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A CONTEXTUAL ANALYSIS OF
DEFINITE AND INDEFINITE INTERPRETATIONS OF TENSE

BY

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DISSERTATION

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ABSTRACT

This dissertation analyzes tense, in particular the past tense, within English in the framework of formal semantics. Previous tense theories are either indexical or quantificational—whether tenses refer to time or an existentially quantified time interval prior to the time of utterance suffices for a past tense morpheme. This dissertation proposes that tense has both interpretations, definite and indefinite, and which interpretation a tense has depends on whether tense denotes salient times in the context. Tense involves a free variable over times and is assigned its value via an assignment function. Two different readings are achieved by two different types of assignment function: an assignment function fixed by the context assigns salient times to definite tenses, and another type of assignment function for indefinite tenses, which agrees with the function fixed by the context.

In a discourse, times denoted by tenses and temporal adverbials are added to the context as salient. There may be multiple time intervals that are contextually salient, and these are available for the interpretation of subsequent temporal elements. That is, they may work as an antecedent of anaphoric adverbials, be assigned to definite tenses, or possibly, be involved in complex tenses without further proposing a fourth time, as some previous theories have done. The system in this dissertation, with both definite and indefinite interpretations of tense, successfully accounts for some dynamic temporal phenomena without overlooking either quantificational or indexical aspects of tense. Also, this dissertation affirms that tenses are interpreted within a limited domain and shows how temporal domains are selected and shifted in discourse. Temporal adverbials are analyzed as well and some previously raised problems are solved in the analysis. *Immediately* is also investigated, which shows sensitivity to the size of relevant temporal domains and characterizes the interval between the two events it connects.

This dissertation presumes that tense is contextual and relationally determined by time intervals in the context. Contentious ideas in previous tense theories are unified in this dissertation with regard to definiteness, which has been a more robust concept for nominals, and such a framework makes a tense theory more flexible and comprehensive. This theory provides novel intuitions about various temporal phenomena in a discourse, which are contextually and pragmatically shaped.

To My Family

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CHAPTER 1

INTRODUCTION

1.1 How Does Language Encode Time?

How do people perceive time? How does language, which is said to be the essence of humanity, encode time and express unfolding states and affairs bound by time? Such questions have fascinated many philosophers and logicians since Aristotle. Tense is a grammatical phenomenon that relates time and propositions. Comrie (1985: 9) asserts that tense is “a grammaticalised location in time,” most often with respect to the time of utterance.¹ Basically, we start from “now,” the time of utterance, and use different tenses depending on whether the time associated with the tense is before, simultaneous with, or after the “now” time. Not all languages have these three tenses. Some languages have a dichotomy between past and non-past, and some languages do not even mark tenses grammatically. This dissertation aims to present an accurate analysis of tense, mostly the simple past tense, or preterit.

One of the many threads of tense discussion throughout history has been to classify tenses into definite and indefinite ones (Binnick 1991). In the 1700s, Bishop Lowth (1762) proposed a taxonomy of tenses, as shown in (1) (Binnick 1991: 45-46). To Lowth, indefinite tenses were those which had no aspect marked, or, in modern terms, simple tenses. His classification was influenced by the Stoic tense system. (2) shows Holt’s (1943) interpretation of the Stoic system of Greek tenses, in which *indefinite* means that aspect is undetermined (Binnick 1991: 23). In such terms, future and aorist are classified as indefinite tenses; everything else is definite.²

(1) Lowth’s (1762) taxonomy of English tenses:

- a. Indefinite (undetermined): present (*love*), past (*loved*), future (*shall love*)
- b. Definite (determined): present imperfect (*am loving*), present perfect (*have loved*), past imperfect (*was loving*), past perfect (*had loved*), future imperfect (*shall be loving*), future perfect (*shall have loved*)

¹ On the contrary, in the same book, Comrie says that aspect deals with “different ways of viewing the internal temporal constituency of a situation,” which is outside the scope of this dissertation.

² Simply put, aorist corresponds to the simple past in English.

(2) Holt's interpretation of the Stoic tense classification:

	Definite tenses		Indefinite tenses
	<i>Extended</i>	<i>Complete</i>	
Present/future	present	perfect	future
Past	imperfect	pluperfect	aorist

In this long history of tense classification, grammarians have used these terms *definite* and *indefinite* in many different ways. The sense of definite- and indefiniteness of tense suggested by Pickbourn, as cited by Binnick (1991), is as follows: “[an indefinite tense ...] cannot be used in ascertaining the precise time of an individual action ... and a definite tense ... is capable of being applied to that purpose.” In other words, an indefinite tense does not select a specific time interval in the interpretation, while a definite tense does.

In modern day formal semantics, many researchers have been arguing that tenses are referring expressions like pronouns. The distinction I will make between definite and indefinite readings of tense is also relevant to that of definite and indefinite determiner phrases (DPs). Thus, in Pickbourn's terms and based on the meaning of *(in)definite* we use for DPs, intuitive readings of the simple past may be expressed as in (3). An indefinite view of tense is aligned with existential quantification over times, which was advocated by Montague (1973), Dowty (1979, 1982), and Ogihara (1989, 1996). On the other hand, the more recent perspective, as pointed out by Binnick, that simple past denotes a particular time interval, is a referential analysis wherein tense morphemes are treated as a pronoun. This position has been supported by Partee (1973), Enç (1981, 1986), Kratzer (1998), and others.

(3) Intuitive readings of the simple past for a sentence φ :

- a. Indefinite: There is a time t such that φ is true.
- b. Definite: At the designated time t , φ is true.

Let's take Partee's famous sentence (4a) as an example. This sentence is often mentioned as a counterexample to quantificational analyses. As she argues, it seems to accord with the definite reading of the simple past tense: the speaker would have in mind a particular moment in the

past at which she did not complete the action of turning off the stove, and if at this particular interval the speaker did not turn off the stove, then the sentence is true. Let us consider more ordinary sentences—those without negations—typical declarative past tense sentences, such as (4b). Of course, the speaker could pick out the exact time at which John took the garbage out if she was with John, checking the exact time when John was taking out the garbage. However, even though the speaker realizes that the garbage can is empty after she returned home from running errands, (and therefore, not knowing the exact time of the event), if some time interval in which the described event occurred exists and John took out the garbage at some time in the past, the sentence still holds true. John’s action of taking out the garbage does not have to occur at a particular time in the past known to the speaker, as long as there *exists* a time in the past at which the event occurred.

- (4) a. I didn’t turn off the stove.
- b. John took out the garbage.

However, this does not seem to paint the whole picture. Take (5) as an example. The speaker is describing a single accident using two different verb phrases (VPs), whose tenses denote the same time. The first tense may be eligible for an indefinite reading, but not for *bit*—its tense refers to a time that is already quite salient in the context and hardly invokes indefiniteness. Another example in (6) presents a question-answer pair. It may be that the tense used in (6a) is still indefinite, even though the interlocutors are discussing the contextually salient party; however, the tense in (6b) cannot denote a completely random time in the past since it is clearly anaphoric to the tense used in (6a). Examples (4)-(6) cannot be accounted for with only one type of assumption. Though we find both kinds of examples, I have not witnessed an analysis that includes indefinite and definite interpretations of tense. Many tense theories take one stance and only discuss the possibility of the other interpretation. Besides, tense interpretation depends heavily on context, but so far the role that the context plays in tense interpretation has not been explicitly examined.

- (5) I got one tiny scar right there. That’s where a raccoon bit me.

- (6) a. Did you go to the party?
b. Yes, I did.

Therefore, in this dissertation, I propose an analysis that investigates the context sensitivity of tense in more detail, encompassing indefinite and definite uses of tense within the framework of formal semantics. In my analysis, an indefinite tense introduces a free variable that is used over times and is bound by existential closure, and thus is existentially quantified. I will also appeal to domain restriction or *domain anchoring*, in which the context plays a role in providing a pragmatically limited domain for the interpretation of tense. When the context provides a salient time interval, we have a definite tense whose value is fixed by the context. On their own, neither stance can account for tense phenomena. I intend to present a descriptively and theoretically coherent analysis of tense unifying both interpretations of tense.

While it seems plausible to account for both indefinite and definite readings for the simple past in a single system, we now ask how definite interpretations are distinguished from indefinite ones, especially when English does not morphologically mark definite vs. indefinite past, unlike English DPs. I briefly discuss some languages that lack articles and therefore do not overtly mark definiteness of DPs. Given the lack of articles in those languages, it is not an absurd conjecture to state that the definiteness of tense may also be covertly marked, and determined by the context, as observed in other languages in a “parallel” domain.

Now, let us return to this ambitious and challenging question: how does language encode time? Profound ontological reflection about time would be outside the scope of this dissertation; how language users process time and how temporal structure is formed in their mind are fascinating questions, but not the ones to be addressed here. This dissertation may be placed somewhere in the middle of the two fields of study, with a clear focus on the structure of grammar in the framework of formal semantics. It is my intention that this dissertation provides some clue to these intriguing but vast questions.

1.2 Theoretical Premises

In this dissertation I propose a formal semantic theory, that is truth-conditional and compositional (Frege 1892; Montague 1970, 1973; Gamut 1991). We use $\llbracket \]$ to represent denotations of expressions and use letters of the Greek alphabet as variables over linguistic expressions, following

the practice in formal semantics. For any expression α , $[[\alpha]]^w$ is the denotation of α relative to world w . Declarative sentences denote either truth (= 1) or falsity (= 0). Commonly known logical connectives and brackets are also used in this dissertation. For example, in a simple formal language, (7a) may be represented as (7b) where t is a variable over times.

- (7) a. John smiles.
b. $\exists t[\text{smile}(j,t)]$

1.3 Organization of the Dissertation

This dissertation is organized as follows: Chapter 2 reviews some theories of tense from both sides discussed above, quantificational and referential, which are meaningful and commonly discussed in formal semantics literature. After we review the gist of the selected analyses and some challenges they face, we will close the chapter with a conclusion that a proper tense theory should account for both indefinite and definite uses of tense, with advantages for both types of theory.

Chapter 3 presents my analysis of tense, integrating quantificational and indexical aspects of tense. To have a better idea of what we mean by an indexical or a definite tense, we will first discuss definite descriptions and see how we connect definiteness as characterized in one domain of grammar to definiteness/indexicality of tense, which is another domain of grammar. This exploration will provide grounds for expanding parallelism between tense and pronouns to the realm of tense and nominals. This parallelism between nominals and tense as proposed in this dissertation will not only be based on anaphora resolution, but also comes from definite readings of tenses associated with contextually salient time intervals, without any obvious *antecedent* in previous discourse. Different types of assignment function, one fixed by the context, the other in agreement with the assignment which is fixed by the context, will account for these definite and indefinite interpretations of tense.

Based on the grammar established in Chapter 3, in which indefinite and definite uses of tense are allowed, the following two chapters will explore how this phenomenon is at work specifically and how other temporal elements work within such a grammar. Chapter 4 deals with temporal anaphora and temporal phenomena in a larger portion of sentences. We will see how limited temporal domains are selected and shifted within a discourse, and how contextually sali-

ent times and other pragmatic assumptions contribute to this process. Multiple time intervals, which are highlighted as salient, will be available for complex tense interpretation.

Temporal adverbials are investigated in Chapter 5. We will begin with temporal locating adverbials. The presence of a time adverbial within a sentence raises a problem of how the bare tense should be consistently interpreted—that is, whether or not there is a time adverbial. I will present an analysis that solves this problem; further, I will assert that temporal adverbials restrict the context, so that the tense morpheme may be interpreted in a more restricted domain. Also, we will see how different types of temporal locating adverbials contribute in different ways to the context. We will save a section for *immediately*, which not only makes reference to the relevant time interval involved in its interpretation, but also shows sensitivity to its size. Lastly, I will present my conclusions in Chapter 6.

CHAPTER 2

REVIEW: THEORIES OF TENSE

I've made a connection in the Introduction, namely, that the distinction between indefinite and definite tenses in earlier times is analogous to the more recent debate about tense being quantificational or referential/indexical in formal semantics. In this chapter, we will review some of those theories of the nature of tense and tense interpretation—both quantificational and indexical approaches—along with their issues and problems. I will also present some arguments for existential quantification over times, which I hope will lead us to the position that it is the default mechanism for tense interpretation; nevertheless, the indexical property of tense cannot be totally discarded, based on empirical grounds. A proposal that both quantificational and indexical components are indispensable for tense semantics will conclude this chapter. In a way, the finding in this chapter implies that neither approach deserves to be completely recanted or retained. Before we jump into these contentious positions, with hopefully, a reasonable amount of formal details, Reichenbach's idea will be reviewed first, as it has been the underlying theme of many recent analyses of tense.

2.1 Reichenbach (1947)

Among varied perspectives from which Reichenbach's (1947) idea may be summarized, I would like to begin by pointing out that he defined tenses in terms of relations between time intervals. Reichenbach makes references to particular points of time and explains various tenses and aspects in terms of the relationship of those time parameters. The three points of importance in his analysis are the point of speech (S), the point of reference (R), and the point of event (E). The point of speech refers to the time point at which the sentence is uttered, the point of the event is the time when an action takes place, and the point of reference is the time point in which the event is interpreted—which is determined by the context or the progression of the narrative. For example, in the past perfect sentence presented in (1), the point of reference is 'last Wednesday', which precedes the point of speech; and the point of event is when John completed the project, which precedes the point of reference.

(1) Last Wednesday, John had completed the project.

These main time points are specified with respect to another time point, usually the point of speech, and relationally determined tenses and aspects (p. 288). Tenses and aspects in English, according to the combinations of the time parameters, are summarized in (2), where “,” indicates simultaneity and “—” precedence. Main tenses—simple past, present and future—are determined in terms of the relationship between the point of speech and the point of reference. If the point of reference occurs before the point of speech, we have past tense (2b); simultaneous with the point of speech, simple present (2g); after the point of speech, simple future (2l). In the case of simple tenses, the point of reference is simultaneous with the point of event (E, R); hence, it is equivalent to say that we have simple past when the point of the event occurs before the point of speech, simple present when the point of event is simultaneous with the point of speech, and simple future when the point of event takes place after the point of speech.

(2) Reichenbach’s tense representations (p. 297):

<i>Structure</i>	<i>New Name</i>	<i>Traditional Name</i>
a. $E—R—S$	Anterior past	Past perfect
b. $E, R—S$	Simple past	Simple past
c. $R—E—S$	Posterior past	—
d. $R—S, E$	Posterior past	—
e. $R—S—E$	Posterior past	—
f. $E—S, R$	Anterior present	Present perfect
g. S, R, E	Simple present	Present
h. $S, R—E$	Posterior present	Simple future
i. $S—E—R$	Anterior future	Future perfect
j. $S, E—R$	Anterior future	Future perfect
k. $E—S—R$	Anterior future	Future perfect
l. $S—R, E$	Simple future	Simple future
m. $S—R—E$	Posterior future	—

The future tense, according to Reichenbach, is ambiguous, (2h) and (2l), one of the deviations of his system as he calls it. Sentences in (3) are in future tense, but one of them has *now*, which is present, and the other *tomorrow*, which is future (p. 295). According to Reichenbach, adverbials are referred to as the point of reference, not to the point of event.³ *Now* coincides with *S*, and thus *R* coincides with *S*; *tomorrow* follows *now*, and thus *R* follows *S* and coincides with *E*. Since neither one is more prevalently used, Reichenbach claims that both options are retained for simple future.

