A Proper Treatment of the Sequence-of-tense Phenomenon in English*

Mean-Young Song

My purpose in this paper is to provide an appropriate account of the sequence-of-tense (SOT) phenomenon in English. I address some problems with the previous studies of the sequence of tense such as Ladusaw (1977) and Ogihara (1992). Ladusaw's (1977) claim that the matrix past tense is copied onto the based-generated present tense in the complement clause runs into trouble when it deals with present-under-past sentences. Ogihara's proposal that the embedded tense is deleted under its identity to the matrix tense is not sufficient to account for sentences where the non-stative predicates occur in the complement clause. I propose the Tense Co-indexing rule which roughly says that the embedded tense is co-indexed with the matrix tense under identity. This rule is intended to denote a precedence or simultaneous relation between the matrix tense and the embedded tense. I also propose a SOT rule that says the embedded tense is deleted when bound by the matrix tense. The Tense Co-indexing rule triggers the application of the SOT to a given sentence. The analysis which I propose here takes account of those sentences that are not properly treated by Ladusaw (1997) and Ogihara (1992).

1. Introduction

This paper is devoted to discussing sequence-of-tense phenomena, as exemplified in (1), and formulating an appropriate rule that takes account of them.

(1) John believed that Mary was beautiful

Tense agreement[1] between the matrix tense and the embedded tense

*This work is supported by the Dongguk University Research Fund. I'd like to thank two anonynous reviewers for their comments and suggestions, All remaming errors are, of course, my own.

in indirect speech has been traditionally known as a "sequence of tense" (henceforth SOT). The SOT is characterized by the fact that when a finite verb appears in the complement of propositional attitude verbs, the embedded tense is interpreted relative to its embedding tense, rather than to the speech time. For example, in a sentence like (1), where the past tense appears in the complement of the propositional attitude verb *believe*, the temporal interpretation of the embedded past tense is dependent on that of the matrix past tense, leading either to a simultaneous reading in which the time of John's believing (i.e. the reporting time) is simultaneous with the time of Mary's being beautiful or to a shifted reading in which the time of Mary's being beautiful is prior to the time of John's believing.

In this paper, I will discuss how the SOT phenomena have been dealt with in the modern linguistic literature. After that, I will argue that they are not properly accounted for by their previous analyses. As an alternative to the previous analyses, I will propose an SOT rule which can account for the phenomena in a better way.

I will briefly mention how this paper is organized. Section 2 includes the discussion of the previous treatments of the SOT phenomena and their problems. In Section 3, I will propose an alternative SOT rule, along with the Tense Co-indexing rule which roughly states that the embedded tense is co-indexed with the matrix tense if the former is identical to the latter.

2. Review of Previous Sequence-of-Tense Rules

In this section, I will discuss the SOT rules proposed in the previous literature and why they are not sufficient to deal with the SOT phenomenon. In order to account for sentences like (2),

(2) John said that Mary was proud of her dissertation

a transformational rule called the SOT rule has been introduced

1. Tense agreement is a terminology used by traditional grammarians. This states that the tense of an embedded clause must coincide with that of its embedding clause in indirect speech.

according to which the past tense in the embedding clause is copied onto the present tense in the embedded clause (Comrie (1985, 1986), Ladusaw (1977), and Ross (1967)), as illustrated in (3):

(3) SOT Rule (Ladusaw (1977: 97))

	X	(Tense)	Y	PAST	Z	(Tense)	W
SD:	1	2	3	4	5	6	7
SC:	1	4	3	4	5	4	7

[4 commands 2 and 6, but neither 2 nor 6 commands 4][2]

SD stands for structural description, and SC structural change. SD is an input for transformational rules like a SOT rule, while SC an output of the application of those rules. The SOT rule in (3) states that the embedded tense commanded by the matrix tense is converted to a past tense when the matrix tense is a past tense. Given this, a sentence like (2) has a D-structure like (4):

(4) John PAST say that Mary PRES be proud of her dissertation

By applying the SOT rule in (3), we obtain its surface form of (2).

