# Some Remarks on the Theory of Embedded Tense

Kyung-Hak Kim

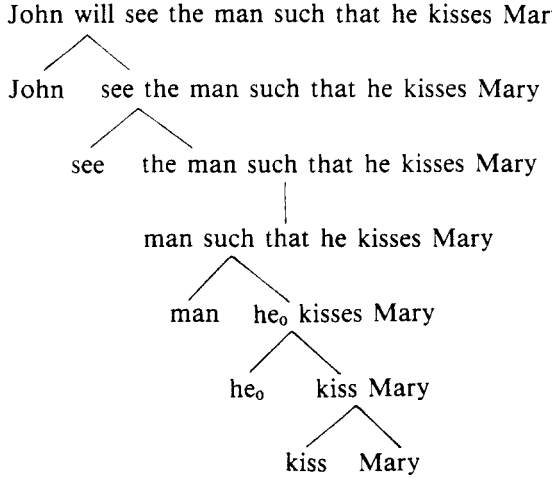
## 1. Introduction: Problems in PTQ

Ladusaw(1977) notes that the PTQ fragment with its priorian tense operators predicts that there will be interesting interactions between the tense operators and the two sources for NPs.

(1) John will see the man who kisses Mary.

If the noun phrase "the man who kisses Mary" is introduced directly into the tree, as illustrated in (2a), then the translation will be produced in which the translation of embedded clause appears within the scope of tense operator of main clause as shown in (2b).

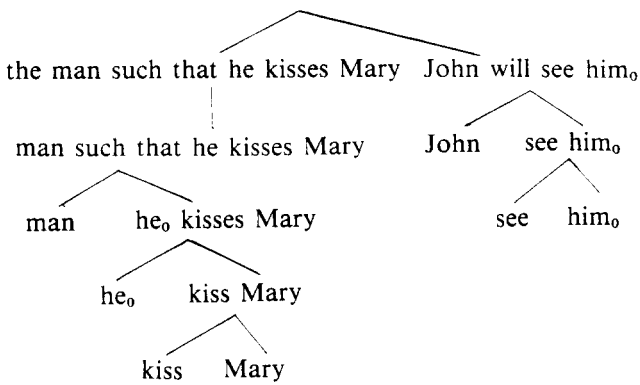
(2) a.




b. $W\exists y[\forall x[man'(x) \wedge kiss'(x, \hat{}m)] \leftrightarrow x = y] \wedge see'_{*}(j, \check{}y)$

It means that the individual that John will see is the man who at the time John sees him is kissing Mary. On the other hand, if the noun phrase in question is introduced by the NP quantification as illustrated in (3a), then the translation of embedded clause will appear outside the scope of main clause tense.

(3) a. John will see the man such that he kisses Mary




b. $\exists y[\forall x\ man'(x) \wedge kiss'(x, \check{\alpha}\hat{}\ m)] \leftrightarrow x = y] \wedge W\ see'_{*}(j, \hat{\alpha}\check{}\ y)$

It means that the man who is at issue is the one kissing Mary at the moment of speech. Therefore Ladusaw (1977) presents following 18 possible interactions between the three tense operators and the two sources for NP. (actually 12 possible interactions because the present tense in main clause doesn't make any ambiguity)

(4)

| | main verb operator | embedded operator | (a) quantification | (b) direct insertion |
|---|---|---|---|---|
| 1 | H | H | H.....H | H.....[H] |
| 2 | H | $\phi$ | H.....$\phi$ | H.....[$\phi$] |
| 3 | H | W | H.....W | H.....[W] |
| 4 | $\phi$ | H | $\phi$.....H | $\phi$.....[H] |
| 5 | $\phi$ | $\phi$ | $\phi$.....$\phi$ | $\phi$.....[$\phi$] |
| 6 | $\phi$ | W | $\phi$.....W | $\phi$.....[W] |
| 7 | W | H | W.....H | W.....[H] |
| 8 | W | $\phi$ | W.....$\phi$ | W.....[$\phi$] |
| 9 | W | W | W.....W | W.....[W] |

[Ladusaw(1977: 95): (15)]

However, the problem is that English sentences do not show all the ambiguities given in (4). Consider the following sentences:

(5) a. John will find the unicorn that has walked.
b. John will find the unicorn that (is) walk(ing).
c. John will find the unicorn that will walk.

