Temporal Identification through Binding

Satomi Niwa

1. Introduction

There have been various approaches to the explanation for temporal interpretation of complex sentences. In Hornstein (1977, 1981, 1990), time denoting entities, E, R, S are introduced, and with the analysis of the status of these entities, the issue of how temporal construal is established has been of interest. In the study of temporal interpretation, structural properties and semantic properties must be taken into account. In this paper, I will propose a possible mechanism of temporal construal for complex sentences on the basis of the semantic properties of tense and predicates along with the structural factors.

Following this introduction, facts and previous approaches to the temporal interpretation are briefly looked through. In section 3, with the observation that tense is similar to pronominals to some extent, a mechanism of temporal interpretation by binding is proposed. Section 4 contains concluding remarks.

2. Facts and Previous Approaches

2.1 Facts

There is a phenomenon called Sequence of Tense (SOT) in English. SOT is generally seen in an embedded clause in indirect speech. It is understood as a kind of rule that 'converts' or 'shifts' the tense of the complement clause according to the tense denoted in the matrix clause.

(1) John said that Bill was sick.

There are two interpretations for this sentence. One interpretation is that Bill's being sick and John's reporting this incident happened simultaneously. The other is that Bill's being sick happened before John's reporting it. These readings can be paraphrased in direct speech as follows:

(2) a . John said, "Bill is sick."

b . John said, "Bill was sick."

Application of SOT to (2) derives the sentence (1). To analyze why these two interpretations are possible, there have been various studies in the literature.

At the same time, in indirect speech, there is a sentence as in (3).

(3) John said that Bill is sick.

This sentence means that Bill has been sick before (or, at least, since) John's reporting this till up to the time of the speaker's utterance. This is a case where SOT has not been applied. Although the temporal inflection on the verb in the embedded sentence is present, the event described in the embedded clause is interpreted as something 'from past till present'. Here is another problem; why can the embedded event be considered from past with no past material in the embedded sentence?

The embedded clauses in (1) and (3) are complement clauses. When the embedded clauses are adjuncts, the situation is different. Enç (1987) points out that finite relative clauses, which are adjuncts, are independent of the tense of matrix clauses in tense interpretation.

(4) a . John gave a book to a boy who hit the ball.

b . John gave a thousand dollars to the man who sold your house.

(Stowell 1993b: 2, 14)

For (4a), John's giving a book to a boy can either be before or after the boy's hitting the ball. The situation is the same for (4b) that the event described in the matrix clause can be before or after the event in the relative clause.

With these facts in mind, recent previous approaches to the tense interpretation mechanism are briefly looked through in the next section.

2.2 Previous Approaches

2.2.1 Three Theoretical Entities

Following a Reichenbachaian approach to tense analysis, Hornstein (1977, 1981, 1990) assumes that three theoretical entities explain temporal interpretations in English: a moment of the speech S, a moment of the event described in the embedded sentence E, and a reference point R. Fundamentally, they are used in linear order. How each tense is represented with them is partly shown in the following:

(5) Simple present: S, R, E
Simple past: E, R, _S
Simple future: S_R, E (Hornstein 1977: 522)

In this framework, when a line separates two temporal entities, it means that the left side temporal entity precedes the right side one; and when a comma separates two entities, it means that the two entities are 'occurring' at the same time. In Hornstein (1990) the Event time is associated with VP and the Reference time and the Speech time belong to Inflectional projections.

2.2.2 Time Denoting Entities as Thematic Roles

There have been various ways of interpreting what these entities are and where they should belong. One approach is to consider the time denoting entities to be thematic roles.

Zagona (1988) argues that the relationship between I^0 and its complement VP is similar to the relationship between V^0 and its complement DP and that I^0 gives a temporal theta role to VP. Within Zagona's framework, the matrix verb receives the temporal feature [±Past] from I^0. This feature identifies the argument of I^0, VP, in terms of temporal thematic roles. I^0 also takes its external argument and gives a thematic role to it. The theta role given to the external argument of I^0 is equivalent to S in Hornstein's approach, and the other thematic role given to its internal argument is equivalent to E in Hornstein's.

Stowell (1993a, b), modifying Zagona's (1988) approach, introduced a new projection ZP (Zait Phrase), which is a referential functional category that appears between TP and VP. It is argued that ZP's relationship with its argument VP is analogous to that of DP with NP. Just as V^0 gives its internal thematic role to its argument, T^0 gives ZP an internal thematic role: Event time theta-role. The head position of this ZP binds a temporal variable in the specifier position of VP.[1]

In Stowell (1993a, b), T^0 also gives its external thematic role to an item in the specifier position of TP. This external theta-role is the Reference time theta-role. The item in the specifier position of TP denotes time, just as T^0's internal argument ZP does. It is considered that this external argument is null ZP. Moreover, this null ZP is considered to be a temporal analogue of PRO. These operators, variables and PROs enter into the binding relationship, and a temporal interpretation is given in Stowell's framework. Stowell (1993a) argues that morphological tense is a kind of polarity item and through control theory true tense can be interpreted.

There are three points to be considered here. One is whether Event time is a thematic role or not. Among these studies, the status of Event seems to be connected to or associated with VP, but there is no evidence that Event is a thematic role. In

Higginbotham (1985) it is argued that Event is a non-thematic argument in the argument structure of verbs.[2]

Secondly, the status of the time denoting theta-role assigner is different from other thematic role assigners. Originally, a thematic role is given by a lexical category to its lexical arguments. In Stowell (1993a, b) and Zagona (1988), Event 'thematic role' is given from T^0, a functional category, to VP.