The SOT rule in (3) runs into troubles when it applies to the embedded tense in sentences like (5a) and (5b):

(5) a. John believed that Mary is a hard worker
b. John said that Mary will arrive here at 9

In (5a), the present tense is embedded in the matrix past tense. The matrix past tense commands the embedded present tense and not vice versa. Therefore, the SOT rule in (3) would predict that the embedded present tense should be converted to a past tense, which is contrary to fact. The same comments hold for (5b). Overall, the SOT rule in (3) cannot account for sentences where tenses other than the past tense occur under the matrix past tense.

2. The definition of "command" can be stated as follows (cf. Langacker (1969)): A constituent α commands a constituent β iff every S-node that dominates also dominates β.

Another problem with the SOT rule is that it cannot account for the difference between the semantic representation of "past under past" and that of "present under past", as has been noted by Enç (1987). Consider the following sentences:

(6) a. John knew that Mary was pregnant
b. John knew that Mary is pregnant

According to the SOT theory, the underlying structures of (6a) and (6b) are like (7a) and (7b), respectively:

(7) a. John PAST know that Mary PRES be pregnant
b. John PAST know that Mary PRES be pregnant

The meaning of (6a) is obviously different from that of (6b)-that is, the former has a simultaneous reading, whereas the latter has a double-access reading in which the time at which Mary's allegedly pregnant overlaps both the time of John's saying and the utterance time. Since the SOT rule is optional, it applies to (7a), deriving the S-structure like (6a) from the D-structure like (7a). On the other hand, the SOT rule doesn't apply to (7b), obtaining (6b) as its S-structure. As is seen in (7a) and (7b), the two sentences (6a) and (6b) should have the identical representation at DS which is later fed into the semantic interpretation: hence, the SOT rule fails to capture the difference between the semantic representations of (6a) and (6b).

In his recent work, Ogihara (1996) proposes a SOT rule which is inspired by Ladusaw (1977) and Ross (1967), but which is different from the SOT rule in (3). His version of the SOT rule is this:

(8) If a tense A is locally commanded by another tense B at LF and A and B are occurrence of the same tense (i.e., either present or past), A is optionally deleted. (Ogihara (1996: 124))

One major difference between the SOT rule in the spirit of transformational grammar (cf. Ladusaw (1977) and Ross (1967)) and Ogihara's version of the SOT is that the latter is like a tense deletion

rule, whereas the former a copying rule. In addition, unlike the traditional SOT rule which is effective just in case the matrix tense is in past tense, the SOT rule proposed by Ogihara (1996) is extended to a degree that the SOT rule is applied when the matrix tense is either in past tense or in present tense. What is important about the application of the rule is that the embedded tense is the same as the matrix tense. Let us consider the following sentences for illustration:

(9) John said that Mary was sick

A sentence like (9) is ambiguous between a shifted reading, in which the time of Mary's illness is prior to the time of John's report, and a simultaneous reading, in which the time of Mary's illness coincides with the time of John's report. (9) has S-structure like (10):

(10) John PAST say that Mary PAST be sick

Since the embedded PAST is locally commanded by the matrix PAST, and furthermore the embedded tense is the same as the matrix tense, the embedded PAST is optionally deleted at LF by the SOT rule in (18); hence, (10) has two different LF's, as in (11a-b):

(11) a. John PAST say that Mary Ø be sick
b. John PAST say that Mary PAST be sick

(11a) is the result of the application of the SOT rule to (10), while this is not the case with (11b) (recall that Ogihara's SOT rule is optional). According to Ogihara (1996), when the embedded tense is deleted, a simultaneous reading is obtained, whereas the embedded tense is not deleted, a non-simultaneous reading is obtained. Thus, (11a) is an LF for a simultaneous reading, and on the other hand, (11b) is an LF for a non-simultaneous reading, i.e., a shifted reading in this case.

Ogihara's proposal makes a clear distinction between the semantic representation of "past under past" sentences and that of "present under past" sentences, which, as we saw above, are not well accounted for in terms of the traditional SOT rule. Consider the following sentences:

(12) a. John said that Mary was sick
b. John said that Mary is sick

Sentences like (12a-b) have S-structures like (13a) and (13b), respectively:

(13) a. John PAST say that Mary PAST be sick
b. John PAST say that Mary PRES be sick

Notice that the tense in the complement in (13a) is the same as the matrix tense, while the tense in the complement in (13b) is not. Therefore, the SOT rule is applicable in (13a), but not in (13b), as in (14a-b):

(14) a. John PAST say that Mary be sick
b. John PAST say that Mary PRES be sick

An LF representation like (14a), where the SOT rule is applied, produces a simultaneous reading, while an LF representation like (14b) does not, namely (14b) is an LF for a "double access reading" (DAR) in which the time at which Mary's allegedly sick overlaps both the time of John's saying and the utterance time.