- (3) a. Now I shall go. (*S*, *R*—*E*)
 b. I shall go tomorrow. (*S*—*R*, *E*)

Six tenses combined with the perfect aspect in English are diagrammed in (4) (p. 290). As you can see in (4) and (2), the reference time (*R*) serves a more important role in determining the perfect tenses. In past perfect, present perfect, and future perfect, the point of event (*E*) always precedes the point of reference (*R*), which is not the case in simple tenses. Namely, the essence of the perfective aspect is well represented, in that the event of interest has already taken place at some point prior to a particular time (*R*) of some importance in the discourse or in the context.⁴

³ Normally, temporal adverbials are anchored to the reference time. That is one way of explaining why these sentences (i) and (ii) are ungrammatical. The reference time of (i) is present and the reference time of (ii) is past, and thus the adverbials are a mismatch for each sentence: i. *John has arrived yesterday.

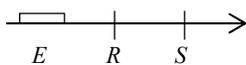
ii. *John arrived now.

However, temporal adverbials seem to be able to anchor to the event time as well. In (iii) and (iv), it is a possible reading that John arrives at 3, in which case *at 3* anchors to the event time. When the adverbial anchors to the reference time, we have a reading that John arrives some time before 3, either in the past or in the future depending on the tense: iii. John will have arrived at 3.

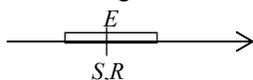
iv. John had arrived at 3.

⁴ Interestingly, the progressive aspect is represented by an extended point of event (*E*). The progressive in each tense in English is illustrated below (p. 290):

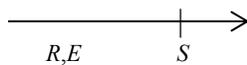
Past, Perfect, Extended
 I had been seeing John



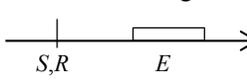
Present, Extended
 I am seeing John



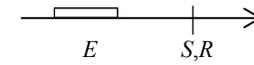
Simple Past, Extended
 I was seeing John



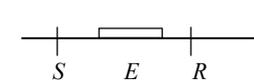
Simple Future, Extended
 I shall be seeing John

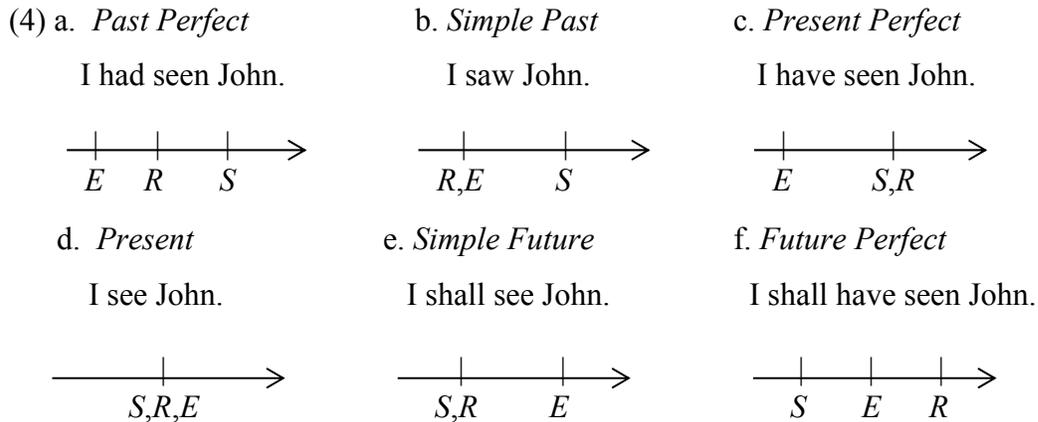


Present Perfect, Extended
 I have been seeing John



Future Perfect, Extended
 I shall have been seeing John





Reichenbach's analysis has a few advantages, especially when compared to an operator system. If the sentence *I saw John* is represented with a past tense operator P, we will have (5a); to represent the past perfect, we would have to iterate the operator as you see in (5b). This arbitrary iteration of operators is not necessary in Reichenbach's system. Also, his system draws a clear semantic difference between past and present perfect. As you will see in more detail in the next section, a classic operator theory would represent past and present perfect with the same operator (either P or H), which does not satisfactorily reflect the difference between past and present perfect in natural language use. On the contrary, Reichenbach distinguishes between past and present perfect by employing different positioning of the reference time (*R*), as shown in (4b) and (4c).

- (5) a. P(I see John)
- b. PP(I see John)

Ogihara (1989, 1996) characterizes Reichenbach's system as compositional, in that various combinations of tenses and aspects are represented individually in accordance with different relationships, between *S* and *R/E* and *R*. Modal auxiliaries, tenses, and perfect may be combined in various and constrained ways in English and such morphosyntactic combinations correspond to appropriate sequences of time parameters at the semantic level. Based on this critique on compositionality, Ogihara takes a step further and points out a problem with Reichenbach's system: Reichenbach's structure does not exhibit the syntactic composition of *will* (present tense + *woll*)

and *would* (past tense + *woll*). A quite complex case, for which the three time parameters of Reichenbach cannot account, is presented in (6). The italicized part of (6) is a subordinate clause in a complex sentence whose main tense is past and which contains the combination of *would* and the present perfect. The problem is that while perfect specifies that the event time precedes the reference time ($E < R$), *would* specifies the contradictory order $R < E$; what *would* indicates in terms of the relationship between the time parameters is supposedly that, according to Ogihara, the event time (E) occurs later than some point (R) in the past. To resolve this problem, Ogihara proposes the fourth time point, the Quasi-reference point (QRpt), which is revised as the reference time for a modal verb (RM, not the reference time for a tense morpheme, which is RT) in his later work (1996). Of course, his famous *Sequence-of-Tense* analysis is built up from this structure later in his system.⁵

(6) John and Bill were talking about the July 28th deadline for the submission of dissertations.

John said that *Mary would have finished hers a month before that*. (Ogihara 1989: 36)

If you construe Reichenbach's analysis as one using three time parameters, you will find a copious number of implementations of this idea, either thorough or rough. The gist of the Reichenbachian system, that tenses are determined in terms of the relationship between particular time points, is retained in Klein (1994), among others. As Klein summarizes, "Tenses are grammaticalised temporal relations" (p. 120). Only, Klein did not agree with having the reference time as the third time; he claimed that the reference time is vacuous and rather vague, and that it cannot be completely identified with either the time of other event in a discourse or the time pointed out by a temporal adverbial (pp. 25-26). Instead, he proposed the *topic time* (TT, which Demirdache and Uribe-Etxebarria (2005, 2007) call the *assertion time*) as the third time. TT is "the time for which a claim is made" or "the time span to which the speaker's claim is confined" (pp. 3-6). For example, the event time (or the *time of situation* in Klein's terms) in (7a) is the time during which the light was on, which precedes the time of utterance. The topic time of (7a) becomes more understandable if you think of it as an answer to (7b): simply put, the topic time for (7a) would be the time at which the hearer looked into the room. The question would be

⁵ In referring to adding another time index, Dowty (1982) proposed the quasi-speech time in addition to the two time parameters—the speech time and the reference time—in his analysis in order to account for embedded sentences under future tense. More detail will come in the next section on Dowty's analyses.

whether the light was on at the time of interest of the interlocutors, not the entire duration of the light being on. If the light is on at the topic time, the sentence is true; and since it is a past-tensed sentence, the topic time precedes the utterance time.

(7) a. The light was on.

b. What did you notice when you looked into the room? (Klein 1994: 2-4)

The topic time of Klein, however, does not seem, in its function, different to me from the Reichenbachian notion of reference time. Klein's words that define topic time might be clearer and more constrained, but the times referred to as the topic time in discourses are the same times picked out as the reference time. For instance, in (8) from Klein (1994: 40), the TT is fixed by the *when*-clause in the question. However, Reichenbach would choose the same time at which the addressee enters the room as the reference time. Unless the TT is fixed by a *when*-clause or an adverbial, its concept is still vague as well.

(8) What did you notice when you entered the room?

Moreover, Klein basically makes the same claims about the relationships between the time parameters that determine tenses and aspects, though these are not the only claims about the definition of tenses and aspects. (9) stipulates the relation between the TT and the TU for simple tenses and the relation between the TT and the TSit; and in Reichenbachian terms, (9a) and (9b) amount to saying that tense concerns the relation between the reference time and the speech time, and aspect concerns the relation between the reference time and the event time, which was already made clear above.

(9) a. Tense concerns the relation between TT and TU (time of utterance).

b. Aspect concerns the relation between TT and TSit (time of situation)—the way, or sometimes ways, in which some situation is hooked up to some TT. (Klein 1994: 6)

Whether you use the reference time or the topic time for this third time parameter, there seems to exist some conceptually substantive time in a speaker's mind, which is necessarily in-

volved in the determination of tenses and aspects. Time intervals picked out by *when*-clauses or temporal adverbials will come up again as a *temporal domain* in Chapter 4. A more faithful implementation of the Reichenbachian system would be found in Nerbonne (1986). Demirdache and Uribe-Etxebarria (2005, 2007) use the time parameters suggested by Klein and propose the syntax of tenses and aspects in relational terms.

2.2 Quantificational Theories of Tense

What is more significantly contentious in tense discussion in formal semantics is whether tense contains a quantificational or indexical interpretation. In this section we will first review a few significant analyses, which assume (or are equivalent to) existential quantification over times. I would like to begin with Prior's (1967) operator system, which provided a logical basis for more recent quantificational theories of tense semantics.

2.2.1 Prior (1967) and Montague (1973)

Prior's (1967) semantics of tense treats tense as a sentential operator. For example, let us say that the sentence *John runs a marathon* corresponds to φ ; if this proposition occurs in the past tense, that is, *John ran a marathon*, it is now represented as $P\varphi$. Likewise, for φ in the future tense, Prior used another operator, F . These operators are defined in (10).

- (10) a. $P\varphi$ is true iff it has been the case that φ .
- b. $F\varphi$ is true iff it will be the case that φ .

Though it is intuitive, the Priorian tense system has faced some challenges. As briefly mentioned above, an operator system does not distinguish the preterit and the perfect as both tenses are represented by a single operator, P . The behavior of preterit and perfect, however, is different, particularly with temporal adverbials. Adverbials that denote time intervals in the past occur with the preterit, but those that are relevant to the present occur with present perfect. For example, (11a) is good, but (11b) is not; (11c) is odd, but (11d) is not, as time intervals denoted by *since 1999* include those in the present as well.

- (11) a. Last Friday, John ran a marathon.

- b. #Last Friday, John has run a marathon.
- c. #John played the cello here since 1999.
- d. John has played the cello here since 1999.

Another problem with regard to operators comes from the fact that this system would iterate tense operators to mark complex tenses like past perfect and future perfect. As shown in (12a), past perfect would be represented with iterated operators PP. But what is observed in natural language is slightly different: strictly speaking, there is one tense per clause, and as can be seen in (12a), an additional tense(-like) morpheme indicates aspectual subtleties of the given event. There is the interesting example of stacking tense morphemes in Korean: (12b) shows a case in which the past suffix *-ess* is repeated three times with some additional pragmatic effect. This is not often found, but not impossible, especially in informal contexts. Notice, however, that this is the upper limit on the number of occurrences of *-ess* in a clause without a facetious tone, and that it is unnatural to observe that all three of those suffixes serve purely temporal purposes even though they have morphologically identical forms. Shin (1988) points out that the suffix *-ess* has an aspectual meaning of discontinuity and each suffix has a different semantic scope.

- (12) a. John had run a marathon: PP[run-a-marathon(J)]
 b. John-i marathon-ul hay-(e)ss -ess -ess -ta
 Nom Acc do Past Past Past Dec
 ‘John had run a marathon.’⁶

Also, the operator system has scope-induced problems when tense operators interact with negation and/or a time adverb which introduces another operator. Partee’s example, *I didn’t turn off the stove* as uttered, for example, in a car to a friend about what happened immediately before the speaker departed for the current outing, clearly shows a bad interaction between a tense operator and negation. The two possible interpretations of the sentence are stated in (13) below. (13a) would be true if there is any time in the past during which the speaker did not turn off the stove; (13b) tells us that not even once in the past did the speaker turn off the stove. However, what we understand is that the speaker did not turn off the stove at some time in the past—specifically,

⁶ *Nom* indicates a nominative marker, *Acc* an accusative, and *Dec* a declarative.

close to the time she left home. This problem still holds if you change the operator in (13) to the existential quantifier in (14). Due to this faulty interaction, Partee (1973) suggests that tenses refer to a specific point of time like pronouns, rather than being existentially quantified. This indexical or referential approach, with which Enç (1986, 1987) and others concur, will be discussed in more detail in the next section.

- (13) a. $P\neg$ (I turn off the stove)
 b. $\neg P$ (I turn off the stove)

- (14) a. $\exists t$ [t precedes the time of utterance $\wedge \neg$ [I turn off the stove]]
 b. $\neg\exists t$ [t precedes the time of utterance \wedge I turn off the stove]

A more serious problem arises with temporal adverbials, a problem which in the literature has been dubbed the *adverbial scope paradox*. Consider the sentence φ , *John gave a speech yesterday*: the interval at which John gave a speech falls within the time frame denoted by *yesterday*. Under an operator system, as *yesterday* introduces a new temporal operator Y , for example, to the sentence φ , which means *it was yesterday that φ* , we now have two options for interpreting the sentence, as presented in (15). Roughly, (15a) says that it is true in the past that it was yesterday (or the day before) that John gave a speech, and (15b) says that it is true that it was yesterday that in the past that John gave a speech. Either way, they place the time interval at which the event took place at some point even before *yesterday*, which is the day before the day containing the time of utterance. And of course this is not the desired reading. To solve this problem, a Priorian tense logic would suggest that we only keep the operator introduced by *yesterday* and eliminate P , introduced by the past tense. Such an approach, however, does not provide a compositional explanation, since the past tense and the temporal adverb are analyzed as a single unit, as if the past tense is no longer effective, given the presence of the temporal adverb.

- (15) a. PY [give-a-speech(J)]
 b. YP [give-a-speech(J)]

There are two more examples that an operator system cannot explain. The examples in (16) are discussed in Kamp (1971) and repeated in Ogihara (1989, 1996) and Binnick (1991). Priorian tense logic may explain (16a) as in (16c): when F is under the scope of P, *will* could turn into *would*. But it cannot explain the embedded future in (16b): the time at which this child becomes king is later than the time of utterance, outside the scope of the past, and the child is not king yet while (16b) is being uttered. These complications are presented by complex tense-under-tense structures, which have posed some challenges to other approaches as well. Ogihara (1989) proposed his tense deletion theory, recanting Reichenbach's system, to account for the sequence-of-tense phenomena, and Dowty (1982) proposes the fourth time parameter to make sense of future-under-future sentences, and so on.