Thirdly, the temporal morphology is treated in a special way. In this framework, control theory determines what Reference time denotes. Reference Time is the external argument of matrix T^0. The controller of this argument is a c-commanding ZP, which does not exist for the main clause. Thus, this external argument, PRO-ZP, denotes the Speech time. The shifted reading for (1) derives as follows: the PRO-ZP in the embedded sentence is controlled by the temporal variable e_i in the matrix VP specifier position, which is the closest c-commanding controller. This variable is bound by the Z^0 of the matrix ZP_i, which has Event time theta-role given by the matrix T^0. Thus the Speech time is after a time ZP_i at which John says that ZP_i is after a time ZP_j at which Bill was sick.[3]

(6) $[_{TP}$ ZP (= PROarb) $[_{T'}$ $[_{T}$ PAST $[_{ZPi}$ Z_i $[_{VP}$ e_i $[_{VP}$ $[_{DP}$ John $[_{V''}$ $[_{V}$ said $[_{CP}$ $[_{C}$ that $[_{TP}$ ZP (= PRO_i) $[_{T'}$ $[_{T}$ PAST $[_{ZPj}$ $Z_j]$ $[_{VP}$ e_j $[_{VP}$ Bill was sick]]]

For the simultaneous reading for (1), Stowell (1993a) argues that a past porality item (past) in a lower clause is licensed by a past tense in a higher clause, as the past tense in the lower clause is actually not a realization of true tense. The absence of true tense in the lower clause precludes a shifted reading and it gives rise to the simultaneous reading. Thus the same word was is treated as an item with true tense at one time and as a tenseless item at another.

It seems plausible that T^0 has something to do with tense interpretation, but in the literature, the mechanism is not precisely determined. T^0 (or I^0) and V or VP function for interpretation, as in Zagona (1988), or arguments of T^0's, i.e. new temporal projections in the specifier position and complement position of TP play the role, as in Stowell (1993a, b). In Stowell (1993a, b) the new projection ZP for time interpretation appears in two different positions; one is in the specifier position of TP, which is a PRO, and the other is in the complement position of TP. Moreover these two play two different roles in temporal interpretation. The one in the specifier position plays the part of an operator as a whole projection; on the other hand, the head of the complement of TP binds a variable in the specifier position of its complement, VP. Both of the two ZPs, arguments of T, receive temporal theta-roles, and these thematic roles

are different ones; so this may be plausible. However, if possible, it seems desirable to be able to avoid this complicated new functional projection.

With the above taken into consideration, I will look at semantic properties in detail in the following section.

3. Tense Interpretation through Binding

3.1 Factors that Affect Tense Interpretation

3.1.1 Stage-level Predicates and Individual-level Predicates

In 2.1, the fact is shown that a sentence like (1) *John said that Bill was sick* has two interpretations. But there are other types of sentences that have the same structure as (1) but do not allow ambiguity.

(7) Mary said that she bought a book.

For (7), the interpretation that her buying a book and Mary's reporting it happened at the same time is impossible: the only possible reading is that her buying a book occurred before Mary's reporting it. There is no structural difference, so there should be some other factor behind this.

One difference between (1) and (7) is the predicate types of the embedded sentences. The predicate *be sick* in (1) carries the meaning "state," and the predicate *buy* in (7) the meaning "action." This difference is also categorized by the term individual-level predicates and stage-level predicates. To see the difference, look at the setnteces in (8).

(8) a . Manon is dancing this morning.

b . Manon is a dancer. (Krazar 1995: 128)

In (8a), the event described in the predicate *is dancing* is an event happened just around that time, so the predicate is considered to be stage-level. On the other hand, in (8b), the predicate *is a dancer* is interpreted to be individual-level predicate. This difference is reflected on other sentences concerning temporal interpretations.

The following sentences are examples to which SOT is not applied.

(9) a . John said that Bill is sick. (=(3))

b . He said that his girlfriend has blue eyes.

The next are examples with SOT.

(10) a . John said that Bill was sick. (=(1))

b . He said that his girlfriend had blue eyes.

The interpretation difference between (9a) and (10a) is that upon hearing the sentence (9a) the hearer understands that John told the reporter of (9a) that Bill was sick and

is still sick at the time when (9a) is produced. On the other hand, neither the hearer nor the producer of (10a) knows whether Bill is still sick or not at the time of the utterance of this sentence.[4] The predicates in the embedded clauses in (9) and (10) are individual-level predicates. Now take a look at a sentence with the same structure and a stage-level predicate.

(11) a . She said that he tells lies.
b . She said that he told lies.
c . She said that he told a lie.

It is possible to make the apparently same kind of sentences with stage-level predicates, but the interpretations show the following difference. (11a) means that she reported his habitual action of telling lies. (11b) means that she reported his repetition of lying before the time of reporting. In (11c), it is described that she reported his telling a lie occurred at one time before her reporting it. It never means the same temporal situation described as in the sentences in (9). The predicate in the embedded clause in (12) is another stage-level predicate, and here, it is impossible to make a sentence that is an exception to SOT application.

(12) a . Janet said that she killed her neighbor's cat.
b . *Janet said that she kills her neighbor's cat.

The predicate in (12), *kill*, can be a repetitive action. When the word *neighbor's* is taken off, the sentence *Janet said that she kills cats* means that *she* repeats killing cats: the habitual reading is available as in (11a).[5] However, the described situations become more restrictive in meaning and existence in reality for a stage-level predicate to be used in this kind of construction.

This suggests that the meaning of a phrase is established with the interaction of semantic properties of each item within the phrase. Therefore this must be included in the interpretation mechanism.

As seen so far, an individual-level predicate implies that the event of the predicate has certain temporal duration, while the event of a stage-level predicate is rather temporal or it rather focuses on changing from one state to another. This difference can create a different temporal location of an event. [±Past] is given to a verbal item as the central semantic property and the semantic property of predicate type works as a function. An individual-level predicate creates durational temporal meaning, mapping the temporal value of an event as a linear location on the time stream or time axis; on the other hand, a stage-level predicate maps the temporal value on the time stream rather as a point. Also the semantic interaction within a phrase cannot be overlooked. These

ideas will be integrated into the temporal interpretation mechanism in 3.2.

3.1.2 Temporal Adverbials

Another factor that affects temporal interpretation can be seen in the sentences with gerundive relatives. Before going into gerundive relatives, first look at a sentence with a finite relative clause.

(13) A passenger who was waiting for flight 307 complained to the flight attendant. (Thompson 2001: 290)

There are three possible readings for (13). In (13), complaining and waiting may take place at the same time or either one can take place first. Now take a look at a sentence with a gerundive relative clause.