(6) a. Mary has found the unicorn that has walked.
b. Mary has found the unicorn that (is) walk(ing).
c. Mary has found the unicorn that will walk.

Ladusaw notes that the three sentences in (5) that have the future tense in main clause seem to be ambiguous in the way predicted but those sentences in (6) do not. It means that Montague's treatment of present perfect as a simple past isn't adequate in predicting these readings. Ladusaw suggests that the non-ambiguity of the PTQ-H-embedded sentences in (6) is then predicted by the non-ambiguity of any structure embedded under a present tense, considering the present perfect tense with *have* as an aspectual auxiliary specifying priority. Consider the following past embedded sentences:

(7) Mary saw the unicorn that walked.

(8) a. Mary saw the unicorn that is walking.
b. Mary saw the unicorn that will walk.
c. Mary saw the unicorn that would walk.

Only the embedded past tense in (7) seems to show the predicted ambiguity. The other sentences in (8) don't show any ambiguity: sentences such as (8a) and (8b) have only the indirect reading which is the deep structure of a wide scope reading for an NP, while (8c) has a direct reading which is the deep structure of the narrow scope reading for an NP.

Ladusaw tries to solve this problem by adopting the type of syntax used in Cooper (1976) and the ordering between the NP-Lowering transformation and the sequence of tense rule. For example, in the case of (8a) and (8b), the NP-Lowering transformation will insert the wide scope NP into its lower surface position after the application of the sequence of tense rule. In this order, the sequence of tense rule cannot meet the structural description and then it can't apply.

In the case of (8c), the narrow-scope NP have the subordinate tense node in the right place at the right time and the sequence of tense rule must apply. Therefore the future modal verb *will* should be changed to *would*. According to this method, however, the narrow-scope NP derivation of

(7) must have the following surface structure rather than (7) as Dowty(1982) comments.

(9) Mary saw the unicorn that had walked.

There is another problem about the relation of de-re/de-dicto ambiguity in intensional contexts.

(10) a. Bill sought a man who will be leaving.
b. Bill sought a man who would be leaving.

In order to explain the embedded tense in (10a), to which the sequence of tense rule doesn't apply, the noun phrase containing the relative clause must be a wide scope NP, which should have only a de-re reading in intensional contexts. On the other hand in (10b) the sequence of tense rule does apply. Thus, the NP in (10b) must be a narrow scope one which should have a de-dicto reading in intensional context.

Though the judgements on these sentences are not clear, Ladusaw and Dowty(1982) suggest that these sentences can have both the de-re and de-dicto reading. It means that either the tense analysis or the de-re/de-dicto analysis should be changed.

In addition, because there is no independant motivation for a quantifying-in rule for *that-clause* we cannot explain the following complement structure:

(11) a. John will say that someone is searching his apartment.
b. John said that someone will be in his apartment.

Therefore giving up the treatment of tense with a scope in this way, Ladusow concludes that all embedded tense operators must be grounded at the speech time of the matrix clause regardless of the intervening operators.

## 2. Independance of Embedded Tense: Past Tense in the Matrix Clause

Let us look at some of the relevant data.

(12) Sam married a woman who left him for another.

This sentence does not seem to be interpreted as explicitly claiming that the woman in question left Sam before she married. As a matter of fact, we would probably tend to understand (12) to be claiming that the woman left Sam at some time after she married. In other words, the interpretation of the two past tenses in (12) is apparently quite independant as Ladusaw

suggests. Henry(1982) suggests that it is perfectly natural that the two tenses should be independant of each other if the sentence like (12) is regarded as having the logical form of a conjunction like (13).

(13) Sam married a woman and she left him for another.

Even though this logical form predicts the independant use of the two past tenses, we cannot explain the difference between the relative clause like (12) and the conjunction like (13) if we regard them as having the same logical form. Furthermore, this approach violates the surface compositionality principle.

On the other hand, Dowty(1982) suggests the following formula to explain the independant use of the two past tenses.

(14) PAST $[\phi \wedge \text{PAST } \psi] \equiv [\text{PAST}\phi \wedge \text{PAST } \psi)$

This formula can explain the following data easily.

(15) a. The woman that stole the book saw John.
b. The woman that stole the book saw John that robbed the bank.