- (16) a. A child was born who would become king.
- b. A child was born who will become king.
- c. $P(\text{a child is born and } F(\text{it becomes king}))$

(17) also causes a problem, as pointed out by Enç (1986). (17b) and (17c) with a tense operator P are possible readings for (17a), but we have a serious problem with (17c). Since both noun phrases, *rich men* and *obnoxious children*, are bound by the single past tense operator, being a rich man and being an obnoxious child are happening at the same time, which is not possible. Plus, (17a) could be read to mean that some of the men are rich only in the present and some were rich in the past as well; but (17b), not to mention (17c), does not present such an interpretation because it merely states that all men are rich in the present.

- (17) a. All rich men were obnoxious children.
- b. $\forall x [\text{rich-man}(x) \rightarrow P[\text{obnoxious-child}(x)]]$
- c. $P\forall x [\text{rich-man}(x) \rightarrow \text{obnoxious-child}(x)]$

Adopting Prior's assumption that tense is a scope-taking propositional operator, Montague (1973) presents an analysis that tense in effect is interpreted as an existential quantification over times. Montague uses two operators, *W* and *H*, which are read as "it will be the case that" and "it has been the case that" (Notice that there is no distinction between past and present per-

fect). For a formula φ , $W\varphi$ and $H\varphi$ are defined in (18) in the metalanguage. \mathfrak{A} is a model, j is a time of evaluation, and \leq indicates a linear ordering. Notice that both (18a) and (18b) are equivalent to existential quantification in that there is a time in the future or in the past at which φ occurs; φ is true at j , which is either in the future or the past.

- (18) a. $[W\varphi]^{\mathfrak{A},i,j,g}$ is 1 iff $\varphi^{\mathfrak{A},i,j',g}$ is 1 for some j' such that $j \leq j'$ and $j' \neq j$.
 b. $[H\varphi]^{\mathfrak{A},i,j',g}$ is 1 iff $\varphi^{\mathfrak{A},i,j,g}$ is 1 for some j' such that $j' \leq j$ and $j' \neq j$.

This is where the difference from Prior's perspective comes in: of course Montague's system is model-theoretic, in that expressions are evaluated in the model and relative to the indices, but not only that—times in the past or in the future are real to Montague, but not to Prior. Prior contends that what actually exists is present, not past or future; thus, he would not allow for the relativization of denotations to times. This distinction concerns their ontological commitments to the notion of time, that are discussed in more detail in McTaggart (1908), Prior (1967), and Binnick (1991). Since Montague maintains that tense is a propositional operator, his analysis is still bound by the problems of the Priorian system, as discussed thus far.

2.2.2 Dowty (1979, 1982)

Dowty (1979) directly uses the existential quantifier in his analysis, as represented in (19). (19a) is the definition of the AT operator; (19b) and (19c) are the definitions of the tense predicates, clearly given in his fragments. Dowty treats PAST, PRES, and FUT as predicates of times; AT is a two-place operator which connects a tensed sentence and a particular time interval, chosen by the tense; i is an interval of time, t is a variable over times, τ is a meaningful expression of type of intervals, and φ is a sentence. After the rules are applied, the sentence *John slept* in (20a) is translated as in (20b). (20b) reads something like, *For some past time t , John's sleeping is true at t .*

(19) Dowty's (1979) tense interpretation rules (pp. 353, 359)

- a. $[[AT(\tau, \varphi)]]_{\mathfrak{A},w,i,g} = 1$ iff $[[\varphi]]_{\mathfrak{A},w,i',g} = 1$, where $i' = [[\tau]]_{\mathfrak{A},w,i,g}$.
 b. $[[PAST(\tau)]]_{\mathfrak{A},w,i,g} = 1$ iff there is some non-empty $i' \in I$ such that $[[\tau]]_{\mathfrak{A},w,i,g} < i' < i$.
 c. $[[PRES(\tau)]]_{\mathfrak{A},w,i,g} = 1$ iff $[[\tau]]_{\mathfrak{A},w,i,g} = i$.

(20) a. John slept.

b. $\exists t[\text{PAST}(t) \wedge \text{AT}(t, \text{sleep}'(j))]$

Using quantifiers over times is more expressive than a simple propositional operator system, as a variable under the scope of one quantifier can be related to another variable, which is outside the scope of the quantifier.⁷ Also, if we analyze (17a) as (21) using quantifiers rather than a propositional operator, we can account for the sentence because, now, time parameters can be more freely bound by quantifiers. Note here that Enç's (1986) idea that NPs, not only verbs, take a pragmatically defined time argument is also applied. The variable i_1 is bound by the universal quantifier and thus it covers all the time intervals related to each man denoting different times for each man; all the intervals coincide with or follow i_2 . So, (21) says that all rich men who were or are rich at different times were all obnoxious children at i_2 . This is the missing reading pointed out above, and it is now obtained with quantifiers over times and time arguments for NPs. But referentialists would argue that, as previously mentioned, this type of existential quantification over times cannot explain the bad interaction between the existential quantifier and negation as found in *I didn't turn off the stove*.

(21) $\forall i_1 \exists i_2 [\forall x [\text{rich-man}(x) \text{ at } i_1] \rightarrow [\text{obnoxious-child}(x) \text{ at } i_2] \wedge [i_2 \leq i_1]]$

The biggest difference in Dowty (1982) from his earlier work would be that he uses multiple time indices. He proposed this technique in order to solve the adverbial scope paradox. What was first suggested in Dowty (1979) is called a syntactic solution: a separate set of rules for adverbials is proposed, and applied to tenses that occur with a temporal adverbial in the same sentence. It is not an easy task to select the correct rule to apply to temporal adverbials, and it is a disadvantage to have two separate sets of tense rules depending on the presence or absence of a temporal adverbial. Dowty's (1982: 32) new set of tense rules in (22) with double indices now semantically solves the scope paradox problem.

⁷ Such an example is given here, thanks to Lasersohn: $\exists t[t=\text{now} \wedge \text{AT}(t, \alpha(a, \exists t'[t'<t \wedge \text{AT}(t', \beta(b, \exists t''[t''=t \wedge \text{AT}(t'', \varphi)])))]]$. The quantifier for t'' is in the scope of the quantifier for t' , but t'' is related to t , which is not possible in an operator system.

- (22) a. $\llbracket \text{PRES } \phi \rrbracket^{ij} = 1$ iff $\llbracket \phi \rrbracket^{ij} = 1$ and $i = j$.
 b. $\llbracket \text{PAST } \phi \rrbracket^{ij} = 1$ iff $\llbracket \phi \rrbracket^{ij} = 1$ and $i < j$.
 c. $\llbracket \text{FUT } \phi \rrbracket^{ij} = 1$ iff $\llbracket \phi \rrbracket^{ij} = 1$ and $j < i$.

This multiple-indexing technique is accredited to Kamp's (1971) proposal to solve the problem pointed out in (16b). In order to account for the reading that a child who is not currently a king was born, Kamp inserts N before F, which is now under N, not P, and thus, the reference time is no longer in the past, but is now the time of utterance, so that we have the future tense in relation to *now* (the time of utterance).

- (23) a. A child was born who will become king.
 b. P[a child is born and NF[it becomes king]]

As I have briefly mentioned above, Dowty (1982) proposes the fourth time parameter in the sense of Reichenbach, the quasi-speech time, which offers a three-indexing interpretation. What made Dowty propose another time index is (24): according to Dowty, the event of finding a unicorn takes place not on *tomorrow*, the day after the day containing the time of utterance, but the day after *tomorrow*, because *tomorrow'* is under the scope of the FUT of the main clause. However, if you look closely at the new addition to the rules in (25), with Dowty's original notations, this third index j is not so much needed other than in this future-under-future adverbial context. Also, as Dowty himself points out, the motivation for double indexing no longer serves its purpose, in that tenses and temporal adverbials are now interpreted in relation to different time indices—tenses to the quasi-speech time and adverbials to the actual speech time. Again, it seems possible to solve this problem if we forgo the assumption that tense is a scope-taking operator. Interpretation of tenses and temporal adverbials will be tackled in more detail in Chapter 5.

- (24) a. John will meet a man who will find a unicorn tomorrow.
 b. FUT ... *tomorrow'*(λt [... FUT ...]) ...] (Dowty 1982: 51)

(25) Revised tense rules with the quasi-speech time (Dowty 1982: 52)

Definition of *true₃* relative to a triple of intervals $\langle i, j, k \rangle$:

(Here i = ‘reference time’, j = ‘quasi-speech time’, and k = ‘actual speech time’)

[[PRES ϕ]] ^{i,j,k} = 1 iff [[ϕ]] ^{i',j,k} = 1 for some $i' \leq i < j$

[[PAST ϕ]] ^{i,j,k} = 1 iff [[ϕ]] ^{i',j,k} = 1 where $i' = j$

[[FUT ϕ]] ^{i,j,k} = 1 iff [[ϕ]] ^{i',j,k} = 1 for some $i' < j$.

[[*tomorrow*]] ^{i,j,k} = the set of all sets of intervals containing an interval falling within the
Day after the day containing k .

A triple $\langle i, j, k \rangle$ is an *utterable context* iff $j = k$.

If $\langle i, j, k \rangle$ is utterable, then ϕ is *true₁* at k iff there is some i such that ϕ is *true₃* relative to $\langle i, j, k \rangle$.

2.2.3 Ogihara (1989, 1996, 2006)

Ogihara (1989, 1996, 2006) forcefully defends a quantificational interpretation of tense. His formal language and analysis are similar to Dowty’s, and Ogihara (1989) also uses the AT operator, but not in Ogihara (1996). In Ogihara (1996), tensed verbs have an argument position for a time; as was mentioned above, the quasi-reference time (t_{QR}) becomes the reference time for a modal verb (t_{RM}). Let us take a look at some definitions from Ogihara (1996).

Tenses are defined as given in (26). t_{RT} is the reference time associated with the tense morpheme, and t_{RM} is the reference time associated with the future auxiliary (p. 58). As we have seen above, *woll* is due to the syntactic decomposition of *will* and *would*. (26a) shows that the past tense is defined in terms of the relation of two time intervals, and in matrix clauses t_2 is the speech time (s^*). What brings about existential quantification over times is the manner in which the truth of a tensed matrix sentence is defined, as shown in (27). The sentential existential quantifier requires the existence of some time interval (in relation to the speech time) at which the sentence is true.

(26) Ogihara’s (1996: 60) definitions of tense items:

a. *Past* = $\lambda t_1 \lambda t_2 [t_1 < t_2 \ \& \ t_1 \subseteq t_{RT}]$

b. *Pres* = $\lambda t_1 \lambda t_2 [t_1 = s^* \ \& \ t_1 \subseteq t_{RT}]$

c. *woll* = $\lambda t_1 \lambda t_2 [t_2 < t_1 \ \& \ t_1 \subseteq t_{RM}]$

(27) Ogihara's sentential truth (1996 : 58):

An *IL* expression ϕ of type $\langle i, \langle i, t \rangle \rangle$ that serves as a translation of a natural language matrix sentence is true in the context c (in the structure M) iff there is a time $i \in T$ such that $\llbracket \phi \rrbracket_{M, c_W, g_c, c} (c_T)(i) = 1$ (equivalently, $\llbracket \exists t[\phi(s^*)(t)] \rrbracket_{M, c_W, g_c, c} = 1$).

Now, (23a), repeated in (28a), is represented in Ogihara's style as you can see in (28b), including Ogihara's notations (1996: 35). A time variable due to tense is existentially quantified according to (27). He makes clear the point that some temporal expressions, such as *would* are sensitive to the evaluation time or serve to order the time relation in accordance with a shiftable time interval, and expressions such as *will* and *now* are sensitive to the speech time (p. 35). Tense morphemes are sensitive to the context, as well as to different elements of the context.

(28) a. A child was born who will become king.

b. $\exists t[t < s^* \ \& \ \exists x[\text{child}'(t, x) \ \& \ \text{be-born}'(t, x) \ \& \ \exists t'[s^* < t' \ \& \ \text{becomes-ruler-of-the-world}'(t', x)]]]$

Ogihara (1996) did not include existential quantification as part of the lexical semantics of tense morphemes, and instead chose to let the truth definition take care of that aspect. Ogihara (2006: 233) introduces another possible technique to achieve the quantificational force—temporal expressions, such as tensed verbs, are defined in such a way that what a tense describes holds *within the time* denoted by its time argument, not *at the time*. (29) is a denotation of a tensed version of the proposition that John is eating lunch. The value of the variable t over times is assigned via g , and John eats lunch during $g(t)$, not at $g(t)$.

(29) $\llbracket \text{eats_lunch}(\text{John}, t) \rrbracket^g = 1$ (Ogihara 2006: 233)

As quantifiers, instead of propositional operators, are used and as more time parameters are used to determine the reference point of temporal expressions, we have more flexibility in tense interpretation—especially in the interpretation of complex tenses and embedded tenses. Actually, Ogihara is more famous for his *sequence-of-tense* theory: his main complaint about the

referential approach comes from Enc's (1987) treatment of embedded tense (see Ogihara (1989, 1996) for more detail). Ogihara's tense deletion rule will be discussed again in Chapter 4.

2.3 Indexical Theories of Tense

A referential/indexical analysis basically assumes that tense behaves like a pronoun, denoting a particular time. This position has been maintained by Partee (1973, 1984), and Enç (1986), among others. These authors disputed the notion that tenses are scope-taking sentential operators. Let us start with Partee's claims and move on to Enç.

2.3.1 Partee (1973, 1984)

Partee (1973) holds that tenses are parallel with pronouns, which have deictic, anaphoric, and bound variable uses. We are able to find uses of tense that correspond to all three. The value of deictic pronouns is dynamically fixed by the context: sometimes this occurs by pointing with a finger as (30a) shows, or others by shared knowledge between the interlocutors, such as in (30b) when they clearly know who they are talking about, or in cases such as (30c), in which the referents of the pronoun are not so clear. Deictic tenses are parallel with deictic pronouns. The time denoted by the tense in (30d) is fixed by the extra-linguistic context and in (30e), like (30c), the tense refers to whenever it was that John went to school, though the time it refers to is left vague. (30d) was mentioned in (13): if we adopt the concept that the tense refers to a particularly fixed time interval by the context, we no longer have the scope paradox.

(30) a. Deictic pronouns: *He shouldn't be in here.*

b. *She left me.*

c. *They haven't installed by telephone yet.*

d. Deictic tenses: *I didn't turn off the stove.*

e. *John went to a private school.* (Partee 1973: 602-603)

A pronoun is also anaphorically used in the following sentences: in (31) from Partee, *it* in (31a) refers to *the car* in the first clause, and *he* in the second part of (31b) refers to the first *he*, modified by the relative clause. Tense also has an anaphoric use in which the tense in the subse-

quent clause indicates the same time, as denoted by the tense in the antecedent clause, as in (31c) and (31d).