(14) A passenger waiting for flight 307 complained to the flight attendant. (Thompson 2001: 290)

Thompson (2001) argues that the reading that the event of waiting takes place at some time in the past but not before the complaining is unavailable for (14). The gerund event of waiting in (14) may take place at the time of the matrix event of complaining, where the meaning is 'A passenger complained to the flight attendant while he was waiting for flight 307.' The event of waiting may also take place at the Speech time, where the meaning is 'A passenger who is waiting now for flight 307 complained to the flight attendant.' This means that there is no "shifted" reading available for (14). The difference between (13) and (14) is caused by the non-existence of explicit temporal marking on the gerundive verb. Which tense the gerundive relative clause denotes has to "rely on" something else as it does not have its own tense marking. Thompson (2001) argues that there should be a locality condition for the gerundive relatives to have their temporal identities.[6]

This is supported by the following facts:

(15) a. A passenger waiting (yesterday/*tomorrow) for flight 307 complained to the flight attendant.

b. A passenger waiting (*yesterday/tomorrow) for flight 307 will complain to the flight attendant. (Thompson 2001: 292)

(15) shows that the adverbials that denote time in gerundive relatives cannot co-occur with the matrix verb with "contradicting" temporal expression. Thompson argues that (15) means that gerundive relatives are temporally dependent on the tense of the main clause. In (15), it seems that the tense of gerundive clause is bound by the matrix tense, but let us look at what Comrie (1985) noted.

(16) The easiest way of establishing such a reference point is to insert an adverbial of temporal location into the participal construction, as in *the passengers awaiting flight 26 yesterday proceeded to gate 5 the day before*, where the adverbial *yesterday* provides a reference point for the interpretation of the temporal location of the participle *awaiting*. (Comrie 1985: 58)

The event in the gerundive clause of *the passengers awaiting flight 26 yesterday proceeded to gate 5 the day before* does not occur before the matrix event just as Thompson pointed out for (14), but the temporal identity of the gerundive clause is not at the same time as the temporal identity of the matrix event. Both of the events are the events of past, but they did not occur at the same time. It is not "shifted", but it is not bound, either. Moreover, the sentence with the same construction can have the reading which Thompson (2001) denied: the reading that the event of waiting takes place at some time in the past but not before the complaining. The sentence *A passenger waiting for flight 307 yesterday complained to the flight attendant today/proceeded to the gate 5 today* can be possible.

This means that gerundive relatives are not necessarily temporally dependent on the tense of the main clause. It seems that when there is a temporal adverb in a gerundive clause, the temporal identity of the gerundive clause has already been partially determined. In other words, it seems possible to consider that there is a certain temporal sphere established within a gerundive relative clause with a temporal adverb, even if it does not have its own temporal marking on its verbal item. We may say that because the temporal adverbial "guides" the temporal location of the event described in the gerundive clause, it derives the grammaticality difference seen in (14).[7]

Moreover, in Thompson (2001) the following sentences are given to show the position of temporal adverbials affects the temporal interpretation.

(17) a . Mary had left her office at 3 p.m.

b . Mary claimed that she had left the office at 3 p.m., and left the office at 3 p. m. she had.

c . At 3 p.m., Mary had left the office. (Thompson 2001: 289-290)

(17a) is ambiguous: Mary's leaving could have taken place at 3 p.m. or her leaving could have been before 3. p.m.. When this temporal adverbial *at 3 p.m.* is unambiguously associated with VP, as in the VP fronting construction in (17b), the event of her leaving takes place at 3 p.m. and not before that. On the contrary, for (17c), in which the temporal adverbial is associated not with VP but with a projection above VP, the event of her leaving takes place before 3 p.m., and not at 3 p.m.. This again points to

the fact that the temporal adverbial *at 3 p.m.* establishes a certain guideline for the temporal interpretation for its associated VP. Thus, temporal adverbials affect temporal interpretation or temporal location of their associated projection. Thus, we may say that within a projection, when tense on a verbal item is not available and a temporal adverb is present, there seems to be certain guidelines established for temporal interpretation of the phrase or projection. This also supports the idea that the meaning of a phrase is determined within a phrase, seen in 3.1.1.

One thing we must remember is that a gerundive relative is an adjunct and not a complement clause. Complement clauses are different from adjuncts in the determination of their temporal identity.

(18) a . He seems to be hungry.
b . It seems that he is hungry.
(19) a . He seemed to be hungry.
b . It seemed that he was hungry.
(20) a . He seems to have been hungry.
b . It seems that he was hungry.

Each sentence *a* in (18), (19) and (20) can be paraphrased as each sentence *b*, respectively. Without its own temporal marking, a non-finite clause must depend on the tense in the main clause for its temporal location. Thus non-finite complement clauses and adjuncts are different when they enter into temporal interpretation.

3.1.3 Discourse

There seems to be another factor that may affect determining which temporal interpretation a phrase or a sentence should receive: discourse.

(21) a . Dante was born in 1265. He regretted that Italy was/?? is shaped like a boot.
b . Italy has a funny shape. Dante regretted that it??was/is shaped like a boot.
(Tanaka 1991: 166)

The discourse plays another factor influencing the embedded tense. In (21a), because of the first sentence, the focus is on Dante. Thus the second sentence, which is reporting the already deceased Dante's feeling, prefers past tense in the embedded clause, even though the fact that Italy has a shape like a boot has not changed. On the other hand, in (21b), the first sentence casts focus on Italy's shape and also it is the fact at the present time. Thus, even though Dante has been dead, the present tense seems to be preferred in the embedded clause.

Closely looking at the examples concerning this issue in Tanaka (1991), all of them

contain complement clauses whose propositions are about universal truth or an unchanging fact.

(22) a . The ancient Egyptians were very clever. They knew that the earth was/??is round.

b . A: Do you know what water is made up?

B: We learned in school yesterday that water is/??was a combination of hydrogen and oxygen. (Tanaka 1991: 166-167)

A proposition stating universal truth is usually the case for exception of SOT application. Thus, in (21b) and (22b) present tense is preferable. From the (21a) and (22a), it is possible to say that the discourse value given by the first sentence gives certain selectional restriction on the matrix verb in the second sentence: when the discourse designates as past, SOT applies to any proposition. This kind of tense selectional restriction of the verb can be seen in the sentences in (23).

(23) a . The ancient Egyptians knew that the earth is/was round.

b . Dante regretted that the earth ?is/was round. (Tanaka 1991: 163)

(23) shows that certain groups of verb prefer SOT application to any type of their complements. Sentence (23b) shows that the subject's semantic property and the predicate's semantic property interact to have SOT application preferable. From the observation of (23a) and (23b), the difference arises from the selectional property of the verbs. Comparing (21), (22) and (23), discourse does affect the selection. Therefore I assume that discourse does "guide" the temporal location of the sentence, and that influence of discourse is imposed on the matrix VP or TP, which is another factor for temporal interpretation.