Because this new system allows the reference times to be different in main and subordinate clauses, the sentnce (15a) not only permits the time of seeing to be the same as the time of stealing but also permits the time of seeing to be later or even earilier than the time of stealing. Furthermore, the sentence (15b) permits the three reference times (the stealing, seeing, and robbing) all to be at different times. Dowty modifies (14) as (16), which is a method of always systematically introducing a new reference time for each subordinate clause.

(16) PAST $[\phi \wedge \text{At}(t_o, \text{PAST } \psi)] = [\text{PAST } \phi \wedge \text{At}(t_o, \text{PAST } \psi)]$

According to the formula, the translation rule for relative clauses and that-complement verbs like *say* and *believe* can be revised as follows:

(17) Relative clause translation rule:
(Montague) $\lambda x_n [\zeta'(x_n) \wedge \phi']$
(Revised) $\lambda x_n [\zeta'(x_n) \wedge \exists t (\text{At}(t_o , \phi'))]$

(18) Translations of S-complement rules:
(Montague) believe-that′
(Revised) $\lambda P \lambda x \exists t$ [believe-that′ (x, $\hat{}$At(t, $\check{}$p))]

Hense (15a) can be translated as follows:

(19) PAST [∃x[∀y[woman′(x) ∧∃t[AT(t, PAST steal-the-book′(y))] ↔ x = y] ∧ see′(x, ^j)]]

This translation does indeed make the time of seeing and the time of stealing independant, though both are past.
Note the following examples:

(20) a. James bought a stamp that will be priceless.
b. James bought a stamp that would be priceless.

In order to explain these sentences, Dowty suggests that *FUT* operator and *WOULD* operator can be defined separately as follows:

(21) a. $[[\text{FUT}\phi]]^{i,j} = 1$ iff $[[\phi]]^{i,j} = 1$ and $i > j$
b. $[[\text{WOULD}\phi]]^{i,j} = 1$ iff $[[\phi]]^{i',j} = 1$ for some $i' > i$

It means that *WOULD* operator, in contrast to *FUT* operator, does behave like a priorian tense operator, shifting the point of evaluation to some new reference time later than the embedded reference time, not necessarily later than the time of speech.
Therefore, (20) can be translated as follows:

(22) a. PAST [∃x [stamp′(x) ∧∃t [AT(t, FUT be-priceless′(x))]] ∧ buy′(j, ˇx)]
b. PAST [∃x [stamp′(x) ∧∃t [AT(t, WOULD be-priceless′(x))]] ∧ buy′(j, ˇx))]]

There is no problem in (22a), but (22b) has some problems. In the past complex sentence with the subordinate clause containing *would* as in (20b) *would* is grounded at the reference time of matrix clause. In other words, the reference time which *would* in subordinate clause makes is later than the reference time of the matrix clause. However, in (22b), the time of stamp's being priceless may bear any temporal relation to the past time of James' buying a stamp. For this reason, Dowty suggests two alternative approaches.
Solution A: Return the translation rules for relative clauses and believe-type verbs to the original PTQ forms and modify the semantic rules for PAST to introduce a new reference time as follows:

(23) $[[\text{PAST}\phi]]^{i,j} = 1$ iff $[[\phi]]^{i',j} = 1$ for some $i'$ such that $i' < j$ (and $i' \leqslant i$)

The drawback of this solution that Dowty points out is that it no longer permits a theory of time reference in a simple manner, because the event time i′ of the main clause is separated from the reference time i of that sentence.

(24) John left.

According to (23), the time of John's leaving is actually a time i′ which might be earlier than the reference time i of the sentence.

Solutin B: modifying the interpretation of AT relative clauses rule and believe-type verbs as follows:

(25) a. $\lambda x_n$ ($\zeta'(x_n)$ $\wedge\exists t$ [$t \leqslant t^* \wedge AT(t, \phi')$]]
b. $\lambda p \lambda x$ $\exists t$ [$t \leqslant t^*$ $\wedge$ believe-that′ (x, $\hat{}$At (t, $\check{}$p′))]

Though the second solution provides a correct result for an embedded *USED-TO* $\phi$, it does not correctly analyze an embedded *WOULD* $\phi$ because it still does permit the reference time of *WOULD* $\phi$ to bear any temporal relation to the reference time of the matrix clause.

However, Dowty suggests that either of the modified aproaches can have an advantage even though neither of them gives completely satisfactory results.