- (31) a. Anaphoric pronouns: *Sam took the car yesterday and Sheila took it today.*
b. *He who stole my cow, he will suffer the penalties.*
c. Anaphoric tenses: *Sheila had a party last Friday and Sam got drunk.*
d. *When Susan walked in, Peter left.* (Partee 1973: 604-605)

A bound variable use of pronouns is found in (32a) and (32b). The value of *it* in (32a) is set and reset depending on which arrow hits the target or who does the speaking. Similarly, tenses sometimes behave like a bound variable whose value depends on the interpretation of its previous tense. The time denoted by the consequent clause is specified by the proper interaction with the time denoted by the tense in the antecedent clause, as if the tense in the consequent clause is bound by the tense in the antecedent clause.

- (32) a. Bound variable pronouns: *If one of the arrows hits the target, it's mine.*
b. Bound variable tenses: *If Susan comes in, John will leave immediately.*
(Partee 1973: 605-606)

Dowty (1982), in arguing the case for his double indexing analysis of tense, shows that (30d) *I didn't turn off the stove*, which a normal quantificational analysis has difficulty explaining, can be accounted for with his two time indices. On the one hand, this is how Dowty's double indexing accounts for the indexical character of the past tense (p. 37): truth is defined as in (33), so that the reference time works as a contextual parameter. With this being the case, the reference time can now refer to the particular time in the near past, at which the speaker did not turn off the stove (which sounds very much like Klein's conceptualization of topic time). Recall (22), in which tenses are defined merely in terms of the precedence relation between the reference time *i* and the speech time *j*. On the other hand, even though Dowty proposed a quantificational approach, he concedes the indexical character of the past tense. A quantificational theory can account for (30d) with an addition, which will be discussed in the next section.

(33) ‘ ϕ is true₂ at $\langle i, j \rangle$ ’ is interpreted as ϕ is true when uttered at j and used to talk about the time i ’.

What Partee (1984) primarily discusses in her later work is temporal anaphora resolution, which exclusively focused on the anaphoric usage and bound variable usage of tense, in the framework of Discourse Representation Theory. She claims that the reference time plays a crucial role in temporal anaphora (p. 256). Let us take the example of (34), in which Partee quotes from Hinrichs (1981) (Partee 1984: 254). e indicates an event and s a state. According to Partee, as represented in (35), where r_0 is some reference time in the past and r_s is the current reference time, reference times must include event times and be included within state times. That is, e_1 is included in r_0 and introduces another reference time, r_1 , which occurs slightly after the event. This new reference time includes the next event time, and so on.

(34) Jameson entered the room (e_1), shut the door carefully (e_2), and switched off the light (e_3).
It was pitch dark around him (s_1), because the Venetian blinds were closed (s_2).

(35) a. $e_1 \subseteq r_0$

b. $e_1 < r_1 < r_s$

c. $e_2 \subseteq r_1$

d. $e_2 < r_2 < r_s$

e. $e_3 \subseteq r_2$

f. $e_3 < r_3 < r_s$

g. $r_3 \subseteq s_1$

h. $r_3 \subseteq s_2$

(part of Partee’s DR from p. 255)

Due to this characteristic of the “moving forward of time” in temporal anaphora, Partee retracts her original claim that tenses are referring expressions. She abandons the idea of direct parallelism between tenses and pronouns and argues that tense does not directly refer to times. Also, as Partee points out, time intervals denoted by consecutive clauses or sentences do not always perfectly coincide. Obviously, in the following example from Partee, Jones’ introduction of Smith occurs before Smith speaks: *When Smith spoke, Jones introduced him*. In the previous ex-

ample *When Susan walked in, Peter left*, the time interval at which Susan walked in may not precisely overlap with the time interval at which Peter left. However, as we have seen, Partee maintains the idea that tenses are anaphoric, and thus her analysis is still indexical.

2.3.2 Enç (1981, 1986)

Enç (1981, 1986) forcibly proposes a scopeless tense theory and argues that NPs and tensed VPs are indexicals, and therefore tense does not affect NPs. Including (17) as we discussed above, Enç presents a series of problems with the traditional scope-taking tense operators. (36) provides another such example. Consider a situation (36b) for (36a). We have three individuals who are currently seniors, as well as a group of former, current, and future US Presidents, whom each senior will have met individually. Suppose that we are currently in Ronald Reagan's Presidency, which includes the time of utterance and the days before and after it, and that President George H.W. Bush will become the next president, in January of 1989. Now let us say Bob had met Lyndon Johnson during his Presidency, Mary met Bush yesterday and therefore Bush is not yet a President, and tomorrow Tom will meet the current President, Reagan. By February of 1989, when H.W. Bush becomes the President, (36a) will turn out to be true.

(36) a. Every senior will have met a President. (Enç 1986: 408)

b. Seniors = {Tom, Mary, Bob}

Presidents = {Johnson, Reagan, Bush}

During Johnson's Presidency: Meet(B, J)

The day before the time of utterance: Meet(M, B)

The day after the time of utterance: Meet(T, R)

Now, let us try to capture this reading with a traditional operator system, with the three possibilities as seen in (37). Each tense operator corresponds to a tense morpheme; thus we have F for *will* and P for the perfect, in this order. In order to obtain the reading with (36b), we need to quantify over a past President, a current President, and a future President, which is impossible to represent with quantifiers and propositional tense operators. (37a), (37b), and (37c) may be roughly paraphrased as (37a'), (37b'), and (37c'), respectively. (37a') says that someone is a President some time between February of 1989 and the time of utterance, or even before the time of

utterance, which may be Reagan or Johnson, but not Bush; therefore, (37a) is false. (37b) is false because Johnson and Bush are not currently Presidents; (37c) is false because Johnson is someone who *was* a President.

(37) a. $\forall x[\text{senior}(x) \rightarrow \text{FP } \exists y[\text{president}(y) \ \& \ \text{meet}(x, y)]]$

a'. For all seniors, someone who will have been a president they will have met.

b. $\forall x[\text{senior}(x) \rightarrow \exists y[\text{president}(y) \ \& \ \text{FP } \text{meet}(x, y)]]$

b'. For all seniors, someone who is currently a president they will have met.

c. $\forall x[\text{senior}(x) \rightarrow \text{F } \exists y[\text{president}(y) \ \& \ \text{P } \text{meet}(x, y)]]$

c'. For all seniors, someone who will be a president they will have met. (Enç 1986: 408)

One might argue that we stipulate that tense operators are strictly local and VPs do not interact with NPs to save the operator approach. However, Enç claims that this is too restrictive and cannot account for other scopal interaction between VPs and NPs. Instead, in order to account for the time-sensitivity of VPs and NPs, she proposes that VPs and NPs take a temporal argument. One difference between a VP temporal argument and an NP temporal argument is how their temporal arguments are motivated and assigned their value. A VP temporal argument is morphologically motivated, but the value of the temporal argument of a noun will be available if it is possible for the context to provide one. Since the temporal interpretation of NPs is pragmatically fixed, independently of the verb tense, there is no problem due to the scopal interaction between a verb and an NP. To Enç there was no true motivation for treating tense as a scope operator.

2.4 Arguments for a Unifying Approach

In this section I will present some arguments for the quantificational approach and show why a tense interpretation should be quantificational by default. I will take a further step and discuss that in spite of the adequacy of a quantificational analysis of tense, we may not completely eliminate the referential aspect of tense. It is my intention that by the end of this Chapter it may be persuasive that neither a narrow sense of parallelism between tense and pronouns nor an exclusively quantificational theory is adequate for a fair tense theory.

Let us go back to the sentence *I didn't turn off the stove*, which Partee used to show that existential quantification is inadequate for tense interpretation. It can be dismissed if we take domain narrowing into consideration. As Lasersohn (2017) pointed out, we restrict the domain of quantification over times disregarding irrelevant time intervals to the utterance, and now we can account for the sentence. The domain of quantification in general is pragmatically determined (Lasersohn 1999). Restrictions on the model may be applied in such a way that only relevant individuals or time intervals are contained. For the above sentence, the immediate past is of interest to us, and if within such a sufficiently limited domain there is a time interval during which the speaker does not turn off the stove, the sentence is true, in which case the idea of existential quantification over times suffices. Ogihara (1989: 52-53) puts it this way: “as far as the simple past tense in English is concerned, that the existential quantifier meaning is central and that its contextual dependency stems from the fact that context imposes an additional restriction upon the interpretation of tense.” He does not specify that this *additional restriction* is domain narrowing; but if we assume that the context intervenes in tense interpretation, for example, by providing a well-limited domain, existential quantification gives an interpretation without a problem with regard to expressions, which apparently seem to have an indexical character.

Stronger evidence for a quantificational analysis comes from sluicing and pre-sluicing constructions, as pointed out in Lasersohn (2017). Examples cited from Lasersohn are presented in (38); (38a) and (38b) are sluicing constructions and (38a') and (38b') are corresponding pre-sluicing ones from which sluicing sentences are derived through ellipsis. Such constructions require indefinite descriptions in the antecedent clause: a sentence like *John is dating Linda but I don't know who* does not make sense. Lasersohn shows that the same pattern is possible with Partee's example, as follows: *John turned off the stove, but I don't know when*. If this parallelism holds, it may be that such constructions require indefinite interpretation for tense involving existential quantification over times. Treating tenses like a definite as though they select a particular time interval cannot explain why the sentence with indefinite temporal antecedent is acceptable, because the speaker does not know exactly when John turned off the stove.

(38) a. John is dating someone, but I don't know who.

a'. John is dating someone, but I don't know who he is dating.

b. Mary left her wallet someplace, but can't remember where.

b'. Mary left her wallet someplace, but can't remember where she left her wallet.

Ogihara (2006) argues that existential quantification is necessary as we may see in (39), “even if a particular salient past interval is involved in determining their interpretation” (p. 233). For example, let us say this salient time is John and Bill’s lunch time, between noon and 1 p.m., which is a time period set by their company. Nevertheless, the time during which Bill actually carried out the action of eating may not be the entire one hour time period. Therefore, some time interval within this one-hour period, which is existentially quantified, is relevant to the interpretation of the past tense.

(39) John: Did₁ you eat lunch?

Bill: Yes, I did₂.

It seems agreeable that *did*₁ may denote some existentially quantified time in the past. However, it is not clear whether *did*₂ also denotes a random existentially quantified time independently of *did*₁. *did*₂ in the answer is a proform of the VP in the question, and is anaphoric to *did*₁, which is a clear link between *did*₁ and *did*₂. Such grammatical coherence must not be overlooked; therefore, existential quantification cannot be the singularly available mechanism for tense interpretation. Moreover, the entire time interval Ogihara suggested as salient does not seem to serve as the value of the tense morpheme in (39). As he described, the time during which Bill actually ate lunch is included in this longer interval. I would like to treat this extended time interval as a *domain* in which a tense morpheme is interpreted rather than directly involved in the relational tense interpretation. Of course this domain may be a salient time in the context—in the case of (39), since John and Bill already know what their regular lunch hour is, and that workers are expected to eat lunch during this time, the lunch period is therefore contextually salient as shared knowledge between the interlocutors.

It is possible that John asked the question without knowing at what time Bill ate lunch, but Bill knows the exact time during which he ate lunch and had that time in mind when he answered John’s question. Still, however, my claim that *did*₂ must be anaphorically (therefore, indexically) treated is not necessarily about whether the times denoted by *did*₁ and *did*₂ actually overlap. As Partee (1984: 275) points out:

Intuitively, noun phrases ‘refer’ and tenses don’t; nominal anaphora can be viewed as involving a generalization and explication of the notion inaccurately but intuitively labelled ‘co-reference’. Temporal anaphora is more subtle because of the categorial variety of the expressions involved – tenses, adverbs, adverbial clauses, and main clauses (including the aspectual classification of the clauses themselves into even-like and state-like). It is still fair to say that tenses, like pronouns, are anphoric, and like pronouns can be construed with either linguistic or non-linguistic antecedents; but it doesn’t follow that they ‘refer’ to times to the degree that pronouns ‘refer’ to individuals.

This matter concerns how a tense system characterizes a grammatical correlation that cannot be dismissed between the tenses, regardless of their referring to times.

Ogihara (2006) quotes Partee as she concluded that existential quantification is the most empirically accurate analysis of tense. I now add to this statement “by default,” without neglecting the indexical character of tense. As we have seen, anaphoric usage of tense shows a clear connection between the two relevant tenses. Additionally, it is not uncommon that tenses specifically denote a contextually salient time. Partee, who originally proposed a referential analysis, later retracted her claim and accepted existential quantification, and Dowty, an advocate of the quantificational approach, attempted to account for the indexical character of tense with the double indexing technique (although it is not clearly stated that Dowty was convinced that the indexical character of tense should be part of tense semantics). Obviously, tense does have both a quantificational and indexical character, a fact which needs to be properly addressed. However, to date, to my knowledge, there has been no analysis proposed which systematically combines these two interpretations of preterit in the grammar. This is exactly what my dissertation aims to achieve, among other goals.

Another change I will present in this dissertation is that we have multiple time parameters available for tense interpretation. As we have seen above, Reichenbach began with the three time parameters and defined tenses and aspects in terms of their relations. However, Dowty and Ogihara had to suggest a fourth time interval in order to account for complex temporal relations due to embedded tenses and multiple temporal adverbials. Now, my analysis adds and keeps multiple salient time intervals in the context, so that the context not only keeps track of time intervals de-

noted by tense morphemes and temporal adverbials, but also provides possible candidates in a much more dynamic and flexible way for complex temporal interpretation, which is also relationally determined. This aspect of my tense system will be presented in more detail in Chapter 4.

CHAPTER 3

AN ANALYSIS OF TENSE

3.1 Ambiguity of Tense

As I have shown in the previous chapter, prior theories of tense provide explanations for how tense is interpreted (mostly in English) to some extent, but they are not free from problems. Quantificational analyses of the past tense cannot explain the pronoun-like usage of tense, especially in a discourse in which the tense specifically denotes the time interval that was highlighted in the previous discourse. Referential analyses seem to fail to account for the quantificational reading that is obviously present in English preterit, as previously shown. To alleviate the problems caused on each side, I will present an analysis that systematically combines these two lines of account so that a wider range of examples may be explained with more flexibility.

I argue that we have both the quantificational and referential interpretations of tense, depending on the context; tenses work as a free variable over times in the semantic derivation, and a quantificational interpretation is the default unless there is a salient time interval supplied by the context. When there is a contextually salient time interval, whether it is established in a previous discourse or some particular time interval known to the interlocutors, the tense morpheme in the following utterance selects that salient time interval.

By allowing for both types of tense interpretation, we are in an advantageous position to account for how different categories of temporal adverbials work, and in similar terms how temporal anaphora is resolved in a discourse. As I discussed in the previous chapter, with the help of domain narrowing the apparently bad interaction between the tense operator (or an existential quantifier for time variables) and negation can be resolved, thereby maintaining existential quantification over times. If a definite time interval is specified by the context, and if a tense morpheme concerns that time, the time variable of the tense is anaphorically bound to that time interval.