So far, three important facts have been examined. A difference in temporal interpretation arises depending on whether the embedded VP predicate is a stage-level predicate or an individual-level predicate. When a gerundive clause, which does not have its own temporal marking, has a temporal adverbial, there seems to be a temporal interpretation determined within the phrase without an explicit temporal marking on the verbal item. Discourse and subject affect the temporal interpretation of the embedded sentence. With these facts in mind, I will propose an approach for temporal interpretation of embedded clauses.

3.2 Binding Mechanism for Temporal Interpretation

3.2.1 Tense and Pronominals

To clarify my idea of how temporal interpretation is established, let us first look at

what temporal markings really are.

English finite clauses seem to have explicit time markings. However, how explicit are the temporal markings in English?

Take a look at what identity past and present actually have. These expressions *present* and *past* seem to be very clear in what they stand for at first sight, but actually their identities are not absolute but rather relative. In English, there are only two inflections for temporal expression: present or past. A speaker selects each lexical item with inflection by comparing the event(s) she/he is going to describe with the standard where she/he stands: the point which he/she considers 'present'. Stowell (1993a) insightfully points out that morphological tense as a polarity item gets the value of true tense through control. In his system, PRO is used for temporal interpretation as seen in 2.2.1. This suggests that present and past are in some ways similar to pronominals. Stowell (1993a, b) assumes PRO for tense as the items in his framework are invisible. However, I assume tense is pronominal, as tense appears with its form and pronunciation and it has its own identity to some extent.

Tense has its own identification to some extent, but its value is given less, just as pronominals, compared with R-expressions. The identity of a pronominal expression is determined relatively.

(24) a . He is a friend of mine.

b . That student is a friend of mine.

c . John hates him.

d . His parents think that they are great.

In (24), the subject *he* is understood to be third person singular (and masculine), but nothing more is known. In (24b), even though whether the subject is male or not is unknown, it has some more information compared with the subject in (24a). Relatively gained identity can be seen in interpreting the examples (24c) and (24d). In (24c), the knowledge of the object *him* that it cannot be *John* is obtained as well as what is already known by the word alone. The identity of *they* in (24d) can be *his parents* or some people not mentioned in the sentence, and the information can be obtained by the relation with other items.

Turning to tense, tense has its own identity: past or present. However, a temporal location of an event described in a sentence can not be precisely designated by the temporal inflection alone. It does tell us which part in the time stream the temporal location points to, compared to the speaker's *present*. With temporal adverbs, with interaction with finite verbal items in other clauses (and sometimes with discourse), the

temporal location of an event is relatively determined to some extent, as seen in (25).

(25) a . I went to Disneyland.
b . I went to Disneyland yesterday.
c . I have been studying English since I was 15.
d . He said that John is sick.
e . He said that John was sick.

Temporal adverbials and/or aspects help to clarify the temporal identity of an event described in a clause, as seen in (25b, c). For (25d, e), seen as (3) and (1) respectively, the temporal interpretation for the embedded clause is affected by the main clause temporal expression. Thus, the temporal information is not determined by tense on verbal items alone but rather determined relatively with the help of some other temporal factors.

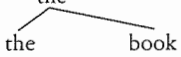
3.2.2 Temporal Identity

In the section above, the idea that tense is somewhat similar to pronominals is discussed. Thus I assume that the mechanism for relatively obtained identity of pornominals can be applied to temporal interpretation. In this framework, I assume the structure with light verb v that takes VP complement and with subject originally in the specifier position of vP. I assume aspects are members to compose multiple VP projections. It is also argued that adverbials can be base adjoined only to X' or phrases headed by v or functional categories in Chomsky (1995: 330). Therefore I assume that the position for temporal adverbials to be adjoined to vP to create another vP. Then I assume that relative clauses are base adjoined to N'.

In Chomsky (1999), a new idea that the derivation of EXP (an expression) proceeds by "phase" is introduced. Within a phase, syntactic, phonological and semantic computations are completed among the items present. Chomsky (1999) argued that CP and vP are phases, at least. Therefore, within vP, one phase, the semantic computation for it is established before moving up to another phase. As seen in 3.1, the factors except the discourse are all within this embedded vP in the framework here, and it seems plausible to consider that there should be some interpretation already established at this phase. This is what has been underlying through the observation so far.

In Chomsky (1995), a "bare phrase structure" theory is suggested, and that the features of a head percolate through the entire projection of the head, as shown in (26).

(26)



(Chomsky 1995: 246)

Analogously, it is plausible to consider that the features of head percolate up to its maximal projection for semantic interpretation. As seen so far, the meaning of a phrase is not determined only by the meaning of a head, but by gathering information within the projection.

(27) a . What did you study at school today?

b . What will we have for dinner today?

Both of the sentences in (27) have the same adverbial *today*, but what temporal identity it has in each sentence is different. Because of the past tense on the auxiliary *did*, *today* in (27a) means sometime in the past within the day, while, in (27b), the event is something that is going to happen in the future later on the day. *Today* is an adjunct in each sentence in (27); therefore within the phase every semantic feature interacts to create certain amalgamated meaning and through head it is passed on to the following phase to have interpretation computed.

For temporal interpretation, first within the vP phase at the embedded vP, the features concerning temporal location gather up to make up the possible temporal meaning of the vP. Remember that the gerundive relative clause in the sentence *A passenger waiting for flight 307 complained to the flight attendant*, seen in (14) above, has a few possible readings. This means that within the gerundive clause, its temporal location is yet undetermined, but that it will be determined with other factors outside the projection. During the course of Spellout for semantic interpretation, the temporal interpretation of each phase is determined, but its full identity is not yet determined; the clearer identity is derived by the interaction with other temporal factors at the following phase. However, even with a finite clause, the 'true' temporal identity of the clause may not always be available. As seen in the sentence *John gave a book to a boy who hit the ball*, in (4a), the event in the relative clause can be understood as an event at certain past time but it can either be after the past event of John's giving a book or before it. Therefore, the temporal location of the relative clause event has not yet been fully determined at the phase within its vP nor its CP.

The similarity to pronominals has been mentioned above, and this incomplete identity seems another similarity to pronominals.