(26) John believed that Bill was here.

Under both modifications, the time of Bill's being here is correctly required to be prior to or at the same time as the time of believing.

However, if we admit that this prediction is intuitively right as Dowty does, we must give up the advantage of the independant use of two past tenses which Ladusaw suggests.

Note the following examples:

(27) a. Sam married a woman who was an actress.
b. Sam married a woman in 1950 who was an actress when I met her in 1940.
c. Sam married a woman in 1950 who was an actress when I met her in 1960.

According to these modifications, we can easily explain (27b), but we cannot explain (27c). Furthermore, the example (12) is a real problem for those modifications.

(12) Sam married a woman who left him for another.

Unlike the prediction, (12) is more likely to permit the time of leaving him to be later than the time of marriage because of the pragmatic knowledge about the world. If the time of leaving was in fact earlier than that of marriage, which might be supported by those modifications, the appropriate sentence is (28), not (12).

(28) Sam married a woman who had left him for another.

Therefore those modifications cannot provide any correct results. Note the data containing WOULD $\phi$ again:

(20) a. James bought a stamp that will be priceless.
b. James bought a stamp that would be priceless.

If we regard (20) as having the logical form of a conjunction as (29), (29b) has the same kind of problem that Dowty suggests, even though (29a) can give a preferred reading of (20).

(29) a. James bought a stamp and it will be priceless.
b. James bought a stamp and it would be priceless.

In order to solve this problem, Richards(1982) adopts the lambda abstraction over the future-tense-variables in the second conjunct, representing the logical form of (20b) as (30), instead of (20b).

(30) $\text{Past}_{(w,\,i)}$ [James buy it and $\lambda w \lambda\ \text{Fut}_{(w,\,i)}$ (it be preiceless)]

According to Richards' definition, the logical form like (30) can give a preferred reading of (20b), which implies that the stamp James bought has in the meantime become priceless. However, it still does violate the surface compositionality principle even if it can give the correct result.

Note the exceptional case of the independant use of the two tenses:

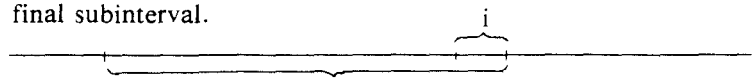
(31) a. James bought a stamp which had been priceless.
b. James bought a stamp which would be priceless.

Henry coniders the sentences like (31) as a real problem if the tenses in relative clauses are really independant. In order to solve this problem, Henry suggests the pragmatic binding which can relate the reference time of the matrix clause to the relevant time of the subordinate clause instead of Richards' abstraction method. However, Henry's solution is too vague.

Instead, we can find a solution in Dowty's analysis of perfect operator

*HAVE*.

(32) a. $[[\text{PRES}\phi]]^{i,j} = 1$ iff $[[\phi]]^{i,j} = 1$ and $i = j$
b. $[[\text{PAST}\phi]]^{i,j} = 1$ iff $[[\phi]]^{i,j} = 1$ and $i < j$
c. $[[\text{HAVE}\phi]]^{i,j} = 1$ iff $[[\phi]]^{i',j}$, where i′ is some interval of which i is final subinterval.




[Dowty(1982: 32)

Dowty doesn't consider the perfect operator *HAVE* as the basic tense operator. Unlike the basic tense operator, the perfect operator *HAVE* as the aspectual auxiliary does make reference to a new time i′, which is somewhat analoguous to a distinct event time. In other words, the perfect operator *HAVE* can behave like a priorian operator in that it shifts the point of evaluation of its embedded sentence from i to i′.

Therefore, we can easily explain (31a) if we assume that the past perfect operator *had* in the subordinate clause is something like PAST [.....HAVE $\phi$].

Then (31a) can be translated as follows:

(33) PAST [$\exists$x [stamp′(x) $\wedge$ $\exists$t [AT(t, HAVE (be-priceless′(x)))]] $\wedge$ buy′(j, ˇx)]

Because the embedded perfect operator *HAVE* is bound to the matrix past tense, the embedded sentence "the stamp be priceless" can be evaluated at the new event time i′ which might be earlier than the reference time i at which the matrix clause is evaluated. Thus this analysis can give a correct result.