Many researchers have already pointed out that tense interpretation is contextually sensitive (Binnick 1991; Ogihara 2006; Lasersohn 2017): the content of a tensed sentence may vary with pragmatic context—in particular, with the utterance time. For example, if *John is giving a seminar talk today* is uttered on April 13, 2015, the sentence expresses the content that John

gives a seminar talk on April 13, 2015; but if this is uttered the next day, the content expressed is that John gives a seminar talk on the 14th of the same month (Lasersohn 2017). In tense interpretation, the time that tense morpheme denotes is sensitive to the time of utterance: a time denoted by past tense precedes the utterance time, a time denoted by present tense coincides (or overlaps) with the utterance time, and so on.

Interestingly, Binnick (1991: 247) argues that the past tense in the sentence *Brutus killed Caesar* has two readings, indefinite and definite, depending on the context in which the sentence occurs. The sentence seems to refer to a particular, definite time interval in (1a), but not necessarily so in (1b). Binnick suggests that if we negate the sentence, the difference becomes clearer. After we negate the sentence we continue as follows: *But Brutus didn't kill Caesar—he waited until later and killed him* [then]. It is agreeable that this kind of continuation is possible with (1a) because *the moment* (that Brutus killed Caesar) is mentioned in the previous utterance and hearers are led to think about some particular moment. If the past tense in *Brutus killed Caesar* denotes the same time interval highlighted in the previous sentence, the above continuation could make sense—namely, that the negation is merely relevant to that particular time interval. The same cannot hold for (1b): if we finish (1b) with *But Brutus didn't kill Caesar*, it is a contradiction and there is no way to save the passage, as we did in (1a).

- (1) a. There was nothing Brutus could do. Caesar was becoming a tyrant. Nothing could stop him now. When the Ides came, Brutus was ready. The moment had come. Brutus killed Caesar.
- b. There is considerable testimony that Brutus was there, that he had a motive, that he was prepared to commit the deed. There is no alibi. There is no testimony that he was absent or innocent. There is no doubt. Brutus killed Caesar.

However, such a distinction between definite and indefinite tenses isn't explicit yet. Binnick does illustrate how different contexts lead to different readings of tense, but it is not clear what he means by (in)definite tense in this example. One could intuitively agree with his illustrations, and we associate the indefinite reading of the preterit with a quantificational analysis and the definite with an indexical analysis.

Since I state that both quantificational and indexical interpretations of tense are allowed in the grammar, the nature of the tense in my system will be ambiguous. I will argue in the following section that such an ambiguous tense system is (not only more explanatory but also) feasible based on the data from other languages, such as Korean. But before that, let me first discuss why fusing the two kinds of interpretation of tense into a single system is not totally bizarre: I will make more explicit under what conditions we have one or the other interpretation of tense, pointing out a similarity between tense and some aspects of DPs.

3.1.1 Definite and Indefinite Tenses

Traditionally, in attempts to classify tenses, there has been discussion on which tenses are definite and which are indefinite. Of course, there is a caveat: people have been using these terms *definite* and *indefinite* in various but vague ways in the context of tense discussion. Sometimes, the indefinite/definite distinction in tenses means simple vs. non-simple tenses or aspects (Bhatt 2007, Binnick 1991); if you use the term *definite* tense for Turkish data, it means evidentiality marked by one of the two separate suffixes for the verb.

The notion of definiteness for tense has been fluctuant in the discussion of that subject. Binnick (1991) recapitulates the indefinite and definite tense discussion by “vernacular grammarians.” In their earlier discussion, rather an intuitive idea was that preterit was classified as indefinite past and perfect as definite past. Their sense of definiteness, however, does not seem quite settled. You see here in (2) one of the first differentiations between preterit and perfect, coming from a French grammarian named Jean Pillot in 1550. The reason perfect was classified as definite is that it “denotes a more determinate perfect time, but a little past,” while preterit “signifies a time [...] not determined, and a thing long past,” as quoted in (2). But the statement sounds as though it describes some graded tense system that has distant and immediate past tenses depending on how close the event time is located from the speech time. Also, characterizing one tense as determinate because it denotes a time immediately prior to the present seems a bit impressionistic in that one could always insist inversely. The notion of definite tense is not definite, but rather obscure, as we observe that it changed over time.

- (2) [T]he perfect preterite in the indicative is two-fold, the first of which [*sic*] can be called ‘Indefinite’: for it signifies a time assuredly preterite, but not determined, and a thing

long past. The second of these in truth denotes a more determinate perfect time, and but a little past, as when we say: *I' ay lu aujourd' hui l' Evangile*. (Binnick 1991: 39)⁸

In relatively modern times, the sense of definiteness begins to mean something similar to what we are familiar with: it stems from the question of whether tense refers to a particularly fixed time or specific point assumed by a speaker, although this is not the settled definition of definite tense. However, since Partee (1973) proposed that (simple past) tense refers to a particular or definite time interval—establishing the analogy between tense and pronouns—simple past is considered a definite tense by many (Partee 1973; Enç 1986; Binnick 1991; Kratzer 1998; Kearns 2011).

Binnick also introduces a possibility of a Priorian-style dual operator system in which there are two separate operators for definite and indefinite past, such as PAST_{def} and PAST_{indef}. But he seems to be concerned about stacking operators like this even for more complex aspectual meanings, such as future perfect progressive. Such subtleties will not be elaborated with a series of operators like Fut(Perf)(Prog), which merely paraphrases what we have in syntax. Using two operators for a single tense in the metalanguage may not be an attractive way of treating indefinite (or quantificational) and definite (or indexical) readings of the past tense, especially when such a difference is not morphologically marked. Though it seems difficult to completely discard the idea that simple past does sometimes behave like a pronoun, we do not commit ourselves to this idea—to the extent that we employ dual operators for the simple past.

Providing a detailed taxonomy of tenses is not a main goal of this dissertation, and I do not attempt to support one of the positions that simple past is exclusively definite or exclusively indefinite. I discussed the parallelism between tense and pronouns, first pointed out by Partee, and now I would like to extend this analogy or connection slightly farther to the more general domain of DPs. If I describe my claim in terms of definiteness of tense, it will be that simple past is both indefinite and definite. More precisely, past tense is quantificational unless the context provides a salient time interval, which qualifies a definite or indexical interpretation. A tense theory should be built with a system that reflects this sensitivity of tense to the context. Though my analysis allows for both definite and indefinite readings of past, this is not analogous to a du-

⁸ Peck, H. T. (1911). *A History of Classical Philology from the Seventh Century, B.C. to the Twentieth Century, A.D.* New York: Macmillan.

al operator analysis: my system will have variables over times whose values are fixed by different types of assignment functions, with respect to contextual parameters rather than operators.

But, still, definiteness is not yet explicitly defined. Actually, if an action took place some time in the past, the time at which the action took place must be definite or specific whether it is known to the interlocutors or not—an action that took place in the past means that it took time for the action to take place and this time interval that exists in the past is specific in the sense that it exists. Due to such confusion in terminology, I will clarify and delimit my use of the “definite” sense of tense in the next section, starting from a brief sketch of some of the properties used to define definiteness in the domain of NPs/DPs and showing how different or similar my idea of temporal definiteness is from nominal definiteness, which has been more commonly discussed and is therefore probably more familiar to us.

Definite DPs include different types of DPs, such as definite descriptions (*the* + NP), pronouns, demonstratives, possessive DPs, and proper names. Since definite DPs are not our main focus in this dissertation, I would like to limit my discussion with regard to definiteness in this section only to definite descriptions, which are DPs headed by the determiner *the*, to the exclusion of other types of definite DPs, such as pronouns or demonstratives. Of course it is easy to identify definite descriptions in English, as *the* clearly marks the definiteness of the DP, but there is another reason I will not concern myself about theories of pronouns at the moment: although pronouns are commonly classified as definites, they have unshared characteristics with definite descriptions. For example, there are some cases in which pronouns do not seem to have the uniqueness effect, which is one of the defining properties of definite descriptions. Heim’s (1982) sage plant example represented in (3) is often mentioned. If the italicized pronoun *it* denotes a unique sage plant *x* among the nine she bought, sage plant *y*, for example, makes the sentence false. This is contrary to our intuition—(3) is still true even if *it* denotes sage plant *y*. Later, this example was used by many against the claim that the pronoun requires a unique individual to satisfy the descriptive content of its antecedent.

(3) Every woman who bought a sage plant here bought eight others along with *it*.

Roberts (2003), using psycholinguistic and corpus studies, discussed another difference between pronouns and definite descriptions, which is that pronouns generally require an antecede-

ent in the local context or context of utterance. However, this is not always the case for definite descriptions. Even when a definite description is used the first time in a discourse without an indefinite antecedent, it is felicitous via accommodation. Illustrations of this in (4) and (5) come from Roberts (2003: 290). The (a) sentences contain a definite description that is underlined in each sentence and it is expected that there will be only one clown in the puzzle or only one button in the box. However, when we substitute pronouns for definite descriptions, as instantiated in (b), the sentences do not have the same reading as the (a) sentences. (4b) will be felicitous only if there is a particular man already salient in the context; in (5b), the speaker pushed the lid, never a button as in (5a). In other words, as Roberts puts it, when a new definite description is uttered, it takes the focus of a discourse or becomes salient, while pronouns refer to an element that is already highly salient in the context of utterance without shifting the focus of a discourse. Properties such as uniqueness and accommodation, which usually pertain to definite descriptions, do not work for pronouns. For these reasons our exploration of the nature of definiteness in the next section will be limited to definite descriptions, and I will correlate it with definite- or indefiniteness of tense. Parallelism between tense and pronouns will be brought up again for more discussion in later sections. For more detailed taxonomies and typological discussion on definite DPs, see Abbott (2004) and Lyons (1999).

(4) a. On the next page, you will find a puzzle. Find the clown in the puzzle.

b. On the next page, you will find a puzzle. Find him in the puzzle.

(5) a. I found a box in my attic the other day. I opened the lid and pushed the button I found inside. You won't believe what happened.

b. I found a box in my attic the other day. I opened the lid and pushed it. You won't believe what happened.

3.1.1.1 Definiteness of DPs: uniqueness

Russell's (1905) theory would be the classic theory of definiteness, one in which definite descriptions require uniqueness. Russell rejected the idea that was maintained for a long time that a definite description refers to a particular object. Rather, Russell set variables for a definite DP and quantificationally analyzed it, requiring that there should be one and only one entity that sat-

ifies the descriptive content of the DP, which is represented in (6). For example, for the sentence *The philosophy professor is late* to be true, there must be one and only one x , such that x is a philosophy professor, and s/he is late.

(6) a. The φ is ψ .

b. $\exists x(\varphi x \wedge \forall y(\varphi y \rightarrow y = x) \wedge \psi x)$

Intuitively, uniqueness seems to be a viable option. As soon as you hear the sentence about the philosophy professor, you would assume that there must be one and only one philosophy professor who is of interest to us. Otherwise, the use of *the* is infelicitous. However, there is not simply one philosophy professor in the universe. Unless we take the context or shared knowledge between the interlocutors into account, the felicity of the sentence is inexplicable. Russell's uniqueness doesn't seem to have this contextual element, or in other words, suffers an *incomplete description*. For example, when you hear the sentence, *John put this book on the desk*, you would assume that there must be only one desk that you and the speaker both know about. In this case, the uniqueness of the desk is relative to a limited set that has been pragmatically provided. A purely semantic or conventional approach which requires there to be one and only one desk in the universe does not give us a complete picture of this uniqueness, which is either assumed by the interlocutors or entailed by the context.

People have been pointing out the pragmatic nature of this uniqueness and responding to Russell's semantic analysis in different ways. The desk example with an incomplete description above or cases of "bridging" as seen in (7) below are counterexamples to Russell's analysis (Roberts 2003). Clark (1975) actually uses the term *implicature* as he explicates bridging. Among millions of dashboards in the universe, there is only one dashboard in one car, and based on this implicature or pragmatic knowledge we associate the dashboard in (7) with the car, which is of interest to us in this context. We often interpret definites using pragmatically filled-in information, and without it, the interpretation of definites in terms of purely semantic uniqueness as defined by Russell is not complete. However, McCawley (1979) argues that such moves that provide a pragmatically limited domain cannot save the Russellian uniqueness approach. Look at sentences (8a) and (8b). Let us say there is only one dog in our pragmatically limited universe of

discourse in order for *the dog* to refer to that unique dog. Then, (8a) amounts to saying (8a') and (8b) to (8b'). Obviously, neither (8a') nor (8b') is what (8a) means.

(7) This car has a statue on the dashboard. (Roberts 2003: 290)

(8) a. The dog likes all dogs.

a'. The dog likes himself.

b. The dogs like all dogs.

b'. The dogs like each other.

(McCawley 1979: 378)

Later, to solve this incompleteness problem of the uniqueness analysis, Heim (2011) suggests covert domain restriction for DPs so that a unique, one-and-only-one individual that meets the descriptive content of a definite description may be picked out within a limited set. A restrictor set may be, for example, a set of things in our house or a set of things recently mentioned, and the idea is that a definite selects the unique individual that meets the descriptive content of the DP from the restrictor set. This type of contextual restriction may save the uniqueness analysis. Take (7) again as an example. If *the dashboard* picks out its referent from the set of things that are recently mentioned and things that are relevant to them, we don't need to worry about all other dashboards in the world but only the dashboard of the car being discussed. Consequently, as Heim also pointed out, restrictors bring equivalent effects to Lewis's salience theory, which will be discussed in more detail.

Another discussion of Russell's uniqueness concerns the presuppositionality of definites. Russell further argued that if the reference of a definite description does not exist, the sentence containing the definite description is false. For example, (9a), the famous example from Russell, entails (9b). When there is no king in France, (9a) turns out to be false because the fact that there is no king in France is contradictory to (9b), which is part of the assertion made by (9a). Russell's position was supported by Neale (2005) and Kaplan (2005), among many others.

(9) a. The King of France is bald.

b. There is exactly one King of France and he is bald.

Russell explained the negation of a sentence with a definite description in terms of a “primary occurrence” and a “secondary occurrence” of a definite description, which now correspond to wide scope and narrow scope, respectively. Consider (10a), which is a negation of (9a), and assume there is no king in France. When the definite description *the King of France* takes wide scope over negation as in (10b'), (10a) is false. Since the definite description is not affected by the negation, (10a) asserts that there is a unique king in France, which is contradictory to the fact that there is no king in France. In contrast, when *the King of France* takes a narrow scope, (10a) asserts (10c') which can be paraphrased as (10c). In this case, (10a) turns out to be true because the proposition that it is not the case that there is a unique king in France coincides with the fact that there is no king in France.