(28) a . John$_{\{i\}}$ told Mary$_{\{j\}}$ that they$_{\{i,j\}}$ should leave.

b . John$_{\{i\}}$ told Mary$_{\{j\}}$ that they$_{\{i,j,k\}}$ should leave. (Chomsky 1995: 99)

Here in (28), the identity of the pronominal *they* is not yet determined in the embedded vP or CP phase. At the main clause CP phase, it can be determined as shown with indices, but *they* can be some people other than John and Mary as shown with the index

k. In the case that *they* are not Mary and John, the identity of this pronominal is left undetermined or discourse will help it in determining its identity.

Therefore, as Stowell (1993a, b) has suggested, I assume that tense has a kind of "pronominal" characteristics and that other temporal information as features is obtained through a kind of binding along with its own semantic features, just like pronominals.

Now let us clarify what [±Past] is considered to be in this framework.

In semantic interpretation, [±Past] is not a formal feature but a semantic feature and it is the central (core) feature for temporal interpretation. Other temporal factors make the location of [±Past] more precise.

Present (i.e. [−Past]) is always explicit in its identity. It is always understood both by the hearer and the speaker as at the point the utterance is made and heard. So, just as *he* is not bound by *she* in *She thinks he is handsome*, [−Past] does not bind [+Past] nor the other way around. [+Past] is bound by [+Past], but the difference or variety of identity arises because of its predicate types and other factors. [−Past] is the only definite standard point in temporal interpretation to the speaker and the hearer. Thus any verbal item with temporal marking with [−Past] must be identical in its identity to the speaker's present no matter what projection it is in. This is also a default discourse value.[8] When the discourse value is non-specified, there is no restriction and temporal interpretation occurs upon the only one standard point, present. On the other hand, as in (21), when the discourse value is somewhat given, it will assign certain restriction. According to the observation in 3.1.3, it may be possible to assume that a semantic feature of discourse value as a selectional restriction is assigned to the matrix TP, as it imposes restriction on VP. Thus, at the matrix CP phase, when the discourse value is not default, a restriction is assigned to TP to expel awkward sentences at this phase.

When there is one finite TP in a sentence, its temporal identity is determined mainly with its own temporal inflection, and extra temporal information may be added if there are any time denoting items, such as temporal adverbials. Thus, the main clause [+Past] stands as it is, just like *he* in the sentence *He played the piano*. *He* in this sentence has its own identity but only to some extent. [+Past] is also past compared to the standard, present, but without other temporal information, no more definite temporal point is available.

Predicate types operate as a function that maps the temporal value of an event on the time axis. As observed in 3.1.1, predicate type affects temporal interpretation. Thus finite V has a semantic feature of [+Past] or [−Past] and another semantic feature [stage-level] or [individual-level], which operates as a kind of function.

When there is a temporal adverbial in the projection, its temporal semantic feature is added or make the temporal location of vP more precise. When the temporal features of V projection and the temporal connotation of subject clash at this phase, we get awkward or no good sentences as seen in 3.1.3. In this way, all the features in vP get amalgamated to establish the meaning of vP. At the next phase (i.e. at the embedded CP), the head of vP with the semantic interpretation made at the embedded vP phase enters semantic interpretation with the other factors in this phase, and the meaning of the entire CP is somewhat established. Just as pronominals, as in (28), the temporal location of the event described in this embedded CP is going to be determined by entering or not entering a binding relation with the matrix tense at the relevant phase, the matrix vP or the matrix CP.[9] With the same process, the computation proceeds on at the matrix vP, and then at the following phase what the whole sentence (TP or CP) means is determined.

There are two differences that lie in tense-"binding", compared with binding pronominals. One difference is the possible candidates for identification, just like two *he*s in the sentence *He thinks that he is handsome*. The possibilities for unbound *he* are numerous, while past seems to have only one candidate: past. The possibility of the identity of tense seems to be far more limited than pronominals. Thus I assume that truly identical tense must be in a binding relation in a certain construction. How this is handled is explained later in the actual temporal construal for some example sentences.

The other difference is what the local domain D for binding tense should be. More than one pronominals can appear within a DP, a VP, or a CP, while tense inflection appears one at most within one TP. Thus the situation is totally different on this matter.

Through the observations made so far, it is possible to summarize the difference lies in the interpretation of two types of embedded clauses: complement clauses and adjunct clauses. The fact that a complement clause is selected by the main clause V has something to do with this difference. Predicate types map the temporal location of their event on the time axis as a function, which makes the tense of the complement clause possible or impossible to enter into binding relation with the main clause past tense. When an embedded clause is an adjunct, it is independent in temporal interpretation. Example (4) shows that a finite TP in an adjunct clause does not enter binding relation within the embedded CP and that it keeps its own temporal identity, which is relatively determined by the speaker's *present*.

Let us look at the basic idea for the temporal construal mechanism in this framework.

(29) Binding between Tenses

a . When the temporal marking is the same between the matrix V and the V of its complement clause, it is possible for the tenses to enter a binding relation. When entering a binding relation, the c-commanding matrix tense binds the other.

b . [−tense] complement V must enter binding relation.

(30) a . An individual-level predicate maps the temporal location of the tense as duration on the time axis.

b . A stage-level predicate with [+Past] maps the temporal location of the tense by shifting it as [before [+Past]] on the time axis.

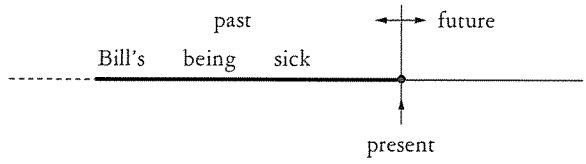
c . An aspectual item also maps the temporal location of the vP onto the time axis.

Now let us see how this works with the sentence we have seen so far.

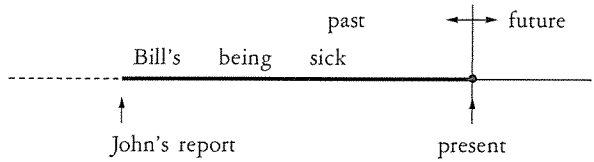
(31) (=(3)) John said that Bill is sick.