Ogihara's proposal of the SOT rule, however, runs into trouble as soon as it deals with the following sentences in (15). This problem may be related to the fact that the SOT rule proposed by Ogihara is optional.

(15) John said that Mary bought a car

Compare (15) with (9) which is a past-under-past sentence. Recall that (9) is ambiguous between a shifted reading and a simultaneous reading. Ogihara's SOT rule deals with (9) successfully, as mentioned above. In contrast to (9), (15) is not ambiguous. (15) has only a shifted reading in which the time of Mary's buying a car is earlier than the time of John's saying. The problem with Ogihara's SOT rule in dealing with (15) is that his rule would predict that (15) should be ambiguous in the same way as (9) is, since according to it, the embedded past tense in (15) is deleted optionally. That is, it predicts a simultaneous reading should be available

in (15), contrary to fact. The reasoning is as follows. Because Ogihara's SOT rule is optional, we have to consider two possibilities: one is that the embedded past tense is deleted, as in (16a) and the other is that it is not, as in (16b).

(16) a. John PAST say that Mary buy a car
b. John PAST say that Mary PAST buy a car

(16a), where the embedded past tense is deleted, is an LF for a simultaneous reading, whereas (16b), where the embedded past tense is not deleted, is an LF for a shifted reading. As we saw above, (15) has only a shifted reading, indicating that the embedded past tense in (15) must not be deleted. Thus, the LF (16a) should be ruled out as ill-formed. However, both of the LF's in (16a-b) are well-formed within Ogihara's framework, which indicates that (15) should be ambiguous between a shifted reading and a simultaneous reading. This is contrary to fact, and hence, Ogihara's SOT rule cannot account for why a simultaneous reading is not available in (15), as noted by Portner (1998). Thus, the SOT rule proposed by Ogihara (1996) is not sufficient to account for the SOT phenomenon.

3. Proposal

Linguists like Comrie (1986), Ladusaw (1977) and Ross (1967) propose a SOT rule which says that an embedding past tense is copied onto the embedded tense. Recently, Ogihara (1996) proposes a SOT rule which is formulated as an embedded tense deletion rule. As we have seen in section 2, neither provides an appropriate treatment of the SOT phenomenon. The purpose of this section is, thus, to propose a more syntactically appropriate way to account for the SOT phenomenon.

3.1. Index mechanism

Based on Partee's (1973) observation that temporal expressions are parallel to nominal ones, Enç (1987) and Abusch (1997) assume that just as pronominal expressions have an index for their interpretation, every

tense bears a temporal index whose role denotes the most salient reference time. In this paper, I will adopt the assumption to describe the temporal relationship between the embedded tense and the matrix tense. Consider the following sentence:

(17) John said that Mary was sick

A sentence like (17) is ambiguous between a simultaneous reading and a shifted reading. On the simultaneous reading, the time of John's saying is co-temporal with the time of Mary's being sick. On the shifted reading, the time of Mary's being sick is prior to the time of John's saying. According to Enç and Abusch, the simultaneous reading of a sentence like (17) is obtained by the co-indexation of the tense in the complement with the matrix tense, as in (17a):

(17a) John $PAST_1$ say that Mary $PAST_1$ be sick

(17a) shows that the two tenses have an anaphoric relation in a way analogous to nominal anaphora, as in (18):

(18) $John_1$ believed that Mary liked him_1

On the other hand, the shifted reading of a sentence like (17) also can be represented by using indices. When a sentence like (17) is interpreted to have a non-simultaneous reading, the embedded tense is not co-indexed with the matrix tense, as in (17b):

(17b) John $PAST_1$ say that Mary $PAST_2$ be sick

The representation in (17b) where the two tenses are not co-indexed indicates that (17) allows a non-simultaneous reading (i.e., a shifted reading in this case). Along the lines of Abusch (1997) and Enç (1987), I will employ indices to denote the temporal relation between the embedded tense and the matrix tense,[3] on the assumption that the

3. Abusch (1997) and Enç (1987) adopt the referential theory of tense in their treatments of

embedded tense is co-indexed with the matrix tense only when a complex sentence produces a simultaneous reading.

