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Temporal reference in English and Japanese

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TEMPORAL REFERENCE IN ENGLISH AND JAPANESE

by

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To My Parents

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This dissertation investigates temporal reference in English and Japanese. To be more specific, I examine the behavior of the tense morphemes in the two languages and propose a framework in which their behavior can be described in a natural manner.

The first half of the dissertation deals with relatively straightforward cases. I try to account for the so-called sequence-of-tense phenomenon in English and the lack of a comparable phenomenon in Japanese. I claim that the sequence-of-tense rule, in one form or another, must be posited in order to account for the behavior of the tense morpheme in English. By contrast, tense morphemes in Japanese always locate an event or state relative to the time that the immediately higher tense or noun denotes. I propose a framework in which the traditional sequence-of-tense rule is encoded as a tense deletion rule which applies at LF after the rule for QR has applied. The tense

deletion rule deletes a tense α if and only if there are tense features β and γ, α has a tense feature β, β has the same feature value as γ, and γ is the local tense feature of β. The proposal also covers Japanese data with the proviso that Japanese does not have a tense deletion rule.

In the second half of my dissertation, I turn to a peculiar reading (the "double-access" reading) associated with English sentences in which a present tense is embedded in the scope of a past tense. After discussing various hypotheses, I conclude that the double-access reading is best explained as a de re attitude report involving a state or event individual. This view presupposes a Davidsonian framework in which a declarative sentence is assumed to make an existential assertion about a state or event.

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CHAPTER 1

INTRODUCTION

1.1. The Scope of the Study

This dissertation deals with temporal reference in English and Japanese. The purpose of the study is two-fold: (i) to describe the behavior of the tense forms in English and Japanese (excluding aspectual markers), and (ii) to propose and defend a theoretical framework which works equally well for the description of the relevant data drawn from the two languages. More specifically, I will deal with the tense morpheme (*-ed*), the future auxiliary (*will*), the perfect (*have -ed*) in English and the so-called past tense morpheme (*-ta*) in Japanese.

To familiarize the reader with the types of data and issues that we will be concerned with in this study, I will briefly preview the material to be presented. In Chapter 2, I will be concerned with the temporal reference of tense morphemes in English and Japanese. In particular, our discussion will center on the problem of sequence of tense in English and its absence in Japanese. The sequence-of-tense phenomenon is exemplified by (1a):

(1a) John said that Mary was in Austin.

(1b) John-wa [$_S$Mary-ga Austin-ni ir -u] to it -ta.
TOP NOM at be PRES that say PST

(1a) allows the interpretation in which the time of Mary's being in Austin is understood to be simultaneous with the time of John's saying. (1b) is a Japanese sentence which invariably has this simultaneous interpretation. Note that in (1a) the embedded verb is in the *past* tense whereas in (1b) the embedded verb is in the *present* tense. Traditionally the fact that the simultaneous reading associated with (1a) is marked by a past tense in the embedded clause is referred to as the *sequence-of-tense phenomenon* (henceforth the ST phenomenon).[1] That is, the fact that the past tense is used to signify a simultaneous reading is regarded as a fact requiring special attention.

It is not obvious that this is a remarkable fact. It is clear that the time of Mary's being in Austin is in the past of the speech time in (1a). Thus, assuming that the past tense morpheme in English means "the past of the speech time", we are naturally led to the conclusion that the simultaneous reading in (1a) is indicated by a past tense in the complement clause. Although this idea is certainly worth mentioning, it is premature to discuss whether (1a) is a noteworthy fact which requires special treatment. At this point, I will simply illustrate what traditional grammarians propose in order to cope with this phenomenon. In my interpretation, traditional grammarians'

[1] In fact, the sequence-of-tense (ST) phenomenon is usually assumed to comprise more data than just the simultaneous reading associated with sentences like (1a). However, it is difficult to give an accurate characterization of the ST phenomenon in its wider sense in a theory-neutral way. Although we must increase the empirical coverage of this study sooner or later, the ST phenomenon can be defined tentatively as the fact that sentences like (1a) can receive a simultaneous reading. We will investigate the ST phenomenon in more detail in Chapter 2.

proposal can be rephrased in the following manner: Assume that (1a) has the following underlying structure, which is suited for semantic interpretation:

(1c) John PST say that Mary PRES be in Austin

This is converted into the surface form (1a), which is actually pronounced. Why is (1c) an appropriate input to interpretation rules? The reasoning goes as follows: (1a) asserts that John said something in the past; it also tells us *what* John said. Since what is described in the verb complement clause is what John said, it seems natural to assume that the event or state described in it is viewed from John's perspective at the time of his saying. The "simultaneous reading" is so called because according to what John said Mary's being in Austin was simultaneous with the time of his saying. Thus, assuming that the tense in the complement clause is in the scope of the matrix past tense (i.e. Mary's being in Austin is described from John's perspective), we expect that the present tense is used in the complement in order to convey a simultaneous interpretation. In fact, this is what happens in Japanese as (1b) shows. Assuming that the interpretation rules work in the same way in English and Japanese, one is led to posit a rule for English which converts an underlying present tense, which contributes to the interpretation, into a surface past tense, which is actually pronounced, when it occurs immediately under a past tense. This is the *sequence-of-tense rule* (henceforth the ST rule) as it is understood in traditional grammar. Under this proposal, Japanese has no ST rule, and the relationship between the surface structure and the "semantic structure" (the structure to which the interpretation rules apply) is transparent.

In the following discussion, I will distinguish between the *sequence-of-tense phenomenon* and the *sequence-of-tense rule.* Any successful theory of temporal reference in English must be able to cope with the ST phenomenon, but it is not necessarily the case that any successful theory must posit a ST rule as it is understood in this context. By "a ST rule", I mean a rule which is specifically designed to deal with the ST phenomenon. I will discuss the pros and cons of the ST rule as it was espoused in traditional grammar and provide a new theory which not only accounts for the ST phenomenon but also serves as a mold within which the behavior of the tense morphemes in English and Japanese can be described in a natural manner. The details of the proposal will be presented in Chapter 3 in the form of two fragments for Japanese and English.

Having examined the relatively unproblematic data involving tenses, I will be concerned with some exceptional cases in Chapter 4. I will discuss the so-called double-access reading (Enç 1987) associated with a present tense embedded under a past tense in English. The double-access reading is obtained when a present tense appears immediately under a past tense in violation of the ST rule (as it is construed in traditional grammar). Consider the following example:

(2) John said that Mary is pregnant.

According to Enç (1987: 637), (2) has a "double-access" reading in that Mary's pregnancy must have access to both the time of John's saying and the speech time of (2). Although this characterization is vague, it is clear that the reading associated with (2) is not the purely simultaneous reading associated with (3), nor is it the reading that (4) has:

(3) John said that Mary was pregnant.

(4) John said that Mary would be pregnant now.

It is clear that Enc's observation is in some sense correct: (2) says something about both the time of John's saying and the time of Mary's pregnancy. However, as we shall see, describing the reading in precise terms requires a great deal of thinking and reassessment of the currently available frameworks. I will propose a framework within which the double-access reading associated with (2) can be represented in a natural manner. The details of the new framework will be given in the second fragments for English and Japanese.

1.2. The Theoretical Frameworks

One of the primary purposes of this dissertation is to propose and defend a theory of temporal reference which is both descriptively and explanatorily adequate. In order to motivate a new framework, one must show the inadequacy of the existing frameworks first. Therefore, I will present the data and its analysis in the most conservative framework and revise it only when it is discovered that a new approach is absolutely necessary. In formal semantics, Montague's framework, in particular the one presented in 'The Proper Treatment of Quantification in Ordinary English' (Montague 1973; henceforth PTQ), is undoubtedly the most widely known. In the following discussion, I adopt a variant of the PTQ framework, Dowty's framework proposed in chapter 7 of Dowty (1979), which is more flexible than the PTQ notation and is suited for the purposes of describing temporal phenomena.

One analysis of the temporal reference of natural language that falls outside the tradition of truth-conditional semantics represented by PTQ is Reichenbach's. It captures certain aspects of temporal meaning which are ignored in PTQ or in Dowty's framework. One genuine contribution that Reichenbach makes in the realm of temporal semantics is his recognition that tense interpretations are context-dependent. For example, *The sun set* does not simply mean that there was a past time at which the sun set, which is trivially true, but that there is a contextually salient time at/within which the sun set (e.g. today). This aspect of tense interpretation cannot be captured in a framework in which a past tense is thought of as a quantifier over all past times. Since its importance in the present context is clear, I will examine Reichenbach's framework as well. As I present the framework, I will also point out its inherent problems.

1.2.1. PTQ and Dowty (1979)

Since this dissertation deals with the temporal reference of tenses in English and Japanese, it is important to examine how the semantic contribution of the tense morphemes is represented in various frameworks. We will examine two frameworks in this sub-section: PTQ and Dowty's (1979). Regarding temporal phenomena, there are two important differences between these two frameworks. One is that PTQ posits sentential operators for tense morphemes, whereas Dowty employs explicit quantification over times. The other is that PTQ is point-based, whereas Dowty's is interval-based.

In PTQ, English sentences are generated by a set of syntactic rules (called formation rules) each of which serves to combine two expressions. They are more powerful than phrase structure rules, which are familiar to linguists, in that they can not only concatenate strings but also perform transformation-like operations upon the inputs. The syntactic system is based on Ajdukiewicz's (1935) categorial grammars, and the syntactic category of the output of a syntactic rule is determined entirely on the basis of the syntactic categories of the inputs. The syntactic rules produce analysis trees, which reveal the "derivational history" of surface strings. In PTQ, the translation rules operate in such a way that they mimic the syntactic operations. They produce IL (intensional logic) expressions which are eventually modeltheoretically interpreted.

Let us start with syntax:

(5) S17. (Syntax rule 17)

If $\alpha \in P_T$ and $\delta \in P_{IV}$, then F12 (α, δ), F14 $(\alpha, \delta) \in P_t$, where: F12 $(\alpha, \delta) = \alpha\delta''$ and δ'' is the result of replacing the first verb in δ by its third person singular future; F14 $(\alpha, \delta) = \delta\delta''''$ and δ'''' is the result of replacing the first verb in δ by its third person singular present perfect.

T stands for "term phrase", whose TG (transformational grammar) equivalent is NP, and IV stands for "intransitive verb phrase", which corresponds to VP in TG. P_T means the set of Phrases of category T. S17 says that there are two ways of combining a NP and a VP. Actual syntactic operations are given as functions (called formation rules) which apply to two strings and produce a different string. If they are combined by F12 (Formation rule 12), the resulting string has a future tense on it. If they are fed into F14, the output has the present perfect tense on it. For example, when the NP *John* and the VP *sleep* are combined by means of F12, the resulting string would be *John will sleep*; if they are fed into F14, the result would be *John has slept.* The translation rules parallel the syntactic rules:

(6) T17. (Translation rule 17)

If $\alpha \in P_T$, $\delta \in P_{IV}$, and α, δ translate into α', δ' respectively, then

F12 (α, δ) translates into $W\alpha'$ ($^\wedge\delta'$)

F14 (a, δ) translates into $H\alpha'$ ($^\wedge\delta'$)

This means that the output of the function applied to α and δ translates into IL as $W\alpha'$ ($^\wedge$ δ') (where α' ($^\wedge$ δ') reads the translation of α applied to the intension of the translation of δ'). W is mnemonic for "it WILL be the case that" and H "it HAS been the case that". The following are some examples of how some English sentences are translated into IL:

(7a) John has slept.

1. John $\Rightarrow$ $\lambda PP\{j\}$
2. sleep $\Rightarrow$ sleep'
3. John has slept $\Rightarrow$ H $\lambda PP\{j\}$ ($^\wedge$sleep')
4. H sleep' (j) [lambda conversion]

(7b) John will sleep.

1. John $\Rightarrow$ $\lambda PP\{j\}$
2. sleep $\Rightarrow$ sleep'
3. John will sleep $\Rightarrow$ W $\lambda PP\{j\}$ ($^\wedge$sleep')
4. W sleep' (j) [lambda conversion]

The IL formulas which result from the translation process are model-theoretically interpreted relative to a model, a world, a time, and a value assignment (M, w, t, g, respectively) (Montague 1974: 258-9):

(8)

1. If $\alpha \in ME_{<a,b>}$ and $\beta \in ME_a$, then $[\![\alpha(\beta)]\!]$M,w,t,g is $[\![\alpha]\!]$M,w,t,g ($[\![\beta]\!]$M,w,t,g).
2. $[\![W\ \Phi]\!]$ M,w, t, g = 1 iff $[\![\Phi]\!]$ M,w, t', g = 1 for some t' such that $t \leq t'$ and $t \neq t'$

   $[\![H\ \Phi]\!]$ M,w, t, g = 1 iff $[\![\Phi]\!]$ M,w, t', g = 1 for some t' such that $t' \leq t$ and $t \neq t'$

According to these rules, (7a) and (7b) are interpreted model-theoretically in the following way:

(7a') $[\![H\ sleep'(j)]\!]^{M,w,t,g} = 1$ iff there is a $t' < t$ such that $[\![sleep'(j)]\!]^{M,w,t',g} = 1$

This is the case iff $[\![sleep']\!]^{M,w,t',g}([\![j]\!]^{M,w,t',g}) = 1$

(7b') $[\![W\ sleep'(j)]\!]^{M,w,t,g} = 1$ iff there is a $t' > t$ such that $[\![sleep'(j)]\!]^{M,w,t',g} = 1$

This is the case iff $[\![sleep']\!]^{M,w,t',g}([\![j]\!]^{M,w,t',g}) = 1$

[N.B. $t_1 < t_2$ reads 't_1 is prior to t_2' and $t_1 > t_2$ 't_1 is later than t_2'.]

$[\![sleep']\!]^{M,w,t',g}$ is the characteristic function of the set of sleepers at t' in w, while $[\![j]\!]^{M,w,t',g}$ denotes the individual John. In plain English, (7a) is true just in case there is a time t' earlier than t and John is an element of the set of sleepers at t'. Similarly for (7b). For our purposes, the point to note is that tenses are treated as sentential operators in PTQ.

Another way of dealing with tenses is to employ variables and quantifiers over times. Dowty (1979, Chapter 7) employs such a system. His system inherits most of the features of PTQ, but diverges from it in several respects. There is one difference between them which is not unimportant but is ignored here. PTQ does not deal with the past tense in English indicated by the *-ed* ending of verbs; instead, it treats the present perfect and translates it as the operator H. On the other hand, Dowty (1979) deals with the past tense in English in exactly the same way that Montague treats the present perfect (save the notational difference to be noted right below). Dowty also treats the perfect but in a drastically different way, recognizing the fact that the meaning of the perfect is more complex than is assumed in PTQ. In comparing PTQ and Dowty's framework, I abstract away from this difference and assume that our objective is to describe the meaning of the simple past tense in English.[2]

There are more substantive differences between the two systems, to which I now turn. One important characteristic of Dowty's system is the following: instead of using sentential operators like H and W, which manipulate temporal indices in the metalanguage, Dowty employs the existential quantifier, time variables, an AT operator, and predicates of times PAST, PRES, and FUT. The semantics of these operators is defined in the following way:

(9) For any time t and sentence φ, $[\![AT\ (t', \varphi)]\!]^{M,w,t,g} = 1$ iff $[\![t']\!]^{M,w,t,g} = t_1$ and $[\![\varphi]\!]^{M,w,t_1,g} = 1$

For any time t, $[\![PAST\ (t')]\!]^{M,w,t,g} = 1$ iff $[\![t']\!]^{M,w,t,g} < t$.[3] Similarly for PRES and FUT.

[2] It is not clear why Montague interpreted the present perfect, rather than the simple past, as an operator which quantifies over past times. One possibility is offered by Bennett and Partee (1973), who suggest that the simple past involves a specified time, whereas the present perfect involves only an unspecified time, or indefinite time. Therefore, the existential force of the operator is better represented by the latter. However, this is hardly a persuasive argument because the meaning of the perfect is more complicated anyway (cf. McCoard 1978, Dowty 1979, etc.)

[3] The symbol < is taken to indicate complete precedence excluding abutting. A more formal definition is given in Chapter 3.

The past tense operator H in PTQ accomplishes several things at once: (i) quantifying existentially over times; (ii) restricting the quantificational force to past times; (iii) manipulating the temporal index in such a way that the temporal interpretation of all the expressions appearing in the scope of H is affected. In effect, what Dowty's proposal does is to break down the meaning of the past tense packed in the interpretation of the past tense operator into various component parts and represent them as such in the object language: (i) the existential force of the past tense is represented by the existential quantifier $\exists$; (ii) the fact that the quantificational force of the past tense is restricted to past times is captured by employing the predicate of times PAST; (iii) the fact that the tense affects the temporal interpretations of all expressions appearing within its scope is indicated by the use of an AT operator.

The semantic rule for existential quantifiers, which is now good for both normal individuals and times, is as follows:

(10) If Φ is a sentence and $u \in Var_a$, then $\exists u\, \Phi \in ME_t$, and $[\![\exists u \Phi]\!]^{M,w,t,g} = 1$ iff there exists x such that $[\![\Phi]\!]^{M,w,t,g'} = 1$, where g' is exactly like g except for the (possible) difference that g' assigns x to u (i.e. $g'(u) = x$).

The relevant syntactic rules and the translation rules in Dowty's system are the following:[4]

---

[4] The notations are slightly different from the original.

(11a) S39. If φ is of type t, F39 (φ) is the result of replacing the main verb of φ with its past tense form.

(11b) T39. If φ is of type t and φ translates into φ', F39 (φ) translates into $\exists t$ [PAST (t) & AT (t, φ')]

(11c) S40. If φ is of type t, S40 (φ) is the result of inserting *will* before the main verb of φ.

(11d) T40. If φ is of type t and φ translates into φ', F40 (φ) translates into $\exists t$ [FUT (t) & AT (t, φ')]

According to the above translation rules, (7a) and (7b) translate into IL formulas as (7a") and (7b"):[5]

(7a") $\exists t$ [PAST (t) & AT (t, sleep' (j))]

(7b") $\exists t$ [FUT (t) & AT (t, sleep' (j))]

As can be easily verified, the model-theoretic interpretations of (7a") and (7b") are exactly the same as these of (7a') and (7b'). Why is it that Dowty proposes a new system rather than adopting PTQ without any modification? The reason has to do with the difficulty that the PTQ system faces in dealing with adverbials like *yesterday* (Dowty, 1979, 1982). Consider the following sentence:

[5] I will ignore the difference between the present perfect and the simple past here and translates the present perfect as if it is a past tense.

(12) John died yesterday.

The intuitive meaning of (12) cannot be represented by the operator analysis of tense. Assume the following interpretation rules for P and Y, which are mnemonic for the past tense and the adverb *yesterday*, respectively:

(13a) $[\![P\varphi]\!]^{M,w,t,g} = 1$ iff for some $t' < t$, $[\![\varphi]\!]^{M,w,t',g} = 1$

(13b) $[\![Y\varphi]\!]^{M,w,t,g} = 1$ iff for some t' which falls within the day preceding the day of which t is part, $[\![\varphi]\!]^{M,w,t',g} = 1$

This predicts two possible scope relationships between P and Y, but neither represents the right truth condition of (12):

(14a) PY [die' (j)]

(14b) YP [die' (j)]

(14a) means that there is a past time t_1, and John died on the previous day of the day of which t_1 is part. (14b) means that there was a time within yesterday t_1, and John died at a time earlier than t_1. Neither scope option guarantees that John's dying took place yesterday. As we have seen, Dowty opts for introducing quantifiers and variables in the object language, which makes it easier to deal with adverbials. According to Dowty's (1979) proposal, (12) is translated into the following formula:

(15) $\exists t\,[\mathrm{PAST}\ (t)\ \&\ \mathrm{AT}\ (t, \mathrm{die}'\ (j))\ \&\ t \subseteq \mathrm{yesterday}']$

Where yesterday' denotes the interval which corresponds to the duration of yesterday. Since we now have a time variable for the time of John's dying, we can simply add another constraint upon the interpretation of this variable, i.e., it falls within yesterday.

I employ Dowty's system in what follows because it is a notational system more flexible than the one which employs sentential operators, not because it is superior.[6] Since our ultimate goal is how English or Japanese sentences are model-theoretically interpreted, not how their meanings are symbolized in an artificial language, we should not be so concerned with the notational system that we adopt for our discussion. The two systems under consideration are not as unlike each other as they might look at first. In Dowty's framework, an AT operator guarantees that the past tense affects the temporal interpretations of the expressions appearing within its scope. Consider (7a") given above:

(7a") $[\![\exists t\,[\mathrm{PAST}\ (t)\ \&\ \mathrm{AT}\ (t, \mathrm{sleep}'\ (j))]]\!]^{M,w_1,t_1,g} = 1$ iff there exists g' which is exactly like g with the possible exception that it assigns t_2 to t and $[\![\mathrm{PAST}\ (t)\ \&\ \mathrm{AT}\ (t, \mathrm{sleep}'\ (j))]\!]^{M,w_1,t_1,g'} = 1$.

[6] The comparison of the two systems is obviously an interesting issue. However, I will abstain from discussing it. See Parsons's comments on Partee (1973) and van Benthem (1977) for relevant discussion.

$[\![PAST\ (t)\ \&\ AT\ (t, sleep'\ (j))]\!]^{M,w_1,t_1,g'} = 1$ iff $[\![PAST\ (t)]\!]^{M,w_1,t_1,g'} = 1$ and $[\![AT\ (t, sleep'\ (j))]\!]^{M,w_1,t_1,g'} = 1$

$[\![PAST\ (t)]\!]^{M,w_1,t_1,g'} = 1$ iff $t_2 < t_1$.

$[\![AT\ (t, sleep'\ (j))]\!]^{M,w_1,t_1,g'} = 1$ iff $[\![sleep'\ (j)]\!]^{M,w_1,t_2,g} = 1$. That is, John sleeps in w_1 at t_2.

Both (7a') and (7a''') predict that (7a) is true at t iff there is a t' such that t' is located prior to t and John is in the extension of the predicate "sleep" at t'. The semantic effects of the sentential operator H and Dowty's approach are exactly the same. In this way, two different formulas produced by two different notational systems can receive exactly the same model-theoretic interpretation.

The other important characteristic of Dowty's system is that it is interval-based. This aspect of Dowty's framework is independent of the fact that he employs quantifiers and variables over times. Intervals can be defined in terms of instants in the following way (Bennett and Partee 1972):

(16) Let T be the real numbers. T is to be regarded as the set of moments of time. Let $\leq$ be the standard dense simple ordering of T. I is an INTERVAL of T if and only if $I \subset T$ and for any $t_1, t_3 \in I$ such that $t_1 \leq t_3$ if t_2 is such that $t_1 \leq t_2 \leq t_3$, then $t_2 \in I$.

In plain English, this means that an interval can be defined as a set of points which does not have any gaps. In an interval-based system, the denotation of a certain expression is determined with respect to a model, a world, an *interval* (not an instant), and a value assignment function. Thus, an interpretation function F applies first to a constant and then to a pair consisting of a world and an *interval* and returns the extension of the constant as its value. The motivation for an interval-based semantic system is by now well-known. The crucial observation is that a tensed sentence can be true at an interval without it being true at any of the moments which are subintervals of the interval in question. Consider the following set of sentences:

(17a) John was in the room for three minutes. [stative]

(17b) John built a house in three months. [accomplishment][7]

Consider (17a) first. Suppose that John was in the room from 1 p.m until 1:03 p.m. Then (17a) is true. Does it follow that *John be in the room* is true at any time within this three-minute interval? The answer is yes. This situation is compatible with a point-based system like PTQ. The situation is different with (17b). Suppose that John started building a house at the beginning of January and completed it at the end of March. In this situation, (17b) is true. Is it true to say that John built a house at any time within this period? The answer is no because John did not build a house at any subinterval of the three-month period; he built it at the whole interval of the three month period. Thus, we would like to be able to say that *John build a house* is true at the three-month interval, but at none of its subintervals. This is impossible if we

[7] The term "accomplishment" is due to Vendler (1967) and refers to sentences which have a built-in goal.

assume a point-based system like PTQ because a sentence can be true at an interval only by virtue of its being true at all points in it. In sum, the desire to capture the independence of the truth at an interval from the truth at the subintervals (particularly, moments) of this interval has led to the introduction of interval-based semantic systems. The reader who wishes to see a more detailed argument for interval-based systems is referred to Bennett and Partee (1972) and Dowty (1979).

Note that adopting an interval-based system has some side effects. As mentioned above, one of the advantages of an interval-based system is that it can define the extension of a certain expression at an interval independently of its extension at the points within this interval. However, this characteristic of an interval-based system can also be its weakness unless we constrain the system in a proper way. The system as such does not tell us anything about the relationship between the extension of a certain expression at an interval i and its extensions at the subintervals of i. As far as accomplishments and statives are concerned, we could say the following, which I believe to be the standard view:

(18a) If φ is an accomplishment sentence and is true at an interval i, φ is false at all proper sub-intervals of i.

(18b) If φ is a stative sentence and is true at an interval i, φ is true at all sub-intervals of i.

But then how should negation be treated in an interval-based framework? Again, there is no predetermined relationship between the truth value of a negated sentence at an interval and the truth value of this sentence at its sub-intervals. Suppose, for example, that (19) is true at an interval i.

(19) John does not turn off the stove

What is its truth value at the sub-intervals of i? We can think of various possibilities, but the most plausible seem to be the following two. A first approach is to think of negation simply as a sentential operator, whose semantic role can be defined in the following way:

(20) If φ is a sentence, $\neg\varphi$ is true at t iff φ is false at t.

Thus, (19) is true at i iff (21) is false at i:

(21) John turn off the stove

The entailment relationships that we have established above for accomplishments and statives work only with true sentences, not with false sentences. Thus, given that (21) is false at i, we do not know the truth value of (21) at any of the subintervals of i. Hence, we do not know the truth value of (19) at these intervals, either. A second approach is to think of negation as something that changes the aspectual class of the sentence with which it is combined. Thus, the extension of (19) is not given in terms of its non-negative counterpart, i.e. (21), but is assigned to it directly. It is often assumed that negated sentences are statives. Thus, we assume here that (19) is a stative sentence and is true. If we follow this line of reasoning, we predict that (19) is also true at all of the subintervals of i because (19) is a stative sentence and a stative sentence has the subinterval property.[8] Thus, the treatment of negation is underdetermined by the basic principles of interval semantics. We will discuss referential analyses of tense in 1.2.4.3., and some examples involving negation will be taken up there.

1.2.2. Multiple-Index Systems

It has long been noticed that a system in which an index is construed as a world-time pair is inadequate in handling certain English sentences. The following examples are discussed by Kamp (1971: 231) to motivate a system which employs a double-index system (i.e. a system which employs two time indices):[9]

(22a) A child was born that would become ruler of the world.

(22b) A child was born that will become ruler of the world.

(22a) places the time of the child's becoming a ruler at some time later than the time of

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[8] Humberstone (1979) discusses the distinction between intuitionistic (= strong) negation and classical (= weak) negation in interval semantics, which is similar to the distinction that I make here.

[9] Let us assume that the relative clauses in (22a) and (22b) are extraposed from the head nouns that they modify.

his birth, whereas (22b) places it some time after the speech time. It is easy to write a formula which represents the meaning of (22a):[10]

(22a') $P\,\exists x[\text{child}'(x)\ \&\ \text{be-born}'(x)\ \&\ F\,[\text{become-ruler-of-the-world}'(x)]]$

where P and F are interpreted in the following way:

$[\![P\varphi]\!]^{M,w,t,g} = 1$ iff for some $t' < t$, $[\![\varphi]\!]^{M,w,t',g} = 1$

$[\![F\varphi]\!]^{M,w,t,g} = 1$ iff for some $t' > t$, $[\![\varphi]\!]^{M,w,t',g} = 1$

On the other hand, the meaning of (22b) cannot be represented using P and F.[11] Kamp proposes the following translation:

(22b') $P\,\exists x[\text{child}'(x)\ \&\ \text{be-born}'(x)\ \&\ NF\,[\text{become-ruler-of-the-world}'(x)]]$

Here, N stands for 'now' and is interpreted in relation to the speech time. For this

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[10] The translations and notations deviate slightly from the original found in Kamp (1971), but I trust that nothing of consequence has been changed.

[11] One obvious alternative is to quantify in the NP, including the extraposed relative clause. However, this does not seem viable since the head noun *child* seems to be in the scope of the matrix past tense. If the NP is quantified in, the resulting interpretation does not seem to do full justice to the reading that (22b) has:

(22b'') $\exists x[\text{child}'(x)\ \&\ F[\text{become-ruler-of-the-world}'(x)]\ \&\ P\,[\text{be-born}'(x)]]$

(22b''), among other things, says that the individual in question is a child now, which is not necessarily the case. This problem disappears if we adopt Enc's proposal (1981, 1986) that nouns are indexicals (a detailed discussion will be given later). However, a question remains as to why this NP *must* be quantified in.

purpose, we need a time index for the speech time which is never shifted by operators. The truth condition of N is the following:

(23) $[\![N\varphi]\!]^{M,w,t,s,g} = 1$ iff $[\![\varphi]\!]^{M,w,s,s,g} = 1$

Now the assumption is that a sentence uttered at s is evaluated with respect to M,w,t,s,g where s is the speech time and t = s. t can be shifted by various operators, but s is not shifted and is used to keep track of the speech time. Let us see how (22b') is interpreted:

(24) $[\![P\ \exists x[\text{child}'(x)\ \&\ \text{be-born}'(x)\ \&\ NF\ [\text{become-ruler-of-the-world}'(x)]]]\!]^{M,w,s,s,g} = 1$ iff there is a time $t_1 < s$ such that the following holds:

$[\![\exists x[\text{child}'(x)\ \&\ \text{be-born}'(x)\ \&\ NF\ [\text{become-ruler-of-the-world}'(x)]]]\!]^{M,w,t_1,s,g} = 1$

This is the case iff there is a value assignment g' which is exactly like g with the possible exception that g' assigns x the value x_1 and the following conditions hold:

(i) $[\![\text{child}'(x)]\!]^{M,w,t_1,s,g'} = 1$

(ii) $[\![\text{be-born}'(x)]\!]^{M,w,t_1,s,g'} = 1$

(iii) $[\![NF\ [\text{become-ruler-of-the-world}'(x)]]\!]^{M,w,t_1,s,g'} = 1$

The conditions (i) and (ii) are straightforward. (iii) is the case iff the following is true:

$$[\![F\ [\text{become-ruler-of-the-world}'\ (x)]]\!]^{M,w,s,s,g'} = 1$$

Note here that the evaluation time is reset to s. It is easy to arrive at the conclusion that the time at which x_1 becomes the ruler lies in the future of the speech time. The important point to note is that some expressions like *would* are evaluation-time-sensitive (i.e. sensitive to the time index which is shiftable), whereas others like *will* and *now* are speech-time-sensitive.

Double-index systems (or multiple-index systems in general) have been proposed by various researchers in order to keep track of certain important times such as the speech time. I will examine a multiple-index system in Chapter 2 which is designed to cope with the problems connected with the ST phenomenon in English.

1.2.3. Reichenbach (1947)

Reichenbach (1947) proposes a framework for temporal reference in English. The system enjoys great popularity among linguists but had not been investigated as a formal model until recently (cf. Nerbonne 1984). I believe that Reichenbach's proposal raises two important issues concerning the temporal system of English and temporal semantics in general. In what follows, I will discuss them separately.

1.2.3.1. The Context Dependency of Tense Interpretation

The most important insight into the semantics of tenses that Reichenbach's framework provides is his observation that the interpretation of tenses is, at least in some cases, context-dependent.[12]

Reichenbach's system employs three temporal entities: the point of speech (S), the point of reference (R), and the point of the event (E). Any theory of temporal reference must make reference to two temporal points: the point of speech and the point of the event. In model-theoretic terms, the point of speech is the original evaluation time (or the speech time index in a double-index system); the point of the event is the time at which the proposition is true. However, Reichenbach argues that a third temporal entity, the reference point, is necessary in order to capture the temporal meanings of English tense forms. The following diagrams are claimed to represent the temporal interpretations associated with various tense forms in English (Reichenbach 1947: 290):

[12] I will use the term "context-dependency" in one special sense. It refers to the fact that at least in some cases tenses seem to refer to some particular interval, rather than making an existential claim about an interval. Tenses may be "context-dependent" in a different sense. Some analyses of tenses claim that tenses are sensitive to the current evaluation time and this alleged characteristic of tenses may also deserve the name "context-dependency". However, I will reserve the term "evaluation-time-sensitive" for this meaning in order to avoid a terminological collision.

(25) We thus come to the following tables, in which the initials 'E', 'R', and 'S' stand, respectively, for 'point of the event', 'point of reference', and 'point of speech', and in which the direction of time is represented as the direction of the line from left to right:

Past Perfect	Simple Past	Present Perfect
I had seen John	I saw John	I have seen John
——————>	——————>	——————>
E R S	R,E S	E S,R

Present	Simple Future	Future Perfect
I see John	I shall see John	I shall have seen John
——————>	——————>	——————>
E,R,S	S,R E	S E R

To a practitioner of traditional model-theoretic semantics, it is puzzling what purpose the new temporal entity R might serve. In fact, Reichenbach's theory cannot be conceived of as a truth-conditional theory (in the narrow sense of the term) of tense forms in English. For example, the introduction of R enables Reichenbach to distinguish between the simple past and the past perfect: the event time is located prior to the reference point for the past perfect, and that the event time is simultaneous with the reference point for the simple past. But from the point of truth conditions there is no overpowering difference between these two forms.

One way of interpreting this distinction between the past perfect and the simple past in the terms offered by PTQ is to say that the past perfect corresponds to iterating the operator H, whereas the simple past is represented by a single occurrence of it. We may be justified in assuming that the iteration of H corresponds to the meaning of the past perfect because the past perfect is used to refer to an event located in the past of a past time. [13] Let us see if this proposal serves to distinguish between the past perfect and the simple past. Consider (26a) and (26b), which translate into (26a') and (26b'), respectively:

(26a) John lost his book.

(26b) John had lost his book.

(26a') H [John-lose-his-book']

(26b') HH [John-lose-his-book']

I will show below that (26a') and (26b') are true under exactly the same circumstances if we make the intuitively reasonable assumption that time is dense. Suppose that time is dense:

(27) $\forall t \forall t' [t' < t \rightarrow \exists t''[t' < t'' < t]]$

[13] I am making a simplifying assumption here. As I shall claim later, the past perfect is ambiguous between an aspectual and a preterit interpretation. I concentrate on the preterit interpretation of the past perfect here.

(28)

1 Show that for any t such that ⟦H [John-lose-his-book']⟧ is true at t, ⟦HH [John-lose-his-book']⟧ is also true at t.

Assume that ⟦H [John-lose-his-book']⟧ is true at t_1. This is the case iff there is a time $t_2 < t_1$ such that ⟦John-lose-his-book'⟧ is true at t_2. According to (16), there is a time t_3 such that $t_2 < t_3 < t_1$ no matter which particular points are chosen as t_1 and t_2. Hence, ⟦H[John-lose-his-book']⟧ is true at t_3. So, ⟦HH[John-lose-his-book']⟧ is true at t_1. Thus, one can conclude that if there is time t at which ⟦H[John-lose-his-book']⟧ is true, ⟦HH[John-lose-his-book']⟧ is also true at t.

2 Show that for any t such that ⟦HH [John-lose-his-book']⟧ is true at t, ⟦H [John-lose-his-book']⟧ is also true at t.

Assume that ⟦HH [John-lose-his-book']⟧ is true at t_1. This is so iff there is a time $t_2 < t_1$ such that ⟦H [John-lose-his-book']⟧ is true at t_2. ⟦H [John-lose-his-book']⟧ is true at t_2 iff there is a $t_3 < t_2$ such that ⟦John-lose-his-book'⟧ is true at t_3. Since $t_3 < t_1$, ⟦H [John-lose-his-book']⟧ is true at at t_1. Thus, one can conclude that if there is a time t at which ⟦HH [John-lose-his-book']⟧ is true, ⟦H [John-lose-his-book']⟧ is also true at t.

The above two procedures show that under the given assumption about the structure of time H[John-lose-his-book'] and HH[John-lose-his-book'] have exactly the same truth conditions. Thus, both (14) and (15) are predicted to be true if and only if there is a past time at which *John lose his book* is true, and we fail to distinguish between (14) and (15) in truthconditional terms. This shows that the distinct semantic contributions that the English simple past tense and past perfect make cannot be captured by iterating or not iterating the past tense operator H, which quantifies existentially over all past times. But how then should we represent the intuitively clear distinction between the simple past tense and the past perfect?

The key to understanding Reichenbach's proposal is to pay attention to the context-dependency of tense interpretations. Reichenbach's proposal requires of a sentence in the past tense that R precede S and E coincide with R. This does not mean that there is *some* time before S which is simultaneous with a time at which the proposition conveyed by the sentence is true. Rather, the reference point in Reichenbach's system should be taken to be the contextually determined interval which is salient at a certain point in discourse. For instance, in a narrative discourse, we do not talk about past times in general. We focus on a specific interval in the past and events or states that obtain at or within it. Thus, a sentence in the simple past tense serves to describe an event or state which occurs at or within this interval,[14, 15] whereas a sentence in the past perfect is used to claim that the event or state described

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[14] The terms "event" and "state" will often be used in a non-technical sense, unless otherwise noted. The technical sense in which these terms will be used later is given in Chapter 4.

[15] It is very important to determine which of the two interpretations (*at* or *within*) is adopted for the past tense. I will be concerned with this question later. For now, we can ignore this distinction as long as we recognize the reference to the salient past interval.

is located prior to the reference time, which itself is located in the past. Consider the following narrative discourse:

(29) John arrived in New York on Monday. He was already tired.
He had left home on the previous day.

The reference time in this example is Monday. The event of John's arrival in New York and the state of his being tired are related in the simple past, and they fall within this day. On the other hand, the event of his leaving home took place on the previous day, prior to the reference time. Thus, it is described in the past perfect. In this way, if the reference time is considered to be a contextually determined definite interval, the distinction between the simple past and the past perfect that Reichenbach proposes seems to be valid. In what follows, I will use the term "context-dependency" of tense interpretation to refer to the fact that tense interpretations are sensitive to a contextually determined definite time interval. The question now is how to characterize the context dependency of tense interpretation more precisely. We will discuss this issue in section 1.2.4.

1.2.3.2. A "Compositional Semantic System" for English

Another appealing characteristic of Reichenbach's analysis of the tense system in English as I understand it is that his system attempts to provide a "compositional semantic system" for the tense forms. Although Reichenbach himself does not claim this explicitly, this interpretation of Reichenbach's system is found in the existing literature. Bouchard (1984) proposes such an interpretation of Reichenbach's system. Ota (1971) also assumes that Reichenbach's system is "compositional" in that each tense form serves to determine the value of a certain temporal point. This point is noteworthy because most of the temporal systems proposed in the formal semantics literature that I am acquainted with (Bennett and Partee (1972), Dowty (1979), Dowty (1982)) do not make an attempt to come up with a semantic system which mirrors the distribution of tense morphemes.[16] In particular, the syntactic independence of the modals and the tense morphemes have not been exploited in these semantic analyses. Syntactically, the auxiliary system of English is quite complex and allows various combinations of the tense morpheme, the modal auxiliary, and the perfect. As was proposed in Chomsky (1957), English allows all the possible expansions of the following set of phrase structure rules (ignoring the progressive and the passive):

(30) Aux → Tns (Modal) (have + en)

Tns → Pres

Past

Tns can be rewritten either as Pres or Past; the modal (for our purposes, *will*) is either present or absent; and the perfect is either present or absent. Reichenbach's system seems to be "compositional" in that the presence or absence of a certain tense form (including the modal and the perfect) has a certain well-defined and constant role to

[16] Ladusaw (1977) and Abusch (1988) are exceptions. Their proposals are discussed in Chapter 2.

play in determining the temporal interpretation of the sentence. By looking at the above diagrams, we can arrive at the following algorithm:

(31) Present tense $\rightarrow$ R = S

Past tense $\rightarrow$ R < S

Presence of the Perfect $\rightarrow$ E < R

Absence of the Perfect $\rightarrow$ E = R

This algorithm allows us to predict the desired interpretations for the following sentences:

(32a) John lost his book.

(32b) John had lost his book.

(32a) is in the past tense. Thus the reference point is located before the speech time, and the event time is simultaneous with this reference point. On the other hand, (32b) is in the past perfect. Thus, the reference point is prior to the speech point, and the event time is located prior to this reference point.

When we turn to more complicated cases, Reichenbach's system as I understand it faces problems in describing them compositionally. So far we have not discussed cases involving the future auxiliary. I will show that when we take them into consideration, coherent rules turn out to be impossible. Compare the following two diagrams employed by Reichenbach for the simple future and the future perfect:

(33a) I shall see John

$$\xrightarrow[\text{S,R} \quad \text{E}]{}$$

(33b) I shall have seen John

$$\xrightarrow[\text{S} \quad \text{E} \quad \text{R}]{}$$

Comparison of (33a) and (33b) reveals that Reichenbach's system cannot be a semantic system which mirrors the syntactic configurations of tense morphemes. In the standard syntactic analysis of the auxiliary system of English, the future auxiliary surfacing as *will* breaks down into the present tense morpheme and the future auxiliary (which we might call *woll*) and the one that appears as *would* consists of the past tense morpheme and *woll*. Given the rules for the tense morpheme and the perfect, any additional rule which respects the independent distribution of the tense morpheme and *woll* fails. Consider (33a). Since *will* is in the present tense, R is simultaneous with S. The futurate meaning associated with *woll* is conveyed by assuming that E is subsequent to R. So let us tentatively assume the following rules:

(34a) Presence of *woll* → R < E

(34b) Absence of *woll* → R = E

(34a) and (34b) are in conflict with the rules for the perfect. Consider (33b). The diagram that Reichenbach gave shows that R is in the future of S and that E is prior to R. This cannot be predicted by the rules for the future auxiliary just proposed. It would be predicted if we assumed the following rules for the future auxiliary:

(35a) Presence of *woll* → S < R

(35b) Absence of *woll* $\rightarrow$ S = R

But this modification creates problems elsewhere. For now (33a) is not predicted. Also sentences in the simple past do not receive a coherent interpretation. Of course, if this is the only problem with Reichenbach's proposal, one might retreat to a more conservative position and say that we should not have regarded Reichenbach's system as a compositional system in the first place. That is, we might take Reichenbach's proposal as a collection of diagrams proposed for various tense forms in English without considering how to arrive at these diagrams. It may well be that this is all we can say about the temporal system in English, but as I will demonstrate below, the temporal system of English *is* a compositional system. If so, Reichenbach's system without an explicit algorithm is not attractive.

One way of preserving the "compositional semantics" approach is to assume a different internal structure of the Aux node. The phrase structure rule proposed above allows only two possible values for the Tns node, whereas the alternative rule for the Tns node that I will suggest has three possible values that it can assume: Past, Pres, Fut:

(36) S $\rightarrow$ NP Aux VP

Aux $\rightarrow$ Tns (have en)

Tns $\rightarrow$ Pst

Prs

Fut

Given this set of syntactic rules, one could consider the following correlation between tenses and relations among S, R and E:

(37) Past $\rightarrow$ $R \leq S$

Present $\rightarrow$ $R = S$

Future $\rightarrow$ $S < R$

Presence of the Perfect $\rightarrow$ $E < R$

Absence of the Perfect $\rightarrow$ $E = R$

At first, this strategy seems to work pretty well. If we fix the diagram for the simple future in the following way, we can maintain the compositional aspect of Reichenbach's system to a certain degree and predict the desired interpretations of all the tense forms correctly:[17]

(38) <u>Simple Future</u>

I shall see John

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————————>
  S    E, R
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[17] In fact, Reichenbach himself says (1947: 295-96) that there are two ways of representing the future tense: S,R - E and S - R,E.

Unfortunately, as we shall see, positing one syntactic position for the past, present, and future tenses for English is wrong, after all. The problem is that we have not considered examples involving *would* so far. First, consider the following:

(39) John said last week that Mary would come to Austin in three days.

It is not clear how to revise the syntactic rules given as (36) in order to generate *would*. It is not simply the future tense since *will* and *would* are not in free variation. Nor is it simply the past tense morpheme because the past tense morpheme and *would* are not in free variation, either. Thus, the only option open to us would be to set up a separate unanalyzable tense form *would* as in the following syntactic rules:

(40) S → NP Aux VP
Aux → Tense (have en)
Tense → Pst
Prs
will
would

Although positing *would* as a separate tense form does not seem an attractive move, it may well be that this is the way the tense forms in English work. If this syntax goes well with a certain algorithm to arrive at desired Reichenbachian diagrams, it may be a necessary sacrifice. However, the revised syntactic rules combined with the assumption that we should adhere to the compositional approach to the semantics of tenses require that *would* too determine the relative order of R and S just like the other tenses that appear in the same slot. Suppose, for instance, that *would* signals that R is subsequent to S. This does not allow us to distinguish between *will* and *would*. Moreover, this position is empirically incorrect; the time of Mary's coming is clearly in the past of the speech time in (39).

The problem is that *would* does not indicate the temporal order of S and R; it indicates something else. In (39), what it does is indicate that Mary's coming is subsequent to John's saying. Thus, let us assume the following rule for *would*:

(41) presence of *would* $\rightarrow$ R < E

This would be fine as long as the perfect would never cooccur with *would*, but in some cases it does. Consider the second sentence in the following short narrative:

(42) John and Bill were talking about the July 28th deadline for the submission of dissertations. John said that *Mary would have finished hers a month before that.*

It is clear that *would* and the perfect *have* have distinct and well-defined roles to play in the sentence. However, our current system cannot describe the semantic contributions that these morphemes make. As the rules now stand, both *would* and *have* serve to determine the order of R and E and in contradictory ways:

(43) the presence of the perfect → E < R

the presence of *would* → R < E

Since Reichenbach's system seems to assume that one clause is allowed to have only one reference time and one event time,[18] this is a contradiction.

The problem is that Reichenbach's system only gives us three temporal entities (S, R, and E), and they are simply not enough. It makes sense in this context to break *would* down into the past tense morpheme and the future auxiliary *woll*. The past tense requires that the reference point be in the past (i.e. the time of John's saying),[19] and the future auxiliary refers to the July 28th deadline introduced in the first sentence. On the other hand, we also need a separate temporal point for the actual time of Mary's finishing her dissertation. Even though making reference to these three points seems essential in understanding the information packed in the italicized clause in (42), we simply do not have enough temporal points, as is clear from the following diagram:

[18] It is not obvious that Reichenbach makes this assumption. However, from the ways in which he draws diagrams, we can say that it is his intention. Furthermore, his principle called the "permanence of the reference point" (to be discussed in Chapter 2) would not make sense if we assumed otherwise.

[19] This is also predicted by Reichenbach's principle called the "permanence of the reference point", which we will discuss in Chapter 2.

(44) ——————————————————>

J's saying < S
R
J's saying < July 28th
?
M finishes < July 28th
E

If we decide to refer to the time of John's saying as the reference point and the time of Mary's finishing her dissertation as the event point, what shall we call the July 28th deadline? Since this date clearly plays a role in the interpretation of the sentence, we need a way of referring to this interval. However, Reichenbach's system does not give us enough tools to accomplish this end.

The above discussion tells us that the set of syntactic rules proposed above as (40) is not the right system for English. In fact, the facts suggest that the original system given as (30) is the right one for English. The tense (present or past) makes a certain well-defined contribution; the presence or absence of the future auxiliary (*woll*) makes a separate contribution; and the presence or absence of the perfect makes yet another contribution. I believe that this is an accurate description of how the temporal system of English works. But if so, Reichenbach's system loses some of its appeal because it does not provide diagrams for certain well-formed English sentences.

One obvious way of saving Reichenbach's proposal without eliminating its compositional nature is to add a new temporal point, which we might call "Quasi-reference point (QRpt)", and leave the original syntactic rules (i.e. (30)) intact.[20] In

[20] If we assume that the "real" reference point is the time of the main story line, the name "quasi-reference time" for the new temporal entity that I have posited seems

(42), July 28th is like another reference point (a contextually salient interval), and the following algorithm serves to represent this intuition:

(45) Present tense → R = S

Past tense → R < S

Presence of *woll* → R < QRpt

Absence of *woll* → R = QRpt

Presence of the perfect → E < QRpt

Absence of the perfect → E = QRpt

I now leave it to the reader to verify that this new algorithm serves to produce coherent and intuitively appealing "interpretations" (i.e. diagrams) for various tense forms in English.

Of course, we should not be satisfied with the fact that we can now draw diagrams for all the possible tense forms in English since our ultimate goal is to arrive at model-theoretic interpretations of various tense forms. This topic will be taken up later.

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appropriate. For the quasi-reference time does not carry the main story line. In other words, this time is unlikely to be picked up by the subsequent discourse. For example, assume that the second sentence in (42) is followed by (a):

(a) Bill agreed.

The time at which Bill agreed is understood to be immediately after the time of John's saying, not after the July 28th deadline.
Otherwise, the naming of this new temporal entity is not important. For instance, we could have named it "a second reference point".

1.2.4. "Referential Analyses" of Tense Interpretations
1.2.4.1. Problems with the View that Tenses are Quantifiers over Times

In the tradition of the formal semantic literature, tenses were commonly construed as quantifiers over times (PTQ, Dowty 1979, etc). For our purposes, it is not important whether the quantificational aspect of tense interpretation is given in the meta-language (e.g. PTQ) or is given explicitly in the object language (e.g. Dowty 1979). PTQ and Dowty (1979) are grouped together here as quantifier analyses of tenses. More recently, some arguments were presented to the effect that the traditional approach in which tenses are construed as involving existential quantification over times is not an optimal means of describing and explaining temporal phenomena in natural language. The opponents of the quantifier analysis of tenses argue for what I will henceforth refer to as a referential analysis of tense. First, I will review the criticisms of quantifier analyses of tenses.

One of the earliest referential analyses is given by Partee (1973), and her stove example is often cited in the literature. She argues that sentence (46a), uttered when the speaker is driving down the freeway, cannot be represented semantically as (46b) or as (46c):

(46a) I didn't turn off the stove.

(46b) $\neg\exists t$ [PAST (t) & AT (t, I-turn-off-the-stove')]

(46c) $\exists t$ [PAST (t) & AT (t, $\neg$ I-turn-off-the-stove')]

(46b) means that "it is not the case that there is a past time at which I turn off the stove" (or "I never turned off the stove in the past"), which is probably false at the time (46a) is uttered. Even if it is true, it does not represent the meaning intended by the speaker of (46a). (46c), which means "there is a past time at which I did not turn off the stove", is very trivially true since nobody spends every second of his life turning off a stove. However, (46c) does not represent accurately what the speaker of (46a) intended. Instead, claims Partee, (46a) refers to a particular time whose identity is generally clear from the extra-linguistic context. In this particular case, the past tense is claimed to be used "deictically" since there is no previous discourse that supplies a contextually salient time which serves as the "antecedent" of the past tense occurring in (46a). However, in some cases, such as narrative discourses, the event described in a sentence establishes a contextually salient time, which (or a time slightly after which) is picked up by the immediately following sentence. The following example is given in Partee (1973):

(47) Sheila had a party last Friday, and Sam got drunk.

In this example, the time of Sheila's having a party serves as the time to which the past tense in the second clause refers (at least in a very loose sense of "reference"). The main argument that Partee advances is that at least in some cases, referential treatment of natural languages tenses is called for. It seems, then, we need a theory which is sensitive to contextual factors.

1.2.4.2. Possible Formalizations of the Referential Analysis of Tense

As mentioned above, Partee (1973) is one of the earliest proponents of the referential analysis of tense. She claims that there are some similarities between pronouns and tenses. In the traditional logical analysis of pronouns, it is generally assumed that pronouns translate either as bound variables or free variables. We might refer to the former as bound-variable pronouns, the latter as referential (alternatively, pragmatic or deictic) pronouns. The assumption is that when variables are not bound by an operator, the context assigns appropriate values to these free variables. Consider the following examples:

(48a) John went to the party, and he got drunk.

(48b) Everyone said that he bought a car.

The second conjunct contains the pronoun *he*, and it can be represented as in (48a'). On the other hand, the occurrence of *he* in (48b) would be represented as a bound variable as in (48b'):

(48a') $\exists t$ [PAST (t) & AT (t, go-to-the-party' (j))] & $\exists t'$ [PAST (t') & AT (t', get-drunk' (x))]

(48b') $\exists t$[PAST (t) & AT (t, $\forall x$[person' (x) $\rightarrow$ say' (x, ^ $\exists t'$ [PAST (t') & AT (t', buy-a-car' (x))]][21]

[21] There is another reading of (48b) in which the scope relationship between the existential quantifier and the universal quantifier is reversed, but we are not concerned with the problems associated with scope relationships among quantifiers here:

Let us focus on the case of referential pronouns and consider the following questions: (i) are there temporal analogues of referential pronouns?; (ii) if the answer is yes, how should they be represented formally? The default assumption would be that if there were temporal analogues of referential pronouns, they would be represented as free variables in the translation language and receive appropriate values from the context.

As far as I can see, there are two possible ways of formalizing temporal analogues of referential pronouns. One way is to employ the framework proposed in Dowty (1979) chapter 7, but to modify it in such a way that the existential quantifier is not introduced at the sentential level. Thus, (49a) would translate as (49a') in the modified system instead of (49a"), which Dowty's original system produces:

(49a) John slept.

(49a') PAST (t) & AT (t, sleep' (j))

(49a") $\exists$t [PAST (t) & AT (t, sleep' (j))]

After the value of the free variable t (say, t_1) is contextually supplied, (49a') means that t_1 is located in the past of the speech time and John is in the set of sleepers at t_1.

An alternative is to assume that predicates have a special argument position for a temporal argument. This position is occupied by a variable and is not bound at the sentence-level. This is essentially the position defended by Enç (1981, 1986). Her

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(48b") $\forall$x[person' (x) $\rightarrow$ $\exists$t[PAST (t) & AT (t, say' (x, ^ $\exists$t' [PAST (t') & AT (t', buy-a-car' (x))]))] idea is to dispense with the time index, and to posit for any time-sensitive expression a special argument position occupied by an interval. Enç claims that only nouns and verbs are time-sensitive. Therefore, they have one extra argument position for an interval. For example, (49a) is represented in this system as (49a'''):

(49a''') PAST (t) & sleep' (t, j)

I assume the following interpretation for sleep' in this system:

(50) $[\![\text{sleep}'\,(t, x)]\!]^{M,w,g} = 1$ iff g(x) sleeps at g(t) in w.

As far as I can see, the choice between the two alternatives does not affect the content of the following discussion. For the purpose of our discussion, I assume that either of the above two formalizations is a legitimate way of characterizing the referential analysis of tense.

Before we go on, I would like to consider one semantic system which is compatible with a free variable analysis of tenses but is not considered to be a referential analysis of tenses. Take the first system, in which *John slept* is symbolized in the following way:

(49a') PAST (t) & AT (t, sleep' (j))

Suppose that the lexical meaning of sleep' is defined in the following way:

(51) $[\![sleep']\!]^{M,w,t,g} = \{x \mid x \text{ sleeps in } w \text{ sometime within } t\}$

If this is the lexical meaning of sleep', the entire theory no longer deserves the name "referential theory" because the quantificational aspect of the tense interpretation is hidden inside the meaning of the predicate sleep'. The same is true of the second system in which *John slept* is translated into the following formula:

(49a''') PAST (t) & sleep' (t, j)

Suppose that the lexical meaning of sleep' is the following:

(52) $[\![sleep']\!]^{M,w,g} = \{\langle t, x\rangle \mid x \text{ sleeps in } w \text{ at sometime within } t\}$

Exactly the same comment applies here; if sleep' is interpreted in this way, the entire theory which incorporates this interpretation of individual predicates cannot be regarded as a referential analysis of tense. Thus, when I make reference to referential analyses of tense in the following discussion, I exclude this special interpretation of predicates.

1.2.4.3. Problems with the Referential Analysis of Tense

Although the inadequacies of a purely quantificational analysis of tenses in natural languages are well-known, its alleged antithesis, the referential treatment of tense, is not without problems, either. In this sub-section, I will reconsider the arguments for the referential treatment of tense and bring out some problems. Before I do so, several remarks are in order. The referential analysis of tense was initiated by Partee (1973), but this position was modified by Partee herself in her 1984 paper (Partee 1984). The following critique of the referential theory of tenses is directed toward the analysis given in Partee (1973). This position was criticized by Bäuerle (1977), and Partee herself (1984: 276) concedes that the quantificational aspect of tenses is undeniable. Some might feel, therefore, that it is not necessary to criticize the referential treatment of tense here. However, some linguists still maintain that the original referential theory is viable. One notable example is Enç (1981, 1986, 1987), whose work we will take up in Chapter 2. Therefore, I believe that it is useful to discuss this issue here.

First, let us reconsider Partee's (1973, 1984) examples:

(53a) I didn't turn off the stove!

(53b) Sheila had a party, and Sam got drunk.

(53c) When John saw Mary, she crossed the street.

(53d) John got up, went to the window, and raised the blind.

With regard to (53a), consider the following quote from Partee (1973: 602-3):

(54) When uttered, for instance, halfway down the turnpike, such a sentence clearly does not mean either that there exists some time in the past at which I did not turn off the stove or that there exists no time in the past at which I turned off the stove. The sentence clearly refers to a

> particular time --- not a particular instant, most likely, but a definite interval whose identity is generally clear from the extra-linguistic context, just as the identity of the he in sentence (2) [(2) He shouldn't be in here.] is clear from the context.

As mentioned above, (53a) is designed to show that the sentence refers to a contextually salient past time, namely the time shortly before the speaker leaves home.

Partee clearly establishes two points: (i) if we interpret the past tense simply as a quantifier over past times, the correct interpretation is not predicted; (ii) the interpretation of at least some occurrences of the past tense morpheme is context-dependent. It is evident that Partee makes a stronger claim in her 1973 paper: the use of the past tense morpheme in (53a) parallels the use of so-called deictic pronouns. However, it is questionable that this can be justified. Consider an allegedly parallel case in the nominal domain (Partee's (1973) (2)) where the pronoun *he* is used deictically:

(55) He shouldn't be in here! (pointing at a person who is "here")

In this case, in order to understand the utterance, we must fix the value of the free pronoun *he*, i.e. the person who is "here".

If we take the parallel between deictic pronouns and allegedly deictic tenses literally, anyone who understands this utterance should be able to fix the value of the free variable t in the following formula.

(53a') PAST (t) & AT (t, ¬I-turn-off-the-stove')

After an appropriate value is assigned to the free time variable t, (53a') means that it is not the case that I turned off the stove at a contextually salient past time. As mentioned in 1.2.1., it is not clear how negation should be analyzed in an interval-based system. I will show that the evaluation of Partee's argument depends on how negation is interpreted in an interval-based system. Let us consider two most plausible possibilities that I mentioned above.

A first possibility is to assume simply that negation is a sentential operator. Then we arrive at the following model-theoretic interpretation of (53a').

(53a") $[\![\text{PAST}(t) \ \& \ \text{AT}(t, \neg\text{I-turn-off-the-stove'})]\!]^{M,w_1,t_1,g} = 1$ iff $g(t) = t_2$ and $[\![\text{PAST}(t)]\!]^{M,w_1,t_1,g} = 1$ and $[\![\text{AT}(t, \neg\text{I-turn-off-the-stove'})]\!]^{M,w_1,t_1,g} = 1$

This is the case iff $t_2 < t_1$ and $[\![\neg\text{I-turn-off-the-stove'}]\!]^{M,w_1,t_2,g} = 1$ (which is the case iff $[\![\text{I-turn-off-the-stove'}]\!]^{M,w_1,t_2,g} = 0$)

What does it mean to say that a sentence is false at an interval? Suppose that the speaker could have turned off the stove at any time between 2:55 and 3:00. Suppose further that this five-minute interval is the contextually salient time and the value assignment function assigns this interval to the free variable. Then, (53a) can be interpreted as meaning that *I turn off the stove* is false at the interval starting at 2:55 and ending at 3:00. But how do we determine whether I-turn-off-the-stove' is false at this interval? Since we assume here the classical two-valued logic, the most plausible answer would be that it is false iff the speaker fails to be in the extension of the predicate turn-off-the-stove' at the interval in question. Since turn-off-the-stove' is presumably an accomplishment sentence, the speaker is in the extension of the predicate at an interval t_2 iff t_2 corresponds exactly to the time he spent to turn off the stove. Following this interpretation, it is too easy to make (53a) true. Since it does not take five minutes to turn off a stove, it is of course false to say that John is in the extension of the predicate *turn off the stove* at the five-minute interval. Moreover, it is possible to set up a model in such a way that the speaker is not in the extension of turn-off-the-stove' at i even if there is some proper sub-interval of i at which he turns off the stove. This is counterintuitive because (53a) is unacceptable if the speaker turned off the stove within the contextually salient interval. Intuitively, (53a) seems to claim that there is a contextually salient interval (say the interval from 4:45 p.m. to 5:00 p.m.) such that *John turn off the stove* is true at none of its subintervals:

(56) $\text{PAST}(t) \;\&\; \neg\exists t' \subseteq t\, [\text{AT}(t', \text{I-turn-off-the-stove}')]$

If this is the correct way of analyzing (53a), the parallel between the particular use of the past tense morpheme in (53a) and deictic pronouns is not complete because "deictic" tenses contain a quantificational meaning as (56) shows.

The proponent of the referential analysis of tense might argue that we should adopt the second analysis of negation discussed above:

(53a'') $\text{PAST}(t) \;\&\; \text{AT}(t, \text{not-turn-off-the-stove}'(j))$

Here negation is not thought of as a sentential operator. Rather, it is incorporated into the meaning of the predicate and produces a stative predicate which roughly means "being in the state of not turning off the stove." That is, (53a) is construed as meaning "there is a contextually salient past interval t such that at t, John's state of not turning off the stove obtained." If we assume that *John does not turn off the stove* is a stative sentence and is true at t, it follows that the same sentence is true at all the sub-intervals of t. Thus, it looks as though we can defend the referential analysis of tense if negation is construed in this way.

However, even when no negation is involved, the referential analysis of tense suffers from the same type of problem. Consider the following conversational exchange between Bill and John:

(57) Bill: Did you see Mary ? I have to talk to her.
John: Yes, I saw her, but I don't know where she is now.
Bill: What time did you see her?
John: Sometime this morning. I don't remember exactly when.