(31) is interpreted as follows: Bill was sick when John reported it to the speaker of the sentence and Bill is still sick when the speaker produces this sentence. This means that the starting point of the event of Bill's being sick is, at the latest, at the point of John's report of the event. Because the predicate is individual-level, the event of Bill's being sick has a durational meaning. Here, the predicate's feature or property of being individual-level plays a role of a function. It maps the temporal location of its event as "a line" or duration on the time axis. The tense inflection of the embedded clause of (31) is [−Past]. Thus, the semantic temporal location of the embedded event is considered as shown in the time axis in (32). In (32a), the individual-level predicate maps the event of being sick as a duration on the time axis,[10] and the ending point of this duration is present. As seen in (32a), the other end of the duration goes back to the past, and it has [+Past] as the ending point of duration. This is the semantic temporal location spelled out within the embedded vP phase. Then in the matrix vP phase, [+Past] of *said* binds the [+Past] of the embedded event, which is considered as the "starting" point of Bill's being sick. As far as the speaker of this sentence (31) knows, the lasting point of this event is *present*. Then the hearer understands that Bill has been sick since John' report and till the speaker's utterance, at least. However, the hearer does not know exactly when the sickness started. Thus the point when this event has started is not precise, but without any doubt it is [+Past] and the matrix [+Past] binds this ambiguous starting point [+Past] as in (32b).

(32) a.



b.



In this mechanism, matrix [+Past] binds part of the temporal semantic location of its complement. This can be analogous to the binding seen in the pronominal in (33).

(33) $We_{\{i,j\}}$ think $I_{\{i\}}$ will be victorious. (Chomsky 1995: 99)

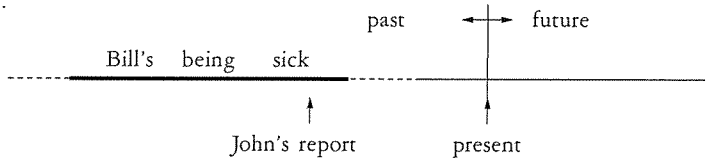
Now let us turn to a sentence with SOT application.

(34) (=(1)) John said that Bill was sick.

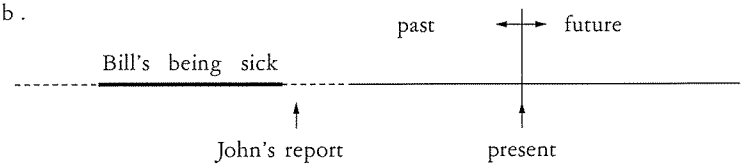
The embedded event is interpreted as occurring at the same time of John's report or before the time of John's report in (34). The embedded V is an individual-level predicate with [+Past], and the time duration of the event is mapped as from some time in the past till some time in the past.

For (34), one of the two interpretations is that the hearer understands that the event of Bill's being sick is till John's report from some time around then. In this case, the matrix [+Past] binds a point of the embedded event within the duration mapped by the function of an individual-level predicate, as seen in (35a). The other interpretation is that the hearer understands that Bill's being sick occurred from sometime till some time before John's report. In this case, the matrix [+Past] binds the ambiguous ended point of the embedded event, as shown in (35b).

(35) a.



b.



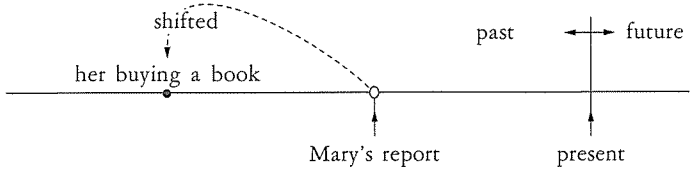
Now let us turn to a complement clause with a stage-level predicate.

A stage-level predicate has a connotation that the event described by this predicate is temporal. When the [+Past] predicate of the complement clause is stage-level, I will assume that it shifts the time location of the event as its mapping function, describing past 'action' being possible only about what has already happened. Originally, the embedded [+Past] is located on the time axis at one point.[11] Then, V being a stage-level predicate, the location is shifted to any point before its original location. [+Past] and [+Past] are identical, and the matrix [+Past] binds the 'emptied' [+Past], which embedded event has been shifted from. This means that the matrix tense cannot bind the true [+Past] of the event of the embedded clause.

(36) Mary said that she bought a book.

For (36), the interpretation that Mary's buying a book and her reporting it occur at the same time is not available. Here, the [+Past] of the complement clause is shifted, which means [before [+Past]], and the interpretation that her buying a book is an already terminated event at the time of Mary's report is derived.

(37)



When there are aspect markers, they play a role of a function and the function of the predicate types works supplementarily. Individual-level predicates originally have durational meaning, and for these predicates there is no need to apply progressive in principle.[12] A sentence with an individual-level predicate with progressive, such as, *She is being kind*, the event becomes a temporal one. Perfective also changes the temporal meaning of the predicate: completed action, continuing action, experience, and so on. Perfectives clarify the temporal denotation of the action verbs or state verbs. Therefore, I assume the function that gives more precise meaning is predominant. Let us see how

it works.

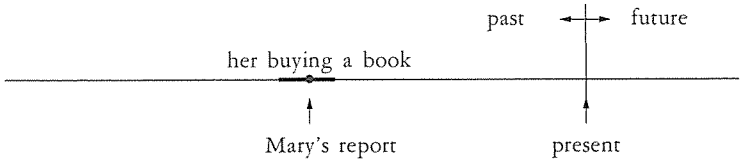
(38) a . Mary said that she was buying a book.

b . Mary said that she had bought a book.

c . Mary said that she had been sick.

With progressive, the action described by a predicate is understood to be continuing for some time. It maps the temporal location of an event as a short and temporal durational property with the point that the inflection denotes as its center. (38a) means that Mary's buying a book occurred at the same time of her reporting it. The mechanism proposed correctly derives this meaning, as the matrix [+Past] binds the any time during the short period of her buying action.

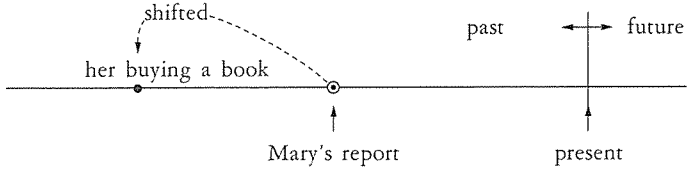
(39)



In a construction with perfective, an event described with perfective occurs at a previous time of the tense inflection on perfective, and it is implied that the occurrence of the event has something to do with the time denoted by the inflection. I assume that a perfective aspect marker maps the temporal location of the event of the predicate with two points: the point that is shifted from the time of the inflection denoted and the point of its inflectional identity.

