CHAPTER 1
ISSUES IN TENSE SEMANTICS

This dissertation investigates the semantics of tense and the temporal interpretation of
tensed and tenseless predicates in natural language. Tense is a well-studied topic in the
semantics literature.1 There are a number of theories of tense, many of which are successful
in accounting for the intuitive meanings of tensed sentences like *Elliott is in Japan* and *Jen
went to Boston*. Examination of the tense interpretation of these simplex, unembedded
sentences does not discriminate one tense theory from another, nor does it tell us much
about what ingredients are necessary for the proper treatment of tense in natural language.
For this reason (and perhaps more), many authors have investigated tense interpretations of
more complex sentences that have one or more tenses embedded under another.

Earlier researchers, such as Saarinen (1979) and Cresswell (1990), conclude that the
natural language tense system must be such that it is able to keep track of all times
introduced in a given sentence.2 This helps narrow down the number of theories of tense.
Many existing theories can in this regard be shown to be empirically inadequate. Among
the theories that meet this criterion, we will consider two here: a tense system that employs
overt quantification over times in the object language, and a system with infinitely many
evaluation indices and operators that control them. (We will further articulate this
distinction in § 1.1.) These two systems have been proven to be equivalent in terms of
expressive power. (See Cresswell 1990.) In this dissertation, we present some evidence
that favors the former system, one with explicit quantification over times in the object
language.

Recent researchers, such as Ogihara (1989, 1995b, 1996), Stowell (1993, 1995a,b),

1 See Kuhn (1989) for a brief summary of many issues on tense and related topics. See also Binnick (1991).

2 For an overview of this issue, see van Benthem (1977).
investigate tense in embedded contexts from a different perspective. These authors focus on particular phenomena called the sequence of tense (SOT) phenomena. The phenomena are typically found in clausal complements of so-called propositional attitude verbs like believe and say. Informally speaking, in languages like English, the present tense in a direct quotation such as *Eva said, "Elliott is in Japan."* becomes the past tense in its indirect quotation counterpart such as *Eva said that Elliott was in Japan.* These authors have contributed a great deal to our understanding of tense in embedded contexts as well as tense in general. Yet there still remain some underinvestigated issues and unsolved puzzles. For example, whether a similar analysis can be carried over to other embedded contexts such as relative clauses and adjunct clauses remains unsolved.

A closely related but much less studied topic is the temporal interpretation of expressions that are not tensed (at least not in English). In the area of the temporal interpretation of noun phrases, there are two major contributions: Enç (1981, 1986) and Musan (1995). The temporal interpretation of other non-tensed expressions such as noun modifiers (adjectives, participles, etc.) has not received much attention, though.

Another issue that has not received enough attention concerns languages that do not exhibit the SOT phenomena, such as Japanese, Polish, and Russian. Unlike languages like English, these languages use the same tense form in both direct and indirect quotations. We will call these languages non-SOT languages. The fact that the SOT phenomena are not universal is well known. Cross-linguistic studies comparing SOT and non-SOT languages show this (Comrie 1985, Ogihara 1989, 1996). Less well-known is the fact that there is a striking difference among non-SOT languages in their tense interpretation in embedded contexts other than clausal complements.

In this dissertation, we bring these issues together and seek a theory of tense that has more empirical coverage both within and across languages. In particular, we propose that

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3 This is a very informal description of the phenomena. The phenomena are not limited to cases of quotations. Also the change is not obligatory for many native speakers. That is, sentences like *Eva said that Elliott is in Japan* are grammatical. We will discuss the SOT phenomena in details in § 1.5.1.
tense morphemes are time variables that saturate the time argument slots of predicates they 'modify'. This proposal implies that event times of predicates are represented in the object language only when the predicates are tensed. It predicts differences between tensed and tenseless expressions in their temporal interpretations. We will examine new data from English and Japanese that support this distinction. We will then look more closely at differences among non-SOT languages. We will see that the proposed tense system with limited overt quantification over times in the object language gives a straightforward account of the observed difference among non-SOT languages.

1.1. Preliminary: Formalities and Assumptions

Let us now return to issues of quantification over time in the object language vs. in the meta-language only. Suppose that Elliott went to Japan on August 20th and came back to the States on December 27th, and that this is the only trip to Japan he made. The sentence Elliott is in Japan would be true when uttered at 3:00 PM on September 15th but it would not when uttered at 3:00 PM on July 4th or December 31st. The sentence Elliott was in Japan would be true when it is uttered at 3:00 PM on December 31st, but not on July 4th. As this example illustrates, the truth conditions of a sentence usually vary depending on when the sentence is evaluated. In most cases, it is when the sentence is uttered, i.e., the speech time.

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4 We will use the term 'event' to cover both events and states.

5 When uttered on September 15th, while Elliott is still in Japan, the sentence Elliott was in Japan is true but misleading. It can give rise to an implicature that he is no longer in Japan. Whether such an implicature arises or not depends on the context in which the sentence is uttered. Issues of context dependency are discussed below.

6 This is not always the case, as Barbara Partee (p.c.) pointed out to me. (This is first discussed in Kratzer 1978, according to Partee.) Take the case of a message on my answering machine: "I am unable to come to the phone now." In normal circumstances, the sentence is not evaluated with respect to the time I say it, i.e., the time of my recording, but with respect to a time somebody calls me when I am not home. I can think of two ways to accommodate cases like this. One is to say that sentences are evaluated with respect to a time that is made salient in the context. In many cases, it is the speech time, but in cases like the above, it is the time of calling. The other way is to say that sentences are always
This means that sentence denotations have to be relativized with respect to times. We can do this by explicitly quantifying over times in the object language or by limiting quantification to the meta-language only. (By the object language, we mean the LF syntactic structure, assuming there is no intermediate level of interpretation.) We will review some of the literature on this issue below, but we refer the reader to Massey (1969), Kamp (1971), Vlach (1973), Partee (1973), Parsons' (1973) and Stalnaker's (1973) replies to Partee, van Benthem (1977), Saarinen (1978), and especially Cresswell (1990).

Since sentence meanings are computed from the meanings of their parts, relativizing sentence denotations with respect to times amounts to relativizing denotations of nouns, verbs, etc with respect to times. In order to determine the truth conditions of a sentence like *Elliott was in Japan*, we will have to determine the denotations of its parts, such as the denotations of the noun *Elliott* and the predicate *be-in-Japan.*

Before moving on, let us address one question. What is time? It had often been assumed, for instance in Montague (1974), that time is the set of moments of time. Bennett and Partee (1972) present arguments against this conception of time, and propose that at least some sentences have to be evaluated with respect to intervals of time. One of the strongest arguments for interval-based semantics comes from accomplishment predicates. Suppose, for instance, that I baked a cake from 3:00 PM to 5:00 PM today. It would not be true to say that I baked a cake at the initial moment of my cake baking time, 3:00 PM. If it were, I would be able to say, "I baked a cake" at 4:00 PM when I was still in the middle of the cake baking. It would also not be true that I baked a cake at the final moment of my cake baking time, 5:00 PM, nor would it be true that I baked a cake at all moments of time between 3:00 and 5:00. We must say that I baked a cake at the interval from 3:00 PM to 5:00 PM. Thus we would want the domain of times to include not only moments of time evaluated with respect to the speech time. But a caller takes my recorded message "as if" I am speaking at the moment.

We treat complex predicates like *be-in-Japan* as single lexical entries.
but also intervals of time. See Dowty (1979) and Cresswell (1985) for more arguments and discussion.\(^8\)

Let us resume our discussion on tense now. Consider first a system with overt quantification over times in the object language, in which we have the following in terms of type theory. We include worlds here since we will eventually need to introduce possible world semantics when we discuss tense in clausal complements. But we will ignore world variables (or indices) for the moment.

(1) a. e, t, i, and s are types
b. For any types \(\alpha\) and \(\beta\), \(<\alpha,\beta>\) is a type
c. Nothing else is a type

We define semantic domains as follows. The model we assume consists of \(D\), the set of all individuals, \(T\), the set of all intervals, and \(W\), the set of all worlds.

(2) a. \(D_e = D\)
b. \(D_t = \) the set of truth values, i.e., \(\{0,1\}\)
c. \(D_i = T\)
d. \(D_s = W\)
e. For any types \(\alpha\) and \(\beta\), \(D_{<\alpha,\beta>}\) is the set of functions from \(D_\alpha\) to \(D_\beta\)

The interpretation function is defined relative to a variable assignment function and a context index: for any expression \(\alpha\), \([\alpha]\)\(^g,c\) is the denotation of \(\alpha\) with respect to a variable assignment function \(g\) and a context index \(c\). A variable assignment is a partial function that

\(^8\) See Tichy (1985) for arguments against an interval-based semantics.
assigns each variable of type $\tau$ a member of $D_\tau$. For any variable $x$ of type $\tau$ with an index $i$, $[[x_i,\tau]]^{g,c} = g(i,\tau)$.\(^9\)

The denotations of *Elliott* and *be-in-Japan* in this framework are the following, ignoring world variables:

(3) a. $[[\text{Elliott}]]^{g,c} = \text{Elliott}$

b. $[[\text{be-in-Japan}]]^{g,c} = f: D_\text{e} \rightarrow D_{<t,\tau>}$

For any $t \in D_i$ and $x \in D_\text{e}$, $f(x)(t)=1$ iff $x$ is in Japan at $t$

Proper names like *Elliott* denote individuals. Predicates like *be-in-Japan*, which are 'ordinarily' considered as one-place predicates are actually two-place predicates in this framework; they take an individual argument and a time argument.\(^10\) Here we assume that the individual argument is the first argument and the time argument is the outermost one.

The mere assumption that predicates take an extra argument for a time does not necessarily mean that we choose to represent times overtly in the object language. By overt quantification over times in the object language, we mean to have LF structures like the following, where the time argument of the predicate *be-in-Japan* is saturated by a time variable $t_i$. (In what follows, many of the LF structures are annotated with their interpretations. These interpretations are, however, not part of the LF representations.)

\(^{9}\) We will omit a specification of types when there is no confusion and write $[[x_i]]^{g,c} = g(i)$ instead.

\(^{10}\) By 'ordinarily', we mean before the introduction of event arguments by Davidson (1967). Since then, many arguments for an event-argument analysis have been presented in the literature. (See Parsons 1990 and Landman 1990, among others.) What we claim in this thesis is that predicates contain an argument slot that has temporal information. We identify it as a time argument for convenience. We are not claiming that event arguments should be replaced by time arguments. In fact, it has been argued in Parsons (1990) that events cannot be individuated just by their times, and we agree with him. Whether it is necessary to posit both event arguments and time arguments or whether event arguments can do all the work is an interesting and perhaps an important issue, but it is beyond the scope of this thesis.
The truth conditions of the whole structure are computed using the following interpretation rules. (See Heim and Kratzer 1998.)

What introduces the time variable $t_i$? Is it a phonologically null pronominal element, or does it have a morphological realization? This is a question that remains to be answered.
The choice between the two systems seems a technical matter at this point. But it does affect the semantics of tense, and when we look at complex sentences with two or more tenses, it ultimately results in empirical differences, as we will see below.

1.2. A Starting Point: Priorian Tense Logic

We have seen that the truth conditions of most sentences vary among other things depending on when the sentences are uttered, i.e., the speech time. And tenses affect the truth conditions. We take this to be uncontroversial and ask the following questions: What system does natural language employ to express the speech time dependency? How do tenses come into the system?

One answer is given in Prior (1967), further developed in Montague (1974): sentence denotations are relative to a temporal index and tenses are sentential operators that affect the index. For instance, the semantics of the past, present, and future tenses are defined as follows in Priorian tense logic, where $t$ is a temporal index and $<$ is an ordering relation:

\[(7) \text{ Where } \phi \text{ is a tenseless sentence,} \]

\[\text{a. } [[\text{Past } \phi]]^t = 1 \text{ iff there is a time } t' \text{ such that } t' < t \text{ and } [[\phi]]^t = 1\]
b. $[[\text{Pres } \phi]]^t = 1$ iff $[[\phi]]^t = 1$

c. $[[\text{Fut } \phi]]^t = 1$ iff there is a time $t'$ such that $t < t'$ and $[[\phi]]^{t'} = 1$

d. $[[\phi]]^t = 1$ iff $\phi$ is true at $t$

These denotations of tenses imply that (at least) the denotations of predicates are relative to a temporal index:

(8) a. $[[\text{Elliott}]] = \text{Elliott}$

b. $[[\text{be-in-Japan}]]^t(x) = 1$ iff $x$ is in Japan at $t$

Given the denotation in (8), we get the desired results.

(9) a. $[[\text{Pres Elliot be-in-Japan}]]^{3:00 \text{ PM}, 9/15} = 1$ iff Elliot is in Japan at 3:00 PM on September 15.

b. $[[\text{Past Elliot be-in-Japan}]]^{3:00 \text{ PM}, 12/31} = 1$ iff there is a time $t$ such that $t < 3:00 \text{ PM December 31st}$ and that Elliot is in Japan at $t$

(9) correctly predicts that the sentences "Elliott is in Japan" and "Elliott was in Japan" are true when evaluated at 3:00 PM, September 15th and at 3:00 PM, December 31st respectively.

The following assumptions are made in this kind of tense semantics: (i) tense manipulates times only in the meta-language, (ii) tense is a sentential operator, (iii) sentences are evaluated with respect to one temporal index, and (v) tense is an existential quantifier over times.\(^{11}\) There are a few more properties of this tense system that are consequences of these assumptions: tense introduces a new time, this new time becomes the evaluation time, and the original evaluation time is lost. There is also a hidden assumption that the tense operators Past, Pres, and Fut correspond to the past tense morpheme, the present tense morpheme, and the future auxiliary respectively. None of these should be taken for granted.

\(^{11}\) The fourth point is only claimed for Past and Future, not for Present.
as necessary assumptions and each has been challenged in the literature explicitly or implicitly.

In this chapter, we will examine these assumptions and their effects, and try to find out what are necessary ingredients for the proper treatment of tense. We take Priorian tense logic as a starting point, and discuss shortcomings of the theory that have been pointed out in the literature. We will then try to fix the analysis without changing the core analysis of Priorian tense logic, as well as present some alternative approaches. These assumptions are not independent of each other and a particular choice for one issue may affect a choice for another issue. Therefore, instead of listing and reviewing all existing theories, we will discuss advantages and disadvantages of theories of tense with respect to the following three issues: issues of explicit quantification over times in natural language, whether tenses are existential quantifiers or not, and issues concerning the relation between what we see (i.e., tense morphemes) and what we understand (i.e., temporal interpretation).

Section 1.3. is devoted to issues of explicit quantification over times in natural language. These issues were discussed extensively in the 1970s in connection with a multiple index tense system proposed in Kamp (1973) and Vlach (1974). Recent semanticists working on tense simply assume one way or the other, and not much attention has been given to this issue. For instance, Ogihara (1989, 1996) and Abusch (1998) assume quantification only in the meta-language, and Ogihara (1995a) and Abusch (1994, 1997a) assume quantification in the object language. We will examine what have been presented as problems for Priorian tense logic and see what changes have to be made to accommodate the problematic data.

In section 1.4., we will look at the context dependency of tense interpretations. This issue was once considered to be an argument against an existential analysis of tenses. We will see that, as argued in Bäurele (1979), Partee (1984), and Ogihara (1989, 1996), resorting to a referential analysis of tenses is not a necessary move to account for context dependency.
Issues of explicit quantification over times are also closely related to the question of whether there is a one-to-one correspondence between tense morphemes and the meaning of anteriority and simultaneity. Once we allow explicit quantification over times in the object language, we have at least three elements that are needed for the right understanding of the temporal interpretation: evaluation times, event times of predicates, and the source of the ordering between the two.\textsuperscript{12} Generally, it is assumed that tenses are what determine the ordering relation between evaluation times and event times. We will discuss the so-called sequence of tense phenomena and the temporal interpretation of non-verbal predicates in section 1.5., which suggests that tense morphemes do not always correspond to what we think they mean and that tense morphemes are not necessary to get temporal interpretations.

Lastly, in section 1.6., we will look at data from languages other than English, such as Japanese, Polish, and Russian. These languages are crucially different from English in that they do not exhibit sequence of tense phenomena. We refer to these languages that do not exhibit the SOT phenomena as non-SOT languages. We will see that not all non-SOT languages behave alike in all embedded contexts. To my knowledge, differences among the non-SOT languages in their temporal interpretations are not discussed in the literature, with the exception of Arregui and Kusumoto (1998), Kusumoto (1998), and Kondrashova (1999). The data presented in this work seem problematic for previous theories of the SOT phenomena that divide languages into SOT and non-SOT languages. In Chapters 2 and 3, we will argue that tense semantics is uniform across non-SOT languages and apparent differences are due to structural differences of the relevant constructions, e.g., relative clauses and temporal adjunct clauses.

\textsuperscript{12} Many authors, such as Reichenbach (1947) and Klein (1994), claim that there is a third time that is involved in temporal interpretation, i.e., Reichenbach’s ‘reference time’ or Klein’s ‘topic’ time. They claim that tenses relate evaluation times and reference times (or topic times.) One advantage in introducing this third notion is to account for the context dependency of tense interpretation. As we will see later, however, context dependency can also be explained by means of implicit domain restrictions, and the latter system has a wider empirical coverage. Therefore, we will adopt the latter system, although it is possible that we will use both systems for context dependency.
1.3. Does Natural Language Employ Explicit Quantification over Times?