Bill's question is hardly interpretable as a question of whether there was some past time at which *John sees Mary* is true. This should be taken to be a question about whether there was a time within a contextually relevant interval (perhaps the day in question) at which *John sees Mary* is true. John's answer "Yes, I saw her" asserts that there was such a time within the interval, but he does not have to be able to pinpoint the exact time of his seeing Mary. The subsequent conversational exchange between John and Bill confirms this intuition. John's first statement translates into the following formula:

(58) $\exists t[\mathrm{PAST}\ (t)\ \&\ t \subseteq t'\ \&\ \mathrm{AT}\ (t, \mathrm{see}'\ (I, x))]$

Here, t' is a free time variable whose denotation must be fixed by the context. Most likely, the value of t' is today' (i.e. the interval for the duration of today). Proponents of the referential analysis of tense might argue that since this analysis involves a free variable just like in deictic pronoun cases, they are similar. The crucial difference, however, is that in deictic pronoun cases, pronouns themselves are translated as free variables. However, in the case of tenses, tense morphemes themselves should not be translated as free variables in any case because tenses always have quantificational force. Note that if this analysis of tense morphemes is correct, the variable t' is not directly related to the meaning of the past tense morpheme itself; it simply restricts the time variable t. Thus (57) argues for the existential quantifier analysis (with an added restriction) of the past tense morpheme in English.

In (53b) a past tense in the second conjunct is said to refer to the time denoted by the tense in the first conjunct. This is taken to be a temporal analogue of the anaphoric relations found in the nominal domain. For example, in (59) *he* in the second sentence is understood to be coreferential with *Sam* occurring in the first sentence (Partee 1984: 245):

(59) Sam is married. He has three children.

However, this analogy between pronouns and tenses is not complete. The time of the party, however it is construed, is longer than the time of Sam's getting drunk. It seems that the referential theory is valid only if it is taken very loosely: the temporal reference of the second conjunct is "dependent upon" the temporal reference of the first.

When-clause examples such as (53c) are also problematic since the event described by the main clause is usually understood as following the event described in the *when*-clause. Again, the best that we could say is that the temporal reference of the matrix clause event is dependent upon the temporal reference of the *when*-clause.

The same is true of discourse examples like (53d) in which the events conveyed by a series of sentences are understood to happen in the order they are related. In this case, an "immediately after" relation seems to be the one that we need, not simultaneity. As Partee (1984: 256) concedes, the anaphoric relations that we find in the temporal domain are not exactly like the ones that we find in the nominal domain since we cannot find a notion akin to the "immediately after" relation in the latter. As she puts it, "it would be as if pronouns referred to the *father* of the last mentioned individual!"

The examples taken up above show that the "contextual dependency" which characterizes the most occurrences of natural language tenses should not be taken to be something analogous to the deictic use of pronouns. It seems, as far as the simple past tense in English is concerned, that the existential quantifier meaning is central and that its contextual dependency stems from the fact that context imposes an additional restriction upon the interpretation of tense. It may be that pronouns and tenses are similar but differ in finer details. However, the fact that the analogy between pronouns and tenses does not hold in various cases makes us question the validity of the referential analysis of tense.

1.2.5. Toward an Integrated Theory of Temporal Reference

In 1.2.3., we discussed Reichenbach's framework and concluded that the interpretation of tenses is context-dependent. In 1.2.4., we concluded that this should be regarded as a contextual restriction upon the interpretation of tenses and that tenses themselves should be considered to have a quantificational meaning. In 1.2.4.3., I indicated how this can be accomplished in a Dowty-type framework. Two questions arise as to the relationship between the Dowty-type framework that I suggested above and Reichenbach's framework. One is about the relationship between contextually salient intervals translated as free variables and the reference point in Reichenbach's system. The other concerns compositionality: At the end of 1.2.3.2., I proposed a modified Reichenbachian system which was claimed to be "compositional". Can we incorporate the insight of this system in a semantic system which derives in a compositional way the desired IL translations from syntactic structures? As they are related questions, we will discuss them together in this sub-section.

In 1.2.3.2., I concluded that in order to deal with the temporal phenomena in English, we must posit the following syntactic rules for the Aux node in English:

(60) Aux → Tns (Modal) (have + en)

Tns → Pres

Past

The following algorithm is posited to arrived at Reichenbachian diagrams:

(61) Present tense → R = S

Past tense → R < S

Presence of *woll* → R < QRpt

Absence of *woll* → R = QRpt

Presence of the perfect → E < QRpt

Absence of the perfect → E = QRpt

This system predicts that the following sentence (cited as (42) earlier and reproduced here as (62a)) has (62b) as its diagram:

(62a) John said that Mary would have finished her dissertation in June.

(62b)
```
main clause          R, E <  S
                     |
subordinate clause   R  <   QR
                             |
                       E  < QR
```
where R = the time of John's saying; QR = the July deadline
E = time of her finishing her dissertation

How could we translate this algorithm into a model-theoretic framework like Dowty's. I will sketch my analysis here. (The complete version will be presented in Chapter 2.) One important point to be captured is the fact that the semantics of the tense morphemes in English is compositional. I posit the following syntactic and semantic rules:

(63a)

Syntax:

1. $S \rightarrow$ NP Aux VP

2. Aux $\rightarrow$ [α past] [α fut] [α perf]

N.B. α is a variable standing for + or -

(Other rules conform to the standard assumptions about syntax.)

(63b)

Semantics:

1. [S NP Aux VP] translates into Aux' (^ [NP' (^ VP')])

2a. [$_{Aux}$ [α past] [α fut] [α perf]] translates into

$\lambda p[[\alpha \text{ past}]' ([\alpha \text{ fut}]' ([\alpha \text{ perf}]' (p)))]$

2b. [+past] translates into $\lambda p \exists t$ [PAST (t) & $t \subseteq t_R$ & AT (t, $^{\vee}p$)];

[-past] translates into $\lambda p \exists t$ [PRES (t) & $t \subseteq t_R$ & AT (t, $^{\vee}p$)]

2c. [+fut] translates into $\lambda p \exists t$ [FUT (t) & $t \subseteq t_{QR}$ & AT (t, $^{\vee}p$)];

[-fut] translates into $\lambda p \exists t$ [PRES (t) & $t \subseteq t_{QR}$ & AT (t, $^{\vee}p$)]

2d. [+perf] translates into $\lambda p \exists t$ [PAST (t) & AT (t, $^{\vee}p$)];

[-perf] translates into $\lambda p \exists t$ [PRES (t) & AT (t, $^{\vee}$p)]

(Other semantic rules conform to the standard assumptions exemplified by Dowty (1979))

t_R and t_{QR} are constants (or free variables whose denotations are determined by the context) which correspond to the reference point and the quasi-reference point in the framework given above. The above rules represent our intuition that the tense morpheme determines the reference point and the future tense determines the quasi-reference point. The presence or absence of the perfect simply determines the event time. Therefore, its translations do not contain a conjunct about a (quasi-) reference time.

Let us see how the above rules work in accounting for the semantics of (64):[22]

(64) Mary will have finished her dissertation.

1. Mary finish her dissertation ⇒ finish-her-dissertation' (m)
2. Mary [$_{Aux}$ [-past][+fut][+perf]] finish her dissertation ⇒
   λp[[-past]' (^ [+fut]' (^ [+perf]' (p)))] (^ finish-her-dissertation' (m))
3. λp [$\lambda p_1 \exists t_1$[PRES (t_1) & $t_1 \subseteq t_R$ & AT (t_1, $^{\vee}p_1$)] (^ $\lambda p_2 \exists t_2$ [FUT (t_2) & $t_2 \subseteq t_{QR}$ & AT (t_2, $^{\vee}p_2$)] (^ $\lambda p_3 \exists t_3$ [PAST (t_3) & AT (t_3, $^{\vee}p_3$)]' (p)))] (^ finish-her-dissertation' (m))

[22] The original example (62a), which involves an instance of the ST phenomenon, is more complex and will not be treated until we have discussed the ST phenomenon in more detail.

4. $\lambda p_1 \exists t_1 [\text{PRES}(t_1) \,\&\, t_1 \subseteq t_R \,\&\, \text{AT}(t_1, {}^\vee p_1)] ({}^\wedge \lambda p_2 \exists t_2 [\text{FUT}(t_2) \,\&\, t_2 \subseteq t_{QR} \,\&\, \text{AT}(t_2, {}^\vee p_2)] ({}^\wedge \lambda p_3 \exists t_3 [\text{PAST}(t_3) \,\&\, \text{AT}(t_3, {}^\vee p_3)] ({}^\wedge \text{finish-her-dissertation}'(m))))$
5. $\lambda p_1 \exists t_1 [\text{PRES}(t_1) \,\&\, t_1 \subseteq t_R \,\&\, \text{AT}(t_1, {}^\vee p_1)] ({}^\wedge \lambda p_2 \exists t_2 [\text{FUT}(t_2) \,\&\, t_2 \subseteq t_{QR} \,\&\, \text{AT}(t_2, {}^\vee p_2)] ({}^\wedge \exists t_3 [\text{PAST}(t_3) \,\&\, \text{AT}(t_3, \text{finish-her-dissertation}'(m))]))$
6. $\lambda p_1 \exists t_1 [\text{PRES}(t_1) \,\&\, t_1 \subseteq t_R \,\&\, \text{AT}(t_1, {}^\vee p_1)] ({}^\wedge \exists t_2 [\text{FUT}(t_2) \,\&\, t_2 \subseteq t_{QR} \,\&\, \text{AT}(t_2, \exists t_3 [\text{PAST}(t_3) \,\&\, \text{AT}(t_3, \text{finish-her-dissertation}'(m))])])$
7. $\exists t_1 [\text{PRES}(t_1) \,\&\, t_1 \subseteq t_R \,\&\, \text{AT}(t_1, \exists t_2 [\text{FUT}(t_2) \,\&\, t_2 \subseteq t_{QR} \,\&\, \text{AT}(t_2, \exists t_3 [\text{PAST}(t_3) \,\&\, \text{AT}(t_3, \text{finish-her-dissertation}'(m))])])]$

The final translation says that there is a present time which is part of the reference interval and there is a future time relative to this present time which is part of the quasi-reference time. Moreover, there is a past time relative to this future time at which Mary finishes her dissertation. This is the desired result.

As the rules now stand, they predict one very curious fact: the perfect does not interact with a contextually salient interval in any way; it simply indicates the event time (i.e. the time at which the untensed sentence is true). This is inherited from the algorithm of Reichenbach's system upon which the current theory is based: the perfect is assumed to determine the order of the quasi-reference time and the event time. However, this turns out to be problematic. Consider the italicized sentence in the following short narrative:

(65) John met Bill. Bill asked John if he had seen Mary. *John had seen Mary*, so he said, "Yes, I saw her."

Assume that the situation is the same as (57) given above. Intuitively, what the italicized sentence means is that there is a contextually salient interval t (perhaps the day in question) and there is some time t' within t such that *John see Mary* is true at t' and t' lies before the time of Bill's asking John the question. However, according to the above rules, this is not the way the sentence is interpreted:

(66)
1. John see Mary $\Rightarrow$ see' (j, m)
2. John had seen Mary $\Rightarrow \lambda p\, [\lambda p_1 \exists t\, [PAST\,(t)\ \&\ t \subseteq t_R\ \&\ AT\,(t, {}^{\vee}p_1)]\ ({}^{\wedge}\, \lambda p_2 \exists t'\, [PRES\,(t')\ \&\ t' \subseteq t_{QR}\ \&\ AT\,(t', {}^{\vee}p_2)]({}^{\wedge}\, \lambda p_3 \exists t''[PAST\,(t'')\ \&\ AT\,(t'', {}^{\vee}p_3)]\ (p)))]\ ({}^{\wedge}\ see'\,(j, m))$
3. $\lambda p_1 \exists t\, [PAST\,(t)\ \&\ t \subseteq t_R\ \&\ AT\,(t, {}^{\vee}p_1)]\ ({}^{\wedge}\, \lambda p_2 \exists t'\, [PRES\,(t')\ \&\ t' \subseteq t_{QR}\ \&\ AT\,(t', {}^{\vee}p_2)]({}^{\wedge}\, \lambda p_3 \exists t''[PAST\,(t'')\ \&\ AT\,(t'', {}^{\vee}p_3)]\ ({}^{\wedge}\ see'\,(j, m))))$
4. $\lambda p_1 \exists t\, [PAST\,(t)\ \&\ t \subseteq t_R\ \&\ AT\,(t, {}^{\vee}p_1)]\ ({}^{\wedge}\, \lambda p_2 \exists t'\, [PRES\,(t')\ \&\ t' \subseteq t_{QR}\ \&\ AT\,(t', {}^{\vee}p_2)]({}^{\wedge}\, \exists t''[PAST\,(t'')\ \&\ AT\,(t'', see'\,(j, m))]))$
5. $\lambda p_1 \exists t\, [PAST\,(t)\ \&\ t \subseteq t_R\ \&\ AT\,(t, {}^{\vee}p_1)]\ ({}^{\wedge}\, \exists t'\, [PRES\,(t')\ \&\ t' \subseteq t_{QR}\ \&\ AT\,(t', \exists t''[PAST\,(t'')\ \&\ AT\,(t'', see'\,(j, m))])])$
6. $\exists t\, [PAST\,(t)\ \&\ t \subseteq t_R\ \&\ AT\,(t, \exists t'\, [PRES\,(t')\ \&\ t' \subseteq t_{QR}\ \&\ AT\,(t', \exists t''[PAST\,(t'')\ \&\ AT\,(t'', see'\,(j, m))])])]$

7. $\exists t$ [PAST (t) & $t \subseteq t_R$ & $t \subseteq t_{QR}$ & AT (t, $\exists t''$[PAST (t'') & AT (t'', see' (j, m))])]

The final line says the following: (i) there is a past time t which is located within the reference interval and the quasi-reference interval; (ii) there is a time t'' prior to to t such that John sees Mary at t''. As claimed earlier, this is not sufficient as the truth conditions for the italicized sentence in (65). This seems to show that a contextually salient interval is necessary for each tense form, including the perfect. Another minor problem in the current system, which is apparent in this example, is that minus-valued features (e.g. [-fut]) as well as plus-valued features are translated. It is necessary to have a reference interval for the past tense, but introducing another existential quantifier, a predicate PRES, and a quasi-reference interval for the absence of the future auxiliary seems to be pointless. Thus, it is more economical (and empirically more accurate as well) to introduce a new time and a contextual restriction only when a certain tense form is actually used.

These considerations lead us to propose the following revised version of syntactic and semantic rules:

(67) 1. S $\rightarrow$ NP Aux VP

2. Aux $\rightarrow$ Tns (woll) (have + en)

3. Tns $\rightarrow$ Pres

Past

(Other rules conform to the standard assumptions about syntax.)

(68) 1. [S NP Aux VP] translates into Aux' (^ [NP' (^ VP')])

2a. [$_{Aux}$ Tns woll have + en] translates into

$\lambda p \exists t$ [Tns' (t) & AT (t, $\exists t'$ [FUT (t') & $t' \subseteq t_{Rn}$ & AT (t', $\exists t''$[PAST (t'') & $t'' \subseteq t_{Rn}$ & AT (t'', $^{\vee}p$)])])]

2b. [$_{Aux}$ Tns woll] translates into

$\lambda p \exists t$ [Tns' (t) & AT (t, $\exists t'$ [FUT (t') & $t' \subseteq t_{Rn}$ & AT (t', $^{\vee}p$)])]

2c. [$_{Aux}$ Tns have + en] translates into

$\lambda p \exists t$ [Tns' (t) & AT (t, $\exists t''$[PAST (t'') & $t'' \subseteq t_{Rn}$ & AT (t'', $^{\vee}p$)])]

2d. [$_{Aux}$ Tns] translates into

$\lambda p \exists t$ [Tns' (t) & AT (t, $^{\vee}p$)]

3a. [$_{Tns}$ Pres] translates into λt [PRES (t) & $t \subseteq t_{Rn}$]

3b. [$_{Tns}$ Past] translates into λt [PAST (t) & $t \subseteq t_{Rn}$]

In the new system, contextually salient times are translated as t_{Rn}, where n is a variable ranging over natural numbers. In the actual translations, n must be replaced by a natural number. Thus, in the above translations, a formula including reference times must be understood as a meta-language representation for a set of translations. Now, the italicized sentence in (65) is translated in the following way:

(69) 1. John see Mary $\Rightarrow$ see' (j, m)

2. John had seen Mary $\Rightarrow \lambda p \exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, $\exists t'$ [PAST (t') & $t' \subseteq t_{R2}$ & AT (t', $^{\vee}p$)])] (^ see' (j, m))

3. $\exists t\ [PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ AT\ (t, \exists t'\ [PAST\ (t')\ \&\ t' \subseteq t_{R2}\ \&\ AT\ (t',$
$see'\ (j, m))])]$

As can be easily verified, this is the desired interpretation for the sentence in question. In the following discussion, we employ the above system as the point of departure.

1.3. The "Tense Morphemes" in English and Japanese
1.3.1. Unproblematic Cases

In Chapter 2, we will discuss the temporal reference of tense markers in English and Japanese in detail. Before we embark upon this project, I would like to make some brief comments about the morphemes that I will take up there. Since we deal with the behavior of tense markers, the tense morphemes in English and Japanese, *-ed* and *-ta* respectively, are obviously on the list. Despite the fact that they are considered to be the past tense morphemes of the two languages, they show some differences in behavior. I have already mentioned one: the *-ed* form in English is subject to the ST phenomenon, whereas the *-ta* form in Japanese is not. Another difference concerns temporal adverbial clauses. Consider the following data:

(70a) [$_{\text{Temp Adv. Cl.}}$ Hon-o yon-da -ato] denwa -o simas-u.
book ACC read PAST after phone ACC do PRES
After I have read the book, I will call you.

(70b) *After (or when) I read (past tense) the book, I will call you.

As (70a) shows, the *V-ta* form in Japanese can be used in temporal adverbial clauses to refer to a future event which obtains earlier than the future event described in the main clause (Nakau 1976, Matsumoto 1985, Ogihara 1987). By contrast, the English past tense morpheme cannot be so used in temporal adverbial clauses.

English and Japanese also differ as to how futurity is expressed. In English one normally employs *will* or *shall* to refer to future events or states, though the simple present tense can also be used for this purpose in some specialized situations (Comrie 1985: 47, Dowty 1979: 155-157). On the other hand, future events in main clauses are always conveyed by the present tense in Japanese, as it has no future auxiliary as such:

(71a) John will come to Austin tomorrow.

(71b) John-wa asita Austin-ni kimas-u.
TOP tomorrow to come PRES
John will come to Austin tomorrow.

When the verb is stative, the present tense can of course be used to make reference to an event going on at the time of the speech:

(72) John-wa Austin-ni ir-u.
TOP at be PRES
John is in Austin.

Thus, the present tense in Japanese is better termed the non-past tense.[23]

23 Tense systems which allow only two values (past vs. non-past) are common among the world's languages (Comrie 1985: 49).

The progressive in English and its alleged counterpart in Japanese *-te iru* are excluded because they are intuitively aspectual markers. However, it is not clear whether the perfect in English is a tense marker or an aspect marker. In what follows, I will claim that the perfect is ambiguous between a tense interpretation and an aspectual interpretation. In Chapter 2, I will only be concerned with its tense interpretation.

1.3.2. The Ambiguity of the English Perfect

Linguists are divided as to whether the perfect in English is a tense marker or an aspect marker. I will argue that it is genuinely ambiguous between a tense meaning and an aspectual meaning.

The claim that the perfect in English is an aspectual construction is based on the observation that it requires some kind of "current relevance" of the event described by the sentence. Consider the following sentence:

(73) John has lost his book.

At least in its most salient reading, its truth requires not only that John lost his book in the past but also that John have not found his book yet as of now. This "current relevance reading" of the present perfect is obligatory in tensed clauses. The "current relevance interpretation of the present perfect is characterized by the fact that it does not allow co-occurring adverbials denoting definite past intervals, such as *yesterday, last month, two years ago,* etc. (cf. McCoard 1978, Dowty 1979):

(74a) *John has lost his ticket last month.

(74b) *John has graduated from college two years ago.

Henceforth, we will refer to this reading as an aspectual reading of the perfect.

I will argue in what follows that other forms of the perfect can act as the preterit, whose interpretation differs from the interpretation that the present perfect in tensed clauses must receive. In order to establish this point, I will turn to some examples involving adverbials. Various forms of the perfect other than the present perfect in tensed clauses can accompany temporal adverbials denoting definite past intervals. In these cases, the perfect seems to play the same role that the simple past tense does in finite clauses. Consider the following data (Stump 1985: 223, 230):

(75a) Having been on the train yesterday, John knows exactly why it derailed. [free adjuncts]

(75b) Mary may have played the piano yesterday. [unmarked infinitival complements]

(75c) Bill seems to have slept yesterday. [marked infinitival complements]

(75d) He said that Mary had been reading books yesterday. [the past perfect]

Note that the adverb *yesterday*, which denotes a definite past interval, is allowed to occur in (75a) through (75d). I take this to be solid evidence for the claim that the perfect can be used as the preterit. This does not mean, however, that the perfect *must* be used as the preterit when used in structures like those above; in those structures too it can have an aspectual interpretation. The simplest way of establishing this claim is to appeal to the fact that the past perfect occurring in indirect quotes can have two different "sources":

(76a) John said that he had lost his ticket.

(76b) John said "I lost my ticket".

(76c) John said "I have lost my ticket".

Note that both (76b) and (76c) entail (76a). We assume that the direct quote in (76c) can only have an aspectual interpretation because the present perfect occurs in a finite clause here. Furthermore, the direct quote in (76b) can only have a preterit interpretation, by definition. Thus, we can conclude that (76a) can receive two interpretations: one aspectual and one preterit. In Chapter 2, I will be concerned only with the preterit interpretation of the perfect.

There is another way of establishing the contrast between the two readings of the perfect. It involves discourse examples. The past perfect can be used in an extended discourse for two different readings, and the distinction that we try to establish is clearly vindicated here. Consider the following narrative discourses:[24]

[24] The diagrams reflect my view of what the analysis of these two narratives should be. S stands for "state" and represents a result state of the event being described.

(77a) John arrived at the station at nine. He had left home two hours earlier.
E_1 E_2
He had met a friend of his on his way to the station.
E_3

.....

E2 E3 E1 S ——>

(77b) John arrived at the station at nine. Mary had already arrived there.
E_1 S_1
He smiled at her.
E_2

E1S1E2 S ——>

The first occurrence of the past perfect form in (77a) induces a flashback effect. The past perfect here serves to introduce a new time located earlier than the time of John's arriving at the station and to assert that John's leaving home obtains at this time. The second occurrence of the past perfect describes an event which occurs after his leaving home, but before his arriving at the station. The past perfect in (77b) has a different flavor. Intuitively, the second sentence describes the "result state" of Mary's arriving at the station, i.e. Mary's being at the station. That is, the second sentence is not presumably construed to assert that there is a time prior to the time of John's arriving at the station (nine) at which *Mary arrives* is true. Instead, it asserts that the result state of Mary's having arrived obtains at nine (or shortly after nine); it is an implication of this assertion that Mary arrived at some earlier time. Put another way, there being a time earlier than nine at which Mary arrives at the station is true is a necessary condition, but not a sufficient condition, for the truth of the second sentence in the discourse. One must make sure that the result state of Mary's arriving at the station (i.e. Mary's being at the station) obtains at the time of John's arriving at the station in order to make the discourse coherent.

While it may be hard to substantiate the existence of two distinct meanings of the past perfect empirically, the difference becomes manifest when we try to translate (77a) and (77b) into Japanese. For the Japanese translations of (77a) and (77b) imply two clearly different constructions. The Japanese discourse which parallels (77a) is (78):

(78) John wa ku -zi -ni eki ni tui -ta.
TOP nine hour at station at arrive PAST

John-wa ni -zikan-mae -ni ie -o de -ta.
TOP two-hour-before at house ACC leave PAST

Totyuu -de tomodati-ni at -ta.
on-the-way at friend DAT meet PAST

Note that in (78), V-*ta* , the so-called past tense morpheme, is used where the past perfect is employed in the English discourse. On the other hand, (77b) translates into Japanese in the following manner:

(79) John-wa kuzi -ni eki -ni tui -ta.
TOP nine-hour at station at arrive PAST

Mary-wa moo eki ni tui -te i ta.
TOP already station at arrive PROG PAST

John-wa Mary-ni hohoemikake-ta.
TOP DAT smile PAST

The *te iru* form in Japanese is usually referred to as the Japanese progressive form.

However, it can also have a different interpretation traditionally referred to as a "result-remaining" (*kekka zanzon*) reading (Kindaichi 1950, Fujii 1966, for an English source see Jacobsen 1982).

If the V-*ta* form is replaced by the V-*te ita* form (the past "progressive" form), or vice versa, in (78) or (79), the resulting discourse is infelicitous, as the following examples show:

(80) John wa ku -zi -ni eki ni tui -ta.
TOP nine-hour-at station at arrive PAST
John arrived at the station at nine.

#John-wa ni -zikan-mae -ni ie -o de -te i -ta.
TOP two-hour-before at house ACC leave PROG PAST
He had the experience of having left home two hours earlier.

#Totyuu -de tomodati-ni at -te i -ta.
on-the-way at friend DAT meet PROG PAST
He had the experience of having met his friend on the way (to the station).

(81) John-wa kuzi -ni eki -ni tui -ta.
TOP nine-hour at station at arrive PAST
John arrived at the station at nine.

#Mary-wa moo eki ni tui -ta.
TOP already station at arrive PAST
Lit. Mary already arrived there.

John-wa Mary-ni hohoemikake-ta.
TOP DAT smile PAST
John smiled at Mary.

In (80), the second sentence is acceptable, but it leaves the reader a strong feeling that the sentence is about some state (perhaps a result state) obtaining at the time John arrived at the station. It means something like "(when he arrived at the station,) John had the experience of having left home two hours earlier" and does not induce a flashback effect. The same is true of the third sentence. In (81), the second sentence is simply bad: the word for "already" (*moo*) cannot occur felicitously with the past tense marker -*ta* in this context. Since the past tense morpheme -*ta* and the "progressive form" -*te iru* in Japanese are not interchangeable, it supports the view that the perfect in English is ambiguous between whatever meanings these two Japanese forms represent. I call the interpretation of the past tense morpheme in Japanese the preterit interpretation, and the reading represented by the -*te iru* form an aspectual interpretation.

One additional support for this position comes from the following fact: It is sometimes noted (e.g. Partee 1984: 264) that the past perfect in English is rarely obligatory. However, when the past perfect is used for the aspectual meaning in discourse, it cannot be supplanted by a past tense, whereas the preterit (flashback) use of the past perfect can:

(82a) John went back home at eleven. #His wife already went to bed.

(82b) John went back home at eleven. His wife had already gone to bed.

(83a) John arrived at the airport at 10. He left his home two hours earlier. He met a friend of his on his way to the airport.

(83b) John arrived at the airport at 10. He had left his home two hours earlier. He had met a friend of his on his way to the airport.

This also supports the distinction between the aspectual reading and the flashback (preterit) reading of the past perfect. In Chapter 2, I will assume that the perfect in English is ambiguous and will only discuss its preterit interpretation.

CHAPTER 2

TEMPORAL REFERENCE OF TENSES IN ENGLISH AND JAPANESE

2.1. A Sequence-of-Tense Theory for English

In Chapter 1, I compared the quantificational analysis and the referential analysis of tense as rivals. I concluded that the quantificational approach is basically correct and that the alleged referential character of tenses should be construed as a contextual restriction upon the quantificational force of tense morphemes. In this chapter, we will test this hypothesis against further data. In particular, we will concentrate upon the sequence-of-tense phenomenon in English and its absence in Japanese.

2.1.1. Verb Complement Clauses

One of the striking differences between Japanese and English concerning tense phenomena is the fact that English has the so-called sequence-of-tense (ST) phenomenon, while Japanese does not. Consider the following examples:

(1a) John said that Mary was ill.

(1b) John said that Mary bought a new car.

(1a), which contains a stative predicate in the complement clause, is ambiguous and has two distinct readings: (i) John said that Mary had been ill (before the time of John's saying);[1, 2] (ii) John said that Mary was ill at the time of his saying. Adopting Enç's (1987) terminology, we will call the first reading a "shifted reading", and the second reading a "simultaneous reading". On the other hand, (1b), which contains an event predicate in the complement, has only one reading: John said that Mary bought a new car before the time of John's saying. The generalization is that when a stative predicate occurs in a verb complement clause and is embedded under a past tense, the complement clause must be in the *past tense* in order to receive a *simultaneous* reading. This will be referred to as the ST phenomenon, and (1a) is a representative example.

It is not obvious that the ST phenomenon is something that deserves special attention. It is prima facie plausible to claim that the past tense morpheme in (1a) has a plain past tense meaning. Suppose that the past tense means "earlier than the speech time". Then, there seems to be nothing wrong with the fact that (1a) has a

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1 Some native speakers strongly prefer the past perfect form for this reading, especially in writing.

2 The English paraphrase of the first reading (i.e. John said that Mary had been ill) is also ambiguous. It is ambiguous in that it can report the following two utterances of John, which are truthconditionally distinct:

(a) John: "Mary has been ill."
(b) John: "Mary was ill."

(a) allows a reading in which Mary's being ill is continuous until the speech time, whereas (b) places Mary's being ill wholly in the past of the speech time (as far as John's claim is concerned). Here we are concerned with the reading in which (b) is reported at a subsequent time. Thus, in order to make clear the intended reading, the first reading of (1a) should be paraphrased as "John said that Mary was ill earlier." I have more to say about the ambiguity of the perfect in English later in this chapter.

simultaneous reading because under this interpretation Mary's illness does obtain in the past of the speech time. Yet, the ST phenomenon has traditionally been considered something requiring special treatment. I will show that there is reason to suspect that the ST phenomenon is a "strange" fact. We will consider two relevant facts.

First, consider the following Japanese data:

(2a) John-wa [$_S$ Mary-ga byookidat-ta] to it -ta.
TOP NOM be-ill PST COMP say PST
John said that Mary had been ill. [Shifted reading only]

(2b) John-wa [$_S$ Mary-ga byookid-a] to it -ta.
TOP NOM be-ill PRES COMP say PST
John said that Mary was ill. [Simultaneous reading only]

In Japanese, the two readings associated with (1a) are distinguished clearly by different tense forms in the verb complement clause. The difference between the two languages is pronounced in the ways the simultaneous reading is expressed. In English a past tense morpheme appears in the verb complement clause, whereas in Japanese a present tense morpheme appears in the corresponding position. Japanese is not alone in this regard; Russian (Comrie 1985: 109) and Polish (Maria Bittner, p.c.) are like Japanese in that a present tense in a verb complement clause embedded under a past tense exhibits a simultaneous reading. This does not necessarily show that having a present tense embedded in the past tense for a simultaneous interpretation is a "normal" case, whereas having a past tense is an "exceptional" case. However, it *does* provide us with a challenging problem of accounting for the discrepancy between the two languages given above. The problem is noteworthy especially because when the matrix clause is in the present tense, a present tense occurs in the complement for a simultaneous reading in both English and Japanese. Consider the following examples:

(3a) John thinks that Mary is ill.

(3b) John-wa [$_S$Mary-ga byoo-ki-da] -to omot-te i -ru.
TOP NOM be-sick PRES that think PROG PRES

(3b) is the Japanese equivalent to the English (3a). Note that in both (3a) and (3b) the complement clause is in the present tense. There is no discrepancy between the two languages here.

Secondly, traditional grammarians (e.g. Roberts 1954) invoke the relationships between verb complement clauses (henceforth, indirect quotes) and their alleged direct speech counterparts (henceforth, direct quotes) in order to establish the claim that the ST phenomenon requires special treatment. Verbs that take clausal complements are called indirect discourse verbs because they are often used to report direct discourse counterparts.[3] Take a representative example, *say*, and consider the following

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[3] It should be noted that this is not always the case. Many of the so-called "indirect discourse" verbs do not have to have a direct discourse counterpart which parallels the indirect discourse one. Consider the following:

(a) John thought that Mary was attractive.
(b) John insinuated (to me) that the firm was nearly bankrupt.

There must have been something that made the speaker think that John had the thought expressed in (a). However, it does not have to be John's statement "Mary is attractive". In (b), because of the inherent meaning of *insinuate*, what John said (if he said anything at all) *cannot* be the statement "the firm is nearly bankrupt". I refer to entailment relationships:

(4a) John said "Mary is ill." → John said that Mary was ill.

(4b) John said "Mary has been ill." → John said that Mary had been ill.

(4c) John said "Mary will be ill." → John said that Mary would be ill.

(4d) John will say "Mary is ill." → John will say that Mary is ill.

(4e) John always says "Mary is ill." → John always says that that Mary is ill.

In each of these pairs, if the first sentence is true, then the second sentence (under an appropriate interpretation) is true as well. This shows that a direct quote and its indirect quote counterpart are closely related in meaning as well as in form. On the basis of the similarity between direct quotes and indirect quotes, traditional grammarians assume that there is a direct discourse "source" for any occurrence of an indirect discourse counterpart. Given the similarity between direct discourse and indirect discourse, the default "conversion" rule would be the following:

(5) Just copy the direct quote source to generate its indirect quote counterpart.

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the discrepancy between verb complement clauses and their direct discourse counterparts in order to explain the ST phenomenon simply because it is a convenient way of illustrating the phenomenon. It need not (and, in fact, should not) be assumed that the D-structures of verb complement clauses resemble their direct discourse counterparts. This issue will be taken up later in this chapter.

Sometimes, the direct discourse version and its indirect discourse version have exactly the same tense forms (e.g. (4a), (4d) and (4e)), but this is not always the case. In other cases, a present tense in direct discourse corresponds to a past tense in the indirect discourse version (e.g. (4b) and (4c)). The ST phenomenon can now be defined as the fact that a present tense in a direct quote corresponds to a past tense in an indirect quote. This new definition supersedes an earlier definition given in Chapter 1. In order to account for the discrepancy between direct quotes and indirect quotes, traditional grammarians posited a rule which applies when direct quotes are "converted into" indirect quote counterparts. The rule can be stated in the following way:

(6) Convert a present tense in direct discourse into a past tense in indirect discourse if and only if the matrix clause is in the past tense.[4]

This is the ST rule in traditional grammar as I understand it.

The assumption that direct quotes are "sources" of indirect quotes work quite well in accounting for Japanese data. If we assume that Japanese has the copying rule (5) but not the ST rule (6), Japanese data are predicted correctly. Consider the following examples (→ indicates an entailment relationship):

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[4] (6) is not general or precise enough to cover more involved cases. For example, it is not crucial that the past tense is in the matrix clause. Rather, what is crucial is that it is immediately higher than the tense being affected. Moreover, (6) cannot deal with cases involving multiple embeddings. A more sophisticated rule will be needed to handle such cases, but (6) will do for now.

(7a) John-wa "Mary-ga byooki-da" to it -ta →
TOP NOM be-sick PRES that say PST
John said "Mary is sick".

John-wa [$_S$Mary-ga byooki-da] to it -ta.
TOP NOM be-sick PRES that say PST
John said that Mary was sick. (the simultaneous reading only)

(7b) John-wa "Mary-ga byookidat-ta" to it -ta. →
TOP NOM be-sick PST that say PST
John said "Mary was sick".

John-wa [$_S$Mary-ga byookidat-ta] to it -ta.
TOP NOM be-sick PST that say PST
John said that Mary had been sick.[5]

(7c) John-wa "Mary-ga byooki-da" to yu -u -daroo. →
TOP NOM be-sick PRES that say PRES probably
John will (probably) say "Mary is sick"

John-wa [$_S$Mary-ga byooki-da] to yu -u -daroo.
TOP NOM be-sick PRES that say PRES probably
John will (probably) say that Mary is sick.

(7d) John-wa itumo "Mary-ga byooki-da" to yu -u. →
TOP always I NOM be-sick PRES that say PRES
John always says "Mary is sick".

John-wa itumo [$_S$Mary-ga byooki-da] to yu -u.
TOP always NOM be-sick PRES that say PRES
John always says that Mary is sick.

As the above data show, Japanese only needs the simple assumption that direct discourse sentences appear in indirect discourse contexts in exactly the same forms.[6]

[5] In Chapter one, I claimed that the perfect in English is ambiguous. Following this idea, we predict that this English translation is ambiguous. Here, we are only concerned with the preterit meaning of the perfect.

[6] One might suspect that Japanese has no indirect discourse at all. I have good reason to believe, however, that Japanese does distinguish between direct discourse and indirect discourse. It can be shown that Japanese has indirect discourse. In Japanese the word *zibun* 'self' cannot be used to refer to the first person in a matrix

Therefore, the assumption that direct quotes are "sources" of indirect quotes is not at all unreasonable from the cross-linguistic viewpoint because many languages are like Japanese in this regard. Thus, traditional grammarians' idea that English requires special treatment (i.e. English has the ST rule) is prima facie plausible.

2.1.2. A First Theory

Although traditional grammarians' strategy of invoking a "derivational" relationship between direct discourse and indirect discourse is useful when one tries to convey the basic ideas behind the ST rule, it makes poor sense in the setting of modern grammatical theories. Since both direct discourse sentences and indirect discourse sentences are full-fledged sentences, indirect discourse sentences are not

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clause at least in the standard dialect. (In an obsolete quasi-military dialect, it is possible.) For example, the following sentence is ruled out:

(a) *Zibun-wa /ga byooki-da.
self TOP/NOM be-sick PRES
[Intended] I am sick.

Therefore, it is expected that this form cannot appear as a direct quote but can appear only as an indirect quote as in the following:

(b) John-wa [zibun-ga byooki-da] to it -ta.
TOP self NOM be-sick PRES that say PST
$John_i$ said that he_i was sick.

This claim is substantiated further when we find that there is a construction which only admits a direct quote:

(c) *John-wa koo it -ta, "Zibun-wa byooki-da".
TOP thus say PST self TOP be-sick PRES
[Intended] John said, "I am sick".

As is expected, (c) is as bad as (a) is. Thus, it is legitimate to assume that Japanese is sensitive to the distinction between direct discourse and indirect discourse.

"derived" from direct discourse sentences.

In order to understand the intention of traditional grammarians, we should understand the alleged "conversion" relationship in a more abstract manner. I suggest that we should reinterpret the argument for a ST-rule-based theory (henceforth a ST theory) voiced by traditional grammarians in the following way: Let us assume the Aspects framework (Chomsky 1965), whose overall organization is shown by the following diagram:

$$
\text{(8)} \qquad
\begin{array}{lcl}
\text{Deep Structure} & \rightarrow & \text{Semantic Interpretation} \\
\downarrow & & \\
\text{Transformations} & & \\
\downarrow & & \\
\text{Surface Structure} & &
\end{array}
$$

The relationship between direct quotes and indirect quotes assumed by a ST theory can be reinterpreted in this framework in the following way: posit for an indirect quote a deep structure form which looks like its direct quote "source". (This assumption applies only to tenses; the cases involving deictic expressions such as *you, here*, etc. are more complicated (cf. Banfield, 1982).) For example, (9a) with a simultaneous reading has (9b) as its deep structure form.

(9a) John said that Mary was sick.

(9b) John Past say that Mary Pres be sick.

Having accepted this reinterpretation, we must consider two questions, one about syntax and the other about semantics: (i) What is the relationship between deep structure forms and surface forms?; (ii) Are deep structure forms appropriate syntactic sources for semantic interpretation? If so, how can we show this to be the case? The answer to the first question is clear. As far as English is concerned, we must posit a transformational rule called the "sequence-of-tense rule", which serves to change an underlying present tense into a past tense if and only if the tense in the immediately higher clause is a past tense:[7]

(10) ST theory (English)

Deep Structure → Semantic Interpretation

↓

The Sequence-of-Tense Rule

↓

Surface Structure

One advantage of this theory is that it describes the behavior of tense morphemes in Japanese succinctly. Japanese indirect quotes are just like their direct quote counterparts, thereby allowing us to posit an underlying form for an indirect

---

[7] It is necessary for the ST rule to apply cyclically top-down to produce multiple embeddings like the following (with the simultaneous reading):

(a) John said that Mary believed that Bill was insane.

quote which is no different from the surface form (as far as tense forms are concerned). For example, consider (11a):

(11a) John-wa [$_S$Mary-ga byooki-da] to it -ta.
TOP NOM be-sick PRES that say PST
John said that Mary was sick. [simultaneous reading only]

(11b) John-wa "Mary-ga byooki-da" to it -ta.
TOP NOM be-sick PRES that say PST
John said, "Mary is sick".

(11c) John-wa [$_S$Mary-ga byooki Pres] to iu Past
TOP NOM be-sick that say

(11b) is the direct discourse counterpart of (11a). Thus, one can posit (11c), which has the same tense form as (11b), as the deep structure source of (11a). The organization of the grammar for Japanese is as follows:

(12) ST theory (Japanese)[8]

Deep Structure → Semantic Interpretation

↓

No Sequence-of-Tense Rule

↓

Surface Structure

[8] Note that a ST theory posits no ST rule for Japanese. The reader should not be misled to think that a ST theory is a theory which posits a ST rule for any language. As mentioned above, a ST theory abbreviates a sequence-of-tense-rule-based theory; it is a theory which recognizes the need to posit a ST rule for English, but not necessarily for other languages.

If we adopt a ST theory, we arrive at the following plausible hypothesis concerning the ways in which tenses function in English and Japanese: The underlying forms for indirect quotes in English and Japanese are exactly parallel and the semantic rules, whatever they are, work in the same way in order to obtain the correct interpretations. The only difference between the two languages concerning tense phenomena is that English has a ST transformational rule, whereas Japanese does not.

Let us turn to the second question about semantics that we posed above: Are the deep structure forms posited appropriate for semantic interpretation? I claim that the answer is yes. However, in order to answer the question properly, we must enter into an involved discussion about propositional attitudes. I would rather reserve this topic until later. At this point, I talk about semantics very briefly and in a vary crude manner. Let us concentrate upon a concrete example. (11a) has as its deep structure (11c). We should ask the following question: do the semantic rules tell us that (11c) produces a simultaneous interpretation? Intuitively, the present tense should mean "present" with respect to (i.e. simultaneous with) some time, the most likely candidates being the speech time and the evaluation time. By "evaluation time", I mean the shiftable temporal index in IL. When we say that (11a) has a simultaneous reading, we mean that John is *talking about* the time of his utterance. Thus, if the complement clause has a present tense morpheme, this must be taken to denote the time simultaneous with the time of John's saying, or rather the time of the matrix verb. If the present tense morpheme is evaluation-time-sensitive, it seems plausible that (11b) receives a simultaneous interpretation because the immediately higher verb is the matrix verb and that the present tense morpheme is evaluated in relation to the time of this verb. The prediction, then, is that the time of Mary's being sick is simultaneous with the time of John's saying.

If this reasoning is on the right track, we find a very strong reason to adopt a ST theory. The above reasoning is rough, and it turns out that it is much more difficult to substantiate ST theory. However, this informal explanation will do for now.

2.1.3. A Second Theory

There are alternative ways of encoding the basic insight of traditional grammarians in the Aspect framework. These alternatives can also counter two criticisms of ST theory voiced by Enç (1987). Enç assumes that the ST rule converts a present tense morpheme into a past tense morpheme if and only if the tense occurs immediately under a past tense, just as we assumed in the previous sub-section. Enç states that the ST rule is quirky in that the rule changes a present tense into a past tense under the scope of another past tense, but it does not change a past tense into a present tense under the scope of another present tense. As the rule now stands this is a valid criticism because the rule simply stipulates that a present tense is replaced by a past tense when a certain syntactic condition is met. For example, one cannot prohibit on principled grounds the following possibility: the deep structure form (13a) is changed into its surface structure form (13b) by the ST rule, and the resulting sentence means that Mary was allegedly pregnant in the past.

(13a) John Pres claim that Mary Past be pregnant [deep structure and the input to the semantic component]

(13b) John claims that Mary is pregnant [surface structure]

Enç's other criticism is that ST theory cannot account for the semantic difference between (14a) and (14b):

(14a) John said that Mary was pregnant. [with a simultaneous reading]

(14a') John Past say that Mary Pres be pregnant.

(14b) John said that Mary is pregnant.

(14b') John Past say that Mary Pres be pregnant.

(14a) with a simultaneous reading has (14a') as its deep structure representation. The present tense in the complement is replaced by a past tense by the ST rule in the course of the derivation and (14a) results. (14b), on the other hand, has a past tense in the matrix and a present tense in the complement. As mentioned earlier, it has a "double-access" interpretation, which is clearly different from what (14a) means. The ST rule does not change a past tense into a present tense. Therefore, we can safely assume that (14b') is the deep structure representation of (14b). Since this is a configuration susceptible to the ST rule, the present tense in the complement would have been changed into a past tense had the rule been an obligatory rule. Since (14b) is an acceptable English sentence, we must conclude that the ST rule is an optional rule: despite the fact that the structural condition is met, it did not apply to (14b'). But the problem is that the semantic component cannot distinguish between (14a) and (14b) because their deep structure forms ((14a') and (14b'), respectively) are identical. Thus, the current theory predicts that they receive the same interpretations.

In order to respond to these criticisms, I propose an alternative version of ST theory. I assume that one of the following three values can be assigned to the tense node in English: present, past, or null (Ø). The ST transformational rule is now defined as follows:

(15) An empty tense slot assumes the value of the immediately higher tense.

Let us see how the new system fares with Enç's criticisms. We will discuss Enç's two criticisms in turn. First, Enç points out that traditional ST theory simply stipulates that a past tense is not changed into a present tense when it is immediately under another present tense. Under the new proposal, (16b) is the deep structure form of (16a):

(16a) John said that Mary was pregnant. [simultaneous interpretation]

(16b) John Past say that Mary Ø be pregnant

The matrix past tense is copied onto the empty tense slot in the complement, and (16a) results.

There are two ways of interpreting Enç's criticism. I will consider them in turn: Suppose that we have (17a) as a deep structure representation. Under the new proposal, (17a) surfaces as (17c) and means that John claims now that Mary smoked in the past. Enç's question is this: why couldn't the ST rule change (17a) into (17b), which presumably surfaces as (17e)? My proposal has no difficulty in answering this question: (17a) has no empty tense in the complement. Thus the ST rule is not applicable, and the past tense morpheme in the complement cannot be changed in any way in the course of the derivation.

(17a) John Pres claim that Mary Past smoke [deep structure]

(17b) John Pres claim that Mary Pres smoke

(17c) John claims that Mary smoked. [surface structure]

(17d) John Pres claim that Mary Ø smoke

(17e) John claims that Mary smokes. [surface structure]

A second interpretation of Enç's criticism is the following: Let us assume that we have (17d) as a deep structure configuration. Under the new framework, the ST rule copies the matrix present tense onto the empty tense position in the complement and produces (17e) as a surface form. Enç might ask the following question at this point: why isn't (17d) an appropriate input to the semantic component for a shifted interpretation? It is easy to answer this question as well. (17d) has a present tense in the matrix clause and an empty tense in the complement. Given the assumption that an empty tense behaves as if there is no tense at all, it is impossible to assign a past-tense-like meaning to it. Thus, the current system can produce (17e) as a surface string, but it does not assign a shifted interpretation to it.

Turning to Enç's second criticism, we can now show that (14a) and (14b) have different deep structure sources. (14a) now has (18a) as its deep structure form, whereas the deep structure form of (14b) is (18b):

(14a) John said that Mary was pregnant.

(14b) John said that Mary is pregnant.

(18a) John Past say that Mary Ø be pregnant.

(18b) John Past say that Mary Pres be pregnant.

Since there is no empty tense in (18b), the ST rule is not applicable here. We cannot show at this point that (18b) is an appropriate input to the semantic component.[9] However, it is at least different from (18a), thereby enabling the semantic component to treat them in different ways.

The new system makes another prediction, which the previous one does not. When an empty tense occurs under a present tense, the above rule predicts that the present tense is copied onto the empty tense node as in the following example:

(19) Deep structure: John Pres claim that Mary Ø be pregnant.
ST rule: John Pres claim that Mary Pres be pregnant.

I believe that this is an advantage of the current system over its predecessor. I will explain why in Section 2.1.4.

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9 This question will be addressed in Chapter 4.

Perhaps, the new implementation is also preferable from a meta-theoretical point of view. The original ST rule required conversions of tense forms, which involves deletion and copying. This is cumbersome if it is justifiable at all. The current theory allows us to posit one simple operation: copying.

I should also mention an alternative which I believe to be a notational variant of the system I have proposed in this sub-section. This system assumes that there are two past tenses in English, one of which occurs only under the scope of a past tense and is semantically empty (i.e., just like an empty tense as far as semantic interpretation is concerned). This system was proposed by Abusch (1988).[10]

2.1.4. Some Remarks on the Traditional Analysis of the Sequence-of-Tense Phenomenon

In this section, I will make clear the point which was implicit in the discussion in 2.1.3. I suggested above that the ST rule as proposed by traditional grammarians must be construed in an abstract manner. In fact, I already deviated from the original ST rule proposed by traditional grammarians when I set up a third value for the tense node in English: a null tense. Since a null tense never occurs as part of surface English sentences (including direct quotes), the idea that direct quotes are "sources" of indirect quotes cannot be taken literally.

Let us step back and consider the reason why traditional grammarians thought that in order to interpret a verb complement clause its direct discourse counterpart

---

[10] In order to make it fully compatible with my proposal, this system should also posit a present tense which occurs only in the scope of another present tense and is ignored in the semantic component.

should be posited as the syntactic source for semantic interpretation. I believe that the reasoning behind this proposal is as follows: A sentence with a verb complement clause typically involves a report of someone's expression of an attitude (e.g. *believe, say*). Traditional grammarians assume that the original attitude expressed by the individual denoted by the subject NP of the verb complement clause is faithfully reproduced in the report. This is of course controversial, but let us accept this position at face value. It follows, then, that the direct discourse counterpart of a verb complement clause is the best source for semantic interpretation because by definition it conveys the perspective of the original speaker accurately. Consider the following examples:

(20a) John said that Mary was pregnant.

(20b) John said, "Mary is pregnant".

As mentioned earlier, (20b) entails (20a). (20b) means that John said something in the past and what he said was "Mary is pregnant". In order to understand the semantic content of (20b), we must consider what it means to say "Mary is pregnant" at a past time. What we do is to imagine ourselves located at a past time when John uttered this sentence. Then, we arrive at the conclusion that Mary was (claimed to be) sick at the time when he was uttering the sentence. The point is the following: using direct quotes has the effect of *embedding* tenses. When a present tense is used in a direct quote, we understand it to be oriented to the time when the quoted utterance was made. Thus, in (20b) the present tense in the direct quote is understood to denote the time of John's saying. The claim of traditional grammarians is that in the underlying structure, tenses are interpreted as embedded even when they do not occur in direct quotes. That is, the underlying structure of (20a) looks roughly like (20c):

(20c) John Past say that Mary Pres be pregnant.

The claim is that the present tense in the complement is interpreted relative to the time of John's saying. It is not so much the exact form of the underlying tense as the fact that the complement clause is interpreted relative to the matrix tense that counts. I therefore posited a null tense instead of a present tense in the complement clause of the underlying form of (20a) as in (20d):

(20d) John Past say that Mary Ø be pregnant.

Note that in the traditional logical analysis of tense, the present tense is expressed as nothing in the logical representation. As long as the intention is to interpret the complement relative to the matrix tense, it is legitimate to deviate from the surface forms of the direct discourse "sources".

In fact, there is no guarantee that a sentence that involves an indirect discourse verb has as its source a direct discourse version. For example, being asked what John, who is Bill's teacher, thinks about Bill, Jim might utter (21):

(21) John implied that Bill was incompetent.

Jim's utterance may well be based on the following conversation that he had with John:

(22) Jim: What do you think of Bill as a scholar?
John: He did very well in exams.

Suppose that Jim knows that John does not criticize his students outright, and infers from what John said that he does not have a high opinion of Bill's scholastic abilities. Thus, Jim utters (21) in order to convey what he believes to be John's true opinion about Bill. In this case, there is no direct discourse sentence which closely resembles the embedded clause of (21). In fact, the meaning of the verb *imply* is such that its sentential complement necessarily has no direct discourse counterpart. (21) may be a wrong way of interpreting John's utterance and may well be false, but this is not important. What is important is that native speakers understand the temporal information that (21) contains (i.e. the time at which John expressed his thought and the time of Bill's being incompetent can be simultaneous) without assuming that the sentence that John uttered was "Bill is incompetent". If one still posits a direct discourse sentence that underlies (21) and on this basis argues for a ST rule, the argument is circular. In general, there is no guarantee that there is a direct discourse counterpart of a sentence involving indirect discourse. Thus, we should not take the relationship between direct and indirect discourses that traditional grammarians cite literally. This is also clear with verbs which do not have pre-established direct discourse counterparts:

(23a) John found that the room was too crowded to accommodate three more people.

(23b) John noticed that there was something wrong with the computer.

Neither of them needs to involve overt verbalization on the part of John.

We would have another problem if we sticked to the exact forms of direct quote "sources" of verb complement clauses. In traditional grammar, a past tense under the scope of another past tense is converted into a past perfect by a ST rule. This is an exception to the rule because a ST rule is expected to convert a present tense into its past tense counterpart. Consider the following:

(24a) John said that Mary had bought a car.

(24b) John: "Mary bought a car."

(24c) John Past say that Mary Past buy a car.

Since (24a) is a legitimate way of reporting (24b) at a later time, we must assume that (24a) is derived from (24c). Then, we must conclude that the past perfect is the "past tense counterpart" of the past tense. The problem stems from the practice of positing the direct quote counterpart of an indirect quote exactly as in the original form as the underlying form of the indirect quote. As mentioned above, there is no reason to abide by this practice as long as we can arrive at the desired interpretation. Note here that the perfect is ambiguous between a preterit interpretation and an aspectual interpretation as I have shown in Chapter 1. Thus, we can assume that the perfect (plus a null tense) can be posited as the underlying form of the past perfect as in (24d):

(24d) John Past say that Mary Ø have+en buy a car.

(24e) John Past say that Mary Past have+en buy a car.

Since the perfect has the preterit interpretation, (24d) is assured of the shifted interpretation that (24a) in fact has. The ST rule applies to (24a), and the surface form (24e) results. Thus, the fact that (24a) has a shifted interpretation requires no stipulation in the new system.

Another advantage of the current system is that it predicts a simultaneous reading for a present tense embedded under a future tense. Consider the following examples:

(25a) John said that Mary is in Austin.

(25b) John said that Mary was in Austin.

(25c) John will say that Mary is in Austin.

As mentioned already, (25a) only has a "double-access" interpretation; it cannot receive a purely simultaneous reading. On the other hand, (25b) and (25c) can receive a purely simultaneous reading: the time of Mary's being in Austin is simultaneous with the time of John's saying. The latter follows naturally in the current system. Under the current proposal, a simultaneous reading is available if and only if the embedded tense is an empty tense in the deep structure. We assume that the present tense morpheme denotes the speech time. The derivation of the above three sentences proceeds in the following way:

(25a') Deep str.: John Past say that Mary Pres be in Austin
ST rule (non-applicable): John Past say that Mary Pres be in Austin
Surface str.: John said that Mary is in Austin

(25b') Deep str.: John Past say that Mary Ø be in Austin
ST rule: John Past say that Mary Past be in Austin
Surface str.: John said that Mary was in Austin.

(25c') Deep str.: John Pres woll say that Mary Ø be in Austin
ST rule: John Past say that Mary Pres be in Austin
Surface str.: John will say that Mary is in Austin

The theory predicts that a simultaneous reading is conveyed by a present tense under a future tense and by a past tense under a past tense. Although the exact meaning conveyed by (25a) remains a mystery, the theory allows the semantic component to distinguish between (25a') and (25b') because they have distinct deep structure forms.

In this way, the ST rule originally proposed by traditional grammarians has been modified in the current framework although it preserves its basic insight. As has been shown, it accounts for the data so far examined. In the following sub-section, we will discuss the behavior of tense morphemes in relative clauses.

2.1.5. Relative Clauses

The ST rule is usually discussed in relation to verb complement clauses. This is partly because the phenomenon was conceptualized by traditional grammarians in terms of the contrast between direct discourse and indirect discourse. Relative clauses obviously do not involve indirect speech contexts. Therefore, in traditional grammar it is hard to make sense of the question of whether the ST phenomenon obtains in relative clauses as well. However, now that we have defined the ST rule in such a way that it applies when certain syntactic conditions are met, we can ask the following question: when a relative clause is in the past tense and the matrix clause is also in the past tense, could we obtain a simultaneous reading?

It is clear that there is a difference between verb complement clauses and relative clauses. In relative clauses, the temporal denotation of a tense *can* be independent of the temporal denotation of the immediately higher tense. For example, there is a contrast between a present tense in a relativized NP embedded within a clause in the past tense and a present tense in a verb complement clause embedded under a matrix past tense:

(26a) Last week, John met [$_{NP}$a man [$_{S'}$who is in this room]].

(26b) Last week, John said that [$_{S}$Mary is pregnant].

In (26a) the time of the man's being in this room is the speech time. On the other hand, (26b) is not so straightforward. As mentioned briefly in Chapter 1, (26b) is said to have a "double-access" reading, which means that the "time of Mary's pregnancy"[11] encompasses both the time of John's saying and the speech time.[12] At this point, we do not know exactly what this means, let alone how to describe its meaning in a formal system. However, it is clear that the interpretation of the present tense in (26b) is not completely independent of the time of John's saying.

A similar contrast is observed between a past tense in a relativized NP embedded under a past tense and a past tense in a verb complement clause embedded under a past tense. The following sentence allows any temporal relationship whatsoever between the time of seeing and the time of laughing; the time of the man's laughing can be prior to, simultaneous with, or subsequent to the time of John's seeing:

(27) John saw [$_{NP}$a man [$_{S'}$who was laughing]].

---

[11] Although the term "time of Mary's pregnancy" is very informal and inaccurate, we do not have a better way of referring to the concept that we attempt to convey. We will try to articulate the interpretation of double-access sentences in Chapter 4.

[12] Note, however, that when the main verb is an intensional verb, a relativized NP can have a "double-access" reading as well (Abusch 1988):

(a) John looked for a student who understands the Incompleteness Theorem.

However, the difference between verb complements and NP's remains in that it is still possible to assign a de re interpretation to the relativized NP in (a), whereas (b) can only have a "double-access" interpretation:

(b) John said that Mary is pregnant.

Note that tenses in verb complements behave in a different way. Compare (27) with (28):

(28) John said that [$_S$Mary was sick].

As mentioned earlier, (28) does not allow the time of Mary's being sick to be after the time of John's saying. Mary's being sick must be either simultaneous with or prior to the time of John's saying. The simultaneous reading is predicted by positing a null tense (i.e. Ø) source for the past tense morpheme and a ST rule; the shifted reading is predicted by assuming that tenses are interpreted as embedded under syntactically higher tenses. On the other hand, (27) allows the time of the man's laughing to be any time before the speech time of (27). None of the assumptions already discussed predicts that the time of the man's laughing can be subsequent to the time of John's seeing the man. The above data show that tense morphemes behave differently in relative clauses and in verb complement clauses. In particular, tense morphemes in relative clauses exhibit behavior which cannot be accounted for by the current system. How should we account for this fact?

2.1.6. A Third Theory

There are several possible ways to proceed from here. One possibility is to assign scope to NP's. It has long been known that the ambiguity associated with sentences which involve more than one quantified NP can be accounted for by assuming that NP's are subject to scoping. This can be executed in various ways: by quantifier lowering (Lakoff 1971), by quantifying in (Montague 1973), by quantifier raising (QR) (May 1977), or by quantifier storage (Cooper 1983). Assuming the Standard Theory, scope assignment to NP's is executed most naturally by Lakoff's quantifier lowering. Lakoff assumes that NP's are located in syntactically higher positions at the deep structure level so that the information about scope is transparent at this level. This structure is transformed into the surface form by the quantifier lowering (QL) transformation. In this system, the interaction of NP scope and the ST rule should be stated in the following way: the ST rule applies *before* the QL transformation does. The overall organization of the grammar is described by the following diagram:

(29) Deep structure (with scoped NP's) → Semantic interpretation

↓

ST rule

↓

Quantifier Lowering

↓

Surface structure

In order to obtain an interpretation of (27) in which the time of the man's laughing is located before the speech time but possibly later than the time of John's seeing the man, the derivation proceeds in the following manner: In the deep structure level, the relativized NP is in a position having scope over the whole sentence, thereby escaping the scope of the matrix tense.[13, 14] The past tense in the relative clause is interpreted in relation to the speech time, thereby *allowing* the time of the man's laughing to be after the time of John's seeing the man. Then, a rule for QL moves the NP to the object position of the verb *see* to produce the surface form (27). Ladusaw (1977) accounts for the interaction of NP scope and the ST phenomenon in an analogous way. We will discuss Ladusaw's system in 2.2.1.

Let us switch to the GB framework (Chomsky 1981, etc.) at this point, as the syntax of our final fragment will be based upon this framework. The traditional grammarian's idea about the ST phenomenon can be recast in this framework in the following way:

(30)

$$
\begin{array}{lll}
\text{D-Structure} & & \\
\downarrow & & \\
\text{S-Structure} & \rightarrow & \text{LF (Logical Form)} \\
\downarrow & & \\
\text{ST rule} & & \\
\downarrow & & \\
\text{PF (Phonetic Form)} & &
\end{array}
$$

---

[13] The deep structure of (27) is roughly of the following form:

(a) $[_S[_{NP_k}$a man who Past be laughing$][_S$I Past see $e_k]]$

[14] Note also that the structural condition for the tense deletion rule is not satisfied here.

As the diagram shows, the traditional ST rule applies in this framework somewhere between S-structure and PF because this rule presumably affects the pronunciation of tensed expressions but not their interpretations. However, we face difficulty here because the rule has to be sensitive to scope assignment to NP's, which is assumed to take place at LF. We propose the following to solve this problem: assume that the D-structure forms of English sentences are no different from their surface forms. Instead of positing a ST rule which copies tenses, we posit a tense deletion rule which applies after QR has applied and which deletes a tense under identity with the immediately higher tense.[15] Schematically, the organization of the grammar is as follows:

(31)

$$\begin{array}{l} \text{D-Structure} \\ \quad\downarrow \\ \text{S-Structure} \rightarrow \text{QR} \rightarrow \text{Tense Deletion} \rightarrow \text{Interpretation} \\ \quad\downarrow \\ \text{PF (Phonetic Form)} \end{array}$$

The basic idea behind the ST rule is preserved intact, but it is executed "backwards", so to speak.[16] For example, assuming that NP's are either adjoined to VP's or to S's

[15] I owe this idea to Mats Rooth (p.c.).