Before we go on, I'd like to mention the indexing system I employ in this dissertation. I will use numerical subscripts to indicate indices. When the index for the embedded tense is identical to that for the matrix tense, it is intended to get a simultaneous reading. If the index for the embedded tense is less than that for the matrix tense, this indicates a shifted reading. Finally, if the index for the embedded tense is greater than that for the matrix tense, a forward-shifted reading is intended, namely the temporal denotation in the embedded clause is posterior to that in the matrix clause. This can be summarized as follows:

(19) In the configuration $[_{CP} \ldots\ldots \alpha_i \ldots\ldots [_{CP} \ldots\ldots \beta_j \ldots\ldots]]$, where α and β are identical tenses,

a. if $i = j$, then a simultaneous reading is intended
b. if $j < i$, then a backward shifted reading is intended
c. if $i < j$, then a forward shifted reading is intended

One should note that the indexing notations in (19a-c) are just notational conventions to represent a temporal relation between the matrix tense and the embedded tense in a simple way. Besides, I assume that temporal indices are provided by the context of use, which is along the lines of the referential theory of tense.

3.2. A Sequence-of-tense rule

In this sub-section, we will spell out an alternative SOT rule and the way an LF for a sentence like (17) can be derived. I assume that the following structure is a S-structure for (17) that we can get after the movement of the VP-internal based subjects to SPEC of IP:

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tense. The referential theory is characterized by the use of indexing mechanism as a means of referring to determinate tense. The fact that I will employ the indexing mechanism here does not mean that my analysis is in the lines of the referential theory.

(20) [$_{IP}$ John$_5$ PAST e$_5$ say [$_{CP}$ that Mary$_6$ PAST e$_6$ be sick]]

I also assume that a structure like (20) is the initial stage to derive a desirable LF. In the course of derivation of the LF for (17), we need two rules which apply at LF: the Tense Co-indexing Rule and the SOT rule. First, the Tense Co-indexing Rule can be stated as follows:

(21) Tense Co-indexing Rule (TCR)
In the configuration [$_{CP}$ .... α ..... [$_{CP}$ ..... β .....]], and are optionally co-indexed iff
(i) α and β are identical tenses, and
(ii) the head of XP which is a sister of INFL immediately dominating β is a stative predicate.

The second condition in the definition of the Tense Co-indexing Rule means that the predicate which morphologically combines with the tense β should be stative. As Portner (1998) notes, in the SOT context the embedded stative predicate is interpreted in a different way the embedded non-stative predicate is. Consider the following sentences:

(22) a. John said that Mary was sick
b. John said that Mary left

In (22a) where the embedded predicate is stative, the time of Mary's sickness either overlaps or precedes the time of John's saying, whereas in (22b) the embedded predicate in (22b) is non-stative, the time of Mary's leaving precedes the time of John's saying. This is the reason why the Tense Co-indexing Rule is sensitive to stative predicates.

The Tense Co-indexing Rule can apply to the representation in (20) since the two conditions are satisfied. The tense in the complement and the matrix tense are both in the same tense, namely the past tense. In (20), the embedded predicate is a stative one. The application of the Tense Co-indexing Rule turns (20) into (20a):

(20a) [$_{IP}$ John$_5$ PAST$_1$ e$_5$ say [$_{CP}$ that Mary$_6$ PAST$_1$ e$_6$ be sick]]

Before we go on, I'd like to mention one thing. According to the Tense

Co-indexing Rule, in (20) the embedded past tense may not be co-indexed with the matrix past tense since the embedded predicate in (20) is stative. In other words, the Tense Co-indexing Rule may not apply to (20). When the rule does not apply to (20), we can think of two possibilities that the index for the embedded past tense in (20) is smaller or greater than the index for the matrix past tense, as illustrated in (20b) and (20c):

(20b) $[_{IP}$ John$_5$ PAST$_2$ e$_5$ say $[_{CP}$ that Mary$_6$ PAST$_1$ e$_6$ be sick]]

(20c) *$[_{IP}$ John$_5$ PAST$_1$ e$_5$ say $[_{CP}$ that Mary$_6$ PAST$_2$ e$_6$ be sick]]