To simplify the discussion, let us assume for the moment that tense is a sentential operator, and that tense involves existential quantification over times. In Priorian tense logic, sentences are evaluated with respect to one temporal index. As a consequence, whenever tense introduces a new time, the original evaluation time is lost. This makes a particular prediction for cases where one tense is in the scope of another. And this is where it is criticized. Consider the following examples from Kamp (1971):

(10) a. A child was born who would become ruler of the world  
     b. A child was born who will become ruler of the world

The two sentences differ in their tense in the relative clauses. Priorian tense logic posits a future tense operator as defined above. This operator corresponds to both will and would in English. Morphologically, however, the future auxiliary will is present tensed and would is past tensed. This fact is not incorporated into the system. We believe this is because the authors were more concerned with how to represent the intuitive meaning of a sentence using these tense operators than they were with the syntax-semantics mapping. As we will see below, however, will and would are semantically different, and it is natural to assume that the difference between them comes from their difference in tense. We will later decompose the words will and would into the future auxiliary *woll*, and a present tense and a past tense respectively.\(^\text{13}\) The future tense operator defined above can be seen as the denotation of the auxiliary *woll*.\(^\text{14}\)

\(^{13}\) The word *woll* is used in Abusch (1988).

\(^{14}\) Hall (1964) observes a contrast between (i) and (ii) regarding whether will and would can occur in if-clauses, and claims that there are two different interpretations of will and would, a volitional interpretation and a future interpretation.

(i) a. If everyone will be brief, we can finish almost on time  
     b. If everyone would be brief, we can finish almost on time

(ii) a. * If he will see the great white whale, he will try to kill it  
     b. * If he would see the great white whale, he would try to kill it
Now let us return to the meanings of the sentences in (10a). The first sentence has the representation in (11a) and is predicted to have the truth conditions in (11b) by the tense semantics given in (7).

\[(11)\]
\[\begin{align*}
  \text{a.} & \quad \text{Past [a child be born [Fut who become ruler of the world]]} \\
  \text{b.} & \quad [[(11a)]]^t = 1 \iff \text{there is a time } t' \text{ such that } t' < t \text{ and that there is a child } x \text{ at } t' \text{ and } x \text{ is born at } t' \text{ and there is a time } t'' \text{ such that } t' < t'' \text{ and that } x \text{ becomes ruler of the world at } t''
\end{align*}\]

The time of a child becoming ruler of the world is placed in the future with respect to the time of his/her birth, and the truth conditions of the sentence do not tell whether or not s/he has already become ruler of the world by the speech time. The second sentence, on the other hand, has different truth conditions: it cannot truthfully be uttered when the speaker knows that the child has already become ruler of the world. The time of his/her becoming ruler has to be located after the speech time.

In order to capture this interpretation, the future operator has to be evaluated with respect to the original evaluation time. However, in Priorian tense logic, after the past tense is introduced in the sentence, it affects the temporal index. It introduces a new time, \(t'\), in the meta-language, and the original evaluation time, \(t\), is lost at this point. As a result, the future auxiliary \textit{will} cannot have access to the original evaluation time, \(t\), when embedded under another tense operator as is the case in (10b). The only temporal index available is \(t'\). Therefore, Priorian tense logic cannot capture the intuitive meaning of the sentence.

Cf. If he sees the great white whale, he will try to kill it

In this thesis, we will only be concerned with the future interpretation of \textit{will} and \textit{would}.  

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The use of the future *will* under a past tense operator is not the only case in which Priorian tense logic makes a wrong prediction. A past tense embedded under another past tense provides another case. Consider the following examples:\(^{15}\)

(12) a. Hillary married a man who became the president of the U.S.
   b. Who hired the person who wrote this article?

If the surface structure is what we interpret, Priorian tense logic predicts that these sentences are true only when the time at which the event described by the matrix predicate takes place -- the matrix event time --- follows the embedded one. This is because the embedded past tense is in the scope of the matrix past tense. According to the tense semantics, the embedded past tense takes the new time introduced by the matrix past tense as its evaluation time and places the embedded event time further in the past. However, the sentence (12a) is understood as a true report about Hillary Clinton in 1999, who married Bill Clinton, who became the president after their marriage. Similarly, when uttered by a chief editor, the sentence (12b) is most likely to be understood as a question to find out who is responsible for hiring the person who, after being hired, wrote the article. This type of interpretation where the embedded event time follows the matrix event time has sometimes been called the 'forward-shifted' interpretation. This name seems to imply that the embedded tense is evaluated with respect to the matrix event time and somehow shifted forward. We believe that this is not how we understand the temporal ordering of these sentences. So we will use a more neutral term and call this type of interpretation the later-than-matrix interpretation.\(^{16}\) Priorian tense logic is unable to predict the availability of this interpretation.

Kamp (1973) proposes a two-dimensional system to cope with this situation; sentences are evaluated with respect to a pair of temporal indices. The first index is like the

\(^{15}\) The (b) example is due to Barbara Partee.

\(^{16}\) The term is suggested by Barbara Partee (p.c.).
one we had before. It is a working index with respect to which sentences are evaluated, and it is affected by tense operators. The second index is to keep the original evaluation time. He also proposes a new operator $N$ (for now), which takes the stored original evaluation time and sets it as the new evaluation time.

\[(13) \quad \begin{align*}
\text{a.} & \quad [[\text{Past } \phi ]]_{t,t'} = 1 \text{ iff there is a time } t'' \text{ such that } t'' < t \text{ and } [[\phi]]_{t'',t'} = 1 \\
\text{b.} & \quad [[\text{Fut } \phi ]]_{t,t'} = 1 \text{ iff there is a time } t'' \text{ such that } t < t'' \text{ and } [[\phi]]_{t'',t'} = 1 \\
\text{c.} & \quad [[N \phi ]]_{t,t'} = 1 \text{ iff } [[\phi]]_{t,t'} = 1 \\
\text{d.} & \quad [[\phi]]_{t,t'} = 1 \text{ iff } \phi \text{ is true at } t
\end{align*}\]

With this we can have a representation of the sentence (10b) as follows.

\[(14) \quad \begin{align*}
\text{a.} & \quad \text{Past [a child is born } N [\text{Fut who become ruler of the world}]] \\
\text{b.} & \quad [[(14a)]]_{t,t'} = 1 \text{ iff there is a time } t'' \text{ such that } t'' < t \text{ and that there is a child } x \text{ at } t'' \text{ and } x \text{ is born at } t'' \text{ and there is a time } t''' \text{ such that } t < t''' \text{ and that } x \text{ becomes ruler of the world at } t'''
\end{align*}\]

The second index is stored and is not affected by the past tense operator. The $N$ operator takes the stored original evaluation time and sets it as the working evaluation time. And then the future operator is evaluated with respect to the original evaluation time.

Similarly, the speech time dependency of the English simple past in the case of (12) is derived by applying the $N$ operator before the embedded past tense operator as follows:

\[(15) \quad \begin{align*}
\text{a.} & \quad \text{Past [Hillary married a man who } N [\text{Past [became the president of the U.S.]]]} \\
\text{b.} & \quad \text{Past [Who hired the person who } N [\text{Past [wrote this article?]]]}
\end{align*}\]
The effect of this is that two past tenses are both evaluated with respect to the original evaluation time. The truth conditions of the sentence (15a) for instance, say that both marriage time and the man's becoming the president time are before the original evaluation time. This leaves the two times unordered with respect to each other, predicting the possibility of the embedded event time following the matrix one.

The two sets of data we examined show that the original evaluation time should always be retrievable. A double-index system like Kamp's allows us to keep track of the original evaluation time and use it whenever we like by using the $N$ operator.

Vlach (1973) presents another argument against a single-index tense system like Priorian tense logic. The following examples show that it is not enough to keep track of the original evaluation time; we need to keep track of the intermediate evaluation times.

(16) a. John was once going to cite everyone who was then speeding
    b. The writer complained to a person who hired an editor who he was working with.

For instance, in (16a), the time of speeding is understood to be at the past time when John was going to cite people. This reading is not derived in Priorian tense logic. If we assume that the phrase be going to corresponds to the future operator in Priorian tense logic, the sentence has the logical form of Past Fut John cite ..... The future operator introduces a new time, which is a future time with respect to the past time introduced by the past operator. And at this point the time introduced by the past operator is lost.

Vlach proposes an operator which stores an evaluation time introduced by tense operators such as the following:

(17) $[[K \phi]]^{t,t'} = 1$ iff $[[\phi]]^{t,t} = 1$

The sentences in (16) are translated into the following representation:
The interpretation of the sentence (16a), for instance, is derived in the following way: the $K$ operator is applied after the matrix past tense operator in order to store a new evaluation time, and the $N$ operator is then used when evaluating the relative clause to retrieve that stored evaluation time. (Here we are only interested in representing possible interpretations for the sentences and ignore the fact that the predicate *speeding*, for instance, in the object language is past tensed but there is no corresponding past tense operator in the semantic representation below.)

Note that in the representation in (18a), we only store the past time when John was going to cite people and it is this time that the $N$ operator has access to. This means that in this representation, the original evaluation time is not accessible, which it should be, considering the following sentences.

(19)  
   a. John was going to cite all those who were then speeding, who are now in jail  
   b. The writer complained to a person who hired an editor who he was and still is working with

To capture the meanings of the examples above, we need to store two times; the original evaluation time and the first intermediate evaluation time that is introduced by the first past tense operator. This means that the two dimensional system is not powerful enough. We need a three-dimensional system. It is not difficult to construct examples where we need four, five or six-dimensional systems, and we can go on indefinitely. This point has been established by authors like Gabbay 1974, Saarinen 1978, and Cresswell 1990. In order to capture what we can express in the English language (or any other natural language), our
tense system must be a multiple-index system where sentences are evaluated with an infinite number of indices, and the $K$ and $N$ operators must be able to be used as many times as we want for each index.

The system should look like the following:\(^{17}\)

\[\begin{align*}
(20) \quad & a. \quad [[N_n \phi]]^\tau = 1 \text{ iff } [[\phi]]^\tau[n/0] = 1 \\
& b. \quad [[K_n \phi]]^\tau = 1 \text{ iff } [[\phi]]^\tau[0/n] = 1 \\
& c. \quad [[\text{Past } \phi]]^\tau = 1 \text{ iff there is a time } t \text{ such that } t < \tau(0) \text{ and } [[\phi]]^\tau[t/0] = 1 \\
& d. \quad [[\text{Fut } \phi]]^\tau = 1 \text{ iff there is a time } t \text{ such that } \tau(0) < t \text{ and } [[\phi]]^\tau[t/0] = 1 \\
& e. \quad [[\phi]]^\tau = 1 \text{ iff } \phi \text{ is true at } \tau(0)
\end{align*}\]

$\tau$ is any infinite sequence of times. $\tau[n/0]$ is the sequence just like $\tau$ except that $\tau[n/0](0) = \tau(n)$, and $\tau[0/n]$ is the sequence just like $\tau$ except that $\tau[0/n](n) = \tau(0)$.

We continue to simply call this system a multiple-index system, but we exclude systems where we impose a limit on numbers of indices possible. In other words, we will not consider two-, three-, or seventeen-dimensional systems as candidates for a multiple-index system.

A different way of temporally relativizing sentence denotations is to have explicit quantification over temporal variables. Here is one way of implementing this idea. Let us assume that predicates have an extra argument position for a time variable. (Recall that this assumption alone does not guarantee overt quantification over times. We will come back to this issue later.) The denotation of be-in-Japan is now as follows:\(^{18}\)

---


\(^{18}\) This is not a necessary change to represent event times in the object language. We could introduce a special predicate such as Dowty’s (1979) $AT$, which introduces time variables in the object language while keeping the denotation of one-place predicates such as be-in-Japan as one-place predicates.
(21) \[[\text{be-in-Japan}]\]^{g,c} = f: D_e \to D_{<i,t>}

For any \( t \in D_i \) and \( x \in D_e \), \( f(x)(t) = 1 \) iff \( x \) is in Japan at \( t \)

The denotations of tense operators are changed minimally from the ones in Priorian tense logic:

(22) a. \[[\text{Past}]\]^{g,c} = f: D_{<i,t>} \to D_{<i,t>}

For any \( p \in D_{<i,t>} \) and \( t \in D_i \), \( f(p)(t) = 1 \) iff there is a time \( t' \) such that \( t' < t \) and \( p(t') = 1 \)

b. \[[\text{Pres}]\]^{g,c} = f: D_{<i,t>} \to D_{<i,t>}

For any \( p \in D_{<i,t>} \) and \( t \in D_i \), \( f(p)(t) = 1 \) iff there is a time \( t' \) such that \( t' = t \) and \( p(t') = 1 \)

c. \[[\text{Fut}]\]^{g,c} = f: D_{<i,t>} \to D_{<i,t>}

For any \( p \in D_{<i,t>} \) and \( t \in D_i \), \( f(p)(t) = 1 \) iff there is a time \( t' \) such that \( t < t' \) and \( p(t') = 1 \)

For simplex sentences like \textit{Elliott was in Japan}, we have the following structure:
We will call a time variable that saturates the open slot of a tensed sentence \( t \) in this case) the evaluation time variable of the tense operator, and a time variable that saturates the time argument of the main predicate \( t' \) in this case) the event time variable.\(^{19}\)

Note that the semantics given in (21) and (22) does not force syntactic saturation of the temporal argument. This has to be stipulated in this framework.\(^{20}\) We also assume that

\(^{19}\) In simple tensed sentences like *Elliott was in Japan* and *Jen went to Boston*, what we call the event time variable saturates the time argument slot of the main predicates such as *be-in-Japan* and *go-to-Boston*. In more complex sentences with various auxiliaries, we will have to ask at what point in a structure a time variable appears. For instance, in sentences with Perfect such as *John had opened the door*, we can assume that a time variable occurs at the VP level and saturates the time argument slot of the predicate *open-the-door*, or at a higher level above *have-en*, and saturates the open slot of the clause *have-opened-the-door* (assuming that *have-en* is an operator that takes properties of times and returns properties of times), or both. We will not discuss sentences with Perfect, i.e., *have-en*.

\(^{20}\) One way to force syntactic saturation compositionally is to make the time argument of a predicate the innermost one:

(i) \[ [\textit{be-in-Japan}] \in \text{C} = f: D_t \rightarrow D_{\text{ Japan}} \]

For any \( t \in D_t \) and \( x \in D_{\text{ Japan}} \), \( f(t)(x) = 1 \) iff \( x \) is in Japan at \( t \)
a lambda binder is freely inserted in the LF structure whenever necessary for compositional reasons. For instance, without the abstractor over the variable $t'$, the above structure would be uninterpretable.

Assuming that unbound variables denote the speech time, the truth conditions of the sentence when uttered at 3:00 PM, December 31 are as follows:

(24) $\text{[[} (23b) \text{)]^c} = 1$ iff there is $t' < 3:00\text{ PM, December 31st}$ such that Elliott is in Japan at $t'$

This is the desired result.

How does the system deal with the problematic examples presented against Priorian tense logic? Kamp's sentence receives the following LF. (This LF does not give the word order of the sentence. Since we are concerned with the restrictive interpretation of the relative clause, we assume that this is the structure we interpret. Our analysis of tense interpretation does not rely any of these assumptions.)

(25) a. A child was born who will become ruler of the world
b. 

Assuming that the individual argument is syntactically saturated by an NP, this denotation forces syntactic saturation of the temporal argument.
Suppose that unbound variables are understood to denote the speech time. In this representation, the evaluation time variables of the past and future operators, $t$ and $t''$, are unbound, and therefore denote the speech time. As a result, both operators are relative to the speech time irrespective of the scope.

The system also predicts the availability of the later-than-matrix readings of tense in relative clauses correctly. There, the two past tenses have their own evaluation times explicitly at LF, and they are given values independent of each other.
(26) a. Hillary married a man who became the president

b. $t$

Past

$\lambda t'$

$t'$

Hillary

marry

a

man

who

$t''$

Past

$\lambda t''$

$t''$

become the president

Again assuming that unbound variables denote the speech time, the analysis predicts that the two event times are unordered.

In this system, all times introduced in sentences are represented in the object language. This means that we keep track of not only the original evaluation time, but also the intermediate ones. Therefore we can account for Vlach's examples, too.
The most embedded event time, the time of speeding, represented as a time variable, is bound by the relevant lambda operator in the higher clauses. So far, we have considered two tense systems: a multiple-index system and a system with explicit quantification over time in the object language, i.e., the LF structure. (Recall that we are only considering as a multiple-index system a system with infinite number of temporal indices and infinite sets of $K$ and $N$ operators.)
The need for systems like those above has been challenged by Stowell (1993) and Uribe-Exebarria (1993).\textsuperscript{21} They argue that the relevant readings are derived by means of movement. We will call this a movement analysis. For instance, they argue that a clause containing \textit{will} cannot be and is not in the scope of the past tense at LF. In the case of Kamp's example, repeated here as (28a), a conceivable LF would be (28b).

\begin{enumerate}
\item A child was born who will become ruler of the world
\item A child [who Fut become ruler of the world] Past be born
\end{enumerate}

The future auxiliary \textit{will} in (28b) is no longer in the scope of the past tense and therefore has access to the original evaluation time. Ogihara (1996) dismisses this possibility since it assumes that the subject NP \textit{a child} is not in the scope of the past tense, predicting that the individual in question has to be a child at the original evaluation time, which it does not have to be.\textsuperscript{22} The problem of the temporal interpretation of NPs in this particular case can be overcome, however. Enç (1981, 1986) and Musan (1995) argue that the temporal interpretation of an NP is not necessarily dependent on the scope of the tenses of the sentence in which it occurs. According to them, roughly speaking, the fact that the NP \textit{a child} is not in the scope of the past tense operator does not necessarily mean that the individual under discussion has to be a child at the evaluation time. Enç and Musan each propose a system of temporal interpretation of NPs that does not rely on the scope of tenses. We will come back to this issue in § 1.5.2. If Enç and Musan are right, we can overcome the problem noted by Ogihara in this case.

A similar claim is made for the case of the speech time dependency of embedded past tenses. Authors including Ladusaw (1977), Ogihara (1989, 1996), and Stowell (1993) argue that the later-than-matrix interpretation of past tensed relative clauses is due to

\textsuperscript{21} They did not present a movement analysis as a challenge to a multiple-index system, though.