[16] Ladusaw (1977) deals with the interaction of NP scope and sequence of tense in much the same manner, but he faces a problem for which he has no solution. I will turn to this problem later on.

and that the tense deletion rule is optional, (27) has three possible derivations:[17]

(27) John saw $[_{NP}$a man $[_{S'}$who was laughing]].

(27a) D & S-structure: John Past see $[_{NP}$a man $[_{S'}$who Past be laughing]]

QR: $[_{S}[_{NP_k}$a man $[_{S'}$who Past be laughing]] $[_{S}$John Past see e_k]]

The Tense Deletion Rule does not apply. (The condition is not met.)

(27b) D & S-structure: John Past see $[_{NP}$a man $[_{S'}$who Past be laughing]]

QR: John Past $[_{VP}[_{NP_k}$a man $[_{S'}$who Past be laughing]]$[_{VP}$ see e_k]]

Tense Deletion: John Past $[_{VP}[_{NP_k}$a man $[_{S'}$who Ø be laughing]]$[_{VP}$ see e_k]]

[N.B. Ø signifies an empty tense node]

(27c) D & S-structure: John Past see $[_{NP}$a man $[_{S'}$who Past be laughing]]

QR: John Past $[_{VP}[_{NP_k}$a man $[_{S'}$who Past be laughing]]$[_{VP}$ see e_k]]

We choose not to apply the Tense Deletion Rule.

(The condition is met.)

Under appropriate assumptions about semantics, (27a) allows the man's laughing to obtain at any time before the speech time. (27b) requires it to be simultaneous with the time of John's seeing the man. (27c) allows it to be any time before the time of John's seeing the man. Although these predictions are not inconsistent with the actual observations, some of these readings are redundant. In fact, (27a) covers the readings

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[17] I assume that extensional two-place predicates like *see* are semantically of type <e, <e,t>>. Therefore, NP's (assuming that they are uniformly of type <<s, <e,t>>, t>) in the object position cannot be interpreted in situ.

afforded by (27b) and (27c) as well. Thus, one might doubt that the readings (27b) and (27c) are mere artifacts of the theory, not genuinely independent readings. In particular, we should pay attention to the derivation (27b). This derivation assumes that the tense deletion rule applies in relative clauses as well. The problem is that since the simultaneous reading associated with (27b) is included in the reading predicted by (27a), it is hard to prove that it is a separate reading. There are two things that we must show here: (i) NP's can be interpreted as embedded under syntactically higher tenses; (ii) tenses in relativized NP's are subject to the tense deletion rule just as tenses in verb complements are when they are syntactically embedded under higher tenses.

There is reason to believe that relative clauses can be interpreted as being embedded under higher tenses. We find cross-linguistic evidence that relative clauses can be interpreted as embedded under higher tenses. In Japanese, the following sentence has two readings:

(32) John-wa [$_{NP}$ warat-te ir -u otoko]-ni at -ta.
TOP laugh PROG PRES man DAT meet PAST
John met a/the man who was laughing. [simultaneous reading] or
John met the man who is laughing.

(32) has a reading in which the laughing of the man is simultaneous with the speech time. This reading is not salient but is easily forced by supplying some appropriate adverbials:

(32') John-wa [$_{NP}$ ima asoko-de warat-te ir -u otoko]-ni
TOP now there at laugh PROG PRES man DAT

kinoo at -ta.
yest. meet PST

Yesterday, John met the man who is laughing over there.

Thus, both in English and Japanese, relative clause NP's can be independent of higher tenses. More importantly, however, the salient reading of (32) is that in which the time of the man's laughing and John's seeing him are simultaneous. This fact is accounted for by assuming that the present tense morpheme in Japanese can be interpreted as embedded when it is syntactically embedded under a higher tense.

This prompts us to go back to English and to check if relative clauses in English *can* be interpreted as embedded for we have no reason to believe that NP's in English and Japanese behave in different ways unless proven otherwise. In this connection, we should also investigate if the tense deletion rule is applicable. In fact, we do find some data which suggest that relative clauses *can* be interpreted as embedded under higher tenses and that the tense deletion rule is activated:

(33a) Two years ago today, John met a man who would become his great supporter.

(33b) Two years ago today, John met a man who will become his great supporter.

(33a) places the time of the man's becoming his supporter after the time of John's meeting the man and not necessarily after the speech time, whereas the time of the man's becoming his supporter is after the speech time in (33b). It seems to me that the most reasonable hypothesis that we should pursue is that the relativized NP in (33a) is scoped to the VP level (i.e. within the scope of the matrix tense) and the past tense on *would* is deleted by the tense deletion rule. The configuration which is subject to the semantic rules is the following:

(33a') Two years ago today, John Past meet a man who Ø woll become his great supporter.

[N.B. *woll* is the tense-neutral form common to *will* and *would*]

Assuming that *woll* means "subsequent to the time of the immediately higher verb", we predict that the temporal location of the man's becoming his supporter is some time after the time of John's meeting the man, which is empirically correct.[18]

On the other hand, in (33b) the time of the man's becoming John's supporter *must* be located sometime in the future of the speech time. The current system predicts that (33b) *can* receive this interpretation. If the relativized NP has scope over the whole sentence, the time of the ma 's becoming his supporter is predicted to be located after the speech time. However, it does not predict that (33b) must receive this interpretation because, presumably, the relativized NP can be scoped to the VP

[18] I am agnostic about the status of the wide scope reading of the relativized NP, in which the past tense on *would* is interpreted as a non-empty tense. Some linguists (e.g. Abusch 1988) claim that this is possible. It is true that a wide scope reading (if it exists) includes a narrow scope reading. Thus, my argument is not so strong here. I will return to this issue later, when we are in a position to discuss semantic issues in more precise terms.

level as well. In this case, we predict that the time of the man's becoming his supporter is located sometime after the time of John's meeting the man, not necessarily after the speech time. In order to account for the data, we assume that the English present tense morpheme is inherently speech-time-oriented.

Another piece of evidence that relativized NP's can be interpreted as embedded under the main clause tense and that the tense deletion is applicable there is provided by the following example:

(34) At the airport, John will meet a man who is holding a copy of L&P in his hand.

Suppose that John, who is a semanticist, visits Austin for the first time and Bill is going to the airport to pick him up. But John does not know what Bill looks like. In order not to miss each other, Bill sent an e-mail message to John telling him to look for a man at the airport with a copy of L&P in his hand. In this situation, (34) has a reading in which the individual denoted by the relativized NP is holding a copy of L&P at the future time, but not now. This reading is predicted only if we assume that the NP in question can be interpreted as embedded under the main clause tense. In my analysis, the matrix present tense deletes the present tense in the relative clause, thereby producing the following structure:[19]

[19] I assume that the tense deletion rule operates between two present tense morphemes as well as between two past tense morphemes. The details of the theory will be given explicitly in the following sub-section.

(35) At the airport, John Pres woll $[_{VP}[_{NP_k}$a man who Ø be holding a copy of L&P in his hand] $[_{VP}$ meet e_k]].

Additional support comes from participial modifiers for the position that NP's can be interpreted as embedded under syntactically higher tenses. Consider the following example:

(36) John met $[_{NP}$a man crying in sorrow].

The most salient reading of (36) is that the man's crying is simultaneous with John's meeting him. This is possible only if the temporal interpretation of the NP is determined in relation to the time of the matrix verb. This does not prove that the tense deletion rule applies in relative clauses as well as in verb complements, but it does show that NP's can be interpreted as embedded under the matrix tense. If NP's can be interpreted as embedded under higher tenses just as verb complements, there is no plausible way of distinguishing between tenses in verb complements and tenses in relativized NP's configurationally. Thus, if one wants to claim that the tense deletion rule does not apply to tenses appearing within NP's, one must add a special provision which specifically mentions relative clauses. This is quite undesirable.

Finally, I present the most conclusive example:

(37) John said that he would buy a fish that was still alive.

This can receive an interpretation in which the time of his buying the fish is in the future of the speech time and, moreover, coincides with the time of the fish's still being alive. Note that we cannot obtain this reading by giving wide scope to the NP. The reading can be predicted if we assume that NP's can be interpreted as embedded under the scope of the intermediate past tense and that the tense deletion rule applies to relativized NP's as well. The LF representation of (37) after the application of the tense deletion rule is the following:

(37') John Past say $[_{S'}$that he Ø woll $[_{VP}[_{NP_k}$a fish that Ø be still alive$][_{VP}$buy $e_k]]]$.

It is clear that (37') receives the desired interpretation.

The conclusion is that the ST phenomenon obtains in relative clauses as well as in verb complement clauses. However, the fact that NP's can have scope over the matrix tense obscures this fact.[20] The distinction between the narrow scope reading of an NP containing an empty past tense (i.e. a past tense deleted by the tense deletion rule) and the wide scope reading of an NP containing a non-empty past tense is hardly visible since the wide scope reading almost always contains the narrow scope reading.

[20] It will be shown later that sentential subjects cannot receive wide scope interpretations inspite of the evidence (provided by Japanese) that they are NP's.

2.1.7. The Semantics of Embedded Clauses

We are now in a position to discuss in more concrete terms how the semantic system works. In particular, we will look into the semantics of propositional attitudes. In the previous sub-section, we have decided that the grammar is organized in the following way:

(38)

$$\begin{array}{l} \text{D-Structure} \\ \quad\downarrow \\ \text{S-Structure} \rightarrow \text{QR} \rightarrow \text{Tense Deletion} \rightarrow \text{Interpretation} \\ \quad\downarrow \\ \text{PF (Phonetic Form)} \end{array}$$

We assume that each LF representation is translated into an IL formula, which is model-theoretically interpreted. In Chapter 1, I proposed a small fragment for English which handles sentences with no embeddings. I will expand on that fragment, incorporating verb complement clauses and relativized NP's. Consider the following syntactic rules:

(39)
1. S → NP Aux VP
2. Aux → Tns (woll) (have + en)
3. Tns → Pres
   Past
4. VP → V S'
5. S' → COMP S

6. NP → Name

Det N'

7. N' → N' S'

8. N' → N

Transformational Rules (ordered as follows):

1. Wh-movement: Move a wh-phrase to COMP

2. Quantifier Raising (optional):[21] Chomsky-adjoin an NP to an S or to a VP

   e.g. $[_S \ldots NP \ldots] \Rightarrow [_S NP_t[_S \ldots e_t \ldots]]$, $[_{VP} \ldots NP \ldots] \Rightarrow [_{VP} NP_t[_{VP} \ldots e_t \ldots]]$

3. Tense Deletion (optional): Delete a tense β iff α and β are occurrences of the same tense morpheme and α is the local tense for β.

Definitions:

α commands β iff the first S node that dominates α also dominates β.[22]

α is the local tense for β iff α and β are tenses, α commands β and no other tense that α commands commands β.

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[21] I think that it is better to say that QR is optional because NP's must be able to be interpreted in situ when the verb involved is an intensional verb like *seek*. With extensional verbs like *meet*, I assume that their semantic type is <e, <e,t>> and that if the object NP is not scoped, the resulting sentence is syntactically well-formed but semantically ill-formed.

[22] Command is due to Langacker (1969).

For each branching structure of a syntactic tree, one semantic rule is introduced:

(40) 1. $[_S$ NP Aux VP$]$ translates into Aux' (^ [NP' (^ VP')])

2a. $[_{Aux}$ Tns woll have + en$]$ translates into

$\lambda p \exists t$ [Tns' (t) & AT (t, $\exists t'$ [FUT (t') & $t' \subseteq t_{Rn}$ & AT (t', $\exists t''$[PAST (t'') & $t'' \subseteq t_{Rn}$ & AT (t'', $^{\vee}$p)])])]

2b. $[_{Aux}$ Tns woll$]$ translates into

$\lambda p \exists t$ [Tns' (t) & AT (t, $\exists t'$ [FUT (t') & $t' \subseteq t_{Rn}$ & AT (t', $^{\vee}$p)])]

2c. $[_{Aux}$ Tns have + en$]$ translates into

$\lambda p \exists t$ [Tns' (t) & AT (t, $\exists t''$[PAST (t'') & $t'' \subseteq t_{Rn}$ & AT (t'', $^{\vee}$p)])]

2d. $[_{Aux}$ Tns$]$ translates into $\lambda p \exists t$ [Tns' (t) & AT (t, $^{\vee}$p)]

3a. $[_{Tns}$ Pres$]$ translates into NOW

[N.B. $[\![$NOW (t')$]\!]^{M,w,t,g}$ = 1 iff $[\![$t'$]\!]^{M,w,t,g}$ = $[\![$s*$]\!]^{M,w,t,g}$ where s* is a special constant which always denotes the speech time.]

3b. $[_{Tns}$ Past$]$ translates into λt [PAST (t) & $t \subseteq t_{Rn}$]

3c. $[_{Tns}$ Ø$]$ translates into PRES

4a. $[_{VP}$ V S'$]$ translates into V' (^ S'') [S'' = the translation of S']

4b. $[_{VP}$ NP_k [VP ... e_k ...]] translates into λy NP' (^ λx_k [VP' (y)])

5a. $[_{S'}$COMP S$]$ translates into S' [S' = the translation of S]

5b. $[_{S'}[_{COMP}wh_k]$ [S ... e_k ...]] translates into λx_k S'

5c. $[_S$ NP_k $[_S$ ... e_k ...]] translates into NP' (^ λx_k S')

6a. $[_{NP}$ Name$]$ translates into $\lambda P P\{Name'\}$

6b. $[_{NP}$ Det N'] translates into Det' (^ N'')[23]

[N'' = the translation of N']

7. $[_{N'}$ N' S'] translates into λx [N'' (x) & S'' (x)]

8. $[_{N'}$ N] translates into N'

Several comments are now in order. Unlike in the earlier fragment, the Tns node can assume one of three values at LF: Pres, Past, or Ø (empty). As is clear from the data involving relative clauses, the present tense morpheme in English behaves as if it is always speech-time-sensitive. Thus, I translate the present tense morpheme as NOW, which is a unary predicate of times defined above. This has exactly the same effect as having the Now operator of Kamp (1971) discussed in Chapter 1. One way of defining the predicate NOW is to posit a second time index which keeps track of the speech time. I opted for an alternative: to posit a special constant which denotes the speech time and define the predicate in terms of this constant. Unlike the present tense morpheme, the past tense morpheme in English is interpreted as embedded. Therefore, it is translated as the predicate PAST plus a contextual restriction. When the tense deletion rule is activated, an empty tense node (Ø) is created. In the current system, this is translated as the predicate PRES. Let me reiterate that the tense deletion rule works with present tense morphemes as well as with past tense morphemes. This feature of the proposal enables us to predict a purely simultaneous reading with sentences like (41a) and (41b), even though we

[23] I assume that the determiner *a* is translated into IL in the following way:

(a) a translates into $\lambda P \lambda Q \exists x[P\{x\}\ \&\ Q\{x\}]$

assigns a speech-time-oriented semantic value to the present tense morpheme:

(41a) John will claim that Mary is sick.

(41b) John will meet a man who is holding a copy of L&P in his hand.

Now we are ready to tackle sentences involving embeddings. Let us start with easy ones: relative clauses. Let us consider the examples taken up above:

(42a) Two years ago today, John met a man who would become his great supporter.

(42b) Two years ago today, John met a man who will become his great supporter.

The only reading (or the most salient reading) that (42a) has is a narrow scope reading. We assume that the semantic type of meet' is <e, <e,t>>. Thus the narrow scope reading of the object NP of *meet* is handled by adjoining it to the VP. Since the matrix past tense is in the Aux node, it locally commands the past tense in the relative clause and serves to delete the lower past tense. The derivation and the translation of the narrow scope reading are represented in the following way (ignoring the adverbial):

(43) After QR: [$_S$John Past [$_{VP}$[$_{NP_k}$ a man who$_i$ e_i Past woll become his great supporter] [$_{VP}$ meet e_k]]]

After Tense Deletion:

[$_S$John Past [$_{VP}$[$_{NPk}$ a man who$_i$ e$_i$ Ø woll become his great supporter] [$_{VP}$ meet e$_k$]]]

1. who$_i$ e$_i$ Ø woll become his great supporter $\Rightarrow \lambda x\, \exists t$[PRES (t) & AT (t, $\exists$t' [FUT (t') & t' $\subseteq$ t_{R1} & AT (t', become-his-great-supporter' (x))])]

   [N.B. The internal structure of the VP in the relative clause is ignored for simplicity.]

2. $\lambda x\, \exists$t' [FUT (t') & t' $\subseteq$ t_{R1} & AT (t', become-his-great-supporter' (x))]

3. man who$_i$ e$_i$ Ø woll become his great supporter $\Rightarrow \lambda x$ [man' (x) & $\exists$t' [FUT (t') & t' $\subseteq$ t_{R1} & AT (t', become-his-great-supporter' (x))]]

4. a man who$_i$ e$_i$ Ø woll become his great supporter $\Rightarrow \lambda P \exists x$ [man' (x) & $\exists$t' [FUT (t') & t' $\subseteq$ t_{R1} & AT (t', become-his-great-supporter' (x))] & P{x}]

5. [$_{VP}$[$_{NPk}$ a man who$_i$ e$_i$ Ø woll become his great supporter] [$_{VP}$ meet e$_k$]] $\Rightarrow$

   λz [$\lambda P \exists x$ [man' (x) & $\exists$t' [FUT (t') & t' $\subseteq$ t_{R1} & AT (t', become-his-great-supporter' (x))] & P{x}] (^ λy meet' (y)(z))]

6. λz[$\exists x$ [man' (x) & $\exists$t' [FUT (t') & t' $\subseteq$ t_{R1} & AT (t', become-his-great-supporter' (x))] & meet' (z, x)]]

7. $[_S$John Past $[_{VP}[_{NPk}$ a man who$_i$ e_i Ø woll become his great supporter] $[_{VP}$ meet $e_k]]]$ $\Rightarrow$ $\exists t''[PAST(t'') \& t'' \subseteq t_{R2} \& AT(t'', \exists x\, [man'(x) \& meet'(j, x) \& \exists t'\, [FUT(t') \& t' \subseteq t_{R1} \& AT(t', become\text{-}his\text{-}great\text{-}supporter'(x))]]])]$

The last line says that John met the man in the past of the speech time and that the time of the man's becoming John's supporter is in the future of the meeting time.

Because of the way the semantics of the present tense morpheme is set up, (42b) has the same interpretation regardless of whether the relativized NP is scoped to the VP-level or to the S-level. Let us do the wide-scope reading first:

(44) After QR: $[_S[_{NPi}$ a man who$_k$ e_k Pres woll become his great supporter]$[_S$John Past meet $e_i]]$

1. a man who$_k$ e_k Pres woll become his great supporter $\Rightarrow$ $\lambda P \exists x\, [man'(x) \& \exists t[NOW(t) \& AT(t, \exists t'\, [FUT(t') \& t' \subseteq t_{R1} \& AT(t', become\text{-}his\text{-}great\text{-}supporter'(x))])] \& P\{x\}]$
2. $[_S[_{NPi}$ a man who$_k$ e_k Pres woll become his great supporter]$[_S$John Past meet $e_i]]$ $\Rightarrow$ $\lambda P \exists x\, [man'(x) \& \exists t[NOW(t) \& AT(t, \exists t'\, [FUT(t') \& t' \subseteq t_{R1} \& AT(t', become\text{-}his\text{-}great\text{-}supporter'(x))])] \& P\{x\}]\, (^\wedge \lambda y\, [\exists t''[PAST(t'') \& t'' \subseteq t_{R2} \& AT(t'', meet'(j, y))]])$

3. $\exists x$ [man' (x) & $\exists t$[NOW (t) & AT (t, $\exists t'$ [FUT (t') & $t' \subseteq t_{R1}$ & AT (t', become-his-great-supporter' (x))])] & $\exists t''$[PAST (t'') & $t'' \subseteq t_{R2}$ & AT (t'', meet' (j, x))]]

4. $\exists x$ [man' (x) & $\exists t'$ [FUT (t') & $t' \subseteq t_{R1}$ & AT (t', become-his-great-supporter' (x))] & $\exists t''$[PAST (t'') & $t'' \subseteq t_{R2}$ & AT (t'', meet' (j, x))]]

The final line says that there was a past time at which John met some man x such that x will become John's supporter in the future of the speech time. The result is the same if the relativized NP is scoped to the VP-level:

(45) After QR: [$_S$John Past [$_{VP}$[$_{NPi}$ a man who$_k$ e_k Pres woll become his great supporter][$_{VP}$ meet e_i]]]

1. a man who$_k$ e_k Pres woll become his great supporter $\Rightarrow$ $\lambda P \exists x$ [man' (x) & $\exists t$[NOW (t) & AT (t, $\exists t'$ [FUT (t') & $t' \subseteq t_{R1}$ & AT (t', become-his-great-supporter' (x))])] & P{x}]

2. [$_{VP}$[$_{NPi}$ a man who$_k$ e_k Pres woll become his great supporter][$_{VP}$ meet e_i]] $\Rightarrow$ λy[$\lambda P \exists x$ [man' (x) & $\exists t$[NOW (t) & AT (t, $\exists t'$ [FUT (t') & $t' \subseteq t_{R1}$ & AT (t', become-his-great-supporter' (x))])] & P{x}] (^ λz[meet' (z)(y)])]

3. λy [$\exists x$ [man' (x) & $\exists t$[NOW (t) & AT (t, $\exists t'$ [FUT (t') & $t' \subseteq t_{R1}$ & AT (t', become-his-great-supporter' (x))])] & meet' (y, x)]]

4. $[_S$John Past $[_{VP}[_{NP_i}$ a man who$_k$ e_k Pres woll become his great supporter$][_{VP}$ meet $e_i]]] \Rightarrow \exists t''[PAST(t'') \& t'' \subseteq t_{R2} \& AT(t'', \exists x [man'(x) \& meet'(j, x) \& \exists t[NOW(t) \& AT(t, \exists t' [FUT(t') \& t' \subseteq t_{R1} \& AT(t', \text{become-his-great-supporter}'(x))])]])]$

Now, the important point here is the following: despite the fact that the translation of the present tense in the relative clause is in the scope of the matrix past tense, the present tense refers back to the speech time thanks to the way the predicate NOW is interpreted. Thus, the model-theoretic interpretation of (44) line 4 is equivalent to that of (45) line 4.

I will also show that (46), which was taken up above, is predicted to be three-way ambiguous.

(46) John saw a man who was laughing.

(46a) D & S-structure: John Past see $[_{NP}$a man $[_{S'}$who Past be laughing]]

QR: $[_S[_{NP_k}$a man $[_{S'}$who Past be laughing]] $[_S$John saw $e_k]]$

The Tense Deletion Rule does not apply. (The condition is not met.)

(46b) D & S-structure: John Past see $[_{NP}$a man $[_{S'}$who Past be laughing]]

QR: John Past $[_{VP}[_{NP_k}$ a man $[_{S'}$who Past be laughing]]$[_{VP}$ see $e_k]]$

Tense Deletion: John Past $[_{VP}[_{NP_k}$ a man $[_{S'}$who Ø be laughing]]$[_{VP}$ see $e_k]]$

[N.B. Ø signifies an empty tense node]

(46c) D & S-structure: John Past see $[_{NP}$a man $[_{S'}$who Past be laughing]]

QR: John Past $[_{VP}[_{NP}$a man $[_{S'}$who Past be laughing]]$[_{VP}$ see e_k]]

We choose not to apply the Tense Deletion rule.

(The condition is met.)

(46a') LF: $[_S[_{NPk}$a man $[_{S'}$who Past be laughing]] $[_S$John saw e_k]]

1. $[_{NPk}$a man $[_{S'}$who Past be laughing]] $\Rightarrow$

   $\lambda P \exists x[\text{man}'(x) \;\&\; \exists t'[\text{PAST}(t') \;\&\; t' \subseteq t_{R2} \;\&\; \text{AT}(t', \text{be-laughing}'(x))] \;\&\; P\{x\}]$

2. John saw $e_k \Rightarrow \exists t[\text{PAST}(t) \;\&\; t \subseteq t_{R1} \;\&\; \text{AT}(t, \text{see}'(j, x))]$

3. $[_S[_{NPk}$a man $[_{S'}$who Past be laughing]] $[_S$John saw e_k]] $\Rightarrow$

   $\lambda P \exists x[\text{man}'(x) \;\&\; \exists t'[\text{PAST}(t') \;\&\; t' \subseteq t_{R2} \;\&\; \text{AT}(t', \text{be-laughing}'(x))] \;\&\; P\{x\}](\hat{}\, \lambda y\, \exists t[\text{PAST}(t) \;\&\; t \subseteq t_{R1} \;\&\; \text{AT}(t, \text{see}'(j, y))])$

4. $\exists x[\text{man}'(x) \;\&\; \exists t'[\text{PAST}(t') \;\&\; t' \subseteq t_{R2} \;\&\; \text{AT}(t', \text{be-laughing}'(x))] \;\&\; \exists t[\text{PAST}(t) \;\&\; t \subseteq t_{R1} \;\&\; \text{AT}(t, \text{see}'(j, x))]]$

This reading locates both the time of the man's laughing and the time of John's seeing him in the past of the speech time, and these two times are unordered with respect to each other.

(46b') LF: John Past $[_{VP}[_{NPk}$ a man $[_{S'}$who Ø be laughing$]][_{VP}$ see $e_k]]$

1. $[_{NPk}$ a man $[_{S'}$who Ø be laughing$]]$ ⇒

   $\lambda P\, \exists x[man'(x)\ \&\ \exists t[PRES(t)\ \&\ AT(t, be\text{-}laughing'(x))]\ \&\ P\{x\}]$

2. $\lambda P\, \exists x[man'(x)\ \&\ be\text{-}laughing'(x)\ \&\ P\{x\}]$ (simplified)

3. $[_{VP}[_{NPk}$a man $[_{S'}$who Ø be laughing$]][_{VP}$ see $e_k]]$ ⇒

   $\lambda z[\lambda P\, \exists x[man'(x)\ \&\ be\text{-}laughing'(x)\ \&\ P\{x\}]\ ({}^\wedge \lambda y[see(y)(z)])]$

4. $\lambda z[\exists x[man'(x)\ \&\ be\text{-}laughing'(x)\ \&\ see(z, x)]]$

5. John Past $[_{VP}[_{NPk}$a man $[_{S'}$who Ø be laughing$]][_{VP}$ see $e_k]]$ ⇒

   $\exists t[PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, \exists x[man'(x)\ \&\ be\text{-}laughing'(x)\ \&\ see(j, x)])]$

(46c') LF: John Past $[_{VP}[_{NPk}$a man $[_{S'}$who Past be laughing$]][_{VP}$ see $e_k]]$

1. $[_{NPk}$ a man $[_{S'}$who Past be laughing$]]$ ⇒

   $\lambda P\, \exists x[man'(x)\ \&\ \exists t[PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, be\text{-}laughing'(x))]\ \&\ P\{x\}]$

2. $[_{VP}[_{NPk}$ a man $[_{S'}$who Past be laughing$]][_{VP}$ see $e_k]]$ ⇒

   $\lambda z\, [\lambda P\, \exists x[man'(x)\ \&\ \exists t[PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, be\text{-}laughing'(x))]\ \&\ P\{x\}]\ ({}^\wedge \lambda y[see'(y)(z)])]$

3. $\lambda z[\exists x[man'(x)\ \&\ \exists t[PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, be\text{-}laughing'(x))]\ \&\ see'(z, x)]]$

4. John Past [$_{VP}$[$_{NPk}$ a man [$_{S'}$who Past be laughing]][$_{VP}$ see e_k]]

$\Rightarrow \exists t'[PAST(t') \;\&\; t' \subseteq t_{R1} \;\&\; AT(t', \exists x[man'(x) \;\&\; see'(j, x) \;\&$

$\exists t[PAST(t) \;\&\; t \subseteq t_{R1} \;\&\; AT(t, be\text{-}laughing'(x))]])]$

(46b') represents a simultaneous reading, and (46c') a shifted reading. As mentioned above, since both of these readings are covered by the wide scope reading of the relativized NP (i.e. (46a')), they do not strike native speakers as independent readings. At this point, we will turn to Japanese, which provides evidence that the current framework is on the right track.

Assuming a fragment for Japanese,[24] we discuss how the following two Japanese sentences are interpreted:

(47a) John-wa [$_{NP}$[$_{S'}$warat-te ir -u] otoko] ni at -ta.
TOP laugh PROG PRES man DAT see PST

John met a man who was laughing [simultaneous reading] or
John met a man who is laughing (now).

(47b) John-wa [$_{NP}$[$_{S'}$warat -te ir -ta] otoko] ni at -ta.
TOP laugh PROG PST man DAT see PST

John met a man who was laughing [the time of the man's laughing can be any time before the speech time]

As mentioned earlier, (47a) is ambiguous between two readings. These two readings correspond to the wide and narrow scope readings of the relativized NP:

[24] Since it is obvious what a Japanese fragment should looks like, I will not give a formal fragment here. The interested reader is referred to Chapter 3, where a formal fragment for Japanese, as well as one for English, is presented.

(47a') wide scope: LF $[_S[_{NPk}\ [_{S'}$warat-te ir Pres] otoko]$[_S$John-wa e_k ni at Past]]

1. $[_S$John-wa e_k ni at Past] 'John saw e_k' $\Rightarrow \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ AT\ (t, see'\ (j, x))]$

2. $[_{N'}[_{S'}$warat-te ir Pres] otoko] 'man who is laughing $\Rightarrow$ $\lambda x\ [be\text{-}laughing'\ (x)\ \&\ man'\ (x)]$

3. $[_{NPk}\ [_{S'}$warat-te ir Pres] otoko] 'a man who is laughing' $\Rightarrow$ $\lambda P\ \exists x\ [be\text{-}laughing'\ (x)\ \&\ man'\ (x)\ \&\ P\{x\}]$

4. $[_S[_{NPk}\ [_{S'}$warat-te ir Pres] otoko]$[_S$John-wa e_k ni at Past]] $\Rightarrow$ $\lambda P\ \exists x\ [be\text{-}laughing'\ (x)\ \&\ man'\ (x)\ \&\ P\{x\}]\ (\hat{}\ \lambda y \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ AT\ (t, see'\ (j, y))])$

5. $\exists x\ [be\text{-}laughing'\ (x)\ \&\ man'\ (x)\ \&\ \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ AT\ (t, see'\ (j, x))]]$

(47a") narrow scope: LF $[_S$John-wa $[_{VP}[_{NPk}\ [_{S'}$warat-te ir Pres] otoko]$[_{VP}e_k$ ni at]]$[_{Aux}$ Past]]

1. $[_{NPk}\ [_{S'}$warat-te ir Pres] otoko] $\Rightarrow \lambda P\ \exists x\ [be\text{-}laughing'\ (x)\ \&\ man'\ (x)\ \&\ P\{x\}]$

2. $[_{VP}e_k$ ni at] $\Rightarrow$ see' (y)

3. $[_{VP}[_{NPk}\ [_{S'}$warat-te ir Pres] otoko]$[_{VP}e_k$ ni at]] $\Rightarrow$ $\lambda z[\lambda P\ \exists x[be\text{-}laughing'\ (x)\ \&\ man'\ (x)\ \&\ P\ \{x\}]\ (\hat{}\ \lambda y[see'\ (z, y)])]$

4. $\lambda z[\exists x[be\text{-}laughing'\ (x)\ \&\ man'\ (x)\ \&\ see'\ (z, x)]]$

5. $[_{S}$John-wa $[_{VP}[_{NPk}$ $[_{S'}$warat-te ir Pres] otoko]$[_{VP}e_k$ ni at]]$[_{Aux}$ Past]] $\Rightarrow$

$\exists t[PAST(t) \& t \subseteq t_{R1} \& AT(t, \exists x[\text{be-laughing}'(x) \& \text{man}'(x) \& \text{see}'(j, x)])]$

The translation given in (47a') represents a reading in which the man's laughing is simultaneous with the speech time, which corresponds to the interpretation of (48):

(48) John saw a man who is laughing.

More importantly, the simultaneous reading predicted by the derivation (46b') in English parallels the narrow scope reading given here as (47a").

Consider next (47b). The theory predicts that (47b) has two readings.

(47b') wide scope: LF $[_{S}[_{NPk}$ $[_{S'}$warat -te ir Past] otoko]$[_{S}$John-wa e_k ni at Past]]

1. $[_{NPk}$ $[_{S'}$warat -te ir Past] otoko] 'a man who was laughing' $\Rightarrow \lambda P\, \exists x[\text{man}'(x) \& P\{x\} \& \exists t[PAST(t) \& t \subseteq t_{R2} \& AT(t, \text{be-laughing}'(x))]]$

2. $[_{S}$John-wa e_k ni at Past] $\Rightarrow \exists t\,[PAST(t) \& t \subseteq t_{R1} \& AT(t, \text{see}'(j, y))]$

3. $[_S[_{NPk}\, [_{S'}$warat -te ir Past] otoko]$[_S$John-wa e_k ni at Past]] $\Rightarrow$
$\exists x[\text{man}'(x) \,\&\, \exists t_1[\text{PAST}(t_1) \,\&\, t_1 \subseteq t_{R1} \,\&\, \text{AT}(t_1, \text{see}'(j, x))] \,\&$
$\exists t[\text{PAST}(t) \,\&\, t \subseteq t_{R2} \,\&\, \text{AT}(t, \text{be-laughing}'(x))]]$

(47b") narrow scope: LF $[_S$John-wa $[_{VP}[_{NPk}\, [_{S'}$warat -te ir Past] otoko]$[_{VP}e_k$ ni at]]$[_{Aux}$Past]]

1. $[_{NPk}\, [_{S'}$warat -te ir Past] otoko] 'a man who was laughing' $\Rightarrow \lambda P$
$\exists x[\text{man}'(x) \,\&\, P\{x\} \,\&\, \exists t[\text{PAST}(t) \,\&\, t \subseteq t_{R2} \,\&\, \text{AT}(t, \text{be-laughing}'(x))]]$
2. $[_{VP}e_k$ ni at] $\Rightarrow$ see' (y)
3. $[_{VP}[_{NPk}\, [_{S'}$warat-te ir Past] otoko]$[_{VP}e_k$ ni at]] $\Rightarrow$
$\lambda z[\lambda P\, \exists x[\text{man}'(x) \,\&\, P\{x\} \,\&\, \exists t[\text{PAST}(t) \,\&\, t \subseteq t_{R2} \,\&\, \text{AT}(t, \text{be-laughing}'(x))]]\,(^\wedge \lambda y[\text{see}'(z, y)])]$
4. $\lambda z[\exists x[\text{man}'(x) \,\&\, \text{see}'(z, x) \,\&\, \exists t[\text{PAST}(t) \,\&\, t \subseteq t_{R2} \,\&\, \text{AT}(t, \text{be-laughing}'(x))]]]$
5. $[_S$John-wa $[_{VP}[_{NPk}\, [_{S'}$warat -te ir Past] otoko]$[_{VP}e_k$ ni at]] $[_{Aux}$Past]] $\Rightarrow$
$\exists t_1[\text{PAST}(t_1) \,\&\, t_1 \subseteq t_{R1} \,\&\, \text{AT}(t_1, \exists x[\text{man}'(x) \,\&\, \text{see}'(j, x) \,\&$
$\exists t[\text{PAST}(t) \,\&\, t \subseteq t_{R2} \,\&\, \text{AT}(t, \text{be-laughing}'(x))]])]$

The time of the man's laughing can be any time before the speech time with (47b') and any time before the time of John's seeing the man with (47b"). These two readings of (47b) correspond to the readings of the English sentence (46) available through the derivations (46a) and (46c). On the other hand, the simultaneous reading of (46) available through the derivation (46b) is conveyed in Japanese by a different sentence, i.e. (47a), which contains a relative clause in the *present* tense. The simultaneous reading of (47a) is obtained when the relativized NP is interpreted to have narrower scope than the matrix tense as in (47a"). This confirms the view that the simultaneous reading associated with (46b) in English is an independent reading and that the tense deletion rule is operative in relative clauses as well. The above discussion shows that the current theory offers an effective means of predicting correct temporal interpretations of relative clauses in both English and Japanese.

Having taken care of relative clauses, we are in a position to discuss verb complement clauses. Here, the discussion will be more involved. We will show that the current system assigns the right interpretation to sentences like (49). Let us concentrate upon the simultaneous reading of (49):

(49) John said that Mary was sick.

D-structure: John Past say that Mary Past be sick

QR: not applicable

Tense Deletion: John Past say that Mary Ø be sick

(49') 1. that Mary Ø be sick $\Rightarrow$ be-sick' (m)

2. say that Mary Ø be sick $\Rightarrow$ say' (^ be-sick' (m))

3. John said that Mary Ø be sick $\Rightarrow \exists t[\text{PAST}(t) \ \& \ t \subseteq t_{R1} \ \& \ \text{AT}(t, \text{say}'(j, {}^\wedge \text{be-sick}'(m)))]$

Let us see how the final line of the translation is model-theoretically interpreted.

$[\![\exists t[PAST(t) \& t \subseteq t_{R1} \& AT(t, say'(j, {}^\wedge be\text{-}sick'(m)))]]\!]^{M,w_1,t_1,g} = 1$ iff there is a $g^{t2/t}$ (a value assignment function exactly like g with the possible exception that t_2 is assigned to t) such that $[\![PAST(t) \& t \subseteq t_{R1} \& AT(t, say'(j, {}^\wedge be\text{-}sick'(m)))]\!]^{M,w_1,t_1,g^{t2/t}} = 1$. This is the case iff

(i) $[\![PAST(t)]\!]^{M,w_1,t_1,gt_2/t} = 1$

(ii) $[\![t]\!]^{M,w,t_1,g^{t2/t}}$ is part of the contextually salient time $[\![t_{R1}]\!]^{M,w,t_1,g}$ and

(iii) $[\![AT(t, say'(j, {}^\wedge be\text{-}sick'(m)))]\!]^{M,w_1,t_1,g^{t2/t}} = 1$

These conditions further reduce to

(i) $t_2 < t_1$ and t_2 is part of $[\![t_{R1}]\!]^{M,w,t_1,g}$

(ii) $[\![say'(j, {}^\wedge be\text{-}sick'(m))]\!]^{M,w_1,t_2,g} = 1$

In plain English, the condition (i) says that t_2 is a past time and falls within the "reference interval", and the condition (ii) requires that the saying relation hold between John and the proposition $^\wedge$ be-sick' (m) in w_1 at t_2.

The interpretation rule for propositions is the following:

(50) If $\alpha \in ME_t$, then $[\![{}^\wedge \alpha]\!]^{M,w,t,g}$ is that function h with domain W X T such that for all $<w', t'>$ in W X T, h ($<w', t'>$) is $[\![\alpha]\!]^{M,w',t',g}$

In the set-theoretic notation, $[\![{}^\wedge \alpha]\!]^{M,w,t,g}$ (where α is of sentence-type) is the following set:

(51) $\{<w', t'> \mid [\![\alpha]\!]^{M,w',t',g} = 1\}$

Thus, (49) is true iff there is a time t_2 which is located in the past of t_1, and the saying relationship holds in w_1 at t_2 between John and the following proposition:

(52) $\{<w'',t''> \mid [\![\text{be-sick}'(m)]\!]^{M,w'',t'',g} = 1\} =$

$\{<w'', t''> \mid$ Mary is sick in w'' at t''$\}$

One realizes that it is not easy to claim that in (49) the time of John's saying is simultaneous with the time of Mary's being sick. We know that the time of John's saying is t_2. But what is "the time of Mary's being sick"? In fact, it is hard to make sense of this question because the object that John stands in the saying relation to is the proposition ^ sick' (m), which is the *set of world-time pairs* at which Mary is sick. In spite of this apparent problem, I claim that there is a way of arriving at the conclusion that t_2 is the "time of Mary's being sick" in a very restricted sense which I will discuss immediately below.[25]

[25] To make clear the problem involved here, let us briefly turn to simultaneous readings obtained with relative clauses in Japanese. Consider the following example:

(a) [NP [S' nai-te iru] otoko]-ga ki -ta.
crying man NOM come PST
A man who was crying came.

This sentence has two readings: a simultaneous reading (the man is crying at the time of his coming) and an independent reading (the man is crying now). Let us concentrate upon the former, which is expected to obtain when the NP is adjoined to the VP node. The following IL translation of (a) represents the meaning involved here:

(b) $\exists t[PAST(t) \;\&\; AT(t, \exists x[\text{be-crying}'(x) \;\&\; \text{man}'(x) \;\&\; \text{come}'(x)])]$

I will not show how this IL translation of (a) is arrived at by compositional rules. The interested reader can consult a formal fragment to be presented later in order to make sure that (b) is the way (a) should be translated. It is clear that the existence of a

The semantic interpretation rule for say' is given in the following way:[26]

(53) $[\![\text{say}']\!]^{M,w,t,g} = \{\langle x,p\rangle \mid x \text{ stands in the saying relation to } p \text{ at } t \text{ in } w\}$

The question that is raised immediately is the following: what is the saying relation? It cannot be defined explicitly, but we can provide the following necessary condition for the saying relation to hold between x and p:

(54) Suppose g(x) utters the sentence in w at t. If g(x) stands in the saying relation to g(p) at t in w, then g(x) speaks the truth at t in w iff $g(p)(\langle w,t\rangle)$ is true.

With this interpretation of say' in mind, let us examine how the sentence (49) is interpreted:

man who was crying in the actual world at some past time is a necessary condition for the whole formula to be true. Moreover, (b) states explicitly that there was a past time at which a coming and a crying obtained simultaneously. In other words, it is straightforward to arrive at the conclusion that the relative clause receives a simultaneous reading here. By contrast, the case of verb complement clauses is more complicated because intensional contexts are involved.

26 Although simultaneous arguments are prohibited in IL, it is customary to interpret $\alpha(\beta)(\gamma)$ as the relation α which holds between γ and β and to use the relational notation $\alpha(\gamma, \beta)$. In (53), say' is interpreted as a relation between an individual and a proposition and is encoded as a set of such pairs in the set-theoretic notation. In IL, say' is a function which first applies to a proposition, and second to an individual.

(55) $[\![\text{say}' (j, {}^\wedge \text{be-sick}' (m))]\!]^{M,w_1,t_2,g} = 1$ iff

$\langle j, \{\langle w'',t''\rangle \mid [\![\text{be-sick}' (m)]\!]^{M,w'',t'',g} = 1 \}\rangle \in [\![\text{say}']\!]^{M,w_1,t_2,g}$

How do we know whether this condition is satisfied? We know at least that if the sentence is true then the following conditional holds: if John spoke the truth in w_1 at t_2, then Mary was sick in w_1 at t_2. This is what a "simultaneous reading" amounts to.

To sum up, our current framework serves to predict that (49) has a "simultaneous" reading if we assume the following:

(i) If (49) is true, then the following holds:

John speaks the truth at $\langle w_1, t_2\rangle$ iff Mary is sick at $\langle w_1, t_2\rangle$.

(ii) Assume that John *does* speak the truth at $\langle w_1, t_2\rangle$.

Then, it follows from (i) and (ii) that Mary is sick at $\langle w_1, t_2\rangle$.

A parallel argumentation can be constructed to show that the current system also predicts the so-called "shifted reading" associated with sentences like the following:

(56) John said that Mary bought a car.

Now that I have shown how to arrive at a simultaneous reading, it would be trivial to do the same for a shifted interpretation. I will leave the reader to demonstrate that it can be done.

I hope to have established enough reason to adopt the current system for temporal interpretation in English and Japanese. The current system has the following characteristics: (i) tenses are assumed to have quantificational force; (ii) the context constrains the quantificational force of tenses; (iii) tenses are evaluation-time sensitive (except the present tense morpheme in English); (iv) tenses affect temporal interpretations of syntactically lower expressions; (v) English has a ST (i.e. a tense deletion) rule, but Japanese does not.

2.1.8. Other Triggers of Sequence of Tense

So far we have only discussed cases in which the ST phenomenon (technically the deletion of a tense at LF) is triggered by a tense morpheme. In this sub-section, I point out that "triggers" are not restricted to tense morphemes.

2.1.8.1. The Perfect

I will show that the perfect can be a trigger of the ST phenomenon. Consider the following examples:

(57a) John may have said that he would attend the meeting.

(57b) Having claimed that he would never come back, John cannot go back home.

In these examples, *would* appears, which I take to be a diagnostic of the ST phenomenon, and the sentences are well-formed. The time of his attending the meeting is located after the time of John's saying in (57a), whereas the time of his never coming back is after the time of his claim in (57b). The past tense morpheme suffixed to *woll* in both (57a) and (57b) do not have any semantic role to play and is subject to the tense deletion rule at LF. These examples look exactly like paradigm examples of the ST phenomenon except that the trigger is not a tense morpheme; in (57a) and (57b), the trigger is the perfect (*have* + past participle). That the perfect is the trigger is confirmed by removing the perfect from (57a):

(58) John may say that he would attend the meeting.

(58) is hard to interpret unless it is embedded in a discourse or *woll* is interpreted in a non-temporal sense. We can also show that a simple past tense exhibits a simultaneous reading under a perfect:

(59) John will have claimed that he was sick.

This has an interpretation in which the time of his being sick is simultaneous with the time of John's claiming. It is a possible reading even if the time of claiming is in the future of the speech time. This fact can also be accounted for if we assume that the perfect can be a trigger of tense deletion. The LF representation of (59) after the application of the tense deletion rule is the following:

(59') John will have said that he Ø be sick

On the basis of this syntactic representation, we arrive at the following IL representation:

(59") $\exists t'[FUT (t') \& t' \subseteq t_{R2} \& AT (t', \exists t[PAST (t) \& t \subseteq t_{R1} \& AT (t, say' (j, {}^\wedge$ $be\text{-}sick' (x)))])]$

This is the desired interpretation of (59).

Thus, the deletion of a past tense is triggered not only by a past tense morpheme but also by an element which behaves like a past tense. In Chapter 3, I will show how this can be implemented in a formal fragment.

2.1.8.2. Adjectives

Some special adjectives such as *earlier* also act as triggers for the ST phenomenon. For this we must turn to noun complement clauses. A noun complement clause occurs in a complex NP (Ross 1967) with a structure similar to that of a relative clause. The difference between a relative clause and a noun complement is that the former has a gap whereas the latter does not. It is usually assumed that relative clauses are higher in structure than noun complements. The point to be made in this sub-section is that noun complements exhibit effects characteristic of the ST phenomenon even when no tense morpheme is around to trigger it. Consider the following examples:[27]

[27] Examples like the following are due to Irene Heim (p.c.).

(60a) This contradicts [$_{NP}$John's earlier [$_{N'}$claim [$_{S'}$that [$_S$Mary would win the prize]]]].

(60b) [$_{NP}$John's earlier [$_{N'}$claim [$_{S'}$that [$_S$Mary would win the prize]]]] is well-known.

In these examples, the past tense form of *woll*, i.e. *would*, appears due to the presence of the word *earlier*. Or to put more accurately, the ST phenomenon is triggered by the fact that the time of the claim is earlier than the time of the matrix verb. This confirms the hypothesis suggested in the previous sub-section that the ST phenomenon is triggered by an element which behaves like a past tense: the adjective *earlier* in (60a) and (60b). The fact that the time of Mary's winning the prize is located after the time of claiming shows that the past tense in the noun complement is interpreted as an empty tense (i.e. a tense deleted at LF). Since the matrix clause is in the present tense, the only conceivable trigger of the past tense morpheme suffixed to *woll* is the adjective *earlier*. The LF representation of (60a) after the application of the tense deletion rule is the following:

(60a') This Pres contradict [$_{NP}$John's earlier [$_{N'}$claim [$_{S'}$that [$_S$Mary Ø woll win the prize]]]].

Although I will defer until Chapter 3 the discussion of how this is translated into IL and is model-theoretically interpreted, it is clear how the time-sensitive elements are interpreted. The noun complement is assumed to be in the scope of the past-tense-like adjective *earlier*. This presumed scope relationship predicts that the time of Mary's winning the prize is later than the time of John's claiming, which is located in the past of the speech time.

To show that what I have just presented is the correct analysis of the data, let us consider (61), which is like (60a) except that the adjective modifying the noun *claim* is changed from *earlier* to *current*, thereby forcing the time of John's claim to be simultaneous with the time of everybody's being amused by it. The intended interpretation is that the time of Mary's winning the prize is sometime after the speech time.

(61) # Everybody is amused by [$_{NP}$John's current [$_{N'}$claim [$_{S'}$that [$_{S}$Mary would win the prize]]]].

Under this interpretation, the occurrence of *would* (for temporal interpretation) is illicit. This shows that the adjective *earlier* is the trigger of the ST phenomenon in (60a-b). One way to account for the above data is to posit a feature common to a past tense morpheme, a perfect, and special adjectives like *earlier* (as well as for the perfect) and formulate the tense deletion rule in such a way that this feature triggers tense deletion. Details are given in Chapter 3.

2.2. Sequence-of-Tense, Intensionality, and Scope

2.2.1. Ladusaw (1977)

Ladusaw (1977) proposes a theory which attempts to account for the interaction between NP scope, intensionality, and the ST phenomenon. I consider Ladusaw

(1977) to be a precursor of my proposal. Ladusaw's proposal can be summarized in the following way: He assumes a set of phrase structure rules which produce structures analogous to LF structures in GB theory. NP's are assigned scope already at this level. These structures are translated into IL formulas. In addition to the phrase structure rules, he posits a number of transformational rules which convert underlying structures into surface forms. For our purposes, the most important are the ST rule and the NP lowering rule. The ST rule in Ladusaw's proposal converts a present tense into a past tense when it is commanded by a past tense. Ladusaw's syntactic rule for the Aux node adopts the idea that the tense morphemes and the modal verbs are distributionally independent (e.g. Chomsky 1957). Thus, *will* and *would* are analyzed morphologically as *Pres woll* and *Past woll*, respectively (where *woll* is the future auxiliary itself). The ST rule is sensitive to the morphological forms of the verbs, not to their temporal interpretations. I agree with Ladusaw on this point. The NP lowering rule serves to move scoped NP's to lower surface positions.[28] In order to account for the fact that scope assignment for NP's affects the applicability of the ST rule, Ladusaw orders the ST rule *before* the NP lowering transformation. Ladusaw and I again make the same empirical claim, except that our systems do things in the reverse order. However, my current system is not a notational variant of Ladusaw's in that the former can produce *will* under the scope of a past tense, whereas the latter can produce *will* only when it is not in the scope of a past tense.[29]

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[28] As mentioned above, this is analogous to the Quantifier Lowering Transformation proposed by Lakoff (1971).

[29] In general, my current system can produce sentences in which a morphological present tense is embedded under a past tense (so-called double-access sentences).

For example, Ladusaw's system predicts that in (62a) and (62b) the future tense in the relative clause can only be licensed if it is outside the scope of the matrix past tense:

(62a) Bill sought a man who will be leaving.

(62b) John wished to walk in a park that won't be closed on Christmas.

Thus, the base forms (i.e. the "LF representations") for (62a) and (62b) must look like the following:

(62a') $[_S[_{NP_k}$ a man who Pres woll be leaving$][_S$ Bill Past seek $e_k]]$

(62b') $[_S[_{NP_k}$ a park that Pres woll not be closed on Christmas$][_S$John Past wish to walk in $e_k]]$

We first attempt to apply the ST rule to (62a') or (62b'), but it is non-applicable here since the matrix past tense does not command the present tense in the relative clause. Then, the NP lowering rule applies and the relativized NP is moved down to the object NP position in the matrix clause. Since the base structures (or the LF representations in our terms) (62a') and (62b') are translated into IL and are eventually model-theoretically interpreted, Ladusaw predicts that the relativized NP's in (62a) and (62b) only receive a de re interpretation. For example, (62a') is translated (in our notational system) into IL as (62a"):

(62a") $\exists x$ [man' (x) & $\exists t$ [FUT (t) & $t \subseteq t_{R1}$ & AT (t, be-leaving' (x))] & $\exists t_1$[PAST (t_1) & $t_1 \subseteq t_{R2}$ & AT (t_1, seek' (b, ^ $\lambda P P\{x\}$))]]

(62a") represents a de re interpretation of (62a).

However, Ladusaw observes that they can in fact receive a de dicto reading as well. (Dowty (1982) agrees with Ladusaw's judgment on these examples.) Since his system cannot account for this fact, he questions his own proposal at the end of his paper. Henceforth, we will refer to the dilemma that Ladusaw faces as "Ladusaw's puzzle".

By contrast, my own proposal can produce *will* in the syntax even if the relativized NP's are not scoped, as the following derivation of (62a) shows:

(63) D-str: Bill Past seek a man who Pres woll be leaving.

LF: Bill Past seek [$_{NP}$ a man who Pres woll be leaving]. [the tense deletion rule is not applicable]

The tense deletion rule is not applicable because it only operates between two occurrences of the same tense morpheme. At first glance, the semantic machinery of my system seems to provide (62a) with the correct interpretation:

(63') 1. a man who Pres woll be leaving $\Rightarrow$ $\lambda P \exists x$[man' (x) & $\exists t$ [NOW (t) & AT (t, $\exists t_1$[FUT (t_1) & $t_1 \subseteq t_{R1}$ & AT (t_1, be-leaving' (x))])] & P {x}]

2. Bill Past seek [$_{NP}$ a man who Pres woll be leaving] $\Rightarrow \exists t_2$[PAST (t_2) & $t_2 \subseteq t_{R2}$ & AT (t_2, seek' (b, $^\wedge \lambda P \exists x$[man' (x) & P {x} & $\exists t$ [NOW (t) & AT (t, $\exists t_1$[FUT (t_1) & $t_1 \subseteq t_{R1}$ & AT (t_1, be-leaving' (x))])]]))]

The line 2 says that Bill stood in the seeking relation to the property of properties of some x such that x is a man and x is leaving at some time after the speech time of (62a). This strikes native speakers as the right reading for (62a). If so, this gives us a reason to prefer my system over Ladusaw's. However, I believe that the interpretations of (62a) and (62b) are more complicated than one might think and that the analysis of (62a) offered by my current system is wrong. Note that (62a) is similar to (64), which we briefly discussed earlier, in that a present tense morpheme appears immediately under the matrix past tense:

(64) John said that Mary is pregnant.

A hypothesis that I will pursue is that all sentences that have a present tense embedded under a past tense (we will refer to them as "double-access sentences") should be analyzed in a uniform manner. As my fragment cannot analyze (64) semantically, it is likely that its alleged success in accounting for the semantics of (62b) is more apparent than real. Since I consider the problem associated with double-access sentences to be very important, I will devote an entire chapter (Chapter 4) to its discussion. Until then, we will ignore a host of problems connected with double-access sentences, including Ladusaw's puzzle.

2.2.2. Abusch (1988)

In the above sections, I have motivated a version of ST theory. Abusch (1988) independently reached the same conclusion. As far as the necessity of a ST rule is concerned, Abusch and I are in agreement. In the same paper, Abusch also discusses the relationships between the ST phenomenon, intensionality and scope. In this section, I would like to take up this issue.

For the purpose of our discussion, let us assume that ST theory is basically correct and that our task is to define exactly how and where the ST rule applies. Earlier in this chapter, I cited various examples to show that tenses in relativized NP's can be interpreted as embedded under syntactically higher tenses and that tenses occurring within relative clauses are subject to the ST rule just as tenses in verb complements are. Abusch (1988) clearly establishes the fact that tenses occurring within NP's (relativized NP's in particular) can be interpreted as embedded under syntactically higher tenses with examples involving intensional contexts. In the following example cited in Abusch (1988), a relative clause is embedded in a verb complement clause:

(71) John suspected that a. a man who killed him
b. a man who would kill him
was behind the door.

Abusch observes that (71a) is possible only when it is taken to have a *de re* (or wide-scope) interpretation with respect to the main predicate *suspect*. When it is interpreted *de dicto*, the time of killing is understood to be located in the past of John's suspecting, resulting in a pragmatically impossible reading. In order to obtain a pragmatically acceptable de dicto interpretation, we must employ (71b). The same point can be made with the following example, which is also discussed by Abusch:

(66) John looked for a woman who married him.

The de dicto reading of (66) is possible only if the time of the marriage precedes the time of the search, whereas a de re reading allows the time of the marriage to follow the time of the search. These examples clearly show that when a relativized NP receives a de dicto interpretation, the relative clause tense is interpreted as embedded under the immediately higher tense.

By contrast, sentences such as (67) which involve an extensional matrix verb and a relative clause do not make clear the scope relationship between the matrix verb and the relative-clause tense:

(67) John saw a man who robbed the bank.

The only thing that we can say about (67) is that the time of the man's robbing the bank is sometime before the speech time. The time of John's seeing the man and the time of the man's robbing the bank are unordered with respect to each other. On the basis of the above data, Abusch states the following generalization:

(68) A sentence with a past tense embedding verb V_1, and a past tense embedded verb V_2, may have a shifted forward [sic] interpretation[30] iff in the logical form of that sentence, V_2 does not appear within an intensional argument of V_1.

As Abusch observes, examples involving intensional contexts distinguish the two possible temporal readings of tenses in relative clauses clearly.

Expanding on the above generalization, Abusch proposes the following hypothesis about the ST phenomenon:

(69) In sentences with an embedded Tns_2, Tns_2 is in a transposing context iff it is within an intensional argument of a past tense verb V_1.

Abusch assumes that there are two past tense morphemes: $Past_1$ and $Past_2$. $Past_1$ indicates a precedence relation, whereas $Past_2$ indicates an overlapping relation. In our system, the former corresponds to a past tense which is not deleted by the tense deletion rule, and the latter corresponds to the null tense Ø. $Past_2$ is allowed to occur only in transpositional contexts.[31] In our terms, this means that the tense deletion rule

[30] For example, the interpretation of (66) in which the time of the marriage is located somewhere between the time of the search and the speech time is an instance of "forward shifted reading" in Abusch's terms.

[31] Transpositional contexts are contexts in which the ST rule can apply.

only applies to a tense which appears within an intensional argument of a verb in the past tense. However, it is hard to show that being in an intensional context is a necessary condition for the ST phenomenon, and Abusch concedes at the end of her paper that there is no way of distinguishing her theory and a theory like Ladusaw's, which simply makes reference to scope relationships among tenses at LF in order to define ST contexts.

However, it is possible to test Abusch's hypothesis if we consider sentences which involve multiple embeddings:

(70) John met a man who would buy a fish which was still alive.

(70') John Past [$_{VP}$[$_{NP_k}$ a man who Ø woll [$_{VP}$ [$_{NP_i}$ a fish which Ø be still alive] [$_{VP}$ buy e_i]][$_{VP}$ meet e_k]]

According to the native speakers that I consulted, (70) is unacceptable if it is uttered in a situation where the man will buy a living fish tomorrow. The LF structure for this reading is indicated in (70') above. (70) does not contain any opacity inducing expressions, and this could be the reason that (70) is rejected by native speakers under the intended reading. Note that (70) is quite similar to (71), which is acceptable for the reading that the LF structure (71') represents, except that (71) contains an indirect discourse verb *say*:

(71) John said that he would buy a fish which was still alive.

(71') John Past say that he Ø woll [$_{VP}$ [$_{NPi}$ a fish which Ø be still alive] [$_{VP}$ buy e_i]]

But the data are murky. Consider the following example:

(72) John looked for a man who would buy a fish which was still alive.

If we follow Abusch's hypothesis, we expect that (72) can receive the intended simultaneous reading (i.e. the time of the man's buying a fish is after the speech time and is simultaneous with the fish's being alive) if and only if the NP receives a de dicto interpretation. However, the native speakers that I consulted reported that the sentence is marginal even with a de dicto interpretation. Jim Barnett (p.c.) hypothesizes that an indirect discourse context triggers the ST phenomenon, not an intensional context. According to his intuitions, (72) sounds slightly better with a de dicto interpretation because this reading allows us to imagine a situation in which John actually said "I am looking for a man who will buy a fish which is still alive". However, it is not clear whether intensionality (or an indirect discourse verb) is absolutely necessary in order to create a ST context. Consider the following example (p.c. Sue Schmerling):

(73) Last year the U.S. and Canada signed an agreement to go into effect next year that would have as a consequence that imports from each country would sell for the price they had in a free market.

(73) seems to involve no opacity inducing expression, but it can receive an interpretation in which the time at which imports are sold is subsequent to the speech time and is simultaneous with the time of their having the price in a free market.

Given the fact that no clear generalization emerges from the above examples, I simply assume that scope relationships holding among tenses at LF determine ST contexts.

2.3. Alternatives to a Sequence-of-Tense Theory

Many linguists feel that the sequence of tense rule is unattractive since it is construed as a "surface" transformational operation which is completely ignored in the semantic component. Thus, some alternative approaches have been suggested in the literature. From now on, we will refer to such approaches as non-ST theories (meaning theories which do not posit a ST rule). Before I discuss individual proposals, let us consider what ingredients a non-ST theory must possess.

Let us assume the GB framework. As was discussed above, the traditional ST rule can be implemented in various ways. I assume here that a non-ST theory is substantially different from any of them in that no special rule is posited which is specifically designed to take care of the ST phenomenon. Therefore, as far as tense forms are concerned, the D-structure form and the LF representation of (74a) (for a simultaneous reading) are no different from (74a) itself. For example, the LF representation of (74a), which is subject to interpretation, looks like (74b):

(74a) John said that Mary was sick.

(74b) John Past say that Mary Past be sick

(75) non-ST theory (English)

D-structure

↓

S-structure → L(ogical) F(orm)

↓

P(honetic) F(orm)

[No ST rule posited anywhere in the grammar]

The proponent of this theory must show, for example, that the LF representation (74b), which is no different from the surface form (74a) is sufficient to predict the simultaneous reading that (74a) in fact has. The proponent of a non-ST theory must also show that there is a principled way of accounting for the behavior of tense morphemes in languages like Japanese, which does not have a ST phenomenon.

As we shall see below, however, non-ST theories are inadequate even if we restrict our attention to English; it cannot provide an adequate semantic system which accounts for the English data, the ST phenomenon in particular. I will discuss three concrete proposals: one by Enç, another by Reichenbach and Smith, and a third by myself.

2.3.1. Enç (1987)
2.3.1.1. Preliminaries

Enç (1987) proposes a theory which is one instance of a non-ST theory. Her theory is based upon a referential approach to temporal phenomena in general. In her earlier work (Enç 1981, 1986), Enç argued that the temporal properties of nouns do not depend upon syntactically higher tenses. For example, the sentence (76a) has two scopally-ambiguous interpretations (given here as (76b) and (76c)) under the standard analysis of tenses. Following Enç's original (1986: 407), I will not add "reference times" in the translations:

(76a) All rich men were obnoxious children.