According to (19), (20b) where the index of the matrix past tense is greater than that of the embedded past tense represents the backward shifted reading of (20) where the time of Mary's sickness is earlier than the time of Mary's saying, whereas (20c) where the index of the matrix past tense is smaller than that of the embedded past tense represents the forward shifted reading where the time of Mary's sickness is later than the time of Mary's saying, which is impossible in (20). We need to rule out the structure (20c) as ill-formed.[4] In order to exclude a structure like (20c), I propose the following constraint:

(23) Tense Indexing Constraint (TIC)
The index of the present and the past tense embedded in the complement of propositional attitude verbs cannot be greater than that of the tense which serves as a local evaluation time for that embedded tense.

In (20), the embedded past tense has the matrix past tense as a local evaluation time. (20c) violates the TIC because the index of the embedded past tense is greater than the index of the matrix tense, hence (20c) is out.

Let us get back to the main line of our discussion. Given (20a), the next step is to apply the SOT rule to (20a). I will adopt but slightly

4. Paul Portner pointed out this to me.

modify Ogihara's SOT rule which roughly says that the embedded tense is deleted under identity to its matrix tense, as we already discussed in section 2. The SOT rule I will propose here is basically defined in terms of a binding relation between two tenses. Binding can be defined as follows:

(24) Definition of Binding (Primary)
α binds β iff is co-indexed with β and α c-commands β.[5]

Given (24), the SOT rule I have in my mind is something like this:

(25) SOT Rule (Preliminary Version)[6]
In the construal $[_{CP}$ .... α_i ..... $[_{CP}$ ..... β_j ..... $]]$, β_j is deleted iff α_i binds β_j, where i and j are indices

Let us get back to (20a). In (20a), the matrix tense binds the embedded tense since they share the same index and the former c-commands the latter. Thus, the SOT rule converts (20a) to (20d):

(20d) $[_{IP}$ John$_5$ PAST$_1$ e$_5$ say $[_{CP}$ that Mary$_6$ Ø e$_6$ be sick]]

(20d) is the LF representation for a sentence like (20) that we want to obtain. One thing I'd like to mention is that there is an ordering relation between the Tense Co-indexing Rule and the SOT rule. The Tense Co-indexing Rule must apply before the SOT rule, and not the other way around.

3.3. Sentential subjects

The SOT rule in (25) seems to work properly with a sentence like (20),

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5. α c-commands β iff α does not dominates β and every γ that dominates α also dominates β.

6. Although I propose the SOT rule (25) under the influence of Ogihara, some differences still exist. I will not discuss the differences for the time being because the SOT rule in (25) is not the final version I have in my mind, as we will see below. I will get back to this later in this sub-section.

yet it runs into troubles as soon as it accounts for some structures such as sentential subjects, as illustrated in (26) and (27). In what follows, I will discuss the problem and modify the SOT rule slightly so that it can capture those problematic structures. Recall that the SOT rule in (25) is defined in terms of the binding defined on the basis of the "c-command" relation.[7] The definition of the binding in the SOT rule which is based on c-command cannot explain the following sentences:

(26) That Bob liked Susan was obvious

(27) The rumor that John was suffering from amnesia surprised me

A sentential subject occurs in the sentence (26), and the complex NP occupies the subject position in (27). Sentences like (26) and (27) can be understood to have a simultaneous reading. The stative predicates occur both in the sentential subject in (26) and the complex NP in (27).[8] After the application of the Tesne Co-indexing Rule, the structures for (26) and (27) look like (26a) and (27a), respectively:

(26a) $[_{CP}\ [_{IP}\ [_{CP}$ That Bob $PAST_1$ like Susan$]\ [_{I'}\ PAST_1$ be obvious$]]]$

(27a) $[_{CP}\ [_{IP}\ [_{NP}$ The rumor $[_{CP}$ that John $PAST_1$ be suffering from amnesia$]]\ [_{I'}PAST_1$ surprise me$]]]$

In (26a) and (27a), the matrix tense does not c-command the embedded tense; hence, the SOT rule in (25) cannot apply since the matrix tense does not bind the embedded tense. A way out would be to introduce an alternative syntactic relation between the matrix tense and the embedded tense in a way that the matrix tense can "see" the embedded tense syntactically. We can make the matrix tense see the embedded tense by incorporating the notion of "m-command" into the definition

7. Recall from section 2 that Ogihara (1996) does not employ "c-command" in his definition of the SOT rule. Instead, he uses "command". Furthermore, he doesn't employ a binding relation between the matrix tense and the embedded tense.

