tenses the desired interpretation. Under the proposed analysis SQT-past tense is not semantically vacuous, as it satisfies the condition of temporal precedence non-locally.

Although SQT theory covers all past tense examples handled by the independent theory, as well as additional data the latter fails to generate, I want to preserve the independent theory with its de re belief component. In section 11 we saw that de re interpretation of tense plays a central role in the interpretation of Prs\Pst sentences as it accounts for their double access reading.

Independently of SQT, a theory of tense must include the generalized version of the constraint on acquaintance relations, i.e., the upper limit constraint. This says the reference of tense cannot follow a local evaluation time parameter, which in a belief context can be equated with the believer's internal now. We saw that keeping track of such a parameter (as in Montague's IL) is independently motivated by data having to do with the temporal perspective of modals such as might. The upper limit constraint is related to a branching future concept of modal space, where the past but not the future is determined from the point of view of one modal alternative.

Notes

This paper is a contribution on my part to the Dyana-II project commissioned by the European community. My interests in sequence of tense was triggered many years ago by reading a manuscript on French indirect discourse by Hans Kamp and Christian Rohrer, a work which unfortunately has never been published. I benefited from talking to Hans Kamp on these issues. Murvet Enc's work on embedded tense gave old issues a new semantic twist. I owe a lot to her work which pointed at the important problems. Finally and most importantly, Mats Rooth helped clearing vagueness and getting me see what the real issues are. My long discussions with him over the topics presented in this paper were invaluable. A shorter version of this paper appeared in the proceedings of the Ninth Amsterdam Colloquium. Earlier versions of this work were presented at the Tense and Modality workshop at Ohio State in July 1993, the Event and Grammar conference at Bar-Ilan University, in October 1993, and the Ninth Amsterdam Colloquium in December 1993. I am indebted to the audience on these occasions for helpful comments. I am alone responsible for any mistakes or inadequacy.

1 For discussion of tense anaphoricity see Partee (1977, 1984).

2 Enc (1987) used indexed structures as in (2) as a representation for the simultaneous reading. Enc treats tenses as similar to nominal reflexives or PRO, in that they require a local antecedent, or rather, in Enc's theory, local 'anchoring', a more general notion.

3 As discussed in Dowty (1982), this simple description breaks down once we consider future-oriented embedding contexts, such as will. In Dowty's example (i) the time of the walking can be the time of the finding, rather than the speech time.

(i) John will find a unicorn that is walking.

In the cited paper, Dowty develops what I would call an independent theory of tense, thought he uses the tools of tense logic. He deals with the observation about will, originally due to Ladusaw (1977), by introducing an additional temporal index which is affected by will. In the text, I ignore this point in order to explain in simple terms what is appealing about the independent theory.

4 This example is from Perry (1977).

5 Lewis rejects the possibility in which Hume and Heimson are vicariously identical by having a common counterpart at some world. This is so because they differ in their origin, attributes and deeds, which stops them from having a common counterpart under any reasonable counterpart relation.

6 This idea is discussed in the appendix to Cresswell and von Stechow (1982). They also give arguments for allowing elements of arbitrary semantic and syntactic types to be

interpreted de re. This supports my proposal on the de re interpretation of tenses. I am using the LF representation simply to allow a compositional semantic rule to be stated.

[7] There is a problem in this formalization, in that the acquaintance relation (14) might not be specific enough to assure uniqueness. I will not go into how this problem might be addressed.

[8] Lewis proposed that de se pronouns be interpreted as de re pronouns with an acquaintance relation of identity. In my notation, the LF (i) is using relation (ii):

(i) John thinks$_1$ [he$_1$ λx[x is clever]]

(ii) λx_{self} λt_{now} $\lambda z[z=x_{self}]$

[9] As is the pronoun him.