When we compare (31a) with (31b), the only difference is that *had* in (31a) is converted to *would* in (31b), we can show this difference as follows:

(34) a. PAST [$\phi \wedge$ HAVE $\psi$]
b. PAST [$\phi \wedge$ WILL $\psi$]

This means that (31b) can be easily explained like (31a) if we assume that *would* in the subordinate clause is something like PAST ...WILL and the future operator is not a basic one. Fortunately, the future operator *will* is a modal auxiliary as the perfect operator *have* is an aspectual auxiliary. Therefore, we can modify the future operator *will* to behave like a priorian operator as follows:

(35) (Modified) $[[\text{WILL } \phi]]^{i,j} = 1$ iff $[[\phi]]^{i',j} = 1$ where i′ is later than i

This modification can give a correct result. Therefore, we can argue that the perfect operator *HAVE* and the future operator *WILL* behave like priorian operators. They combine with *PRES* or *PAST* to form *have* or *had* and *will* or *would*, respectively. In case of (20a), the future operator *will* in the subordinate clause can't combine with the *PAST* tense of the matrix clause. Therefore, we can have a surface structure of (20a) as follows:

(36) PAST [$\phi \wedge$ PRES [WILL $\psi$]]

Because the two basic tense operators can behave independantly, a subordinate clause can be evaluated at the new event time i' later than the speech time i ($i = j$). This modification permits the preferred reading of (20a) as well as (20b). In addition, we need not postulate a *WOULD* operator separately.

## 3. Ambiguity of Embedded Tense: Future Tense in the Matrix Clause

When we turn to the future tense, we find a strikingly different pattern. We limit ourselves here to *will,* though there are many other ways of obtaining relativization to the future.

Note the following example:

(37) a. John will marry a woman who is rich.
b. John will marry a woman who was rich.
c. John will marry a woman who will be rich.

As Ladusaw notices, these sentences are ambiguous in subordinate clause tense. For example, in (37a), the time of woman's being rich can be the same as either the time of marrying or the speech time.

In other words, tenses embedded inside of *WILL* sometimes seem to behave as if they were priorian operators, even if they do not when embedded in *PAST*. Richard can solve this problem by adopting the abstraction method in the following ways:

(38) a. $\text{Fut}_{(w,\,i)}$ [John marry her and $\lambda w \lambda i\ \text{Pres}_{(w,\,i)}$ (she be rich)]
b. $\text{Fut}_{(w,\,i)}$ (John marry her) and $\text{Pres}_{(w,\,i)}$ (she be rich)

Though this approach can provide a correct result, we cannot adopt it because it violates the compositionality principle and because it would give an ad hoc explanation of the past tense matrix clause.

On the other hand, Dowty suggests the following generalization about embedded tenses:

(39) a. When embedded in a matrix clause past tense, the tenses past, present and future always relate the time of their clauses to speech time in a fixed way: they are absolute tenses in this case.
b. When embedded in a matrix clause future tense, the tenses past, present and future relate the time of their clauses consistently to the time of the matrix clause: they are relative tenses in this case.

Therefore the future operator is modified as the following substitution operator:

(40) FUT$\phi$ is true at <i, j> iff $\phi$ is true at <i′, i′>, for some i′ such that i′>j

According to this new definition, the future tense as the substitution operator has the effect of providing the reference time of the matrix clause as a kind of quasi-speech time to its subordinate clause. Thus tense operators embedded inside of *WILL* can relate their reference time to the reference time of the matrix clause i′ not to the actual speech time j, because $\phi$ is evaluated at <i′, i′>

Though this modification can give one reading for the ambiguous future sentence, it can't give a complete satisfactory result because it doesn't explain another reading in the following sentences.

(41) a. John will say that Mary is happy.
b. John will say that Mary was happy.

These sentences exhibit precisely the same ambiguity as relative clauses: We can't use the quantifying-in rule because there is no independant motivation for that-clause. Furthermore, in the following sentence, the tense operator in the subordinate clause clearly refers to the speech time, but not the reference time of matrix clause.

(42) One day John will regret that he is treating me like this.

In order to solve this problem, Dowty suggests two alternative possible sotutions either by (i) adopting a quantifying-in rule for that-clause or by (ii) treating the future tense as ambiguous. However, Dowty doesn't give an ultimate solution because he believes that many other sentences cannot have an interpretation like (42).