\textsuperscript{22} Ogihara (1996, p.66, footnote 14).
movement like QR (or quantifying-in, depending on the framework they adopt). The LF representations we want to interpret should look like the following:

\[(29)\]

a. \([\text{a man who Past become the president}]_t \text{ Hillary Past marry } t_i\]

b. \([\text{the person who Past write this article}]_t \text{ Who Past hire } t_i ?\]

In these representations, neither the matrix past tense nor the embedded one is in the scope of the other. Therefore, both tenses are evaluated with respect to the original evaluation time. As a result, the truth conditions of the sentences only require that the time of the man’s becoming the president and the marriage time precede the original evaluation time, and no order is given between the two. The later-than-matrix interpretation is compatible with the sentence meaning.

According to proponents of a movement analysis, therefore, the temporal interpretations of the examples we have considered are not true counterexamples to a single-index system such as Priorian tense logic. They claim that the relevant readings may be derived by movement. However, they have to face the consequences of such movement. For instance, they have to deal with examples involving other scope-bearing elements. In Chapter 2, we will show that a movement analysis in a single-index system is untenable by examining examples that produce a scope paradox.

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23 Partee (1973) already suggested a correlation between tense interpretations and quantifier scope. The following is the example she has:

(i) If John had married Susan, he would have had everything he wanted

The sentence is ambiguous; the NP *everything he wanted* may have a transparent interpretation in which it 'refers' to everything he wanted in some past time, a time at which he might have married Susan, in the actual world, or an opaque interpretation in which the NP is in the scope of the modal operator. Partee (1973) suggests that the past tense on the verb *wanted* is deictic on the former interpretation. This leads to an idea that embedded tenses may have an independent interpretation without quantifying in, the idea we will pursue in this thesis.

Barbara Partee (p.c.) has also pointed out to me that the idea of relating tense interpretations and quantifying in was already around possibly in the late 1960s, but I have not been able to locate a published work that discusses the issue explicitly.
Before concluding, we consider another possible way to account for the speech time dependency. That is to adopt an absolute tense theory in the lexical semantics of tenses, which assumes that tenses are always evaluated with respect to the speech time. Ogihara (1996) argues that the speech time dependency of sentences containing will under a past operator is due to a lexical property of will itself. He claims that the future auxiliary will is inherently speech time sensitive. Here is one way to implement his idea.24

\[
\text{[[will]]}^g_c = f : D^{\langle i,t \rangle} \rightarrow D_t
\]

For any \( p \in D^{\langle i,t \rangle} \), \( f(p) = 1 \) iff there is a time \( t' \) such that \( t_c < t' \) and \( p(t') = 1 \)

Sentences are evaluated with respect to a temporal index and a speech context. Each speech context uniquely determines the speech time \( t_c \), and the future will shifts the temporal index to the future from the speech time. The semantics of will above does the job that both future and \( N \) operators in Kamp's system do. Thus, it assures a more transparent mapping from syntax to semantic representation.

Whether Ogihara's proposal for the case of will is adequate or not, this solution is not extendable to all the cases of speech time dependency. Consider the following denotation of the past tense:

\[
\text{[[Past]]}^g_c = f : D^{\langle i,t \rangle} \rightarrow D_t
\]

For any \( p \in D^{\langle i,t \rangle} \), \( f(p) = 1 \) iff there is a time \( t' \) such that \( t' < t_c \) and \( p(t') = 1 \)

This is a direct extension of what is proposed for the future will. This semantics predicts that a past tense, no matter how deeply embedded, always means past with respect to the

\[24\text{Ogihara analyzes the future auxiliary will as the present tense plus a modal, which he calls woll, the term used in Abusch (1988). The inherent speech time dependency of will stems from the semantics of the present tense, and it does not have to be stipulated in the way we did. Also the proposal presented here as an implementation of Ogihara's claim differs from his actual proposal, which hinges on movement of the future auxiliary will above the past tense.}\]
speech time. Thus, the intended readings of sentences like (12), the Hillary example, may be correctly derived. Since the proposal makes use of two indices after all, we can say that this particular proposal is a variant of Kamp's two-dimensional system. We presented this system as a separate option since we treat it as an example of an absolute tense system. The same results can be achieved by any version of absolute tense theories, including a referential analysis of tenses, which will be presented in the following section. And the same criticisms are applied, too.

How can this proposal handle Vlach's examples?

(32)  
   a. John was once going to cite everyone who was then speeding  
   b. The writer said that Nancy hired an editor who he was working with

If we analyze the most embedded past tense in the examples as the speech time sensitive past, the semantic representation we get is compatible with the situation where the speeding time and the working time coincide with the matrix past event times.

A problem with this analysis is that it always predicts a speech time dependency for the English simple past. Consider the following examples, however.25

(33)  
   a. I will marry a man who went to Harvard  
   b. I thought that the student would not admit that he cheated  
   c. David will say that he was out of town  
   d. No matter what you give him to eat, he will eat it and tell you that he liked it

When uttered by a five year old girl, the sentence (33a) can be true when the man she marries has a degree from Harvard by the time she marries. The sentence (33b) can be

---

25 Barbara Partee (p.c.) points out that not everyone accepts the past tense usage in (33a). For some speakers, a present perfect *has gone* has to be used to express a past-relative-to-future-reading.
truthfully uttered when the student in question, who looked suspicious to me, had not yet cheated, and the sentence (33c) can be used to make a guess about what David will say when I ask him the day after tomorrow where he was tomorrow. Similarly for (33d). The semantics of the past tense operator in (31) does not predict past-relative-to-a-future-time interpretations. It is for this reason that Ogihara (1989, 1996), where the indexical analysis of will is proposed, argues that the same analysis should not be carried over to the cases of past tense interpretation.

To conclude, we have seen four theories of tense: Priorian tense logic as an example of a single-index system, a multiple-index system, a system with explicit quantification over times in the object language, and an absolute theory of tense. Contrary to what has been claimed by many authors, the particular examples we considered do not justify the need for a multiple-index system. With LF movement of the appropriate elements, Priorian tense logic does seem to make the correct predictions for those cases. The proponents of this position are left with the tasks of showing that the LF movement necessary to derive the right temporal interpretation is a licit, and hopefully independently motivated one, and dealing with the consequences of such movement in other domains of semantic interpretation, such as quantifier scope and variable binding. It will be shown in Chapter 2 that this option is inadequate.

A multiple-index system and a system with explicit quantification over times in the object language are alternatives. At the cost of introducing multiple indices or overt temporal variables, we can deal with the speech time dependency of embedded tenses. This is the cost we have to pay if a single-index system is not an option, and it will be shown that it is not. Making a choice between a system where the speech time dependency is a matter of the meta-language and a system where we quantify explicitly over times is difficult. Cresswell (1990) shows in Entities and Indices that the expressive power of explicit quantification amounts to having an infinite number of temporal indices and operators that tell us which predicates are associated with which indices. That is, in order to express what
we can express with our language, it must employ either full explicit quantification over
times or an infinite number of temporal indices plus an infinite set of the \( K \) and \( N \) operators.

In a system with overt quantification over times, relations between time variables are
represented in LF syntax by means of binding, parallel to pronominal binding. Kamp
(1971) and Cresswell (1990) both argue for a system without explicit quantification since
according to them, systems with explicit quantification complicate the syntax with extra
argument places. This is certainly true. However, in a system without explicit quantification
over times, we need a mechanism to derive appropriate syntactic structures with the \( N \) and \( K \)
operators in the right places. We believe that this is at least as considerable a departure
from the actual form of the original sentences as a system with extra argument positions in
the syntax. Assuming that we believe in explicit quantification over individuals and use
mechanisms such as indexing and the Binding Theory to derive relations between two or
more variables, we believe that a system with explicit quantification is less stipulative and
less complicated. In the chapters that follow, we will try to show evidence, though indirect,
that favors explicit quantification over times in the object language.

We have also considered but dismissed a theory that explains the speech time
dependency by incorporating the speech time into the semantics of operators as a version of
absolute theories of tense. This analysis predicts no scope relation between two tense
operators when one is embedded under the other. This seems correct when the future \textit{will} is
embedded under a past tense operator, but not when a past tense operator is embedded
under the future. As Ogihara (1996) argues, the past tense operator does not seem to be
inherently speech time sensitive. The fact that the past tense operator sometimes exhibits a
speech time dependency, but not always, suggests that the effect should not be accounted
for as a lexical property.

1.4. Context Dependency of Tense Interpretation: Is Tense an Existential Quantifier?
In the previous section, we assumed that tense introduces an existential quantifier over times,
following Prior (1967), and considered different ways of accounting for the data that have
been presented as a problem of Priorian theory. This first assumption has also been
challenged, and this is the topic of this section. Among the proponents of tense without
existential quantification, there are at least two subgroups, depending on whether or not
explicit quantification over times in the object language is employed. One is the referential
theory of tenses advocated by Partee (1973), where she treats tenses as pronominal
elements. This analysis necessarily implies explicit quantification over times in the object
language, assuming that pronominal elements such as pronouns and reflexives are variables
in the object language.\textsuperscript{26} Theories of tense without existential quantification do not
necessarily imply explicit quantification over times in the object language, however. A
system proposed in Dowty (1982) is a two-dimensional tense system, where tenses
manipulate times only in the meta-language.

We will start our discussion with the famous stove example:

(34)  I didn't turn off the stove

Partee argues that this example poses a problem to the Priorian view of tenses like the
following.

(35)  Where $\varphi$ is a tenseless sentence,

$$[[\text{Past } \varphi]]^t = 1 \text{ iff there is a time } t' \text{ such that } t' < t \text{ and } [[\varphi]]^{t'} = 1$$

We can derive two distinct LFs for the sentence depending on whether the past tense or the
negation takes wide scope. We predict that the sentence has two distinct truth conditions.

\textsuperscript{26} Treating pronominal elements such as pronouns and reflexives as expressions
denoting individuals (i.e., of type $<e>$) is a common practice in the syntactic literature. But
this does not mean that this is the only way to analyze pronominal elements. Prior and Fine
(1977) have shown that pronouns can be analyzed as operators. If so, analyzing tenses as
pronominal elements does not imply explicit quantification over times. I thank Barbara
Partee (p.c.) for pointing this out to me.

31
(36) a. $[[\text{Past } \not\text{ [ I turn off the stove]} ]]_t = 1$
iff $\exists t'[t' < t \& \neg \text{turn-off-the-stove(I)(t)}]$

b. $[[\not\text{[ Past [ I turn off the stove]} ]]_t = 1$
iff $\neg \exists t'[t' < t \& \text{turn-off-the-stove(I)(t)}]$

(36a) asserts the existence of the time at which I didn't turn off the stove while (36b) means that I have never turned off the stove. (36a) would almost always be true if uttered by an ordinary adult individual and (36b) would almost always be false. Suppose that I was to go out and it took me twenty minutes to get ready, getting dressed, closing the windows and so on. When I utter the sentence later on, the contextually salient interval is the time while I was getting ready. When uttered halfway down the turnpike, the sentence means neither (36a) nor (36b). Rather, it means that during the twenty-minute interval before I left the house, I didn't turn off the stove.

Partee (1973) claims that this kind of context dependent use of tenses is analogous to the deictic usage of pronouns like the following:

(37) She left me

Further analogies between pronouns and tenses are also observed:\textsuperscript{27}

(38) Definite antecedents

a. Sheila had a party last Friday and Sam got drunk

b. When John saw Mary, she crossed the street

c. Sam is married. He has three children.

\textsuperscript{27} All the examples are from Partee (1973) or Partee (1984) except for the example (41a, b). The donkey sentence (41b) is originally due to Geach (1962).
Indefinite antecedents

a. Mary woke up sometime during the night. She turned the light on

b. Peter owns a donkey. He takes good care of it.

Bound variable

a. Whenever Mary telephoned Sam was asleep

b. Whenever Mary wrote a letter, Sam answered it two days later

c. No woman fully appreciates her mother

'Donkey sentences'

a. Every friend of mine who visited Boston said that she had a good time there

b. Every farmer who owns a donkey takes good care of it

Partee claims that just like pronouns, tenses can be referential, anaphoric, or bound. What do these analogies tell us? Partee (1973) claims that these analogies suggest that tenses and pronouns should be treated on a par. To make this a substantial claim, we have to know what pronouns are. Pronouns are treated as variables of an individual type, i.e., of type <e>, and their interpretation is variable assignment dependent. Thus we have the following:

\[
[[\text{hej}]]^g_c = g(i) \\
[[\text{shej}]]^g_c = g(i)
\]

Note that in (40b) it is not the past tense on the verb *answer* that is bound by the universal quantifier introduced by *whenever*, but an implicit variable associated with *later* as represented below.

\[
\forall t [\text{Mary writes a letter at } t \text{ and } t \text{ is before the speech time } \rightarrow \exists t' [t' \text{ is two days after the day of } t \text{ and Sam answers it at } t']
\]
These denotations obviously miss the gender difference between the two pronoun *he* and *she*. *He*, for instance, can only be referential, anaphoric, or bound by an NP whose gender is identified as a male individual.\(^{29}\) This gender distinction may be incorporated into the definedness condition.

\[(43)\]
\[
a. \quad [[\text{he}]]^{g,c} \text{ is only defined if } g(i) \text{ is a male individual}\\
   \text{When defined, } [[\text{he}]]^{g,c} = g(i)\\
\]
\[
b. \quad [[\text{she}]]^{g,c} \text{ is only defined if } g(i) \text{ is a female individual}\\
   \text{When defined, } [[\text{she}]]^{g,c} = g(i)\\
\]

This explains why the anaphoric or bound variable reading is not available for the pronouns in the following sentences.

\[(44)\]
\[
a. \quad \text{John said that she was sick}\\
b. \quad \text{No woman fully appreciates his mother}\\
\]

The definedness condition is not enough for the construal of pronouns that are not syntactically bound. Consider the second sentence in the example (38c), and suppose that the pronoun *he* has an index \(i\). Then consider the truth conditions of the sentence under a variable assignment that assigns the index \(i\) the male individual Mark. The sentence should mean that Mark has three children, and it is true when Mark in fact has three children and false when he doesn't. But if the speaker of the sentences in (38c) tries to convey this information, i.e., Sam is married and Mark has three children, the usage of the pronoun *he*

\(^{29}\) There are exceptions to this generalization. One is a case like the following, when NPs that bind a pronoun are 'neutral' in the sense that they include both men and women.

(i) \quad \text{Everybody likes his mother}\\

I do not know how 'exceptions' like this should be treated in the grammar.
in the second sentence does not seem appropriate. The use of a free pronoun should be more constrained; its value should be given by the speech context. Let us formulate this restriction in the following way.\textsuperscript{30}

\begin{equation}
(45) \text{ Appropriateness Condition} \\
\text{A context } c \text{ is appropriate for an LF } \phi \text{ only if } c \text{ determines a variable assignment } g_c \\
\text{whose domain includes every index which has a free occurrence in } \phi.
\end{equation}

When the second sentence in (38c) is uttered following the first one, and no other extralinguistic factor (such as pointing to a man who just walked into the room) is involved, the only way to appropriately use the free pronoun \textit{he} in this context is to mean \textit{he} denotes Sam.

If we assume the semantics of pronouns as above, and try to analyze tenses on a par with pronouns, we are led to the hypothesis that tenses are also variables. Partee argues along this line and suggests that tenses are time denoting variables that can be anaphoric, referential, or bound. One way to translate her suggestion into our framework is as follows\textsuperscript{31}: the past tense morpheme is a time variable and it saturates the time argument slot. Like pronouns, the value of the variable is assignment function dependent. Under this analysis, the semantic contribution of the past tense morpheme is that it restricts its value to a time prior to the speech time. We incorporate it in the definedness condition on the past tense as in (46). We assume here that sentences are evaluated with respect to a speech context \(c\) and each speech context determines the speech time \(t_c\).

\textsuperscript{30} From Heim and Kratzer (1998).

\textsuperscript{31} This particular implementation is from Kratzer (1995) and Heim (1994).
The Partee sentence will have the LF in (47b). With the semantics of the past tense and the predicate *turn-off-the-stove* and when defined, it is true iff I didn't turn off the stove at g(i).

(47) a. I didn't turn off the stove
b. not [TP pasti [vp I turn off the stove]]
c. ¬ turn-off-the-stove(I)(pasti)

The analysis implies that the event times of predicates are explicitly represented in the LF syntax as tense morphemes, denoting times. And it presupposes that there is a way to introduce those variables somehow. Here, we assume that predicates have an extra argument slot for times. Therefore, the analysis is subject to the same criticism Kamp (1973) and Cresswell (1990) present to theories with explicit quantification over time, that this complicates our analysis of syntactic structures.

But apart from conceptual issues, does this really capture the intuition? Ogihara (1989, 1995b, 1996) argues that it does not. In the scenario above, the contextually salient interval is the twenty-minute interval while I was getting ready. But it is wrong to say that that interval is the interval at which I didn't turn off the stove, since turning off the stove does not take more than a few seconds. In order for the sentence to be felicitous, the speaker has to have such a short interval in mind. This is because the time variable *pasti* (47b) is free, and therefore it is subject to the appropriateness condition.

Rather, the meaning we want to attribute to the sentence in this context is that there is no time within the twenty-minute interval before I got out of the house at which I turned off the stove. That is, the truth conditions we want are something like (48), with an existential quantifier.

\[
(46) \quad [\text{pasti}]^{g,c} \text{ is only defined if } g(i) < t_c.
\]

When defined, \( [\text{pasti}]^{g,c} = g(i) \)
(48) \[ \neg \exists t [t \subseteq t_R \text{ and } \text{turn-off-the-stove}(\text{I})(t)], \text{ where } t_R \text{ is the contextually salient interval, i.e., the twenty-minute interval before I got out of the house.} \]

So where does this existential quantifier come from? If we try to follow the original Partee theory of 1973, one solution is to build an existential quantifier into the semantics of verbs, that is, switch from truth \textit{at} an interval to truth \textit{in} an interval.\(^{32}\)

(49) \[ [\text{turn-off-the-stove}] = f: \text{De} \rightarrow \text{D}_{\langle i, t \rangle} \]
For all \( x \in \text{De} \) and \( t \in \text{Di} \), \( f(x)(t) = 1 \) iff \( x \) turns off the stove \textit{in} \( t \)
(I.e., \( f(x)(t) = 1 \) iff there is a time \( t' \subseteq t \) such that \( x \) turns off the stove at \( t' \))

In this theory, tenses are referential and denote contextually salient intervals. In the above scenario, it is the twenty-minute interval before I left the house. With an existential quantifier built into the semantics of the verb, we correctly predict the truth conditions in (48).