- (10) a. The King of France is not bald.
 b. There is exactly one King of France and he is not bald.
 b'. $\exists x(Kx \wedge \forall y(Ky \rightarrow y = x) \wedge \neg Bx)$
 c. It is not the case that there is exactly one King of France and he is bald.
 c'. $\neg \exists x(Kx \wedge \forall y(Ky \rightarrow y = x) \wedge Bx)$

Not all authors agree with Russell. Strawson (1950) argued that *there is a king in France* in (9b) is not part of *what is asserted* or part of the meaning of the sentence, but rather, part of *what is implied* or indicative of the speaker’s implicit knowledge. Uniqueness is not part of descriptive content, but rather, of presupposition. This may be confirmed via von Stechow’s *Hey, wait a minute* test. Consider examples in (11) and (12) taken from von Stechow (2004: 326). After the (a) sentences, it is natural to have a response like the (b) sentences in which the existence of the definite description’s potential referent is being questioned. However, responses like the (c) sentences cause “squeamishness” due to the conflict in presuppositions—namely, that there is no king in France or no such mathematician who proved the Conjecture.

- (11) a. The King of France attended the APEC conference this week.
 b. Hey, wait a minute—I had no idea that France is still a monarchy.
 c. Hey, wait a minute—I had no idea that he was at that conference.

- (12) a. This year's Fields Medal was awarded to the mathematician who proved Goldbach's Conjecture.
b. Hey. Wait a minute—I had no idea that someone proved the Conjecture.
c. Hey. Wait a minute—I had no idea that she got the medal.

Prior to Strawson, Frege (1892) posited that the existence of a referent of a definite description is presupposed, not entailed. Let us return to (10a), negation. With (10a), what is negated is what is entailed by the (9a). *There is one and only one King of France* is presupposed by *the King of France* and thus the unique existence of the King of France is not negated although the entire sentence found in (9a) is negated. When there is no unique, one-and-only-one object denoted by a definite description, the sentence is neither true nor false. In such a case of presupposition failure, we have a truth-value gap—that is, the absence of a truth value.

Frege and Strawson's position has been supported by Heim (1991), Roberts (2003), Kripke (2005) and Elbourne (2010), among many others. Support for presuppositional uniqueness also comes from definite descriptions embedded under propositional attitude verbs and their scope interaction with quantifiers and conditionals. See Kripke (2005), Elbourne (2010), and Heim (2011) for more discussion about this subject.

If definiteness of tense is defined in terms of uniqueness: a definite tense will involve a unique, one-and-only-one time interval at which the action described by the tense takes place. However, it is not an easy task to characterize a time interval that is unique. Can a time interval, which is abstract by nature, be unique in a speaker's mind? What makes a time interval unique? Perhaps a time interval might become unique if an event takes place at that time, and that time interval is associated with the event. In such a case, it is the event that makes the time interval unique, not vice versa. It may be quite challenging to prove the uniqueness of a time interval to be a requirement for a definite tense. Another problem comes from cases like (13). Let us apply Russell's definition in (6b) to tense as represented in (13). Let φ be a sentence *I didn't turn off the stove*; (13) roughly reads as though there is a time t at which the speaker did not turn off the stove and for all other times at which the speaker didn't turn off the stove, those times are t . However, it is possible that the speaker did not turn off the stove not only at t —say some time on Friday afternoon, but again at some other time, such as Monday morning. Russellian uniqueness does not seem to work for tense, and may not be a suitable notion for definiteness of tense.

$$(13) \exists t(\varphi(t) \wedge \forall t'(\varphi(t') \rightarrow t' = t)) \wedge \varphi$$

3.1.1.2 Definiteness of DPs: familiarity

Some people have related definiteness to knowledge of interlocutors. Christophersen (1939) is often cited in this line of theory—interlocutors use *the* when they are acquainted with the referent of the DP in question. Heim (1982) develops this idea and accounts for indefinite and definite descriptions in terms of Novelty/Familiarity Conditions. Definiteness is now governed by a felicity condition, which is a matter of pragmatics rather than a semantic principle.

Both indefinites and definites involve a variable in Heim’s analysis. An indefinite DP introduces a new free variable (or *starts a new file*, in Heim’s File Change Semantics) into a discourse, which is bound by an unselective binder at the text level. A definite DP is interpreted with a discourse-old variable, coindexed with a variable that has already been introduced. Heim treats definite descriptions and pronouns in the same way, but a file card for definites, of course, has a description compatible with the definite DP. Heim’s Extended-Novelty-Familiarity Condition is summarized in (14) (pp. 369-370). *F* indicates a file and roughly corresponds to the context, as position with which many semanticists agree (Kadmon 2001, Roberts 2003). Heim’s theory is advantageous for examples like (15) from Heim. The problem of incomplete description mentioned in the previous section is not a problem anymore for familiarity. *A wine glass* starts a new card with a variable *x*, and the card has the information that this wine glass *x* broke last night. The coindexed definite *the glass* is associated with this already established or familiar card, and the variable *x* on it and the compatible description is still on the card and available for the interpretation of the definite DP.

(14) For φ to be felicitous w.r.t. *F* it is required for every NP_i in φ that:

- (i) if NP_i is [-definite], then $i \notin \text{Dom}(F)$;
- (ii) if NP_i is [+definite], then
 - (a) $i \in \text{Dom}(F)$, and
 - (b) if NP_i is a formula, *F* entails NP_i .

(15) A wine glass broke last night. The glass had been very expensive.

However, English speakers sometimes use *the* for NPs which have not been introduced in a discourse. Being called *novel definites* by Heim, such definites as seen in (16a) may still be felicitous via Lewis's (1979) accommodation. Abbott (2004) discussed a problem of complete description for familiarity, which is illustrated in (16b). Due to the descriptive content associated with the definite NP, it is possible to select a unique entity in Russell's terms, and the underlined definite description is felicitous, although *a big bag* was not previously introduced in the discourse. Accommodation will again solve this and explain the felicity of the utterance, but, as Abbott pointed out, such cases "seem contrary to at least the spirit of the familiarity type of approach."

(16) a. Watch out, the dog will bite you. (Heim 1982)

b. If you're going into the bedroom, would you mind bringing back the big bag of potato chips that I left on the bed? (Abbott 2004)

Roberts (2003) proposed a more nuanced version of familiarity. She called Heim's version of familiarity a strong familiarity and proposed a weak familiarity. In Heim's terms, a discourse referent of a familiar DP has an antecedent in the prior discourse; Roberts' weakly familiar DPs are the ones whose discourse referents are entailed in the local context of interpretation or common ground, whether or not they have been previously introduced in the discourse. Uniqueness is also combined in Roberts' analysis—weakly familiar discourse referents to interlocutors should also be unique. This analysis now can explain examples such as (17) from Roberts (2003), interpreted similarly to the bridging ones. As Roberts puts it, a knife or stabbing is not "absolutely entailed," but in order to relate the second sentence to the first, we "accommodate" that John was stabbed, from among many possibilities of how a person is murdered. Once the stabbing is accommodated, the existence of a knife as the murder weapon is entailed by the common ground, which licenses a weakly familiar discourse referent. Roberts also argued that pronouns do not trigger uniqueness effect, but only definite descriptions do.

(17) John was murdered yesterday. The knife lay nearby.

How do we apply familiarity to tense? Again, it is not easy to associate DPs which have tangible referents with abstract time intervals. But, still, we could at least say that familiar time variables are definite, whether these are coindexed variables with a previously occurring one or those whose referents are entailed by the context. Such theories can be advantageous, as discourse-old time variables are distinguished from those associated with events that are introduced to a discourse for the first time.

3.1.1.3 Definiteness of DPs: salience

McCawley (1979), like many others mentioned above, pointed out problems with Russell's uniqueness in his discussion of definite descriptions. He further argued that domain restriction is not a solution for the incomplete description problem of the uniqueness analysis, due to examples in (8), *The dog likes all dogs*. If *the dog* is interpreted in a restricted domain where there is only one dog and denotes this unique dog, the sentence is analogous to *the dog likes himself*. To solve this, he adds the *contextual domain* in his system and the interpretation of definite descriptions is related to the contextual domain, not to the universe of discourse or even to some restricted domain. McCawley's contextual domain represents the set of objects, and the set includes both kinds of objects that are mentioned in the previous discourse (or, *familiar*, in Heim's terms) and those "taken for granted" (*entailed by the context* in Roberts' terms). A search is done for the members of the contextual domain to select a referent for a definite description that satisfies the semantic content.

McCawley also employed the "context," which is a set of propositions. The context and the contextual domain become incremented as the discourse proceeds. For example, a discourse referent of an existentially quantified NP in the antecedent clause is added to the contextual domain, and it then works as a *referential constant* (or a discourse referent) in subsequent utterances. As the antecedent clause is uttered, the proposition introduced by the antecedent is added to the context, and so, incremented. These incremented context and contextual domain are now available for the interpretation of the definite description in the consequent clause. Contextual incrementation may be temporary for conditionals until the acceptability of the consequent checks out and the next utterance is produced.

Let's take an example in (18), from McCawley (p. 382). (18b), with McCawley's notation, shows that the context X and the contextual domain Y are incremented when the antecedent

clause is uttered, and the definite descriptions in the consequent are interpreted relative to these enlarged context and contextual domain. The antecedent clause is interpreted relative to X and Y ; the consequent clause is interpreted relative to the updated X' and updated Y' . X' contains all the propositions in X and the propositions due to the antecedent (x' is a motorcycle, y' is a truck, and x' collides with y' ; x' and y' are the two discourse referents); Y' has one motorcycle (x') and one truck (y'). Since these are now the only objects in the contextual domain for the interpretation of the consequent clause, they are selected as the referents for the definites in the consequent. This idea of updated or incremented context and contextual domain is quite similar to Kamp's Discourse Representation Theory or Heim's File Change Semantics.

(18) a. When a motorcycle collides with a truck, the motorcycle is generally damaged worse than the truck.

b. $((\exists x: \text{motorcycle } x)(\exists y: \text{truck } y)(x \text{ collides with } y))$

X

Y

$\supset (the \text{ motorcycle is generally damaged worse than the truck})$

$X' = X \cup \{x' \text{ collides with } y', \text{ motorcycle } x', \text{ truck } y'\}$

$Y' = Y \cup \{x', y'\}$

Salience enters as an answer to this question “What if there is more than one object in the enlarged contextual domain?” for the interpretation of a definite description. McCawley posits that the contextual domain is not merely a set, but a structured set with a hierarchy “of successively broader domains” among the individuals in the context, and we have different levels (though it is not very explicit what these levels are) in the hierarchy through which we can search for acceptable elements for the interpretation of definite descriptions. He also stipulates that the hearer, interpreting a definite description, searches from the first level of the hierarchy where temporarily added elements to the context are found, until he finds an element that is the appropriate referent of the definite description. If there is no element prominent enough at the level, you move on to a lower level and search for the next most prominent object that fits the description of the definite DP, and so on. If there is more than one element that satisfies the definite description, or no such element exists throughout all the levels, the definite description is not interpreted.

In order to show that the contextual domain is a structured set, McCawley uses an example such as (19). He also allows the addition of new items to the contextual domain, which corresponds to *accommodation* in Lewis's (1979) terms. It seems that the referent of *the dog* is added to the first level of the contextual domain and the referent of *a dog* is added at a lower level, which becomes available for the search for the referents of *the dogs* in the second sentence. According to McCawley, the prominence structure, or hierarchy, is determined by the speaker. Notice that this type of salience analysis uniformly treats a definite description with an existentially quantified antecedent and a deictically used definite.

(19) Yesterday the dog got into a fight with a dog. The dogs were snarling and snapping at each other for half an hour. I'll have to see to it that the dog doesn't get near that dog again.

Lewis (1979) is another author who discussed salience for the interpretation of definite descriptions. He also pointed out that the uniqueness of a definite description, even in the contextually determined domain, is not enough, especially for the cases in which there is more than one object in the domain that fits the description. Lewis also referred to McCawley's example in (19): although there are two dogs in the context, hearers still understand the utterance with *the* shifting from dog 1 to dog 2. This is due to salience—that is, the referent of the definite description is the most salient individual, according to the salience ranking.

What makes an object salient or how is salience ranking determined? Lewis asserted that it is contextually determined and conversational means can raise the salience of an individual. For example, an object thrown to the interlocutors in the middle of a conversation gains salience at the moment; you raise the salience of an object by pointing. Conversational means could include the course of a conversation such as talking more and more about an object and introducing an existentially quantified object (indefinite NP), as in *a cat is on the lawn*, wherein the cat on the lawn is now at the top of the salience ranking. According to his *accommodation rule for comparative salience*, which is introduced in (20) below, salience shifts in a way that contextual acceptability is maintained.

- (20) If at time t something is said that requires, if it is to be acceptable, that x be more salient than y ; and if, just before t , x is no more salient than y ; then – *ceteris paribus* and within certain limits – at t , x becomes more salient than y .

The salience analysis that von Heusinger (2013) elaborated is less vague than McCawley’s or Lewis’s presentation of salience in the sense that he compositionally shows how, according to salience, the referent of a definite description is selected. He uses a context dependent choice function that applies to a set of entities and chooses one element from the set that is at the top of an ordering associated with each context. This association is indicated by an index on a function: for example, a choice function f_i is associated with the context i . Consider a situation in which there are three cat owners: Ann, Beatrice, and Carola, who own, respectively, cats Albert, Bobby, Casimir, and a sentence (21a) whose logical form is in (21b) (p. 368). When (21a) is uttered by Ann, the choice function f_{ann} associated with Ann applies to the set of the three cats {Albert, Bobby, Casimir} and yields the most salient cat to Ann, which is Albert, and so on.

- (21) a. The cat is very intelligent.
 b. $\text{Very_Intelligent}(f_i(\text{cat}))$

Originally, choice functions were proposed by Reinhart (1997) and Winter (1997) for the interpretation of indefinites. In von Heusinger’s analysis, a choice function is also used for definites. He also called his choice function a *global* one, which depends on the common ground shared by the speaker and the hearer, contrasted with Reinhart’s or Winter’s *local* choice function. Their choice function is considered local according to von Heusinger because it is bound at some point in the derivation, “but not higher than the text level.” For example, *A man comes* in (22a) would be analyzed as in (22b) in the choice function approach, with Winter’s notation (p. 434). (22b) asserts that there is a choice function and that the individual selected by this function, which is applied to the set of men is in the extension of *comes*. The variable over choice functions is existentially closed.

- (22) a. A man comes.
 b. $\exists f_{et}e[CH(f) \wedge \text{come}_{et}(f(\text{man}_{et}))]$

Now, let's expand this example in (22a) to the anaphoric use of definite descriptions by adding *The man smokes* as in (23a) (von Heusinger 2013: 370). Like Lewis, von Heusinger maintains that an indefinite NP not only introduces a new discourse referent, but also “gives the highest salience ranking to an individual that fits the description.” He uses both kinds of choice function in his analysis—a local one for indefinites and a global one for definites representing the salience structure. The indefinite NP *a man* denotes an arbitrary object (\mathbf{d}) via the Reinhart/Winter style choice function f_x which selects an individual not from all the sets but from associated sets which meet the descriptive content of the indefinite,⁹ and this object becomes the most salient one in the ranking (he uses the term *salience change potential*). Now, in the second sentence in (23a), *the man* denotes the same individual \mathbf{d} , since it is the most salient man in the context, which coincides with our intuition. We start with the initial context i and the global choice function f_i , and due to the indefinite introduced to the discourse, we now have the updated context j , and the updated choice function f_j . « » in (23c) indicates the updated part of the choice function: f_j is identical to f_i except for the assignment to the set of men, which is represented by \mathbf{d} .