(76b) $\forall x$ [rich-man' (x) $\rightarrow \exists t$[PAST (t) & AT (t, obnoxious-child' (x))]]

(76c) $\exists t$[PAST (t) & AT (t, $\forall x$[rich-man' (x) $\rightarrow$ obnoxious-child' (x)])]

Enç points out that neither of these two translations captures one interpretation that (76a) has: all the current and former rich men used to be obnoxious children. (76b) only involves the current rich men, and (76c) only involves rich men in the past.[32] This seem to show that the current system must be modified in some way. Enç assumes that nouns are indexical expressions and that their temporal interpretation is determined by contexts. She posits one extra argument place for nouns, which is occupied by a temporal argument.

There are many possible ways of treating the rest of the system. One way is to preserve the idea that tense morphemes have quantificational force:

(77) $\forall x$ [rich-man' (t', x) $\rightarrow \exists t$[PAST (t) & be-obnoxious-child' (t, x))]]

[32] (76c) has an additional problem in that the time of being rich is predicted to be the same as the time of being an obnoxious child.

I translated the verb *be* and the predicate nominal together as a predicate whose temporal interpretation is dictated by the interpretation of the tense. t' in the formula is a free time variable, whose denotation is fixed by the context. I assume the following interpretation rule for the two-place predicate rich-man':[33]

(78) $[\![\text{rich-man}'(t', x)]\!]^{M,w,t,g} = 1$ iff g(x) is a rich man in w at g(t')

Thus, the time index is ignored in interpreting the predicate rich-man'. Now, if this is the right way of understanding Enç's position, the new proposal does not help solve the problem that she has raised. The only interpretation available to (77) requires that all the relevant men be rich men simultaneously. Thus, the reading that Enç is interested in, i.e. the one which involves the past as well as the current rich men, is not obtainable.[34]

There is another way of setting up the whole semantic system. Assuming that

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[33] Similarly for be-obnoxious'.

[34] Moreover, for a given individual the time of being a rich man and the time of being an obnoxious child are predicted to be unordered with respect to each other. But, in fact the time of being a rich man *must be subsequent* to the time of being an obnoxious child. For example, the following sentence is not as good as (a):

(a) ?? In the 19th century, all obnoxious children were rich men.

The intended interpretation is that in the 19th century, all obnoxious children became rich men later in their lives. I am inclined to believe that the past tense (a) means something like *used to* and the sentence as a whole is a generic sentence. This account is not complete, however. It does not account for the reason why (b) does not talk about future rich men, whereas (c) seems to cover future dogs as well.

(b) All rich men used to be obnoxious children.
(c) Dogs are faithful animals.

her semantic analysis of nouns is on the right track, Enç further argues that a tense morpheme should be analyzed essentially in the same way: as a free time variable occupying a special argument position of a verb and a restriction upon the interpretation of the variable. Enç's proposal is based upon her claim that only verbs and nouns are time-sensitive (Enç 1986). She claims that instead of determining the denotation of every expression relative to a world and a time, we should evaluate all expressions relative to a world only and add a time element as an extra argument of a predicate in the object language only when it is needed for the interpretation of this predicate. In Chapter 1, we discussed a system in which tense morphemes are treated in this way. We now treat nouns in essentially the same way. If we follow Enç's proposal strictly, there is no time index with respect to which the temporal interpretation of an expression is determined. Therefore, the semantic rule for the predicate PAST must also be revised:

(79) $[\![\text{PAST (t)}]\!]^{M,w,c,g} = 1$ iff $g(t) < t_c$ where t_c is the time of the context. (where c stands for context)

In such a system, (76a) is analyzed as follows:

(80) $\forall x$ [rich-man' (t', x) $\rightarrow$ [PAST (t) & obnoxious-child' (t, x)]]

As far as the interpretation of the noun is concerned, this system makes exactly the same prediction as the first system given above. The two systems differ as to the interpretation of the predicate obnoxious'. The first system allowed the time of being an obnoxious child to differ from one person to another. By contrast, the current system only allows the time of being an obnoxious child to be the same for all the relevant individuals. This adds another problem to the one that I have already pointed out in connection with the first system.

The "under-generation" problem I have just pointed out is solved if we preserve the quantificational force of tense morphemes and introduce another existential quantifier which binds the time variable occupying the temporal argument position of rich-man':[35]

(81) $\forall x[\exists t' \text{ [rich-man' } (t', x)] \rightarrow \exists t[\text{PAST } (t) \ \& \text{ obnoxious-child' } (t, x)]]$

This fact raises a question as to the validity of the referential approach to temporal phenomena in general. This does not mean, however, that introducing an existential quantifier with restricted scope for each noun solves the problem completely. One problem is that the interpretation (81) provides is too permissive: (i) it allows the time of being a rich man to be subsequent to the speech time, and (ii) the order of being a rich man and being an obnoxious child is unspecified. The first problem is "solved" by introducing a new predicate of times NON-FUT as in (82):

[35] This observation is due to Irene Heim (p.c.).

(82) $\forall x[\exists t' [\text{NON-FUT}(t') \,\&\, \text{rich-man}'(t', x)] \rightarrow \exists t[\text{PAST}(t) \,\&\, \text{obnoxious-child}'(t, x)]]$

[N.B. $[\![\text{NON-FUT}(t')]\!]^{M,w,t,g} = 1$ iff $[\![t']\!]^{M,w,t,g} \leq t$]

When overt "temporal adjectives" like *former* and *later* restrict the temporal interpretation of the common noun that they modify, this approach may be justifiable. However, when there is no overt adjective, there is no explanation as to why predicates of times such as NON-FUT must be introduced.[36]

Without having an explicit way of constraining the readings, I remain agnostic as far as temporal interpretations of nouns without "temporal adjectives" are concerned and simply assume that the temporal interpretations of nouns are determined by the temporal index. This should not be taken to mean that this conservative position is defensible in the face of the data Enç discusses. I wish to leave it as a future problem.

2.3.1.2. Discussion

Enç's (1987) alternative account of the ST phenomenon is essentially an extension of the line of research set forth by Partee (1973). Enç argues that the idea that tenses are referential expressions on a par with pronouns accounts for the ST

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[36] The following formula takes care of the second problem:

(a) $\forall x[\exists t'[[\text{NON-FUT}(t') \,\&\, \text{rich-man}'(t', x)] \rightarrow \exists t[t < t' \,\&\, \text{obnoxious-child}'(t, x)]]]$

However, it is not clear how this translation is arrived at in a compositional manner. Perhaps, this problem is unique to the copula construction, and I will not be concerned with it in the remainder of the dissertation.

phenomenon. More specifically, she assumes that verbs and nouns have one extra argument position reserved for intervals. If we assume as proposed above that these special argument positions are occupied by free time variables and that their values are assigned by the context in which they occur, a question arises as to how the values of these free time variables are determined because the values that they can assume are highly constrained. The "anchoring conditions for tense", which Enç proposes, can be thought of as restrictions imposed by syntax upon the possible range of values that the free time variables can assume. In particular, these conditions are claimed to take care of the ST phenomenon in English.

Let us examine Enç's proposal in detail. She assumes that tenses obligatorily carry a temporal index and that COMP's optionally carry a temporal index. We assume that indices on tenses denote intervals, which are values assigned to the free time variables serving as temporal arguments of verbs in the logical representation. She defines the local COMP of a tense α in the following way:

(83) A COMP β is the local COMP of a tense α iff β governs α. (Enç's (25))

Enç defines government in such a way that the local COMP of a tense is the COMP of the minimal clause in which the tense occurs. For example, the COMPβ is the local COMP of the tense α in the following structure:[37]

[37] Here, government is defined in terms of head government. The head (a category of type X^0) of a certain maximal projection is assumed to govern its complement and the head of the complement. For example, in a verb complement clause, the COMP of the complement clause governs the Infl Phrase (= the complement clause) and its

(84) $[_{S'}$ COMP $[_S$ NP Tns V $[_{S'}$ COMPβ $[_S$NP Tnsα VP]]]]

Enç specifies a restriction on denotations of tenses in the following way:

(85a) Where α is a past tense and β is a COMP with a temporal index and β is the local COMP of α, $\|\alpha\|$ is an interval T such that every moment t in T precedes every moment t' in $\|\beta\|$.

(85b) Where α is a present tense and β is a COMP with a temporal index and β is the local COMP of α, $\|\alpha\|$ is an interval T such that T = $\|\beta\|$.

If all COMP's carried a temporal index, the above rules would predict just those readings that do not involve the ST phenomenon.

In order to predict "simultaneous readings" discussed above, Enç introduces the Anchoring Principle, which is given immediately below:

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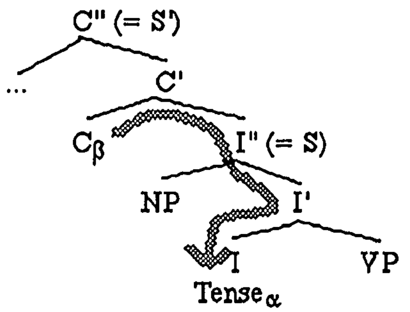
head (i.e. Infl). Assuming that tense is a feature or constituent of Infl, Enç argues that the COMP also governs the tense (though this may not be so uncontroversial as Enç assumes). Schematically, a tense α is governed by its local COMP β in the following manner:



(86) Each tense must be anchored. (Enç's (26))

The following Anchoring Conditions tell us what it means for a tense to be anchored:

(87a) Tense is anchored if it is bound in its governing category, or if its local COMP is anchored. Otherwise, it is unanchored.

(87b) If COMP has a governing category, it is anchored iff it is bound within its governing category.

(87c) If COMP does not have a governing category, it is anchored iff it denotes the speech time.

Put simply, the anchoring conditions are a set of licensing conditions for tense morphemes. A tense can be anchored in one of two ways: (i) the tense itself is anchored or (ii) its local COMP is anchored. (i) covers the ST phenomenon, whereas (ii) covers other cases. I assume that temporal indices are like referential indices for NP's and that if a tense is bound by another tense, this is taken to mean that they are "coreferential" or "the same variables". For our purposes, it is sufficient to assume that if a tense is bound by another tense, they are translated as free variables picked up by the same contextually salient time.

According to Enç's proposal, simultaneous readings are available when a tense is directly bound by another tense. The idea is that the ST phenomenon is claimed to be an instance of coreference analogous to the case of pronouns. Since a past tense occurring in a verb complement clause can denote a time simultaneous with the time denoted by the past tense of the immediately higher clause, the system should predict that the governing category for the embedded verb is the higher sentence so that the higher tense can bind the lower one. Enç defines governing category in such a way that this is correctly predicted.[38]

Let us present an example and see how Enç's anchoring conditions work. There are two ways in which a tense can be anchored: (i) a tense is bound in its governing category, or (ii) its local COMP is anchored.

(88) John said that Mary was ill

Let us consider the matrix tense first. According to the above proposal, a matrix tense has no governing category.[39] This, in turn, means that it is anchored iff its local COMP is anchored. Since the matrix COMP (i.e. the local COMP of the matrix tense) has no governing category, it denotes the speech time. Hence, the anchoring conditions predict that the time of the matrix verb is always located in relation to the speech time, as desired. Thus, the matrix past tense must denote an interval prior to the speech time:

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[38] Enç assumes Chomsky's Barriers approach (Chomsky 1986), where the governing category is defined as the Complete Functional Complex containing the governor. This allows her to define the governing category as a domain where the governor of tense (COMP) is in the scope of the subject. Thus, the governing category for a complement tense is the domain which contains a subject that c-commands the governor, i.e., the matrix S. (In the LGB (Chomsky 1981) approach, on the other hand, SUBJECT is not required to be accessible to the governor.)

[39] There is no governing category for a matrix tense since its governor, the matrix COMP is not c-commanded by a subject.

(88') COMP$_{\emptyset}$ John Past$_t$ say that Mary Past be ill

where Ø indicates the speech time and t < Ø

On the other hand, the embedded tense can be anchored in two ways. The governing category of the embedded tense is the matrix clause, and the embedded tense can satisfy the anchoring conditions by being bound by the matrix tense:

(89) COMP$_{\emptyset}$ John Past$_t$ say that Mary Past$_t$ be ill

where Ø indicates the speech time and t < Ø

Enç does not make the intended semantic interpretation of the indices explicit. Given the fact that the matrix past tense and the embedded past tense are coindexed, I formally represent the reading of (88) indicated by the above indexing in the following way:

(90) PAST (t) & AT (t, say' (j, ^ AT (t, ill' (m))))

A second option is to anchor the local COMP. When a local COMP is anchored, it carries a temporal index. Thus, the above restriction on temporal denotations of tenses is activated. (Note that (85a) and (85b) have a condition which says "[where] β is a COMP with a temporal index.") However, (87a) does not tell us what it means for a local COMP to be anchored. Thus, we must go to (87b-c). (87b) says that if COMP has a governing category (i.e., if COMP is not the COMP of the matrix), it is anchored iff it is bound within its governing category. For example, the embedded COMP in (88) can be anchored by being bound by the matrix tense, as (91) shows:

(91) $COMP_{\emptyset}$ John $Past_t$ say $that_t$ Mary Past be ill
where Ø indicates the speech time and $t < \emptyset$

At this point, rule (85a) applies and assigns a time prior to *t* to the embedded tense since the past tense in the complement clause must denote an interval earlier than the interval denoted by the local COMP:

(92) $COMP_{\emptyset}$ John $Past_t$ say $that_t$ Mary $Past_{t'}$ be ill
where Ø indicates the speech time and $t' < t < \emptyset$

This predicts the shifted reading of (88).

The anchoring conditions as given above have one obvious problem: they do not say what binder-bindee combinations are permitted. Therefore, a past tense can presumably bind a present tense and vice versa. Obviously, this is empirically undesirable as (93) demonstrates:

(93) John $knows_t$ that Mary was_t in London.

The indexing given above is legal and is predicted to have a simultaneous reading, which is in fact unavailable. Enç modifies the definition of "local COMP" in order to solve this problem:

(94) A COMP β is the [sic] local COMP of a tense α iff β governs α or β governs a tense γ and γ binds α.[40]

(94) says that the bindee inherits the binder's local COMP. In (93), the highest local COMP of the embedded tense (= the local COMP of the matrix tense) denotes the speech time. Thus, the past tense in the embedded clause is required to denote a time prior to the speech time. On the other hand, since it is bound by the matrix tense, it needs to denote the same time as the matrix tense denotes, which is the speech time. There is no way that the embedded past tense satisfies both of these two requirements, and (93) is ruled out as uninterpretable.

The revised definition of a local COMP tightens the conditions for tense bindings. Under the new definition, tense-bindings are permitted only if a sequence of tense-bindings contains a syntactically highest tense whose local COMP has a temporal index and this COMP is also a local COMP of all the lower tenses. This requires that all the tenses of a given sequence of tense-bindings consist of occurrences of the same tense (i.e. present or past), as a contradiction would result

[40] It seems that the new definition of "local COMP" allows a tense to have more than one local COMP, as the disjunction in the definition shows. Thus, "the local COMP of a tense α" in the definition should be replaced by "a local COMP of a tense α", instead. For example, the embedded tense in (93) has two local COMP's: the matrix COMP and the lower COMP. It is clear that the highest local COMP (which is necessarily indexed) is the one we should focus on.

otherwise. Consider the following schematic example:

(95) $[_{COMP\emptyset}\ [_S \ldots Past_t \ldots [_{S'} \ldots Past_t \ldots [_{S'} \ldots Past_t \ldots]]]]$ where t < the speech time

In (95) a sequence of tense-bindings ends with the matrix past tense which denotes a time prior to the speech time, which the matrix COMP denotes. The matrix COMP is a local COMP of all the three occurrences of the past tense morpheme, according to the revised definition of a local COMP. Since an occurrence of the past tense morpheme is required to denote a time prior to the time that its local COMP denotes, all the occurrences of the past tense morpheme in (95) are capable of denoting *t*, which is prior to the speech time. Thus, sentences that conform to this schema are well-formed. On the other hand, the following configurations lead to a contradiction:

(96a) $*[_{COMP\emptyset}\ [_S \ldots Pres_t \ldots [_{S'} \ldots Past_t \ldots]]]$

(96b) $*[_{COMP\emptyset}\ [_S \ldots Past_t \ldots [_{S'} \ldots Pres_t \ldots]]]$

In (96a) a past tense is bound by a present tense. Since the matrix COMP is the local COMP of the matrix present tense, the present tense is required to denote the speech time. On the other hand, the matrix COMP is a local COMP of the embedded past tense as well. Therefore, the past tense must denote a time prior to the speech time. Thus, the two tense morphemes are required to denote the same time, and yet they are co-indexed. This is a contradiction. The same is true of (96b).

Enç's approach has potential advantages over the traditional ST theory. First, by treating the ST phenomenon as a case of tense-binding, Enç can offer one possible rationale for the ST phenomenon. The lower past tenses of (95), for example, denote the same time as the highest tense. The past tenses in the lower clauses are licensed because every one of them acts like a "real past tense" in relation to the highest COMP. This is potentially an effective argument against the traditional approach to the ST phenomenon. This revised definition of "local COMP" requires that when a tense binds another tense, the bindee also acts like a real tense in relation to the local COMP of the binder since it is a local COMP of the bindee as well. Thus, any occurrence of the past tense morpheme in English is predicted to mean "past of the time denoted by its highest local COMP". Enç's framework seems attractive because it removes the need to posit a ST rule which is semantically unmotivated. Unfortunately, this revised theory of Enç's has empirical problems.

A major drawback of Enç's proposal as I understand it is that it does not consider cases involving the future auxiliary *will.* Consider the following example due to Lee Baker (p.c.):

(97) I told Bill that you would say that *you only had three magic tricks to do,* but it looks as if you have brought enough equipment to do six or seven.

Suppose that (97) is uttered by John at 3 p.m. when the addressee has just arrived with equipment for magic tricks to be performed at 7 p.m. on the same day. The point of this example is that the time of your saying can be subsequent to the speech time, and the time of your having can be interpreted to be *simultaneous* with the time of your saying. Let us concentrate upon this particular reading and see if Enç's proposal can account for it.

Enç (1987) does not deal with the future tense auxiliary *will*, and she seems to believe that the behavior of the future auxiliary *will* patterns with other modal verbs and, hence, should be treated independently of the past tense morpheme *-ed*.[41] If we follow her idea literally, the future auxiliary in the intermediate clause in (97) is ignored. If we did this, however, we would not know how to deal with the past tense in the lowest clause (henceforth γ). It is clear that coindexing the past tense in the matrix (henceforth α) and γ does not provide us with the right interpretation because the time of my telling is not required to be simultaneous with the time of your having three magic tricks to do:

(98) I $Past_t$ tell Bill that you would say that *you only* $Past_t$ *have three magic tricks to do*, ...

This means that we cannot afford to ignore the future auxiliary in constructing a theory of temporal reference for English and that Enç's theory must be modified. The following is my attempt to make Enç's theory empirically adequate without abandoning her basic idea.

Let us try the standard morphological analysis of *would* and assume that it

41 Enç says in the footnote 2 of Enç (1987) that the temporal properties of *will* pattern with other modals, rather than with tenses.

consists of a past tense (henceforth β) and *woll* (the underlying form of the future auxiliary). Since β is a tense, we are allowed to index it. The following indexing possibility is doomed:

(99) I Past_t tell Bill that you Past_t woll say that *you only* $\textit{Past}_t$ *have three magic tricks to do, ...*

This indexing option co-indexes the three tenses, α, β, and γ, and ignores the semantic contribution of *woll* completely. In other words, *t* in the intermediate clause is assumed to be the temporal argument of the verb *say* and indicates the "time of saying". This indexing is obviously problematic since the time of my telling, the time of your saying, and the time of your having are claimed to be simultaneous with each other, and this is impossible.[42] The following options give us equally bad results:

(100a) I Past_t tell Bill that_t you $\text{Past}_{t'}$ woll say that *you only* $\textit{Past}_{t'}$ *have three magic tricks to do, ...*
where $t' < t$

[42] Another possible interpretation would be that the past tense on *would* denotes the time with respect to which the temporal location of the future auxiliary *woll* is determined. We further assume that *woll* has an index on its own which denotes an interval later than the tense on it denotes. This indexing represents a possible interpretation (although it is intuitively a wrong way of predicting this particular reading). But, the intended interpretation cannot be predicted:

(a) I PST_t tell Bill that you PST_t $\text{woll}_{t'}$ say that *you only* $\textit{PST}_t$ *have three magic tricks to do, ...*
where $t < t'$

(100b) I Past_t tell Bill that_t you $\text{Past}_{t'}$ woll say that *you only Past* $_{t''}$ *have three magic tricks to do*, ...
where t' < t and t'' < t'

Regardless of how *woll* is interpreted (not indicated above), both (100a) and (100b) produce either anomalous interpretations or readings that do exist but are predicted by Enç's theory only accidentally.

It is intuitively obvious why the above attempts failed: they ignored the semantic contribution of the future auxiliary (i.e. *woll*). In an attempt to obtain the intended interpretation, we might adopt the following indexing:

(101) I Past_t tell Bill that you Past_t $\text{woll}_{t'}$ say that *you only Past* $_{t'}$ *have three magic tricks to do*, ...
where t < t'

Here, *woll* is interpreted as a future tense morpheme. So it can bind another tense as well. This seems to be more in line with our intuitions. The simultaneous reading that we are interested in is represented by assigning the same index to *had* and *woll* as in (101). Assuming that the index on *woll* is the temporal argument of *say*, the above indexing predicts that the time of your saying is simultaneous with the time of your having three magic tricks. Since *woll* is a tense, it must have a local COMP. We will assume that β acts as the local COMP of *woll* in this case and *woll* denotes some time subsequent to the time that the "local COMP" denotes. (Generally, assume that the tense on *woll* acts like its local COMP.) Now, it looks as if the desired reading is indicated by the indexing represented in (101).

There is a flaw in this argument. *woll* must denote a time later than its local COMP, i.e. the tense on *woll*, because it is a future tense. On the other hand, γ is bound by *woll*, so the local COMP of *woll* is also a local COMP of γ according to (94). Thus, γ must denote a time which is earlier than its highest local COMP, i.e. the past tense on *woll*. Nevertheless, *woll* and γ are required to denote the same time. Clearly, this is a contradiction. A special provision is necessary to circumvent the problem. One possibility is to stipulate the following: *woll* denotes a time subsequent to the time which its own tense denotes, but it has no local COMP. Perhaps, this is more desirable since the tense on *woll* is not a COMP after all. Since the restriction on binding possibilities imposed by (94) no longer applies to *woll*, *woll* can now bind any tense. For example, both *had* in (102a) and *have* in (102b) are predicted to be acceptable for a simultaneous reading.

(102a) I Past_t tell Bill that you Past_t $\text{woll}_{t'}$ say that *you only* $\textit{Past}_{t'}$ *have three magic tricks to do, ...*
where $t < t'$

(102b) I Past_t tell Bill that you Past_t $\text{woll}_{t'}$ say that *you only* $\textit{Pres}_{t'}$ *have three magic tricks to do, ...*
where $t < t'$

The prediction is borne out with respect to (102a), where the past tense on *had* is bound by *will*. It is not clear what (102b) means, but we will not be concerned with some potential problems associated with its interpretation.[43, 44]

We find a serious problem with the above proposal when we look further. If we change *would* into its present tense counterpart: i.e. *will*, the simultaneous reading of *had* disappears. That is, the reading represented by the following indexing is illicit:

(103) #I $told_t$ Bill that you $Pres_{t'}$ $woll_{t''}$ say that <u>you only $had_{t''}$ three magic tricks to do,</u> ...

where t < utterance time, t' = utterance time, and t'' > t'

However, the proposal under discussion fails to predict this fact. Now, we must explain the fact that the tense on *woll* influences the temporal interpretation of *had*. The descriptive generalization is the following: *woll* is allowed to bind a past tense iff

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43 (102b) seems to have a reading which resembles the so-called double-access reading associated with a present tense embedded under a past tense (to be discussed in detail in Chapter 4). The difference between the past tense and the present tense in the lowest clause is clearer in the following example (adapted from Abusch's (1988) example):

(a) John decided that he would say to his mother that they were/are having their last meal together.

It seems that the present tense version has the speech-time orientedness associated with double-access sentences, whereas the past tense version only allows purely simultaneous or shifted readings.

44 There is another reading in which *had* denotes a time prior to the time the COMP that governs it denotes:

(a) I $told_t$ Bill that you $Past_t$ $woll_{t'}$ say $that_{t'}$ *you only* $had_{t''}$ *three magic tricks to do*, ...

where t < t' and t'' < t'

it is accompanied by a past tense morpheme.

Now, let us remind ourselves the basic intuition behind Enç's proposal about the ST phenomenon. A past tense α can be bound by another past tense β iff α acts like a "real past tense" in relation to a well-defined temporal point, i.e. the time that the highest local COMP denotes. However, this is not the case. In (93), the time that the past tense on *had* denotes is not earlier than any relevant time mentioned in the sentence. Rather, the correct empirical generalization is that a tense **A** can be bound by *woll* iff the latter is accompanied by a tense morpheme **B** and **A** and **B** are occurrences of the same tense. This shows that binding possibilities are controlled by the morphological forms of the tenses involved, not by their temporal interpretations. I do not see any way of rectifying Enç's proposal without abandoning the basic idea contained in it.

One possible solution is not to analyze *will* and *would* morphologically and to stipulate their difference in behavior: *will* is a future tense auxiliary which denotes a time subsequent to the speech time, and *would* is a future tense auxiliary which denotes a time after the time that the immediately higher tense denotes. At this point, we must stipulate that *will* can only bind a present tense but *would* can bind a past tense.[45] We could leave this contrast as a stipulation, but it is puzzling why there is such a contrast. There is a clear relationship between the tense on *woll* and the type of tense that *woll* can bind. If so, encoding this fact as a stipulation leaves an

[45] As pointed out above, there is a question as to whether *would* can bind a present tense. This is not irrelevant to our concern, but regardless of whether it is a genuine simultaneous reading, the solid contrast between *will* and *would* that I have just pointed out establishes the difference between them.

important generalization unexplained.

The same point can be made with infinitive clauses. Some verbs such as *promise* produce a "future interpretation" in their infinitival complements. Consider the following example:

(104) John promised to say that he did not know anything about the crime.

Here the time of saying is located in the future of the time of promising. We refer to this type of interpretation as a "future interpretation" of an infinitival clause. (104) can receive an interpretation in which the time of John's not knowing anything about the crime is simultaneous with his saying and this time is in the future of the speech time. Note that this simultaneous interpretation is ruled out when the matrix is in the future tense:

(105) John will promise to say that he did not know anything about the crime.

(105) does not allow the reading in which the time of John's saying is simultaneous with the time of his not knowing anything about the crime. (104) and (105) show that whether or not the temporal argument of *say* can denote the same time as the temporal argument of *know* depends upon the tense form of the matrix clause, not upon the semantic behavior of *to say*. Note that in both (104) and (105) *to say* has a "future interpretation" (in that the time of saying is in the future of the time of promising). The only difference between (104) and (105) is the tense form in the

matrix clause. It is clear that this state of affairs is problematic for Enç's original proposal or any of its revised versions considered above.

2.3.2. Reichenbach (1947) and Smith (1978)

Reichenbach's theory has been discussed in the literature primarily in connection with the temporal semantics of simple sentences. However, his theory makes interesting predictions about tense interpretations in complement clauses as well. In particular, the "permanence of the reference point" that he proposes to account for the ST phenomenon is worthy of attention (Reichenbach 1947: 293):

(106) When several sentences are combined to form a compound sentence, the tenses of the various clauses are adjusted to one another by certain rules which the grammarians call the rules of the *sequence of tenses.* We can interpret these rules as the principle that, although the events referred to in the clauses may occupy different time points, the reference point should be the same for all clauses -- a principle which, we shall say, demands *the permanence of the reference point.* Thus, the tenses of the sentence, 'I had mailed the letter when John came and told me the news', may be diagramed as follows:

1st clause:	E1 --	R1	-- S
2nd clause:		R2, E2	-- S
3rd clause:		R3, E3	-- S

In order to make the permanence of the reference point an empirical claim about tense morphemes in English, we must have an independent means of establishing temporal relationships among E, R, and S. Let us assume the following algorithm for this purpose:

(107) present tense (absence of -ed) → R is simultaneous with S

past tense (presence of -ed) → R precedes S

the presence of the future auxiliary (woll) → E follows R

the absence of the future auxiliary → E is simultaneous with R

the absence of the perfect → E is simultaneous with R

the presence of the perfect → E precedes R

It should be noted that (107) is an algorithm which was abandoned in Chapter 1 because of the contradiction that it contained: when the future auxiliary *woll* and the perfect co-occur, the above rules instruct us to do two things that are incompatible. The revised version proposed in Chapter 1 involves a new temporal entity which we tentatively called the "quasi-reference point" and cannot be used in this context because Reichenbach's proposal about the ST presupposes only three temporal entities (i.e. S, R, and E). It may be concluded at this point that a proposal which works in conjunction with a contradictory algorithm is doomed to a failure. I will show in what follows, however, that even if we restrict our attention to sentences which do not involve the cooccurrence of the future auxiliary and the perfect in the same clause, the permanence of the reference point as proposed by Reichenbach faces some problems.

As far as simple examples are concerned, Reichenbach's permanence of the reference point works well. Consider the following example:

(108) John said that Mary was sick.

The above algorithm tells us the following: (i) the R for the matrix is in the past of the speech time, and the E for the matrix is simultaneous with the R; (ii) the R for the complement is located in the past of the speech time, and the E for the complement is simultaneous with the R. The permanence of the reference point requires that the two R's be simultaneous. Thus, we obtain the following diagram for (108):

(109) matrix: R, E -- S
|
embedded: R, E -- S

This diagram is in fact what we want: it predicts a simultaneous reading for (108). The shifted interpretation of (110) is also predicted correctly:

(110) John said that Mary had bought a car.

1st clause: R, E -- S
|
2nd clause: E -- R

The perfect in (110) is used to show that the event time in the complement precedes the reference time. Since the event time for the matrix is simultaneous with R, it follows that the time of Mary's buying a car precedes the time of John's saying.

In this way, the permanence of the reference point combined with the algorithm given above has the effect of triggering the ST phenomenon. If successful, Reichenbach's proposal accounts for the ST phenomenon in an explanatory manner: the reference time, which can be interpreted as a contextually salient time, is constant for a given sentence seems to have an intuitive appeal. I will give some examples that Reichenbach himself cites (p. 293). (111a) involves a temporal adverbial clause, while (111b) involves a verb complement clause:[46]

(111a) I had mailed the letter when John came and told me the news.

1st clause:	E1 --	R1 --	S
2nd clause:		R2, E2 --	S
3rd clause:		R2, E3 --	S

(111b) I did not know that you would be here.

1st clause:	R1, E1	--	S
2nd clause:	R2	--	S, E2

In (111a), the reference time is the time of John's coming and his telling me the news. The past tense morpheme appearing in each clause establishes the reference time. The perfect used in the main clause establishes the event time for my mailing the letter, which is prior to the reference time. The permanence of the reference point guarantees that the time of mailing the letter precedes the time of John's coming and telling me the news. (111b) is an example involving a verb complement clause. The future auxiliary *would* is assumed to be composed of a past tense morpheme and *woll*; the past tense signifies the location of the reference point, while the future auxiliary *woll* means that E is subsequent to R.[47]

46 The diagrams as well as the examples are Reichenbach's.

47 Although Reichenbach employs an example which strongly suggests that E2 and S are simultaneous and the above diagram (his own) suggest this to be the intended

The problems with the permanence of the reference point of Reichenbach are clear when we examine more complex examples like the following:[48]

(112) [$_{S1}$John decided a week ago that [$_{S2}$in ten days at breakfast he would say to his mother that [$_{S3}$they were having their last meal together]]].

According to the permanence of the reference point, (112) is predicated to have the following interpretation:

$$
\begin{array}{lll}
\text{(113) S1:} & \text{R, E ---} & \text{S} \\
 & \quad | & \\
\text{S2:} & \text{R --- E} & \\
 & \quad | & \\
\text{S3:} & \text{R, E} &
\end{array}
$$

The intended interpretation is the one in which the time of their having their last meal together is simultaneous with the time of his saying to his mother. However, the permanence of the reference point does not predict this to be a possible reading. As the diagram shows, the prediction is that the time of their having their last meal is

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meaning of (111b), this should not be taken to be an integral part of the temporal meaning contributed by *woll.* For example, the following example, which employs exactly the same tenses, does not require (or does not even suggest) that the event time of the embedded clause is simultaneous with the speech time; it is simply subsequent to R:

(a) John said that Mary would buy a car.

48 (112) is due to Abusch (1988). It is of the same nature as Lee Baker's "magic trick" sentence cited above. Kamp and Rohrer (ms.) present similar examples in French.

simultaneous with the time of deciding. This is subsumed under the shifted reading for the past tense in the lowest clause, but only accidentally. The interpretation that we are interested in can be predicted within the framework under consideration, only if the permanence of the reference point and the algorithm for a past tense morpheme are abandoned. As far as I can see, this undermines the basic motivation for Reichenbach's approach to the ST phenomenon. The diagram for the intended interpretation can be drawn if we allow the reference point for S3 to be simultaneous with the event time for S2, as in the following diagram:

(114)

```
S1:     R, E   ---          S
        |
S2:     R    --- E
                 |
S3:              R, E
```

It is obvious that the permanence of the reference point cannot account for the data.

Reichenbach (pp. 194-95) introduces a principle called "the positional use of the reference point" in addition to the permanence of the reference point. Reichenbach states:

(115)

When a time determination is added, such as is given by words like 'now' or 'yesterday', or by a nonreflexive symbol like 'November 7, 1944', it is referred, not to the event, but to the reference point of the sentence. We say, 'I met him yesterday'; that the word 'yesterday' refers here to the event obtains only because the points of reference and of event coincide. When we say, 'I had met him yesterday', what was yesterday is the reference point, and the meeting may have

> occurred the day before yesterday. We shall speak, therefore, of the positional use of the reference point; the reference point is used here as the carrier of the time position.

Reichenbach employs this principle to account for data that are not covered by the permanence of the reference point, but he does not give examples involving verb complements.[49] Since Lee Baker's example given above does not involve any adverbials, the positional use of the reference point does not help solve the problem. I conclude that Reichenbach's theory falls short of accounting for the ST phenomenon.

An alternative is to adopt the revised algorithm proposed in Chapter 1 in order to cope with the problem. This presupposes a revision of the permanence of the reference point as well because two reference-time-like entities are now involved. I will not pursue this possibility in this dissertation.

Following Reichenbach, Smith (1978) argues against the ST rule. She claims that two principles, the sharing principle and the orientation principle, serve to predict the correct temporal interpretations for English sentences, including those that involve verb complement clauses. The sharing principle does what Reichenbach's permanence of the reference point does: it says that the Reference point for the

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[49] He only provides examples involving the temporal conjunction *before* and the comparative conjunction *than* (p. 295):

(a) He telephoned before he came.
(b) He was healthier when I saw him than he is now.

Reichenbach gives the diagram (b') for (b):

(b')
1st clause: R_1, E_1 -- S
2nd clause: R_2, E_2 -- S
3rd clause: S, R_3,E_3

embedded clause can be the same as the reference point for the matrix. The orientation principle says that the Reference time for the embedded clause can be oriented to a time established by the matrix. More concretely, we can posit the following rules for the orientation principle:

(116) Present tense → R for the complement is simultaneous with R for the matrix

Past tense → R for the complement precedes R for the matrix

The orientation principle serves to predict the shifted interpretation of (118). Since Smith's sharing principle does the same job as Reichenbach's permanence of the reference point, the problems with the latter that I have already pointed out are also true of the former. Let us consider whether Smith's orientation principle can account for the data. Consider (112). The intended interpretation is that the time of John's saying is simultaneous with the time of their having their last dinner. Thus, the time of their having their last meal is subsequent to the time of John's deciding. However, what the orientation principle predicts is that the reference time for S_3 is prior to the reference point shared by S_1 and S_2. As the following diagram shows, this results in a reading in which the time of their meal is located before the time of John's deciding. This happens to be a possible reading of (112) (only accidentally), but it is not the reading under discussion:

(117) S_1: $R_1 < S; E_1 = R_1$

S_2: $R_2 = R_1; R_2 < E_2$

S_3: $R_3 < R_2, R_3 = E_3$

It seems that it is impossible to reformulate Smith's proposal to make it empirically adequate. The impasse of the approaches under consideration is of exactly the same nature as the problems with Enç's approach discussed earlier.

2.3.3. Another Non-ST Theory of Tense

In this sub-section, I will present my own attempt to provide a non-ST theory of temporal reference for English. I adopt a three-index system, which Dowty (1982) proposes at the end of his paper, but I modify it in such a way that the tense morpheme (*-ed*) and the future auxiliary (*will*) are treated independently with each having its own meaning.

2.3.3.1. Introduction

The need for a ST rule stems from the observation that some occurrences of the past tense morpheme in English do not mean "past of a certain well-defined temporal point" but mean "simultaneous with a certain well-defined temporal point". Thus, if the ST rule were to be abandoned, we would be committed to the following contention: the past tense in English always means "past of a certain well-defined temporal point". The following is one attempt to formulate a non-ST theory of tense for English which satisfies this criterion: the past tense morpheme always denotes a time prior to a "certain well-defined temporal point".

Arguing against a ST rule, one might entertain the following possibility: a past tense in English invariably means "past of something", presumably "past of the speech time". Take (118), for example:

(118) John claimed that Mary was in the room.

It is true under either of the two readings (simultaneous or shifted) to say that John's claiming and Mary's being in the room are temporally located in the past of the speech time. Thus, it seems plausible to say that the past tense in English means "past of the speech time". However, this simple idea is too good to be true as mentioned earlier.

Despite the fact that the complement clause is in the past tense, it is not sufficient to say that Mary's being in the room is in the past of the speech time. In (118), the time at which Mary is allegedly in the room must be either before or simultaneous with the time of John's claiming. Thus, (118) cannot be taken to mean that the time at which Mary is allegedly in the room is located somewhere between the time of John's claiming and the speech time. This shows that denoting a time prior to the speech time is not a sufficient condition for a past tense to be used felicitously. Second, note the following sentence in which a past tense is embedded under a future tense.

(119) John will claim that Mary was pregnant.

In this sentence, *will* in the main clause locates the time of claiming in the future of the speech time. The past tense in the complement indicates that the time of Mary's pregnancy is prior to the time of the claiming, but not necessarily before the speech time. Thus, a past tense morpheme does not need to denote a time prior to the speech time.

It seems, then, that we must dispose of the idea that the temporal denotation of a past tense morpheme in English is always determined relative to the speech time. However, there may be a way of saving the basic insight that the denotation of the past tense in English is determined in relation to the speech time. I propose a system which is designed to do just that.

2.3.3.2. Discussion

The system proposed here adopt a triple-index system proposed in Dowty (1982); however, its details are quite different from Dowty's original. In particular, the present system assumes that tense morphemes and the future auxiliary make independent contributions in figuring out the meaning of the sentence in which they occur, unlike Dowty's (1982) system.

I shall discuss my ideas informally first by giving some examples. Consider (120a) and (120b):

(120a) John claimed that Mary was in Austin.

(120b) John claimed that Mary would be in Austin.

John makes two different claims in (120a) and (120b). In (120a) the time at which Mary is allegedly in Austin is either simultaneous with the time of John's claim or prior to it. On the other hand, in (120b) this time must be subsequent to the time of John's claim. The crucial difference between (120a) and (120b) is the presence or absence of *woll.* The idea that I would like to pursue here is that the tense morpheme and the future auxiliary make independent contributions to the meaning of the sentence and that the absence of *woll* is semantically significant as well as its presence. What does *woll* mean? Our intuition is that *will* in (121) means that John's reading the book occurs at a time subsequent to the speech time, which is also the evaluation time in (121):

(121) John will read the book.

Let us assume that woll means "subsequent to the time of evaluation". Supposing that the absence of *woll* indicates the complement of what the presence of *woll* indicates, we hypothesize that the absence of *will* means "not subsequent to the time of evaluation".

If we extend this idea to cases like (120a), we obtain a desirable result. Suppose that we have decided to divide the denotations of tenses into those of tense morphemes and those of the future auxiliary. Furthermore, let us assume that the past tense feature [+past] means "the set of intervals prior to the speech time" and the future auxiliary feature [-fut] "the set of intervals not subsequent to the time of evaluation". Then, the denotation of the tense feature [+past] in the above example is the set of intervals prior to the speech time, and the denotation of the future auxiliary feature [-fut] is the set of intervals that are either simultaneous with or prior to John's claiming. If we intersect these two sets, we obtain the set of intervals which are either simultaneous with or prior to John's hearing. This predicts both a simultaneous reading and a shifted reading, since we would say that (120a) is true iff there is an interval which is simultaneous with or prior to John's claiming and at which Mary is in Austin (according to what John claimed). Thus, the two readings of (120a) are accounted for even though we assume simply that the past tense morpheme denotes some time before the speech time.

A second alleged problem for the claim that the past tense morpheme means "past of the speech time" is that sentences like (119) show that a past tense can denote an event that occurs in the future of the speech time. In order to solve this problem, I adopt a triple-index system similar to the one proposed by Dowty (1982). In this system, the denotation of an Auxiliary node containing a tense feature and a future auxiliary feature is determined in relation to three temporal indices: one is the so-called "evaluation-time index", the second one is the "quasi-speech time index", and the third the "real speech time index". It can be argued that a triple-index system is cumbersome, and I will not take a position on its overall desirability. However, we can say that a triple-index system is well-suited to represent the generalization that we wish to express here: i.e., the past tense in English denotes a time prior to the speech time. Here, the speech time cannot mean the real speech time since, as we have seen above, the past tense can indicate events or states occurring in the future of the speech time when embedded under a future tense. What we mean by "the speech time" here is what Dowty calls "the quasi-speech time", which is updated whenever we use the future tense (i.e., *will*). I adopt Dowty's triple-index system and his idea that a future tense introduces a quasi-speech time, but my system differs from Dowty's particularly in that the denotations of tenses are assumed to be subdivided into tense feature denotations and future auxiliary feature denotations. The following list shows how various combinations of tense and future auxiliary features are realized morphologically:

(122) [+past][-fut] = a past tense (e.g., *was*)
[-past][-fut] = a present tense (e.g., *is*)
[+past][+fut] = *would*
[-past][+fut] = a future tense (e.g., *will be*)

I assume that the feature [+past] denotes the set of intervals prior to the quasi-speech time and that the feature [-past] denotes the set of intervals not prior to the quasi-speech time. As for future auxiliary features, [+fut] means "the set of intervals subsequent to the time of evaluation (i.e., the time denoted by the higher verb)", and [-fut] "the set of intervals not subsequent to the time of evaluation". The denotation of a tense is assumed to be the intersection of the tense and the future auxiliary features.

At this point, let us be more formally explicit and describe how the entire system works. I will present the system as a mini-fragment and explain how it works immediately below.

Basic model-theoretic definitions:

1. If α is a non-logical constant, then $[\![\alpha]\!]^{M,w,i,j,k,g} = [F(\alpha)](\langle w, i\rangle)$ where F is the interpretation function of M.

2. If α is a variable, then $[\![\alpha]\!]^{M,w,i,j,k,g} = g(\alpha)$

3. If φ is of type t, $[\![\ \underset{\substack{[-past]\\ [+fut]}}{TNS}\ \varphi\ ]\!]^{M,w,i,j,k,g} = 1$

iff there is an interval i_1 such that $[\![[-past]'(i_1)]\!]^{M,w,i,j,k,g} = 1$, $[\![[+fut]'(i_1)]\!]^{M,w,i,j,k,g} = 1$ and $[\![\varphi]\!]^{M,w,i_1,i_1,k,g} = 1$

[N.B. t is the semantic type of sentences.]

Otherwise:

If φ is of type t, $[\![\ \underset{\substack{[\alpha past]\\ [\beta fut]}}{TNS}\ \varphi\ ]\!]^{M,w,i,j,k,g} = 1$

iff there is a t such that $[\![[\alpha\ past]'(t)]\!]^{M,w,i,j,k,g} = 1$, $[\![[\beta\ fut]'(t)]\!]^{M,w,i,j,k,g} = 1$ and $[\![\varphi]\!]^{M,w,t,j,k,g} = 1$

4. $[\![[+past]']\!]^{M,w,i,j,k,g}$ is the characteristic function of the set of intervals $\{t \mid t < j\}$

5. $[\![[-past]']\!]^{M,w,i,j,k,g}$ is the characteristic function of the set of intervals $\{t \mid t \geq j\}$

6. $[\![[+fut]']\!]^{M,w,i,j,k,g}$ is the characteristic function of the set of intervals $\{t \mid t > i\}$

7. $[\![[-fut]']\!]^{M,w,i,j,k,g}$ is the characteristic function of the set of intervals $\{t \mid t \leq i\}$

8. A triple $\langle i,j,k\rangle$ is an utterable context iff $i=j=k$

[N.B. i = the evaluation time; j = the quasi-speech time; k = the real speech time]

Syntax:[50]

[N.B. α, β are variables standing for either + or -]

1. $S \rightarrow NP \quad \underset{[\beta fut]}{\overset{Aux}{[\alpha past]}} \quad VP$

2. $VP \rightarrow V\ (S')$

3. $S' \rightarrow$ that S

Semantics:

1. $[_S NP \quad \underset{[\beta\ fut]}{\overset{Aux}{[\alpha past]}} \quad VP]$ translates into $\underset{[\beta fut]}{\overset{TNS}{[\alpha past]}} \quad NP'\ (\wedge\ VP)$

2a. $[_{VP}\ V]$ translates into V'

2b. $[_{V'}\ V\ S']$ translates into $V'\ (\wedge\ \ddot{S}'')$

3. $[_{S'}$ that S$]$ translates into S'

Pay attention to the model-theoretic definitions first. 1 says that a non-logical constant is evaluated relative to a pair consisting of a world index and a first time index (i.e. the "evaluation time"). In other words, second and third time indices are ignored as we compute the denotations of non-logical constants. 3 is crucial for our purposes. It defines how operators with tense and future auxiliary features are

[50] The perfect is ignored in the fragment.

interpreted.[51] We need to stipulate that when an operator has features [-past] and [+fut] (i.e. the surface form is *will*), the operator causes the quasi-speech time as well as the evaluation time to be updated. Otherwise, a sentence of the form TNS φ evaluated at t (where t is the evaluation time index) is true iff there is a time t' which is an element of the intersection of the denotations of the two features associated with the tense operator and φ is true at t'. 4 and 5 say that the tense features are evaluated in relation to the quasi-speech time, and 6 and 7 say that the future auxiliary features are evaluated relative to the evaluation time. 8 says that when we interpret (an occurrence of) a formula modeltheoretically, we must start with a triple <i, j, k> where k is the speech time of this sentence and i = j = k. As far as syntactic and semantic rules are concerned, the only comment to be made is on the rule 1. The reason that I posited the tense and the future auxiliary as features on the Aux node is the following: Since it is necessary to translate the Aux node as an operator whose behavior is jointly contributed by the presence or absence of the past tense *and* the presence or absence of the future auxiliary, the information about the tense morpheme and the future auxiliary must be available at the level of the Aux node. If we assumed a system which posited the tense morpheme and the future auxiliary as full-fledged morphemes dominated by the Aux node, this would result in a violation of the

[51] I adopt an operator analysis of tenses and, therefore, it is subject to the criticisms of the operator analysis of tenses given above. It is possible to opt for an analysis which employs quantifiers and variables over times in the object language, but such a system requires a variant of Dowty's AT operator which serves to manipulate the quasi-speech time index. It is much simpler to employ operators in order to formalize my ideas. As we shall see below, the current system has problems that are independent of the problems that are inherent in operator analyses of tense. Thus, I have decided to propose an operator analysis in order to point out the problems with the current proposal.

principle of compositionality. Thus, I use features simply to conform to the principle of compositionality. The semantic rule 1 can be thought of as a translation schema; since α and β are variables for + and -, this schema produces four different tense operators depending upon the values of the two features. The model-theoretic interpretations of these four operators are given above as part of model-theoretic definitions.

Let us discuss some examples.

(For typographical reasons, I introduce the following notational conventions:

1. Aux <[αpast][βfut]> is equivalent to $\begin{array}{c}\text{Aux}\\ [\alpha\text{past}]\\ [\beta\text{fut}]\end{array}$

2. TNS <[αpast][βfut]> is equivalent to $\begin{array}{c}\text{TNS}\\ [\alpha\text{past}]\\ [\beta\text{fut}]\end{array}$)

(123) John said that Mary was pregnant.

1. that Mary Aux <[+past][-fut]> be pregnant ⇒

   TNS <[+past][-fut]> be-pregnant' (m)

2. say that Mary Aux <[+past][-fut]> be pregnant ⇒

   say' (^ TNS <[+past][-fut]> be-pregnant' (m))

3. John Aux <[+past][-fut]> say that Mary Aux <[+past][-fut]>be pregnant ⇒ TNS <[+past][-fut]> say' (j, ^ TNS <[+past][-fut]> be-pregnant' (m))

Let us see how the last line is interpreted.

$[\![$ TNS <[+past][-fut]> say' (j, ^ TNS <[+past][-fut]> be-pregnant' (m))$]\!]^{M,w,s,s,s,g} = 1$ iff there is a time $t_1 \in \{t \mid t < s\} \cap \{t \mid t \leq s\}$ such that $[\![$say' (j, ^ TNS <[+past][-fut]> be-pregnant' (m))$]\!]^{M,w,t_1,s,s,g} = 1$, which is the case iff John stands in the saying relation to the following proposition at $\langle w, t_1\rangle$: $\{\langle w',t'\rangle \mid [\![$ TNS <[+past][-fut]> be-pregnant' (m))$]\!]^{M,w',t',s,s,g} = 1\}$. This is equivalent to $\{\langle w',t'\rangle \mid$ there is a $t_2 \in \{t \mid t < s\} \cap \{t \mid t \leq t'\}$ such that $[\![$ be-pregnant' (m)$]\!]^{M,w',t_2,s,s,g} = 1\}$. If what John said is true, then $\langle w,t_1\rangle$ is one of the elements of this set. In that case, it follows that the time of Mary's being pregnant is either simultaneous with or is prior to John's saying. This is empirically correct.

Next, let us consider (124):

(124) John will claim that Sue said that Mary was pregnant.

(124') John Aux <[-past][+fut]> claim that Sue Aux <[+past][-fut]> say that Mary Aux <[+past][-fut]> be pregnant.

Its translation into IL proceeds in the following way:

(124") 1. that Mary Aux <[+past][-fut]> be pregnant $\Rightarrow$
TNS <[+past][-fut]> be-pregnant' (m)

2. that Sue Aux <[+past][-fut]> say that Mary Aux <[+past][-fut]> be pregnant $\Rightarrow$ TNS <[+past][-fut]> say'
(s, ^ TNS <[+past][-fut]> be-pregnant' (m))

3. John Aux <[-past][+fut]> claim that Sue Aux <[+past][-fut]> say that Mary Aux <[+past][-fut]> be pregnant ⇒
TNS <[-past][+fut]> claim' (j, ^ TNS <[+past][-fut]>
say' (s, ^ TNS <[+past][-fut]> be-pregnant' (m)))

The final line is interpreted in the following way:

⟦TNS <[-past][+fut]> claim' (j, ^ TNS <[+past][-fut]> say' (s, ^ TNS <[+past][-fut]> be-pregnant' (m)))⟧M,w,s,s,s,g = 1 iff there is a time $t_1 \in \{t \mid t \geq s\} \cap \{t \mid t > s\}$ and ⟦claim' (j, ^ TNS <[+past][-fut]> say' (s, ^ TNS <[+past][-fut]> be-pregnant' (m)))⟧M,w,t_1,t_1,s,g = 1. Note here that t_1 must be an interval which is located after the speech time. Note further that the quasi-speech index is updated because the operator has the features [-past] and [+fut]. ⟦claim' (j, ^ TNS <[+past][-fut]> say' (s, ^ TNS <[+past][-fut]> be-pregnant' (m)))⟧M,w,t_1,t_1,s,g = 1 iff John stands in the claiming relation to the following proposition at $<w, t_1>$: $\{<w', t'> \mid$ ⟦TNS <[+past][-fut]> say' (s, ^ TNS <[+past][-fut]> be-pregnant' (m))⟧M,w',t',t_1,s,g = 1$\}$, which is equivalent to $\{<w', t'> \mid$ there is a $t_2 \in \{t \mid t < t_1\} \cap \{t \leq t'\}$ and ⟦say' (s, ^ TNS <[+past][-fut]> be-pregnant' (m))⟧M,w',t_2,t_1,s,g = 1$\}$. From this we can arrive at the conclusion that if John made a true claim, the time of Sue's saying is prior to the time of John's claiming. ⟦say' (s, ^ TNS <[+past][-fut]> be-pregnant' (m))⟧M,w,t_2,t_1,s,g = 1 iff Sue stands in the saying relation to the following proposition at $<w, t_2>$: $\{<w'', t''> \mid$ ⟦TNS <[+past][-fut]> be-pregnant' (m))⟧M,w'',t'',t_1,s,g = 1$\}$, which is equivalent to $\{<w'', t''> \mid$ there is a $t_3 \in \{t \mid t < t_1\} \cap \{t \mid t \leq t''\}$ and ⟦be-pregnant' (m)⟧M,w'',t_3,t_1,s,g = 1$\}$

Assuming that Sue spoke the truth, we can conclude that the time of Mary's pregnancy is either simultaneous with or prior to the time of Sue's saying. This is empirically accurate and predicts both the simultaneous and shifted readings.

2.3.3.3. Problems

Up to now, the current proposal has been successful, but it turns out that it is empirically inadequate. I will show an example which cannot be dealt with by the current system. Consider the following example:

(125) John said that Mary would come to Austin.

The current system does not predict that the time of Mary's coming can be any time after the time of John's saying. (125) is translated into IL as shown in (126):

(126) John Aux <[+past][-fut]> say that Mary Aux <[+past][+fut]> come to Austin. ⇒ TNS <[+past][-fut]> say (j, ^ TNS <[+past][+fut]> come-to-Austin' (m))

(126) is modeltheoretically interpreted in the following way:

⟦TNS <[+past][-fut]> say (j, ^ TNS <[+past][+fut]> come-to-Austin' (m))⟧^{M,w,s,s,s,g} = 1 iff there is a $t_1 \in \{t \mid t < s\} \cap \{t \mid t \leq s\}$ such that ⟦say (j, ^ TNS <[+past][+fut]> come-to-Austin' (m))⟧^{M,w,t_1,s,s,g} = 1. This is the case iff John stands in the saying relation to the following proposition at $\langle w, t_1 \rangle$: $\{\langle w',t' \rangle \mid$ ⟦ TNS

$<[+past][+fut]>$ come-to-Austin' (m)$]\!]^{M,w',t', s,s,g} = 1\}$. This is equivalent to $\{<w',t'> \mid$ there is a $t_2 \in \{t \mid t < s\} \cap \{t \mid t > t'\}$ and $[\![$come-to-Austin' (m)$]\!]^{M,w',t_2, s,s,g} = 1\}$

The prediction is that the time of Mary's coming to Austin is located between the time of John's saying and the speech time. This is the wrong prediction. The time of Mary's coming to Austin can be subsequent to the speech time. I do not see any way of making the current proposal empirically adequate without abandoning the basic idea that the past tense morpheme always means "past of some well-defined temporal point".

Since the current proposal cannot deal with relatively simple examples like (125), it is not surprising that it cannot deal with more complex ones such as (127), which we have already discussed earlier in this chapter:

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

Suppose that the time of John's saying to his mother is simultaneous with the time of their having their last meal. It is clear from the adverbials that the time of John's saying is in the future of the speech time. Therefore, the time of their having their last meal is prior to none of the times referred to in the sentence. Note that this time is not even prior to the quasi-speech time, which is simultaneous with the real speech time according to the rules of the current system. I will not go into the details of how the present system fails to account for the reading of (127). It is sufficient for our purposes to note that the current system is inadequate to deal with the ST phenomenon.

2.4. Sequence of Tense in Other Constructions

Before presenting first fragments for Japanese and English in Chapter 3, I would like to discuss some clausal constructions which have not been touched upon so far.

2.4.1. Adjective Complement Clauses

Adjectives take sentential complements as verbs do. Concerning the ST phenomenon, adjective complement clauses behave in the same way as verb complement clauses at least in English. Consider the following data:[52]

(128a) John was [$_{AP}$aware [$_{S'}$that he was wrong]].

(128b) John was [$_{AP}$aware [$_{S'}$that Mary would come to see him]].

(128c) John was [$_{AP}$aware [$_{S'}$that Mary had left]].

The ST phenomenon observed in verb complements occurs in (128a) through (128c) as well. For example, in (128a) the time of his being wrong can be simultaneous with John's being aware of it. I believe all the other relevant facts are the same as verb complement cases. Thus, I will ignore this construction in the fragment presented below.

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[52] The syntactic analysis assumed here is that of Jackendoff (1977: 76).

2.4.2. Sentential Subjects

Sentential subjects show the same behavior as verb and adjective complement clauses.

(129a) $[_{NP}[_{S'}$That John was wrong]] was obvious.

(129b) $[_{NP}[_{S'}$That John would accept the offer]] was obvious.

(129c) $[_{NP}[_{S'}$That the earth was round]] was not known to people in the old days.

Some examples such as (129a) and (129b) do not contain an expression which denotes the subject of the attitude being expressed. The speaker or the people in general are the most likely candidates for the attitude holder in such cases. If these implicit attitude holders are supplied at the level of interpretation, these examples can be subsumed under normal attitude verb cases. The double-access reading associated with a present tense embedded under a past tense (to be discussed in detail in Chapter 4) is also present, as (130) shows:

(130) $[_{NP}[_{S'}$That Mary is ill]] was announced to everyone.

Sentential subjects in Japanese behave in the same way as other clausal complements discussed above (i.e., they do not exhibit a ST phenomenon) except that they require nominalization markers *no* or *koto*, but not the complementizer *to*, which is required in verb complement cases:

(131a) [$_{NP}$[$_{S}$John-ga matigat -te ir -u] no]-wa akirakadat -ta.
NOM be-wrong PROG PRES N TOP be-obvious PST

(131b) [$_{NP}$[$_{S}$John-ga matigat -te ir -u] koto]-wa akirakadat -ta.
NOM be-wrong PROG PRES N TOP be-obvious PST
That John was wrong was obvious. [simultaneous reading only]

[N.B. N = nominalizer]

We assume here that sentential subjects are NP's though this is not uncontroversial. In English, there is no clear NP marker as such for sentential subjects, nor is it clear that they occupy NP positions.[53] The claim that sentential subjects are NP's is supported by morphological evidence in Japanese, in which a sentential subject must accompany a nominalizing suffix. Note also that full-fledged sentences and S-bar complements of verbs cannot appear in the subject position in Japanese. Consider the following data:

(132a) *[$_{S}$John-ga matigat -te iru] -wa akirakadat -ta.
NOM be-wrong PROG TOP be-obvious PST

(132b) *[$_{S'}$[$_{S}$John-ga matigat -te iru] to] -wa akirakadat -ta.
NOM be-wrong PROG that TOP be-obvious PST

A complete sentence occupies the subject position in (132a), and (132b) an S'

[53] One could argue for the NP-status of sentential subjects along the following lines: Assume the correctness of subjacency. If we assume further that sentential subjects are NP's, we can account for the fact that sentential subjects are islands (domains from which elements cannot be extracted) because an extraction from a sentential subject would require crossing two bounding nodes (S and NP) and result in a subjacency condition violation.

complement of a verb is sitting in the subject position in (132b). Both (132a) and (132b) are ungrammatical.

I have demonstrated that what I call "sentential subjects" in Japanese are NP's. In spite of this fact, they cannot escape the scope of the matrix tense. In other words, "sentential subjects" in Japanese are obligatorily interpreted as being under the scope of the immediately higher tense. This is true of sentential subjects in English as well. It is easy to verify that this is so. We should consider sentences in which a past tense occurs in the matrix and in the sentential subject, and determine whether the time of the verb in the sentential subject can fall somewhere between the time of the matrix verb and the speech time. Let us examine the following sentences:

(133a) $[_{NP}[_{S}$That John accepted the offer]] was obvious.

(133b) $[_{NP}[_{S}$John-ga mooside-o ukeire-ta] no] wa akirakadat-ta.
NOM offer ACC accept PST N TOP obvious PST

Both in (133a) and (133b), it is impossible to locate the time of accepting somewhere between the time of being obvious and the speech time. This clearly shows that sentential subjects must be in the scope of the matrix tense.

2.4.3. Infinitival Clauses

Infinitival clauses in English act as if they have a future tense or present tense morpheme. Consider the following examples:

(134a) John believed Bill to be a nice person.

(134b) John promised to call me.

They are roughly equivalent to the following:

(135a) John believed that Bill was a nice person. [with the simultaneous reading]

(135b) John promised that he would call me.

That is, (135a) means that John believed at a past time t that Bill was a nice person at t. On the other hand, (135b) means that John promised at t that he would help me at some time later than t. Verbs like *believe* induce simultaneous readings, whereas verbs like *promise* produce future readings. In order to describe a situation where the event or state that the infinitival clause talks about is located before the time of the higher verb, the perfect must be employed as in the following example:

(136) John believes Bill to have committed a crime.

(136) clearly places John's committing a crime in the past of the time of believing (i.e. in the past of the speech time). However, we should not conclude from this that the perfect employed in infinitival clauses necessarily locates the event described in the past of the time of the higher verb. The right generalization is that the perfect locates the event in the past of the time that the infinitival itself denotes. Consider the following example:

(137) John promised to return to Austin on May 25th.

He also promised to have finished his paper a week before that.

As the second sentence shows, what John promised was not that he had already finished his paper at the time of promising, which is nonsensical under the normal interpretation of *promise* anyway, but that he would have finished his paper a week earlier than May 25th. The descriptive generalization, then, is that when the higher verb has a "forward-looking" meaning as in the case of *promise*, the time of the infinitival clause is located in the future of the time of the higher verb. Then, when the infinitival is a perfect, the event or state described is asserted to be located before this future time.

Another fact to be noted is that when an infinitive occurs immediately under a past tense ($Past_1$) and immediately above another past tense ($Past_2$) (schematically in the following form), the lower past tense can be deleted at LF because of the presence of the higher past tense.

(138) ... $Past_1$ ... [... infinitival ... [... $Past_2$ ...]] ...

Consider the following examples:

(139a) John thought that Bill will claim that he did not know anything about the crime.

(139b) John thought that Bill would claim that he did not know anything about the crime.

(139c) John asked Bill to claim that he did not know anything about the crime.