Note that the event times of predicates are no longer represented in the object language in this system. Only the reference times are. This creates another problem. Recall the point made by Vlach (1973). He established that the natural language tense system should be able to keep track of all intermediate evaluation times as well as the original evaluation time. Intermediate evaluation times in Vlach's system partially correspond to the event times of predicates in the system we are currently considering. If we build an existential quantifier into the semantics of predicates as above, event times are not overtly realized in the LF syntax. This is problematic. Consider the following example in a context in which students are told to talk to a doctor for annual check-up during a particular period, say between May 23rd to 27th.

\(^{32}\) See Cresswell (1985) for more discussion of truth \textit{at} or \textit{in} an interval.
Every student talked to a doctor who was available then

We understand the reference time, i.e., the time the matrix past tense denotes, to be that five-day period. And the adverb *then* can be understood to refer to that period. But there is another interpretation in which *then* gets a bound variable interpretation; every student talked to a doctor who was available during the time he/she talked but not during the entire five day period. In this system, however, the time of each student's talking is not syntactically represented as a time variable, and therefore cannot act as the antecedent of *then*.

Alternatively, we may give up analyzing tenses themselves as referential. In her 1984 paper, Partee in fact argues against her own earlier claim that tenses are referential. There she claims, following Bäuerle (1977, 1979) and Hinrichs (1981), that what is referential is the reference time in the sense of Reichenbach (1947). Here is an implementation of the idea. The past tense is a function from intervals to functions from properties of times to propositions, and it involves existential quantification over times. The first argument of the past tense is its reference time (tR) and the semantics of the past tense requires it to be a past interval.

\[
\text{(51)} \quad a. \quad [[[\text{past}}]\!^g_c] f : D_i \rightarrow D_{\langle i,t \rangle}
\]

For all \( t \in D_i \) and \( p \in D_{\langle i,t \rangle} \), \( f(t)(p) = 1 \) iff \( \exists t' \) such that \( t' \subseteq t \) and \( p(t') = 1 \).

\[
b. \quad [[[\text{past} [ tR ]]\!^g_c] f : D_{\langle i,t \rangle} \rightarrow D_t
\]

When defined, \( [[[\text{past} [ tR ]]\!^g_c = f : D_{\langle i,t \rangle} \rightarrow D_t
\]

For all \( p \in D_{\langle i,t \rangle} \), \( f(p) = 1 \) iff \( \exists t' \) such that \( t' \subseteq t_R \) and \( p(t') = 1 \).

The stove example has the LF in (52b) under this analysis.\(^{33}\)

\(^{33}\) In order to derive the right interpretation, it has to be stipulated that negation takes a sentential scope. This stipulation is not compatible with the standardly assumed structure of inflectional categories. We will leave this problem open.
(52)  
\[ a. \quad I \text{ didn't turn off the stove} \]
\[ b. \quad \text{not } [TP \text{ past } [tR] \ [VP \ I \text{ turn off the stove}]] \]
\[ c. \quad \neg \exists t (t \subseteq tR \text{ and turn-off-the-stove}(I)(t)) \]

The new analysis captures the right intuition.

Both of Partee's theories discussed above may be classified as absolute theories of tense. Their definedness condition refers to the speech time, and this is where the "pastness" of sentences with the past tense originated. Therefore, these theories face the same problem as the sentential operator treatment of tenses that incorporates the speech time dependency into the semantics of the operators. We considered the following examples:

(53)  
\[ a. \quad I \text{ will marry a man who went to Harvard} \]
\[ b. \quad I \text{ thought that the student would not admit that he cheated} \]
\[ c. \quad \text{David will say that he was out of town} \]
\[ d. \quad \text{No matter what you give him to eat, he will eat it and tell you that he liked it} \]

We want the embedded past tenses to be evaluated with respect to the future event times of the next higher clauses. Clearly, these examples show that some element that can shift the evaluation time, something analogous to a Priorian operator, is necessary.\(^{34}\)

Partee (1984) also discusses examples that suggest Priorian tense semantics.\(^{35}\)

(54)  
\[ a. \quad \text{Who killed Julius Caesar?} \]

\(^{34}\) This does not necessarily deny that the past tense in sentences like the stove example cannot be analyzed as an absolute tense as we did following Partee. It could be that the past tense is ambiguous between an absolute interpretation (as in the stove example) and a shifting interpretation (as in the examples in (53)). This is in fact the line Kratzer (1998b) takes. We do not have an argument against positing this ambiguity, but we will see that both interpretations may be derived by a single denotation of the past tense morpheme.

\(^{35}\) (a) is from Partee (1984) and (b) is a variant of an example from Partee (1973).
b. John went to Harvard

The original Partee version (1973) predicts presupposition failure in these examples if speaker and hearer are not presumed to share knowledge of the times of the relevant (purported) events. To utter the sentence (54a), however, the speaker does not have to know when Caesar was killed. Similarly, the speaker of (54b) is conveying the information that John is a Harvard graduate and when specifically he graduated is irrelevant. These examples show that tenses are not always anaphoric, at least not in a way parallel to anaphoric pronouns. Partee (1984) argues that this is one argument in favor of her 1984 theory over the 1973 one. She claims that when no particular past time is presupposed, the entire past interval before the speech time may become the reference time of the past tense. And the event times are existentially quantified and expected to fall within the reference time. If this is the right analysis for the examples above, all they show is that we cannot do without existential quantifiers over times in the semantic representation. Therefore, the original Partee with truth in an interval theory can handle them equally well.

As another variant of theories of tense without existential quantification, we should mention one version of Dowty's (1982) analysis of tense. Tenses are still operators, but they are not existential quantifiers. And the theory operates on times in the meta-language alone. The analysis is based on Johnson's (1979) work on tense and aspect in Kikuyu, which in turn is based on the two-dimensional tense logic of Kamp (1973) and Vlach (1974). The semantics of the tenses are defined as follows:

(55) Where $\phi$ is a tenseless sentence,

a. $[[\text{Past } \phi]]^{i,j} = 1$ iff $[[\phi]]^{i,j} = 1$ and $i < j$

b. $[[\text{Pres } \phi]]^{i,j} = 1$ iff $[[\phi]]^{i,j} = 1$ and $i = j$

---

36 Dowty's intent, as far as I understand, is not to argue for or against an existential analysis of tenses. The analysis that will be presented below is what he initially presents (p.32). He later suggests a change in the semantics of the past and future operators so that they involve existential quantification.
c. \([\text{Fut } \phi]\)_{i,j} = 1 \text{ iff } \([\phi]\)_{i,j} = 1 \text{ and } j < i

d. \([\phi]\)_{i,j} = 1 \text{ iff } \phi \text{ is true at } i

Sentences are evaluated with respect to a pair of temporal indices \(<i,j>\) with \(i\) as the reference time and \(j\) as the speech time in the sense of Reichenbach (1947). Tense operators do not shift temporal indices.

In this system, the utterance context also has to provide the value for \(i\). Suppose that the sentence "Elliott is in Japan" is uttered at 3:00 PM, September 15th to answer the question "Where is Elliott now", and that the sentence "Elliott was in Japan" is uttered at 3:00 PM, December 31st when we are discussing where Elliott was at 7:00 PM on Christmas evening. As you can see, we get the desired results.

(56) a. \([\text{Pres Elliott be in Japan}]\)_{3:00 PM, 9/15, 3:00 PM, 9/15} = 1 \text{ iff Elliott is in Japan at 3:00 PM on September 15}

b. \([\text{Past Elliott be in Japan}]\)_{3:00 PM, 12/31, 7:00 PM, 12/25} = 1 \text{ Elliott is in Japan at 7:00 PM, December 25th, and 7:00 PM, December 25th < 3:00 PM, December 31st}

A nice consequence of this analysis, Dowty claims, is seen in cases where one tense operator is embedded under another. Since the tense operators no longer shift the evaluation time, the theory predicts that embedding does not affect the interpretation of tenses. It does predict wrongly, however, that the temporal locations of the matrix and embedded event coincide. This is because the reference time \(i\) is given by the speech context. What we need is a method to introduce a new reference time for each tense. Since we can embed as many tenses as we want in one sentence, we need a multiple-index system
where there is no limit on the number of indices we use. Here is one implementation, borrowing the idea from Cresswell (1990).37

(57) a. \([\text{Past}_n \phi]^{\tau} = 1 \text{ iff } [\phi]^{\tau[n/0]} = 1 \text{ and } \tau(n) < \tau(0)\)

b. \([\phi]^{\tau} = 1 \text{ iff } \phi \text{ is true at } \tau(0)\)

Each past tense in the following example is ordered with respect to the speech time according to this semantics, allowing the possibility that her husband's becoming the president is after the marriage.

(58) a. Hillary married a man who became the president of the U.S.

b. PAST1 [Hillary marry a man who PAST2 [become the president]]

c. \([((58b))]<^{0,t1,t2} = 1 \text{ iff there is a man } x \text{ at } t1 \text{ and Hillary marries } x \text{ at } t1 \text{ and } t1 < t0 \text{ and } x \text{ becomes the president at } t2 \text{ and } t2 < t0\)

37 Dowty proposes to introduce a new reference time by introducing the \(AT\) operator in the translation of relative clauses (and that-complement clauses).

(i) a. Relative clause translation rule of the form \([N \phi]\)

\[
\lambda x[N(x) \& \exists(t(AT(t, \phi)))]
\]

b. \([[AT(t, \phi)]^{i,j} = 1 \text{ iff } [[\phi]]^{i',j} = 1, \text{ where } i' = [[t]]^{i,j}\]

With this semantics, the reference time of the embedded past tense is \(t\) introduced by the \(AT\) operator and this is independently ordered with respect to the speech time \(j\), correctly predicting the intended interpretation where the man Hillary married became president after the marriage.

(ii) a. Hillary married a man who became the president

b. PAST \([\exists x[\text{man}(x) \& \exists(t[AT(t, \text{PAST become-the-president}]) \& \text{marry}(x)(\text{Hillary})]\]

c. \([[(13a)]^{i,j} = 1 \text{ iff there is a man at } i \text{ such that there is a time } t \text{ such that } x \text{ becomes the president at } t \text{ and } t < j \text{ and that Hillary marries } x \text{ at } j \text{ and } i < j.\]

He notes that in this treatment, the embedded event time is existentially quantified, whereas the matrix tense is context dependent, and this matches his intuition. If he is right, the implementation that we presented loses this.
In this sense, this analysis is similar to the indexical and referential analyses of tenses considered so far. It therefore shares a similar weakness with the indexical analysis. It does not predict the availability of the later-than-matrix interpretation when a past tense is embedded under another past tense, and the past-relative-to-a-future-time interpretation when a past tense is embedded under the future auxiliary. Dowty (1982) proposes two different modifications to overcome these problems, which involve existential quantification over times. The analysis also shares the same problem as Partee's (1973) theory that Ogihara (1989, 1995) pointed out due to the very fact that nothing introduces an existential quantifier. In order to utter sentences like I didn't turn off the stove, I need not have in mind a particular moment precisely at the time which I didn't turn off the stove. Given the scenario where it took me twenty minutes before I left the house, the sentence should mean that there is no interval during these twenty minutes at which I turned off the stove. This means that we cannot do without an existential quantifier. We might solve this problem by building an existential quantifier into the semantics of predicates, as we tried with the 1973 Partee theory. But we already saw that this creates another problem: event times become inaccessible.

Since our conclusion is that we need an existential quantifier to deal with the temporal interpretation of natural language, and that we need to introduce it in the syntax, not in the lexical entries of predicates, we can let tense operators themselves introduce it.\footnote{Problems that arise by treating tenses as existential quantifiers have been pointed out in the literature, such as Kratzer (1978), Bäuerle (1979), Bäuerle and von Stechow (1980), and more recently von Stechow (1995a). (The following discussion is based on von Stechow.) These authors consider sentences that contain adverbs of quantification such as always and usually. von Stechow considers the following example: (i) Today Vashek was always funny. Intuitively, the sentence is true when Vashek is funny at all times t such that t falls within today and t is before the speech time. He argues that an existential analysis of the past tense predicts that the sentence may be true in a situation in which Vashek is funny at some time before the speech time during today. von Stechow argues, based on Kratzer (1978) and Bäuerle (1979), that a solution is to separate existential quantification from the semantics of the past tense. In such an analysis, an existential quantifier is introduced as a default option when there is no other quantificational adverb. Since we are mostly dealing with examples without adverbs of quantification, we continue to assume that tenses are responsible for existential quantification to simplify syntactic structures.}
This is what Priorian tense logic is designed to do. But we have already seen that Priorian tense logic is not capable of dealing with Partee's example. Partee's example shows that the temporal interpretation of natural language can be context dependent. Partee (1973) captures this by saying that tenses themselves denote event times of the predicates they 'modify'. Partee (1984) does so by introducing reference time. But the fact that tense may be anaphoric does not necessarily exclude an operator analysis of tense such as Priorian tense logic. What the example shows is that (i) a simple unrestricted quantificational analysis of the past tense yields the wrong interpretation, (ii) the interpretation of the past tense may be context dependent, and (iii) there needs to be an existential quantification over times. As Ogihara (1989, 1995b, 1996) argues, these observations can all be captured without resorting to a referential theory of tense. In nominal domains, it has been observed that quantifiers are interpreted with respect to a contextually determined set. This is true not only for the so-called strong quantifiers like every and most, but also for the weak ones. If tenses are existential quantifiers, then it is not unreasonable to assume that the same mechanism of restricting quantifier domains for determiner quantifiers is also available to them. This can be implemented in the following way, based on von Fintel's treatment of restriction on quantifier domains (von Fintel 1994); the past tense operator takes another argument, represented as C in syntax, whose value is determined by the context of utterance.

(59)  

```
(59)  
     TP
        /\ 
       t  TP
          /\ 
         PAST C VP
```
(60)  a.  \[ [[\textsc{PAST}]] = f: D_{\langle i, t \rangle} \to D_{\langle \langle i, t \rangle \rangle} \]

For all \( p, q \in D_{\langle i, t \rangle} \), and \( t \in D_i \), \( f(p)(q)(t) = 1 \) iff there is a time \( t' \) such that \( t' < t \), \( p(t') = 1 \), and \( q(t') = 1 \)

b.  \[ [[\textsc{C}]]^g = f: D_i \to D_t \]

For all \( t \in D_i \), \( f(t) = 1 \) iff \( t \in t_R \), the set of times given in \( c \)

This semantics can handle Partee's example. When the negation takes scope over the past tense, we get the desired result saying that there is no time during the twenty-minute interval at which I turned off the stove.

In this section, we have reviewed theories of context dependency of tense interpretations. As has been pointed out in Bäuerle (1977, 1979), Hinrichs (1981), Partee (1984), and Ogihara (1989, 1996) among others, taking tenses themselves as pronominal elements that denote (contextually salient) times as suggested in Partee (1973) does not accurately represent our intuition. Partee (1984), following Bäuerle (1977, 1979) and Hinrichs (1981), argues that the context dependency of temporal interpretation is better captured by incorporating the notion of reference time. We presented an implementation of this idea in our framework by representing reference time as a time variable in the LF syntax. We have also presented a slightly different way of representing context dependency using domain restriction variables \( C \) in the sense of von Fintel. We will see in the following chapter that we will need a mechanism like the latter in certain embedded contexts.

1.5. Tense Morphemes and Temporal Interpretations

The truth value of a sentence depends on when it is uttered. The same sentence "Elliott was in Japan" is true at 3:00 PM, December 31st but not at 3:00 PM, July 4th, given the above scenario in which Elliott went to Japan on August 8th and came back to the States on December 27th, 1998. The sentence we are considering is tensed, and its truth conditions partially depend on the choice of tenses. Thus, the sentences "Elliott was in Japan" and
*Elliott is in Japan* may have different truth values at a given point. In Priorian tense logic, this difference is a direct consequence of choosing different tense operators.

(61) Where $\phi$ is a tenseless sentence,

a. $[[\text{Past } \phi]]^t = 1$ iff there is a time $t'$ such that $t' < t$ and $[[\phi]]^{t'} = 1$

b. $[[\text{Pres } \phi]]^t = 1$ iff $[[\phi]]^t = 1$

c. $[[\text{Fut } \phi]]^t = 1$ iff there is a time $t'$ such that $t < t'$ and $[[\phi]]^{t'} = 1$

For instance, if the verb *was* is 'derived' from the tenseless form *be* plus the past tense affix, we can say that the past tense operator, *Past*, is the meaning of the past tense affix.

This is true of Partee's 1973 theory, too. Whatever variation of her 1973 theory we take, the denotation of *past* is meant to be the meaning of the past tense morpheme. In her 1984 theory, the relation between the tense morpheme and the tense interpretation is not as clear. In my rendition of her theory, the definedness condition takes a constituent $[\text{past } t_R]$. But what gives us the past meaning is the reference time, $t_R$.

(62) $[[\text{past } [ t_R ] ]]^{g,c}$ is only defined if $g(t_R) < t_c$.

When defined, $[[\text{past } [ t_R ] ]]^{g,c} = f: D_{<t,t>} \rightarrow D_t$

For all $p \in D_{<t,t>}$, $f(p) = 1$ iff $\exists t'$ such that $t' \subseteq t_R$ and $p(t') = 1$.