[10] Kamp and Rohrer (1984) give the following example as an evidence for a SQT-like theory:

(i) Hier il decida enfin ce qu'il allait faire. Dans trois jours
Yesterday he decided finally what he was going to do. In three days
il dirait a ses parents qu'il allait quiter la maison.
he would say to his parents that he was going to leave home.

They note '...it is clear that the saying event to which the second sentence refers is to take place after the utterance time of the discourse' (p. 3, there).

[11] David Beaver has suggested to me that the were having in (38) might be a subjunctive rather than a SQT past tense verb. However, I do not think this is correct. One test for the subjunctive mood is the ability to replace were for was without effecting the meaning of the sentence, except for a change in register: were is somewhat more formal than was. For instance, wish in (i) and the conditional in (ii) trigger the subjective, and in both cases we can use was and were:

(i) I wish I was / were rich.

(ii) If I was / were not tired now, I would be talking to you.

In general, there are only a couple of contexts which license the subjunctive, and a simple modal is not by itself such a context. In (iii) will and might do not trigger the subjunctive, as indicated by the ungrammaticality of were:

(iii) * If anyone calls, I will / might say that I were busy.

The same example with was is licensed, but it does not have the simultaneous reading which would be possible for a subjunctive. Instead, was in (iii) is a past tense verb:

(iv) If anyone calls I will / might say that I was busy.

Similarly, when we change (35) into the singular, replacing the embedded subject they by he, we end up with an ungrammatical sentence:

(v) *John decided a week ago that in ten days he would say to his mother that he were seeing her for the last time.

Therefore, the modal context in (v) is not one which licenses a subjunctive, and so (38) cannot be a subjunctive.

(38) John decided a week ago that in ten days he would say to his mother that they were having their last meal together.

If were having in (38) were a subjunctive rather than a SQT past tense, there is no explanation for the ungrammaticality of the corresponding sentence (v) with were seeing, given the assumption that were and was have the same distribution as subjunctives.

[12] The modal would behaves differently from might and ought when embedded to extensional contexts. Consider:

(i) On May 7 1983 Jane met the man she would marry.

The time of the marrying in (i) is later than the meeting, but not necessarily later than the utterance time. One possible explanation is that there is a past tense on would which is anaphoric to the past tense on met (or to the time adverb). This past tense denotes the time the modal measures from, i.e., it denotes the perspective point for the modal. Example (i) differs from the extensional examples (39) and (42) with the embedded modals ought and might, since the latter measure possibilities and obligations from the utterance time.

Notice that in intentional contexts the past tense on would can be viewed as a SQT past tense denoting a time co-temporal with the believing:

(ii) Jane believed that she would marry a rich man.

This is why the marrying is interpreted as later than the believing.

[13] A forward shifted reading which violates the ULC seems marginally possible in some examples with event verbs. Consider:

(i) ? John hoped to discover a disease he later / eventually cured.

According to the ULC, the curing time can either precede or be simultaneous with the discovering time. But the reading where the curing follows the discovery is marginally possible. I think that (i) is better than examples with statives:

(ii) * Sue hoped to marry a man who later was rich.

But many examples with events seem just as bad:

(iii) When he moved to California John hoped to meet a Guru who *later resolved / would later resolve his spiritual problems.

[14] In my 1988 paper I used an example similar to (53) to demonstrate that when a tense of a RC is embedded under an intensional transitive verb, it behaves exactly like a complement tense. Namely, when a tense of a RC (for instance, past tense on <u>were</u> in (53)) is in the scope of an intensional verb, it may have the SQT reading. I offered this as an argument against Enc (1987) who attributed the different interpretations of embedded RC's and complements (only the former have a forward shifted reading) to a difference in syntactic structure. Enc proposes constraints similar to GB binding theory applying at D-structure. In my 1988 paper I claimed the right generalization instead has to do with scope relations which in GB would not be captured at D-structure.

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Institut für maschinelle Sprachverarbeitung
Universität Stuttgart
Azenbergstr. 12
D-70174 Stuttgart
Germany
dorit@adler.ims.uni-stuttgart.de