Consider Dowty's example:

(43) a. Smith will claim on the witness stand that he is in Mexico.
b. Smith will claim on the witness stand that he was in Mexico.

Suppose that A and B are two FBI agents who caught the criminal, and B knows that Smith may have arranged on alibi that he is spending the entire current month in Mexico. Dowty argues that if B tells this fact to A, the utterance is (43b) not (43a). Dowty also suggests that the difference between (42) and (43) indicates that the time of the general topic of discourse in which a sentence occurs affects the possibilities for the sequence of tense interpretation. In other words, Dowty considers the substitution operator like (40) as the basic future operator and makes use of pragmatic elements such as discourse topics to explain (42).

However, in order to solve this complicated problem, Dowty(1983) gives up his previous system and suggests a new system which involves two kinds of tense operators: (a) absolute tense operators (PAST, PRES and FUT) which always relate the time of their clauses to speech time, (b) relative tense operators (past, pres and fut) which relate the time of their clauses consistently to the time of the matrix clause.

Then their definitions are modified as follows:

(44) Recursive semantic clauses, relative to three parameters: 'i' is the index shifted by tense operators (and relative to which basic expressions are assigned values): 'r' is the discourse interval (or reference time), and 's' is the speech time,

a. $[[\text{PAST } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' \leqslant r$, and $r < s$.
b. $[[\text{PRES } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' \leqslant r$, and $i' = s$.
c. $[[\text{FUT } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' \leqslant r$, and $r > s$.
d. $[[\text{past}\phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' < r$, and $i' < r$.
e. $[[\text{pres } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' \leqslant i$, and $i' \geqslant s$.
f. $[[\text{fut } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' > i$, and $i' > s$.
g. $[[\text{have } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' < i$.
h. $[[\text{would } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' > i$.

A formula is true with respect to discourse interval 'r' and the speech time 's' iff $[[\phi]]^{i,r,s} = 1$ and $i = r$ (i.e. the 'outermost' index 'i' equals discourse interval).

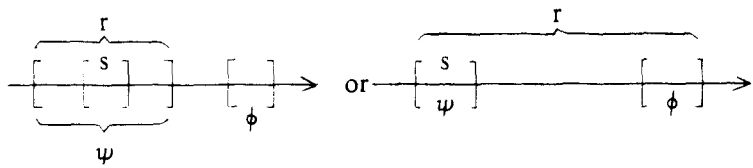
This new system can explain the complicated example about the matrix future tense:

(45) a. One day, John will regret that he is treating me like this.
b. (In the context of a future narrative:) But Mary will deny that John is working for her.

The present tense in the embedded clause is not evaluated at the reference time of the matrix clause, but at the speech time. Therefore, these sentences

can be treated as cases of the absolute present embedded in the relative future. According to the new system, they can be explained as follows:

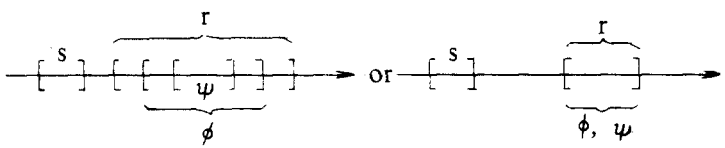
(46) a. fut [$\phi \wedge$ PRES $\psi$]

b. 


Note a case of the absolute future embedded in the absolute future.

(47) John will think that Mary will be asleep (so he will think she won't hear him).

(48) a. FUT [$\phi \wedge$ FUT $\psi$]

b. 


Both (45) and (47) are problematic under the Dowty's(1982) system because the present and future tenses embedded in the matrix future tense don't relate their reference time to the reference time of matrix clause, but the speech time.

However, they can be explained as a case of the absolute tense embedded in the future which is evaluated at the speech time.

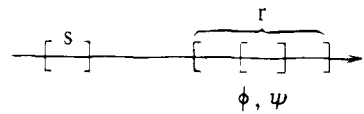
Note another case in which Dowty(1982) regards the matrix future as a substitution operator.

(49) a. When he hears the noise at the window, John will think that a burglar is trying to break in.
b. John will catch the thief that stole the painting.
c. John will think that Mary will win.