If *past* in (62) is what corresponds to the past tense morpheme in English, the theory implies that there is no direct relation between the tense morpheme and temporal ordering. This is because the semantics of the past tense morpheme itself does not carry any meaning of anteriority as defined below:

(63) $[[\text{past }]]^{g,c} = f: D_1 \rightarrow D_{<it,t>}$

For all $t \in D_1$ and $p \in D_{<i,t>}$, $f(t)(p) = 1$ iff $\exists t'$ such that $t' \subseteq t$ and $p(t') = 1$. 

46
Once we allow explicit quantification over both evaluation and event times like the following, things become more complicated.

\[(64)\] 
\[\text{[Past]}^g.c = f : D_{<i,t>} \rightarrow D_{<i,t>}\]

For any \(p \in D_{<i,t>}\) and \(t \in D_i\), \(f(p)(t) = 1\) iff there is a time \(t'\) such that \(t' < t\) and \(p(t') = 1\)

\[(65)\]

a. Elliott was in Japan

\[\exists t'[t' < t \& \text{be-in-Japan}(t')(Elliott)]\]

b. \[\lambda t \exists t'[t' < t \& \text{be-in-Japan}(t')(Elliott)]\]

Here we have at least three elements that are necessary to derive the right temporal interpretations, the evaluation time of the tense operator, the time variable that saturates the time argument slot of the predicate, and what gives the temporal ordering between the two, Past and Pres. It looks most reasonable to assume that the tense morphemes correspond to what gives the ordering. If so, we will need a general mechanism of representing evaluation and event times in the object language. If the tense morphemes correspond to a time
variable that is syntactically realized instead, we have the following denotations of the present and past tense morphemes.

(66) a. \[[\text{past}_i]\]_g = g(i)  
b. \[[\text{pres}_i]\]_g = g(i)

Then we need a theory to tie a particular tense morpheme to the corresponding tense interpretation. That is, we need to prevent the past tense morpheme from co-occurring with the present tense operator and vice versa; that would predict that sentences like *Elliott was in Japan* have the same truth conditions as the sentence *Elliott is in Japan*.

The assumption that there is a one-to-one correspondence between each tense morpheme in the surface syntactic forms of natural language and the meanings of anteriority, simultaneity, and posteriority seems to be a reasonable one, and certainly makes the mapping from LF syntactic structures to semantic representations transparent. Everything being equal, a preferable theory of tense would be one where the denotation of each tense morpheme directly gives us the temporal interpretation of the sentences it is in. Therefore, a departure from such a theory would need justification.

But is it true that whenever we see a past tense morpheme, it carries the meaning of anteriority? Is it also true that whenever some element of a sentence has a past meaning, it is accompanied by a past tense morpheme? That is, is there a direct one-to-one correspondence between the morphology and the temporal ordering? The answer is no, at least in some languages. This is the topic of the following sections.

1.5.1. Sequence of Tense Phenomena

In this section, we will see an answer to the question whether there is always a one-to-one correspondence between the past tense morpheme and the meaning of anteriority. As an example to show that there is not, we will discuss issues concerning so-called sequence of tense (SOT) phenomena. After describing what the phenomenon is, we will look at theories
of the SOT phenomena that assume that there is a one-to-one correspondence. We will then present two major problems to those theories, leading to the conclusion that we do not always interpret the past tense as what we think the past tense means. Lastly, we will discuss two semantic theories of the SOT phenomena, and their advantages and disadvantages.

1.5.1.1. Introduction

Sequence of tense (SOT) phenomena are illustrated by examples like the following.

(67)  a. Bernhard believed that Junko was sick.
     b. Gordon said that Josephine was pregnant

The sentences in (67) may be true in two distinct situations. (67b), for instance, may be true when what Gordon said is something like "Josephine is pregnant" or "Josephine was pregnant". That is, the time of the event described by the embedded predicate --- the embedded event time --- may be 'simultaneous' or 'prior' to the matrix event time. The former we call the simultaneous reading and the latter the earlier-than-matrix reading. The third interpretation, namely, that the embedded event time is 'posterior' to the matrix event time, is considered to be unavailable. We will come back to this issue later.

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39 For some speakers, this is not the case. For these people, the sentence (67b), for instance, can only have the interpretation in which what Gordon said is "Josephine is pregnant". To express the other meaning, the past perfect must be used. That is, they have to say "Gordon said that Josephine had been pregnant." Since what is problematic for any theory of tense is the former interpretation, we will not be concerned with this difference among native speakers in this thesis.

40 As we will see when we discuss temporal de se, there is no direct ordering between the matrix event time and the embedded one. Hence the terms are in quotation.

41 The term 'simultaneous reading' is due to Enç (1987) and 'earlier-than-matrix' is suggested by Barbara Partee (p.c.). The latter is called the 'backward-shifted' reading by Enç (1987) and many others.

42 It might be hasty to conclude based on examples like (68) that the later-than-matrix interpretation is unavailable at all in clausal complements. There seem to be at least
(68) a. Gordon said, "Josephine is sick" (the simultaneous reading)
b. Gordon said, "Josephine was sick" (the earlier-than-matrix reading)
c. * Gordon said, "Josephine will be sick" (the later-than-matrix reading)

Assuming that the sentence (67a) has the following LF, Priorian tense logic can yield only the second interpretation.

(69) a. Past [Gordon say that Past [Josephine be pregnant]]

This is due to the assumption that past tenses are evaluation time shifters and embedded tenses take the new time introduced by the next higher tense as their evaluation time. In order to get the simultaneous interpretation, what we need is the following LF.43

(70) Past [Gordon say that Pres [Josephine be pregnant]]

two cases in which the later-than-matrix interpretation is possible. The first are cases where sentences describing the so-called scheduled events are embedded.

(i) The announcer said that the Red Sox played tomorrow

Note that what the announcer actually said is something like "the Red Sox play tomorrow". The second are cases where future oriented verbs such as predict are used as the matrix verb.

(ii) John correctly predicted that the Red Sox won

Examples like the above were brought to my attention by Barbara Partee and Chris Tancredi (p.c.) independently. Both agree that the judgment is not clear, but that it is only possible, if possible at all, when the prediction is right. In other words, if John's prediction turns out to be incorrect, we have to say something like John (wrongly) predicted that the Red Sox would win. We will discuss the former case in Chapter 2, but leave the latter for future research.

43 Or the LF could be without the present tense operator.

(i) Past [Gordon say [that Josephine be pregnant]]
This goes with our intuition that the simultaneous interpretation seems to be derived by converting the present tense in the direct quotation *Gordon said, "Josephine is pregnant"* into the past tense in its indirect quotation counterpart. This is called the sequence of tense (SOT) phenomenon. The past tense in embedded contexts such as (67) seems semantically vacuous when the sentences receive the simultaneous interpretation.

Traditionally, the SOT phenomenon is accounted for literally by means of a sequence of tense rule of one form or another. (See Ross 1967, Comrie 1986 among others.) For instance, in early transformational grammar, the sentence (67b) is derived from a D-structure of the form *Gordon said that Josephine is pregnant* by rules like the following:

(71) Sequence of tense rule (preliminary version)

If the tense of the verb of reporting is non-past, then the tense of the original utterance is retained; if the tense of the verb of reporting is past, then the tense of the original utterance is backshifted into the past.

(Comrie 1986, p.279)

Thus the past tense on the embedded verb is a disguised present tense. This approach as well as many others take the SOT phenomenon as a kind of agreement phenomenon of tense features. As a result, they hold the view that what we see as the past tense morpheme has two distinct interpretations, one that is temporally vacuous, and another that is not. Most recent generative linguists, including Ladusaw (1977), Comrie (1985, 1986), Ogihara (1989, 1996), Abusch (1988, 1994, 1997a), Stowell (1993, 1995a,b), Kratzer (1998), and Kondrashova (1998, 1999), also support this view.

44 This is a preliminary version of the rule. Comrie later revises it and makes backshifting optional to accommodate cases where the present tense and the future auxiliary *will* are embedded under the past tense.
1.5.1.2. Absolute Tense Theory and the SOT Phenomena

The view that the past tense is ambiguous is not a theoretically attractive one since we have to resort to the ambiguity of the past tense in English. Enç (1987) tries to avoid this and pursues the thesis that there is only one past tense in English. She argues that taking tenses as absolute tenses is the answer to the SOT phenomena. Intuitively speaking, if Gordon's saying time is in the past relative to the speech time, and Josephine's pregnancy holds at that time according to what he says, then we can conclude that the pregnancy time also has to be in the past relative to the speech time. And this is what gives us the past tense in sentences like (67).

If this line of explaining the SOT phenomena is on the right track, some of the theories we have considered so far seem to give us the right answer without any modification. We will consider the following three absolute theories of tense before Enç's own proposal: an existential quantifier analysis with the speech time in it (72), a version of Dowty's (73), and a version of Partee's (74).

\[
(72) \quad [[\text{Past}]] \varepsilon^c = f: D_{<i,t>} \rightarrow D_t
\]

For any \( p \in D_{<i,t>} \), \( f(p) = 1 \) iff there is a time \( t' \) such that \( t' < t_c \) and \( p(t') = 1 \)

\[
(73) \quad [[\text{Past}_n \phi]]^T = 1 \text{ iff } [[\phi]]^T[n/0] = 1 \text{ and } \tau(n) < \tau(0)
\]

\[
(74) \quad [[\text{past}_i]]^c \text{ is only defined if } g(i) < t_c.
\]

When defined, \( [[\text{past}_i]]^c = g(i) \)

Kamp's system with the \( N \) operator is another possibility, but this gives us the same interpretation as the existential operator analysis in (72) as far as the SOT phenomena is concerned. So we will treat it as a variant of the existential quantifier analysis.

\[\text{Gennari (1997, 1999a) also pursues this line. Her approach will be briefly discussed in the following chapter (§ 2.1.2.)}\]
Proponents of an absolute tense theory often describe the temporal interpretation of sentences with a past tense under another past tense in their complement clauses in the following way: the matrix tense locates the matrix event time before the speech time and the embedded tense locates the embedded event time before the speech time. For instance, in evaluating the sentence *Gordon said that Josephine was pregnant* we understand the time of Gordon's saying and the time of Josephine's pregnancy are both in the past relative to the speech time. But what is "the time of Josephine's pregnancy"? The sentence may be true without Josephine being pregnant at all. Gordon might be wrong or lying. In such a case, there is no event time at which Josephine is pregnant, not in the evaluation world. How do we understand the truth value of the sentence then? First, we need a semantics of propositional attitude verbs. Let us begin with the traditional analysis of propositional attitudes. The object of such attitudes is considered to be propositions, sets of possible worlds. Again, parallel to times, we have options to relativize sentence denotations with respect to worlds; we could quantify over worlds in the meta-language alone using world indices for instance, or we could explicitly quantify over worlds in the object language. We will assume without argument that predicates take another argument for a world, but unlike time arguments, world arguments are implicit in the syntax. Adopting a version of Hintikka's (1962) semantics of propositional attitude verbs, this is what we need to calculate the truth conditions of sentences like *Gordon said that Josephine was pregnant*.

\[(75) \quad [[\text{say/believe}]] = f: D_{<t>} \rightarrow D_{<i,\text{st}>>} \]

For all \( p \in D_{<t>}, x \in D_e, t \in D_i, \) and \( w \in D_s, f(p)(x)(t)(w) = 1 \) iff for all worlds \( w' \) that are compatible with what \( x \) says/believes in \( w \) at \( t \), \( p(w') = 1 \)

The verb *say* takes a proposition, i.e., a set of worlds, as its object. This proposition is not evaluated with respect to the actual world, but with respect to the subject's utterance/belief worlds, i.e., worlds that are compatible with what the subject says/believes.
Under the Partee analysis, the sentence *Gordon said that Josephine was pregnant* may be given either of the following LFs:

(76)  
\begin{align*}
(a) & \quad \text{past}_i \text{ Gordon say past}_i \text{ Josephine be pregnant} \\
(b) & \quad \text{past}_i \text{ Gordon say past}_j \text{ Josephine be pregnant}
\end{align*}

The matrix past tense is free, but the embedded one can either be free or bound. The Partee analysis of tense together with the semantics of *say* above will give us the following respective truth conditions for the LFs above. (We ignore the definedness condition for the moment.)

(77)  
\begin{align*}
(a) & \quad \text{When defined, } \mathbb{[(76a)]}_{g,c}(w) = 1 \text{ iff for all worlds } w' \text{ that are compatible} \\
& \quad \text{with what Gordon says in } w \text{ at } g(i), \text{ Josephine is pregnant in } w' \text{ at } g(i) \\
(b) & \quad \text{When defined, } \mathbb{[(76b)]}_{g,c}(w) = 1 \text{ iff for all worlds } w' \text{ that are compatible} \\
& \quad \text{with what Gordon says in } w \text{ at } g(i), \text{ Josephine is pregnant in } w' \text{ at } g(j)
\end{align*}

When the embedded past tense is bound, the matrix and embedded event times are assigned the same value, yielding the simultaneous interpretation. When free, the two time variables are assigned a value independently of each other. In both cases, intervals denoted by \(g(i)\) and \(g(j)\) are past with respect to the speech time due to the definedness condition. Therefore, the truth conditions in (77b) are compatible with a situation in which Josephine's pregnancy time coincides with Gordon's saying time. As we have already seen, there are at least two problems with this analysis. One apparent problem is that it also predicts the later-than-matrix interpretation, which is not attested.\(^{46}\)

\(^{46}\) As we have seen before, it is not clear whether or not the later-than-matrix interpretation is prohibited at all. (See footnote 42 above for potential counterexamples.) If they are genuine counterexamples and there is an independent reason to prevent the later-than-matrix interpretation in examples like *Gordon said that Josephine was pregnant*, this argument against absolute tense theories is not decisive.
This problem is also present in the other two absolute tense analyses. In both analyses, the time of Josephine's pregnancy is ordered only with respect to the speech time, but not with respect to the time of Gordon's utterance, making it possible to either precede or coincide with it, but also to follow it.

The other problem is more serious. These theories cannot predict interpretations in which past tenses can be relative to a future time when the past tense is embedded under the future auxiliary. I see no easy way to overcome this problem.

The above version of the referential analysis also faces another problem, due to the fact that it derives "pastness" through presupposition. This is pointed out in Heim (1994), and the problem is the following. Due to presupposition projection, the definedness condition of the entire sentence is as follows. (We are ignoring the presupposition of the matrix past tense here.)

\[(78)\]

\[a. \quad [[(76ba)]]^g_c \text{ is only defined when } [[\text{past}j \text{ Josephine be pregnant}]] \text{ is defined for all } w' \text{ that are compatible with what Gordon believes in } w \text{ at } g(i).\]

\[b. \quad [[\text{past}j \text{ Josephine be pregnant}]]^g_c \text{ is only defined when } g(j) < t_c \text{ in } w'.\]

This means that in order for the sentence denotation to be defined, Gordon has to believe that the time of Josephine's pregnancy precedes the speech time. The sentence *Gordon said that Josephine was pregnant* has no such presupposition.

Enç (1987) avoids these problems while maintaining the absolute theory of tense. She succeeds in avoiding the problems by saying that tenses are not always independent. This conclusion is based on the different tense behavior in complement clauses and relative clauses. In complement clauses, when a past tense is embedded under another past tense, only the simultaneous and earlier-than-matrix interpretations are possible. The later-than-matrix interpretation is not attested.

\[(79)\]  

*Gordon said that Josephine was pregnant*
When a past tensed relative clause is embedded under a past tensed clause, the sentence is compatible with three different situations.

(80) Eva talked to the boy who was crying

a. Eva talked to the boy who was crying at \( t \), where \( t \) is at the time of her talking to him  
   (the simultaneous interpretation)

b. Eva talked to the boy who was crying at \( t \), where \( t \) is before her talking to him  
   (the earlier-than-matrix interpretation)

c. Eva talked to the boy who was crying at \( t \), where \( t \) is after her talking to him.  
   (the later-than-matrix interpretation)

Some native speakers might find the earlier-than-matrix and later-than-matrix readings difficult in the above example. With the help of context and/or temporal adverbs, however, these readings can easily be obtained.

(81) a. I talked to the students who failed the midterm.

b. Eva talked to the boy who was crying the day before

(82) a. Who hired the person who wrote this article?

b. (On my wedding day,) my mother gave me the ring which I gave to my daughter (on her wedding day)

c. A week ago Eva talked to the boy who was crying just now.

d. Hillary married a man who became the president of the U.S.
Enç argues that the tense interpretation mechanism should be sensitive to the syntactic differences in the constituents containing tense in order to account for the observed difference that tense in relative clauses is independent while tense in complement clauses is not. Note that all three theories of tense we considered above assume that each occurrence of tenses may be independent of each other irrespective of its environment, and therefore they are unable to capture the difference between relative clauses and complement clauses. Enç argues that the seemingly vacuous occurrences of the past tense are a by product of syntactic conditions imposed on the occurrences of the past tense. Below are the semantics of tenses and the syntactic conditions she proposes. She takes a referential view of tenses, and therefore tenses denote times.

\[(83)\]

a. Where \(\alpha\) is a past tense, \(\beta\) is a Comp with a temporal index, and \(\beta\) is a local Comp of \(\alpha\), \([\alpha]\) is an interval \(T\) such that every moment \(t\) in \(T\) precedes every moment \(t'\) in \([\beta]\).

b. Where \(\alpha\) is a present tense, \(\beta\) is a Comp with a temporal index, and \(\beta\) is a local Comp of \(\alpha\), \([\alpha]\) is an interval \(T\) such that \(T = [\beta]\).

c. A Comp \(\beta\) is a local Comp of a tense \(\alpha\) iff \(\beta\) governs \(\alpha\).

\[(84)\] The Anchoring Principle
Each tense must be anchored

\[(85)\] Anchoring Conditions

a. Tense is anchored if it is bound in its governing category, or if its local Comp is anchored. Otherwise, it is unanchored

b. If Comp has a governing category, it is anchored if and only if it is bound within its governing category

c. If Comp does not have a governing category, it is anchored if and only if it denotes the speech time.
Unlike all the absolute theories discussed above, the "pastness" of the past tense is defined through its relation with some Comp, which serves as the local evaluation time whose value depends on the syntactic structure that embeds it. A Comp can denote either the speech time or the event time of the predicate that governs it, or it can be irrelevant to the tense interpretation. This is what the conditions (71b) and (71c) say. Moreover, this is what makes the difference between relative clauses and complement clauses. Under the theory of government and phrase structures that Enç adopts (Chomsky 1981), a Comp in relative clauses has no governing category, and therefore always denotes the speech time when it is anchored. On the other hand, a Comp in complement clauses cannot denote the speech time since it is governed. It can only denote, if it has a denotation at all, the event time of the next higher predicate. When its local Comp has a denotation, then a past tense is an interval preceding the interval the Comp denotes. When it does not, then a past tense has to be bound. This is what the condition (71a) says.