In (139a), the second highest clause is in the future tense (or the present tense morphologically), and, therefore, the past tense in the lowest clause cannot be interpreted as an empty past tense. In other words, the time of Bill's not knowing anything about the crime cannot be simultaneous with the time of Bill's claim; it has to be prior to Bill's claim. On the other hand, (139b) allows the interpretation in which the time of Bill's claim is simultaneous with the time of Bill's not knowing about the crime thanks to the past tense suffixed to *woll*. Compare these facts with (139c). An infinitival clause subordinated to the verb *ask* has a future meaning in that the time of Bill's claim is located in the future of the time of John's asking Bill. It turns out that (139c) allows Bill's not knowing anything about the crime to be simultaneous with the time of his claim, just as (139b) does. This means that a past tense can be deleted by an immediately higher past tense even if an infinitival clause intervenes between them. Since infinitival clauses do not contain overt tense morphemes, the formulation of the tense deletion rule is not affected by infinitival clauses. That is, one can preserve the generalization that a tense β can be deleted iff α and β are occurrences of the same tense morpheme and α is the local tense of β.[54] After the tense deletion rule has applied, we obtain the following structure for (139c), which has the desired

[54] This simple formulation of the tense deletion rule must be replaced by a more involved one when we consider ST cases triggered by nouns and the perfect. However, this is independent of the point made here.

interpretation:

(139c') John Past ask Bill to claim that he Ø do not know anything about the crime.

The details of the proposal will be presented in the fragment to be given below.

2.4.4. Temporal Adverbial Clauses

Temporal adverbial clauses in English and Japanese behave differently. The past tense form in Japanese, V-*ta*, can be used in temporal adverbial clauses to refer to events which obtain after the speech time provided that they are located before the events described in the main clause. By contrast, the past tense in English, V-*ed*, cannot be so used in temporal adverbial clauses (Nakau 1976, Matsumoto 1985, Ogihara 1987).[55] Instead, English employs the present perfect (or the simple present) in order to convey this meaning. Consider the following examples:

(140a) *When I finished reading the book, I will call you.

(140b) When I have finished (or finish) reading the book, I will call you.

(140c) Hon o yomi owat-ta ra/toki, denwa -simas-u.
book ACC read finish PST if/when telephone do PRES

[55] This generalization holds unless the whole sentence, including the adverbial clause, is embedded in a ST context.

The intended interpretation of the above sentences is that there is some future time t such that *I call you* is true at t and *I finish reading the book* is true at some time t' < t.[56] The past tense is employed in the temporal adverbial clause in (140a), and it is ill-formed. In (140b) the present perfect is used to show that the time of my finishing reading the book is located before the time of my calling you, and the sentence is acceptable. On the other hand, (140c) shows that the past tense morpheme *-ta* in Japanese is capable of signaling the fact that my finishing reading the book precedes my calling you.

Note also that other temporal conjunctions such as *ato* 'after' and *mae* 'before' behave in a similar way:

(141a) Hon -o yomi-owat -ta ato ni denwa simas-u.
book ACC read finish PST after at telephone do PRES
(I will) call (you) after (I) have finished (lit. finished) reading the book.

(141b) Hon -o yomi-owar -u mae ni denwa simas-u.[57]
book ACC read finish PRES before at telephone do PRES
(I will) call (you) before (I) finish reading the book.

Consider (141a) first. *Ato* 'after' indicates that the event described in the temporal adverbial clause precedes the main clause event. *Mae* 'before', on the other hand, has the opposite meaning. The above data tell us that the denotations of tense morphemes

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56 There is a (presumably pragmatic) constraint that t and t' be very close.

57 *ni*, which appears in the Japanese sentences, is a postposition meaning *at*. Thus, temporal adverbial clauses in Japanese seem to have the following structure:

(a) [$_{PP}$[$_{NP}$[$_{S}$ Hon -o yomi-owat -ta] ato] ni]
book ACC read finish PST after at

in temporal adverbial clauses are determined in relation to the denotations of immediately higher tenses. The past tense morpheme appears in the temporal adverbial clause in (141a) to indicate that the time of my finishing reading the book is located before the time of the telephone call. The present tense morpheme appears in the temporal adverbial clause to show that my finishing the book follows my calling you.[58] If we assume that temporal adverbial clauses in Japanese are in the scope of the matrix clause tense, the behavior of the tense morphemes in Japanese receives a simple account. We will show in Chapter 3 how this idea is formally implemented.

At first, this line of reasoning seems to take care of English data as well. Consider the following examples:

(142a) When (or after) I have finished reading the book, I will call you.

(142b) When (or after) he had finished reading the book, John called Mary.

If we assume that the temporal adverbial clause is in the scope of the matrix and that the tense deletion rule is applicable here as well, we predict that the time of my finishing reading the book is prior to my calling you. In fact, some English data suggest that in temporal adverbial clauses, the tense deletion rule *must* apply. Thus, the tense in the matrix and the tense in the adverbial clause must match. We can say, for example, in the following illicit instances of temporal adverbials, the tense in the temporal adverbial clause fails to agree with the tense in the main clause:

58 As mentioned in Chapter 1, the Japanese present tense morpheme has a double-duty in that it can either function as a present tense morpheme or as a future tense morpheme. Here, it is interpreted to have a future meaning.

(143a) *John will leave when Mary arrived.

(143b) *John left after Mary is singing.

(143c) *John will leave after Mary arrived.

(143d) *John left before Mary arrives.

(143e) *John will leave when Mary will arrive.

(143f) *John left before Mary will arrive.

(143c) and (143f) are particularly noteworthy. If we assume that two clauses connected by *after* serve to assert that the event described in the matrix occurs after the event described in the embedded clause (and similarly for *before*) and that the tenses in the two clauses serve to locate the events independently from the speech time, they do not seem to be problematic as far as their interpretations are concerned. For instance, if John will leave (after the speech time) and Mary arrived (before the speech time), then it follows that John's leaving is prior to Mary's arrival. Nevertheless, (143c) is simply ill-formed. The above proposal that the tense in a temporal adverbial clause must agree with the tense of the matrix makes the correct prediction here.

However, not all temporal adverbial clauses in English can be accounted for in this manner. Consider the following example discussed by Stump (1985):

(144) John will leave after Mary said he would.

(144) is acceptable and interpretable. In this example, the mismatch of the tenses in

the two clauses does not result in the unacceptability of the sentence. Note that *after* in this example does not relate the time of John's leaving and the time of Mary's saying. Rather, *after* relates the time of John's leaving and the time at which he allegedly leaves. In other words, the time variable which constrains the time of John's leaving comes from the lower clause embedded within the temporal adverbial clause. There are two problems with this example: (i) The tense of the temporal adverbial clause does not agree with that of the main clause, in violation of the hypothesis that we have posited; (ii) Assuming that the past tense on the verb *say* is a non-empty tense and that the temporal adverbial clause is in the scope of the matrix tense, we predict that the time of Mary's saying can be any time before the time of John's leaving. However, this prediction fails. The time of Mary's saying must be located before the speech time.

We might hope to solve the first problem by saying that the clause which contains the time variable constraining the time of the matrix event must have an empty tense. In (144) the lower clause in the temporal adverbial clause has an empty tense, and this new hypothesis works:

(145) John Pres woll leave after Mary Past say he Ø woll

However, according to the native speakers that I consulted, the following sentence is also acceptable:

(146) John will leave after Mary said he will.

This is problematic since there is no empty tense in this sentence. The second problem is also serious given the semantic rule that we posited for the past tense morpheme in English. Despite the prediction that a tense occurring in a temporal adverbial clause is interpreted as embedded under the immediately higher tense, the past tense on *say* behaves as if it is unembedded. However, if we assume that a temporal adverbial clause is unembedded under the matrix tense, we lose the explanation that the perfect in a temporal adverbial clause behaves as if it is embedded. I do not have a good solution to the dilemma that we have faced, and it is left as a future problem. Hence, temporal adverbial clauses will not be dealt with in the English fragments.

CHAPTER 3

FIRST FRAGMENTS OF JAPANESE AND ENGLISH

3.1. Introduction

In what follows, I will present a fragment for Japanese and one for English. These fragments are given in a framework much like Dowty's (1979), but there are some differences between these two approaches. I assume a syntactic level of Logical Form (LF) along the lines initiated by May (1977). The semantic rules which serve to translate English into Intensional Logic (IL) apply to LF representations, rather than to analysis trees used in PTQ or Dowty's framework (1979). Furthermore, for syntactic categories, I employ labels such as NP and VP (instead of categorial grammar labels) to which linguists are more accustomed. Thus, the following fragments do not exhibit a transparent relationship between syntactic categories and their semantic types. The empirical coverage of these fragments is limited in that the one for Japanese can only deal with the past tense morpheme, V-*ta*, and the so-called present tense morpheme, V-*ru*, and that the one for English can only deal with the past tense morpheme, V-*ed*, the preterit interpretation of the perfect (*have* + *en*), and the future auxiliary *woll* (which we assume to be the tense-neutral underlying form of *will* and *would*).[1] I will comment on each of the rules after the whole fragment is

[1] Strictly speaking, we cannot completely separate the issues involving tense morphemes and those involving aspectual morphemes. For example, simultaneous readings incurred by a present tense embedded under a past tense in Japanese (e.g. (a)) must satisfy a condition having to do with aspect: the verb in the embedded clause must be stative. When we present examples with a simultaneous reading, we supply the right verb. However, nothing in the following fragment guarantees this.

presented. I hope that this will help the reader understand the intuitive content of these rules. The reader is encouraged to read the comments before trying to "crack the code" by himself.

The syntactic rules for the English fragment can produce a sentence with a present tense embedded under a past tense (e.g. John said that Mary is pregnant). However, the semantic rules as given here cannot deal with such sentences. The double-access readings associated with them are discussed in detail in Chapter 4.

3.2. Fragments

Model-Theoretic Definitions

(The bulk of the following definitions is from Dowty (1979).)

The set of types is the smallest set T such that (1) e, t, i, are in T (regarded as the types of entities, truth values, and intervals of time, respectively), (2) if a, b $\in$ T, then $\langle a, b\rangle \in T$, and (3) if a $\in$ T, then $\langle s, a\rangle \in T$.

An intensional model M for the translation language is an ordered quintuple $\langle E, W, M, <, F\rangle$ defined as follows:

(1) E is a non-empty set (the set of basic entities).

(2) W is a non-empty set (the set of possible worlds).

(3) M is a non-empty set (the set of moments of time).

Moreover, in some examples to be given below, the V-*te iru* form is used to induce a simultaneous reading. I will assume in such cases that V-*te iru* is an unanalyzable stative verb.

(a) John-wa [$_S$ Mary-ga Austin-ni ir-u] to it -ta.
TOP NOM to be PRES that say PST
John said that Mary was in Austin. [simultaneous reading only]

(4) $<$ is a strict linear order of M.

(5) The set of intervals of time I is the set of all subsets i of M such that if $i \in I$, then for all $m_1, m_2, m_3 \in M$, if $m_1, m_3 \in i$ and $m_1 < m_2 < m_3$, then $m_2 \in I$. Given $<$ for M, $<$ for I can be defined as follows: $i_1 < i_2$ iff $\forall m_1 \in i_1, \forall m_2 \in i_2 \exists m_3 [m_3 \notin i_1 \& m_3 \notin i_2 \& m_1 < m_3 < m_2]$.

(6) For each type $a \in T$, the set D_a of possible denotations of type *a*, is defined recursively as follows: (a) $D_e = E$, (b) $D_t = \{0, 1\}$ (the truth values "false" and "true" respectively), (c) $D_i = I$, (d) $D_{<a,b>} = D_b^{D_a}$, and $D_{<s,a>} = D_a^{W \times I}$. The set of senses of type a, denoted S_a, is $D_{<s,a>}$.

(7) F (the interpretation function) assigns to each constant of the translation language of type *a* a member of S_a. A value assignment g is a function that assigns to each variable of type *a* a value in D_a.

The Syntax and Interpretation of IL

The set of basic expressions of IL consists of a set Con_a, of *constants of type a*, and a denumerably infinite set Var_a, of *variables of type a*, for each $a \in T$.

The set of meaningful expressions of IL of type a, ME_a, is defined recursively as follows, together with the recursive definition of *the denotation of a meaningful expression* α with respect to *an interpretation M, world w, interval of time i* and *value assignment g*, denoted $[\![\alpha]\!]^{M,w,i,g}$.

1. If $\alpha \in Con_a$, then $\alpha \in ME_a$, and $[\![\alpha]\!]^{M,w,i,g} = F(\alpha)(<w, i>)$.
2. If $u \in Var_a$, then $u \in ME_a$, and $[\![u]\!]^{M,w,i,g} = g(u)$.

3. If $\alpha \in ME_{<a,b>}$ and $\beta \in ME_a$, then $\alpha(\beta) \in ME_b$, and $[\![\alpha(\beta)]\!]^{M,w,i,g} = [\![\alpha]\!]^{M,w,i,g} ([\![\beta]\!]^{M,w,i,g})$

4. If $\alpha \in ME_a$, and $u \in Var_b$, then $\lambda u\alpha \in ME_{<b, a>}$, and $[\![\lambda u\alpha]\!]^{M,w,i,g}$, is that function h with domain D_b that gives for each argument x the value $[\![\alpha]\!]^{M,w,i,g'}$ where g' is that assignment exactly like g except for the (possible) difference that g' (u) = x.

5. If $\alpha, \beta \in ME_a$, then $[\alpha = \beta] \in ME_t$, and $[\![[\alpha = \beta]]\!]^{M,w,i,g} = 1$ iff $[\![\alpha]\!]^{M,w,i,g}$ is $[\![\beta]\!]^{M,w,i,g}$

6. If $\varphi \in ME_t$, then $\neg\varphi \in ME_t$, and $[\![\neg\varphi]\!]^{M,w,i,g} = 1$ iff $[\![\varphi]\!]^{M,w,i,g} = 0$. (Similarly for &, $\vee$, $\rightarrow$ and $\leftrightarrow$.)

7. If $\varphi \in ME_t$ and $u \in Var_a$, then $\exists u\ \varphi \in ME_t$, and $[\![\exists u\varphi]\!]^{M,w,i,g} = 1$ iff there exists x such that $[\![\varphi]\!]^{M,w,i,g'} = 1$, where g' is as in 4. (Similarly for $\forall u\ \varphi$.)

8. If $\alpha \in ME_a$ then $^\wedge\alpha \in ME_{<s,a>}$, and $[\![^\wedge\alpha]\!]^{M,w,i,g}$ is that function h with domain W X I such that for each $<w', i'> \in$ W X I, h $(<w',i'>) = [\![\alpha]\!]^{M,w',i',g}$

9. If $\alpha \in ME_{<s,a>}$ then $^\vee\alpha \in ME_a$, and $[\![^\vee\alpha]\!]^{M,w,i,g} = [\![\alpha]\!]^{M,w,i,g}, (<w,i>)$

10. If $\varphi \in ME_t$, $\zeta \in ME_i$, then AT $(\zeta, \varphi) \in ME_t$, and $[\![AT\ (\zeta, \varphi)]\!]^{M,w,i,g} = 1$ iff $[\![\varphi]\!]^{M,w,i',g} = 1$ where $[\![\zeta]\!]^{M,w,i,g} = i'$.

11. If $\zeta \in ME_i$ then PAST $(\zeta) \in ME_t$, and $[\![PAST\ (\zeta)]\!]^{M,w,i,g} = 1$ iff $[\![\zeta]\!]^{M,w,i,g} < i$. (Similarly for FUT.)

12. If $\zeta \in ME_i$ then PRES $(\zeta) \in ME_t$, and $[\![PRES\ (\zeta)]\!]^{M,w,i,g} = 1$ iff $[\![\zeta]\!]^{M,w,i,g} = i$.

13. If $\zeta, \xi \in ME_i$ then $[\zeta \subseteq \xi]$ and $[\zeta < \xi] \in ME_t$, and (i) $[\![\zeta \subseteq \xi]\!]^{M,w,i,g} = 1$ iff $[\![\zeta]\!]^{M,w,i,g} \subseteq [\![\xi]\!]^{M,w,i,g}$ and (ii) $[\![\zeta < \xi]\!]^{M,w,i,g} = 1$ iff $[\![\zeta]\!]^{M,w,i,g} < [\![\xi]\!]^{M,w,i,g}$. Similarly for $\leq$, $>$, and $\geq$.

(I.e. $\zeta < \xi$, where ζ and ξ are intervals, is interpreted as meaning that ζ completely precedes ξ and that ζ does not abut ξ.)

Syntactic Categories and their Semantic Types

Symbol	Full name	Semantic Type
MS	matrix sentence	t
S	sentence	<i, t>
Aux	auxiliary	<<s,t>,<i, t>>
Tns	tense	<<s,t>,<i,t>> (Japanese)
		<i,t> (English)
N'	N-bar	<e,t>
S'	S-bar	t
Adj.	adjective	<<s,<e,t>>,<e,t>>
NP	noun phrase	<<s,<e,t>>,t>
N^0	noun (w/ 0 arguments)	<e,t>
N^1	noun (w/ 1 argument)	<<s,t>, <e,t>>
N^2	noun (w/ 2 argument)	<<s,t>, <e,<e,t>>>
VP	verb phrase	<e,t>
V^0	verb (w/ 0 argument)	<e,t>

V^1	verb (w/ 1 argument)	<<s,<<s,<e,t>>,t>>, <e,t>>
		<e, <e,t>>
		<<s,t>, <e,t>>
Adv. P	adverbial phrase	<<s,<e,t>>, <e,t>>
Adv.	adverb	<<s,<e,t>>, <e,t>>
Conj.	conjunction	<<s, <i,t>>, <<s,<e,t>>,<e,t>>>
Det	determiner	<<s,<e,t>>, <<s,<e,t>>,t>>

Variable Symbol	Type of Variable
x, y, z, ...	e
P, Q, ...	<s, <e,t>>
p, q, ...	<s,t>
$\wp$	<s, <<s,<e,t>>,t>>
$t, t', t'', t_1, t_2, \ldots$	i
$P_t, Q_t, \ldots$	<s,<i,t>>

Notational conventions:

$\alpha\,(\beta, \gamma)$ is a relational notation equivalent to $\alpha\,(\gamma)(\beta)$

$\alpha\{\beta\}$ is $[{}^{\vee}\alpha]\,(\beta)$

$g^{e/u}$ is a value assignment just like g with the possible exception that the individual e is assigned to the variable u.

3.2.1. A Fragment of Japanese

Japanese:

Syntax:

1. MS → S [N.B. MS = matrix sentence]

2. S → NP VP Aux

3. Aux → Tns

4. Tns → Pres
        Past

5. NP → N'
        Name

6. N' → S' N'
        Adj N'
        (S') (NP) N

7. S' → S to yuu (= noun complement clause)
        S to (= verb complement clause)
        S

8. VP → (NP) V
        S' V
        Adv. P VP

9. Adv. P → Adv.
        S Conj.

Transformations:

10. Wh-movement: At the level of S-structure (or at LF), move an empty wh-element to COMP.

11. Quantifier Raising: At the level of Logical Form, NP's are optionally Chomsky-adjoined to a VP or an S.

    [N.B. B is said to be Chomsky-adjoined to A when the following operation is performed: $[_A \ldots] \Rightarrow [_A B[_A \ldots]]]$

Lexicon:

12. Adj. $\rightarrow$ *izen-no* 'prior-GEN', *mae-no* 'before-GEN', *noti-no* 'later-GEN'

13. Conj. $\rightarrow$ *mae* 'before', *ato* 'after', *toki* 'when'

Semantics:

[N.B. In translating an LF representation into IL, syntactic traces are translated as variables in IL.]

1. $[_{MS}$ S] translates into $\exists t$ [S' (t)]

2. $[_S$ NP VP Aux] translates into Aux' (^ [NP' (^ VP')])

3. $[_{Aux}$ Tns] translates into Tns'

4a. $[_{Tns}$ Pres] translates into $\lambda p\ \lambda t$ [PRES (t) & AT (t, $^{\vee}$ p)] or

$$\lambda p\ \lambda t\ [\text{FUT}(t)\ \&\ t \subseteq t_{Rn}\ \&\ \text{AT}(t, {}^{\vee}p)]$$

[N.B. Note that t_{Rn} in the above formulas stands for a family of constants of type i which has natural numbers in place of n (e.g. t_{R1}, t_{R2}). Thus, each of the above formulas represents a family of translations of [$_{Tns}$ Pres].]

4b. [$_{Tns}$ Past] translates into $\lambda p\ \lambda t$ [PAST (t) & $t \subseteq t_{Rn}$ & AT (t, $^{\vee}$ p)]

5a. [$_{NP}$ N'] translates into $\lambda P\ \exists x$ [N' (x) & P {x}]

5b. [$_{NP}$ Name] translates into $\lambda P P$ {Name'}

6a. [$_{N'}$ S' N'] translates into λx [S'' (x) & N'' (x)]

6b. [$_{N'}$ Adj N'] translates into Adj.' (^ N'') [N.B. N'' = the translation of N']

6c. [$_{N'}$ S' NP N^2] translates into λx NP' (^ λy [$N^{2\prime}$ (^ S'')(y)(x)])

[N.B. S'' = the translation of S-bar]

6d. [$_{N'}$ S' N^1] translates into $N^{1\prime}$ (^ S'') [N.B. S'' = the translation of S-bar]

6e. [$_{N'}$ N^0] translates into $N^{0\prime}$

7a. [$_{S'}$ S to yuu] translates into $\exists t$ [S' (t)] [N.B. S' = the translation of S]

7b. [$_{S'}$ S to] translates into $\exists t$ [S' (t)] [N.B. S' = the translation of S]

8a. [$_{VP}$ NP V^1] translates into $V^{1\prime}$ (^ NP')

8b. [$_{VP}$ V^0] translates into $V^{0\prime}$

8c. [$_{VP}$ S' V^1] translates into $V^{1\prime}$ (^ S'') [S'' = the translation of S-bar]

8d. [$_{VP}$ Adv. P VP] translates into Adv. P' (^ VP')

9a. [$_{Adv.\,P}$ Adv.] translates into Adv.'

9b. [$_{Adv.\,P}$ S Conj.] translates into Conj' (^ S')

10. [$_{S'}$ [$_S$ ... e_k ...] [$_{COMP}$ wh_k]] translates into $\lambda x_k\ \exists t$ [S' (t)] .

11a. [$_S$ NP_k [$_S$ ... e_k ...]] translates into NP' (^ $\lambda x_k\ \exists t$ [S' (t)])

11b. [$_{VP}$ NP_k [$_{VP}$ ... e_k ...]] translates into λy NP' (^ λx_k [VP' (y)])

Lexicon:

12. *izen-no* 'prior-GEN' translates into

$\lambda P \lambda x\ \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

mae-no 'before-GEN' translates into

$\lambda P \lambda x\ \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

noti-no 'later-GEN' translates into

$\lambda P \lambda x\ \exists t\ [FUT\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

13. *mae-ni* 'before' translates into $\lambda P_t\ \lambda P \lambda x\ [P\{x\}\ \&\ \exists t_1\ [t_1 > t^*\ \&\ M\ (t^*, t_1)\ \&\ P_t\ \{t_1\}]]$

ato-ni 'after' translates into $\lambda P_t\ \lambda P\ \lambda x\ [P\{x\}\ \&\ \exists t_1\ [t_1 < t^*\ \&\ M\ (t^*, t_1)\ \&\ P_t\ \{t_1\}]]$

toki-ni 'when' translates into $\lambda P_t\ \lambda P \lambda x\ [P\{x\}\ \&\ \exists t_1\ [M\ (t^*, t_1)\ \&\ P_t\ \{t_1\}]]$

Comments:

This fragment serves to account for the behavior of the past tense morpheme in Japanese, *-ta*, and the "present tense" morpheme, *-ru*, in the following constructions: (i) independent clauses; (ii) verb complement clauses; (iii) noun complement clauses; (iv) sentential subjects; (v) relative clauses; (vi) temporal adverbial clauses. In general, the behavior of the past tense morpheme in Japanese is quite orderly. I will comment on each rule in what follows.

1. Syntax: MS → S

   Semantics: $[_{MS}\ S]$ translates into $\exists t\ [S'\ (t)]$

The translation of S is of type <i, t> and is not a full-fledged sentence unless it is existentially closed. This special rule for the root (= matrix) sentence is for existential closure.

2. Syntax: S → NP VP Aux

   Semantics: $[_S\ NP\ VP\ Aux]$ translates into Aux' (^ [NP' (^ VP')])

I do not intend to make a strong syntactic claim about the tripartite structure of S. One advantage of this flat structure, however, is that the subject NP is not higher in structure than the Aux node, which enables us to say (without positing a vary complex semantic rule) that the subject NP is within the scope of the Aux. The translation shows that the translation of the untensed sentence (i.e. NP' (^ VP')) appears within the scope of the AT operator. This ensures that the whole sentence (including the subject NP) is within the scope of the matrix tense. This becomes important when we turn to tense morphemes occurring within NP's (i.e. tenses occurring within relative clauses, noun complements, and sentential subjects).

3. Syntax: Aux → Tns

   Semantics: $[_{Aux}\ Tns]$ translates into Tns'

Straightforward.

Syntax:

4. Tns → Past

Pres

Semantics:

4a. $[_{\mathrm{Tns}}$ Pres] translates into $\lambda p\, \lambda t\, [\mathrm{PRES}\ (t)\ \&\ \mathrm{AT}\ (t, {}^{\vee} p)]$ or

$\lambda p\, \lambda t\, [\mathrm{FUT}\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ \mathrm{AT}\ (t, {}^{\vee} p)]$

4b. $[_{\mathrm{Tns}}$ Past] translates into $\lambda p\, \lambda t\, [\mathrm{PAST}\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ \mathrm{AT}\ (t, {}^{\vee} p)]$

As mentioned before, the so-called present tense morpheme in Japanese is better termed a non-past tense. However, I assume that the Japanese present tense morpheme *-ru* is ambiguous between the present tense meaning and the future tense meaning, rather than assuming that it is vague. This is because the present tense in Japanese cannot be employed to claim that some state or event obtains either now or in the future. For example, (1a) cannot receive the interpretation the formula (1b) represents:

(1a) John-wa Tokyo-ni ir -u.
TOP at be PRES

(1b) $\exists t\, [\mathrm{NON\text{-}PAST}\ (t)\ \&\ t \subseteq t_{R1}\ \&\ \mathrm{AT}\ (t, \text{be-in-Tokyo}'\ (j))]$

[N.B. NON-PAST is a unary predicate of times such that $[\![\mathrm{NON\text{-}PAST}\ (t')]\!]^{M,w,t,g} = 1$ iff $t \leq [\![t']\!]^{M,w,t,g}$]

According to my intuitions, (1a) is ambiguous between (1c) and (1d):[2]

(1c) $\exists t$ [PRES (t) & AT (t, be-in-Tokyo' (j))] = be-in-Tokyo' (j)

(1d) $\exists t$ [FUT (t) & $t \subseteq t_{R1}$ & AT (t, be-in-Tokyo' (j))]

Thus, the translation rule for the present tense morpheme in Japanese states that it is translated either as $\lambda p\ \lambda t$ [PRES (t) & AT (t, $^{\vee}$ p)] or as $\lambda p\ \lambda t$ [FUT (t) & $t \subseteq t_{Rn}$ & AT (t, $^{\vee}$ p)].

PAST and FUT introduce a new reference time, but PRES does not. Here, PRES, PAST and FUT are unary predicates of times such that $[\![\text{PRES}(t')]\!]^{M,w,t,g} = 1$ iff $g(t') = t$, $[\![\text{PAST}(t')]\!]^{M,w,t,g} = 1$ iff $g(t') < t$, $[\![\text{FUT}(t')]\!]^{M,w,t,g} = 1$ iff $g(t') > t$. The second conjunct in the translation (i.e. $t \subseteq t_{Rn}$) (excluding the formula which includes the predicate PRES in it) requires that the value of the time variable be part of the reference time, which is given by the context in which the sentence is used. Sometimes, the "reference time" is simply the whole past interval, and this amounts to imposing no contextual restriction upon the quantificational force of the past tense morpheme. In the translations of tenses given above, the reference time is introduced as a meta-language variable standing for constants in IL serving as reference times

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2 The reading (1d) is obtained easily if we add an adverbial and embed it in an appropriate context:

(a) John-wa kyoo-no gogo Osaka o tat -u.
TOP today GEN afternoon ACC leave PRES
Dakara asuno imagoro-wa Tokyo-ni ir-u.
so tomorrow this-time TOP at be PRES
John is leaving Osaka this afternoon. So he will be in Tokyo around this time tomorrow.

(i.e. t_{Rn}). Actual reference times occurring in the IL translations of Japanese sentences should have reference times with natural numbers in place of n. As shown earlier, various restrictions upon tense interpretations imposed by context (Partee 1973, 1984) do not constitute any evidence that tenses can be used deictically on a par with pronouns; they simply indicate that some implicitly given intervals restrict the quantificational force exerted by tenses. The current proposal captures this aspect of temporal interpretation straightforwardly.

The conjunct dealing with the reference time (i.e. $t \subseteq t_{Rn}$) in the above translations should be taken as a presupposition and not as part of the assertion.[3] For example, (2), which is translated into IL as (2'), is predicted to be true if the reference time t_{R1} is a future time:

(2) John didn't come.

(2') $\neg\exists t\,[\mathrm{PAST}\,(t)\ \&\ t \subseteq t_{R1}\ \&\ \mathrm{AT}\,(t, \mathrm{come'}\,(j))]$

(2') is true iff there is no time t which satisfies all the three conjuncts in the formula. Thus, (2') is predicted to be true if the "reference time" is not a past time. However, (2) is not considered to be a true sentence just because we are talking about a non-past time. Intuitively, (2) *presupposes* that there is a contextually salient past interval, and *asserts* that John did not come at/within that interval. Although this aspect of the temporal meaning conveyed by an occurrence of the past tense morpheme is ignored

[3] Irene Heim (p.c.) pointed out this problem. Dowty (1979: 325) notes a similar problem with his system.

in the above fragment, the reader should be aware of this potential problem. I will deal with examples which do not interfere with the problems associated with presuppositions.

The reason that the translation does not contain an existential quantifier is that the stage of derivation where sentences have semantic values of type $<i, t>$, which is often referred to as "temporal abstract" (e.g. Stump 1985), is necessary in order to deal with the semantics of temporal adverbial clauses correctly. As mentioned above, we assume an existential closure rule for the matrix clause. (We also assume existential closure rules for all embedded clauses except adverbial clauses. Please refer to the comments on the relevant rules.)

5a. Syntax: NP $\rightarrow$ N'

Semantics: $[_{NP}\ N']$ translates into $\lambda P\, \exists x\, [N'(x)\ \&\ P\{x\}]$

We assume that the semantic type of an N' is a property. At the NP level, the type is changed to that of a generalized quantifier. As is well-known, Japanese has no articles. Thus, "bare nouns" can constitute NP's and can receive various interpretations including those similar to definite and indefinite NP's in English. However, we will only be concerned with the existential quantifier meaning of NP's, which is traditionally associated with indefinite NP's in European languages.

5b. Syntax: NP $\rightarrow$ Name

Semantics: $[_{NP}\ \text{Name}]$ translates into $\lambda P P\{\text{Name}'\}$

Names are translated as generalized quantifiers.

6a. Syntax: $N' \rightarrow S'\ N'$

Semantics: $[_{N'}\ S'\ N']$ translates into $\lambda x\ [S''(x)\ \&\ N''(x)]$

Here S' is a relative clause. This rule serves to form a property expression out of the translations of a relative clause and an N'. Although some "relative clauses" in Japanese do not seem to contain gaps (not at least ones analogous to the gaps in English relative clauses), I will only be concerned with those that do contain a gap.[4]

6b. Syntax: $N' \rightarrow Adj\ N'$

Semantics: $[_{N'}\ Adj\ N']$ translates into $Adj.'(\hat{}\ N'')$ [N.B. N'' = the translation of N']

[4] So-called relative clauses in Japanese have properties that their alleged counterparts in English do not possess. For example, relative clauses in Japanese do not have a relative pronoun. Moreover, they often contain no gap, not at least an obvious one. For example, the following NP involving a relative clause is well-formed:

(a) [NP[RC zoo -ga omosiro -i] saakasu]
elephant NOM interesting PRES circus
[rough gloss] a/the circus such that its elephants are interesting

Note that the "relative clause" in (a) does not seem to contain a gap because the adjective *omosiroi* 'interesting' is clearly a one-place predicate. Some claim that the gap is located in the prenominal position of the noun *zoo* 'elephant'. That is, there may be a genitive case marked empty NP position immediately before *zoo* 'elephant'. However, this argument is not convincing. Moreover, it does not have a relative pronoun. Thus, syntactically the "relative clause" is a plain sentence, not an S'. I believe that these potential inadequacies of the syntactic analyses do not affect the semantic treatments of these constructions. As far as I can see, despite the possible syntactic differences between English and Japanese, the core facts concerning the temporal interpretation of these constructions are the same in these languages.

Here we are concerned with special adjectives such as *izen-no* 'earlier', which are like tense morphemes used in verbal constructions. Henceforth, we shall refer to them as "temporal adjectives". As we shall see below, temporal adjectives are translated as functions which apply to property-denoting expressions and return property-denoting expressions as their values. See 12 for translations of these adjectives. These adjectives are covered by the fragment primarily because they can serve as modifiers of nouns like *syutyoo* 'claim' and *yosoo* 'prediction' which can take clausal complements. However, they are also good for common nouns like *daitooryoo* 'president', *horyo* 'hostage', etc. which are discussed by Enç (1981, 1986), except that there are some collocational restrictions that hold between "temporal adjectives" and nouns. For example, *moto* 'former' can cooccur with nouns like *daitooryoo* 'president', but not with nouns like *syutyoo* 'claim'.

6c. Syntax: N' → (S') (NP) N

Semantics: $[_{N'}$ S' NP $N^2]$ translates into λx NP' (^ λy [$N^{2'}$ (^ S") (y) (x)]) [N.B. S" = the translation of S-bar]

The superscripted *n* appearing to the right of N is a variable indicating the polyadicity of the noun. Here, we are only concerned with nouns such as *syutyoo* 'claim' whose polyadicity is two and which take both S' and NP as their complements. These nouns are translated as three-place predicates having an individual, a proposition, and another individual (intuitively an event) as arguments. The semantic rule is straightforward.

Nouns which may take clausal complements are distinguished in this fragment from "ordinary" common nouns, such as (Japanese equivalents of) *dog, cat, book, man,* in the following way: nouns taking a clausal complements are considered to be three-place relations among an event, an individual, and a proposition, whereas "ordinary" common nouns are unary predicates of individuals. We do not posit special variables for events, and they are treated simply as entities (type e). Some verbs are assumed to denote a property of "normal" individuals (e.g. *sun-deiru* 'live', *hasiru* 'run', *neru* 'sleep', etc.); others denote a property of events (e.g. *suru* lit. 'do', 'occur', etc.); perhaps, some others denote both a property of "normal" individuals and a property of events (e.g. *yoku sirare-te iru* 'be well-known').

The word order proposed here ($[_{N'}$ Adj. $[_{N'}$ S' NP N]]) is just one of many possible word orders among temporal adjectives, clausal complements, and NP's.[5] I adopt this word order because it enables us to propose a semantic rule which treats clausal complements and genitive-case-marked NP's as arguments of this special class

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[5] All the word-order possibilities listed below are possible in Japanese. (d) is the one that is generated by the rules proposed. I do not have strong intuitions as to which of the following is the most preferred word order.

(a) $[_{NP}[_{S'}[_{S}$Mary-ga toosensu-ru] to yuu] John-no izen-no yosoo] -wa
NOM be-elected PRES GEN earlier prediction TOP
yokusirarete i -ru.
be-well-known PRES
John's earlier claim that Mary would be elected is well-known.

(b) $[_{NP}$John-no $[_{S'}[_{S}$Mary-ga toosensuru] to yuu] izen-no yosoo]-wa yokusirarete i-ru.
(c) $[_{NP}$Izen-no John-no $[_{S'}[_{S}$Mary-ga toosensuru] to yuu] yosoo]-wa yokusirarete i-ru.
(d) $[_{NP}$Izen-no $[_{S'}[_{S}$Mary-ga toosensuru] to yuu] John-no yosoo]-wa yokusirarete i-ru.

of nouns. Furthermore, by generating the possessive NP within the N' we can preserve the generalization that the semantic type of an N' is a property. This position is defensible in Japanese because it does not have determiners and possessive NP's behave like adjectives. However, as we shall see later, the rule proposed here does not work in English because possessive NP's in English occupy determiner positions and hence must be generated as sisters to N's. I leave open the question of whether or not the rule which will be proposed below for English should be adopted for Japanese as well. (See the relevant comments on the English fragment.)

The truth conditions of the predicate prediction' can be given in the following way:

(3) $[\![\text{prediction}'\ (x, y, p)]\!]^{M,w,t,g} = 1$ iff $[\![\text{predict}'\ (y, p)]\!]^{M,w,t,g} = 1$ and x is the event of g(y)'s predicting g(p) at <w, t>.

This truth condition avoids the following potential problem. Since the extensions of prediction' and predict' are independent of each other unless stipulated otherwise, interpreting the formula $[\![\text{prediction}'\ (x, y, p)]\!]^{M,w,t,g}$ as meaning 'g(x) is a prediction by g(y) that g(p) at <w,t>' does not necessarily lead to the understanding that the time of g(y)'s predicting that g(p) is t.[6, 7] The above truth condition of prediction'

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[6] Irene Heim (p.c.) pointed out this potential problem to me.

[7] I believe there is another way of coping with the problem: keep the default interpretation of the predicate prediction' (i.e. $[\![\text{prediction}'\ (x, y, p)]\!]^{M,w,t,g}$ means 'x is a prediction by y that p at <w,t>') and assume that g(x) is a prediction only at the maximal interval of g(y)'s predicting that g(p). Under this proposal, it follows that t is the time of predicting without positing the truth condition proposed in the text.

guarantees that the time of evaluation (t in this case) is the time of predicting. Another advantage of (3) is that we do not have to explain separately why the time of the event or state described by the complement of the predicate prediction' is determined in relation to the time of predicting; this is derived from the fact that the event or state described by the complement of the predicate predict' is determined in relation to the time of predicting, which is explained elsewhere.

One example involving a noun with a clausal complement is given below:

(4) [$_{NP}$ izen-no [$_{S'}$ Mary-ga toosensur-u-to yuu] John-no
earlier NOM be-elected PRES GEN

yosoo] -wa yoku si-rare-te ir-u.
prediction TOP well be-known PRES

John's earlier prediction that Mary would be elected is well-known.

1. Mary-ga toosensur-u 'Mary woll be elected [Lit. is elected]' ⇒

   λt [FUT (t) & t $\subseteq$ t_{R1} & AT (t, be-elected' (m))]

2. Mary-ga toosensur-u to yuu 'that Mary woll be elected [Lit. is elected]' ⇒ $\exists t'$ [λt [FUT (t) & t $\subseteq$ t_{R1} & AT (t, be-elected' (m))](t')]

3. $\exists t$ [FUT (t) & t $\subseteq$ t_{R1} & AT (t, be-elected' (m))]

4. Mary-ga toosensur-u to yuu John-no yosoo 'John's prediction that Mary woll be elected' ⇒

   λx [λPP{j} (^ λy [prediction' (^ $\exists t$ [FUT (t) & t $\subseteq$ t_{R1} & AT (t, be-elected' (m))]) (y) (x)])]

5. $\lambda x\, \lambda y$ [prediction' ($\wedge\ \exists t$ [FUT (t) & $t \subseteq t_{R1}$ & AT (t, be-elected' (m))]) (y) (x)] (j)

6. λx [prediction' ($\wedge\ \exists t$ [FUT (t) & $t \subseteq t_{R1}$ & AT (t, be-elected' (m))]) (j) (x)]

7. izen-no Mary-ga toosensur-u to yuu John-no yosoo 'John's earlier prediction that Mary would be elected' (N'-level) $\Rightarrow$

   $\lambda P \lambda y\ \exists t'$ [PAST (t') & $t' \subseteq t_{R2}$ & AT (t', P {y})]

   ($\wedge\ \lambda x$ [prediction' ($\wedge\ \exists t$ [FUT (t) & $t \subseteq t_{R1}$ & AT (t, be-elected' (m))]) (j) (x)])

8. $\lambda y\ \exists t'$ [PAST (t') & $t' \subseteq t_{R2}$ & AT (t', prediction' ($\wedge\ \exists t$ [FUT (t) & $t \subseteq t_{R1}$ & AT (t, be-elected' (m))]) (j) (y))]

9. izen-no Mary-ga toosensur-u to yuu John-no yosoo 'John's earlier prediction that Mary would be elected' (NP-level)$\Rightarrow$

   $\lambda P\ \exists x$ [$\lambda y\ \exists t'$ [PAST (t') & $t' \subseteq t_{R2}$ & AT (t', prediction' ($\wedge\ \exists t$ [FUT (t) & $t \subseteq t_{R1}$ & AT (t, be-elected' (m))]) (j) (y))] (x) & P {x}]

10. $\lambda P\ \exists x$ [$\exists t'$ [PAST (t') & $t' \subseteq t_{R2}$ & AT (t', prediction' ($\wedge\ \exists t$ [FUT (t) & $t \subseteq t_{R1}$ & AT (t, be-elected' (m))]) (j) (x))] & P {x}]

11. John-no [$_{S'}$ Mary-ga toosensur-u-to yuu] izen-no yosoo]-wa yoku sirare-te ir-u (untensed). 'John's earlier prediction that Mary would be elected be well-known' $\Rightarrow$

    $\exists x$ [$\exists t'$ [PAST (t') & $t' \subseteq t_{R2}$ & AT (t', prediction' ($\wedge\ \exists t$ [FUT (t) & $t \subseteq t_{R1}$ & AT (t, be-elected' (m))]) (j) (x))] & be-well-known' (x)]

12. John-no [$_{S'}$ Mary-ga toosensur-u-to yuu] izen-no yosoo]-wa yoku sirare-te ir-u (tensed). 'John's earlier prediction that Mary would be elected is well-known' $\Rightarrow$
$\lambda p\, \lambda t$ [PRES (t) & AT (t, $^{\vee}$ p)] ($^{\wedge}$ $\exists$x [$\exists$t' [PAST (t') & t' $\subseteq$ t_{R2} & AT (t', prediction' ($^{\wedge}$ $\exists$t [FUT (t) & t $\subseteq$ t_{R1} & AT (t, be-elected' (m))]) (j) (x))] & be-well-known' (x)])

13. λt [PRES (t) & AT (t, $\exists$x [$\exists$t' [PAST (t') & t' $\subseteq$ t_{R2} & AT (t', prediction' ($^{\wedge}$ $\exists$t [FUT (t) & t $\subseteq$ t_{R1} & AT (t, be-elected' (m))]) (j) (x))] & be-well-known' (x)])]

14. John-no [$_{S'}$ Mary-ga toosensur-u-to yuu] izen-no yosoo]-wa yoku sirare-te ir-u (matrix sentence). 'John's earlier prediction that Mary would be elected is well-known' $\Rightarrow$
$\exists$t [PRES (t) & AT (t, $\exists$x [$\exists$t' [PAST (t') & t' $\subseteq$ t_{R2} & AT (t', prediction' ($^{\wedge}$ $\exists$t [FUT (t) & t $\subseteq$ t_{R1} & AT (t, be-elected' (m))]) (j) (x))] & be-well-known' (x)])]

15. $\exists$x [be-well-known' (x) & $\exists$t' [PAST (t') & t' $\subseteq$ t_{R2} & AT (t', prediction' (x, j, $^{\wedge}$ $\exists$t [FUT (t) & t $\subseteq$ t_{R1} & AT (t, be-elected' (m))]))]] [$\exists$-elimination for PRES; relational notation]

Notice here that the present tense in the noun complement corresponds to FUT in the translation. This is because the present tense has a future meaning here. Note that the future tense in the noun complement is in the scope of the past-tense-like adjective *izen-no* 'earlier'.

At this point, let us briefly discuss an issue connected with the interaction between relative clauses and noun complements. Employing a temporal adjective is not the only way to indicate the time of the event associated with the predicate prediction'; we can also use a relative clause to specify the time of predicting as in (5):

(5) $[_{NP}[_{S'}$ John-ga e_i si -ta $wh_i]$ $[_{N'}[_{S'}$Mary-ga toosensur-u-to yuu]
NOM do PST NOM be-elected PRES

yosoo]] -wa yoku sirare-te ir-u.
prediction TOP be-well-known PRES

The prediction that Mary would be elected which John made is well-known.

In this sentence, *John* appearing in the relative clause is not an argument of the noun *yosoo* 'prediction'. Thus, it can be concluded that it is possible for the noun *yosoo* to take only one argument (i.e. to be used semantically as a two-place predicate). A potential problem shows up, however, in dealing with the temporal property of *yosoo* 'prediction'. Under the current proposal, the final translation of (5) is the following:[8]

(5') $\exists x$ [be-well-known' (x) & $\exists t'$ [PAST (t') & $t' \subseteq t_{R1}$ & AT (t', make' (j, x))] & prediction' (x, ^ $\exists t$ [FUT (t) & $t \subseteq t_{R2}$ & AT (t, be-elected' (m))])]

[8] We assume here that prediction' is a two-place predicate because the "agent argument" is expressed in the relative clause, not in the complement of the noun *yosso* 'prediction'.

make' denotes a two-place relation taking an individual and an event individual as arguments. Since x is an argument of prediction' here, make' (j, x) can be read in plain English as 'j makes x'. Note that the past tense in the relative clause does not have scope over the translation of the N'. Thus, the translation of the N' is read as "x is a prediction that Mary be elected in the future". Since the translation of the N' is not in the scope of the past tense in the relative clause, it is not obvious that the time of prediction is predicted to be located in the past of the speech time. In fact, the default conclusion would be that the time of prediction is simultaneous with the speech time. One possible conclusion to be drawn from this fact is that our translation rule for relative clauses is at fault. That is, the tense in the relative clause should have scope over the translation of the N'.[9] Alternatively, we might try to arrive at the time of predicting without changing the rule for relative clauses. For example, in the above formula, we know that John made g(x) at g(t'). We also know that g(x) is the event of predicting that there is a future time at which Mary is elected (i.e. $^\wedge \exists t$ [FUT (t) & AT (t, be-elected' (m))]). We may be able to conclude from this that the time of predicting is g(t'), a past time.

The general question is how to determine the temporal properties of nouns. The data involving time-sensitive nouns like *tizi* 'governor' and *horyo* 'hostage' are relevant here, but they do not give us a clear-cut answer to this question. For example, according to my intuition, the individual denoted by the subject NP in (6) must be an incumbent governor at the time of the party, which suggests that the N' *tizi* 'governor'

[9] It is not clear how to bring about this result compositionally, however.

is not in the scope of the past tense in the relative clause. This is predicted to be the case under the current system:

(6) [$_{NP}$[$_{S'}$ Mary-to noti kekkonsu-ru] tizi] -mo sono paatii
with later marry PRES governor also that party

ni ki -ta.
to come PST

The governor who would marry Mary also came to the party.

[N.B. the present tense in the relative clause has a future meaning here.]

(6') $\exists t''[\text{PAST}(t'') \ \&\ t'' \subseteq t_{R3} \ \&\ \text{AT}(t'', \exists x\,[\text{governor}'(x) \ \&\ \text{come-to-the-party}'(x) \ \&\ \exists t\,[\text{FUT}(t) \ \&\ t \subseteq t_{R1} \ \&\ \text{AT}(t, \text{marry}'(x, m))]]\,)]$

As (6') shows, the translation of the relative clause and the translation of the N' are independent of each other. Thus, the time of g(x)'s marrying Mary is located in the future of the time of the party, and the time of g(x)'s being a governor is located at the time of the party.

However, when we turn to examples which involve truly quantificational determiners (e.g. *hotondo* 'most'), the current rule for relative clauses appears to be problematic:

(7) [So-no paatii-ni ki -ta tizi no hotondo]-ga
that party to come PST governor GEN most NOM

koko-ni ir-u.
here at be PRES

Most (of the) governors who came to the party are here.

Let us assume the following semantic rule (which employs a set-theoretic notation) for most' which translates *hotondo* 'most', which I believe to be standard:

(8) $[\![\text{most}'(X, Y)]\!]^{M,w,t,g} = 1$ iff $|X \cap Y| \geq 1/2\ |X|$ where X is the translation of the N' and Y is the translation of the VP.

Following this rule for most', we arrive at the prediction that (7) evaluated at <w, t> is true just in case the following is true: $|A \cap B| \geq 1/2\ |A|$ where $B = \{x \mid [\![\text{be-here}'(x)]\!]^{M,w,t,g} = 1\}$ and $A = \{x \mid [\![\text{governor}'(x)]\!]^{M,w,t,g} = 1\ \&\ [\![\exists t' [\text{PAST}(t')\ \&\ \text{AT}(t', \text{come-to-the-party}'(x))]\!]^{M,w,t,g} = 1\}$. However, this does not agree with my intuition. It seems that the time of being a governor must be the time of the party and not the speech time.

There are several possible ways of settling the issue, but none of them seems convincing. The following possibilities come to mind: (i) put the translation of the N' in the scope of the relative clause tense; (ii) introduce a free variable of type i for each noun, following Enç's (1981, 1986) suggestion. If the proposal (i) is adopted, (7) is taken care of correctly. However, the problem is that it is not always the case that nouns are interpreted as embedded in the scope of the relative clause tense as (6) shows. The proposal (ii) is compatible with any reading because the temporal property of a noun is determined by the value assigned to the free time variable reserved for the noun. However, this prediction is too liberal if it is true that the N' in (7) can only be interpreted as being in the scope of the relative clause tense. Without having any strong evidence for any of the alternatives, I leave the rules for relative clauses and nouns intact.

6d. Syntax: N' $\rightarrow$ (S') (NP) N^n

Semantics: $[_{N'}\ S'\ N^1]$ translates into $[N^{1'}(\wedge S'')]$) [N.B. S'' = the translation of S']

This rule is for sentential subjects. I assume that the Japanese nominalizers *no* and *koto* are nouns which take S' as a complement. The semantics of the nominalizer no' is given in the following way:

(9) $[\![no'(x, p)]\!]^{M,w,t,g} = 1$ iff g(x) is the individual correlate of g(p).

Let us present an example and explain how the predicate no' works:

(10) [NP John-ga mooside-o kotowat-ta no] wa
NOM offer ACC refuse PST N TOP

akirakadat -ta.
be-obvious PST

[N.B. N = nominalizer]

That John refused the offer was obvious.

1. John-ga mooside-o kotowat-ta 'John refused the offer' $\Rightarrow$

   $\lambda p\, \lambda t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, {}^{\vee}p)]\ ({}^{\wedge}\ refuse\text{-}the\text{-}offer'(j))$

2. $\lambda t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, refuse\text{-}the\text{-}offer'(j))]$

3. $\exists t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, refuse\text{-}the\text{-}offer'(j))]$

4. John-ga mooside-o kotowat-ta no 'that John refused the offer' $\Rightarrow$

   $no'({}^{\wedge}\exists t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, refuse\text{-}the\text{-}offer'(j))])$

5. $\lambda P\, \exists x\, [no'({}^{\wedge}\exists t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, refuse\text{-}the\text{-}offer'(j))])(x)\ \&\ P\{x\}]$

6. John-ga mooside-o kotowat-ta no wa akiraka 'that John refused the offer be obvious' $\Rightarrow$

   $\exists x\, [be\text{-}obvious'(x)\ \&\ no'(x, {}^{\wedge}\exists t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, refuse\text{-}the\text{-}offer'(j))])]$

7. John-ga mooside-o kotowat-ta no wa akirakadat-ta 'that John refused the offer was obvious' $\Rightarrow$ $\lambda p\, \lambda t\, [PAST(t)\ \&\ t \subseteq t_{R2}\ \&\ AT(t, {}^{\vee}p)]\ ({}^{\wedge}\exists x\, [be\text{-}obvious'(x)\ \&\ no'(x, {}^{\wedge}\exists t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, refuse\text{-}the\text{-}offer'(j))])])$

8. $\lambda t\, [PAST(t)\ \&\ t \subseteq t_{R2}\ \&\ AT(t, \exists x\, [be\text{-}obvious'(x)\ \&\ no'(x, {}^{\wedge}\exists t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, refuse\text{-}the\text{-}offer'(j))])])]$

9. $\exists t\, [PAST(t)\ \&\ t \subseteq t_{R2}\ \&\ AT(t, \exists x\, [be\text{-}obvious'(x)\ \&\ no'(x, {}^{\wedge}\exists t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, refuse\text{-}the\text{-}offer'(j))])])]$

Intuitively, (10) asserts that the proposition denoted by the subject NP has the property of being obvious. However, in order to maintain the existing correspondences between syntactic categories and semantic types in a typed system like ours, we should preserve the generalization that one-place predicates like be-obvious' take individuals as arguments. In order to enable propositions to serve as arguments for predicates like be-obvious', we must "type-shift" the proposition from <s,t> to e. Thus, we need a model-theoretic entity which is an individual type-wise but is intuitively a proposition. This is what we mean by the "individual correlate of g(p)" in the above truth conditions of no'.

In (10), the subject NP is interpreted in situ, and the sentence receives the desired interpretation: the subject NP is in the scope of the matrix tense. According to the above rules, the NP also has the option of being QR-ed to an S-adjoined position. This predicts a non-existing reading in which the time of being obvious and the time of John's refusal are independent of each other. Intuitively, the reason is clear. The matrix adjective *akiraka-da* 'be-obvious' is used to express an attitude of a concealed agent (the speaker, the general public, etc.) about a proposition. Thus, *akiraka-da* 'be-obvious' is like a propositional attitude verb and takes an argument which has a propositional content. Put in plain terms, the proposition which is considered obvious must be viewed from the perspective of the person(s) who thought that it was obvious, and it cannot escape the scope of the matrix tense. Therefore, the reason that the subject NP cannot be QR-ed (or quantified in in MG terms) is because it has a proposition-like semantic content. Since the NP status of sentential subjects in Japanese is not in doubt,[10] this raises an interesting question as to what licenses QR. One possibility is that QR is not licensed by the categorial status of the

10 See Chapter 2 for details.

constituent (i.e. being an NP) in question but by something else. Since I am not clear about what this something else is, I simply stipulate that NP's denoting a proposition occurring under an propositional-attitude adjective cannot be QR-ed.

6f. Syntax: NP → Name

Semantics: $[_{NP}$ Name$]$ translates into λPP{Name'}

Names are translated as generalized quantifiers as is customary in a Montagovian framework.

Syntax:

7. S' → S to yuu

S to

Semantics:

7a. $[_{S'}$ S to yuu$]$ translates into ∃t [S' (t)] [N.B. S' = the translation of S]

7b. $[_{S'}$ S to$]$ translates into ∃t [S' (t)] [N.B. S' = the translation of S]

This syntactic rule serves to produce noun complements and verb complements. The semantic rule introduces an existential quantifier and serves to produce a sentence out of a temporal abstract (i.e. an expression of type <i, t>).

Syntax:

8. VP → (NP) V

S' V

Adv. P VP

Semantics:

8a. $[_{VP}$ NP $V^1]$ translates into $V^{1'}$ (^NP')

8b. $[_{VP}$ $V^0]$ translates into $V^{0'}$

8c. $[_{VP}$ S' $V^1]$ translates into $V^{1'}$ (^S") [S" = the translation of S-bar]

8d. $[_{VP}$ Adv. P VP] translates into Adv. P' (^VP')

8a and 8b are standard and straightforward. 8c is also standard, but since this rule is quite important in the present context, I will give an example and show how the rule works. Note that the tense morpheme appearing in the verb complement is in the scope of the matrix tense.

(11) John-ga $[_S$Mary-ga ki -ta] -to it -ta.
NOM NOM come PST that say PST
John said that Mary came (or had come).

1. Mary-ga ki-ta 'Mary came' $\Rightarrow \lambda t\,[PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, come'(m))]$

2. Mary-ga ki-ta to 'that Mary came' $\Rightarrow \exists t\,[PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, come'(m))]$

3. Mary-ga ki-ta-to iu 'say that Mary came' $\Rightarrow say'(x, \wedge \exists t\,[PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, come'(m))])]$

4. John-ga $\Rightarrow \lambda PP\{j\}$

5. John-ga $[_S$Mary-ga ki-ta]-to it-ta 'John said that Mary came' $\Rightarrow$ $\lambda t'\,[PAST(t')\ \&\ t' \subseteq t_{R2}\ \&\ AT(t', \lambda PP\{j\}(\wedge \lambda x\,[say'(x, \wedge \exists t\,[PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, come'(m))])]))]$

6. $\lambda t'$ [PAST (t') & $t' \subseteq t_{R2}$ & AT (t', say' (j, ^ $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, come' (m))]))]

7. $\exists t'$ [PAST (t') & $t' \subseteq t_{R2}$ & AT (t', say' (j, ^ $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, come' (m))]))]

8d takes care of adverbials. We are only concerned with temporal adverbials in this fragment. Temporal adverbials are functions of type <<s, <e,t>>, <e,t>> which take VP-intensions as arguments and return VP-extensions. Both (lexical) adverbs such as *sitigatu 23 niti* 'July 23rd' and temporal adverbial clauses such as *John-ga ie-ni kaet-ta ato* 'after John left for home' fall under the category Adverbial Phrase. Adverbials in general serve as temporal frames within which the event or state described in the sentence obtains. In other words, adverbials impose restrictions on the domain over which the past tense morpheme quantifies. We will see how adverbial phrases are treated below:

Syntax:

9. Adv. P $\rightarrow$ Adv.

S Conj.

Semantics:

9a. $[_{\text{Adv. P}}$ Adv.$]$ translates into Adv.'

9b. $[_{\text{Adv. P}}$ S Conj.$]$ translates into Conj' (^ S')

These rules serve to generate adverbial phrases, which are either plain adverbs or temporal adverbial clauses.[11] Adverbial phrases must be of type <<s, <e, t>>, <e, t>>. In 6b, the translation of S is of type <i, t> (temporal abstract). Thus, conjunctions are of type <<s,<i, t>>, <<s, <e, t>>, <e, t>>>. Plain adverbials such as *on June 20th* are translated in the following way:

(12) on July 20th' = $\lambda P\ \lambda x[\ t^* \subseteq$ July 20th' & $P\{x\}]$

[N.B. July 20th' denotes the interval corresponding to the duration of July 20th.]

Here, t* (due to Dowty (1982)) is an indexical constant which always denotes its evaluation time:

(13) $[\![t^*]\!]^{M,w,t,g} = t$

Let us examine how the following sentence is translated:

(14) John-wa sitigatu hatuka ni sin-da.
TOP July 20th on die PAST
John died on July 20th.

[11] Syntactically, it is more accurate to label temporal adverbial clauses in Japanese as postpositional phrases, rather than adverbial phrases, because the postposition ni 'at' is usually attached to the conjunction in question:

(a) $[_{PP}[_{Adv.P}[_S$ Mary-ga kit -ta$]$ $[_{Conj.}$ ato$]]$ $[_P$ ni$]]$
NOM come PST after at
after Mary comes (or has come) (Lit. at after Mary came)

1. sitigatu hatuka ni 'on July 20th' $\Rightarrow \lambda P \lambda x\ [t^* \subseteq \text{July 20th'} \ \&\ P\{x\}]$
2. sitigatu hatuka ni sinu 'die on July 20th' $\Rightarrow \lambda x\ [t^* \subseteq \text{July 20th'} \ \&$ $\text{die'}(x)]$
3. John-wa sitigatu hatuka ni sinu 'John die on July 20th' $\Rightarrow t^* \subseteq \text{July}$ $\text{20th'} \ \&\ \text{die'}(j)$
4. John-wa sitigatu hatuka ni sin-da 'John died on July 20th' $\Rightarrow$ $\lambda t\ [\text{PAST}(t)\ \&\ t \subseteq t_{R1}\ \&\ \text{AT}(t, \text{die'}(j)\ \&\ t^* \subseteq \text{July 20th'})]$
5. $\exists t\ [\text{PAST}(t)\ \&\ t \subseteq t_{R1}\ \&\ \text{AT}(t, \text{die'}(j))\ \&\ t \subseteq \text{July 20th'}]$

Note that the adverb rule allows multiple occurrences of adverbials:

(15) [$_{VP}$1987-nen sitigatu hatuka-ni sinu]
year July 20th on die
die on July 20th in 1987

1. sitigatu hatuka-ni sinu 'die on July 20th' $\Rightarrow$ $\lambda P\ \lambda x[\ t^* \subseteq \text{July 20th'} \ \&\ P\{x\}]\ \ (^\wedge\ \text{die'})$
2. $\lambda x\ [t^* \subseteq \text{July 20th'} \ \&\ \text{die'}(x)]$
3. 1987-nen sitigatu hatuka-ni sinu 'die on July 20th in 1987' $\Rightarrow$ $\lambda P\ \lambda x\ [t^* \subseteq \text{1987'} \ \&\ P\{x\}]\ \ (^\wedge\ \lambda x\ [t^* \subseteq \text{July 20th'} \ \&\ \text{die'}(x)])$
4. $\lambda x\ [t^* \subseteq \text{1987'} \ \&\ t^* \subseteq \text{July 20th'} \ \&\ \text{die'}(x)]$

See my comments on 13 for an example involving a temporal adverbial clause.

10. Syntax: Wh-movement at S-structure

Semantics: $[_{S'} [_S \ldots e_k \ldots] [_{COMP}\ wh_k]]$ translates into $\lambda x_k\ \exists t[S'(t)]$

It is customary in syntax to assume that relative clause formation involves wh-movement. I follow this practice and assume that the wh-element in a relative clause is moved at S-structure (or at LF) to COMP, creating an operator-variable configuration between the moved wh-element and the trace it leaves behind. Since there are no overt relative pronouns in Japanese, I assume that there are empty wh-elements.[12] The semantic rule for relative clauses simply takes this syntactic structure as the input and translates the wh-phrase as the combination of a lambda abstractor and a variable. The following example shows how the rule works:

(16) $[_{NP}[_{S'} [_S e_k$ warat-te ir -u] [COMP wh_k]] otoko]-ga ki -ta.
laugh PROG PRES man NOM come PST
A man who was/is smiling came.