For (38b), the temporal location of the embedded event is shown in (40). The shifted point is where the time of the event is understood as definitely before Mary's report, because the main clause [+Past] binds the embedded identical [+Past], which is the temporal point where the perfective inflection points.

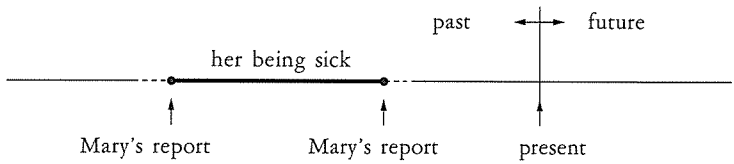
(40)



(38c) has an individual-level predicate in its complement clause, so it supplementarily gives a durational figure for the embedded event on the time axis. With the perfective, it gives the [+Past] point and the shifted point on the durational line. Either point is

bound by the matrix [+Past] at the main clause vP phase to derive the two possible meaning, as in (41).

(41)



When there is perfective progressive, which is a combination of progressive and perfective, the mapping is expected to be duration with a point, thus it correctly accounts for why perfective progressive means continuation.

As an infinitival TP complement clause does not have its own temporal identity, it must acquire its temporal identity in the course of derivation, or its interpretation becomes unavailable. The core temporal features, [±Past] are left unspecified at the phase of the embedded vP. If there is no temporal information added to at this phase, the core identity is specified at the relevant phase, which derives the interpretation observed in (18), (19), (20). This shows a similarity to controlled PRO. It is possible to consider that [-tense] in a complement clause must be bound by the matrix tense to get the temporal identification of its event.

On the other hand, adjuncts seem to be independent of the tense of the main clause, as seen in 3.1.2. Without binding, multiple possibilities arise, as in (13). The gerundive adjunct in (14) does not enter into binding, and the adverbial is the determining factor within the phase. Therefore, the core identity is specified or guided by the adverbial within this phase. When the adverbial has precise temporal identity as yesterday and so on, it specifies the core identity; while the adverbial is not precise, it guides the temporal location of the phrase.

There is one thing that should be added to the temporal interpretation of adjunct clauses. Stowell (1993a) points out that one of the two interpretations for the event of the relative clause is the past-shifted one with comparison not to the embedded event, but to the main clause event, when a relative clause originates within a complement clause. The relative clause event is independent of the embedded event in (42).

(42) Mary thought that John gave his book to a boy who hit the ball.

(Stowell 1993a: 3)

In my approach, it is an adjunct and it is independent within the complement clause. As the predicate in this adjunct is stage-level, the past tense in this adjunct can not enter

into a binding relation even with the tense in the main clause, as in (36); thus it gets only 'shifted' reading.

(43) Mary thought that John gave his book to a boy who was sick.

For (43), where the adjunct has an individual-predicate, the boy's being sick can be before or at the same time of the matrix event. The mechanism here correctly derives the possible interpretations.

4. Conclusion

In this paper, I have proposed a mechanism of binding for temporal interpretation of complex sentences. There are a few factors along with the structural factor that should be taken into consideration in temporal interpretation. The semantic type of predicate changes the temporal value of the described event. When some item with temporal information appears in the projection, it does affect, guide, or determine the temporal point or value of the event. Discourse affects the possibility for selecting the type of proposition. Tense is a kind of relative marking on a verbal item and tense seems to be similar to pronominals in some ways in interpreting its reference. With these factors in mind, it is suggested that by adopting the idea of derivation by phase, temporal interpretation can be possible through binding, which is something similar to the mechanism applied to the interpretation of pronominals. The fact that tense appears once at most in one TP, and the limited selection for identity for tense require the different binding mechanism from pronominals. The construction difference whether an embedded clause is a complement clause or an adjunct, the predicate types and aspects create the differences in the possibility of binding and the temporal values of the event. The mechanism correctly provides how various interpretations are derived.

Notes

* I would like to thank Professor Craig Volker and Professor Yuko Ono for the grammaticality judgment and interpretations of the English example sentences in this paper. Also, for the information of Chinese sentences, I am grateful to Professor Midori Niijima

1 In Stowell (1993a) The structure of VP is assumed as follows:

$[_{ZP}\ Z_i\ [_{VP}\ e_i\ [_{VP}$ John $[_{V'}$ sing$]]]]$ (Stowell 1993a: 10)

In this structure, e_i is the temporal argument (and variable) bound by Z_i, the head of ZP, and subject and verb appear within VP.

2 In Higginbotham (1985), event argument is considered as follows:

i) see+V, −N, ⟨1, 2, E⟩ Higginbotham (1985: 555)

In this argument structure, 1 is the position for the external argument of *see*, 2 is for the intermal argument, and E is a hidden position for the Event. Higginbotham assumes that all verbs have Event argument in the argument structure. Krazar (1995) and Diesing (1992) argue that Event argument is present only in the argument structure of stage-level predicates, and not in individual-level predicates.

[3] Here when it is written that time A is *after* time B, it means that time A is closer to future or present than time B is.

[4] For (9b) and (10b), as eyes being certain color does not usually change, (9b) and (10b) do not have actual interpretation difference. The difference between (9a) and (9b) is that the property described by the predicate in (9a) is rather temporal, compared with (9b).

[5] Replacing the word *cat* with plural *cats* and producing a sentence *Janet said that she kills her neighbor's cats*, to make the described situation happen, the neighbor must supply a cat after cat to prepare for her serial killing. This sentence is not acceptable to my informants.

[6] Thompson (2001) adopted the idea in Hornstein (1990) and argued that gerundive relatives are AspP, lacking inflectional projection and that there is a locality requirement for tense construal. Her research focuses on gerundive relatives modifying subject and this makes it necessary to mention the position of subject and matrix TP. For further discussion, see Thompson (2001).

[7] There are other examples that the event of gerundive clause cannot be prior to the event of main clause in Thompson (2001).

i) a. *The men arriving yesterday are swimming now.
b. *The men waiting for the flight tomorrow are swimming now.

(Thompson 2001: 292)

This seems to have something to do with the status or meaning of the form gerund itself has, but this is a residual problem here.