8. Notice that progressives are referred to as stative.

of the binding relation in the SOT rule. The structural relation "m-command" can be defined as follows:

(28) α m-commands β iff α does not dominate β and every maximal projection γ that dominates α also dominates β.

For the purpose of the definition of the binding relation between the matrix tense and the embedded tense, I will revise the definition of binding (24) as (29) in which its definition is given in terms of m-command.

(29) Definition of Binding (Final)
α binds β iff α is co-indexed with β and α m-commands β.

Let us get back to (26a) and (27a) and see how the definition of binding in terms of "m-command" works. In (26a), the matrix tense which occupies the head of the higher IP does not dominate the embedded tense which occupies the head of the lower IP dominated by the higher IP, and the maximal projection of the matrix tense, namely the higher IP, which dominates the matrix tense also dominates the embedded tense. Thus, the matrix tense m-commands the embedded tense. This enables the matrix tense to bind the embedded tense. The same comments hold for (27a). We will use "m-command" instead of "c-command" in defining the binding relation in the SOT rule. Given this, the application of the SOT rule turns (26a) and (27a) into (26b) and (27b), respectively, where the embedded tenses are deleted:

(26b) [$_{CP}$ [$_{IP}$ [$_{CP}$ That Bob Ø like Susan] PAST$_1$ be obvious]]

(27b) [$_{CP}$ [$_{IP}$ [$_{NP}$ The rumor [$_{CP}$ that John Ø be suffering from amnesia]] PAST$_1$ surprised me]]

3.4. Multi-embedded clauses: A final version of the SOT rule

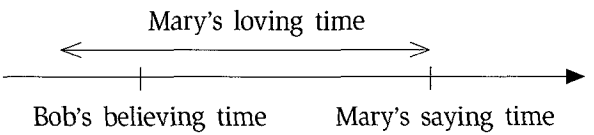
This sub-section is devoted to discussing how the SOT rule works in multi-embedded clauses. Consider the following sentence. This is similar

to Lee Baker's example cited in Ogihara (1992):

(30) Bob believed that in a week Mary will say to him that she loved him

(30) can be interpreted to mean that the time of Mary's loving Bob could be any time before her saying time. This indicates that (30) can get three possible temporal relations between Bob's believing time and Mary's loving time. In other words, Mary's loving time could precede, coincide with, or follow Bob's believing time, as illustrated in (31).

(52)



It is worth noticing that a sentence like (30) motivates Ogihara (1996) to introduce "local domain" into his definition of SOT rule, as we saw in section 2. The local domain can be defined as follows within our framework:

(32) Local Domain[9]
A tense β is in the local domain of α iff α m-commands β and there is no tense γ intervening between α and β such that α m-commands γ and γ m-commands β

According to him, if the local domain were not incorporated into the definition of the SOT rule, it would be predicted that as a result of applying the SOT rule to (33a), the lowest past tense could be deleted at LF because of the highest past tense, as in (33b):[10]

9. Ogihara (1996) defines the local domain in terms of "command".

10. Notice that the tenses don't bear indices in the structures in (33a-b). They are given in terms of Ogihara's framework.

(33) a. Bob PAST believe that in a week Mary PRES WOLL say to him that she PAST love him.[11]
b. Bob PAST believe that in a week Mary PRES WOLL say to him that she Ø love him.

He claims that if the null tense Ø in (33b) is interpreted relative to Mary's saying time, it is predicted that the time of Mary's loving Bob should be simultaneous with her saying time, which is incorrect. In order to prevent such a wrong prediction, the local domain needs to be incorporated into the SOT rule. The lowest past tense in (33a) is not in the local domain of the highest past tense since there is an intervening tense, namely PRES, which m-commands the lowest past tense. Thus, the deletion of the lowest past tense is blocked.