Let us see how this works. In relative clauses, we have two options, depending on whether the embedded Comp is anchored or not. When it is not anchored, as in (86a), the embedded past tense has to be bound in order to be anchored. This yields the simultaneous interpretation. When the embedded Comp is anchored by denoting the speech time, as in (86b), the embedded past tense is an absolute tense. It is relative to the speech time. This predicts that the order of the two events are undetermined by the truth conditions of the sentence, allowing all three possibilities.

\[47\text{The definition of government is as follows:}\]

(i) A governs B iff
   
a. A is X^0, and
   b. A and B are contained in all the same maximal projections

Whether the distinction between relative clauses and complement clauses follows from this definition depends on the phrase structures assumed. Enç assumes structures like \[V\{V S\{S Comp S\}\}\] for complement clauses. Therefore, V and Comp are contained in all the same maximal projections. On the other hand, an NP always intervenes between Comp and V in relative clauses. Thus a Comp in relative clauses is not governed.
In complement clauses, we also have two options. The first is the same as for the relative clauses. When the embedded Comp is not anchored, the embedded past tense has to be bound by the matrix past tense, yielding the simultaneous interpretation. The other option is different since the anchoring condition for a Comp is different depending on whether it is governed or not. In complement clauses, it is anchored when it is bound by the next higher verb. This itself makes the embedded past tense anchored: it denotes a time that is before what its local Comp denotes. This yields the earlier-than-matrix interpretation.

In this analysis, the later-than-matrix interpretation is not predicted since an embedded Comp in complement clauses cannot denote the speech time. It also predicts correctly the past relative to future reading in sentences like *I will marry a man who went to Harvard*.

It is hard to see how this should work compositionally. This is partly because of the semantic role played by Comp. Not all Comps are interpreted. (88) is as close as we can get to compositionality.

(88) \([\text{past}_i]^{g,c}\) is only defined if \(g(i) < g(n)\), where \(n\) is an index on its local Comp when the local Comp is anchored, or the closest anchored Comp when its local Comp it is not anchored. When defined, \([\text{past}_i]^{g} = g(i)\)
The index 0 plays a special role: For any assignment function $g_C$ that is determined by an utterance context $x$, $g_C(0) = t_C$, the speech time.

This does not make the LFs Enç assumes, such as the ones in (86) and (87), interpretable compositionally, though. We get the truth value before we interpret indices on Comp. We believe we either have to remove Comp from structures we interpret or give up the referential analysis of tense. This implementation also gives rise to the presupposition projection problem we saw earlier.

Giorgi and Pianesi (1997) have recently proposed a similar account for the SOT phenomena in Italian. They argue that the past tense carries the meaning of anteriority with respect to some evaluation time, schematized as follows using a Reichenbachen approach.

\[(89)\quad \text{(past) imperfective in Italian} \]

\[t_E X\]

Informally speaking, $X$ is the evaluation time and $t_E$ is the event time of the predicate that the tense is associated with. In unembedded contexts, $X$ is identified as the speech time, and the semantics of (past) imperfective requires the event time of the predicate to be located before it. When embedded, we have two choices. When $X$ is identified as the speech time and $t_E$ is identified as the time of the matrix event, we get the simultaneous interpretation. When $X$ is identified as the matrix event time, the shifted interpretation is obtained.

The idea explored here is almost identical to Enç's, and shares the same problem if we try to make it work compositionally. Therefore we will not try it here.

1.5.1.3. Past Tenses are Ambiguous

Both Enç's and Giorgi and Pianesi's theories maintain that the past tense meaning is uniform and derive the SOT effects from something else. Everything else being equal, keeping the past tense meaning constant seems better than sequence of tense accounts so far as tense meaning is concerned. Unfortunately, as Abusch (1988, 1994, 1997a) and Ogihara
(1989, 1995, 1996) point out, everything else is not equal and Enç's proposal as well as other absolute theories of tense face some shortcomings. There are cases where the event time of a past tense verb is not "past" in any sense.⁴⁸

(90)  

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

b. John said he would buy a fish that was still alive

There is a reading for (90a) in which what John decided to say to his mother is something like "We are having our last meal together." Similarly, a fish John is willing to buy is one that is alive at a future time of his buying, not those that was once alive but dead then. On such readings, the time of the underlined past tensed verbs is neither before the speech time nor any evaluation time. Because of these examples, we cannot maintain that the past tense always expresses "pastness". Some occurrences of past tense clearly do not carry any meaning of anteriority. I conclude that the ambiguity thesis is indispensable.

Another inadequacy of theories like Enç's has been pointed out by more than a few researchers, such as Ogihara (1989, 1996), Abusch (1997a), Heim (1994), von Stechow (1995a,b), Kratzer (1998). The problem lies in the assumption that when sentences with a past tense under another past tense in complement clauses receive the so-called simultaneous interpretation, the event time of the embedded clause coincides with the event time of the matrix clause. In referential theories of tense like Enç's, this means that the intervals the two past tenses refer to are the same interval. As in cases of coreference of two occurrences of pronouns, these are represented at LF as coindexed tenses.

(91)  

a. Gordon said that Josephine was pregnant

b. [Comp[0 Gordon pasti say [Comp Josephine pasti be pregnant ]]

⁴⁸ The example (a) is taken from Abusch (1988), which is based on a similar example in French discussed in Kamp and Rohrer (1984). (b) is due to Ogihara (1989).
The truth conditions are derived based on the following denotation of the verb *say*. This is equivalent to what we have used to evaluate the other absolute theories of tense in SOT.

\[(92) \quad [[\textit{say}]]^g_c = f: D_{s,t} \rightarrow D_{e,<i,st>}
\]

For all \( p \in D_{s,t}, x \in D_e, t \in D_i, \) and \( w \in D_s, f(p)(x)(t)(w) = 1 \) iff for all worlds \( w' \) that are compatible with what \( x \) says in \( w \) at \( t \), \( p(w') = 1 \).

The embedded proposition in (91a) is a set of worlds in which Josephine is pregnant at \( t' \). This proposition is specified temporally, as the time argument of the embedded predicate *be-pregnant* is saturated by the time variable introduced by the tense morpheme *pasti*. Moreover, the time variable is coindexed with the matrix tense morpheme, ensuring the simultaneous interpretation.

The truth conditions in (91c) seem intuitively adequate. Consider the following situation, however. Suppose that Josephine was pregnant on December 1998, and expected to give birth to her baby on January 6th, 1999. On the morning of December 31st, Gordon and Josephine were involved in a car accident. Josephine and her baby were not injured, but Gordon was and was carried to a hospital. He was in a coma. Four months later at 11:00 AM, on May 1st, Gordon suddenly woke up and remembered everything including the accident, up to his losing consciousness. He was worried about his wife and said, "Where's Josephine? She is pregnant." One can truthfully report what Gordon said using the sentence *Gordon said that Josephine was pregnant*. This is not correctly predicted by the current analysis. The denotation of \( g(i) \) in this context is the time of Gordon's speaking, namely 11:00 AM, May 1st. And this has to be Josephine's pregnancy time in worlds compatible with what Gordon said at that time. But Gordon himself did not know that it
was May 1st at the time he woke up. If we asked what day it was, most likely he would say it was December 31st. This means that in worlds that are compatible with what Gordon says, Josephine is not pregnant on May 1st, but on December 31st. In fact, given the nature of human pregnancy and that she was due January 6th, in no world is Josephine pregnant on May 1st. Clearly, the absolute theory of tense predicts the wrong result.

Ogihara (1989, 1996), Heim (1994), and von Stechow (1995a,b), following Perry (1977) and Lewis (1979), convincingly argue that taking the object of propositional attitude verbs as propositions gives the wrong result. They discuss examples like the following.

(93) a Karen believed that it was 11:00 A.M.
    b. Emma believes that it is dinner time

Suppose that after a long, very tiring day, Karen decides to go to bed early at 8:00 P.M. She wakes up after a while and notices that her clock says that it is 11:00. She believes that it is 11:00 A.M. since she knew that she was very tired before going to bed, but in fact she slept for only three hours and it is 11:00 P.M. now. Given the semantics of tense and propositional attitude verbs above, Karen's belief must be contradictory; she locates herself in a world in which 11:00 A.M. is 11:00 P.M. Similarly, if Emma feels hungry at 3:00 P.M., and believes that it is dinner time, her belief must be that it is dinner time at 3:00 P.M. But being a little dog, Emma usually has no idea what time it is.

What this shows is that just like normal individuals do not know (in the objective sense) which world they are located in, nor do they know what time they are located at. They know only which worlds are compatible with what they believe (in a given world). If we capture this by quantifying over possible worlds, as we did in the semantics of propositional attitude verbs in (92), we should do the same for times.
(94) \[\text{[[say]]} = f : D_{<i,s,t>} \to D_{<e<i,s,t>}>\]

For all \( p \in D_{<i,s,t>}, \ t \in D_i, \ x \in D_e, \) and \( w \in D_s, \ f(p)(x)(t)(w) = 1 \) iff for all
worlds \( w' \) and times \( t' \) that are compatible with what \( x \) says in \( w \) at \( t, \ p(t')(w') = 1 \)

This denotation implies that a sentence embedded under a propositional attitude verb cannot
denote a proposition of type \(<s,t>\); it must instead denote properties of time, \ of type \(<i,st>\).
Our syntax of tense would give the wrong type. A solution to this is to introduce an
operator that abstracts over the embedded past tense, as suggested in Heim (1994), von
Stechow (1995), and Abusch (1997a).

(95) a. \[\text{[Comp} \ 0 \ \text{Gordon past}_j \ \text{say} \ [\lambda_j \ \text{Josephine past}_j \ \text{be pregnant}]\]

b. \[\text{[[} (95) \text{]]}_{g,c}(w) = 1 \text{ iff for all worlds } w' \text{ and times } t' \text{ that are compatible with what Gordon says in } w \text{ at } g(i), \text{ Josephine is pregnant in } w' \text{ at } t'\]

This will give us the right interpretation. Notice, however, that Enç's insight is lost in this
representation. The truth conditions say that for all worlds \( w' \) and times \( t_j \) that are
compatible with what Gordon says in the evaluation world at a past time that \( g(i) \) denotes,
Josephine is pregnant in \( w' \) at \( t_j \). There is no past meaning associated with \( t_j \) in this
semantics. In this particular example, we could still say that since Gordon believed on May
1st that it was December 31st, his subjective 'now' (December 31st) is past relative to the
objective 'now' (May 1st). But this way of justifying the usage of past tenses in embedded
contexts can easily be proven to be wrong. In Karen's example, where she thought she
overslept but she in fact didn't, her subjective 'now' is future relative to the objective 'now'.
Yet, the use of the past tense is accepted.

These considerations have led many recent authors, including Ogihara (1989, 1995b,
(1995a,b), and Kratzer (1998), to adopt the ambiguity thesis. The SOT phenomena are a
kind of agreement phenomena, and embedded past tenses are sometimes semantically
different from unembedded ones in that they can be vacuous. All of these authors agree in
the following respect: the embedded clause of the sentence Gordon said that Josephine was
pregnant denotes the property of time at which Josephine is pregnant. This necessarily
yields the simultaneous interpretation when combined with our analysis of attitude verbs.
The question is how we get the denotations of embedded sentences like that Josephine was
pregnant to be of type \(<i, st>\) compositionally. In other words, how, technically, do we make
the past tense vacuous? Different authors answer this question differently. We will discuss
Ogihara's (1989, 1995, 1996) and Abusch's (1994, 1997a) proposals, the two important
contributions in the semantics of the SOT phenomena. Before doing so, we will ask in the
next section whether the present tense is also ambiguous. This is because the two authors
differ in this respect, and the answer to this question will affect the overall structure of a
theory of tenses.

1.5.1.4. Are Present Tenses Ambiguous, Too?
Cases of past under past have been given lots of attention in the literature, perhaps because
the simultaneous interpretation we get from those embedded past tenses goes against our
intuition of what the past tense should mean. Many linguists have asked whether past
tenses in the SOT contexts are in fact vacuous, and if so, what conditions govern the
distribution of vacuous past tenses. We have concluded in the previous two sections that
there are real and vacuous past tenses. Questions concerning the distribution of vacuous
tenses will be discussed in the following section.

In this section, we will ask the same question concerning the present tense: Are
present tenses ambiguous? This is not quite the same question as we asked for the past
tenses. In the case of the past tenses, our intuition is that their semantics should carry some
meaning of anteriority with respect to some evaluation time. Priorian tense logic captures
this intuition by saying that the past tenses are operators that shift the current evaluation
time into the past. The seemingly vacuous past tenses in the SOT contexts do not fit into
the system. This is where the questions arise.
In the case of the present tenses, we have a different situation. In fact, the question
did not even arise when the SOT phenomena were viewed as the result of applying the
sequence of tense rule as part of transformational processes from D-structure to S-
structure. The rule only applies when the matrix tense is past and changes the present tense
into the past tense, yielding a seemingly vacuous past tense as in (96b).

(96) a. Kathy said, "Angelika is sick"
    b. Kathy said that Angelika was sick

(97) a. Kathy says, "Angelika is sick"
    b. Kathy says that Angelika is sick

(98) a. Kathy will say, "Angelika is sick"
    b. Kathy will say that Angelika is sick

Under this analysis, the semantic interpretation takes place at the level of D-structure, and
the right interpretations are obtained for the (b) examples in (97) and (98) by assuming that
the present tense is semantically vacuous.

What this SOT rule-based analysis does not predict is (i) that sentences like Kathy
said that Angelika is sick, where the embedded tense does not agree with the matrix one, are
in fact grammatical for many speakers, and (ii) the semantic difference between present
under past constructions such as the one above and past under past constructions such as
(96b). The first point is due to the fact that the rule is supposed to be an obligatory one.
The second point is more difficult since precise semantic differences between the two are
difficult to pin down. Comrie claims that when the reported event is relevant (Comrie 1985)
or has continuing applicability (Comrie 1986) at the speech time, the present tense in D-
structure can remain as the present tense in S-structure. A precise definition of "relevance"
or "continuing applicability" is not presented, though. A naïve intuition is that the speaker
of the present under past sentences asserts that the reported event is true at the speech time. For instance, in uttering the sentence *Kathy said that Angelika is sick*, what the speaker asserts is roughly paraphrased as *Kathy said that Angelika was sick, and she is still sick now*. Though this is one of the contexts that makes the usage of the present tense under the past felicitous, Ogihara (1989, 1995a, 1996) and Abusch (1991, 1994, 1997a) convincingly show that it is not a necessary condition for felicitousness.\(^{49}\) We will not go into details of the semantics of the present under past constructions here. It suffices to understand that the interpretation of the present under past constructions, whatever it is, is not the same as the simultaneous interpretation of the past under past constructions.

Comrie (1986) revises his sequence of tense rule to accommodate this. (The revision is italicized.)

\[(99) \quad \text{Sequence of tense rule (revised version)} \]

If the tense of the verb of reporting is non-past, then the tense of the original utterance is retained; if the tense of the verb of reporting is past, then the tense of the original utterance is backshifted into the past, except that if the content of the indirect speech has continuing applicability, the backshifting is optional.

(Comrie 1986, p.284085)

Now the rule is optional, and correctly predicts that whenever the present tense remains as the present tense in S-structure, the past tensed sentences containing it have a special meaning.

In more recent syntactic frameworks where semantic interpretation takes place at LF, we must derive the appropriate interpretation of the present under past constructions from the semantics of the present tense. It is clear that we cannot simply maintain the semantics of the present tense in Priorian tense logic, where the present tense is considered

\(^{49}\) Both their description of the phenomena and their theories have recently been challenged in Gennari (1999a,b).
semantically vacuous. This is because it predicts the simultaneous interpretation for the present under past constructions. In the present under past constructions, it looks like the present tense does not want to be vacuous, but indexical, referring to the speech time. But it is not always the case that the present tense behaves like an indexical. The present tense can sometimes be vacuous when embedded under another present tense as in (97) and (98). (Recall that will is analyzed as the present tensed form of the auxiliary woll.) We could argue that the present tense is ambiguous in a very similar way that the past tense is. We could define the present tense as an operator that is inherently indexical. This becomes the source of the speech time relevance in present under past constructions. However, when embedded under another present tense, the present tense may become vacuous, a precise mechanism of which is yet to be explained.

But the fact that the semantics of the present tense in Priorian tense logic does not make correct predictions for the present under past constructions does not necessarily mean that we have to resort to the ambiguity of the present tense meaning. In fact, some authors argue that the meaning of the present tense in English is uniform, and that it is non-past. (See Abusch 1997a, Gennari 1999a,b). Under this kind of analysis of the present tense, the English facts are explained in the following way. Suppose that the meaning of the present tense is something like the following:

(100) b. $$[[\text{Pres}]]^{\mathcal{C}} = f : D_{< t_0, t>} \rightarrow D_t$$

For any $$p \in D_{< t_0, t>}, f(p)(t) = 1$$ iff there is a time $$t'$$ such it is not the case that $$t' < t_0$$, and $$p(t') = 1$$

Intuitively, present tensed sentences are true when they are true at some time not before the speech time. This prevents the present under past constructions from yielding simultaneous interpretations. When embedded under a past tense, the present tense cannot be completely vacuous. The interval at which $$p$$, the complement of Pres, is true has to stretch over to include the speech time. When embedded under another present tense or the future will,
this is not necessary. The present tense can be vacuous, and it still satisfies the requirement that the p interval be not before the speech time.