1. otoko 'a man' ⇒ man'
2. warat-te iru 'who is laughing' ⇒ $\lambda x\ [\exists t\ [\lambda t'\ [PRES\ (t')\ \&\ AT\ (t',$ be-laughing' $(x))](t)]]$
3. $\lambda x\ [\exists t\ [PRES\ (t)\ \&\ AT\ (t,$ be-laughing' $(x))]]$

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[12] This part of the proposal should not be taken seriously. Alternatively, it is possible to arrive at the correct interpretation of relative clauses in Japanese by assuming the following semantic rule (suggested to me by Irene Heim) assuming that the gap in the S (relative clause) is co-indexed with the head noun:

(a) $[N'\ S\ N_k]$ translates into $\lambda x_k\ [S'\ \&\ N''\ (x_k)\ \&\ P\ \{x_k\}]$

4. warat-te iru otoko (N'-level) 'a man who is laughing' $\Rightarrow$

   $\lambda y\ [\lambda x\ [\text{be-laughing}'\ (x)]\ (y)\ \&\ \text{man}'\ (y)]$

5. $\lambda y\ [\text{be-laughing}'\ (y)\ \&\ \text{man}'\ (y)]$

6. warat-te iru otoko (NP-level) 'a man who is laughing' $\Rightarrow$

   $\lambda P\ \exists x\ [\lambda y\ [\text{be-laughing}'\ (y)\ \&\ \text{man}'\ (y)](x)\ \&\ P\{x\}]$

7. $\lambda P\ \exists x\ [\text{be-laughing}'\ (x)\ \&\ \text{man}'\ (x)\ \&\ P\{x\}]$

8. warat-te iru otoko-ga kur 'a man who is smiling come' $\Rightarrow$

   $\exists x\ [\text{man}'\ (x)\ \&\ \text{be-laughing}'\ (x)\ \&\ \text{come}'\ (x)]$

9. warat-te iru otoko-ga ki-ta 'a man who is smiling came' $\Rightarrow$

   $\lambda t[\text{PAST}\ (t)\ \&\ t \subseteq t_{R1}\ \&\ \text{AT}\ (t, \exists x\ [\text{man}'\ (x)\ \&\ \text{be-laughing}'\ (x)\ \&\ \text{come}'\ (x)])]$

10. $\exists t[\text{PAST}\ (t)\ \&\ t \subseteq t_{R1}\ \&\ \text{AT}\ (t, \exists x\ [\text{man}'\ (x)\ \&\ \text{be-laughing}'\ (x)\ \&\ \text{come}'\ (x)])]$

Note that the present tense morpheme in the relative clause is evaluated with respect to the time of coming, which is in the past of the speech time. Put another way, the tense in the relative clause is in the scope of the matrix tense. This is so because the NP is interpreted in situ. If it is scoped over the matrix clause, the tense in it is evaluated with respect to the speech time; i.e. independently of the matrix tense. This option is illustrated right below in connection with QR.

Syntax:

11. Chomsky-adjoin an NP to S or VP at LF (optional)

Semantics:

11a. $[_S\ NP_k\ [_S \ldots e_k \ldots]]$ translates into $NP'\ (^\wedge \lambda x_k\ \exists t\ [S'\ (t)])$

11b. $[_{VP}\ NP_k\ [_{VP} \ldots e_k \ldots]]$ translates into $\lambda y\ [NP'\ (^\wedge \lambda x_k\ [VP'\ (y)])]$

NP's are optionally scoped over as S or a VP. First, consider 11a. Let us take the sentence discussed immediately above and consider the wide scope option for the NP.

```
(17)   [NP[S' [Sek warat-te ir     -u] [COMP whk]] otoko]-ga     ki     -ta.
                 laugh PROG PRES                   man    NOM come PST
       A man who is/was smiling came.
```

LF structure:

```
[S[NPi[S' [Sek warat-te ir     -u] [COMP whk]] otoko]-ga
                  laugh PROG PRES                man    NOM
[S ei  ki     -ta]]
       come PST
```

1. warat-te iru otoko 'a man who is laughing' ⇒

   $\lambda Q\ \exists x$ [man' (x) & be-laughing' (x) & Q {x}]

   (see above for detailed derivations)

2. $[_S\ e_i$ ki-ta] ⇒ λt [PAST (t) & $t \subseteq t_{R1}$ & AT (t, come' (x))]

3. $[_S[_{NPi}[_{S'}\ [_S\ e_k$ warat-te ir-u] $[_{COMP}\ wh_k]]$ otoko]-ga $[_S\ e_i$ ki-ta]]

   ⇒ $\lambda Q\ \exists x$ [man' (x) & be-laughing' (x) & Q {x}]

   ($\lambda y\ \exists t'$ [λt [PAST (t) & $t \subseteq t_{R1}$ & AT (t, come' (y))]](t'))

4. $\exists x$ [man' (x) & be-laughing' (x) & $\exists t'$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, come' (x))]]

Notice that in this derivation, the time of the man's laughing is interpreted independently of the matrix past tense. Thus, the time of laughing is interpreted in relation to the speech time. The resulting interpretation is that a person who is laughing at the speech time came at a time earlier than the speech time.

11b provides a means of accounting for the case where an NP appears to have scope over an intensional verb (such as *sagasu* 'seek') and within the tense.

(18) John-wa $[_{NP}[_{S'}[_{S}e_k$ warat-te ir -u] $[_{COMP}$ $wh_k]]$ otoko]-o
TOP laugh PROG PRES man ACC

sagasi -ta
look-for PST

LF structure:

John-wa $[_{VP}[_{NP_i}[_{S'}[_{S}e_k$ warat-te i Pres] $[_{COMP}$ $wh_k]]$ otoko]-o$[_{VP}$ e_i sagasu] Past]

1. warat-te ir-u otoko 'a man who is laughing' ⇒

   $\lambda Q\, \exists x\, [\text{man}'(x)\ \&\ \text{be-laughing}'(x)\ \&\ Q\{x\}]$

2. e_x sagasu 'look for' ⇒ look-for' $(^\wedge \lambda PP\{x\})$

3. warat-te ir-u otoko-o sagasu 'look for a man who is laughing' ⇒

   $\lambda y\, \lambda Q\, \exists x\, [\text{man}'(x)\ \&\ \text{be-laughing}'(x)\ \&\ Q\{x\}]\ (^\wedge \lambda z\, [\text{look-for}'\ (^\wedge \lambda PP\{z\})\ (y)])$

4. $\lambda y\, \exists x\, [\text{man}'(x)\ \&\ \text{be-laughing}'(x)\ \&\ \text{look-for}'\ (^\wedge \lambda PP\{x\})\ (y)]$

5. John-wa $[_{VP}[_{NP_i}[_{S'}\ [_S e_k$ warat-te i Pres] $[_{COMP}\ wh_k]]$ otoko]-o$[_{VP}\ e_i$ sagasu Past]] 'John looked for a man who was [Lit. is] laughing' $\Rightarrow$

   $\lambda t[PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ AT\ (t, \exists x\ [man'\ (x)\ \&\ be\text{-}laughing'\ (x)\ \&\ look\text{-}for'\ (\wedge\ \lambda PP\{x\})\ (j)])]$

6. $\exists t[PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ AT\ (t, \exists x\ [man'\ (x)\ \&\ be\text{-}laughing'\ (x)\ \&\ look\text{-}for'\ (\wedge\ \lambda PP\{x\})\ (j)])]$

7. $\exists t[PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ AT\ (t, \exists x\ [man'\ (x)\ \&\ be\text{-}laughing'\ (x)\ \&\ look\text{-}for'* \ (j, x)])]$

   [N.B. $look\text{-}for'* =_{def.}\ \lambda y \lambda x\ [look\text{-}for'\ (\wedge\ \lambda PP\{y\})\ (x)]$

The point of this example is that it is possible for the NP in question to receive a de re interpretation (i.e. having scope over the verb) even if the tense contained in it is interpreted as being under the scope of the matrix tense. Note that in this derivation, the NP is scoped to a position between the matrix tense and the matrix verb. The final line of the translation shows that the NP escapes the scope of the intensional verb *sagasu* 'look-for' but the present tense occurring in it receives its interpretation relative to the time of looking for (i.e. the NP tense is in the scope of the matrix tense), as desired. The description of the individual denoted by the NP is attributed to the speaker, whereas the time of the man's laughing is simultaneous with the time of looking for.

12. *izen-no* 'prior-GEN' translates into

$\lambda P \lambda x\ \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

mae-no 'before-GEN' translates into

$\lambda P \lambda x\ \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

noti-no 'later-GEN' translates into

$\lambda P \lambda x\ \exists t\ [FUT\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

These special adjectives ("temporal adjectives") serve to indicate the temporal location of the head noun in relation to the evaluation time of the NP. Note that these adjectives are also good for common nouns such as *daitooryoo* 'president', *horyo* 'hostage', etc. which do not take any complements.

13. *mae-ni* 'before' translates into $\lambda P_t\ \lambda P \lambda x\ [P\{x\}\ \&\ \exists t_1\ [t_1 > t^*\ \&\ M\ (t^*, t_1)$ $\&\ P_t\ \{t_1\}]]$

ato-ni 'after' translates into $\lambda P_t\ \lambda P\ \lambda x\ [P\{x\}\ \&\ \exists t_1\ [t_1 < t^*\ \&\ M\ (t^*, t_1)$ $\&\ P_t\ \{t_1\}]]$

toki-ni 'when' translates into $\lambda P_t\ \lambda P \lambda x\ [P\{x\}\ \&\ \exists t_1\ [M\ (t^*, t_1)\ \&\ P_t\{t_1\}]]$

Temporal conjunctions are of type <<s,<i,t>>, <<s,<e,t>>, <e,t>>>, i.e. those which take properties of times as arguments and VP-operators as their values. The two-place relation M is due to Stump (1985: 122). It is a two-place relation of type <i, <i,t>>. It imposes a restriction upon the relation between the two intervals. In most cases, the restriction imposed is that of temporal proximity. This is particularly true of *toki-ni* 'when', which requires that the event or state described in the adverbial clause and the event or state described in the main clause be temporally close. This proximity requirement is much looser with *ato-ni* 'after' and *mae-ni* 'before', but the requirement is still there. The exact nature of M remains unclear, but I ignore this problem. Let us take a sentence which involve *ato* 'after' and see how the translation proceeds:

(19) $[_{Adv.P}$ Mary-ga kit -a ato -ni] John-wa syuppatusur-u.
NOM come PST after at TOP leave PRS
John will leave after Mary has arrived.

1. ato-ni 'after' $\Rightarrow \lambda P_t \lambda P \lambda x\, [P\{x\}\ \&\ \exists t_1\, [t_1 < t^*\ \&\ M(t^*, t_1)\ \&\ P_t\{t_1\}]]$
2. Mary-ga kit-a 'Mary came' $\Rightarrow \lambda t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, come'(m))]$
3. Mary-ga kit-a ato-ni 'after Mary came' $\Rightarrow \lambda P_t \lambda P \lambda x\, [P\{x\}\ \&\ \exists t_1\, [t_1 < t^*\ \&\ M(t^*, t_1)\ \&\ P_t\{t_1\}]]\, (^\wedge \lambda t\, [PAST(t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, come'(m))])$
4. $\lambda P \lambda x\, [P\{x\}\ \&\ \exists t_1\, [t_1 < t^*\ \&\ M(t^*, t_1)\ \&\ PAST(t_1)\ \&\ t_1 \subseteq t_{R1}\ \&\ AT(t_1, come'(m))]]$
5. Mary-ga kit-a ato-ni syuppatusur 'leave after Mary came' $\Rightarrow$ $\lambda x\, [\, leave'(x)\ \&\ \exists t_1\, [t_1 < t^*\ \&\ M(t^*, t_1)\ \&\ PAST(t_1)\ \&\ t_1 \subseteq t_{R1}\ \&\ AT(t_1, come'(m))]]$

6. Mary-ga kit-a ato-ni John-wa syuppatusur 'John leave after Mary came' ⇒

   $[\text{leave}'(j) \,\&\, \exists t_1\, [t_1 < t^* \,\&\, M(t^*, t_1) \,\&\, PAST(t_1) \,\&\, t_1 \subseteq t_{R1} \,\&\, AT(t_1, \text{come}'(m))]]$

7. Mary-ga kit-a ato-ni John-wa syuppatusur-u 'John will leave after Mary came' ⇒

   $\lambda t[FUT(t) \,\&\, t \subseteq t_{R2} \,\&\, AT(t, \text{leave}'(j) \,\&\, \exists t_1\, [t_1 < t^* \,\&\, M(t^*, t_1) \,\&\, PAST(t_1) \,\&\, t_1 \subseteq t_{R1} \,\&\, AT(t_1, \text{come}'(m))])]$

8. $\exists t[FUT(t) \,\&\, t \subseteq t_{R2} \,\&\, AT(t, \text{leave}'(j) \,\&\, \exists t_1\, [t_1 < t^* \,\&\, M(t^*, t_1) \,\&\, PAST(t_1) \,\&\, t_1 \subseteq t_{R1} \,\&\, AT(t_1, \text{come}'(m))])]$

9. $\exists t[FUT(t) \,\&\, t \subseteq t_{R2} \,\&\, AT(t, \text{leave}'(j)) \,\&\, \exists t_1\, [t_1 < t \,\&\, M(t, t_1) \,\&\, t_1 \subseteq t_{R1} \,\&\, AT(t_1, \text{come}'(m))]]$

Note that under the current proposal, the time variable which is bound by the existential quantifier in the adverbial clause can only come from the outermost clause within the adverbial clause. That is, when a temporal adverbial clause contains some embedded clauses, the time variable in question cannot come from any of them. This seems to be the right generalization for Japanese, for (20a) does not have the reading which corresponds to the English counterpart (20b), which is discussed by Stump (1985: 145):

(20a) John-wa [$_{\text{Adv. P}}$[$_S$Mary-ga [$_S$John-ga ku -ru]
TOP NOM NOM come PRES

-to it -ta] ato ni] ku -ru.
that say PST after come PRES

(20b) John will come after Mary said he would.

Instead, (20a) has the reading that the English example (21) has:

(21) John will come after Mary has said that he would.

The current proposal assigns the right interpretation to (20):

(20') 1. ato-ni 'after' $\Rightarrow \lambda P_t \lambda P \lambda x\, [P\{x\}\ \&\ \exists t_1\ [t_1 < t^*\ \&\ M\,(t^*, t_1)\ \&\ P_t\ \{t_1\}]]$

2. Mary-ga John-ga kuru-to it-ta 'Mary said he woll come' $\Rightarrow$ $\lambda t_2[PAST\,(t_2)\ \&\ t_2 \subseteq t_{R1}\ \&\ AT\,(t_2, say'\,(m, {}^\wedge\, \exists t_3[FUT\,(t_3)\ \&\ t_3 \subseteq t_{R2}\ \&\ AT\,(t_3, leave'\,(j))]))]$

3. Mary-ga John-ga kuru-to it-ta ato-ni 'after Mary said he woll come' $\Rightarrow$

$\lambda P_t \lambda P \lambda x\, [P\{x\}\ \&\ \exists t_1\ [t_1 < t^*\ \&\ M\,(t^*, t_1)\ \&\ P_t\ \{t_1\}]]$

$({}^\wedge\, \lambda t_2[PAST\,(t_2)\ \&\ t_2 \subseteq t_{R1}\ \&\ AT\,(t_2, say'\,(m, {}^\wedge\, \exists t_3[FUT\,(t_3)\ \&\ t_3 \subseteq t_{R2}\ \&\ AT\,(t_3, come'\,(j))]))])$

4. $\lambda P \lambda x\, [P\{x\}\ \&\ \exists t_1\ [t_1 < t^*\ \&\ M\,(t^*, t_1)\ \&\ [PAST\,(t_1)\ \&\ t_1 \subseteq t_{R1}\ \&\ AT\,(t_1, say'\,(m, {}^\wedge\, \exists t_3[FUT\,(t_3)\ \&\ t_3 \subseteq t_{R2}\ \&\ AT\,(t_3, come'\,(x))]))]]]$

5. [Mary-ga John-ga kuru-to it-ta ato-ni] kuru ' [lit.] come after Mary said John woll come' ⇒
λx [come' (x) & $\exists t_1$ [$t_1 < t^*$ & M (t^*, t_1) & [PAST (t_1) & $t_1 \subseteq t_{R1}$ & AT (t_1, say' (m, ^ $\exists t_3$[FUT (t_3) & $t_3 \subseteq t_{R2}$ & AT (t_3, leave' (j))]))]]]
6. John-wa [Mary-ga John-ga kuru-to it-ta ato-ni] kuru '[lit.] John will come after Mary said John woll come' ⇒
$\exists t$ [FUT (t) & $t \subseteq t_{R3}$ & AT (t, come' (j) & $\exists t_1$ [$t_1 < t^*$ & M (t^*, t_1) & [PAST (t_1) & $t_1 \subseteq t_{R1}$ & AT (t_1, say' (m, ^ $\exists t_3$[FUT (t_3) & $t_3 \subseteq t_{R2}$ & AT (t_3, leave' (j))]))]]])]
[N.B. The present tense is translated as FUT here.]
7. $\exists t$ [FUT (t) & $t \subseteq t_{R3}$ & AT (t, come' (j)) & $\exists t_1$ [$t_1 < t$ & $t_1 \subseteq t_{R1}$ & M (t, t_1) & AT (t_1, say' (m, ^ $\exists t_3$[FUT (t_3) & $t_3 \subseteq t_{R2}$ & AT (t_3, leave' (j))]))]]

The final line says that the time of John's coming is after the time of Mary's saying, not after the time at which John allegedly comes. This is the right interpretation of (20a). By contrast, (20b) only allows the reading in which John's coming is after the time at which he allegedly comes. (20b) is much more difficult to deal with than (20a) and will be left as a future problem.

Lastly, I will present some examples involving both verb complement clauses and relative clauses. In (23a) and (23b), a relativized NP occupies the subject NP position of a verb complement clause. Schematically, they are of the form given in (22):

(22) $[_S \ldots [_S[_{NP}[_{Rel\ Cl} \ldots$ V Tns ...] N'] V Tns ...] to V Tns]

[N.B. *to* is a complementizer corresponding to *that* in English.]

(23a) John-wa $[_S[_{NP}[_{S'}$ hon -o yon-de i -ru] hito] -ga
TOP book ACC be-reading PRES person NOM

kitigai -da] -to omot-ta.
be-crazy PRES that think PST

John thought that a person who was reading a book was crazy. or
John thought that a person who is reading a book [now] was crazy.

[N.B. Two readings are available: one is a "double simultaneous reading" in which the time of reading, the time of the person's being crazy, and the time of John's thinking are simultaneous; another reading requires that the time of thinking and the time of the person's being crazy be simultaneous and that the time of reading be simultaneous with the speech time.]

(23b) John-wa $[_S[_{NP}[_{S'}$ hon -o yon-de i -ta] hito] -ga
TOP book ACC be-reading PST person NOM

kitigai -da] -to omot-ta.
be-crazy PRES that think PST

John thought that a person who was reading a book was crazy.

[N.B. The time of thinking and the time of the person's being crazy are required to be simultaneous just as in (23a). The time of reading can be any time before the speech time.]

Let us consider (23a) first.

(23a') John-wa [$_S$[$_{NP}$[$_{S'}$ hon -o yon-de ir-u] hito]-ga kitigai-da]-to omot-ta.

[all in situ]

1. hon-o yon-de ir-u hito 'a person who be reading a book' $\Rightarrow$ $\lambda Q\, \exists x$ [man' (x) & be-reading' (x) & Q {x}] [see earlier examples]

2. hon-o yon-de ir-u hito-ga kitigaida 'a person who be reading a book be crazy' $\Rightarrow$ $\exists x$ [man' (x) & be-reading' (x) & be-crazy' (x)]

3. John-wa hon-o yon-de ir-u hito-ga kitigaida-to omot-ta 'John thought that a person who be reading a book be crazy' $\Rightarrow$ λt[PAST (t) & $t \subseteq t_{R1}$ & AT (t, think' (j, ^ $\exists x$ [man' (x) & be-reading' (x) & be-crazy' (x)])]

4. $\exists t$[PAST (t) & $t \subseteq t_{R1}$ & AT (t, think' (j, ^ $\exists x$ [man' (x) & be-reading' (x) & be-crazy' (x)])] [existential closure]

This derivation represents the "double simultaneous" reading mentioned above. The NP is predicted to receive a de dicto reading. This is in fact the case. It is possible to QR the relativized NP to the level of the verb complement clause, but this predicts the same interpretation as the one we have just discussed.

(23a") [$_S$[$_{NPk}$[$_S$hon -o yon-de ir-u] hito]-ga[$_S$John-wa [$_S$ e_k kitigai-da]-to omot-ta]]

1. [$_{NPk}$[$_S$hon -o yon-de ir-u] hito]-ga 'a man who be reading a book' $\Rightarrow$ $\lambda Q\, \exists x$ [man' (x) & be-reading' (x) & Q {x}]

2. $[_S$John-wa $[_S\ e_k$ kitigai-da]-to omot-ta] 'John thought that e_k be in the room' $\Rightarrow$ $\lambda t\ [PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ AT\ (t, think'\ (j, \wedge\ be\text{-}crazy'\ (x)))]$

3. $[_S[_{NPk}[_S$hon -o yon-de ir-u] hito]-ga$[_S$John-wa $[_S\ e_k$ kitigai-da]-to omot-ta]] $\Rightarrow$ $\lambda Q\ \exists x\ [man'\ (x)\ \&\ be\text{-}reading'\ (x)\ \&\ Q\ \{x\}]\ (\wedge\ \lambda y\ \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ AT\ (t, think'\ (j, \wedge\ be\text{-}crazy'\ (y)))]\ )$

4. $\exists x\ [man'\ (x)\ \&\ be\text{-}reading'\ (x)\ \&\ \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ AT\ (t, think'\ (j, \wedge\ be\text{-}crazy'\ (x)))]]$

This derivation represents the reading in which the NP takes scope over the whole S. The prediction is that the time of reading a book is simultaneous with the speech time and that the NP receives a de re interpretation. This is in fact a possible interpretation.

The system that I proposed above predicts another reading of (23a). It is obtained when the relativized NP is Chomsky-adjoined to the VP of the matrix clause. Then, the NP is in the scope of the matrix past tense but is outside the scope of the propositional attitude verb *omou* 'think'. The prediction is that the time of reading is simultaneous with the time of thinking even though the NP receives a de re interpretation.

(23a''') $[_S$John-wa $[_{VP}[_{NPk}[_S$hon -o yon-de ir-u] hito]-ga$[_{VP}[_S\ e_k$ kitigai-da]-to omot]]-ta]

1. $[_{VP}[_S\ e_k$ kitigai-da]-to omot] 'think that e_k be crazy' $\Rightarrow$ think' (^ be-crazy' (x))
2. $[_{NPk}[_S$hon -o yon-de ir-u] hito]-ga 'a man who be reading' $\Rightarrow$ $\lambda Q\, \exists x\, [\text{man}'(x)\ \&\ \text{be-reading}'(x)\ \&\ Q\,\{x\}]$
3. $[_{VP}[_{NPk}[_S$hon -o yon-de ir-u] hito]-ga$[_{VP}[_S\ e_k$ kitigai-da]-to omot]] $\Rightarrow$ $\lambda y\, [\lambda Q\, \exists z\, [\text{man}'(z)\ \&\ \text{be-reading}'(z)\ \&\ Q\,\{z\}]\ (\wedge\ \lambda x\, [\text{think}'(\wedge\ \text{be-crazy}'(x))\,(y)])\,]$
4. $\lambda y\, \exists x\, [\text{man}'(x)\ \&\ \text{be-reading}'(x)\ \&\ \text{think}'(\wedge\ \text{be-crazy}'(x))\,(y)]$
5. $\lambda y\, \exists x\, [\text{man}'(x)\ \&\ \text{be-reading}'(x)\ \&\ \text{think}'(y, \wedge\ \text{be-crazy}'(x))]$
6. $[_S$John-wa $[_{VP}[_{NPk}[_S$hon -o yon-de ir-u] hito]-ga$[_{VP}[_S\ e_k$ kitigai-da]-to omot]]-ta] $\Rightarrow$
   $\exists t\, [\text{PAST}(t)\ \&\ t \subseteq t_{R1}\ \&\ \text{AT}(t, \exists x\, [\text{man}'(x)\ \&\ \text{be-reading}'(x)\ \&\ \text{think}'(j, \wedge\ \text{be-crazy}'(x))])]$

Note that in the final translation of the sentence, be-reading' (x) is in the scope of the AT operator (hence in the scope of the matrix past tense) but is outside the scope of think'. For example, this reading is compatible with the following state of affairs: John thought that Bill was crazy and Bill is identified by the speaker as a man who was reading a book at the time of John's thinking. In other words, *hon-o yon-de ir-u hito* 'a man who be reading a book' is the speaker's description of the person in question. Though the judgment is delicate, I think the prediction is borne out.

Next, consider the sentence (23b), where the present tense in the relative clause in (23a) is replaced by a past tense morpheme. A first possibility is to interpret everything in situ.

(23b') John-wa [$_S$[$_{NP}$[$_S$hon -o yon-de i-ta] hito]-ga kitigai-da]-to omot-ta.
[all in situ]

1. hon-o yon-de ita 'who Past be reading a book' ⇒
$\lambda x\, \exists t[PAST (t) \,\&\, t \subseteq t_{R1} \,\&\, AT (t, \text{be-reading}' (x))]$
2. hon-o yon-de ita hito 'person who Past be reading a book' ⇒
$\lambda x\, [\exists t[PAST (t) \,\&\, t \subseteq t_{R1} \,\&\, AT (t, \text{be-reading}' (x))] \,\&\, \text{person}' (x)]$
3. hon-o yon-de ita hito 'a person who Past be reading a book' [NP-level] ⇒ $\lambda P\, \exists x\, [\exists t[PAST (t) \,\&\, t \subseteq t_{R1} \,\&\, AT (t, \text{be-reading}' (x))] \,\&\, \text{person}' (x) \,\&\, P \{x\}]$
4. hon-o yon-de ita hito-ga kitigai 'a person who Past be reading a book be crazy' ⇒ $\exists x\, [\exists t[PAST (t) \,\&\, t \subseteq t_{R1} \,\&\, AT (t, \text{be-reading}' (x))] \,\&\, \text{person}' (x) \,\&\, \text{be-crazy}' (x)]$
5. hon-o yon-de i-ta hito-ga kitigai-da-to omot 'think that a person who Past be reading a book be crazy' ⇒
$\text{think}' (\hat{}\ \exists x\, [\exists t[PAST (t) \,\&\, t \subseteq t_{R1} \,\&\, AT (t, \text{be-reading}' (x))] \,\&\, \text{person}' (x) \,\&\, \text{be-crazy}' (x)])$

6. John-wa hon-o yon-de i-ta hito-ga kitigai-da-to omot-ta 'think that a person who Past be reading a book be crazy' $\Rightarrow$

   $\lambda t'[\text{PAST}(t') \,\&\, t' \subseteq t_{R2} \,\&\, \text{AT}(t', \text{think}'(j, {}^\wedge \exists x\,[\text{person}'(x) \,\&\, \text{be-crazy}'(x) \,\&\, \exists t[\text{PAST}(t) \,\&\, t \subseteq t_{R1} \,\&\, \text{AT}(t, \text{be-reading}'(x))]]))]$

7. $\exists t'[\text{PAST}(t') \,\&\, t' \subseteq t_{R2} \,\&\, \text{AT}(t', \text{think}'(j, {}^\wedge \exists x\,[\text{person}'(x) \,\&\, \text{be-crazy}'(x) \,\&\, \exists t[\text{PAST}(t) \,\&\, t \subseteq t_{R1} \,\&\, \text{AT}(t, \text{be-reading}'(x))]]))]$

This represents a reading in which the time of the person's reading a book is prior to the time of his being crazy and the time of his being crazy is simultaneous with the time of John's thinking, which is a possible reading.

(23b") describes the translation procedure of an LF structure in which the relativized NP is adjoined to the matrix S:

(23b") $[_S[_{NPk}[_S$hon -o yon-de i-ta] hito]-ga$[_S$John-wa $[_S\ e_k$ kitigai-da]-to omot-ta]]

1. $[_{NPk}[_S$hon -o yon-de i-ta] hito]-ga 'a man who was reading a book' $\Rightarrow \lambda P\, \exists x\, [\exists t[\text{PAST}(t) \,\&\, t \subseteq t_{R1} \,\&\, \text{AT}(t, \text{be-reading}'(x))] \,\&\, \text{person}'(x) \,\&\, P\{x\}]$

2. $[_S$John-wa $[_S\ e_k$ kitigai-da]-to omot-ta] 'John thought that ek be in the room' $\Rightarrow$

   $\lambda t\,[\text{PAST}(t) \,\&\, t \subseteq t_{R2} \,\&\, \text{AT}(t, \text{think}'(j, {}^\wedge \text{be-crazy}'(x)))]$

3. $[_S[_{NPk}[_S$hon -o yon-de i-ta] hito]-ga$[_S$John-wa $[_S$ e_k kitigai-da]-to omot-ta]] $\Rightarrow$ $\lambda Q\, \exists x$ [person' (x) & $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, be-reading-a-book' (x))] & Q {x}]
($^\wedge \lambda y[\exists t$ [PAST (t) & $t \subseteq t_{R2}$ & AT (t, think' (j, $^\wedge$ be-crazy' (y)))]])

4. $\exists x$ [person' (x) & $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, be-reading-a-book' (x))] & $\exists t$ [PAST (t) & $t \subseteq t_{R2}$ & AT (t, think' (j, $^\wedge$ be-crazy' (x)))]]

In this derivation, the time of the person's reading a book is prior to the speech time, and the time of John's thinking and the person's being in the room is also in the past of the speech time. These two times are not ordered with respect to each other. Since this reading allows a situation in which the time of the person's reading a book is prior to the time of John's thinking, it partially overlaps the shifted reading that (23b') has, as far as temporal interpretation is concerned. But the important prediction that this derivation makes is that when the time of the person's reading is understood to be located between the time of John's thinking and the speech time, the NP can only receive a de re reading. According to my intuition, this prediction is borne out.

There is another derivation in which the NP is Chomsky-adjoined to the VP of the matrix clause. This predicts that the the time of reading is prior to the time of John's thinking and that the NP has a de re interpretation. This reading is entailed by the interpretation given as (23b").

3.2.2. A Fragment of English

The main differences between the temporal system of English and that of Japanese are the following: (i) the former possesses a ST rule, but not the latter; (ii) in English, the future tense auxiliary *will* and the perfect *have*, which has the preterit interpretation, are distributionally independent of each other, whereas Japanese has only one tense morpheme (i.e. -*ta*). The English fragment deals with all the constructions covered by the Japanese fragment with the exception of temporal adverbial clauses.

Syntax:

[N.B. α is a variable standing for + or -.]

1. MS → S

2. S → NP Aux VP
   [α fin] [α fin]

3. Aux → Tns (woll) (have + en)
   [+fin] <[+past]>

4. Aux → to (have + en)
   [-fin] <[+past]>

5. Tns → Past
   <[+past]>
   Pres
   <[-past]>

6. NP → Det N'

   Name

   S'

7. N' → Adj N'

   N' S'

   N (S')

8. Det → NP Poss

9. S' → COMP S

10. VP → V (NP)

    V S'

    VP Adv. P

11. Adv. P → Adv.

Transformations:

12. Wh-movement: At the level of S-structure, move a wh-element to COMP.

13. Quantifier Raising: At the level of Logical Form, NP's are optionally Chomsky-adjoined to a VP or an S.

    [N.B. **B** is said to be Chomsky-adjoined to **A** when the following operation is performed: $[_A \ldots] \Rightarrow [_A B[_A \ldots]] \ ]$

14. Tense Feature Deletion: At the level of Logical Form, a tense morpheme α can be deleted if and only if the following conditions are satisfied: there are tense features β and γ, α has the feature γ, β and γ have the same

value, and β is **the local tense feature** of γ. **This rule applies after QR has applied.**

Feature Percolation Convention:

I assume that the rightmost tense feature dominated by an Aux node percolates up to the Aux node at some level of representation before LF.

Definitions:

α c-commands β iff the first branching node which dominates α dominates β.

α is the local tense feature of β iff α c-commands β and no other tense feature that α c-commands c-commands β.

Lexicon:

15. Det $\rightarrow$ a, the

16. Adj. $\rightarrow$ earlier, previous, later

<[+past]> <[+past]>

Semantics:

1. $[_{MS}\ S]$ translates into $\exists t\,[S'\,(t)]$

2. $[_S\ NP\ Aux\ VP]$ translates into $Aux'\,(\,^\wedge[NP'\,(^\wedge VP')])$

3a. $[_{Aux}Tns\ woll]$ translates into

$\lambda p\,\lambda t[Tns'\,(t)\ \&\ AT\,(t, \exists t'\,[FUT\,(t')\ \&\ t' \subseteq t_{Rn}\ \&\ AT\,(t', {}^\vee p)])]$

3b. $[_{Aux}Tns\ woll\ have{+}en]$ translates into

$\lambda p\,\lambda t[Tns'\,(t)\ \&\ AT\,(t, \exists t'\,[FUT\,(t')\ \&\ t' \subseteq t_{Rn}\ \&\ AT\,(t', \exists t''[PAST\,(t'')\ \&$

$t'' \subseteq t_{Rn}\ \&\ AT\,(t'', {}^\vee p)])])]$

3c. $[_{Aux}$Tns have+en] translates into $\lambda p\, \lambda t[\text{Tns}'(t)\ \&\ \text{AT}(t, \exists t'[\text{PAST}(t')\ \&$
$t' \subseteq t_{Rn}\ \&\ \text{AT}(t', {}^{\vee}p)])]$

3d. $[_{Aux}$ Tns] translates into $\lambda p\, \lambda t[\text{Tns}'(t)\ \&\ \text{AT}(t, {}^{\vee}p)]$

4a. $[_{Aux}$ to have + en] translates into $\lambda p\, \lambda t[\text{to}'(t)\ \&\ \text{AT}(t, \exists t'[\text{PAST}(t')\ \&$
$t' \subseteq t_{Rn}\ \&\ \text{AT}(t', {}^{\vee}p)])]$

4b. $[_{Aux}$ to] translates into $\lambda p\, \lambda t[\text{to}'(t)\&\ \text{AT}(t, {}^{\vee}p)]$

4c. *to* translates into either $\lambda t\ [\text{FUT}(t)\ \&\ t \subseteq t_{Rn}]$ or PRES

5. $[_{Tns}$ Past] translates into $\lambda t\ [\text{PAST}(t)\ \&\ t \subseteq t_{Rn}]$;

$[_{Tns}$ Pres] translates into NOW

[N.B. NOW, a predicates of times, is defined as follows:

$[\![\text{NOW}(t')]\!]^{M,w,t,g} = 1$ iff $[\![t']\!]^{M,w,t,g} = [\![s^*]\!]^{M,w,t,g}$ where

$[\![s^*]\!]^{M,w,t,g}$ is the utterance time (i.e. s* is a special constant which always denotes the utterance time).]

6a. $[_{NP}$ Det N'] translates into Det' (^ N'')

6b. $[_{NP}$ Name] translates into $\lambda P P\{\text{Name}'\}$

6c. $[_{NP}$ S'] translates into $\lambda P \exists t[P\{x\}\ \&\ \text{NOM}(x, {}^{\wedge}S'')]$

[N.B. NOM is of type <<s,t>, <e,t>> and $[\![\text{NOM}(x, p)]\!]^{M,w,t,g} = 1$ iff g(x) is the individual correlate of g(p).]

7a. $[_{N'}$ Adj. N'] translates into Adj.' (^ N'')

7b. $[_{N'}$ N' S'] translates into $\lambda x\ [S''(x)\ \&\ N'(x)]$

7c. $[_{N'}$ N^1 S'] translates into $N^{1\prime}$ (^ S'')

7d. $[_{N'}$ N^0] translates into $N^{0\prime}$

8a. $[_{Det}$ NP Poss] translates into Poss' (^ NP')

8b. Poss translates into $\lambda\wp\lambda P\lambda Q\exists y\, [\forall x\, [P\,\{x\}\ \&\ \wp\{{}^\wedge\, POSS\,(x)\}$ $\leftrightarrow x = y\,]\ \&\ Q\,\{y\}]$

[N.B. POSS denotes a relation between two individuals (type <e,<e,t>>) such that $[\![POSS\,(x, y)]\!]^{M,w,t,g} = 1$ iff g(x) stands in a certain non-trivial nonsymmetric relation to g(y). See the comment on the rule for details.]

9. $[_{S'}$ COMP S] translates into $\exists t\,[S'\,(t)]$

10a. $[_{VP}\ V^0]$ translates into $V^{0'}$

10b. $[_{VP}\ V^1$ NP] translates into $V^{1'}\,({}^\wedge\, NP')$

10c. $[_{VP}\ V^1$ S'] translates into $V^{1'}\,({}^\wedge\, S'')$

10d. $[_{VP}$ VP Adv. P] translates into Adv. P' (^ VP')

11. $[_{Adv.\,P}$ Adv.] translates into Adv.'

12. $[_{S'}[_{COMP}\ wh_k]\ [_S \ldots e_k \ldots]\,]$ translates into $\lambda x_k\, \exists t\,[S'\,(t)]$

13a. $[_S\ NP_k\ [_S \ldots e_k \ldots]]$ translates into $NP'\,({}^\wedge\, \lambda x_k\, \exists t\,[S'\,(t)])$

13b. $[_{VP}\ NP_k\ [_{VP} \ldots e_k \ldots]]$ translates into $\lambda y\, NP'\,({}^\wedge\, \lambda x_k\,[VP'\,(y)])$

14. $[_{Tns}\ \emptyset]$ translates into PRES

Lexicon:

15. *a* translates into $\lambda P\lambda Q\, \exists x\, [\, P\{x\}\ \&\ Q\{x\}]$

the translates into $\lambda P\lambda Q\exists y\, [\forall x[P\,\{x\} \leftrightarrow x = y\,]\ \&\ Q\,\{y\}]$

16. *earlier* translates into $\lambda P\lambda x\exists t\, [PAST\,(t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\,(t, P\,\{x\})]$

previous-translates into $\lambda P\lambda x\exists t\, [PAST\,(t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\,(t, P\,\{x\})]$

later translates into $\lambda P\lambda x\exists t\, [FUT\,(t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\,(t, P\,\{x\})]$

Comments:

1. Syntax:

$MS \rightarrow S$

Semantics:

$\exists t\,[S'\,(t)]$

This is an existential closure rule for matrix sentences.

2. Syntax:

$$\underset{[\alpha\ \mathrm{fin}]}{S} \rightarrow NP\quad \underset{[\alpha\ \mathrm{fin}]}{Aux}\quad VP$$

Semantics: $[_S\ NP\ Aux\ VP]$ translates into $Aux'\,(\,{}^\wedge[NP'\,({}^\wedge VP')])$

This semantic rule ensures that the whole sentence (including the subject NP) is in the scope of the tense morphemes in the auxiliary.

Syntax:

3. $\underset{[+\mathrm{fin}]}{Aux} \rightarrow Tns\ (woll)\ (have + en)$

Semantics:

3a. $[_{Aux} Tns\ woll]$ translates into

$\lambda p\, \lambda t[Tns'\,(t)\ \&\ AT\,(t, \exists t'\,[FUT\,(t')\ \&\ t' \subseteq t_{Rn}\ \&\ AT\,(t', {}^\vee p)])]$

3b. $[_{Aux} Tns\ woll\ have{+}en]$ translates into

$\lambda p\, \lambda t[Tns'\,(t)\ \&\ AT\,(t, \exists t'\,[FUT\,(t')\ \&\ t' \subseteq t_{Rn}\ \&\ AT\,(t', \exists t''[PAST\,(t'')\ \&\ t'' \subseteq t_{Rn'}\ \&\ AT\,(t'', {}^\vee p))])])]$ [N.B. $n \neq n'$]

3c. $[_{Aux}$Tns have+en$]$ translates into $\lambda p\, \lambda t[Tns'(t)\ \&\ AT(t, \exists t'[PAST(t')\ \&$

$t' \subseteq t_{Rn}\ \&\ AT(t', {}^{\vee}p))])]$

3d. $[_{Aux}$ Tns$]$ translates into $\lambda p\, \lambda t[Tns'(t)\ \&\ AT(t, {}^{\vee}p)]$

This syntactic rule serves to produce both finite (i.e. tensed) and infinitival clauses, represented respectively by the features [+fin] and [-fin]. The semantic rule guarantees that the subject NP is in the scope of the tenses occurring in the Aux node. The Aux node can be either [+fin] or [-fin]. The syntactic structure of the auxiliary node for finite clauses is the version proposed in Chomsky (1957).[13] The most important insight of this analysis that I adopt here is that it affords independent syntactic slots for the tense morpheme and the future auxiliary. The flat structure assumed for the tense morpheme, *woll*, and *have+en* does not mirror the ways in which they combine with the translation of the rest of the sentence in that *have+en* is in the scope of *woll*, which in turn is scoped within the tense morpheme as far as semantics is concerned. The rules for syntax and the semantics proposed here do not constitute a violation of the principle of compositionality since all the elements in the Aux node are sisters and do not have predetermined scope relationships. I adopt the syntactic and semantic rules given above partly because they avoid the possibility that

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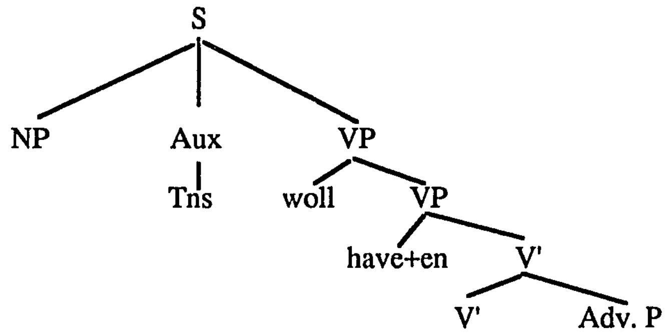
[13] Chomsky's original rules are as follows:

(a) Aux → C (M) (have+en) (be+ing)
C → S in the context NPsing ___
Ø in the context NPpl ___
past

The Tense node in my rule corresponds to Chomsky's C (standing for concord). The progressive is ignored in my proposal.

adverbials (which are considered to be VP modifiers here) constrain times other than event times (relevant data will be given below). An alternative is to give a hierarchical structure to these morphemes so that the syntactic structure mirrors the semantic structure and to posit temporal adverbials as V' modifiers as in (24):

(24)



If we adopted this strategy, it would be less straightforward to make sure that the subject NP is interpreted as semantically embedded under all the tense-like morphemes (i.e. the tense morpheme, *woll*, and *have+en*). Thus, whichever theory we choose to adopt, we are obliged to make a compromise.

Let us discuss one example involving an Aux node which contains a future auxiliary and a perfect. First, I will show how the tense deletion rule works. Second, I will show how the output of the tense deletion rule is translated into IL:

(25) John will have claimed that he was sick.

D-str.: [$_S$John Pres woll have+en claim that
<[-past]> <[+past]>

[$_S$he Past be sick]]
<[+past]>

QR: non-applicable

Tense Deletion:

D-str.: [$_S$John Pres woll have+en claim that
<[-past]> <[+past]>

[$_S$he Ø be sick]]
<[+past]>

The fact the matrix Aux node contains two tense features creates a technical difficulty. Intuitively, the [+past] feature (call it β) on *have+en* is the local tense feature of the [+past] feature (henceforth γ) on the lowest past tense because the lowest clause is semantically in the scope of the perfect, not in the scope of the present tense. (Consult the translation of (25) to be given below for details.) However, since I have opted for a flat structure for the Aux node in the syntax, there are no ways of distinguishing between the [-past] feature on the matrix present tense (henceforth α) and β in configurational terms. For the purpose of this thesis, I will appeal to precedence relation as stated in the feature percolation convention so that the rightmost tense feature percolates up to the Aux node. Alternatively, we could set up the syntactic rules in such a way that the scope relationships among tense morphemes are directly mirrored in the syntax. In (25), β percolates up to the Aux node, thereby serving as the local tense feature of γ. As a result, γ is deleted.

(25') $[_S$John Pres woll have+en claim that $[_S$he Ø be sick]]

1. he Ø be sick ⇒ $\lambda t[PRES(t) \& t \subseteq t_{R1} \& AT(t, \text{be-sick}'(y))]$

2. that he Ø be sick ⇒ $\exists t[PRES(t) \& AT(t, \text{be-sick}'(y))]$

3. be-sick' (y)

4. John claim that he Ø be sick ⇒ claim' (j, ^ be-sick' (y))

5. John will have claimed that he was sick ⇒

   $\exists t[NOW(t) \& AT(t, \exists t'[FUT(t') \& t' \subseteq t_{R1} \& AT(t', \exists t''[PAST(t'') \& t'' \subseteq t_{R2} \& AT(t'', \text{claim}'(j, {}^\wedge \text{be-sick}'(y)))])])]$

6. $\exists t'[FUT(t') \& t' \subseteq t_{R1} \& AT(t', \exists t''[PAST(t'') \& t'' \subseteq t_{R2} \& AT(t'', \text{claim}'(j, {}^\wedge \text{be-sick}'(y)))])]$

The last line says that there will be a future time t' within a contextually salient time and there is a time t" earlier than t' such that John claims that he is sick at that time (i.e. at t"). This is in fact what (25) means.

Syntax:

4. Aux → to (have+en)
   [-fin]

Semantics:

4a. $[_{Aux}$ to have + en] translates into $\lambda p\, \lambda t[to'(t) \& AT(t, \exists t'[PAST(t') \& t' \subseteq t_{Rn} \& AT(t', {}^\vee p))])]$

4b. $[_{Aux}$ to] translates into $\lambda p\, \lambda t[to'(t) \& AT(t, {}^\vee p)]$

4c. *to* translates into either $\lambda t\,[FUT(t) \& t \subseteq t_{Rn}]$ or PRES

The semantic rules show that an infinitival clause is translated as if it has an empty tense or a future tense. I do not mean to claim that the choice can be made randomly. The choice between the two possibilities is controlled by the verb which subordinates the infinitival clause in question. For example, some verbs such as *seem*, and *believe* only allow simultaneous readings (i.e. the choice of the predicate is PRES). Other verbs such as *want* and *promise* only allow future interpretations (i.e. the choice of the predicate is PRES). I ignore this aspect of semantic interpretation and let the fragment overgenerate interpretations.

I will provide two examples involving infinitival clauses. First, I will show how the tense deletion rule interacts with infinitival clauses. I will then show how the translation proceeds.

(26) John promised to say that he was sick.

D-str.: [$_S$John Past promise [$_S$ e to say that [$_S$he Past be sick]]]
<[+past]> <[+past]>

QR: non-applicable

Tense Deletion:

[$_S$John Past promise [$_S$ e to say that [$_S$he Ø be sick]]]
<[+past]> <[+past]>

Several comments are in order. The [+past] feature on the matrix past tense (henceforth α) percolates up to the Aux node. Thus, this feature c-commands the [+past] feature on the lowest past tense (henceforth β). Moreover, there is no other tense feature that α c-commands. Thus, α is the local tense feature of β. Note that the fact that there is an intervening infinitival clause has no effect because it contains no tense feature.

(26') [$_S$John Past promise [$_S$ e to say that [$_S$he Ø be sick]]]

1. that he Ø be sick ⇒ be-sick' (y)

2. e to say that he Ø be sick ⇒ $\exists t[\text{FUT}(t) \,\&\, t \subseteq t_{R1} \,\&\, \text{AT}(t, \text{say}'(z, {}^\wedge \text{be-sick}'(y)))]$

3. John Past promise e to say that he Ø be sick ⇒ $\exists t'[\text{PAST}(t') \,\&\, t' \subseteq t_{R2} \,\&\, \text{AT}(t', \text{promise}'(j, {}^\wedge \exists t[\text{FUT}(t) \,\&\, t \subseteq t_{R1} \,\&\, \text{AT}(t, \text{say}'(z, {}^\wedge \text{be-sick}'(y)))]))]$

The last line says that there was a past time t' within a "reference time" t_{R2} and John promises at t' that he will say at some time t > t' (lying within t_{R1}) such that he is sick at t. This is exactly the interpretation of (26) that we are interested in.

5. Syntax:

Tns → Past

Pres

Semantics:

[$_{Tns}$ Past] translates into $\lambda t\, [\text{PAST}(t) \,\&\, t \subseteq t_{Rn}]$;

[$_{Tns}$ Pres] translates into NOW

[N.B. NOW, a predicates of times, is defined as follows:

$[\![$NOW (t')$]\!]$ M,w,t, g = 1 iff $[\![$t'$]\!]$ M,w,t, g = $[\![$s*$]\!]$M,w,t,g where $[\![$s*$]\!]$M,w,t,g is the utterance time (i.e. s* is a special constant which always denotes the utterance time).]

There is an asymmetry between the present tense morpheme and the past tense morpheme in English. The past tense morpheme is like the past tense morpheme in Japanese in that it is translated as a temporal abstract involving the predicate PAST. Every time a past tense is used, a new reference point is introduced. (The same is true of the future tense auxiliary *woll.*) We hypothesize that the present tense morpheme in English is different from the present tense morpheme in Japanese in that it always denotes the speech time no matter where it occurs (no matter what its evaluation time is). This assumption predicts the right interpretations for relative clauses. For example, the following sentence only allows an interpretation in which the present tense in the relative clause denotes the speech time:

(27) John met a man who lives in this city.

This fact is accounted for if we assume that the present tense in English always denotes the speech time. On the other hand, this assumption does not predict the right reading for a double-access sentence like the following:

(28) John said that Mary is pregnant.

Although the syntactic rules of the current system produce (28), its translation makes the wrong prediction:

(28') $\exists t[\text{ PAST }(t) \ \&\ t \subseteq t_{R1} \ \&\ \text{AT }(t, \text{say}' (j, {}^\wedge \exists t'[\text{NOW }(t) \ \&\ \text{AT }(t, \text{be-pregnant}' (m))]))]$

(28') says that John stood in the saying relation to the following proposition in the past: Mary is pregnant at the speech time of (28). Although (28) says something about its speech time, (28') does not convey the complex meaning conveyed by (28). We will devote Chapter 4 to this topic and will ignore the problems associated with it in the rest of this chapter.

As we shall see below, the ST rule as it is implemented here produces empty tenses for which we use the symbol Ø. This empty tense in English is similar to the present tense morpheme in Japanese in that it is translated as the predicate PRES. (See below.)

Syntax:

6. NP → Det N'

Name

Semantics:

6a. $[_{NP}$ Det N'$]$ translates into Det' (^ N'')

6b. $[_{NP}$ Name$]$ translates into λPP{Name'}

6c. Syntax: NP $\rightarrow$ S'

Semantics: $[_{NP}$ S'$]$ translates into $\lambda P \exists t[P\{x\}$ & NOM $(x, {}^\wedge S'')]$

[N.B. NOM is of type $<<s,t>, <e,t>>$ and $[\![NOM (x, p)]\!]^{M,w,t,g} = 1$ iff $g(x)$ is the individual correlate of $g(p)$.]

The rule 6a takes care of both "normal" determiners like *a* and *the* and possessive NP's like John's (which are generated by a morphological operation concatenating an NP and Poss). The semantic type of N' is $<e,t>$. By combining the translation of N' with the translation of Det, we obtain an expression with a generalized quantifier meaning. Examples involving possessive NP's will be given below in connection with the rule for nouns like *claim, prediction*, etc.

6b is straightforward: names are translated as generalized quantifiers.

6c is for sentential subjects. I assume that sentential subjects in English are NP's although there is no solid evidence for this position. Since English has no explicit nominalizer unlike Japanese, I posit an implicit nominalizer NOM, which is defined above.

7a. Syntax: N' $\rightarrow$ Adj. N'

Semantics: $[_{N'}$ Adj. N'$]$ translates into Adj.' $({}^\wedge N'')$

The comments I made about the corresponding rule for Japanese apply here as well.

7b. Syntax: $N' \rightarrow N'\ S'$

Semantics: $\lambda x\ [S''\ (x)\ \&\ N'\ (x)]$

This rule is for relative clauses.

7c. Syntax: $N' \rightarrow N\ (S')$

Semantics: $[_{N'}\ N^1\ S']$ translates into $N^{1\prime}\ (\wedge\ S'')$

This rule is for nouns such as *claim*, *prediction*, etc. which can take a sentential complement. See the comments on the rules 8a and 8b for relevant discussion.

7e. Syntax: $N' \rightarrow N\ (S')$

Semantics: $[_{N'}\ N^0]$ translates into $N^{0\prime}$

Straightforward. Nouns belonging to the category N^0 denote one-place predicates.

8a. Syntax: $Det \rightarrow NP\ Poss$

Semantics: $[_{Det}\ NP\ Poss]$ translates into $Poss'\ (\wedge\ NP')$

8b. Poss translates into $\lambda \wp \lambda P \lambda Q \exists y\ [\forall x\ [P\ \{x\}\ \&\ \wp\{\wedge\ POSS\ (x)\} \leftrightarrow x = y\ ]\ \&\ Q\ \{y\}]$

This rule is for possessive NP's. Poss is a possessive morpheme, and *John Poss*, for example, surfaces as *John's*. For our purposes, this rule is important in connection with noun complements. POSS denotes a relation between two individuals (type <e,<e,t>>) such that $[\![POSS\ (x, y)]\!]^{M,w,t,g} = 1$ iff g(x) stands in a certain non-trivial nonsymmetric relation to g(y). The prototypical relation between g(x) and g(y) is that of possession: g(x) possesses g(y). However, there are many other possible relations that can be described by possessive NP's in English. For example, g(x) can be the agent of the event denoted by g(x). (29) is the case in point. Since (29) is a good example to illustrate how the tense deletion rule works, I will first show how the D-structure of (29) is changed into its LF structure in the syntax. Secondly, I translate the LF representation into an IL formula. Finally, I will discuss how the final translation should be interpreted.

(29) John's earlier prediction that Mary would be elected is well-known.

D-str.:

$[_S[_{NP}$John's earlier prediction that $[_S$Mary Past woll be
<[+past]> <[+past]>

elected]] Pres be well-known]
<[-past]>

QR: We choose not to apply QR[14]

Tense Deletion:

$[_S[_{NP}$John Poss earlier prediction that $[_S$Mary Ø woll be
<[+past]> <[+past]>

elected]] Pres be well-known]
<[-past]>

The [+past] feature on *earlier* (henceforth α) is the local tense feature of the [+past] feature on the past tense (henceforth β) in the relative clause. This is so because (i) the first NP or S node which dominates α also dominates β and (ii) there

[14] Scoping the subject NP to the matrix clause level makes no difference in this particular case.

is no other tense feature that α dominates. Moreover, α has the same feature value as β. Thus, the past tense in the relative clause can be deleted. Let me point out on the side that the [-past] feature on the matrix present tense (henceforth γ) is not the local tense feature of β: γ c-commands β. However, a tense feature which γ c-commands (i.e. α) c-commands β. Thus, γ is not the local tense feature of β.

(30) LF structure:

$[_{NP}$ John Poss earlier prediction $[_{S'}$ that Mary Ø woll be-elected]] Pres be well-known

1. that Mary Ø woll be-elected $\Rightarrow \exists t'$ [FUT (t') & $t' \subseteq t_{R1}$ & AT (t', be-elected' (m))]
2. prediction that Mary Ø woll be-elected $\Rightarrow$ prediction' (^ $\exists t'$ [FUT (t') & $t' \subseteq t_{R1}$ & AT (t', be-elected' (m))])
3. earlier prediction that that Mary Ø woll be-elected $\Rightarrow$ $\lambda P \lambda x \exists t$ [PAST (t) & $t \subseteq t_{R2}$ & AT (t, P {x})] (^ prediction' (^ $\exists t'$ [FUT (t') & $t' \subseteq t_{R1}$ & AT (t', be-elected' (m))]))
4. $\lambda x \exists t$ [PAST (t) & $t \subseteq t_{R2}$ & AT (t, prediction' (x, ^ $\exists t'$ [FUT (t') & $t' \subseteq t_{R1}$ & AT (t', be-elected' (m))]))]
5. John $\Rightarrow \lambda P P$ {j}
6. Poss $\Rightarrow \lambda \wp \lambda P \lambda Q \exists y$ [$\forall x$ [P {x} & $\wp$ {^ POSS (x)} $\leftrightarrow$ x = y] & Q {y}]

7. John Poss $\Rightarrow$

$\lambda\wp\lambda P\lambda Q\exists y\ [\forall x\ [P\ \{x\}\ \&\ \wp\{\hat{}\ POSS\ (x)\} \leftrightarrow x = y\ ]\ \&\ Q\ \{y\}]$

$(\hat{}\ \lambda P_1 P_1\{j\})$

8. $\lambda P\lambda Q\exists y\ [\forall x\ [P\ \{x\}\ \&\ \lambda P_1 P_1\{j\}(\hat{}\ POSS\ (x)) \leftrightarrow x = y\ ]\ \&\ Q$

$\{y\}]$

9. $\lambda P\lambda Q\exists y\ [\forall x\ [P\ \{x\}\ \&\ POSS\ (j, x) \leftrightarrow x = y\ ]\ \&\ Q\ \{y\}]$

10. John Poss earlier prediction that Mary Ø woll be elected $\Rightarrow$

$\lambda Q\exists y\ [\forall x\ [\exists t\ [PAST\ (t)\ \&\ t \subseteq t_{R2}\ \&\ AT\ (t, prediction'\ (x,\ \hat{}\ \exists t'$

$[FUT\ (t')\ \&\ t' \subseteq t_{R1}\ \&\ AT\ (t', be\text{-}elected'\ (m))]))]\ \&\ POSS\ (j, x) \leftrightarrow$

$x = y\ ]\ \&\ Q\ \{y\}]$

11. $[_{NP}$ John Poss earlier prediction $[_{S'}$ that Mary Ø woll be-elected]]

PRES be well-known $\Rightarrow$ $\exists y\ [\forall x\ [\exists t\ [PAST\ (t)\ \&\ t \subseteq t_{R2}\ \&\ AT$

$(t, prediction'\ (x,\ \hat{}\ \exists t'\ [FUT\ (t')\ \&\ t' \subseteq t_{R1}\ \&\ AT\ (t', be\text{-}elected'$

$(m))]))]\ \&\ POSS\ (j, x) \leftrightarrow x = y\ ]\ \&\ be\text{-}well\text{-}known'\ (y)]$

The final line says that there is a unique event of predicting the proposition described above (i.e. $\hat{}\ \exists t'\ [FUT\ (t')\ \&\ t' \subseteq t_{R1}\ \&\ AT\ (t', be\text{-}elected'\ (m))]$) whose agent is John, and this event is well-known. Several remarks are in order. According to the rules I proposed, determiners like *John's* are interpreted like the definite article with an added condition given by the relation POSS. For example, *John's claim* is interpreted as if it is synonymous with *the claim made by John* i.e. the unique (event) individual which is a claim made by John. Perhaps, possessive NP's can sometimes be interpreted like indefinite NP's, e.g. *John's claim* ≈ *a claim made by John*, but I ignore this possibility. The reason that nouns like *claim* are interpreted as two-place predicates, and not as three-place predicates is that the agent "argument" does not occur within the N'-level, but occurs as a determiner. In order to preserve the generalization that an N' constituent is semantically of type <e,t>, I assumed that nouns like *claim* are two-place predicates taking a proposition and an event individual as arguments. Thus, the agent of the predicting event is not an argument. Instead, the agent enters into the picture indirectly by the relation POSS. In the above formula POSS (j, x) should be read as "John is the agent of g(x)". This correctly describes the interpretation that (30) has.

One advantage of the assumption that nouns like *claim* are two-place predicates is that when these nouns are combined with "normal" determiners like *a* or *the*, we can still provide a well-formed translation:

(31) $[_{NP}$the claim that Mary woll win]

1. Mary woll win $\Rightarrow \lambda t[\text{PRES}'(t) \,\&\, \text{AT}(t, \exists t'[\text{FUT}(t') \,\&\, t' \subseteq t_{R1} \,\&\, \text{AT}(t', \text{win}'(m))])]$
2. that Mary woll win $\Rightarrow \exists t[\text{PRES}'(t) \,\&\, \text{AT}(t, \exists t'[\text{FUT}(t') \,\&\, t' \subseteq t_{R1} \,\&\, \text{AT}(t', \text{win}'(m))])]$
3. claim that Mary woll win $\Rightarrow$ claim' $(^\wedge \exists t[\text{PRES}'(t) \,\&\, \text{AT}(t, \exists t'[\text{FUT}(t') \,\&\, t' \subseteq t_{R1} \,\&\, \text{AT}(t', \text{win}'(m))])])$
4. the $\Rightarrow \lambda P \lambda Q \exists x[\forall x[P\{x\} \leftrightarrow x = y] \,\&\, Q\{y\}]$

5. the claim that Mary woll win $\Rightarrow \lambda Q \exists x[\forall x[\text{claim}' (\wedge \exists t[\text{PRES}' (t) \;\&\; \text{AT} (t, \exists t' [\text{FUT} (t') \;\&\; t' \subseteq t_{R1} \;\&\; \text{AT} (t', \text{win}' (m))])])]) (x) \leftrightarrow x = y] \;\&\; Q \{y\}]$

6. $\lambda Q \exists x[\forall x[\text{claim}' (x, \wedge \exists t[\text{PRES}' (t) \;\&\; \text{AT} (t, \exists t' [\text{FUT} (t') \;\&\; t' \subseteq t_{R1} \;\&\; \text{AT} (t', \text{win}' (m))])])]) \leftrightarrow x = y] \;\&\; Q \{y\}]$

9. Syntax: S' $\rightarrow$ COMP S

Semantics: $[_{S'}$ COMP S$]$ translates into $\exists t\, [S' (t)]$

This is an existential closure rule for verb complements and noun complements.