There is a certain plausibility to his claim, but it gives rise to a problem in case (30) is interpreted as Mary's loving time coinciding with Bob's believing time. If the local domain prevents the lowest past tense from being deleted at LF, (33a) will be an LF for (30). Given this, (33a) cannot get a reading where Mary's loving time is simultaneous with Bob's believing time.[12] Instead, it should get a shifted reading in which the time of Mary's loving him precedes the time of John's belief. Thus, Ogihara's claim can't explain the case where the time of Bob's belief is simultaneous with Mary's loving time. In what follows, I will discuss a possible way out.

Let us get back to the three possible temporal relations I mentioned above concerning (30). These three possibilities can be represented within our framework in terms of the Tense Co-indexing Rule.

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11. The auxiliary verb *will* is analyzed as PRES WOLL, while would PAST WOLL. This indicates that *will* does not refers to the future tense. The semantic function of WOLL locates the event time after the reference time or the local evaluation time, as illustrated in its translation $\lambda P \exists t'[t<t' \ \& \ P(t')]$.

12. Ogihara (1996) acknowledges that there is a possibility that in a sentence like (30), Mary's loving time is simultaneous with Bob's believing time, but he says that he does not pursue this possibility since he regards this kind of simultaneous reading as a special case of "a possible reading of the sentence which is understood as a real past tense" (Ogihara (1996: 148)).

(34) a. Bob $PAST_1$ believe that in a week Mary $PRES_3$ WOLL say to him that she $PAST_2$ love him.
b. Bob $PAST_1$ believe that in a week Mary $PRES_3$ WOLL say to him that she $PAST_1$ love him.
c. Bob $PAST_2$ believe that in a week Mary $PRES_3$ WOLL say to him that she $PAST_1$ love him.

(34a) is a structure for the reading of (30) where Bob's believing time precedes Mary's loving time. (34b) is a structure for the reading where Bob's believing time is simultaneous with Mary's loving time. Finally, (34c) is a structure for the reading where Bob's believing time is later than Mary's loving time. Notice that the SOT rule in (25) is not applicable to (34a) and (34b) since the highest past tense is not co-indexed with the lowest past tense. Thus, my discussion will be focused on (34b). I will not incorporate "local domain" into the definition of the SOT rule since it causes a problem, as mentioned above. I think the co-indexing mechanism which is employed in our framework may play a certain role in getting out of the difficulty with Ogihara's SOT rule which local domain is incorporated into.

It is predicted, according to the SOT rule in (25), that the lowest past tense in (34b) is deleted since it is co-indexed with and m-commanded by the highest past tense. (34b) is, thus, converted to (35):

(35) Bob $PAST_1$ believe that in three days Mary $PRES_3$ WOLL say to him that she Ø love him

A structure like (35) gives rise to a problem. It does not indicate any information of whether the deleted tense coincides with the matrix tense $PAST_1$ or with the intervening tense $PRES_3$. Given this, (35) could be interpreted as the time of Mary's loving him being co-temporal with the time of Mary's saying to him, contrary to fact. In order to prevent this kind of reading, the null tense needs to carry the information that it is bound by the (higher) tense on which its temporal interpretation is dependent. In (35), the null tense Ø must be bound not by $PRES_3$ but by $PAST_1$. This suggests that Ø should bear the same index as that the highest past tense has (recall that the definition of binding is given in

terms of co-indexation and m-command). I will assume that the index of the null tense does not disappear even after its original tense is deleted (i.e., after the application of the SOT rule). At the moment of the application of the SOT rule, the Tense Co-indexing Rule already provides the information of which tense is co-indexed with which tense. This information should be preserved throughout the derivation. Otherwise, we could get an undesired interpretation, as mentioned above. Thus, the LF should look not like (35) but rather like (36) where the index of the null tense is preserved after the application of the Tense Co-indexing Rule (as in (34b)).

(36) Bob $PAST_1$ believe that in three days Mary $PRES_3$ WOLL say to him that she $\varnothing_1$ love him

(36) indicates that Mary's loving time is simultaneous with Bob's believing time, rather than with her saying time, since the null tense is bound by the highest past tense. Thus, (36) gets a simultaneous reading.

Given what I have discussed so far, the revised version of the SOT rule in (25) can be stated as follows:

(37) SOT rule (Final Version)
In the construal $[_{CP}$ ..... α_i ..... $[_{CP}$ ..... β_j ..... $]]$, or $[_{CP}$ ...$[_{CP}$ ..... β_j ....$]$ .... α_i .....$]$, β_j is converted to $\varnothing_j$ iff α_i binds β_j, where i and j are indices and binding is defined in terms of m-command.