(23) a. A man comes. The man smokes.

b. Comes($f_x(\text{Man})$) & Smokes($f_j(\text{Man})$) (with $f_x(\text{Man}) = \mathbf{d}$)

c. $f_j = f_i \ll [[\text{Man}]]^{\text{M.g}/\mathbf{d}} \gg$ (with $f_j(\text{Man}) = \mathbf{d}$) (von Heusinger 2013: 370)

Salience theories give a relatively reliable account of the contextual contribution to the interpretation of definite descriptions—not only those definites with incomplete descriptions or cases that require accommodation, but also the anaphoric use that Heim's familiarity analysis eminently accounts for, which I believe is one of the advantages of salience theories over other theories of definiteness descriptions. Salience is now more explicitly represented in the recent work I have just introduced. My question, though, still pertains to how we apply this to tense. Lewis's point that conversational means or pointing raises the salience of an object makes sense, but time intervals are abstract, in that they can neither be “thrown to the interlocutors in the mid-

⁹ It is stated in von Heusinger (2013) that f_x is a local choice function, as in Reinhart and Winter, but in von Heusinger does not provide an explicit configuration of a choice function for indefinites. For a detailed formalism in von Heusinger's analysis of choice functions, see von Heusinger (2004).

dle of a conversation” nor be pointed at like a tangible object. Whether I refer to salience or familiarity to explicate definiteness of tense, the idea of salience for tense or time intervals still needs to be more clearly defined.

Being salient in the context actually sounds as if it is an idea from the field of language processing. Underlying questions for salience would include what will catch interlocutors’ attention or whether information is foregrounded or backgrounded. When this rather vague idea applies to time intervals, discourse-related features, which might be still vague but formally traceable, will have to be examined to decide whether a time interval is salient. Heim’s theory requires an examination of discourse features, and an account of salience for time intervals will likewise require such an examination. It still seems plausible to say that a time interval gains salience as it is introduced to the discourse or is repeatedly mentioned. Actually, since tense is not restricted by overt markers such as *a/the*, definite and indefinite interpretations of tense may be stipulated with more flexibility. Based on the exposition of definiteness theories presented so far, I adopt a salience-based theory of definiteness as a viable option for the definite tense and take the position that a tense is definite iff it denotes a salient time. Let me discuss in more detail the advantages of a salience account of definite tense and its more specified conditions with regard to a definite tense.

3.1.1.4 Definite tense with contextually salient time intervals

To address in a more concrete way the question of under what conditions we have a definite interpretation of tense, I have discussed some notions used to characterize definiteness of DPs, as definite descriptions are less abstract than time intervals. Additionally, definite descriptions have been explored quite extensively. I will refer to and apply some characteristics of salience among the properties discussed above for definiteness descriptions. As we have seen, salience has virtually the same effect as uniqueness and knownness to interlocutors; also, it can uniformly account for deictic and anaphoric uses of definites, which was not possible with uniqueness or familiarity theory.

The advantage of this uniform treatment of various types of definite DPs is also pointed out by von Heusinger (2013: 367): “With the illustration of this small discourse the anaphoric use of definite descriptions is explained in terms of salience. That means that the anaphoric use can be seen as a specialized form of deictic use. In this way a uniform conception of definite NPs

and deictic and anaphoric pronouns is possible.” Using Lewis’s cat example represented in (24), von Heusinger shows how the most salient cat in the context is determined. By (24) (i), which is added by von Heusinger to the original Lewis example, Bruce is introduced to the discourse and is the most salient cat. Therefore, *the cat* in (ii) denotes Bruce. By (iii) the other cat, Albert, is mentioned and thus gains salience and becomes the most salient cat as the discourse continues with (iv). Therefore, *he* in (vi) and *the cat* in (vii) refer to Albert.

- (24) (i) In the room is a cat. (ii) The cat is in the carton. (iii) The cat will never meet our other cat, (iv) because our other cat lives in New Zealand. (v) Our New Zealand cat lives with the Cresswells. (vi) And there he’ll stay, because Miriam would (vii) be sad if the cat went away.

Anaphors seem to be a unique type of definite. They are not exactly in the form of *the* + NP like commonly known definite descriptions, but on the other hand create the uniqueness effect, as shown when Kadmon (1990) compares (25a) and (25b). *A chair* in (25a) is indefinite, and the object introduced by this expression need not be a unique one identifiable to the speaker or the hearer; the sentence is true as long as Leif has at least one chair. In (25b), we have an anaphor in the second sentence and *a chair* is its antecedent. According to Kadmon, many speakers cannot use (25b) in a situation in which they cannot identify one unique chair among Leif’s other chairs. Namely, we now have the uniqueness effect: (25b) is felicitous only if there is exactly one chair of Leif’s identifiable to the speaker. However, unlike uniqueness, which solely relies on extra-linguistic information to select the referent of a definite description, an anaphor and its antecedent have a strong connection that is linguistically based and traceable in the context. That is, anaphors gain their reference from an indefinite expression in the previous discourse, which renders the expression their antecedent.

- (25) a. Leif has a chair.
b. Leif has a chair. It is in the kitchen.

Lyons (1999) investigates anaphoric NPs in different languages. Typologically, in languages like Hidatsa and Ewe, only anaphoric or previously mentioned NPs occur with a definite

article. In Lakhota, there is an article for general definites, and “its specialized anaphoric form” appears when used for previously mentioned referents (for more discussion on whether such articles are definite or demonstrative, see Lyons 1999). Of course, a definite expression in one language may correspond to an indefinite one in another language; an expression in an articleless language may be marked as indefinite or definite when translated into languages such as English and French, with overt definite and indefinite articles. Although different languages encode definiteness of NPs in a variety of ways, anaphoricity is a key factor in those languages in order to determine the definiteness of NPs.

As coreference of anaphors is important with regard to the definiteness of NPs; coreference of time variables also may be important in definiteness of tense. Time variables denoting identical time intervals have some grammatical connection that enforces coreference. Also, as a time interval is repeatedly denoted, it will become entrenched in the minds of the interlocutors with higher salience.

We apparently digressed to definiteness of NPs from definiteness of tense. Of course, we cannot exhaustively apply all the notions used to define definiteness of NPs to tense. Expanding the parallelism between the two domains first suggested by Partee should be restricted in a well-constrained manner to some applicable notions to an abstract domain. Though Partee retracted some of her initial proposals in her later work, the pronoun-like behavior of tense is still an intriguing idea. The link between an anaphor and its antecedent is noteworthy in English, but in some languages it is the only feature that defines the definiteness of NPs. It is not totally implausible for a tense to have a definite interpretation in cases in which coindexation or coreference is established between a time variable and its reference.

As to definiteness or contextual salience of a time interval, we maintain that an interval that is first introduced in the discourse gains salience. When the same interval is used again, such as an anaphoric pronoun or a definite description, it is now a more salient time and induces a definite, indexical interpretation. In other words, once a time interval gains salience, it is considered definite, but it is still possible that a time interval is more salient than others depending on the context. Let us take an example from Partee (1973: 605): *Sheila had a party last Friday* introduces a time interval in the discourse which gains salience, and the past tense of the clause has

an indefinite reading involving existential quantification over its variable.¹⁰ It is natural to infer that Sam's becoming drunk occurred during the time in which Sheila was having a party, and the tense in the second clause involves this already salient interval, yielding a definite interpretation. Likewise, in (26b) the sentence *When Susan walked in* involves a variable ranging across a past time which is existentially quantified, and the past tense in the subsequent clause has an indexical reading due to the repeatedly used salient time interval.

- (26) a. Sheila had a party last Friday and Sam got drunk.
b. When Susan walked in, Peter left.

One might raise a question about a discrepancy between salience and definiteness. While salience is a gradable notion, in that you could say one object is more salient than another, definiteness is basically a binary concept. I posit that once an interval gains some salience in the context, a tense involving that interval has a definite interpretation, as suggested in McCarthy's, or von Heusinger's salience theory of definite descriptions. Still, one interval may be more salient than another interval, and they both induce a definite interpretation.

We allow a definite interpretation and a default indefinite interpretation in our tense system, unifying both lines of analysis reported in the literature. Unless there is a contextually salient time interval, we have a quantificational interpretation of tense. Basically, interlocutors will track what is going on in the context with respect to temporal elements. When a new time variable is introduced into a discourse or a coindexed time variable is repeatedly used, the time it denotes will be highlighted or become the most salient one in the minds of interlocutors, compared to other time intervals. Such a treatment of tense represents a situation in which a familiarity theory is intertwined with a salience theory, so that a familiar discourse referent in Heim's terms becomes salient in the context. But a salient discourse referent can become even more salient depending on the context, and being old to the discourse may not be the only factor that makes a time variable salient.

I will assume that a free variable over times, due to an indefinite tense, is bound by the operation of existential closure rather than by an overt quantifier. In that case we do not need to

¹⁰ In her later work, Partee (1984) introduced such cases as "definite anaphors with definite antecedents." This is not the position of this dissertation. Since the past tense of the first clauses in (26) is first introduced in the discourse, I argue that it has an indefinite reading.

appeal to the internal semantics of a tense morpheme, especially when the definiteness of tense is not morphologically marked in English, and the quantificational force of the indefinite reading of tense is still retained. The analogy between tense and pronouns as pointed out by Partee should be revised, so that tense is more like DPs, including indefinite descriptions. I will show the technical implementation of such semantics in a later part of the chapter.

There might still be one more question raised by this unifying approach to tense. As I briefly mentioned above, the definiteness distinction is not overtly marked in the English tense system, unlike definite and indefinite descriptions in English. On what basis do we distinguish two kinds of interpretation? To contemplate this issue, let us expand our DP–tense analogy and take a look into some languages that lack articles—whose (in)definiteness of DPs is also not morphologically marked.

3.1.2 A Case of Korean

If I draw more parallelism between nominals and tenses, I believe the analyses of (in)definite DPs in articleless languages will also give an insight into a similar distinction in tenses. For example, (in)definiteness of DPs is contextually determined in languages like Korean, Chinese, and Japanese, where (in)definiteness of nominals is not overtly marked (Lee 2000). Bare DPs of Korean are represented in (27) from Lee (2000): a bare noun in (27a) is interpreted as indefinite while in (27b) with a perfective auxiliary, it is interpreted as definite.

(27) a. Mary-nun sakwa-lul mek-ess-ta
 top apple-acc eat-past-decl
 ‘Mary ate apples.’

b. Mary-nun sakwa-lul ta mek-e peli-ess-ta
 top apple-acc all eat up-past-decl
 ‘Mary ate up the apple(s).’ (cf. *Mary ate up apples.)

In English, the indefinite article *a* sometimes indicates the cardinality of the following noun as in, *eat an apple*. In such a context, when a head noun occurs with a number modification, we have a numeral classifier construction in a language like Korean, as exemplified in (28). The

distinction, in (27a) and (27b), appears due to *ta* and *pe-li-* indicating aspectual telicity (Mary had to finish the apple or apples for the sentence to make sense), which also holds for numeral classifier constructions. Thus, Lee states that “[i]f not aspectually telic or contextually definite, the numeral classifier construction is typically indefinite.” This is further supported by an existential construction found in (29). Such a construction requires an indefinite noun phrase, which attests to the indefiniteness of the noun. An indefinite reading of bare nouns and nouns with numeral classifiers seems to be a default one in Korean.

(28) Mary-nun sakwa sey kae-lul mek-ess-ta
 top apple three cl-acc eat-past-decl
 ‘Mary ate three apples.’

(29) yeynnal-ey enu maul-ey nongbwu han salam-i sal-ass-ta
 old.days-in a village-in farmer one cl-nom live-past-decl
 ‘Once upon a time, there lived a farmer in a village.’¹¹

As pointed out above, aspect seems to be an important factor in determining the definiteness of bare nominals in the languages discussed above. But in determining the definiteness of tense in English, some other contextual factors seem to be involved. Of course, patterns of nominals found in such languages cannot be the main reason for analyzing English tenses in the same manner. However, the fact that a similar pattern is observed in different domains of grammar in different kinds of languages could be a sufficient basis for the claims about definite and indefinite readings of tense.

More generally, this issue is concerned with the question of how concepts are encoded in the grammar in different languages. Many Indo-European languages mark definiteness of DPs with overt articles; the majority of languages have numbers, but there are languages that only have words for one, two, and three in their number system. The majority of languages do not mark definiteness of tense morphologically, but that does not necessarily mean that such ambiguity between definite and indefinite tenses is an impossible mechanism in the grammar. Plus, def-

¹¹ Examples (27)-(29) are all from Lee (2000) and some are slightly modified. *Top* indicates a topic marker, *nom* a nominative case, *acc* an accusative case, *decl* a declarative ending, and *cl* a numeral classifier.

initeness would be more significant type of information for DPs rather than for tenses, as definiteness is quite abstract. It is likely that many languages have been developed so that definiteness of DPs is overtly marked, but definiteness of tenses is not.

I would also like to introduce another ambiguous case in Korean. The suffix *-ess/-ass* in Korean is commonly known as the past tense marker. However, there has been much debate on the exact categorization of the suffix and its nature (Sohn 1995, Oh 2003). Some researchers have argued that *-ess* is mainly a past tense marker (Kim 1985, Lee 1987), but some have claimed that it marks the perfective aspect (Nam 1972, Sohn 1975). Another group of researchers have maintained that *-ess* represents both tense and aspect (Suh 1976, Lee 1982).

Researchers seem to agree on at least several points—that *-ess* has multiple uses, and its meaning and usage are heavily dependent on various factors such as *aktionsart* of the root verb, temporal adverbials, the contextual information, and so on. Oh (2003), among others, has collected and analyzed conversational discourse data and argues that *-ess* represents both preterit and perfective, depending on the context. For example, in (30a), we have an example of the simple past usage of *-ess*, which is most frequently observed in Oh’s data (2003: 1193-4). The time at which the speaker did not know is within her high school years and thus we have a simple past reading of *-ess*, in that it denotes a time interval in the past. On the contrary, in (30b), the time at which the action of becoming red is not necessarily in the past; *-ess* indicates that the action is completed rather than placing in the past the time during which the action takes place. The inchoative suffix *-ci-* and the transferentive suffix *-ta(ka)* denote the change in state, which also affect the meaning of *ess*.

(30) a. kotung-hakkyo ttay mol -ass-e
 high -school time not-know-past-decl
 ‘(when I was) in high school, I didn’t know her.’

b. ppalkay-ci-ess-taka hayay-ci-e
 red-become-perf-conj white-become-decl
 ‘It [the speaker’s skin] gets red and then white.’

The past tense/aspect marker *-ess* in Korean is ambiguous in the sense that it sometimes represents the preterit and at others the perfective. The simple past English may as well be ambiguous, and the ambiguity in English preterit is about the (in)definiteness of the tense, which depends on context.