Syntax:

10. VP $\rightarrow$ V (NP)

V S'

VP Adv. P

Semantics:

10a. $[_{VP}\, V^0]$ translates into $V^{0'}$

10b. $[_{VP}\, V^1$ NP$]$ translates into $V^{1'}$ (^ NP')

10c. $[_{VP}\, V^1$ S'$]$ translates into $V^{1'}$ (^ S'')

10d. $[_{VP}$ VP Adv. P$]$ translates into Adv. P' (^ VP')

The rules 10a through 10c are straightforward. Temporal adverbial phrases are considered to be VP modifiers. Both temporal adverbial clauses and plain adverbs fall under this category. Let us consider how the italicized sentence in the following discourse is interpreted:

(32) John and Bill were talking about the July 28th deadline for submitting dissertations. *John said that Mary would have finished her paper in June.*

S structure:

John PST say that Mary PST woll have finished her paper in June

LF structure after Tense Deletion:

John PST say that Mary Ø woll have finished her paper in June

1. finish her paper in June $\Rightarrow \lambda P\, \lambda x\, [t^* \subseteq June' \,\&\, P\, \{x\}]\, ({}^\wedge\, finish\text{-}her\text{-}paper')$
2. $\lambda x\, [t^* \subseteq June' \,\&\, finish\text{-}her\text{-}paper'\, (x)]$
3. Mary Ø woll have finished her paper in June $\Rightarrow$ $\lambda p \lambda t[PRES\, (t) \,\&\, AT\, (t, \exists t'\, [FUT\, (t') \,\&\, t' \subseteq t_{R2} \,\&\, AT\, (t', \exists t''\, [PAST\, (t'') \,\&\, t'' \subseteq t_{R1} \,\&\, AT\, (t'', {}^\vee p)])])]\, ({}^\wedge\, [t^* \subseteq June' \,\&\, finish\text{-}her\text{-}paper'\, (m)])$
4. $\lambda t[PRES\, (t) \,\&\, AT\, (t, \exists t'\, [FUT\, (t') \,\&\, t' \subseteq t_{R2} \,\&\, AT\, (t', \exists t''\, [PAST\, (t'') \,\&\, t'' \subseteq t_{R1} \,\&\, AT\, (t'', t^* \subseteq June' \,\&\, finish\text{-}her\text{-}paper'\, (m))])])]$
5. $\lambda t[PRES\, (t) \,\&\, AT\, (t, \exists t'\, [FUT\, (t') \,\&\, t' \subseteq t_{R2} \,\&\, AT\, (t', \exists t''\, [PAST\, (t'') \,\&\, t'' \subseteq t_{R1} \,\&\, t'' \subseteq June' \,\&\, AT\, (t'', finish\text{-}her\text{-}paper'\, (m))])])]$
6. that Mary Ø woll have finished her paper in June $\Rightarrow$ $\exists t'\, [FUT\, (t') \,\&\, t' \subseteq t_{R2} \,\&\, AT\, (t', \exists t\, [PAST\, (t) \,\&\, t \subseteq t_{R1} \,\&\, t \subseteq June' \,\&\, AT\, (t, finish\text{-}her\text{-}paper'\, (m))])]$

7. John said that Mary would have finished her paper in June $\Rightarrow$ $\lambda p \exists t''$ [PAST (t'') & $t'' \subseteq t_{R4}$ & AT $(t'', {}^{\vee}p)$] ($^{\wedge}$ say' (j, $^{\wedge} \exists t'$ [FUT (t') & $t' \subseteq t_{R2}$ & AT (t', $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & $t \subseteq$ June' & AT (t, finish-her-paper' (m))])]))

8. $\exists t''$ [PAST (t'') & $t'' \subseteq t_{R4}$ & AT (t'', say (j, $^{\wedge} \exists t'$ [FUT (t') & $t' \subseteq t_{R2}$ & AT (t', $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & $t \subseteq$ June' & AT (t, finish-her-paper' (m))])]))]

Note that in the above example, the tense morphemes are successively embedded: the perfect is under the scope of the future tense, which is under the scope of the matrix past tense. This scope relationship predicts the right truth conditions for the above sentence. Moreover, the adverbial *in June* correctly constrains the time of the event, i.e. Mary's finishing her paper.

11 through 13. See the comments on the corresponding rules for Japanese.

14. Syntax: Tense Feature Deletion: At the level of Logical Form, a tense morpheme α can be deleted if and only if the following conditions are satisfied: there are tense features β and γ, α has the feature γ, β and γ agree in feature value, and β is **the local tense feature** of γ. **This rule applies after QR has applied.**

Semantics: $[_{Tns}\ \emptyset]$ translates into PRES or λt [FUT (t) & $t \subseteq t_{Rn}$]

As mentioned in Chapter 2, the scope relationships holding at LF affect the applicability of the ST rule. Therefore, we need to posit a tense deletion rule which applies after QR applies. The tense deletion rule presented here covers all the cases of the ST phenomenon discussed in Chapter 2, including those involving temporal adjectives and the perfect *have.* I have already shown how this rule works in connection with the rule 8b. The tense deletion rule produces empty tense nodes, which are translated into IL as PRES.

15. Syntax: Det $\rightarrow$ a, the

    Semantics:

    a translates into $\lambda P \lambda Q\, \exists x\, [\, P\{x\}\ \&\ Q\{x\}]$

    the translates into $\lambda P \lambda Q \exists x[\forall x[P\ \{x\} \leftrightarrow x = y\ ]\ \&\ Q\ \{y\}]]$

I assign conventional meanings to "normal" determiners like *a* and *the.*

16. Comments that I made on the corresponding rule for Japanese apply here as well.

CHAPTER 4

THE SEMANTICS OF "DOUBLE-ACCESS" SENTENCES

In Chapter 3, I claimed that the ST rule can be characterized as a tense deletion rule which deletes a tense morpheme associated with a tense feature α if and only if there is a tense feature β which is the local tense feature of α and α has the same value as β. When the last condition (i.e. α has the same value as β) is not satisfied, the tense deletion rule is not activated.[1] If we restrict our attention to verb complement cases, there are two situations in which embedded tenses are not deleted: (i) a present tense is embedded under a past tense, and (ii) a past tense is embedded under a present tense. In this chapter, we will discuss the case (i).[2] Since a present tense locally c-commanded by a past tense feature is not deleted, the above proposal predicts that this tense morpheme is subject to the interpretation rules. Since the ST

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[1] Even if the condition is satisfied, we can choose not to apply the rule since the tense deletion rule is an optional rule. This allows (a) to have a shifted interpretation, for example.

(a) John said that Mary was pregnant.

But this point is not important for our discussion here.

[2] A past tense embedded under a present tense is not a problem under the theory presented in Chapter 3. It predicts that the past tense morpheme, which is not deleted by the higher present tense at LF, produces a shifted interpretation. This is the right prediction. For example, the time of Mary's graduation must be prior to the speech time in (a):

(a) John believes that Mary graduated from Harvard.

rule in the above system concerns the presence or absence of the past tense morpheme *-ed*, we predict that there are many constructions which fall under this category: a simple present tense embedded under a past tense, a present perfect embedded under a past tense, a future tense (with a present tense marking) embedded under a past tense, and a future perfect embedded under a past tense. Some typical examples of these constructions and their LF representations are given below:

(1a) John said that Mary is in Austin.

(1b) John said that Mary has come to Austin.

(1c) John said that Mary will come to Austin.

(1d) John said that Mary will have come to Austin.

(1a') John Past say that Mary Pres be in Austin.

(1b') John Past say that Mary Pres have come to Austin.

(1c') John Past say that Mary Pres woll come to Austin.

(1d') John Past say that Mary Pres woll have+en come to Austin.

In (1a') through (1d'), a present tense morpheme appears under the scope of a past tense. As a result, the tense deletion rule is not activated. Another characteristic of these sentences is that they make certain claims about both the time of the matrix verb and the speech time.[3] Judging from the syntactic and semantic similarities among the above sentences, one of the desiderata for the ultimate analysis of the above sentences

[3] Needless to say, this characterization of these sentences is extremely vague and is hardly acceptable. It is one of the purposes of this chapter to give a better description of what these sentences mean.

is that they are treated in a uniform way. In the following discussion, we will refer to them as "double-access" sentences.

I will concentrate upon the simple-present-under-past construction since, to the best of my knowledge, this is the only construction that has been discussed in the literature (Costa 1972, Smith 1978, Comrie 1985, Enç 1987) and should be given priority. However, I will also discuss other constructions and show that the solution proposed for the simple-present-under-past construction is also valid in these cases.

4.1. Descriptive Generalizations

In Japanese, when a present tense is embedded under a past tense in a verb complement clause, the sentence receives a simultaneous reading as (2) shows:[4]

(2) John-wa [Mary-ga ninsinsi-te ir-u] to it -ta.
TOP NOM be-pregnant PRES that say PAST

John said that Mary was pregnant. [simultaneous reading]

Under the simultaneous interpretation of (2), John claimed sometime in the past that Mary was pregnant at that time. By contrast, its counterpart in English has a very peculiar interpretation:

(3) John said that Mary is pregnant.

[4] It will be claimed later that (2) can also receive a double-access reading just as its English counterpart (i.e. (3)) can. The point here, however, is that (2) *can* receive a simultaneous reading unlike (3).

(3) is said to have a "double-access" reading because the time of Mary's pregnancy must include both the time of John's saying and the speech time. Of course, a question should be raised immediately as to what we mean by "the time of Mary's pregnancy". Does it refer to the interval at which Mary's pregnancy actually obtains? Does it allude to the interval at which Mary is allegedly pregnant? Or does it mean something else? Although we cannot answer these questions at this point, it is sufficient for our purposes to realize that (3) means something different from either (4) or (5):

(4) John said that Mary was pregnant. [with a simultaneous interpretation]

(5) John said that Mary would be pregnant now.

According to Comrie (1985:115), (3) conveys that Mary's pregnancy is currently relevant. Smith (1978:66) says "the speaker is responsible, as it were, for the complement's being true or relevant at ST [speech time]. More precisely, they indicate that the same event or state referred to holds at the time referred to in the matrix and at ST."

Under the current theory, this difference between English and Japanese follows from the following assumptions: (i) English, but not Japanese, has the ST phenomenon; (ii) the present tense morpheme and the empty tense morpheme in English are distinguished in the semantic component in some way. The theory proposed in Chapter 2 predicts that (4) can receive a simultaneous reading because the tense deletion rule deletes the embedded past tense at LF. (4') is the output of the tense deletion rule, and (4") is its IL translation. On the other hand, the D-structure representation of (3) is (3'), and its LF representation which is subject to the interpretation rules looks also like (3') because the tense deletion rule is not applicable.

(3') John Past say that Mary Pres be pregnant.

(4') John Past say that Mary Ø be pregnant.

(4") $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, say' (j, ^ be-pregnant' (m)))]

It is logically possible to think of a language which possesses a ST rule, but in which the present tense also acts like an empty tense. If we assume counterfactually that English were such a language, the simultaneous reading associated with the Japanese sentence (2) would be conveyed by both (6a) and (6b):

(6a) John said that Mary was pregnant.

(6b) John said that Mary is pregnant.

Assuming that my analysis of the ST phenomenon is correct, we can assume that English is not such a language, because (6a) and (6b) in fact have different interpretations. This means that in English the empty tense and the present tense morpheme must be distinguished in the semantic component in some way.

The current theory distinguishes between Pres and Ø by translating them as NOW and PRES in IL. However, it makes wrong predictions. For example, (3') is translated into IL as (3"):

(3") $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, say' (j, ^ $\exists t'$ [NOW (t') & AT (t', be-pregnant' (m))]))]

(3") predicts incorrectly that (3) talks about a past claim of John's to the effect that Mary is pregnant at the speech time (but not that she is pregnant at the time of the claim). Thus, the semantic difference between the present tense morpheme and the empty tense must be accounted for in some other way. I will continue to assume that the syntactic difference between (3) and (4) that I posited in Chapter 2 is correct and that the remaining task for us is to propose a semantic system which interprets them in the right way.

Unlike English, Japanese has no means by which this distinction can be made explicit. This does not mean, however, double-access interpretations are peculiar to English. I think (2) can receive a reading which is equivalent to (3). If my intuitions are correct, (2) is ambiguous between a purely simultaneous reading and a double-access reading, but this fact has gone unnoticed because these readings are not distinguished by grammatical means, and one reading entails the other. Thus, the ST phenomenon provides English with a means of distinguishing between double-access readings and simultaneous readings overtly.

It should be noted at this point that a present tense which is contained within an NP and occurs immediately under a past tense does not always trigger a double-access reading. Consider the following sentence:

(7) [$_{NP}$ the man who is standing over there] was my boss.

Although the present tense in the relative clause occurs immediately under the matrix past tense, (7) does not have a double-access interpretation. The whole NP is interpreted as if it were not embedded, and the sentence simply means that the man who is standing over there at the speech time used to be the speaker's boss. In other cases, the double-access interpretation of the embedded clause is possible. Consider the following sentence (due to Abusch, 1988):

(8) The professor looked for a student who understands the incompleteness theorem.

Under one interpretation of the sentence, the relativized NP is in the scope of the matrix verb and receives a so-called de dicto reading. In this case, it seems plausible to conclude that the temporal reference of *understands* encompasses both the time of looking for a student and the speech time. However, this double-access interpretation is by no means obligatory in NP cases. (8) also has a de re reading which is true under the following situation: The professor looked for a certain student, who did not know anything about Gödel's theorem at the time. This student came to understand the incompleteness theorem later (before the speech time) and the speaker refers to this property of the student at the speech time in order to refer to this particular person. The generalization seems to be that a present tense in a verb complement clause cannot be completely independent of the matrix past tense, whereas a present tense occurring in a relative clause can.

To explain in a non-ad hoc way why (3) has a double-access reading is one of the most notorious problems that anyone who is concerned with the tense phenomena in English faces. Double-access sentences are problematic partly because they involve intensional contexts, which are notoriously difficult to deal with. I will consider several alternative hypotheses for the correct interpretation of double-access sentences.[5] I will continue to assume with Montague (1973) and others that propositions are functions from the set of world-time pairs to truth values.

Before considering various hypotheses about the semantics of double-access sentences, we will discuss the simultaneous reading of (4), whose interpretation is similar to (3) but is clearly distinct. (4) is true under the simultaneous reading if and only if there is some past interval which is part of a contextually salient interval and at which John stands in the "saying relation" to the proposition *Mary be pregnant.* The sentence (4) translates into IL as (9):

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[5] The "double-access" reading of (a) closely resembles the reading that (b) has:

(a) John claimed that Mary is pregnant.
(b) John has claimed that Mary is pregnant.

However, (a) and (b) have distinct interpretations. Consider the following examples:

(c) *John has told me, before he died, that Mary is pregnant.
(d) John told me, before he died, that Mary is pregnant.
(e) *John has told me in his office that Mary is pregnant.
(f) John told me in his office that Mary is pregnant.

These examples include conditions that serve to distinguish between the past tense and the present perfect. A first condition is that the one denoted by the subject NP must be alive at the speech time in the case of the present perfect. A second condition has to do with locatives: when a locative is used in a perfect sentence, the sentence sounds strange unless the sentence is uttered in the location denoted by the locative expression. Both (d) and (f) fail these tests. This shows that the truth conditions of (c) and (d) (or (e) and (f)) are clearly distinct.

(9) $\exists t\ [\mathrm{PAST}\ (t)\ \&\ t \subseteq t_{R1}\ \&\ \mathrm{AT}\ (t, \mathrm{say}'\ (j, {}^{\wedge}\ \text{be-pregnant}'\ (m))]$

According to PTQ, a proposition is the characteristic function of a set of world-time pairs. In set-theoretic terms, this means that the denotation of a proposition-denoting expression α evaluated at $<w,t>$ is the set $\{<w',t'> \mid [\![{}^{\vee}\alpha]\!]^{M,w',t',g} = 1\}$. Thus, if we say simply that a propositional attitude verb denotes a relation between an individual and a proposition (as interpreted here), we predict the following semantics for say':

(10) Let α be an expression of type $<s,t>$ and β be an expression of type e, $[\![\mathrm{say}'\ (\alpha)(\beta)]\!]^{M,w,t,g} = 1$ iff $[\![\beta]\!]^{M,w,t,g}$ stands in the saying relation to the proposition $\{<w',t'> \mid [\![\alpha]\!]^{M,w',t',g} = 1\}$ at $<w,t>$.

As mentioned in Chapter 2, a necessary condition of the saying relation can be given as follows:

(11) Suppose g(x) utters the sentence in w at t. If g(x) stands in the saying relation to g(p) at t in w, then g(x) speaks the truth at t in w iff g(p)(<w,t>) is true.

The IL formula (9) combined with (10) and (11) tells us that if John stands in the saying relation to the proposition $\{<w',t'> \mid [\![\text{be-pregnant}'\ (m)]\!]^{M,w',t',g} = 1\}$ at $<w,t>$, then if John speaks the truth, the proposition is true at $<w,t>$. That is, Mary is pregnant at $<w,t>$.

However, this does not mean that in order for (4) to be true Mary must be pregnant in the actual world at the time of John's saying. For example, (4) can be true in a model which has properties informally described by the following diagram:

```
(12)
w1 (real world)   ________________________________________
w2                __|____M_|_______________________________  worlds
w3                ____|_M__|_______________________________  consistent w/
w4                ___|_M_____________|_____________________  J's attitude at t1
w5                _______________________|M_____|_______
                        |t1                    |t2
                  the time of             the time of
                  John's saying           the report
```

[N.B. 'M' indicates an interval throughout which Mary's pregnancy obtains.]

In this model, Mary's pregnancy does not obtain in the actual world. However, (4) can be true at $<w_1,t_2>$ in this model as long as John stands in the saying relation to the proposition $\{<w',t'> \mid [\![\text{be-pregnant}'(m)]\!]^{M,w',t',g}\}$ at $<w_1, t_1>$. We will refer to the worlds in which Mary is pregnant at t_1 as the "worlds consistent with John's attitude at t_1". In the model described partially as (12), w_2, w_3 and w_4 are among the worlds consistent with John's attitude at t_1. The important point is that even if the set of worlds consistent with John's attitude at t_1 does not include the actual world, (4) can be true at t_1 in the actual world. Of course, (4) *allows* Mary's pregnancy to obtain in the actual world at t_1 or at an interval encompassing t_1 and t_2, but it does not require that it obtain in the actual world at any time. Since (3) means something different from (4), (3) must be predicted to have properties different from (4).

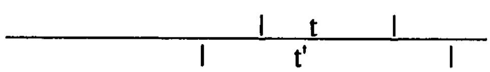
A first hypothesis about the semantic interpretation of double-access sentences such as (3) is the following:[6]

(13) **Hypothesis 1:** The individual denoted by the subject NP of the matrix clause asserts that the proposition denoted by the embedded clause is true at the time of his/her saying, and the proposition denoted by the embedded clause is in fact true in the real world at an interval including the time of the matrix verb and the speech time of the report.

The following formula represents the interpretation of (3):

(14) $\exists t\, [PAST\, (t)\ \&\ t \subseteq t_{R1}\ \&\ AT(t, say\, (j, {}^{\wedge}be\text{-}pregnant'\, (m)))\ \&\ \exists t'[XN\, (t')\ \&\ t \subseteq t'\ \&\ AT\, (t', be\text{-}pregnant'(m))]]$

[N.B. XN stands for "extended now", and $[\![XN\, (t')]\!]^{M,w,t,g} = 1$ iff t is a proper subinterval of $[\![t']\!]^{M,w,t,g}$.]



t is a proper subinterval of t'

According to Hypothesis 1, (3) conveys what (4) conveys and claims, in addition, that the embedded proposition is true at an extended now encompassing the time of John's saying and the time of the report (i.e. the speech time). Thus (3) is compatible

[6] Costa (1972) claims this to be the right analysis.

with a model which is described partially by the diagram (15):

(15)
w1 (real world) ___|M________________________|____ the worlds
w2 ___|M__|_____________________________ consistent w/
w3 _|M____|____________________________ J's attitude at t_1
w4 ______________________________________
|t_1 |t_2
the time of the time of
John's saying the report

Hypothesis 1 predicts that (3) is true if and only if John stands in the saying relation to the proposition $\{\langle w', t'\rangle \mid [\![\text{be-pregnant}' (m)]\!]^{M,w',t',g} = 1\}$ at the time of John's saying, and Mary's pregnancy in fact obtains *in the real world* at an interval including the time of John's saying and the utterance time of (3). Put another way, (3) *requires* that Mary's pregnancy obtain in the actual world at an extended interval containing the time of John's saying and the time of the report. This view seems to be reasonable when we consider the following examples:

(16a) Kepler discovered that the earth revolves around the sun.

(16b) Look, the dip-stick shows oil right up the full mark. But Joe said his car *is/was out of oil.[7]

According to this hypothesis, we can explain the difference in acceptability between

[7] (16b), including the judgment, is due to Costa (1972: 48).

(16a) and (16b) in the following way: (16a) is true because (i) it is true that Kepler discovered that the earth revolved around the sun (at the time of his discovery), and (ii) we know that the earth still goes around the sun now. (16b) sounds strange with a present tense in the second sentence because the first sentence tells us that the car is not out of oil at the speech time.

I will demonstrate, however, that this position is empirically flawed. Consider the following discourse:

(17) At 10 A.M.:

John and Bill are peeping into a room. Sue is in the room.

(a) John: (near-sighted) Look! Mary is in the room.

(b) Bill: What are you talking about? That's Sue, not Mary.

(c) John: I'm sure that's Mary.

1 minute later (Kent joins them); Sue is still in the room.

(d) Bill: (to Kent) John said that Mary is in the room. But that's not true. The one that is in the room is Sue.

As this conversational exchange shows, Bill knows that the one that is in the room is *not* Mary and that *the proposition "Mary be in the room" is false in the real world both at the time of John's saying and also at the speech time.* However, (17d) is true in this situation. We must conclude, then, that the first hypothesis is untenable.

A second hypothesis is that the person denoted by the subject NP of the attitude verb claims at the time of his speech that the proposition expressed by the embedded

S is true at an interval encompassing both the time of the matrix verb and the speech time. (3) is true if and only if John claims that Mary's pregnancy obtains at an interval extending from the time of his claim until the speech time of the report:

(18) **Hypothesis 2:** In all the worlds which are consistent with the attitude expressed by the individual denoted by the subject of the attitude verb, the proposition expressed by the embedded clause is true at an interval including the time at which the attitude is expressed and the time of the report.

(18) predicts that the truth condition of (3) is represented by the following formula:

(19) Version 1: $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, say' (j, $\wedge\exists t' \exists t''$ [PRES (t') & XN (t'') & $t' \subseteq t''$ & AT (t'', be-pregnant' (m))]))]

[N.B. $[\![$XN (t')$]\!]^{M,w,t,g}$ = 1 iff $[\![s^*]\!]^{M,w,t,g}$ is a proper subinterval of $[\![t']\!]^{M,w,t,g}$ where $[\![s^*]\!]^{M,w,t,g}$ = the speech time.]

Let us see how (19) is interpreted:

$[\![\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, say' (j, $\wedge\exists t' \exists t''$ [PRES (t') & XN (t'') & $t' \subseteq t''$ & AT (t'', be-pregnant' (m))]))]$]\!]^{M,w_1,t_1,g}$ = 1 iff there is a $g^{t2/t}$ such that $[\![$PAST (t) & $t \subseteq t_{R1}$ & AT (t, say' (j, $\wedge\exists t' \exists t''$ [PRES (t') & XN (t'') & $t' \subseteq t''$ & AT (t'', be-pregnant' (m))]))$]\!]^{M,w_1,t_1,g^{t2/t}}$ = 1. This holds iff $t_2 < t_1$, t_2 is part of the contextually salient interval t_{R1}, and $[\![$say' (j, $\wedge\exists t' \exists t''$ [PRES (t') & XN (t'') & $t' \subseteq t''$ &

AT (t'', be-pregnant' (m))])$\rrbracket$M,w_1, t_2, g = 1. This is the case iff John stands in the saying relation to the following proposition at <w_1,t_2>: {<w, t> | $\llbracket\exists$t' $\exists$t'' [PRES (t') & XN (t'') & t'$\subseteq$t'' & AT (t'', be-pregnant' (m))]$\rrbracket$M,w, t, g = 1}, which is equivalent to {<w, t> | there is a $g^{t3/t',t4/t''}$ and $\llbracket$PRES (t') & XN (t'') & t' $\subseteq$ t'' & AT (t'', be-pregnant' (m))$\rrbracket$M,w,t,$g^{t3/t',t4/t''}$ = 1}. This is a set of world-time pairs <w, t> such that in w there is an interval t_4 which encompasses both t and $\llbracket$s*$\rrbracket$M,w_1,t_1,g, and Mary is pregnant at t_4.

If we assume that John spoke the truth, it follows that this proposition is true at <w_1,t_2>. Namely, $\llbracket\exists$t' $\exists$t'' [PRES (t') & XN (t'') & t'$\subseteq$t'' & AT (t'', be-pregnant' (m))]$\rrbracket$M,w_1,t_2,g = 1. This holds iff there is a $g^{t3/t',t4/t''}$ and $\llbracket$PRES (t') & XN (t'') & t'$\subseteq$t'' & AT (t'', be-pregnant' (m))$\rrbracket$M,w_1,t_2,$g^{t3/t',t4/t''}$ = 1. This means that the following conditions must be satisfied: $t_2 = t_3$, $\llbracket$s*$\rrbracket$M,w_1,t_1,g is a proper subinterval of t_4, t_3 is part of t_4, and Mary is pregnant in w_1 at t_4. This shows that in every world consistent with John's attitude expressed at <w_1,t_2>, Mary's pregnancy obtains at an interval encompassing t_2 and $\llbracket$s*$\rrbracket$M,w_1,t_1,g.

There is an alternative formalization of Hypothesis 2, which assigns the following interpretation to (3):

(20) Version 2: $\exists$t [PAST (t) & t $\subseteq$ t_{R1} & $\exists$t' [XN(t') & t $\subseteq$ t' & AT (t, say' (j, ^ AT (t', be-pregnant' (m))))]]

In (20), the existential quantifier binding the extended now interval has scope over the AT operator (and the verb *say*), instead of appearing within the scope of *say*. This is a case of so-called de re attitude reports, as a variable appearing within the proposition (i.e. t') is bound by an existential quantifier from outside the scope of the verb *say*, which creates an oblique context. Let us see if this means something different from what the earlier version predicts:

$[\![\exists t\,[PAST\,(t)\ \&\ \exists t'\,[XN(t')\ \&\ t \subseteq t'\ \&\ AT\,(t, say'\,(j, \wedge AT\,(t', be\text{-}pregnant'\,(m))))]]]\!]^{M,w_1,t_1,g} = 1$ iff there is a $g^{t2/t}$ and $[\![PAST\,(t)\ \&\ \exists t'\,[XN(t')\ \&\ t \subseteq t'\ \&\ AT\,(t, say'\,(j, \wedge AT\,(t', be\text{-}pregnant'\,(m))))]]\!]^{M,w_1,t_1,g^{t2/t}} = 1$. This is so iff $t_2 < t_1$ and $[\![\exists t'\,[XN(t')\ \&\ t \subseteq t'\ \&\ AT\,(t, say'\,(j, \wedge AT\,(t', be\text{-}pregnant'\,(m))))]]\!]^{M,w_1,t_1,g^{t2/t}} = 1$. This is so iff there is a $g^{t2/t,t3/t'}$ and $[\![XN(t')\ \&\ t \subseteq t'\ \&\ AT\,(t, say'\,(j, \wedge AT\,(t', be\text{-}pregnant'\,(m))))]\!]^{M,w_1,t_1,g^{t2/t,t3/t'}} = 1$. This condition is satisfied iff t_1 is a proper final subinterval of t_3, t_2 is part of t_3, and John stands in the saying relation at $<w_1,t_2>$ to the following proposition: $\{<w'', t''> \mid [\![AT\,(t', be\text{-}pregnant'\,(m))]\!]^{M,w'',t'',g^{t3/t'}} = 1\}$, which is equivalent to $\{<w'', t''> \mid [\![be\text{-}pregnant'\,(m)]\!]^{M,w'',t_3,g^{t3/t'}} = 1\}$. This is the set of world-time pairs $<w'',t''>$ such that Mary is pregnant at $<w'',t_3>$. Notice that the temporal coordinate in the world-time pair is superfluous here. That is, if Mary is pregnant at t_3 in w'', every world-time pair of the form $<w'', t>$ where t is any time whatsoever is a member of the above set. In other words, in a de re attitude report about an interval, the embedded proposition is described as a timeless proposition. This differs from the version 1, which does not produce this consequence. However, it is not clear if there is any substantive difference between the two versions of Hypothesis 2 that we have just discussed.

If we assume that John spoke the truth, the outcome is the same as the version 1 discussed above. We can assume that $[\![\wedge AT\,(t', be\text{-}pregnant'\,(m))]\!]^{M,w'',t'',g^{t3/t'}}$

$(\langle w_1,t_2\rangle) = 1$. This is the case iff $[\![AT\ (t', \text{be-pregnant}'\ (m))\ ]\!]^{M,w_1,t_2,g^{t_3/t'}} = [\![\text{be-pregnant}'\ (m)]\!]^{M,w_1,t_3,g} = 1$. This means that Mary is pregnant in w_1 at t_3, which is an interval encompassing the time of John's saying and the speech time. This prediction is exactly the same as the version 1.

If we follow the standard way of analyzing de re attitude reports, we should assume that John identified the interval in question in a way that is not actually reported by the speaker. However, this leads to another question. What does it mean to identify an interval (e.g. t_3 in this case)? Does it mean to have an "acquaintance" with the interval? If yes, what does it mean to have an "acquaintance relationship" with an interval? It is not clear how to answer these questions.[8]

Hypothesis 2 predicts that the sentence in question can be true in a model which has properties described informally below:

(21)

```
w1 (real world)  ______________________________________
w2               ____|__________M__________________|  the worlds
w3               |______________M______________|_____  consistent w/
w4               ____|__________M_________________|___ J's attitude at t1
w5               ______________________________________
                     |t1                    |t2
                 the time of            the time of
                 John's saying          the report
```

[8] There is yet another way of symbolizing Hypothesis 2:
$\exists t\ [Past\ (t)\ \&\ t \subseteq t_{R1}\ \&\ \exists t'\ [XN(t')\ \&\ AT\ (t, say'\ (j, {}^\wedge \exists t''\ [Pres\ (t'')\ \&\ t'' \subseteq t'\ \&\ AT\ (t', pregnant'\ (m))]))]]$
This is another version of de re attitude reports. However, it is not exactly clear to me what the difference between the first version and this version is.

Under this construal, the proposition denoted by the embedded clause does not have to be true at an extended interval encompassing t_1 and t_2 *in the real world* as the above diagram makes clear. It is only required that the subject of the attitude verb claim this to be the case. In other words, in every world consistent with John's attitude at $<w_1,t_1>$, Mary's pregnancy must obtain at an interval which includes both t_1 and t_2.

It turns out that the second hypothesis is also untenable. Suppose that John uttered the following sentence at some time in the past:

(22) Mary is pregnant.

Suppose further that Mary was in fact pregnant at that time. Now, the question is whether (22) can be reported by (23) felicitously at a later time:

(23) John said that Mary is pregnant.

According to the proposal under consideration, (23) is true if and only if John employs (22) to claim that the proposition *Mary be pregnant* is true at an interval including the time of his saying and the speech time of (23). This leads to the following hypothesis: If John utters (22) at t, claiming that Mary's being pregnant obtains at an interval involving t and a later time, then the course of events that develops (in the real world) after t does not influence in any way the acceptability of (23) uttered at a time later than t.

However, facts are contrary to this prediction. If the speaker of (23) knows that the embedded proposition was true at the time of John's original utterance, he must make sure that this proposition is still true at the speech time of (23) in order to use it appropriately. The following minimal pair makes the point clear:

(24) On June 20th:

John: Mary is pregnant.

(Bill hears John's statement, asks Mary about it and verifies that John's statement is true.)

[Case 1] On December 20th:

(Bill meets Mary and verifies that she is still pregnant.)

Bill: John said in June that Mary is pregnant. ......

[Case 2] On December 20th:

(Bill meets Mary and learns that Mary has had a miscarriage.)

Bill: #John said in June that Mary is pregnant. .....

This shows that the second hypothesis does not work since it is quite unreasonable to attribute two different properties to John just because the course of events came out differently in these two cases. Presumably, given the capacity of normal human beings, it is unreasonable to expect that a person can predict the possibility of a miscarriage and adjust his belief about the future in accordance with this prediction. However, the second hypothesis described above forces us to accept this unreasonable analysis.

I offer another example which shows that Hypothesis 2 is untenable. Consider the following conversational exchange:[9]

(25) (a) John: (at 10:00 A.M. Bill is reading a book.) Look! Bill is reading a book.

(b) Jim: (at 10:05 A.M. Bill is no longer reading the book.) #John said five minutes ago that Bill is reading a book. That's not true. He is no longer reading a book.

The point of this example is that Jim's statement "John said that Bill is reading a book. That's not true" seems to be a misrepresentation of John's earlier statement (25a). This, in turn, means that (25a) must be taken to mean what it intuitively means, i.e., it asserts that Bill's reading a book obtains at the time of John's speech (at 10:00 A.M.). Therefore, John need not commit himself to Bill's reading a book five minutes later.

A proponent of Hypothesis 2 might defend his position in the following way: It may be true that a sentence in the simple present tense can only be used for a purely simultaneous claim. However, (25b) is unacceptable simply because a double-access sentence is not designed to report a sentence in the simple present tense in the first place; rather, a double-access sentence is acceptable only when it reports a sentence which contains a future-oriented claim as well as a simultaneous claim. Following

[9] Hans Kamp (p. c.) suggested a similar example to me.

this line of reasoning, we predict that (25b) is a perfect report of the following statement because the truth of (26) requires that Bill's reading a book obtain throughout the five-minute interval in question:

(26) John: Bill is reading a book, and he will continue to do so for five more minutes.

Despite this prediction, native speakers of English seem to share the intuition that "John said five minutes ago that Bill is reading a book" is a strange way of reporting (26).

To show convincingly that the explanation offered by Hypothesis 2 is on the wrong track, let us slightly change our earlier example (17) and present it here as (27):

(27) At 10 A.M.:

John and Bill are peeping into a room. Sue is in the room.

(a) John: (near-sighted) Look! Mary is in the room.

(b) Bill: What are you talking about? That's Sue, not Mary.

(c) John: I'm sure that's Mary.

Sue leaves the room; 1 minute later (Kent joins them)

(d) Bill: (to Kent) # John said that Mary is in the room.

In this dialogue, Sue, who John thinks is Mary, leaves the room after the first exchange between John and Bill. So when Kent joins them, the room is empty. Curiously, Bill can no longer use a double-access sentence to report John's earlier statement, as the unacceptability of (27d) shows clearly.

To make the point even clearer, let us consider another situation. Sue goes out of the room. Mary comes in just before Sue leaves. Then, Kent joins John and Bill. The outcome remains the same: Bill cannot report John's earlier utterance by (28) *despite the fact that Mary is in fact in the room now.*

(28) # John said that Mary is in the room. Yeah, he was right! She is in there now.

We can conclude from the above examples that whether Sue's being in the room continues up until the speech time determines the difference in acceptability between (17d) and (27d). The important factor here seems to be that Sue is the source of John's erroneous claim that Mary is in the room. I have already demonstrated that the truth of the sentence "John said that Mary is in the room" does not guarantee that Mary is in the room (in the real world) at an interval including the time of John's saying and the speech time. We have also learned that the truth of (17d) or (27d) is not determined by how far into the future the state of Mary's pregnancy is claimed to continue. Instead, it is required that the situation causally responsible for the attitude being reported continue to obtain at least until the speech time of the report.

Before proposing a new hypothesis, we will add another argument against Hypothesis 2. If Hypothesis 2 were the right proposal about double-access sentences, we would predict that (29a) had exactly the same truth conditions as (29b):

(29a) John said two weeks ago that Mary is pregnant.

(29b) John said two weeks ago that Mary was pregnant and that she would continue to be pregnant for at least two more weeks.

However, this prediction fails. In order to make the comparison easy, let us assume that in both cases, Mary was in fact pregnant in the actual world at the time of John's saying. (29b) straightforwardly describes John's commitment to the truth of the proposition *Mary be pregnant* at the extended interval, and the truth value of (29b) is not affected by what happens in the actual world after the time of John's saying. Suppose that the speaker finds out that Mary is no longer pregnant now. In this situation, (30) is a perfectly acceptable utterance.

(30) John said two weeks ago that Mary was pregnant and she would continue to be pregnant for at least two more weeks. He was wrong. Mary is no longer pregnant.

On the other hand, its double-access counterpart behaves differently as explained above; (31) is anomalous:

(31) #John said two weeks ago that Mary is pregnant. He was wrong. Mary is no longer pregnant.

(31) is anomalous under two different readings. First, if it is uttered as a comment on John's earlier utterance given here as (32a), the first sentence in (31) is an unacceptable report of the original in the situation described.[10] In addition, the second and third sentences are not proper comments on John's original statement. Second, if (31) is intended as a report of John' earlier statement (32b), then the first sentence in (31) is again an unacceptable report[11] although the second and third sentences are a fair evaluation of John's original claim.

(32a) John: "Mary is pregnant."

(32b) John: "Mary is pregnant and will continue to be pregnant for at least two more weeks."

We can conclude from this that Hypothesis 2 is flawed. Hypothesis 2 correctly describes the semantics of sentences like (29b), but not the semantics of double-access sentences.

Let us consider an alternative hypothesis:

[10] This point was already made in connection with (25).

[11] This point was made above in connection with the example (26).

(33) **Hypothesis 3**: the speaker, in addition to reporting the original attitude expressed, makes a counterfactual claim: if the person denoted by the subject NP of the attitude (or indirect discourse) verb were to express his attitude at any time between the time of his saying and the time of the report, he would be prepared to use the same words that he used at the time of his speech.

Let us continue to use the example (17) (and the modified versions of (17)) as a test case. Hypothesis 3 is distinct from Hypothesis 2 in that John does not have to claim at the time of his saying that Mary is in the room at an extended interval. It simply requires that his belief that Mary is in the room continue until the speech time of (17d). Thus, the prediction is that John would still say, if asked, "Mary is in the room" at the time (17d) is uttered. Hypothesis 3 seems to offer a means of explaining why Sue's being the room must continue in order for (17d) to be acceptable: If Sue is still in the room when Bill utters (17d), it seems legitimate to assume that John's opinion about the identity of the person in the room has not changed. On the other hand, if Sue is no longer in the room, we seem to be justified in assuming that John no longer holds the same belief since John should be able to see Sue leave the room even though he is near-sighted.

Unfortunately, this proposal is empirically flawed. Most of the native speakers that I consulted (two disagreed) informed me that (17d) is acceptable even if Bill succeeds in convincing John that the person who is in the room is Sue and not Mary at some point between (17b) and (17d). That is, the following scenario is acceptable to most native speakers:

(34) (a) John: (near-sighted) Look! Mary is in the room.

(b) Bill: What are you talking about? That's Sue, not Mary.
Mary is not that tall.

(c) John: Yeah. You're right. That's Sue.

1 minute later (Kent joins them). Sue is still in the room.

(d) Bill: (to Kent) John said that Mary is in the room.

(35) offers another piece of evidence against Hypothesis 3:

(35) John told me, before he died, that Mary is pregnant.

Assuming that a dead person has no consciousness, it is wrong to say that John holds the same belief (i.e. the belief that Mary is pregnant) at the speech time of (35). Nevertheless, (35) is acceptable to native speakers. This leads us to the following hypothesis:

(36) **Hypothesis 4**: If the individual denoted by the subject NP of the matrix sentence were in the location of the original utterance now with all his physical and mental properties at the time of the original statement intact, he would self-ascribe the same property that he self-ascribed by uttering the original statement.

Under Hypothesis 4, the speaker of double-access sentences is claimed to make two assertions. Consider (17) again. The speaker reports John's earlier statement. He also makes a counterfactual assertion: John, with the same physical and mental conditions as the time of his original utterance, would say now that Mary is in the room. Informally, the idea is that John makes a time-trip and moves to the speech time of the report without changing his properties. If this happened, John would say "Mary is in the room" iff Sue is still in the room. This does not entail that "real" John still thinks that Mary is in the room (in the real world); it only requires that "the John" who expressed the attitude conveyed by the original utterance would have the same attitude now. The problem with Hypothesis 4, however, is that the condition proves to be vacuous. If John makes a time trip and comes to the speech time with all of his properties at the time of his original speech intact, it seems obvious that he would be ready to make the same statement because this is one of the properties he had at the time of his original speech. Thus Hypothesis 4 seems to be inadequate because it is unfalsifiable.

At this point, let us shift our attention from the subject's attitude to the state of affairs that is causally responsible for it. One important characteristic of double-access sentences is that when the state claimed to obtain by the individual denoted by the subject NP of the main clause *does* obtain in the actual world at the time of the claim, this state must obtain at an interval including the time at which the attitude was expressed and the speech time of the report. In other words, the state must be continuous from the time of the original utterance at least until the time of the report. As mentioned in Hypothesis 1, when the matrix verb is a factive verb, the truth conditions of double-access sentences are given straightforwardly. Consider the following sentence:

(37) John found out two weeks ago that Bill is living with Sue.

(37) is true iff (i) John finds out at some past time that Bill is living with Sue at that time and (ii) this state happens to continue until the speech time of (37).

The same type of truth condition (i.e. the conjunction of two separate conditions) is also needed for "double-access sentences" involving causative adverbial clauses. Hans Kamp (p.c.) suggested the following examples to me, which involve causative adverbial clauses:

(38a) John is relating what happened today.
John: I went out in my winter coat because it is very cold today.

(38b) John is writing a letter. Mary enters the room. She wants to talk to John. But since he is writing a letter, she goes out of the room. Five minutes later, Bill describes what happened to Jim. John is still writing a letter.
Bill: Mary left because John is writing a letter.

They resemble double-access sentences involving verb complement clauses in that a present tense is embedded under a matrix past tense. For (38a) to be felicitous, its being cold has to encompass both the time of John's going out in his winter coat and the speech time. The point is made even clearer by (38b). In order for Bill's statement to be felicitous, John's writing a letter must still be taking place now. Moreover, the letter that he is writing must be the same letter that he was writing when Mary came in and left. In other words, even if John is writing a letter both at the time of Mary's going out of the room and at the speech time, if they are different letters, Bill's statement in (38b) is false.

The characteristic common to the complement of a factive verb and a causative adverbial clause is that both of them are factive when they occur in "normal" (non-double-access) sentences. For example, in (39a) the complement clause must be true, and in (39b) the adverbial clause must be true:

(39a) John found out that Bill and Mary were living together. → Bill and Mary were living together.

(39b) I went out in my winter coat because it was cold. → It was cold.

Let us refer to complements of factive verbs and causative adverbial clauses as "factive clauses". This factive nature of factive clauses carries over to double-access sentences involving these two constructions. In general, the semantics of double-access sentences involving factive clauses can be described as follows:

(40) If S_2 of a sentence of the form $[_{S1} \ldots \text{Past } V_1 \ldots [_{S2} \ldots \text{Pres } V_2 \ldots]]$ is a factive clause, S_1 is true iff (i) $[_S \ldots \text{Past } V_1 \ldots [_S \ldots \text{Past } V_2 \ldots]]$ (with a simultaneous reading) is true and (ii) $[_{S2} \ldots V_2 \ldots]$ (untensed) is true at an interval including the time of the event denoted by V_1 and the speech time.

It is clear that the two conditions cannot be reduced to one. For example, (38b) does not claim that John's writing a letter *at an extended now interval* caused Mary to go out of the room. The sentence is true only if what caused Mary to go out of the room is John's writing a letter *at the time of Mary's going out of the room.* Nevertheless, the sentence must must also satisfy the condition that John's writing a letter obtains *at an extended interval including both the time of Mary's going out of the room and the speech time.*

I assume that as far as factive double-access sentences are concerned, the above generalization is correct. In what follows, I will pursue the hypothesis that additional complications associated with double-access sentences involving non-factive attitude verbs stem from the fact the embedded sentence does not have to be true in the real world. The question is whether the truth conditions established for factive cases, with some modification, extend to certain non-factive propositional attitude cases in which the embedded propositions are *false* in the actual world both at the time of the attitude and at the time of the report. It is plausible to claim that the condition (40-i) is appropriate for non-factive cases as well. In fact, this is what I assumed when I proposed Hypotheses 1, 3 and 4. However, the condition (40-ii) seems to make no sense with non-factive clause cases: it requires that the state obtain at an extended interval (in the actual world), and it is precisely this condition that non-factive clause cases fail to satisfy. But there may be ways of reinterpreting the condition so that it applies to non-factive cases as well.

Enç seems to believe that the same "one-continuous-state" condition applies to double-access sentences regardless of whether the embedded proposition is true in the real world. Enç states (1987: 637):

(41) Note that in order to interpret the complement correctly, we must have access to both evaluation times introduced previously. Given the normal length of human pregnancies, (30) is anomalous precisely because the time of Mary's pregnancy cannot encompass the two times.

(A) (her (30)) John heard two years ago that Mary is pregnant.

If I understand Enç correctly, she claims that (A) is anomalous regardless of whether what John heard is a fact. In other words, the embedded proposition must be such that it is at least possible (in accordance with our world knowledge) that it be true at an extended interval encompassing the time of the attitude verb and the speech time of the report. Since one single human pregnancy (whether or not it is real or unreal) cannot last as long as two years, (A) is anomalous.[12] If this is the right way of

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[12] The following example due to Abusch (1988) makes the same point:

(a) #Yesterday at noon John pointed out that the sun is straight overhead.

Even if the sun is again straight overhead at the speech time of (a), (a) is anomalous because a single continuous state of the sun's being straight overhead cannot last for twenty four hours.

understanding Enç's suggestion, its predictive ability is quite limited when the embedded proposition is false. Consider (42), which was discussed in connection with (17) and some other discourse examples:

(42) John said that Mary is in the room.

In all of the discourse examples considered above, it is possible that the state in question (i.e. Mary's being in the room) obtain for one minute because our world knowledge tells us that a person is capable of staying in a room for one minute (or longer). However, (42) is true in some circumstances and not in others. For example, both in (17) and (27) it is possible for Mary to be in the room at an interval encompassing both the time of John's original utterance and the time of Bill's report. However, Bill's reports (i.e. (17d) and (27d)) receive different acceptability judgments in (17) and (27). Thus, the truth of a double-access sentence is controlled by much more than the mere possibility of the embedded proposition's being true at an extended interval. The right generalization seems to be that the requirement suggested by Enç is *a necessary but not a sufficient condition* for the truth of a double-access sentence.

Let us attack the problem from a slightly different angle. Let us go back to example (34). As mentioned above, (34d) is acceptable because Sue is in the room at an extended interval involving the time of John's saying and the speech time of (34d). To show that the state under discussion must be a continuous one involving the time of John's saying and the time of the report, we will consider the following dialogue, which is a variant of (27):

(43) John and Bill are peeping into a room. Sue is in the room.

(a) John: (near-sighted) Look! Mary is standing in the room.

(b) Bill: What are you talking about? That's Sue, not Mary.

On the following day, Bill and Kent are in front of the same room. Sue is inside.

(c) Bill: #John said yesterday that Mary is standing in the room. But that's Sue, not Mary.

Let us assume that the room in question is in an office building. Assume also that Sue went back home and stayed there at night and came back to the office on the following day. In this case, these two references to Sue's standing in the room concern two temporally discontinuous states, and the double-access sentence uttered by Bill is false. Thus, in order to make (43c) true, Sue's standing in the room must be continuous from the time of John's saying until the time of the report. This condition is suspiciously analogous to the condition (40-ii): the state denoted by the complement clause must obtain at an interval including the time of the matrix and the speech time of the report. Sue's presence in the room is clearly connected with the embedded proposition (i.e. Mary be standing in the room), for Sue's standing in the room causes John to think that Mary is standing in the room. But it is not easy to pin down the exact relationship between Sue's standing in the room and the proposition *Mary be standing in the room.*

Despite some apparent difficulties, I will claim in what follows that there is a way of capturing the truth conditions of factive and non-factive propositional attitude cases in a uniform way. Consider the following sentences:

(44a) John: Mary is in the room.

(44b) John said that Mary is in the room.

The situation assumed is the same as in the earlier examples: John utters (44a) by looking at Sue in the room. (44b) is uttered to report (44a). Now, how can we claim that the condition (40-ii) must be satisfied in order to make (44b) true? Since (44b) can be true without Mary's being in the room either at the time of John's saying or at the time of the report, the condition must be modified in the following way: the embedded proposition is true at an extended interval in some of the possible world(s) which are consistent with what John expressed at the speech time of (44a).

In order to test the validity of this hypothesis, we will try to establish a difference in interpretation between (45a) and (45b-c):

(45a) Two days ago John said that Mary is pregnant.

(45b) Two days ago John said that Mary was pregnant. [with a simultaneous reading]

(45c) Two days ago John said that Mary was pregnant and would continue to be pregnant for two more days.

Suppose that John's original utterance is made at t_1 in w_1 and that the reports (i.e. (45a-c)) are made at t_3 in w_1. With (45b), the worlds consistent with John's attitude expressed at $<w_1,t_1>$ are such that Mary's pregnancy obtains at t_1. With (45c), the worlds consistent with John's attitude expressed at $<w_1,t_1>$ are such that Mary's pregnancy obtains at an interval encompassing both t_1 and t_3. Thus, they have distinct truth conditions.

Now, consider (45a). Since John clearly claims that Mary is pregnant at the time of his original utterance, in all the worlds consistent with John's attitude expressed at $<w_1,t_1>$, Mary's pregnancy obtains at t_1. According to our hypothesis, (45a) also requires the following: in *some* of the worlds which are consistent with John's attitude expressed at $<w_1,t_1>$, Mary's pregnancy continues to obtain until t_3. This does distinguish between (45a) and (45c) in that (45c) *requires* that in *all* the worlds consistent with John's attitude at the time of his speech, Mary's pregnancy hold at an interval including t_1 and t_3, while this possibility is merely allowed with (45a). We can also distinguish between (45a) and (45b), at least technically. (45b) *allows* Mary's pregnancy to obtain at an interval encompassing both t_1 and t_3 in a world consistent with John's attitude expressed at $<w_1,t_1>$. Under the current hypothesis, (45a) is different from (45b) in that it *requires* that in some set of the worlds, Mary's pregnancy obtain until the speech time of the report. In other words, (45b) is compatible with there being no worlds compatible with John's beliefs in which Mary's pregnancy continues up to the speech time. For example, we can construct a rather artificial attitude in such a way that John's claim about Mary's pregnancy is restricted to a very short interval around the time of John's speech. For example, John can impose such an artificial restriction by uttering the following sentence:

(46) Mary is pregnant, but she will have a miscarriage before the day is over.

This utterance serves to restrict the interval at which Mary's pregnancy is claimed to obtain to be one ending only briefly after the time of John's utterance. The prediction is that (46) can be reported by (45b), but not by (45a). However, this requirement (i.e. the state denoted by the embedded proposition must continue to obtain until the time of the report in *some* of the worlds consistent with the subject's attitude) seems to be a necessary, but not a sufficient, condition for the truth of a double-access sentence. As we have seen above, double-access sentences can be true or false depending upon the state of affairs in the real world even when the subject's attitude is fixed.

An alternative would be to assume that we can single out by an independent criterion some *specific subset* of the possible worlds that are consistent with John's attitude expressed at $<w_1,t_1>$ and that Mary continues to be pregnant until t_3 in these worlds. But what exactly is the criterion for singling out these worlds? This question brings out a similarity between double-access sentences and progressives. It is well-known that in order to solve what he calls the "imperfective paradox," Dowty (1977, 1979) offers a solution in which the primitive function Inr (inertia world) serves to pick out a set of worlds which develop after a certain time in a way most consistent with the state of affairs in the real world. Many linguists (e.g. Vlach 1981, Abusch

1985) have criticized this proposal because the nature of the inertia function is left unclarified. The proposal that I have just suggested seems to suffer from the same type of problem.

Nevertheless, I believe there is a way of selecting a set of world(s) in which the state denoted by the embedded clause obtains at an extended interval. For this purpose, we again consider the situation where (47b) is uttered to report John's utterance (47a) and Sue, not Mary, is in the room.

(47a) John: Mary is in the room.

(47b) John said that Mary is in the room.

In order to single out a certain set of possible worlds in which Mary is in the room at an interval including the time of John's utterance (i.e. (47a)) and its report (i.e. (47b)), we employ the following counterfactual conditional: if the state that the original speaker claimed to obtain did in fact obtain (at the time of his speech), then this state would obtain at an extended interval encompassing the time of the claim and the time of the report. Adopting this hypothesis, we can analyze (47b) in the following way: Suppose, counterfactually, that John's claim were true, i.e., that the person who is in the room were Mary, not Sue. Then, the hypothesis predicts that Mary's being in the room would continue to obtain until the speech time of the report. But how can we check whether Mary's being in the room continues until the speech time in this counterfactual situation?

According to the proposal made by Lewis (1973) about counterfactual conditionals, in evaluating the truth of counterfactuals, we imagine a world which is closest to the real one among the worlds which satisfy the condition given in the antecedent of the conditional. In (47b), it is a world in which Mary is in the room and acts in such a way that the difference with the actual world is minimal. In this particular case, this means that we should choose a possible world in which Mary behaves as closely as Sue does in the actual world. There is no absolute scale for measuring similarities among worlds, but it seems intuitively appealing to choose the world in which Mary behaves as closely as Sue does in the real world since John cannot distinguish between the two individuals under the situation in question and, hence, these two worlds are indistinguishable from his point of view.[13] If this reasoning is on the right track, we can simply observe Sue's behavior in the actual world to check if Mary's being in the room in that particular possible world obtains or not. Thus, if Sue continues to be in the room until the time of the report (in the actual world), we are assured that Mary's being in the room in the possible world also obtains until that time. In turn, this guarantees that the counterfactual conditional is true. This proposal has an advantage in that we do not need a proviso for double-access sentences with factive clauses. Counterfactual conditionals require that we look for a world which is exactly like the real world except the added condition given in the antecedent. In factive clause cases the condition is already satisfied in the actual world. Thus, we can simply check whether the consequent is true in the real world. This is the desired result because factive cases are now subsumed under a more general proposal about the semantics of double-access sentences.

[13] This point is due to Irene Heim (p.c.).

The truth conditions of double-access sentences under the new hypothesis are described in the following way:

(48) **Hypothesis 5:** A sentence of the form $[_S$ NP Past $V_1 \ldots [_S \ldots$ Pres $V_2 \ldots]]$ is true iff $[_S$ NP Past $V_1 \ldots [_S \ldots$ Past $V_2 \ldots]]$ (with a simultaneous reading) is true and, moreover, if the state claimed[14] to obtain by the individual denoted by the NP did in fact obtain, the state would obtain at an interval including the time of the matrix verb and the speech time.

(48) is all we need for double-access sentences. (48) reduces to (49) for factive clause cases. Note that (49) is exactly the same as (40).

(49) **Hypothesis 5 (Factive Clause Cases):** A sentence of the form $[_{S1}$ NP Past $V_1 \ldots [_{S2} \ldots$ Pres $V_2 \ldots]]$ (where S_2 is a factive clause) is true iff $[_{S1}$ NP Past $V_1 \ldots [_{S2} \ldots$ Past $V_2 \ldots]]$ (with a simultaneous reading) is true and the state claimed to obtain by the individual denoted by the NP obtains at an interval including the time of the matrix verb and the speech time.

Hypothesis 5 covers all the examples that we have discussed so far. It seems to be

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[14] I restrict myself to those indirect discourse verbs (such as *say* and *claim*) for which the word "claim" is appropriate. I ignore more complex cases involving verbs like *doubt* and *deny*.

the most satisfactory hypothesis in view of the various examples that we have so far examined.

The hypothesis also accounts for the observation that when the truthfulness of the original statement is unknown, its report by a double-access sentence sounds better if the type of state referred to by the embedded clause generally holds for a long time. Consider (50a) and (50b):

(50a) John: (At 10 A.M.) Mary is working on her dissertation.
Bill: (At 10: 30 A.M.) John said that Mary is working on her dissertation.

(50b) John: (At 10 A.M.; over the phone) Mary is laughing.
Bill: (At 10:30 A.M.) #John said that Mary is laughing.

In discourse (50a), Bill's statement is acceptable (if the truth is unknown) because dissertation writing (unfortunately) is not something that can be finished in thirty minutes. That is, the fact that Mary's working on her dissertation is a relatively stable state licenses the reasoning that if it was in fact that case that Mary was working on her dissertation at 10:00, then this state would probably continue to hold at 10:30 as well. On the other hand, (50b) is unacceptable since if it is in fact the case that Mary was laughing at 10:00, it is quite unlikely that she would have carried on for thirty minutes. Thus, the conditional is (perceived to be) false.

4.2. De Re Attitude Reports

We have arrived at a tentative conclusion that the semantics of double-access sentences is best described by the conjunction of two conditions. At first glance, this is quite an objectionable proposal. This semantic proposal does not parallel the syntactic structure. Thus, it apparently violates the principle of compositionality. This has caused some linguists to cast doubt upon the proposal. Mats Rooth (p.c.) and Abusch (1988) suggested that perhaps Hypothesis 2, which was presented above and was rejected on empirical grounds, is after all the correct analysis of "double-access" sentences. Consider (51a), which reports John's original utterance (51b).

(51a) John said that Mary is pregnant.

(51b) John: Mary is pregnant.

Rooth and Abusch claim that (52) faithfully represents the interpretation of (51a):

(52) $\exists t\ [PAST\ (t)\ \&\ t \subseteq t_{R1}\ \&\ \exists t'\ [XN(t')\ \&\ t \subseteq t'\ \&\ AT\ (t,\ say'\ (j,\ {}^\wedge AT\ (t',\ be\text{-}pregnant'\ (m))))]]$

As the reader might recall, this is exactly the same as what the version 2 of Hypothesis 2 predicts. Since the time variable t' is bound from outside the opaque domain, (52) involves a de re attitude report. We have already mentioned that (52) does not faithfully represent the original claim made by John. Rooth and Abusch contend, however, that the apparent empirical problems associated with (52) can be attributed to the fact that some de re attitude reports are acceptable even though they involve distortions of the original claim. Their reasoning goes as follows: (51b) can only be taken to mean that Mary is pregnant at the time it is uttered. Suppose, however, that Mary is in fact pregnant at the time John utters (51b) and that this state continues to obtain until a later time. In this situation, the speaker can employ (51a) with the interpretation given above as (52): i.e., John claimed that Mary's pregnancy would obtain at an interval which contains both the time of John's saying and the time of the report. This obviously attributes a false claim to John, but this is tolerated because Mary's pregnancy continues to obtain until the speech time of the report and the distortion is harmless. In other words, the speaker "gets away with" a false report as long as what was claimed to obtain did obtain at the time of the claim and still obtains now. Rooth (p.c.) gave me a parallel example in the nominal domain:

(53a) John said that the Pacific Ocean is/was beautiful.

(53b) John: It's beautiful.

Suppose that as he uttered (53b) John was in Hawaii and was pointing at the ocean that he saw from the beach. Thus, (53a) is an overstatement or distortion of John's original utterance, i.e. (53b). John did not mean that the Pacific Ocean as a whole was beautiful; he merely meant that the piece of ocean that he saw in Hawaii was beautiful. Thus, (53a) is a false report of (53b).

I believe that the Rooth-Abusch analysis of double-access sentences has an important insight that must be incorporated into their ultimate analysis: they involve de re attitude reports. However, the particular version presented above does not provide us with a means of distinguishing between (54a) and (54b), as I pointed out above:

(54a) John said two weeks ago that Mary is pregnant.

(54b) John said two weeks ago that Mary was pregnant and that she would continue to be pregnant for at least two more weeks.

According to the Rooth-Abusch analysis, (54a) tolerates the distortion of John's attitude to a certain degree. That is, it is possible to report John's claim as if he claimed that Mary's pregnancy would obtain at an extended interval. Why is it then that (54b), which presumably would entail (54a), cannot be used for a false de re attitude report similar to the one for which (54a) is allegedly employed? More importantly, why is it that (54a) "specializes", as it were, for false de re attitude reports? Why couldn't it be used for a true de re attitude report of the following utterance by John?

(55) Mary is pregnant and she will continue to be pregnant for two more weeks.

It seems very artificial to restrict the use of double-access sentences to false de re attitude reports of the kind described above. Moreover, the Rooth-Abusch proposal does not make clear how to deal with cases like (17) where the embedded clause is false in the first place.

Another objection is that the Rooth-Abusch theory does not explain why and how the present tense morpheme in the embedded clause contributes to the existential assertion about an extended now interval. For example, there is no solid evidence that a present tense morpheme occurring in a simple sentence serves to make an assertion about an extended now interval. Consider the following pair of examples:

(56a) The temperature is 100 degrees in this room.

(56b) The temperature has been 100 degrees in this room.

(56a) is not synonymous with (56b); (56b) does make a claim about an extended now interval, while the assertion made by (56a) seems to be restricted to the speech time. Why is it then that the present tense morpheme appearing in double-access sentences is capable of conveying an assertion about an extended now interval? No plausible explanation is likely to be forthcoming.

4.3. Explicit Reference to State Individuals

As far as I can see Hypothesis 5 presented above is the most satisfactory proposal from the empirical point of view. I have shown why other seemingly more elegant and syntactically well-motivated proposals are inadequate. However, a question still remains: why is it that double-access sentences with the known syntactic/morphological properties are capable of expressing the conjunction of the two conditions described above? It would be more desirable if we could propose a system in which the meaning of a double-access sentence is obtained in a compositional manner. In this sub-section, I will try to do just that.

I will propose a new system which constitutes a radical departure from the system proposed in Chapter 3 and which accounts for the semantics of double-access sentences in a compositional manner.

My proposal has the following ingredients:

(i) A Davidsonian semantics: a declarative sentence is assumed to involve an existential assertion about an event or state (Davidson 1967).

(ii) State individuals and event individuals differ in the following respect: A state individual s is said to obtain at an interval t iff t is part of the maximal interval occupied by the extension of s. On the other hand, an event individual e is said to obtain at an interval t iff t is equivalent to the maximal interval occupied by the extension of e.

(iii) An Aux node is subject to a rule analogous to QR for NP's except that this rule is a copying rule which leaves behind the original, not a trace. This provision has the effect of imposing a condition upon de re attitude reports which we might call "the temporal directionality isomorphism".

(iv) Double-access sentences are claimed to be employed for de re attitude reports involving state or event individuals.

I will give a new fragment of English in Chapter 5 and explain in detail how double-access sentences are analyzed. In the remainder of this sub-section, I will sketch my analysis and provide motivations for why such an analysis is necessary independently of double-access sentences.

Many linguists as well as philosophers supported the view that a declarative sentence involves an existential assertion about an event or state. According to Davidson (1967), a declarative sentence involves an existential assertion about an event. One argument for events involves anaphora. For example, Davidson offers the following example and argues that his system accounts for our intuition that the pronoun *it* in the second conjunct refers to the event of my buttering the toast:

(57a) I buttered the toast and I did it in the bathroom.

(57b) $\exists$e [PAST (e) & butter (e, I, the toast) & Do-in-the-bathroom (I, e)]

In the following discussion, I will attempt to show that we need state individuals in order to account for the semantics of double-access sentences. I will further argue that state individuals must be distinguished from event individuals. This indirectly supports a Davidsonian framework in that if we need to distinguish between events and states, we need these entities in the semantic system.

We start with the discussion of aspectual properties of verbs. The study of aspectual properties of verbs, often referred to as the study of Aktionsarten, has a long history of its own and I cannot possibly do justice to the entire literature here. I will only talk about the basic distinction between telic and atelic sentences, which is related to the distinction between events and states to be drawn for the purpose of the following discussion. Intuitively, a telic sentence describes something that has a built-in culmination point, whereas a atelic sentence describes something that does not. As mentioned in Chapter 1, interval semantics was motivated by the desire to explain the intuitive difference between telic and atelic sentences (Bennett and Partee 1972, Taylor 1977, Dowty 1979, etc.):

(58a) John built a house.