We will see in what follows how the SOT rule in (37) fits in English examples. Consider the following sentences:[13]

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13. I will briefly discuss how we take account of a sentence (i) in terms of the SOT rule proposed in this paper. This is mentioned by one of anonymous reviewers.

(i) John said that the earth is round

A sentence like (i) in which the present tense occurs under the matrix past is referred to as a double-access sentence in the sense that the time referred to by the embedded present has access to the time of the matrix past and the time of the utterance. Notice that our SOT rule is applicable only when the embedded tense and the matrix tense share the same tense and the same index. In a sentence like (i), however, the matrix tense is different from the embedded tense, and thus the SOT rule is not applicable. I will not go into the further discussion of the double-access sentence because this is beyond the present study. The reader

(38) a. John believed that Mary was sick
b. John believed that Mary bought a car

Recall that a sentence like (38a) is ambiguous between the simultaneous reading in which John's believing time coincides with the time of Mary's being sick and the shifted reading in which the time of Mary's being sick is prior to John's believing time. In contrast, (38b) produces only a shifted reading. First, let us consider the simultaneous reading of (38a). Notice that the embedded predicate is stative. Thus the Tense Co-indexing Rule can be applied to (38a) optionally. If the rule applies to (38a), the embedded past tense shares the same index with the matrix past tense. As a result, the SOT rule in (37) is applicable, which leads to the simultaneous reading. On the contrary, if the Tense Co-indexing Rule does not apply to (38a), the embedded past tense does not share the same index with the matrix past tense. This indicates that the SOT rule is not applicable, and thus, the shifted reading is produced.

Let us get back to (38b). Recall that (38b) is not ambiguous, namely it only receives a shifted reading. Since the embedded predicate is not a stative one, the Tense Co-indexing Rule cannot be applied to (38b), and, in turn, the SOT rule is not applicable. Thus, the embedded past tense cannot be deleted, which represents the shifted reading of (38b).

I will conclude this section by mentioning some important properties of the SOT rule I have proposed in this section. First, indices play an important role in the SOT rule I propose since it is determined by the co-indexation whether the SOT rule applies at LF or not. Second, unlike the SOT rule proposed by Comrie (1986), Ladusaw (1977), and Ross (1967), the SOT rule I propose is involved in the deletion of the embedded tense under the indexical identity. The deletion of the embedded tense is along the lines of Ogihara. In his version of the SOT rule, Ogihara (1992, 1996) proposes to delete the embedded tense when a certain conditions are satisfied, but he does not employ the indexing mechanism, as we saw in section 2. Third, the SOT rule I propose is defined in terms of binding while Ogihara's SOT rule is not. Fourth, the definition of binding is given in terms of m-command, and this enables

can refer to Song (2000) for more detailed semantic account of the double-access sentence.

us to account for the tenses in sentential subjects or in the complex NPs occupying a subject position. Recall that Ogihara's SOT rule is defined in terms of command, as we saw in section 2. Fifth, unlike Ogihara, I do not introduce local domain into the SOT rule proposed by me. Finally, my version of the SOT rule is characterized by the fact that unlike Ogihara's SOT rule which is optional, it is a obligatory rule which applies when certain structures are met.

4. Conclusion

The SOT rule which is intended to account for the SOT phenomena has been elaborated upon in this paper. I argue in this paper that neither the traditional way to deal with the SOT (cf. Ladusaw (1977), Ross (1967)) nor Ogihara's recent proposal provides a proper account of the SOT phenomena. In order to account for the SOT in English, I have proposed the SOT rule which is a direct descendent of Ogihara's (1996) version. My version of the SOT rule is obligatory, while Ogihara's is optional. As a preliminary stage for the application of the SOT rule, I have also proposed the Tense Co-indexing Rule (TCR). TCR plays a crucial role in determining whether the SOT rule applies or not. Ogihara's SOT rule cannot take a proper account of sentences like *John said that Susan walked to school.* In this respect, my SOT rule is in a better position to account for such sentences.

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Department of English
Dongguk University
707 Seokjang-dong, Gyeongju-si
Gyeongbuk 780-714, Korea
E-mail : songmy@mail.dongguk.ac.kr