The ambiguous present tense analysis is pursued in Ogihara (1989, 1996) and the non-past analysis of the present tense by Abusch (1994, 1997a). Their particular choice is a crucial part of their theories of the SOT phenomena and theories of tense in general. Now we turn to their technical implementation of the vacuous past theory.

1.5.1.5. Previous Theories of the SOT: Ogihara and Abusch

In § 1.5.1.3., we concluded that the ambiguity thesis of the past tense in languages like English is unavoidable. There are two interpretations of the past tense morphology in these languages. One is a true past tense that carries the meaning of anteriority, but some occurrences of the embedded past tense are vacuous. The question is what mechanism these languages employ.

Ogihara's (1989, 1995b, 1996) answer to the question is very straightforward. Since we do not want the past tense meaning in order to get the simultaneous interpretation, we simply get rid of it. We can say that his theory of the SOT phenomena is a variant of the sequence of tense rule by traditional grammarians. Instead of transforming tense forms from D-structure to S-structure, his analysis is based on a recent syntactic framework in which the input for semantic interpretations is LF, and he makes LF responsible for the vacuousness of past tenses in SOT environments. He explains the seemingly vacuous past tense by positing a rule that operates on embedded tense at LF in English. It is stated as follows:50

50 The more precise version of the rule is as follows:

(i) The SOT Rule: (Ogihara 1996, p.134)

If a tense feature B is the local tense feature of a tense feature A at LF and A and B are occurrences of the same tense (i.e., either [+present] or [+past]), A is optionally deleted. N.B.: (i) The tense features include [+past] and [+pres] and nothing else. (ii) A tense feature A is "in the scope" of a tense feature B iff B is associated with a common noun and asymmetrically c-commands A, or B is associated with a tense or a perfect and asymmetrically c-commands A. (iii) A tense feature B is the local tense feature of a tense feature A iff A is "in the scope" of B and there is no tense feature C "in the scope" of B such that A is "in the scope" of C.
(101) The SOT rule (to be revised)

A past tense locally c-commanded by another past tense at LF may be deleted.

Ogihara views tenses as Priorian tense operators except that he assumes that predicates take a time variable as their argument.

(102) \[
\text{[[Past]]}^\text{g,c} = f : D_{i,t} \rightarrow D_{i,t} \\
\text{For any } p \in D_{i,t} \text{ and } t \in D_i, f(p)(t) = 1 \text{ iff there is a time } t' \text{ such that } t' < t \text{ and } p(t') = 1
\]

Sentences like (103) have the LF (a). When the SOT rule is applied, it yields the LF representation (b).

(103) Bernhard said that Junko was sick

a. Bernhard say-Past that Junko be-Past sick
b. Bernhard say-Past that Junko be-Ø sick

The tenseless embedded clause denotes the property of times at which Junko is sick, and with the right denotation of *say* we introduced above, we get the simultaneous reading. The rule is optional. When it is not applied, the LF remains as in (a), which yields the earlier-than-matrix interpretation.

Ogihara argues that the SOT rule not only targets the past tense but also the present tense. He generalizes the SOT rule as follows:
The SOT rule

A tense, past or present, locally c-commanded by another tense of the same kind at LF may be deleted.

The rule allows him to delete a present tense when embedded under another present tense including the future will, but not when embedded under a past tense. The latter case does not satisfy the condition of applying the rule; tense features do not match. This correctly captures the distribution of vacuous present tense in English. By assuming that the present tense is inherently indexical in nature, Ogihara also derives the speech time relevance effect of the present under past constructions. We will not go into the exact technical mechanism of their semantic interpretation here. The interested reader is referred to Ogihara (1995a, 1996, 1999).

Ogihara's analysis implies that the SOT phenomena are of a syntactic nature. They are triggered by a (local) c-commanding tense of the same feature. This distinguishes Ogihara from Abusch (1994, 1997a), who claims that intensionality is the trigger of the phenomena. This issue is important for the correct understanding of the phenomena. We will come back to it in the following section.

Empirically, the proposal gives us the right interpretation for the SOT phenomena discussed above. One minor problem might arise in Ogihara's treatment of would. He analyzes would as the past tense + the tenseless future auxiliary woll. Since this is a past under a past environment, the past tense on would can delete. This is the LF (105b) and the resulting interpretation is something that can be paraphrased as Jen said, "Cecilia will move to Amherst", where the moving time is relative to Jen's saying time (or more precisely Jen's subjective 'now' at the time of saying.) The sentence can also have an LF like (105a) by not applying the SOT rule.

Jen said that Cecilia would move to Amherst

a. Jen Past-say that Cecilia woll-Past move to Amherst
b. Jen Past-say that Cecilia will-Ø move to Amherst

The interpretation that is derived from the LF (a) is that according to what Jen said, there was a time t such that t is before Jen's saying time and that Cecilia moves to Amherst in a future time relative to t. This reading is not attested. Ogihara could say that the application of the rule is obligatory in the case of would, or alternatively he could give up analyzing would as the past + woll and treat it along with other modals with special property as suggested in Abusch (1997a) and von Stechow (1995a).

Ogihara also proposes to capture a typological difference between languages like English that exhibits the SOT phenomena and languages like Japanese that do not. He argues that whether the SOT rule is present or absent in the grammar of a given language is a parametric variation. This issue is taken up in §1.6.

It is not clear, however, how to express the content of the SOT rule in a framework such as recent Chomskian syntactic theory including the version we are assuming (Chomsky 1994, 1995), where language- and construction-specific rules have been eliminated and language variation is reduced to morphological differences.

Next, we will look at Abusch (1994, 1997a). Abusch follows Partee (1973) and Enç (1987) and assumes that tenses are pronominal, which can either be bound or left free. One LF corresponding to the sentence in (106a) is (106b). The matrix past tense is free and the embedded past tense is bound by the lambda operator in comp.

(106) a. Bernhard said that Junko was sick
    b. Bernhard Past₁ say λt₂ Junko Past₂ be sick

Tense interpretation serves to relate two times, the event time of a VP and its local evaluation time. A local evaluation time is the speech time in non-intensional contexts and the speaker/believer's 'now' in intensional context. It corresponds to t₂ in the above representation. In her system, tense is a variable, and it saturates the time argument slot of
its complement. In (106), Past1 saturates the time slot of the verb say and Past2 saturates the time slot of the predicate be-sick. Their occurrences are restricted in such a way that a Past variable can only denote an interval that precedes its local evaluation time and a Pres variable can only denote an interval that does not precede its local evaluation time. Thus Past1 denotes an interval that precedes the speech time by this restriction. Past2, however, cannot satisfy this restriction. It is bound by the intensional operator in C and its local evaluation time is $t_2$ by definition. Therefore, it is impossible for Past2 to be bound by the lambda operator $\lambda t_2$ and at the same time denote an interval that precedes its local evaluation time.

To cope with this dilemma, Abusch proposes to employ a system which she calls tense transmission. It is summarized as follows: (Abusch 1997a, p.31)

(i) All temporal arguments are supplied with a relation variable relating their index to local evaluation time, as determined in LF

(ii) An intensional operator such as believe or desire transmits the relation associated with its temporal argument to its intensional argument by a feature passing mechanism. Such relations are cumulative down the tree, so that a tense embedded in an intensional context has access to a set of temporal relation variables.

(iii) The semantics of tense is a constraint on a set of temporal relations, consisting of the local relation together with transmitted relations. For past tense, the constraint is that at least one of the relations must be the temporal precedence relation.

Putting technical points aside, what this does is the following; it makes the restriction of the past tense variable ignored in intensional contexts when embedded under another past tense. In other words, the system allows the tense restriction of the past tense in intensional contexts, such as Past2 in (106) to apply to itself or to the next higher tense, Past1. The former is impossible as we have seen. But the latter can be easily achieved. When applied to Past1, it is required that the interval Past1 denotes be prior to the speech time. This is
already satisfied by the restriction of the \textit{Past1} itself. Thus the representation in (106) satisfies all the tense restrictions and is therefore a legitimate one. This correctly yields the simultaneous interpretation.

Though successful in accounting for the SOT phenomena, the earlier-than-matrix interpretation is problematic in this system. As Heim (1994) pointed out, we have to assume a \textit{de re} theory of tense to derive earlier-than-matrix interpretations. The \textit{de re} theory of tense itself is not a problem. But there are cases that the \textit{de re} theory of tenses cannot handle. One of them results when tenses are embedded under the future auxiliary. Since tenses are time variables that are assignment function dependent, the context has to supply the value when they are not bound. Under normal circumstances, however, contexts cannot assign a specific value to the past tense variable in sentences like \textit{I will marry a man who went to Harvard}.

Lastly, let us discuss another weakness of Abusch's system, her treatment of the present under past constructions. Our first task for the right semantic treatment of these constructions is to explain why they cannot receive the simultaneous interpretation. In Abusch's system, it amounts to explaining why LF representation like (107b) are not grammatical. At first sight, there seems to be no reason why it is ungrammatical.

\begin{equation}
\begin{aligned}
(107) \quad & a. \quad \text{John said that Mary is pregnant} \\
& b. \quad * \quad \text{John Past1 say } \lambda t_2 \text{ Mary Pres2 be pregnant}
\end{aligned}
\end{equation}

The tense restriction on \textit{Past1} requires that the interval it denotes be prior to its local evaluation time, the speech time, and the restriction on \textit{Pres2} requires that the interval it denotes be not prior to its local evaluation time, \( t_2 \). When receiving the simultaneous interpretation, both restrictions are satisfied. Abusch argues that the ungrammaticality is due to the tense transmission. The relation variable associated with the past tense is transmitted down to the present tense. The restriction of the present tense is applied \textit{both} to its own relation variable and the transmitted one. Thus, the transmitted relation variable has
to satisfy two requirements, one imposed by the matrix past tense, which says that the interval that $Past_1$ denotes has to precede the speech time, and the other imposed by the embedded present tense, which says that the same interval should not precede the speech time. Since it is impossible to satisfy both, the representation is ungrammatical.

Notice the difference between the present tense and the past tense as regards how the restrictions are applied. When a present tense is associated with more than two relation variables such as in the case above, it imposes its restriction on all the relation variables. On the other hand, when a past tense is associated with more than two variables such as cases of sequence of tense, it imposes its restriction on at least one of the relation variables. This choice is arbitrary and stipulated in the grammar. The same kind of criticism can be found for the transformational treatment of the SOT phenomena. Under such an analysis, it is stipulated that when embedded by a past tense, a present tense is transformed into a past tense. But there is no rule transforming a past tense into a present tense when embedded under a present tense. This is true not only for the grammar of English but also typologically. In no language does the past tense become vacuous when embedded under a present tense. This fact only follows under Abusch's theory with the stipulation that the past tense restriction applies disjunctively while the present tense restriction applies conjunctively. Under Ogihara's theory, on the other hand, this follows naturally from his rule of deletion under identity of tense features.

1.5.1.6. Are the SOT Phenomena Structural?
Abusch's and Ogihara's theories of the SOT phenomena differ in another respect: whether the SOT phenomena are structural phenomena or not. Ogihara argues that they are. His analysis of the phenomena relies on the notion of c-command. Vacuous past tenses can appear whenever they are in the local scope of a true past tense. Abusch argues that intensionality matters. The issue becomes crucial to account for the tense interpretation in relative clauses. Ogihara argues that the embedded tense in the relative clause in examples like the following may be vacuous. It is c-commanded by the matrix past, and thus properly
licensed. By contrast, relative clauses are not an SOT environment for Abusch. The embedded tense here has to be a real past tense.

(108) Eva talked to the boy who was crying

In examples like (108) above, it is difficult to see empirical predictions of the two theories. Once we allow the embedded tense to be an absolute tense which by some mechanism takes the speech time as its evaluation time, it is possible that the embedded event time and the matrix event time coincide. And the possibility of taking the embedded tense as an absolute tense is necessary to derive the later-than-matrix interpretation. Therefore, examples like the one above cannot be used to distinguish the two theories. Ogihara (1996) argues, however, that the two theories do make different predictions once we embed relative clauses under the future auxiliary.

(109) John said he would buy a fish that was alive

The sentence has an interpretation in which the fish John was going to buy is alive at the time he buys it. Under the structural analysis of the SOT phenomena, the past tense deletion is triggered by the past tense on would, which will also be deleted. Whether Abusch correctly predicts the vacuous past tense in the most embedded clause depends on when relation variable transmission is licensed. Ogihara seems to understand that what Abusch means by intensional operators are intensional predicates such as believe and say. He claims that the only possible trigger to make the most embedded past tense vacuous is the matrix past tense. But this does not yield the interpretation we are interested in. The interpretation that can be derived is the one where the time of the fish being alive is 'simultaneous' to the time of saying, not a future buying time. However, it is reasonable to define the auxiliary would (or more precisely woll) as an intensional operator. If so, examples with the future auxiliary like (109) cannot distinguish the two systems either.
Moreover, the following observation, originally due to Irene Heim, reported in Ogihara (1989, 1996), suggests that these issues might be more semantic in nature.\(^5\)

\[(110)\]  
\begin{enumerate}
\item I know that Mary was a strange child. But her desire to marry a man who resembled her is really bizarre.
\item John's earlier claim that he was innocent is well known
\item He is best remembered for predicting that no computer program would ever beat him at chess
\end{enumerate}

There is a reading where the underlined past tenses are vacuous. But there are no other past tenses that could trigger their vacuousness. In (a), it seems the NP her desire is the trigger. Due to the previous context, we know that her desire should be understood as Mary's past desire when she was a child. In (b), the adjective earlier is the trigger, and in (c) we understand that prediction was made in the past due to the semantics of remember for.

Ogihara maintains the structural analysis of the SOT phenomena and solves these problems by saying that the trigger is not tense morphemes themselves, but features associated with them. The past tense morpheme has the feature [+past]. He further claims that when nouns receive a past interpretation, as in the above examples, they are associated with the feature [+past], too, and this will trigger the SOT.

Abusch, on the other hand, argues that this is also due to the relation variable transmission. She assumes that all predicates, verbal and non-verbal, come with a temporal argument that is overtly represented in the object language. Since relation variables are assigned to all temporal arguments in her system, and these examples contain intensional operators, Abusch correctly predicts the SOT reading in the examples above.

Abusch's assumption, namely, that the time argument of any predicates, including non-verbal ones, is overtly represented in the object language is not uncontroversial. It was first

\[^{51}(a)\text{ is from Abusch (1997a), (b) from Ogihara (1989) and (c) from Heim's lecture notes (1997a).}\]
suggested in Enç (1986), based on an observation in Enç (1981). Recently Musan (1995) has presented data that goes against Enç's treatment of the temporal interpretation of NPs. Musan does not address issue of explicit quantification over times. But her analysis implies that explicit quantification over times is not a necessary step to get the temporal interpretation of NPs right.

This topic concerns us as regards issues of explicit quantification over times per se. We would like to determine what an empirically adequate system of temporal interpretations is. It also concerns us as regards Enç's observation, which shows that not all temporal interpretations of the expressions in a sentence depend on the tense(s) in the sentence. The observation suggests that there is no one-to-one correspondence between tense morphemes and particular temporal interpretations. We will see relevant data in the next section.

1.5.2. Temporal Interpretation of Non-Verbal Predicates

Non-verbal predicates in English are not usually accompanied by an overt element that carries temporal information. This is largely due to a morphological restriction of tense morphemes: they can only attach to verbal predicates such as verbs and auxiliary verbs. To overtly express the temporal location of nouns, adjectives such as former, past, current, or future may be used. Bach (1968), Engdahl (1980, 1986) and Enç (1981) observe that even without these adjectives, we often interpret nouns as if they accompany these adjectives. Here are some examples:

(111) a. Every fugitive is now in jail
    b. Every family member of Mary's graduated from UMass

The sentence (111a) is most naturally understood to mean every (contextually salient) past fugitive is in jail, not every current fugitive is in jail. But the sentence is present tensed, and it does not contain any overt expression to suggest that the relevant individuals are past fugitives. Similarly, the sentence (111b) has a reading where the relevant individuals are
family members of Mary's now but not at the time when they graduated. Again there is no overt temporal expression to yield this interpretation. In these interpretations, the temporal interpretations of NPs are not affected by the tense in the sentences in which they occur. We call these interpretations temporally independent interpretations of the NPs. Some of them are problematic if we assume that tenses (and adjectives like former and current) are the only expressions that carry temporal meanings. For instance, Priorian tense logic gives the following truth condition for the sentence (111a):

(112) \[ [\text{Pres [every fugitive be now in jail]}] ]^t = 1 \text{ iff for all } x \text{ such that } x \text{ is a fugitive at } t, x \text{ is in jail at } t \]

This is the only interpretation that Priorian tense logic can yield, but it is certainly not the interpretation we are concerned with.

Noun modifiers are another type of expression that can have temporally independent interpretations:

(113) a. The homeless people now live in the publicly financed apartments
    b. The dead president was buried yesterday

The subject of the sentence (113a) is most naturally understood as the past homeless people while the sentence as a whole is present tensed. The sentence is contradictory otherwise. The example (113b) shows that the temporal interpretation of the noun modifier can sometimes be independent of that of the noun it modifies. The NP the dead president can refer to somebody who was a president but is now dead.\(^{52}\)

\(^{52}\) Note that we are not making an assumption that dying instantly renders 'normal' human predicates inapplicable. The phrase the dead president could have been used to refer to J.F. Kennedy after Lyndon Johnson had already become a new president.
Previous studies of temporal interpretations of tenseless expressions have focused mainly on nouns. Enç (1981, 1986) and Musan (1995) each develop a system of noun phrase interpretations that makes it possible to obtain temporally independent interpretations. To my knowledge, however, temporal interpretations of other expressions such as those in the examples (113) have not been discussed much in the literature. Enç (1986) briefly comments on this topic. She discusses examples like the dead president and examples like every intelligent linguist, the latter of which does not seem to allow for the adjective to have an interpretation temporally independent of that of the noun, but leaves this issue open.