(58b) John loved Mary.

(58a) involves a telic predicate and talks about a building event which takes time. We wish to say that (58a) is true iff there is a past interval which corresponds to the time John spent to build a house, without claiming that *John build a house* is true at all points within this interval. Bennett and Partee's conclusion is that extensions of natural language expressions should be determined with respect to intervals independently of the points contained within them. This allows us to say that *John build a house* is true at an interval I without claiming that the same proposition is true at all points within I. In fact, it is usually assumed that if a telic sentence φ is true at I, φ is required to be *false* at all subintervals of I.[15] The situation is different with (58b). We have the intuition that if *John love Mary* is true at an interval I', then this entails that the same proposition is true at all points within (or sub-intervals of) I'. Adopting an interval-based semantic system, we can now distinguish between telic and atelic sentences in the following way:

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[15] This thesis may be problematic in some cases. For example, *write a word* is intuitively a telic predicate. If John writes a compound word at some interval I before the speech time, (a) is true. However, there are at least two subintervals of I at which the same proposition is true. (The example is due to Mats Rooth (p.c.).)

(a) John wrote a word.

(59a) φ is a telic sentence iff the truth of φ at an interval I entails the falsity of φ at all proper subintervals of I

(59b) φ is atelic sentence iff the truth of φ at an interval I entails the truth of φ at all subintervals of I

From these definitions, it follows that (58a) is a telic sentence, whereas (58b) is an atelic sentence. The condition given under (59b) is often referred to as the subinterval property. Employing this term, we can say succinctly that atelic sentences have the subinterval property whereas telic sentences do not.

How shall we encode in a Davidsonian framework the distinction between telic and atelic sentences that we have established? I believe that this can be done in the following way: (i) the distinction between telic and atelic sentences corresponds to the distinction between events and states in a Davidsonian framework; (ii) an event is said to obtain at t iff it is equivalent to the interval occupied by the extension of this event, whereas a state is said to obtain at t iff it is *part* of the interval which is occupied by the extension of this state. According to these definitions, one and the same event can obtain at most at one interval, while one and the same state can obtain at many intervals. Here, the "same state" must be one temporally continuous state. For example, if John is in his office from eight to nine and again from four to five, these two discontinuous occurrences of John's staying in his office count as two distinct states. However, if one takes one continuous state, say the state of John's being in his office obtaining from three to four (call it interval i), the same state is claimed to obtain at all sub-intervals of i. The following truth conditions of the predicate PRES formally represent the ideas informally presented above:

(60a) $[\![\text{PRES (e)}]\!]^{M,w,t,g} = 1$ iff t is equivalent to the interval occupied by $[\![e]\!]^{M,w,t,g}$

(60b) $[\![\text{PRES (s)}]\!]^{M,w,t,g} = 1$ iff t is part of the interval occupied by $[\![s]\!]^{M,w,t,g}$

Technically, the new framework is different from the framework presented in Chapter 3 in the following way: (i) PRES, PAST and FUT, which were formerly predicates of times, now serve also as predicates of states and events; (ii) Events and states occupy special argument positions of predicates. Thus, be-pregnant' is no longer a one-place predicate of individuals, but is a two-place predicate denoting a relation between a state and an individual.

In what follows I will explain why the new framework is superior to the one presented in Chapter 3. I will start with factive clause cases, which are relatively easy to deal with. Consider the following sentence:

(61) John found out that Mary is pregnant.

We have been assuming that the LF representation of (61), which is fed into the semantic component, is (62):

(62) John Past find out that Mary Pres be pregnant

However, as mentioned at the beginning of this chapter, the fragment proposed in Chapter 3 predicts the wrong reading for (61):

(62') $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT (t, find-out' (j, ^ $\exists t'$ [NOW (t') & $t' \subseteq t_{R2}$ & AT (t', be-pregnant' (m))]))]

(62') says that John found out at a past time that Mary is pregnant at the speech time of (61). There are two things wrong with the interpretation represented as (62'). First, (62') fails to predict that Mary must be pregnant at a period encompassing both the time of John's finding out and the speech time. Second, it does not predict that what John found out was Mary's being pregnant at the time of his finding out. Instead, it wrongly predicts that what John found out is Mary's being pregnant at the speech time (if this is meaningful at all). Thus, the current semantic system does not yield the right interpretation of (61) from what we consider to be the right syntactic representation of (61) at LF.

On the other hand, we know how to represent the intuitive meaning of (61), but we do not know how to derive from (62) the interpretation afforded by the following IL formula:

(62") $\exists t$ [PAST (t) & $t \subseteq t_{R1}$ & AT(t, find-out (j, ^be-pregnant' (m))) & $\exists t'$[XN (t') & $t \subseteq t'$ & AT (t', be-pregnant'(m))]]

[N.B. $[\![XN (t')]\!]^{M,w,t,g} = 1$ iff t is a proper subinterval of $[\![t']\!]^{M,w,t,g}$.]

Now the problem is to bridge the gap between what we believe to be the right syntactic representation for (61) and what we believe to be the right semantic interpretation for it.

It turns out that if we adopt a Davidsonian framework with the proviso that events and states are distinguished in the manner indicated above, we can arrive at an IL formula in a compositional manner which represents a reading virtually equivalent to the one conveyed by (62"):

(63) $\exists$s [PRES (s) & $\exists$e [PAST (e) & e $\subseteq t_{R1}$ & find-out' (e, j, ^ [PRES (s) & be-pregnant' (s, m)])]]

Before considering how (63) is derived from (62), we will consider why (63) has virtually the same interpretation as (62"). Given the the model-theoretic interpretations of PRES (s) and PRES (e), (63) is interpreted in the following way: there is a state s obtaining now and there was a past event of John's standing in the finding-out relation to the proposition *s obtains and s is a state of Mary's being pregnant.* (63) guarantees that what John found out is Mary's being pregnant at the time of his finding out, as desired. The fact that find-out' is a factive predicate guarantees that the state of Mary's pregnancy obtains in the actual world at the time of John's finding out. Moreover, since this state is the same as the state obtaining now, it follows that Mary's pregnancy obtains at an interval which encompasses both the time of John's finding out and the speech time of (61). This prediction is the same as what (62") predicts.

The strength of the new proposal is revealed when we consider non-factive double-access sentences. As we shall show immediately below, exactly the same mechanism accounts for their interpretations.

(64) John said that Mary is in the room.

Consider the situation described in the example (17), where John mistakes Sue for Mary and Sue continues to be in the room until the speech time. (64) is translated into the following formula:

(64') $\exists s$ [PRES (s) & $\exists e$ [PAST (e) & e $\subseteq t_{R1}$ & say (e, j, ^ [PRES (s) & be-in-the-room' (s, m)])]]

(64') says that there is a state s obtaining at the speech time and there is a past event e of John's standing in the saying relation to the proposition *s obtains and s is a state of Mary's being in the room.* Our interpretation of John's original claim is that he claimed of the state of Sue's being in the room that this state was Mary's being in the room. Since the same state is required to obtain at the speech time as well, it follows that in order for the sentence to be true under the situation in question, Sue must continue to be in the room until the time of the report.

I now turn to the question of how to derive (63) from the LF representation of (64), given here as (65):

(65) John Past say that Mary Pres be pregnant

By Chomsky-adjoining a copy of the Aux node to the matrix S and leaves the original intact, we obtain an LF representation appropriate for IL translation:

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

1. John Past say that Mary $[_{Aux\ ek}$ Pres$]$ be pregnant $\Rightarrow \exists e[PAST\ (e)\ \&\ e \subseteq t_{R1}\ \&\ say'\ (e, j, \wedge\ [PRES\ (s_k)\ \&\ be\text{-}pregnant'\ (s_k, m)])]$
2. $[_S[_{Aux\ k}$ Pres$][_S$ John Past say that Mary $[_{Aux\ ek}$ Pres$]$ be pregnant$]]$ $\Rightarrow \exists s_k[\exists t[\lambda t' \lambda s'[PRES\ (t')\ \&\ AT\ (t', PRES\ (s'))](t)](s_k)\ \&\ \exists e[PAST\ (e)\ \&\ e \subseteq t_{R1}\ \&\ say'\ (e, j, \wedge\ [PRES\ (s_k)\ \&\ be\text{-}pregnant'\ (s_k, m)])]$
3. $\exists s_k[\exists t[PRES\ (t)\ \&\ AT\ (t, PRES\ (s_k))]\ \&\ \exists e[PAST\ (e)\ \&\ e \subseteq t_{R1}\ \&\ say'\ (e, j, \wedge\ [PRES\ (s_k)\ \&\ be\text{-}pregnant'\ (s_k, m)])]$
4. $\exists s[PRES\ (s)\ \&\ \exists e[PAST\ (e)\ \&\ e \subseteq t_{R1}\ \&\ say'\ (e, j, \wedge\ [PRES\ (s)\ \&\ be\text{-}pregnant'\ (s, m)])]]$

The reason that the Aux node is copied rather than moved is that it is necessary to impose a principle which might be called the "temporal directionality isomorphism". The basic idea is very simple: when the speaker makes a de re attitude report about an event or state, the temporal directionality that originally obtained between the subject of the attitude and the event or state must be preserved both in the description of the proposition and in the speaker's description of the event or state.[16] For example, the attitude being reported in (64) is a simultaneous one in that John claims at some past time t that Mary was pregnant at t. This imposes a restriction upon the de re attitude report about the state of Mary's being pregnant in that this state must be described by the speaker as having the same temporal directionality. That is, it must be a current state from the speaker's point of view. The Aux copying rule ensures that this restriction is imposed in the translation. It should also be noted here that the original Aux node which is left intact after the application of the copying rule does not introduce an existential quantifier in its translation. The details of the rules are given in Chapter 5.

In order to better appreciate the effect of the temporal directionality isomorphism, let us consider another type of double-access sentence. If we follow the idea that the future auxiliary which surfaces as *will* consists of the present tense morpheme and *woll*, we predict that sentences like the following fall under the category "double-access sentence" and receive peculiar interpretations characteristic of these sentences. Consider the following example:

(67) John said that Mary will come to Austin.

At first glance, (67) seems to be completely unproblematic: John said in the past that Mary will come to Austin at some time after the speech time of (67). The fragment presented in Chapter 3 predicts an apparently correct interpretation of (67):

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[16] We will discuss examples of de re attitude reports involving event individuals immediately below.

(68) LF: John Past say that Mary Pres woll come to Austin.

$\exists t[\mathrm{PAST}(t) \,\&\, t \subseteq t_{R1} \,\&\, \mathrm{AT}(t, \mathrm{say'}(j, {}^\wedge \exists t' [\mathrm{NOW}(t') \,\&\, \exists t''[t' < t'' \,\&\, t'' \subseteq t_{R2} \,\&\, \mathrm{AT}(t'', \text{come-to-Austin'}(m))]]))]$

Despite this apparent success of the first fragment, I claim that the analysis of (67) that it offers is empirically problematic. John *did* say that Mary would come at some time *t* which is located after the time of his saying, and *t* happens to lie after the speech time of (67). However, the proposition to which John stood in the saying relation should not include the description of *t* as an interval located after the speech time of (67). For John did not describe the time as a time lying after the speech time of (67) in his original utterance. The description of *t* as a time located after the speech time of (67) should be attributed to the speaker. Hence, (67) involves a de re attitude report.

Thus, we have good reason to believe that our new framework helps to account for the data. Assuming the temporal directionality isomorphism, we arrive at the desired interpretation of (67). John's original utterance makes a "future-oriented" claim about Mary's coming to Austin in that the time at which Mary is allegedly coming is after the time at which John expresses this claim. This must be preserved in the de re attitude report in that the event of Mary's coming must also lie after the speech time of the report. This predicts the right truth condition for (67). The LF structure of (67) and its IL translation are as follows:

(69) LF (after the application of the Aux copying rule):

$[_S[_{Aux\ k}$ Pres woll$][_S$ John Past say that Mary $[_{Aux\ ek}$ Pres woll] come to Austin]] $\Rightarrow$

$\exists e[\mathrm{FUT}(e) \,\&\, e \subseteq t_{R1} \,\&\, \exists e'\,[\mathrm{PAST}(e') \,\&\, e' \subseteq t_{R2} \,\&\, \mathrm{say}'(e', j, {}^\wedge$

$\exists t[\mathrm{FUT}(t) \,\&\, t \subseteq tR1 \,\&\, \mathrm{AT}(t, \mathrm{PRES}(e) \,\&\, \text{come-to-Austin}'(e, m))])]]$

(69) predicts that the event of Mary's coming to Austin is required to follow both the time of John's saying and the speech time of (67). Thus, the event must be located after the speech time of (67). This prediction is borne out.

The fact that we can explain the behavior of different types of double-access sentences indicates that the current theory has an advantage over other alternatives. I will give the details of the new proposal as a second English fragment (as well as a second Japanese fragment) in Chapter 5.

CHAPTER 5

SECOND FRAGMENTS OF ENGLISH AND JAPANESE

I will present new fragments of English and Japanese. Since the new proposal is motivated by English data, I will present the English fragment first. Although there is no strong evidence that the same type of framework is absolutely necessary for Japanese, I will offer a Japanese fragment as well and contend that the new framework reveals some concealed but genuine interpretations that are not easily recognized by native speakers.

5.1. Fragments

Model-Theoretic Definitions

The set of types is the smallest set T such that (1) e, t, i, ev, st are in T (regarded as the types of entities, truth values, and intervals of time, events, and states, respectively), (2) if $a, b \in T$, then $<a, b> \in T$, and (3) if $a \in T$, then $<s, a> \in T$.

An intensional model M for the translation language is an ordered 7-tuple $<E, W, M, Ev, St, <, F>$ defined as follows:

(1) E is a non-empty set (the set of basic entities).

(2) W is a non-empty set (the set of possible worlds).

(3) M is a non-empty set (the set of moments of time).

(4) Ev is a non-empty set (the set of events)

(5) St is a non-empty set (the set of states)

(6) $<$ is a strict linear order of M.

(7) The set of intervals of time I is the set of all subsets i of M such that if $i \in I$, then for all $m_1, m_2, m_3 \in M$, if $m_1, m_3 \in i$ and $m_1 < m_2 < m_3$, then $m_2 \in I$. Given $<$ for M, $<$ for I can be defined as follows: $i_1 < i_2$ iff $\forall m_1 \in i_1, \forall m_2 \in i_2 \, \exists m_3 \, [m_3 \notin i_1 \,\&\, m_3 \notin i_2 \,\&\, m_1 < m_3 < m_2]$.

(8) For each type $a \in T$, the set D_a of possible denotations of type *a*, is defined recursively as follows: (a) $D_e = E$, (b) $D_t = \{0, 1\}$ (the truth values "false" and "true" respectively), (c) $D_i = I$, (d) $D_{st} = St$, (e) $D_{ev} = Ev$, (f) $D_{<a,b>} = D_b{}^{D_a}$, and $D_{<s,a>} = D_a{}^{W \times I}$. The set of senses of type a, denoted S_a, is $D_{<s,a>}$.

(9) F (the interpretation function) assigns to each constant of the translation language of type *a* a member of S_a. A value assignment g is a function that assigns to each variable of type *a* a value in D_a.

The Syntax and Interpretation of IL

The set of basic expressions of IL consists of a set Con_a, of *constants of type a*, and a denumerably infinite set Var_a, of *variables of type a*, for each $a \in T$.

The set of meaningful expressions of IL of type *a*, ME_a, is defined recursively as follows, together with the recursive definition of *the denotation of a meaningful expression* α with respect to *an interpretation M*, world *w*, <u>interval of time</u> *i* and *value assignment g*, denoted $[\![\alpha]\!]^{M,w,i,g}$.

1. If $\alpha \in Con_a$, then $\alpha \in ME_a$, and $[\![\alpha]\!]^{M,w,i,g} = F(\alpha)(<w, i>)$.
2. If $u \in Var_a$, then $u \in ME_a$, and $[\![u]\!]^{M,w,i,g} = g(u)$.

3. If $\alpha \in ME_{<a,b>}$ and $\beta \in ME_a$, then $\alpha(\beta) \in ME_b$, and $[\![\alpha(\beta)]\!]^{M,w,i,g} = [\![\alpha]\!]^{M,w,i,g}([\![\beta]\!]^{M,w,i,g})$

4. If $\alpha \in ME_a$, and $u \in Var_b$, then $\lambda u\alpha \in ME_{<b,a>}$, and $[\![\lambda u\alpha]\!]^{M,w,i,g}$, is that function h with domain D_b that gives for each argument x the value $[\![\alpha]\!]^{M,w,i,g'}$ where g' is that assignment exactly like g except for the (possible) difference that g' (u) = x.

5. If $\alpha, \beta \in ME_a$, then $[\alpha = \beta] \in ME_t$, and $[\![[\alpha = \beta]]\!]^{M,w,i,g} = 1$ iff $[\![\alpha]\!]^{M,w,i,g}$ is $[\![\beta]\!]^{M,w,i,g}$

6. If $\varphi \in ME_t$, then $\neg\varphi \in ME_t$, and $[\![\neg\varphi]\!]^{M,w,i,g} = 1$ iff $[\![\varphi]\!]^{M,w,i,g} = 0$. (Similarly for &, $\vee$, $\rightarrow$ and $\leftrightarrow$.)

7. If $\varphi \in ME_t$ and $u \in Var_a$, then $\exists u\ \varphi \in ME_t$, and $[\![\exists u\varphi]\!]^{M,w,i,g} = 1$ iff there exists x such that $[\![\varphi]\!]^{M,w,i,g'} = 1$, where g' is as in 4. (Similarly for $\forall u\ \varphi$.)

8. If $\alpha \in ME_a$ then $^\wedge\alpha \in ME_{<s,a>}$, and $[\![^\wedge\alpha]\!]^{M,w,i,g}$ is that function h with domain W X I such that for each $<w', i'> \in W \times I$, $h(<w',i'>) = [\![\alpha]\!]^{M,w',i',g}$

9. If $\alpha \in ME_{<s,a>}$ then $^\vee\alpha \in ME_a$, and $[\![^\vee\alpha]\!]^{M,w,i,g} = [\![\alpha]\!]^{M,w,i,g}(<w,i>)$

10. If $\varphi \in ME_t$, $\zeta \in ME_i$, then AT $(\zeta, \varphi) \in ME_t$, and $[\![AT(\zeta, \varphi)]\!]^{M,w,i,g} = 1$ iff $[\![\varphi]\!]^{M,w,i',g} = 1$ where $[\![\zeta]\!]^{M,w,i,g} = i'$.

11. If $\zeta \in ME_i$ then PAST $(\zeta) \in ME_t$, and $[\![PAST(\zeta)]\!]^{M,w,i,g} = 1$ iff $[\![\zeta]\!]^{M,w,i,g} < i$. (Similarly for FUT.)

12. If $\zeta \in ME_{ev}$, then PAST $(\zeta) \in ME_t$, and $[\![PAST(\zeta)]\!]^{M,w,i,g} = 1$ iff there is some interval $i' < i$ such that i' is the maximal interval occupied by $[\![\zeta]\!]^{M,w,i,g}$. (Similarly for FUT.)

13. If $\zeta \in ME_{st}$, then PAST (ζ) $\in ME_t$, and $[\![PAST(\zeta)]\!]^{M,w,i,g} = 1$ iff there is some interval i' < i such that i is *part of* the maximal interval occupied by $[\![\zeta]\!]^{M,w,i,g}$. (Similarly for FUT.)

14. If $\zeta \in ME_i$ then PRES (ζ) $\in ME_t$, and $[\![PRES(\zeta)]\!]^{M,w,i,g} = 1$ iff $[\![\zeta]\!]^{M,w,i,g} = i$.

15. If $\zeta \in ME_{ev}$, then PRES (ζ) $\in ME_t$, and $[\![PRES(\zeta)]\!]^{M,w,i,g} = 1$ iff i is equivalent to the maximal interval occupied by $[\![\zeta]\!]^{M,w,i,g}$.

16. If $\zeta \in ME_{st}$, then PRES (ζ) $\in ME_t$, and $[\![PRES(\zeta)]\!]^{M,w,i,g} = 1$ iff i is *part of* the maximal interval occupied by $[\![\zeta]\!]^{M,w,i,g}$.

17. If $\zeta, \xi \in ME_i$ then $[\zeta \subseteq \xi]$ and $[\zeta < \xi] \in ME_t$, and (i) $[\![\zeta \subseteq \xi]\!]^{M,w,i,g} = 1$ iff $[\![\zeta]\!]^{M,w,i,g} \subseteq [\![\xi]\!]^{M,w,i,g}$ and (ii) $[\![\zeta < \xi]\!]^{M,w,i,g} = 1$ iff $[\![\zeta]\!]^{M,w,i,g} < [\![\xi]\!]^{M,w,i,g}$. Similarly for $\leq$, >, and $\geq$.

(I.e. $\zeta < \xi$, where ζ and ξ are intervals, is interpreted as meaning that ζ completely precedes ξ and that ζ does not abut ξ.)

18. If $\zeta \in ME_{ev}$ (or ME_{st}) and $\xi \in ME_i$, then $[\zeta \subseteq \xi] \in ME_t$, and $[\![\zeta \subseteq \xi]\!]^{M,w,i,g} = 1$ iff i' is the interval occupied by $[\![\zeta]\!]^{M,w,i,g}$ and $i' \subseteq [\![\xi]\!]^{M,w,i,g}$.

Syntactic Categories and Their Semantic Types

Symbol	Full name	Semantic Type
S	sentence	t
Aux	auxiliary	<i,<ev,t>>
		<i,<st,t>>

Tns	tense	<i,<ev,t>> (Japanese)
		<i,<st,t>> (Japanese)
N'	N-bar	<e,t>
S'	S-bar	t
Adj.	adjective	<<s,<e,t>>,<e,t>>
		<<s,<e,t>>,<e,t>>
NP	noun phrase	<<s,<e,t>>,t>
N^0	noun (w/ 0 arguments)	<e,t>
N^1	noun (w/ 1 argument)	<<s,t>, <e,t>>
N^2	noun (w/ 2 argument)	<<s,t>, <e, <e,t>>>
VP	verb phrase	<<s, <<s,<e,t>>,t>>, <ev,t>>
		<<s, <<s,<e,t>>,t>>, <st, t>>
V^0	verb (w/ 0 argument)	<<s, <<s,<e,t>>,t>>, <ev,t>>
		<<s, <<s,<e,t>>,t>>, <st, t>>
V^1	verb (w/ 1 argument)	
	<<s,<<s,<e,t>>,t>>, <<s, <<s,<e,t>>,t>>,<ev,t>>>	
	<<s,<<s,<e,t>>,t>>, <<s, <<s,<e,t>>,t>>,<st,t>>>	
		<e, <<s, <<s,<e,t>>,t>>,<ev,t>>>
		<e, <<s, <<s,<e,t>>,t>>,<st,t>>>
		<<s,t>, <<s, <<s,<e,t>>,t>>,<ev,t>>>
		<<s,t>, <<s, <<s,<e,t>>,t>>,<st,t>>>
Det	determiner	<<s,<e,t>>, <<s,<e,t>>,t>>

Variable Symbol	Type of Variable
x, y, z, ...	e
P, Q, ...	<s, <e,t>>
p, q, ...	<s,t>
$\wp$	<s, <<s,<e,t>>,t>>
$t, t', t'', t_1, t_2, \ldots$	i
$P_t, Q_t, \ldots$	<s,<i, t>>
$P_e, Q_e, \ldots$	<s,<ev, t>>
$P_s, Q_s, \ldots$	<s, <st, t>>

Notational conventions:

$\alpha(\beta, \gamma)$ is a relational notation equivalent to $\alpha(\gamma)(\beta)$

$\alpha\{\beta\}$ is $[{}^{\vee}\alpha](\beta)$

$g^{e/u}$ is a value assignment just like g with the possible exception that the individual e is assigned to the variable u.

j*, m*, b* abbreviate $\lambda PP\{j\}$, $\lambda PP\{m\}$, $\lambda PP\{b\}$, respectively.

5.1.1. A Fragment of English

Syntax:

[N.B. α is a variable standing for + or -.]

1. $\underset{[\alpha\ \text{fin}]}{S} \rightarrow NP \quad \underset{[\alpha\ \text{fin}]}{Aux} \quad VP$

2 Aux → Past (woll) (have + en)

[+fin] <[+past]> <[+past]>

Pres

<[-past]>

3. Aux → to (have + en)

[-fin] <[+past]>

4. NP → Det N'

Name

S'

5. N' → Adj N'

N' S'

N (S')

6. Det → NP Poss

7. S' → COMP S

8. VP → V (NP)

V S'

Transformations:

9. Wh-movement: At the level of S-structure, move a wh-element to COMP.

10. Quantifier Raising: At the level of Logical Form, NP's are optionally Chomsky-adjoined to a VP or an S.

11. Aux copying: At the level of Logical Form, Aux's are obligatorily Chomsky-adjoined to the highest S iff they are not directly dominated by

the highest S node and they contain an occurrence of Pres. Unlike the QR rule for NP's, this is a copying rule which leaves the original Aux node intact. When this happens, the original Aux node receives the index e_k while the copy acquires the index k.

[N.B. **B** is said to be Chomsky-adjoined to **A** when the following operation is performed: $[_A \ldots] \Rightarrow [_A B[_A \ldots]]\ ]$

12. Tense Feature Deletion: At the level of Logical Form, a tense morpheme α can be deleted if and only if the following conditions are satisfied: there are tense features β and γ, α has the feature γ, β and γ have the same value, and β is **the local tense feature** of γ. **This rule applies after QR has applied.**

Feature Percolation Convention:

I assume that the rightmost tense feature dominated by an Aux node percolates up to the Aux node at some level of representation before LF.

Definitions:

α c-commands β iff the first branching node which dominates α dominates β.

α is the local tense feature of β iff α c-commands β and no other tense feature that α c-commands c-commands β.

Lexicon:

13. Det → a, the

14. Adj. → earlier, previous, later

<[+past]> <[+past]>

Semantics:

1a. $[_S$ NP Aux e_k VP$]$ translates into

$\exists t\, [Aux'\,(t)(s_k)\ \&\ AT\,(t,\ VP'\,(\hat{}\ NP')(s_k))]$ or

$\exists t\, [Aux'\,(t)(e_k)\ \&\ AT\,(t,\ VP'\,(\hat{}\ NP')(e_k))]$

1b. $[_S$ NP Aux VP$]$ translates into

$\exists s \exists t\, [Aux'\,(t)(s)\ \&\ AT\,(t,\ VP'\,(\hat{}\ NP')(s))]$ or

$\exists e \exists t\, [Aux'\,(t)(e)\ \&\ AT\,(t,\ VP'\,(\hat{}\ NP')(e)])]$

2a. $[_{Aux}$ Pres woll$]$ and $[_{Aux}\ \emptyset$ woll$]$ translate into

$\lambda t \lambda e[FUT\,(t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\,(t,\ PRES\,(e))]$ or

$\lambda t \lambda s[FUT\,(t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\,(t,\ PRES\,(s))]$

2b. $[_{Aux}$ Pres have+en$]$, $[_{Aux}$ Past$]$ and $[_{Aux}\ \emptyset$ have+en$]$ translate into

$\lambda t \lambda e\, [PAST\,(t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\,(t,\ PRES\,(e))]$ or

$\lambda t \lambda s[PAST\,(t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\,(t,\ PRES\,(s))]$

2c. $[_{Aux}$ Pres$]$ and $[_{Aux}\ \emptyset]$ translate into

$\lambda t \lambda e[PRES\,(t)\ \&\ AT\,(t,\ PRES\,(e))]$ or

$\lambda t \lambda s[PRES\,(t)\ \&\ AT\,(t,\ PRES\,(s))]$

3a. $[_{Aux}$ to$]$ translates into

$\lambda t \lambda e[to'\,(t)\ \&\ AT\,(t,\ PRES\,(e))]$ or

$\lambda t \lambda s[to'\,(t)\ \&\ AT\,(t,\ PRES\,(s))]$

3b. *to* translates into:

PRES or

$\lambda t[FUT\,(t)\ \&\ t \subseteq t_{Rn}]$

4a. $[_{NP}$ Det N'$]$ translates into Det' $(\hat{}\ N'')$

4b. $[_{NP}$ Name$]$ translates into $\lambda PP\{Name'\}$

4c. $[_{NP}\ S']$ translates into $\lambda P\exists x[P\{x\}\ \&\ NOM\ (x,\ {}^\wedge S'')]$

[N.B. NOM is of type <<s,t>, <e,t>> and $[\![NOM\ (x, p)]\!]^{M,w,t,g} = 1$ iff g(x) is the individual correlate of g(p).]

5a. $[_{N'}$ Adj. N'$]$ translates into Adj.' ($^\wedge$ N'')

5b. $[_{N'}\ N'\ \ S']$ translates into $\lambda x\ [S''\ (x)\ \&\ N'\ (x)]$

5c. $[_{N'}\ N^1\ S']$ translates into $N^{1\prime}$ ($^\wedge$ S'')

5d. $[_{N'}\ N^0]$ translates into $N^{0\prime}$

6a. $[_{Det}$ NP Poss$]$ translates into Poss' ($^\wedge$ NP')

6b. Poss translates into $\lambda \wp \lambda P \lambda Q \exists y\ [\forall x\ [P\ \{x\}\ \&\ \wp\{^\wedge\ POSS\ (x)\} \leftrightarrow x = y\ ]\ \&\ Q\ \{y\}]]$

[N.B. POSS denotes a relation between two individuals (type <e,<e,t>>) such that $[\![POSS\ (x, y)]\!]^{M,w,t,g} = 1$ iff g(x) stands in a certain non-trivial nonsymmetric relation to g(y). See Chapter 3 for details.]

7. $[_{S'}$ COMP S$]$ translates into S'

8a. $[_{VP}\ V^0]$ translates into $V^{0\prime}$

8b. $[_{VP}\ V^1$ NP$]$ translates into $V^{1\prime}$ ($^\wedge$ NP')

8c. $[_{VP}\ V^1\ S']$ translates into $V^{1\prime}$ ($^\wedge$ S'')

9. $[_{S'}[_{COMP}\ wh_k]\ [_S \ldots e_k \ldots]]$ translates into λx_k S'

10a. $[_S\ NP_k\ [_S \ldots e_k \ldots]]$ translates into NP' ($^\wedge\ \lambda x_k$ S')

10b. $[_{VP}\ NP_k\ [_{VP} \ldots e_k \ldots]]$ translates into $\lambda\wp\ \lambda e NP'\ (^\wedge\ \lambda x_k\ [VP'\ (\wp)(e)])$ or $\lambda\wp\ \lambda s NP'\ (^\wedge\ \lambda x_k\ [VP'\ (\wp)(s)])$

11. $[_S\ Aux_k\ [_S \ldots\ Aux\ e_k \ldots\ ]]$ translates into

$\exists e_k\ [\exists t\ [Aux'\ (t)(e_k)]\ \&\ S']$ or $\exists s_k\ [\exists t\ [Aux'\ (t)(s_k)]\ \&\ S']$

Lexicon:

13. *a* translates into $\lambda P \lambda Q\, \exists x\ [\ P\{x\}\ \&\ Q\{x\}]$

$\lambda P \lambda Q \exists y\ [\forall x[P\ \{x\} \leftrightarrow x = y\ ]\ \&\ Q\ \{y\}]]$

14. *earlier* translates into $\lambda P \lambda x \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

previous-translates into $\lambda P \lambda x \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

later translates into $\lambda P \lambda x \exists t\ [FUT\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

Comments:

The major difference between this fragment and the first fragment is that events and states are employed in the former but not in the latter. We shall see how this will help to account for the meaning of double-access sentences.

1. Syntax: $S \rightarrow NP\ Aux\ VP$

Semantics:

1a. $[_S\ NP\ Aux\ e_k\ VP]$ translates into

$\exists t\ [Aux'\ (t)(s_k)\ \&\ AT\ (t, VP'\ (\hat{}\ NP')(s_k))]$ or

$\exists t\ [Aux'\ (t)(e_k)\ \&\ AT\ (t, VP'\ (\hat{}\ NP')(e_k))]$

1b. $[_S\ NP\ Aux\ VP]$ translates into

$\exists s \exists t\ [Aux'\ (t)(s)\ \&\ AT\ (t, VP'\ (\hat{}\ NP')(s))]$ or

$\exists e \exists t\ [Aux'\ (t)(e)\ \&\ AT\ (t, VP'\ (\hat{}\ NP')(e))]$

2. Syntax: Aux → [+fin]   Past <[+past]> / Pres <[-past]>   (woll)   (have + en) <[+past]>

Semantics: (see above for details)

Unlike the first fragment, a VP denotes a function from generalized quantifiers to sets of states or events and applies to the translation of the subject NP. This allows the subject NP to be interpreted as embedded under the scope of the tense in the same clause. Another difference between the first fragment and the current fragment is that a null tense (Ø) and a present tense (Pres) are translated in exactly the same way in this fragment unlike in the first fragment. The only difference between a present tense and a null tense is that the former must undergo the Aux copying rule, whereas the latter must not. Thus, the speech-time-oriented nature of the English present tense morpheme is now captured by the fact that the Aux copying rule applies obligatorily to an Aux node containing a present tense. Note also that two semantic rules are posited for a unique syntactic configuration as in 1a and 1b. These rules are used in conjunction with the Aux copying rule. 1a is for sentences which contain the "original" Aux node which is left behind after the Aux coping rule has applied. It introduces a a free state or event variable, which is eventually bound by a quantifier that has scope over the whole sentence. 1b, on the other hand, is for sentences which contain an Aux node which is unaffected by the Aux copying rule. This rule introduces a quantifier which binds an event or state variable. Note that the semantic type of Aux is <i, <st,t>> or <i<ev,t>>. Accordingly, the semantic rule 1b introduces a quantifier binding a time variable as well as one binding a state or event variable. The reason for opting for this rather cumbersome system is that Dowty's AT operator is still needed in this fragment to specify the scope of tense morphemes, and time variables are needed in order to employ an AT operator.

As the mechanism will be better understood with examples, I will provide some later.

3. Syntax: Aux $\rightarrow$ to (have + en)

[- fin]

Semantics:

3a. [$_{Aux}$ to] translates into

$\lambda P_e\, \exists e[\text{to}'\,(e)\ \&\ P_e\,\{e\}]$ or

$\lambda P_s\, \exists s[\text{to}'\,(s)\ \&\ P_s\,\{s\}]$

3b. *to* translates into one of the following four:

PRES, $\lambda t[\text{FUT}\,(t)\ \&\ t \subseteq t_{Rn}]$, $\lambda e[\text{FUT}\,(e)\ \&\ e \subseteq t_{Rn}]$, $\lambda s[\text{FUT}\,(s)\ \&\ s \subseteq t_{Rn}]$

The comments that I made on the rules 2 apply here as well.

4 through 11 and 13 through 15.

Note that the semantic rule for adjunction of NP's to VP's (i.e. 11b) has been modified in order to accommodate the change of semantic types assigned to verbs.

12. Aux copying

Semantics: $[_S\ Aux_k\ [_S \ldots\ Aux\ e_k \ldots\ ]]$ translates into

$\exists e_k\ [\exists t\ [Aux'\ (t)(e_k)]\ \&\ S']$ or $\exists s_k\ [\exists t\ [Aux'\ (t)(s_k)]\ \&\ S']$

The Aux copying rule is like QR in that it serves to Chomsky-adjoin the Aux to an S. However, it is different from QR in that the original is left intact after the application of the rule. In other words, the rule is a copying rule, not a movement rule. This fact allows us to encode the temporal directionality isomorphism. A technical problem arises when more than one tense morpheme appears under the Aux node. It is not clear how to make sure that the free variables produced in the translation of the original Aux node are bound by the outermost quantifiers without making ad hoc stipulations. In the above fragment, I proposed only those rules that give rise to one free variable.

Examples:

(1) John said that Mary is in the room.

D-str.: John Past say that Mary [Aux Pres] be in the room.

LF (Aux is QR-ed): $[_S[_{Aux\ k}$ Pres$][_S$John Past say that Mary $[_{Aux\ ek}$ Pres] be in the room]]

1. that Mary $[_{Aux\ ek}$ Pres] be in the room $\Rightarrow$ $\exists t[PRES\ (t)\ \&\ AT\ (t, PRES\ (s_k))\ \&\ AT\ (t, \wedge$ be-in-the-room' $(s_k, m^*))]$

2. $PRES\ (s_k)$ & be-in-the-room' (s_k, m^*)

3. John Past say that Mary [$_{Aux\ ek}$ Pres] be in the room $\Rightarrow$

$\exists e[\text{PAST}(e) \ \&\ e \subseteq t_{R1} \ \&\ \text{say}'(e, j^*, {}^\wedge[\text{PRES}(s_k) \ \&\ \text{be-in-the-room}'(s_k, m^*)])]$

4. [$_S$[$_{Aux\ k}$ Pres][$_S$John Past say that Mary [$_{Aux\ ek}$ Pres] be in the room]] $\Rightarrow$

$\exists s_k \exists t[\text{PRES}(t) \ \&\ \text{AT}(t, \text{PRES}(s_k)) \ \&\ \exists e[\text{PAST}(e) \ \&\ e \subseteq t_{R1} \ \&\ \text{say}'(e, j^*, {}^\wedge[\text{PRES}(s_k) \ \&\ \text{be-in-the-room}'(s_k, m^*)])]]$

5. $\exists s_k[\text{PRES}(s_k) \ \&\ \exists e[\text{PAST}(e) \ \&\ e \subseteq t_{R1} \ \&\ \text{say}'(e, j^*, {}^\wedge[\text{PRES}(s_k) \ \&\ \text{be-in-the-room}'(s_k, m^*)]))]]$

The Aux copying rule produces a copy of the original Aux, and the copy is adjoined to the matrix S. Having these two Aux nodes has the effect of producing a predicate PRES in the higher position and another occurrence of PRES in the proposition. This ensures that we abide by the temporal directionality isomorphism. The final line of the translation says that there is a current state s and there is a past event of John's standing in the saying relation to the proposition that s is a "current" state and s is the state of Mary's being in the room. Since a state individual can obtain at two or more different times, the above formula does not result in a contradiction. This translation explains why Sue's presence was crucial in determining the truth of the sentence (1): Sue's being in the room is the state of which John believed that Mary was in the room. Thus, one of the conditions for the truth of (1) in the situation under consideration is that this state, i.e. Sue's being in the room, still obtains at the speech time.

The attraction of the current proposal is that other "double-access" constructions listed at the beginning of Chapter 4 receive essentially the same account. For example, the semantics of a future tense (i.e. *will*) embedded under a past tense is accounted for in the following manner:

(2) John said that Mary will come.

D-str.: John Past say that Mary [$_{Aux}$ Pres woll] come.

LF (Aux copying): [$_S$[$_{Aux\ k}$ Pres woll][$_S$John Past say that Mary [$_{Aux\ ek}$ Pres woll] come]]

1. Mary [$_{Aux\ ek}$ Pres woll] come $\Rightarrow$ $\exists t$ [FUT (t) & $t \subseteq t_{R2}$ & AT (t, PRES (e_k)) & AT (t, come' (e_k, m*))]

2. $\exists t$ [FUT (t) & $t \subseteq t_{R2}$ & AT (t, PRES (e_k) & come' (e_k, m*))]

3. John Past say that Mary [$_{Aux\ ek}$ Pres woll] come $\Rightarrow$

   $\exists e \exists t$[PAST (t) & $t \subseteq t_{R1}$ & AT (t, PRES (e) & say' (e, j*, ^ $\exists t'$ [FUT (t') & $t' \subseteq t_{R2}$ & AT (t', PRES (e_k) & come' (e_k, m*))]))]

4. [$_S$[$_{Aux\ k}$ Pres woll][$_S$John Past say that Mary [$_{Aux\ ek}$ Pres woll] come]] $\Rightarrow$

   $\exists e_k$[$\exists t$[FUT (t) & $t \subseteq t_{R2}$ & AT (t, PRES (e_k))] & $\exists e \exists t$[PAST (t) & $t \subseteq t_{R1}$ & AT (t, PRES (e) & say' (e, j*, ^ $\exists t'$ [FUT (t') & $t' \subseteq t_{R2}$ & AT (t', PRES (e_k) & come' (e_k, m*))]))]]

5. $\exists e_1$[FUT (e_1) & $e_1 \subseteq t_{R2}$ & $\exists$e[PAST (e) & e $\subseteq t_{R1}$ & say' (e, j*, ^ $\exists$t' [FUT (t') & t' $\subseteq t_{R2}$ & AT (t', PRES (e_1) & come' $(e_1$, m*))])]]

The final translation requires that the event in question be located at a time which lies in the future of the speech time and also in the future of the time of John's saying. Thus, the event must be located in the future of the speech time. This conclusion is derived from the way we characterized events in the fragment: an event can only obtain at the maximal interval occupied by the extension of the event. This analysis does not distort the original attitude expressed by John because the proposition to which John stands in the saying relation describes Mary's coming as lying in the future from John's point of view. Yet, we predict correctly that the event of Mary's coming is located in the future of the speech time. I believe that this translation captures the meaning of (2) accurately.

Another interesting consequence is that we predict a wide scope reading of the embedded past tense in (3):

(3) John said that Mary came.

(3') LF after QR: $[_S[_{Aux\ k}$ Past] $[_S$John Past say that Mary $[_{Aux\ e_k}$ Past] come]]

1. John Past say that Mary $[_{Aux\ e_k}$ Past] come $\Rightarrow$

$\exists$e[PAST (e) & e $\subseteq t_{R1}$ & say' (e, j*, ^ $\exists$t[PAST(t) & t $\subseteq t_{R2}$ & AT (t, PRES(e_k) & come' $(e_k$, m*))])]

2. $[_S[_{Aux\ k}\ Past]\ [_S John\ Past\ say\ that\ Mary\ [_{Aux\ ek}\ Past]\ come]]$

$\Rightarrow \exists e_k\ [\exists t\ [PAST\ (t)\ \&\ t \subseteq t_{R2}\ \&\ AT\ (t,\ PRES\ (e_k))]\ \&$

$\exists e[PAST\ (e)\ \&\ e \subseteq t_{R1}\ \&\ say'\ (e,\ j^*,\ {}^\wedge\ \exists t[PAST(t)\ \&\ t \subseteq t_{R2}\ \&$

$AT\ (t,\ PRES\ (e_k)\ \&\ come'\ (e_k,\ m^*))])]]$

3. $\exists e_k[PAST\ (e_k)\ \&\ e_k \subseteq t_{R2}\ \&\ \exists e[PAST\ (e)\ \&\ e \subseteq t_{R1}\ \&\ say'\ (e,$

$j^*,\ {}^\wedge\ \exists t[PAST(t)\ \&\ t \subseteq t_{R2}\ \&\ AT\ (t,\ PRES\ (e_k)\ \&\ come'\ (e_k,$

$m^*))])]]$

Since the event is required to be located before the speech time and also before the time of John's saying, the time of the event is correctly predicted to be located before the time of John's saying. Of course, this does not strike native speakers of English as an independent reading because it is apparently no different from the straightforward shifted interpretation normally associated with (3). However, there is reason to believe that past-under-past sentences can be used for de re attitude reports involving events or states. For example, as (4a) shows the speaker can identify the temporal location of the event referred to by the embedded clause by a speech-time-oriented temporal adverbial:

(4a) John said last week that Mary came to Austin two weeks ago.

(4b) John: Mary came to Austin last week.

Assuming that (4a) is uttered to report (4b), we seem to be justified in claiming that (3) does have the interpretation given in (3').

Before proceeding to the final problem to be discussed in this thesis, I will show that the new system can also deal with the ST examples presented earlier. Consider the following example:

(5) John decided that he would say to his mother that they were having their last meal together.

LF (after tense deletion): John Past decide that he Ø woll say to his mother that they Ø be having their last meal.

1. they Ø be having their last meal $\Rightarrow$ $\exists s \exists t$[PRES (t) & AT (t, PRES (s) & they-be-having-their-last-meal (s))]
2. $\exists s$[PRES (s) & they-be-having-their-last-meal (s)]
3. he Ø woll say to his mother that they Ø be having their last meal $\Rightarrow$ $\exists e$[FUT (e) & $e \subseteq t_{R2}$ & say-to-his-mother' (e, x, ^ $\exists s$[PRES (s) & they-be-having-their-last-meal' (s)])]
4. John Past decide that he Ø woll say to his mother that they Ø be having their last meal $\Rightarrow$ $\exists e_1$[PAST (e_1) & $e_1 \subseteq t_{R3}$ & decide' (e_1, j*,^ $\exists e$[FUT (e) & $e \subseteq t_{R2}$ & say-to-his-mother' (e, x, ^ $\exists s$[PRES (s) & $s \subseteq t_{R1}$ & they-be-having-their-last-meal' (s)])])]

The last line says that there was a past event of John's deciding (call it e_1) that there would be a future event (in relation to e_1) e such that he says to his mother that there is a state of their having their last meal at the time of the event e. This is the desired reading.

Now, we are ready to tackle the last problem in this dissertation: Ladusaw's puzzle. In Chapter 2, we discussed Ladusaw's framework (Ladusaw 1977), which is one version of ST theory. The problem for the framework was the following: Ladusaw predicts that the sentence (6) can only be produced if the tense in the relative clause is outside the scope of the matrix tense because the ST rule would otherwise convert *will* into *would.* In order to ensure that the tense in the relative clause is outside the scope of the matrix tense, the only means available to Ladusaw's system in order to accomplish this effect is to give wide scope to the relativized NP. Thus, the prediction is that the relativized NP in (6) can only receive a de re interpretation. Despite this prediction, Ladusaw observes that (6) can receive two readings: de dicto as well as de re. This judgment is confirmed by Dowty (1982: 42).

(6) John sought a man who will be leaving.

Ladusaw's framework predicts a de re interpretation, but it cannot explain why a de dicto interpretation is also available.

As mentioned in Chapter 2, the framework presented in Chapter 3 apparently produces the right result, but I believe that it was the wrong analysis. The current framework, I claim, assigns a more accurate interpretation to (6). Note first that (6) *can* be interpreted as a double-access sentence: *will,* which is morphologically present, is embedded under the matrix past tense. (6) *does not have to* be interpreted as a double-access sentence because NP's are assumed to be subject to scoping. Let us see what happens when the relativized NP is scoped to the matrix S level:

(6') QR: $[_S[_{NPk}$ a man who Pres woll be leaving$][_S$John Past seek $e_k]]$

Tense Deletion (non-applicable):

$[_S[_{NPk}$ a man who Pres woll be leaving$][_S$John Past seek $e_k]]$

[N.B. I assume that *be leaving* is synonymous with *leave* in this context and translate the former into IL as an event predicate, rather than as a state predicate.]

1. who Pres woll be leaving $\Rightarrow \lambda x\, \exists e \exists t[\text{FUT}(t)\ \&\ t \subseteq t_{R1}\ \&\ \text{AT}(t, \text{PRES}(e)\ \&\ \text{leaving}'(e, x))]$

2. man who Pres woll be leaving $\Rightarrow \lambda x[\text{man}'(x)\ \&\ \exists e \exists t\, [\text{FUT}(t)\ \&\ t \subseteq t_{R1}\ \&\ \text{AT}(t, \text{PRES}(e)\ \&\ \text{be-leaving}'(e, x))]]$

3. a man who Pres woll be leaving $\Rightarrow \lambda Q\, \exists x\, [\text{man}'(x)\ \&\ Q\{x\}\ \&\ \exists e \exists t\, [\text{FUT}(t)\ \&\ t \subseteq t_{R1}\ \&\ \text{AT}(t, \text{PRES}(e)\ \&\ \text{be-leaving}'(e, x))]]$

4. John Past seek $e_k \Rightarrow \exists e \exists t[\text{PAST}(t)\ \&\ t \subseteq t_{R2}\ \&\ \text{AT}(t, \text{PRES}(e)\ \&\ \text{seek}'(e, j^*, {}^\wedge \lambda PP\{y\}))]$

5. $[_S[_{NPk}$ a man who Pres woll be leaving$][_S$John Past seek $e_k]] \Rightarrow$ $\lambda Q\, \exists x\, [\text{man}'(x)\ \&\ Q\{x\}\ \&\ \exists e \exists t\, [\text{FUT}(t)\ \&\ t \subseteq t_{R1}\ \&\ \text{AT}(t, \text{PRES}(e)\ \&\ \text{be-leaving}'(e, x))]]\ ({}^\wedge \lambda y \exists e \exists t[\text{PAST}(t)\ \&\ t \subseteq t_{R2}\ \&\ \text{AT}(t, \text{PRES}(e)\ \&\ \text{seek}'(e, j^*, {}^\wedge \lambda PP\{y\}))])$

6. $\exists x\, [\text{man}'(x)\ \&\ \exists e \exists t[\text{PAST}(t)\ \&\ t \subseteq t_{R2}\ \&\ \text{AT}(t, \text{PRES}(e)\ \&\ \text{seek}'(e, j^*, {}^\wedge \lambda PP\{x\}))]\ \&\ \exists e \exists t\, [\text{FUT}(t)\ \&\ t \subseteq t_{R1}\ \&\ \text{AT}(t,$ $\text{PRES}\quad (e)\ \&\ \text{be-leaving}'(e, x))]]$

7. $\exists x$ [man' (x) & $\exists e$[PAST (e) & $e \subseteq t_{R2}$ & seek' (e, j*, ^ λPP{x})] & $\exists e$ [FUT (e) & $e \subseteq t_{R1}$ & be-leaving' (e, x)]]

The final translation says that there is a man x such that there was a past event of John's seeking x and there is a future event of x's leaving. This represents a de re interpretation of the relativized NP.

The other reading of (6) which Ladusaw describes as a "de dicto" reading of the NP seems to confuse native speakers.[1] The non-unanimity of opinions among natives about the status of the "de dicto" reading, however, should not lead us to conclude that it is a marginal reading or that it does not exist. I claim that the "de dicto" reading of the NP is in fact a de dicto reading for the NP but a de re reading for the Aux (i.e. tense). My speculation about the unclear status of the so-called "de dicto" reading of the relativized NP is that since we are not accustomed to thinking of a de re reading of a relative clause tense independently of a de re reading of the NP which contains it, native speakers (especially those who know the existing analyses of scope phenomena) cannot make up their mind about this reading.

[1] For example, the participants of the conference titled "the Structure of Events and the Natural Language Metaphysics" (held in Austin in February 1988) were divided as to whether such a reading is possible.

(6") Aux copying:

$[_S[_{Aux\ k}$ Pres woll] $[_S$John Past seek a man who $[_{Aux\ ek}$ Pres woll] be leaving]]

Tense Deletion (non-applicable):

$[_S[_{Aux\ k}$ Pres woll] $[_S$John Past seek a man who$_i$ e_i $[_{Aux\ ek}$ Pres woll] be leaving]]

1. a man who$_i$ e_i $[_{Aux\ ek}$ Pres woll] be leaving $\Rightarrow \lambda Q \exists x$ [man' (x) & Q{x} & $\exists$t [FUT (t) & t $\subseteq t_{R1}$ & AT (t, PRES (e) & be-leaving' (e, x))]]

3. John Past seek a man who$_i$ e_i $[_{Aux\ ek}$ Pres woll] be leaving $\Rightarrow$ $\exists$e[PAST (e) & e $\subseteq t_{R2}$ & seek' (e, j*, ^ $\lambda Q \exists x$ [man' (x) & Q{x} & $\exists$t [FUT (t) & t $\subseteq t_{R1}$ & AT (t, PRES (e_1) & be-leaving' (e_1, x))]])]

4. $[_S[_{Aux\ k}$ Pres woll] $[_S$John Past seek a man who$_i$ e_i $[_{Aux\ ek}$ Pres woll] be leaving]] $\Rightarrow$

   $\exists e_1$[FUT (e_1) & $e_1 \subseteq t_{R1}$ & $\exists$e[PAST (e) & e $\subseteq t_{R3}$ & seek' (e, j*, ^ $\lambda Q \exists x$ [man' (x) & Q{x} & $\exists$t [FUT (t) & t $\subseteq t_{R1}$ & AT (t, PRES (e_1) & be-leaving' (e_1, x))]])]]

The final line says that there is a future event e_1 and there is a past event (call it e) of John's standing in the seeking relation to the property of properties of being a man who would leave in the future of this seeking time and his leaving is e_1. I believe that this is exactly what Ladusaw refers to as a "de dicto" interpretation of the relativized NP. Our framework produces this reading without any stipulations.

5.1.1. A Fragment of Japanese

Japanese:

Syntax:

1. S → NP VP Aux

2. Aux → Tns

3. Tns → Pres
Past

4. NP → N'
Name

5. N' → S' N'
Adj N'
(NP) (S') N

6. S' → S to yuu (= noun complement clause)
S to (= verb complement clause)
S

7. VP → (NP) V
S' V

Transformations:

8. Wh-movement: At the level of S-structure, move an empty wh-element to COMP.

9. Quantifier Raising: At the level of Logical Form, NP's are optionally Chomsky-adjoined to a VP or an S.

10. Aux copying: At the level of Logical Form, Aux's are *optionally* Chomsky-adjoined to the highest S iff they are not directly dominated by the highest S node and they contain an occurrence of Pres. Unlike NP cases, however, this is a copying rule which leaves the original Aux node intact. When this happens, the original Aux node receives the index e_k while the copy acquires the index k.

    [N.B. B is said to be Chomsky-adjoined to A when the following operation is performed: $[_A \ldots] \Rightarrow [_A B [_A \ldots]]]$

Lexicon:

11. Adj. → *izen-no* 'prior-GEN', *mae-no* 'before-GEN', *noti-no* 'later-GEN'

Semantics:

1a. $[_S$ NP VP Aux $e_k]$ translates into

$\exists t\, [Aux'(t)(s_k)\ \&\ AT(t, VP'(\hat{}\ NP')(s_k))]$ or

$\exists t\, [Aux'(t)(e_k)\ \&\ AT(t, VP'(\hat{}\ NP')(e_k))]$

1a. $[_S$ NP VP Aux$]$ translates into

$\exists s \exists t\, [Aux'(t)(s)\ \&\ AT(t, VP'(\hat{}\ NP')(s))]$ or

$\exists e \exists t\, [Aux'(t)(e)\ \&\ AT(t, VP'(\hat{}\ NP')(e))]$

2. $[_{Aux}$ Tns$]$ translates into Tns'

3a. $[_{Tns}$ Pres] translates into one of the following four:

$\lambda t \lambda e[PRES(t) \& AT(t, PRES(e))]$ or

$\lambda t \lambda s[PRES(t) \& AT(t, PRES(s))]$

$\lambda t \lambda e[FUT(t) \& t \subseteq t_{Rn} \& AT(t, PRES(e))]$ or

$\lambda t \lambda s[FUT(t) \& t \subseteq t_{Rn} \& AT(t, PRES(s))]$

3c. $[_{Tns}$ Past] translates into one of the following two

$\lambda t \lambda e[PAST(t) \& t \subseteq t_{Rn} \& AT(t, PRES(e))]$ or

$\lambda t \lambda s[PAST(t) \& t \subseteq t_{Rn} \& AT(t, PRES(s))]$

4a. $[_{NP}$ N'] translates into $\lambda P \exists x [N'(x) \& P\{x\}]$

4b. $[_{NP}$ Name] translates into $\lambda P P\{Name'\}$

5a. $[_{N'}$ S' N'] translates into $\lambda x [S''(x) \& N''(x)]$

5b. $[_{N'}$ Adj N'] translates into Adj.' (^ N'') [N.B. N'' = the translation of N']

5c. $[_{N'}$ S' NP N^2] translates into $\lambda x\ NP'(\hat{}\ \lambda y [N^{2'}(\hat{}\ S'')(y)(x)])$

[N.B. S'' = the translation of S-bar]

5d. $[_{N'}$ S' N^1] translates into $N^{1'}(\hat{}\ S'')$ [N.B. S'' = the translation of S-bar]

5e. $[_{N'}$ N^0] translates into $N^{0'}$

6a. $[_{S'}$ S to yuu] translates into S' [N.B. S' = the translation of S]

6b. $[_{S'}$ S to] translates into S' [N.B. S' = the translation of S]

7a. $[_{VP}$ NP V^1] translates into $V^{1'}(\hat{}\ NP')$

7b. $[_{VP}$ V^0] translates into $V^{0'}$

7c. $[_{VP}$ S' V^1] translates into $V^{1'}(\hat{}\ S'')$ [S'' = the translation of S-bar]

8. $[_{S'}[_S \ldots e_k \ldots][_{COMP}\ wh_k]]$ translates into λx_k S'

9a. $[_S\ NP_k [_S \ldots e_k \ldots]]$ translates into $NP'(\hat{}\ \lambda x_k\ S')$

9b. $[_{VP}\ NP_k\ [_{VP} \ldots e_k \ldots]]$ translates into $\lambda\wp\ \lambda e NP'\ (\wedge\ \lambda x_k\ [VP'\ (\wp)(e)])$ or

$\lambda\wp\ \lambda s NP'\ (\wedge\ \lambda x_k\ [VP'\ (\wp)(s)])$

10. $[_S\ Aux_k\ [_S \ldots\ Aux\ e_k \ldots\ ]]$ translates into

$\exists e_k\ [\exists t\ [Aux'\ (t)(e_k)]\ \&\ S']$ or $\exists s_k\ [\exists t\ [Aux'\ (t)(s_k)]\ \&\ S']$

Lexicon:

11. *izen-no* 'prior-GEN' translates into

$\lambda P \lambda x\ \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

mae-no 'before-GEN' translates into

$\lambda P \lambda x\ \exists t\ [PAST\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

noti-no 'later-GEN' translates into

$\lambda P \lambda x\ \exists t\ [FUT\ (t)\ \&\ t \subseteq t_{Rn}\ \&\ AT\ (t, P\ \{x\})]$

Comments:

Since double-access readings always entail purely simultaneous readings and Japanese has no syntactic means of distinguishing between purely simultaneous readings and double-access readings (if any), it is not clear whether Japanese has double-access sentences. I have no conclusive evidence that Japanese has double-access sentences. However, I will show that if we adopt a new framework, we can predict that some Japanese sentences can be interpreted to have "double-access" interpretations which are consistent with the empirical data. Note that the Aux copying rule must be an optional rule in Japanese since a present tense embedded under a past tense can have a purely simultaneous reading.

For example, (7) is subject to the Aux copying and can receive a de re interpretation in the following way:

(7) John-wa Mary-ga heya -ni ir-u to it -ta.
TOP NOM room at be PRES that say PST
[Intended] John said that Mary is in the room.

(7') D-str.: [$_S$John-wa [$_S$Mary-ga heya -ni i[$_{Aux}$ Pres]] to it [$_{Aux}$Past]]

LF (after Aux copying):

[$_S$[$_{Aux\ k}$ Pres][$_S$John-wa [$_S$Mary-ga heya -ni i[$_{Aux\ ek}$ Pres]] to it [$_{Aux}$Past]]]

1. [$_S$Mary-ga heya -ni i[$_{Aux\ ek}$ Pres]] $\Rightarrow$ $\exists$t[PRES (t) & AT (t, PRES (s_k)) & AT (t, ^ be-in-the-room' (s_k,m*))]
2. [$_S$John-wa [$_S$Mary-ga heya -ni i[$_{Aux\ ek}$ Pres]] to it [$_{Aux}$Past]] $\Rightarrow$ $\exists$e[PAST (e) & e $\subseteq$ t_{R1} & say' (e, j*, ^ [PRES (s_k) & be-in-the-room' (s_k, m*)])]
3. [$_S$[$_{Aux\ k}$ Pres][$_S$John-wa [$_S$Mary-ga heya -ni i[$_{Aux\ ek}$ Pres]] to it [$_{Aux}$Past]]] $\Rightarrow$ $\exists s_k \exists$t[PRES(t) & AT (t, PRES (s_k)) & $\exists$e[PAST (e) & e $\subseteq$ t_{R1} & say' (e, j*, ^ [PRES (s_k) & be-in-the-room' (s_k, m*)])]]
4. $\exists$s [PRES (s) & $\exists$e[PAST (e) & e $\subseteq$ t_{R1} & say' (e, j*, ^ [PRES (s) & be-in-the-room' (s, m*)])]]

According to the final translation, in uttering (7) the speaker claims that there is a state s such that there was a past event of John's standing in the saying relation to the proposition that the state s obtains simultaneously and it is a state of Mary's being in the room.

Lastly, I will show that the current framework can represent relative scope relationships between a main clause tense and a relative clause tense in a purely extensional context:

(8) John-wa [naite-iru otoko]-ni at -ta.
TOP crying man DAT meet PST

John met a man who is/was crying.

Let us concentrate upon the simultaneous reading of (8), which is derived from an LF configuration in which the relativized NP is adjoined to the VP:

(8') LF: John-wa $[_{VP}[_{NP_k}$ naite-iru otoko]-ni $[_{VP}\ e_k$ at]] ta

1. $[_{VP}[_{NP_k}$ naite-iru otoko]$[_{VP}\ e_k$ au]] $\Rightarrow$

   $\lambda\wp\lambda e\lambda Q\, \exists x$ [man' (x) & Q{x} & $\exists s \exists t$ [PRES (t) & AT (t, PRES (s) & be-crying' (s, x))]]($^\wedge\, \lambda x_k$ [meet' $(x_k)(\wp)(e)$])

2. $\lambda\wp\lambda e \exists x$ [man' (x) & meet' (x)($\wp$)(e) & $\exists s \exists t$ [PRES (t) & AT (t, PRES (s) & be-crying' (s, x))]]

3. John-wa $[_{VP}[_{NP_k}$ naite-iru otoko]-ni $[_{VP}\ e_k$ at]] ta $\Rightarrow$

   $\exists e \exists t$[PAST (t) & $t \subseteq t_{R1}$ & AT (t, PRES (e)) & AT (t, $\exists x$ [man' (x) & meet' (x)(j*)(e) & $\exists s \exists t$ [PRES (t) & AT (t, PRES (s) & be-crying' (s, x))]]])]

4. $\exists e \exists t[\text{PAST}(t) \ \& \ t \subseteq t_{R1} \ \& \ \text{AT}(t, \text{PRES}(e) \ \& \ \exists x\ [\text{man}'(x) \ \& \ \text{meet}'(e, j^*, x) \ \& \ \exists s[\text{PRES}(s) \ \& \ \text{be-crying}'(s, x)]])]$

Thanks to the AT operator, the time of the man's crying is correctly predicted to be simultaneous with the meeting time.

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