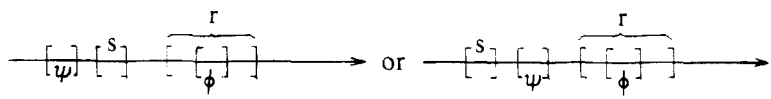
In (49), the embedded tenses relate the time of their clauses constistently to the future of the matrix clause. Therefore, Dowty(1982) employs the substitution operator. But according to the new system they can be explained as a case of the relative tense embedded in the absolute future as follows:

(50) Relative tense embedded in absolute future:

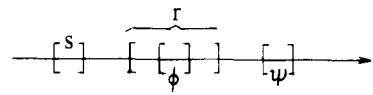
a. FUT [$\phi \wedge$ pres $\psi$] :




b. FUT [$\phi \wedge$ past $\psi$] :




c. FUT [$\phi \wedge$ fut $\psi$] :




As above, this new system which employs both the absolute and relative tenses may be ambiguous in the subordinate clause tense. But it can't give a correct result where the matrix past tense can't give rise to ambiguities in the subordinate clause tense as we argued in section 2. In some ways, it can't be different from the PTQ system: the combination of absolute and relative tense is similar to the interaction of tense operators with two sources for NP in PTQ (see (4)). Therefore, Dowty's(1983) new system may have a wrong prediction like the PTQ system as Ladusaw(1977) points out. Furthermore, it is an ad hoc device in the choice of the absolute or the relative tense operator.

## 4. Summary and conclusion

As we discussed in the previous section, the theory of embedded tense is complicated and any theory can't give a correct result. Therefore, the following modification of the previous theory is presented as an alternative.

First, Dowty's Generalization about the embedded tense is modified as we have argued in the previous section.

(51) a. When embedded in a matrix clause past tense, the subordinate clause past and present tenses always relate the time of their clauses to the speech time in a fixed way: they are absolute tenses in this case.

b. When embedded in a matrix clause future tense, the subordinate clause past and present tenses may relate the time of their clauses

either to the time of the matrix clause or to the speech time: they may be either relative tenses or absolute tenses in this case.

In other words, the embedded tense may be ambiguous when embedded in a matrix clause future tense, while may not when embedded in a matrix clause past tense.

Second, the two absolute tenses, *PAST* and *PRES* except future are adopted as the basic tense operators. Their definitions are given in accordance with Dowty(1983).

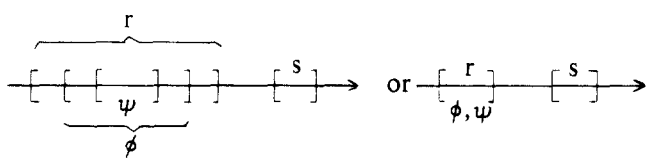
(44)′ a. $[[\text{PAST } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' \leqslant r$, and $r < s$.
b. $[[\text{PRES } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' \leqslant r$, and $i' = s$.

Note the following examples.

(52) a. John believed that Mary was asleep.
b. John found a unicorn that was asleep.

These sentences can be explained as follows:

(53) a. PAST $[\phi \wedge \text{PAST } \psi]$

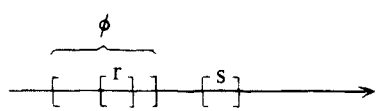
b. 


Third, since the future tense operator 'will' is a modal auxiliary and the perfect tense operator 'have' is an aspectual auxiliary, they can't be regarded as the basic tense operators as we have discussed in section II.

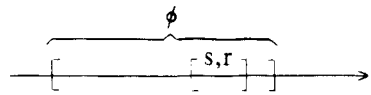
Their definitions are modified a little as follows:

(54) a. $[[\text{have } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' \leqslant i$.
b. $[[\text{will}\phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' > i$.

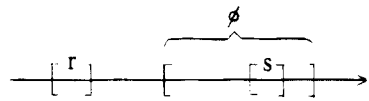
Therefore, they must combine with PAST and PRES to form a compound tense:

(55) a. PAST have $\phi$ : 

b. PRES have $\phi$ :




(56) a. PAST will $\phi$ :



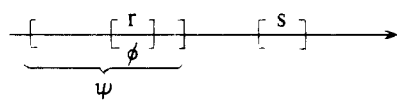

b. PRES will$\phi$ :


Note the following examples:

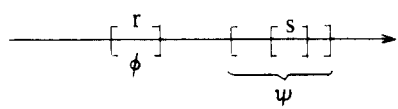
(57) a. John met a woman who had climbed Mount Everest.
b. John met a woman who would climb Mount Everest.