This is an interesting topic of its own. It also further supports the view that there is no one-to-one correspondence between tense morphemes and particular temporal interpretations, which gives us more clues as to the overall picture of tense and temporal interpretations in natural language. Moreover, it interests us, since we are interested in the SOT effects in relative clauses. Consider the following examples:

(114)  a. Eva talked to the boy who was crying like a baby  
       b. Eva talked to the boy crying like a baby

The noun modifier in (114a) is a relative clause, which has its own tense. The modifier in (114b) is a participle, which is tenseless in English. Yet the (a) and (b) examples have an interpretation that is truth-conditionally identical, namely the simultaneous interpretation: the boy's crying time is understood to coincide with Eva's talking time.

Now consider the following examples:

(115)  a. Ana baked the cake that is lying on the table  
       b. Ana baked the cake lying on the table
Again the (a) and (b) examples have an interpretation that is truth-conditionally identical. But this time it is the speech time interpretation; the cake is lying on the table at the time of the speech.

The difference between (114a) and (115a) in their temporal interpretation has been discussed in much of the literature on the SOT phenomena. All authors concluded that the difference in tense in relative clauses is responsible for the different interpretations. If so, how should we account for temporal interpretations of participles? Should the simultaneous interpretation of the example (115b) be derived in the same manner as that of (115a)? Are relative clauses and participles semantically different? We will ask these questions and try to answer them in Chapter 2.

1.5.3. Summary

When a semantic theory of tense defines the meaning of the present and past tenses, we naturally assume that what we mean by the present or past tense is the tense morpheme. We assume, for instance, that the past tense morpheme in English is what is responsible for the past meaning of sentences that contain a past tensed verb. That is, we assume that there is a one-to-one correspondence between the tense morphemes and the meaning of anteriority or simultaneity. At the beginning of this section, we asked whether this is always true. When looking at simplex tensed clauses, there seems to be a pretty good match. However, there is at least one case where this is not the case, namely the so-called sequence of tense phenomena. We have concluded that there are some occurrences of the past tense that are vacuous. We do not necessarily interpret the past tense morpheme as having the meaning of anteriority.

When we look at the temporal interpretation of nouns and their modifiers, the relation between the temporal meaning and the tense morphemes is much less transparent. Nouns, adjectives, and participles are not tensed in English. If the tense morphemes are the only elements that carry the temporal interpretation, we do not seem to predict the freedom of their temporal interpretation. That is, we do not necessarily need the past tense
morpheme to get the meaning of anteriority. We have to abandon the assumption that there is a perfect one-to-one correspondence, at least partially. Yet a theory of tense should be restrictive enough not to predict that past tensed sentences like *Elliott was in Japan* have the same meaning as present tensed sentences like *Elliott is in Japan*, and vice versa.

1.6. Tense in Non-Sequence of Tense Languages

In the previous sections, we have looked only at the tense and temporal interpretation of English sentences. As evidence showing that there is no perfect one-to-one correspondence between tense morphology and the meaning of anteriority, simultaneity, and posteriority, we discussed the sequence of tense phenomena in English. Some occurrences of the past tense in embedded contexts may be vacuous in English. There are a number of languages that have vacuous past tenses like English. Here are some examples from Dutch and Spanish.  

(116) Jan zei dat hij de krant las
      John say-past that he the newspaper read-past
      'John said that he was reading the newspaper' (the simultaneous interpretation)
      'John said that he had read the newspaper' (the earlier-than-matrix interpretation)

(117) a. Juan dijo que María estaba enferma
      John say/past/perf that Mary be/past/imp sick
      'John said that Mary was sick' (the simultaneous interpretation)

53 SOT phenomena in Spanish are discussed in Gennari (1999a, § 5.2.). Gennari cites Cipria and Roberts (1999), which I have not seen, for an analysis of perfective and imperfective aspects in Spanish. SOT phenomena in Dutch are discussed in Hollebrandse (1996, 1998).
There are some cross-linguistic differences. Recall that eventive predicates usually resist the simultaneous interpretation in clausal complements in English. There are no such restrictions in Dutch. The sentence (116) contains the eventive past tensed predicate las 'read' without being accompanied by the progressive marker. But the sentence has an interpretation that corresponds to the English translation 'John said that he was reading the newspaper.', i.e., the simultaneous interpretation as well as the earlier-than-matrix interpretation. In Spanish, the availability of the simultaneous interpretation with a past tensed predicate depends on the aspect markings, i.e., the perfective vs. imperfective distinction. The simultaneous interpretation is only possible with imperfectives. We believe that the (un)availability of the simultaneous interpretation should follow from the semantics of the imperfective and perfective morphemes. In order to do this, we need to explore the semantics of these morphemes. However, we will not go into details here and leave this issue for future research, because we believe that the semantics of the imperfective and perfective aspect cannot solely be responsible for the SOT phenomena. As we will see below, Slavic languages such as Polish and Russian overtly mark imperfective vs. perfective distinction like Spanish. Yet the past imperfective in these languages cannot yield the simultaneous interpretation when embedded under another past tense. The point we want to make here is that languages like English, Dutch, and Spanish have a way of expressing the simultaneous interpretation by some form of a past tensed predicate.

Not all languages behave like English. Consider the following examples in Japanese and compare them with their English counterparts in (119).
Both the Japanese and the English examples have past tenses in both the matrix and the embedded clauses. The English sentences in (119) are ambiguous between the earlier-than-matrix interpretation and the simultaneous interpretation. What Bernhard said may be something like "Junko is sick" and what Mariko believed may be something like "Mako goes to school by bus every day." The Japanese sentences in (118) are unambiguous; they may only have the earlier-than-matrix interpretation where Bernhard's utterance and Mariko's belief are something like "Junko was sick" and "Mako went to school by bus every day", respectively. In other words, the past tense in Japanese cannot be vacuous when embedded under another past tense.

In order to express the simultaneous interpretation, the present tense must be used in the embedded clause as in (120).

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\[54\] The -teiru form is not glossed. It is most commonly used as a progressive marker. But it also has a habitual interpretation or a resultative interpretation depending on the aspectual nature of the predicates. See Kindaichi (1950) and Jacobsen (1981, 1992). See also Ogihara (1998) for a formal semantic analysis of the -teiru form.
(120) a. Bernhard-wa Junko-ga byooki-da to it-ta
   B-top J-nom sick-be-\textbf{pres} comp say-past
   'Bernhard said that Junko was sick'

   b. Mariko-wa Mako-ga mainiti basu-de gakkoo-ni kayotteiru to
   M-top M-nom every day bus-by school-dat go-teiru-\textbf{pres} comp
   sinziteita
   believe-teiru-past
   'Mariko believed that Mako went to school by bus every day'

These examples should be contrasted with the following English examples;

(121) a. Bernhard said that Junko is sick

   b. Mariko believed that Mako goes to school by bus every day

When a present tense is embedded under a past tense in propositional attitude contexts in English, it induces a special meaning, what is called the double-access interpretation. Roughly speaking, the truth of the sentences in (121) implies that the embedded event is true at the speech time as well as the matrix event time (hence the name ‘double-access’).

In other words, the present tense in English is anchored to the original evaluation time (i.e., the speech time), when it is in the scope of a past tense.

In the Japanese examples in (120), there is no such implication. Those sentences may be uttered truthfully in the same situation where the English sentences (119) are uttered. Languages that do not exhibit the SOT phenomena include Polish and Russian. The examples in (122) are from Russian and those in (123) are from Polish.

\footnote{The precise semantics of the double-access sentences will be discussed in the section on the semantics of the present tense in English. See also Abusch (1991, 1994, 1997a,b), Ogihara (1989, 1995a, 1996, 1999) and Gennari (1999a,b).}
(122) a. Ma_a skazala, _to Vova spit
   M say/past/perf that V sleep/pres
   'Masha said that Vova was sleeping'

b. Ma_a skazala, _to Vova spal
   M say/past/perf that V sleep/past/imp
   'Masha said that Vova had been sleeping'

(123) a. Ania powiedzia_a _e Marcin p_acze
   A say/past/perf that M cry/pres
   'Ania said that Marcin was crying'

b. Ania powiedzia_a _e Marcin p_aka_
   A say/past/perf that M cry/past/imp
   'Ania said that Marcin had been crying'

We will refer to languages like English (i.e., languages that exhibit the SOT phenomena) as SOT languages and languages like Japanese as non-SOT languages.

To sum up, there are (at least) two differences between the two language groups. One concerns the past tense. SOT languages have vacuous past tense while non-SOT languages do not. The other concerns the present tense. As the examples in (120), (122) and (123) show, the present tense in non-SOT languages may be 'bound' by the past tense. It does not show an indexical-like behavior and the event time of present-tensed clauses may be located in the past. This is not true of the present tense in SOT languages. The present tense in SOT languages resists being 'bound' by the past tense. A successful theory of tense should be able to account not only for the data in non-SOT languages but also for the typological difference between the two groups of languages.
What is a successful theory of tenses in non-SOT languages? Recall Priorian tense logic and the problems it faces in SOT languages. The semantics of the past and present tense is repeated below.

(124) Where $\phi$ is a tenseless sentence,
   a. $[[\text{Past } \phi]]^t = 1$ iff there is a time $t'$ such that $t' < t$ and $[[\phi]]^{t'} = 1$
   b. $[[\text{Pres } \phi]]^t = 1$ iff $[[\phi]]^t = 1$

The problems of this analysis concerning temporal interpretation in SOT languages like English are two-fold. On the one hand, it does not predict the availability of the simultaneous interpretation of past under past constructions such as (125a). On the other hand, it does not predict the double-access interpretation of present under past constructions such as (125b).

(125) a. Gordon said that Josephine was pregnant
   b. Gordon said that Josephine is pregnant

What it predicts is earlier-than-matrix interpretations for sentences with past under past and simultaneous interpretations for sentences with present under past. If we look at the temporal interpretation in non-SOT languages such as Japanese, this is exactly what we get. The (a) example with past under past only has the earlier-than-matrix interpretation and the (b) example with present under past only has the simultaneous interpretation.

(126) a. Bernhard-wa Junko-ga byooki-dat-ta to it-ta
   B-top J-nom sick-be-past comp say-past
   'Bernhard said that Junko had been sick'
b. Bernhard-wa Junko-ga byooki-da to it-ta
   B-top J-nom sick-be-pres comp say-past
   'Bernhard said that Junko was sick'

The same is true for other non-SOT languages, too. It might be the case that (some version of) Priorian tense logic is a correct way of looking at tense systems in natural language, and that the data in SOT languages should be treated by some special mechanism. Most, if not all, of the literature on the typology of tense in this respect, such as Comrie (1986), Ogihara (1989, 1996), and Stowell (1993) explains the difference between in SOT and non-SOT languages along these lines.

Although the overall picture of the difference between SOT and non-SOT languages is captured by simple parametric differences such as the presence or the absence of a sequence of tense rule, there are different sets of data that divide languages differently typologically. These data show that not all embedded contexts are the same and that Priorian tense logic does not make correct predictions in non-SOT languages, either. We will see this problem in two different embedded contexts, relative clauses and temporal adjunct clauses (TACs) such as before-, after-, and when-clauses.

Let us begin with relative clauses. In non-SOT languages such as English, when a present tense is embedded in a relative clause under a past tense, as in the following example, the present tense behaves like an indexical.\(^{56}\) The sentence has the interpretation where the time of the boy's crying is understood to coincide with the speech time.

(127) Eva talked to the boy who is crying

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\(^{56}\) Not all present tensed relative clauses under a past tense allow the speech time interpretation. Abusch (1988) observes that when a relative clause modifies a noun that is the object of an intensional verb such as look for and want, the double-access interpretation is obligatory.
In Japanese, the sentence is ambiguous: It has the same interpretation as the English sentence in (127) has. But it also has the interpretation where the time of the boy's crying is simultaneous with the time of the matrix event.

(128) Mariko-wa naiteiru otokonoko-ni hanasikaketa
M-top cry-teiru-pres boy-to talk-past
'Mariko talked to a boy who is (now) crying' (the speech time interpretation)
'Mariko talked to a boy who was crying (at the time of her talking to him)'
   (the simultaneous interpretation)

The availability of the simultaneous interpretation in Japanese relative clauses is not surprising. If tense interpretation in Japanese is to be explained along the lines of Priorian tense logic, this is exactly what we expect, assuming that the tense in relative clauses is in the scope of the matrix tense. The speech time interpretation needs an explanation, however: the tense system in Japanese should allow the present tense in embedded contexts such as (128) to have access to the original evaluation time. This can be done either by adopting a multiple-index system or explicit quantification over times, or by syntactically undoing the embedding.

What is more surprising is the tense behavior in some other non-SOT languages. Consider the following examples from Russian:

(129) a. Ma_a videla _eloveka, kotoryi pla_et
M see/past/imp man who cry/pres
'Masha saw a man who is (now) crying'

57 A comma is always inserted between a noun and a relative clause that modifies the noun in Russian and Polish. Unlike English, the existence of a comma does not distinguish restrictive and non-restrictive relative clauses in these languages. In this thesis, we are concerned with a restrictive interpretation of relative clauses unless otherwise noted.
b. Ma_a videla _eloveka, kotoryi plakal
    M see/past/imp man who cry/past/imp
    'Masha saw a/the man who was crying'

Although Russian patterns with Japanese regarding the tense interpretation in clausal complements, it patterns with English and not with Japanese regarding the tense interpretation in relative clauses. When a present tense is embedded in a relative clause under a past tense as in (129a), the sentence only has the speech time interpretation. In order to obtain the simultaneous interpretation, the past imperfective must be used.

Similarly for Polish:

(130) a. Ania spotkala _lopca, ktory placze
    Ania meet/past/imp boy who cry/pres
    'Ania meet a/the boy who is crying'

b. Ania spotkala _lopca, ktory plakal.
    Ania meet/past/imp boy who cry/past/imp
    'Ania meet a/the boy who was crying'

Another difference between Japanese on the one hand and Polish/Russian on the other shows up in temporal adjunct clauses such as before- and after-clauses as reported in Arregui and Kusumoto (1998). Again, Japanese behaves differently from Polish and Russian, the latter two patterning with English.

Japanese before and after have a special selectional property: mae-ni 'before' only takes present-tensed clauses and ato-ni 'after' only takes past-tensed clauses.
(131) a. [Junko-ga kuru mae-ni] Satoshi-wa kaetta
   J-nom come-*pres* before S-top leave-*past*
   'Satoshi left before Junko came'

b.  * [Junko-ga kita mae-ni] Satoshi-wa kaetta
   J-nom come-*past* before S-top leave-*past*

(132) a. [Junko-ga kita ato-ni] Satoshi-wa kaetta
   J-nom come-*past* after S-top leave-*past*
   'Satoshi left after Junko came'

b.  * [Junko-ga kuru ato-ni] Satoshi-wa kaetta
   J-nom come-*pres* after S-top leave-*past*

In Polish and Russian, there are no such restrictions: When the matrix tense is past, the
embedded tense is also past in both *before*- and *after*-clauses.

(133) a. Ania przysz_a na przj_cie zanim Marcin przyszed_
   Ania come/past/perf to party before Marcin come/*past*/perf
   'Ania came to the party before Marcin came'

b.  * Ania przysz_a na przj_cie zanim Marcin przychodzi
   Ania come/past/perf to party before Marcin come/*pres*/perf

(134) a. Ania przysz_a na przj_cie po tym jak Marcin przyszed_
   Ania come/past/perf to party after this how Marcin come/*past*/perf
   'Ania came to the party after Marcin came'
b. * Ania przysz_a na prz_j_cie po tym jak Marcin przychodzi
   Ania come/past/perf to party after this how Marcin come/pres/perf

(135) a. Ma_a pri_la posle togo, kak Vova u_el
   M. come/past/perf after V. leave/past/perf
   'Masha came after Vova left'

b. * Ma_a pri_la posle togo, kak Vova ujdet
   M. come/past/perf after V. leave/fut/perf

(136) a. Ma_a pri_la do togo, kak Vova u_el
   M. come/past/perf before V. leave/past/perf
   'Masha came before Vova left'

b. * Ma_a pri_la do togo, kak Vova ujdet
   M. come/past/perf before V. leave/fut/perf

This tense distribution is the same as in English; when the matrix tense is past, the tense in
TACs agrees with it.58

58 Barbara Partee (p.c.) pointed out that there are exceptions to this generalization. These exceptions are often found in newspapers and in TV newscasts. (These sentences are
not exact copies of what is reported in a newspaper or a TV news program. They are
constructed by Barbara Partee based on her experience.)

(i) a. Just three days after Kennedy's body was recovered, he will be returned to
   the sea in a private burial

b. Two days after Yeltsin fired his most recent prime minister, he will meet
   with the Duma to present his choice of the new prime minister

(ii) The Prime Minister arrived in Washington four days before he is to meet
    with a special joint session of Congress, and has been meeting with cabinet
    officials and representatives of the Defense Department.

According to Partee, these sentences are slightly odd, and she suspect this happens in
newspaper reporting but not daily conversation because they are trying to use as few words
(137)  a. Nancy came to the party before Meredith left/*leaves/*will leave

b. Nancy came to the party after Meredith left/*leaves/*will leave

We draw the distinction between SOT and non-SOT languages based on their tense behavior in complement clauses. But as we have seen, not all non-SOT languages exhibit the same tense behavior in all embedded contexts. When we try to explain the difference, we should keep in mind that the theory should be extendable to the observed difference among non-SOT languages in relative clauses and TACs.

as possible and want to pack things into a single short sentence which would take more words to say if they didn't permit tense mismatch. We will briefly discuss this in § 3.3.2.