[8] It is known that Chinese does not have any overt temporal marking on verbal items. It does have aspect markers, but unlike English and certain other languages the aspect markers do not inflect for tense.

i) a. Wǒ xué le liǎng nián Éyǔ
I study perfect two year Russian
I have studied Russian for two years.
b. Wǒ xué le liǎng nián Éyǔ la
I study perfect two year Russian
I have been studying Russian for two years.
c. Dào míngnián xiàtian wǒ xué le liǎng nián Éyǔ la
till next year summer I study perfect two years Russian
I will have been studying Russian for two years next summer.

(Zhang 2000: 8-9)

Le is perfect aspect marker, and *la* is a particle. It is said that discourse is the guideline

for determining which tense the speaker/writer is referring to for tense interpretation in Chinese. For the mechanism to be universal, access to discourse for temporal interpretation of the main clause must be taken into account.

Also, (ic) seems to support the idea in 3.1.2 that the temporal adverbial *next summer* guides the temporal location of the event.

[9] In this framework, V with temporal marking is considered to enter binding relation, which is at the matrix vP phase. When there is a modal auxiliary, which is in I^0, temporal binding occurs at the matrix CP

[10] The length of the duration mapped on the time axis differs depending on the meaning of the predicate. Some predicates can provide rather clearer time duration: being a Japanese high school student can be for three years (in general, at the longest), and so on. On the other hand, predicates such as being sick cannot give any definite duration.

[11] In concept, depending on the meaning of the action described by the verb, its "figure" on the time axis is different. It can be a little bit closer to being a line than being a point, or it can be a point.

[12] In Krazar (1995), as seen in (8) here, progressive is treated as stage-level predicate. In my framework, I do not categorize it as stage-level or not, but as something temporal with duration.

References

Chomsky, Noam (1991) "Some Notes on Economy of Derivation and Representation," *Principles and Parameters in Comparative Grammar*, ed. by Robert Freidin, 417-454. Cambridge, Mass.: MIT Press

Chomsky, Noam (1995) *The Minimalist Program*, Cambridge, Mass.: MIT Press

Chomsky, Noam (1999) "Derivation by Phase," ms., MIT

Comrie, Bernard (1985) *Tense*, Cambridge, London: Cambridge University Press

Diesing, Molly (1992) *Indefinites*, Cambridge, Mass.: MIT Press

Enç, Mürvet (1987) "Anchoring Condition for Tense," *Linguistic Inquiry* 18, 633-657

Higginbotham, James (1985) "On Semantics," *Linguistic Inquiry* 16, 547-593

Hornstein, Norbert (1977) "Towards a Theory of Tense," *Linguistic Inquiry* 8, 521-557,

Hornstein, Norbert (1981) "The Study of Meaning in Natural Language: Three Approaches to Tense," Hornstein, Norbert & Lightfoot, David (eds.) *Explanation in Linguistics*, London & New York: Longman 116-151

Hornstein, Norbert (1990) *As Time Goes By*, Cambridge: MA: MIT Press.

Kratzer, Angelica (1995) "Stage-level and Individual-level Predicates," *The Generic Book*, ed. by Greg Carlson and Pelletier Francis Jeffery, Chicago: Chicago Press 125-175

Stowell, Tim (1993a) "The Syntax of Tense," Ms., UCLA

Stowell, Tim (1993b) "The Phrase Structure of Tense," *Phrase Structure and the Lexicon*, ed. by Johan Rooryk & Laurie Zaring, Dordrecht: Kluwer 277-291

Tanaka, Kazuhiko (1991) "Eigo ni okeru Jisei no Sho-ou ni tuite," *Studies in English Literature* 67, 159-172

Thompson, Ellen (2001) "Temporal Dependency and Subjects," *Linguistic Inquiry* 37, 287-312

Zagona, Karen (1988) *Verb Phrase Syntax*, Dordrecht: Kluwer

Zhang, Xiu (2000) "Chugokugo Doushi no Tensu to Asupekuto no Taikei (Tense and Aspect System of Verbs in Chinese),"*Chinese Linguistc Information 2*, ed. by Zhang Yu and Qin Zhang, Tokyo: Kobun Shuppan, 1-38

Synopsis

Temporal Interpretation through Binding

Satomi Niwa

There have been various approaches to explain how temporal interpretation is established, especially for complex sentences.

In English, there is a phenomenon called Sequence of Tense (SOT).

(1) a . John said that Bill was sick.

b . John said that Bill is sick.

c . Mary said that he told a lie.

(1a) is an example where SOT is applied. There are two possible interpretations for (1a): Bill's being sick occurs at the same time of John's reporting it and Bill's being sick occurs before John's reporting it. (1b) is an exception of SOT. (1b) means that Bill has been sick since John's report or since sometime before John's report. To give account for how these readings are derived, Hornstein (1977, 1981, 1990) has introduced three entities that denote time: E(vent time), R(eference time) and S(peech time). Stowell (1993a, b) considers the E and R to be a thematic role given to arguments of T^0, and, introducing a new projection ZP, temporal interpretation mechanism is accounted for by binding.

In this paper, inspired by the suggestion in Stowell (1993a, b) that tense has something similar to pronominals, and with further analysis of semantic properties, a suggestion for a possible temporal interpretation mechanisam is made.

Although (1a) and (1c) have the same structure, the reading that the embedded event occurs at the same time of the matrix event is not available for (1c). The difference lies in the semantic type of the predicates. Being an individual-level predicate functions as mapping the temporal location of the event as a duration on the axis of time, while a stage-level predicate functions to map the event as a "point". There are other factors that affect temporal meaning of a phrase. Temporal adverbs make the temporal location of an event more precise or detailed. In English, discourse imposes restrictions on V for its selection of proposition.

By reflecting on the identity of each tense, it seems that tense is similar to pronominals in some ways. It has its own identity, but it can be partially specified. Temporal identity can be gained through comparison with other temporal items. Pronominals have their own identity, but not fully specified, compared with R-expressions. The identity of pronominals can be obtained through binding. Thus, for temporal identification, I proposed a mechanism with binding. Following Chomsky (1999), I assume that syntactic, semantic, and phonological computation is completed phase by phase. Semantic features add up within a projection to establish the meaning of the projection as a whole. Temporal semantic features

gather within a projection and percolate up along the same line. Then only V of a complement clause can enter a binding relation. This mechanism can provide a proper account of how each reading is derived for each construction.