These are explained as follows:

(58) a. PAST [$\phi\Lambda$ have $\psi$] :




b. PAST [$\phi\Lambda$ will $\psi$] :




Fourth, the relative tense will be adopted only when embedded in a matrix clause future tense.

Note the following examples.

(59) a. John will find a unicorn that walked.
b. John will find a unicorn that is walking.
c. John will find a unicorn that will walk.

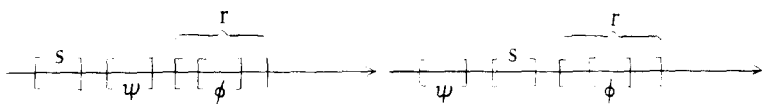
The future tense expressed in a modal auxiliary 'will' seems to create an intensional context for the interpretation of the embedded tense. Then the embedded past and present tense must relate the time of their clauses to the time of the matrix future: they are relative tenses in this case.

The relative tense can be defined in accordance with Dowty(1983):

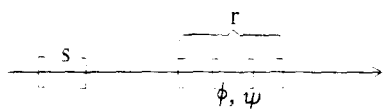
(44) d. $[[\text{past } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' < i$, and $i' < r$.
e. $[[\text{pres } \phi]]^{i,r,s} = 1$ iff $[[\phi]]^{i',r,s} = 1$ for some $i' \leqslant i$, and $i' \geqslant s$.

Then (59) can be represented as follows:

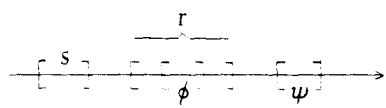
(60) a. PRES will [$\phi \wedge$ past $\psi$] :




b. PRES will [$\phi \wedge$ pres $\psi$] :



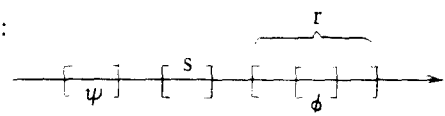

c. PRES will [$\phi \wedge$ pres will $\psi$] :



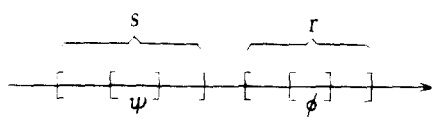

In this case the embedded tense will be in the scope of the modal auxiliary 'will'. However, when this modal 'will' doesn't create an intensional context, the embedded tenses are transparent and they relate the time of their clauses to the speech time: they are absolute tenses in this case.

Then, (59) can be represented as follows:

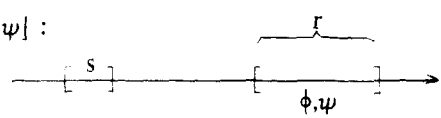
(61) a. PRES [will $\phi \wedge$ PAST $\psi$] :




b. PRES [will $\phi \wedge$ PRES $\psi$] :




c. PRES [will $\phi \wedge$ PRES will $\psi$] :




In this case, the embedded tense won't be in the scope of the modal auxiliary 'will'.

## References

Comrie, B(1981)"On Reichenbach's approach to Tense", *CLS* 17, 24-30.

Dowty, D.R (1979) *Word Meaning and Montague Grammer,* D. Reidel, Dordrecht.

_____ (1982) "Tenses, Time Adverbs, and Compositional Semantic Theory" *Linguistics and Philosophy* 5, 523-55.

_____ (1983) "Time Adverbials, Tenses and the Temporal Interpretation of Discourse", Paper presented at the 83 Seoul Workshop on Formal Grammar, December 19-21.

Ejerhed, Eva (1980) "Tense as a source of Intensional Ambiguity" *Ambiguities in Intensional Contexts,* 231-252. D. Reidel, Dordrecht.

Henry, Flank (1982) Tense, Aspect and Time Adverbials II. *Linguistics and Philosophy* 5, 109-154.

Ladusaw, W (1977) "Some Problems with Tense in PTQ," *Texas Linguistic Forum* 6, 89-102.

Richards, B (1982) "Tense, Aspect and Time Adverbials I," *Linguistics and Philosophy* 5, 59-107.

Smith, C (1978) "The syntax and Interpretation of Temporal Expressions in English," *Linguistics and Philosophy* 2, 43-100.

Suwon College
Suwon 170
Korea