3.2 Formal System

3.2.1 Preliminaries

In this section, I will provide a truth-conditional semantics for the past tense in English, for both indefinite and definite readings of it. First, let me posit that linguistic expressions are assigned their semantic values under a variable assignment function g in a context $c \in C$ (the set of all contexts) relative to a possible world $w \in W$ (the set of all possible worlds). The denotation of a linguistic expression α is represented in (31). Proper names rigidly denote the same individual relative to every world. For example, $\llbracket John \rrbracket^{c,g,w} = \text{John}$, $\llbracket Mary \rrbracket^{c,g,w} = \text{Mary}$, and so on.

- (31) $\llbracket \alpha \rrbracket^{c,g,w}$ (the denotation of a linguistic expression α in context c relative to assignment g and world w)

Let us suppose that contexts are modeled as n -tuples of parameters. The utterance time is one of the parameters of the context, or an index, following Montague (1970). Indices include the speaker, the addressee, the time of utterance, and so on. These elements are devised to account for the context dependence of indexicals; their references are determined by the index. Some contextual elements are introduced in (32). For instance, c_1 may be defined as $c_1 = \langle \text{speaker}_{c_1}, \text{addressee}_{c_1}, \text{time}_{c_1}, \text{place}_{c_1}, c_{\text{SAL}_1}, g_{c_1} \rangle$. The pronoun *I* in context c denotes speaker_c , *now* denotes time_c , *here* denotes place_c , and so on. Each c has an assignment function g_c which maps syntactic indices on referential expressions in a sentence ϕ onto objects in c_{SAL} , a set of salient objects in c . Assignment function g assigns values to variables in such a way that it agrees with g_c on all values for which g_c is defined, as stated in (33). For example, if g_c assigns 1 to John and 2 to Mary, all other g 's also assign 1 to John and 2 to Mary. Since g_c is fixed by the context, variables whose value is fixed by g_c do not vary; thus, g_c is appropriate for assigning values to deictic pronouns and salient tenses. On the other hand, g assigns value to variables, not

part of the context, and is suitable for indefinite DPs and indefinite tenses. Such a technique is employed in Lasersohn (2017)—see Lasersohn (2017) for more discussion and a more detailed implementation of the idea.

(32) Contextual elements for any given context $c \in C$:

- a. $speaker_c$ is the speaker of c .
- b. $addressee_c$ is the addressee of c .
- c. $time_c$ is the time of c .
- d. $place_c$ is the place of c .
- e. $c_{SAL} \subseteq U \cup I$ (the set of salient objects in c ; U is the set of individuals and I is the set of all intervals of time).
- f. g_c is a partial function from \mathbb{Z}^+ (the set of positive integers) into c_{SAL} .

(33) Appropriate assignment g :

g is an appropriate assignment of values to variables for c iff g is a function from \mathbb{Z}^+ into $U \cup I$ agreeing with g_c on all values for which g_c is defined.

Why do I have a context parameter, but not a time parameter? This question is related to another question—whether or not a proposition or content, in Kaplan’s (1989) terms, is time-neutral. He proposed two kinds of meaning, character and content. A *character* of an expression is a function from possible contexts to contents. This context of utterance is the first type of indices that has the agent, the addressee, the time, and the location of the context. A *content* (analogous to *intension*) is a function that maps a possible circumstance or a possible world to a truth value. Indices such as world (and time, for Kaplan is the point at which the truth of the sentence is evaluated) is the second type of indices, which I will call a parameter. Notice that truth values are assigned in two stages. For example, the content of the sentence with an indexical, *I like cats*, changes or varies depending on who says it, or, in other words, the content is fixed by the context of utterance. If John is the agent of the context and utters the sentence, the content of the sentence is that John likes cats. Then, the content of the sentence is assigned its denotation, either true or false, relative to a possible world.

If the content of a tensed sentence φ is sensitive to time, then the content of φ will change depending on the context, particularly the time of the context. For instance, if the sentence *John is smiling* is uttered at 3 p.m., then the content expressed by the sentence is that John is smiling at 3 p.m.; if the sentence is uttered at 5 p.m., then the content is that John is smiling at 5 p.m. The truth value of the sentence will depend on whether John is smiling at the time of utterance. On the other hand, if we posit that the content of a sentence does not vary with the context, then the assignment of truth values to contents is relative to a time parameter—either the time of utterance or some time at which the sentence is evaluated.

The latter option has received an objection. If the content is time-neutral and its denotation is assigned relative to times, it is difficult to define contradiction without contradicting our intuition. For example, *John is smiling* uttered at 3 p.m. and *John is not smiling* uttered at 5 p.m. can both be true if John is smiling at 3 p.m. and not at 5 p.m.; but since the content is time-neutral and determined regardless of time, *John is smiling* and *John is not smiling* contradict with each other no matter when they are uttered (See Lasersohn 2017 for more discussion). Though contradiction may not be an important part of the semantics in this dissertation, I will adopt the first option, accepting the sensitivity of tensed sentences to time, and set up a system that the sensitivity of linguistic contents to time is pertinent to (the time of) the context, rather than to a time parameter.

Having a time parameter in the second stage, from contents to extensions, is analogous to the second option as discussed above with regard to the time-neutrality of the content of expressions. That is, the content of a sentence itself is not sensitive to time, but its truth value is determined by a time parameter. Tense and tensed sentences are also context-sensitive: for example, for the past tense to make sense, the time denoted by the tense morpheme must be prior to the context time. We will have the context to address the indexicality of tense, but not this second type of time parameter for evaluation. Contents are not the same at every time and a time index supplied by the context will suffice for the purposes of this dissertation. For a tensed sentence, its content and truth value are sensitive to the utterance time, which is supplied by the context. A sentential truth predicate is defined as in (34).

- (34) A sentence φ is true in context c relative to w for any assignment function g
iff $\llbracket \varphi \rrbracket^{c,g,w} = 1$.

Now, definitions of types are in (35); domains for the types are listed in (36).

(35) Types:

- a. e is a type
- b. t is a type
- c. i is a type
- d. If a is a type and b is a type, then $\langle a, b \rangle$ is a type
- e. If a is a type, then $\langle s, a \rangle$ is a type

(36) The set of D_a of possible denotations of type a :

- a. $D_e = U$ (the set of relevant individuals)
- b. $D_t = \{0, 1\}$ (the set of truth values; Falsity and Truth, respectively)
- c. $D_i = I$ (the set of relevant time intervals)
- d. $D_{\langle a, b \rangle} = \{f \mid f \text{ is a function from } D_a \text{ to } D_b\}$
- e. $D_{\langle s, a \rangle} = \{f \mid f \text{ is a function from } W \text{ to } D_a\}$

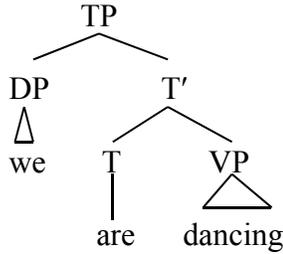
Proper names are already mentioned above as world-independent expressions which denote the same individual in any possible world. Denotations of indexicals like I and you are determined by the context, regardless of a world. $\llbracket I \rrbracket^{c,g,w} = speaker_c$, $\llbracket you \rrbracket^{c,g,w} = addressee_c$, $\llbracket now \rrbracket^{c,g,w} = time_c$, and so on. Some of the lexical items whose denotation may differ from world to world are given in (37). x, y are variables over individuals, t over times, w over worlds. The type of (37a) is $\langle e, \langle i, t \rangle \rangle$, (37b) is $\langle i, \langle e, t \rangle \rangle$, and (37c) is $\langle e, \langle i, \langle e, t \rangle \rangle \rangle$. We use λ -notation in the usual way to represent functions. For example, in $[\lambda x: x \in A. B]$, the expression between the colon and the dot indicates the domain of the function, and B indicates the value of the function for all possible arguments.

- (37) a. $\llbracket lawyer_i \rrbracket^{c,g,w} = \lambda x_e. x \text{ is a lawyer at } g(i) \text{ in } w$
 b. $\llbracket arrive \rrbracket^{c,g,w} = \lambda t_i. \lambda x_e. x \text{ arrives at } t \text{ in } w$
 c. $\llbracket eat \rrbracket^{c,g,w} = \lambda y_e. \lambda t_i. \lambda x_e. x \text{ eats } y \text{ at } t \text{ in } w$

We assume syntactic categories and phrase structure rules in the usual way. Some categories and their abbreviations are given in (38). We indicate an intermediate projection with a bar notation. For example, if we merge an auxiliary (= T) with a verb phrase (= VP), we have a T'. When the T' is merged with a subject, we have a maximal projection TP. An instantiation of such a syntactic structure is seen in (39). Lexical items and phrase structures generated by the English syntactic rules receive a denotation by semantics. Interpretation will be given at the level of the logical form of sentences. At the LF, common nouns, tenses and, hence, tensed verbs bear a temporal index i , which is a positive integer.

(38) Syntactic categories: NOUN (N), VERB (V), ADVERB (ADV), PREPOSITION (P), DETERMINER (D), TENSE/AUXILIARY (T), COMPLEMENTIZER (C)

(39) LF structure for *We are dancing*:



Now we have a compositional function application rule as defined in (40). We also have the operation of existential closure (41) as part of a sentential truth definition, following Heim (1982). This will account for the quantificational character of the indefinite article a or an indefinite tense. Any unbound variables in the derivation will be bound by (41).

(40) Function application rule:

For any types a, b , if α a complex expression consisting of β of type $\langle\langle s, a \rangle, b \rangle$ and γ of type a , then $\llbracket \alpha \rrbracket^{c,g,w} = \llbracket \beta \rrbracket^{c,g,w}(\lambda w'. \llbracket \gamma \rrbracket^{c,g,w'})$.

(41) For each context c , φ is true in c relative to w iff $\exists g[g_c \subseteq g \wedge \llbracket \varphi \rrbracket^{c,g,w} = 1]$.

φ is false in c relative to w iff for all g such that $g_c \subseteq g$, $\llbracket \varphi \rrbracket^{c,g,w} = 0$.

3.2.2 Interpretation of the Past Tense

Time will be modeled with the set of real numbers \mathbb{R} . Though each number corresponds to an instant of time, we will employ intervals of time, not instants, as seen in several theories of tense (Bennett and Partee 1978, Dowty 1979). t_i is a variable over intervals of time, and the set of all intervals of time is I . Singleton sets whose member is an instant of time also qualify as intervals. $<$ indicates a precedence relation: if $t_1 < t_2$, t_1 is prior to t_2 .

The syntactic category TENSE has PAST, PRES, and FUT as its members. Tense involves a free variable over times and bears an index i , a positive integer. Thus, the denotation of tense $\llbracket \text{TENSE}_i \rrbracket^{c,g,w}$ is $g(i)$. The past tense is represented as PAST with an index i at the LF and is defined likewise as in (42). Past tense must denote a time interval that precedes the utterance time and is undefined otherwise.

$$(42) \llbracket \text{PAST}_i \rrbracket^{c,g,w} = g(i), \text{ if } g(i) < \text{time}_c \text{ (undefined otherwise)}$$

For example, *John arrived* is analyzed in (43): the sentence is true in context c iff there is an assignment of a value to 2 such that John arrives at $g(2)$, which precedes the utterance time. In other words, if 2 is mapped onto some time interval prior to time_c , at which John arrives, *John arrived* is true. The index is treated as existentially quantified by the existential closure rule in (41). For example, let us say that g_c maps 1 onto 4:00 p.m. and 2 is not in the domain of g_c ; there is an appropriate g that maps 1 onto 4:00 p.m. and 2 onto 3:00 p.m. If time_c is 5:00 p.m. and John arrived at 3:00 p.m., (43a) is true. (44) shows a syntactic structure of the sentence and the types of each node.

$$(43) \text{John PAST}_2 \text{arrive is true in } c \text{ relative to } w \text{ iff } \exists g [g_c \subseteq g \ \& \ \llbracket \text{John PAST}_2 \text{arrive} \rrbracket^{c,g,w} = 1]$$

$$a. \llbracket \text{John PAST}_2 \text{arrive} \rrbracket^{c,g,w}$$

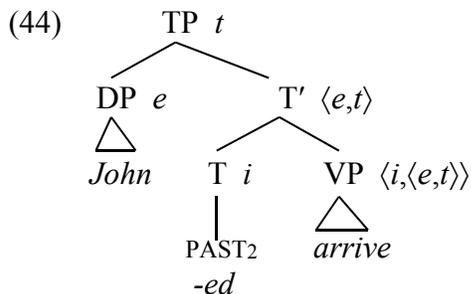
$$b. = \llbracket \text{arrive} \rrbracket^{c,g,w} (\llbracket \text{PAST}_2 \rrbracket^{c,g,w}) (\llbracket \text{John} \rrbracket^{c,g,w})$$

$$c. = \llbracket \text{arrive} \rrbracket^{c,g,w} ([g(2), \text{ if } g(2) < \text{time}_c]) (\text{John})$$

$$d. = [\lambda t. \lambda x. x \text{ arrives at } t \text{ in } w] ([g(2), \text{ if } g(2) < \text{time}_c]) (\text{John})$$

$$e. = 1 \text{ if John arrives at } g(2), \text{ if } g(2) < \text{time}_c \text{ in } w$$

= 0 if John doesn't arrive at $g(2)$, if $g(2) < time_c$ in w
 (undefined if $g(2) \not\prec time_c$)



The above example illustrates an indefinite reading. The sentence with a past tense morpheme is interpreted, provided that the time interval it denotes in c relative to an appropriate g precedes $time_c$. Once a time interval is introduced in the discourse, it becomes a member of c_{SAL} . In (43), 3:00 p.m. is added to c as a salient time interval $time_s$. It can now work as an antecedent of subsequent coindexed time variables if there are any. A new time interval introduced in c_i alters c_{iSAL} , and thus alters c_i to c_{i+1} . For instance, $c_1 = \langle \text{Bill, Mary, 5:00 pm, Urbana, \{John\}, } \langle 1, \text{John} \rangle \rangle$ and Bill says [He_1 PAST₇ arrive]. If $g(7)$ is defined and John arrived at 4:00 p.m., the updated context due to the sentence is now $c_2 = \langle \text{Bill, Mary, 5:00 p.m., Urbana, \{John, 4:00 p.m.\}, } \langle \langle 1, \text{John} \rangle, \langle 7, 4:00 \text{ p.m.} \rangle \rangle \rangle$.

(45) Addition of new time intervals to the context:

For any sentence ϕ containing an expression α_j in $c_i = \langle speaker_{c_i}, addressee_{c_i}, time_{c_i}, place_{c_i}, c_{SAL_i}, g_{c_i} \rangle$, if for all g such that ϕ is true relative to c_i, g , and actual world $w@, g(j) = x$, then $c_{SAL_{i+1}} = c_{SAL_i} + x$. Also, $Dom(g_{c_{i+1}}) = Dom(g_{c_i}) + j$.

Let us now assume that Bill says *John smiled* and that John's smiling co-occurred with his arrival. Therefore, the tense in *John smiled* is coindexed with the tense in *John arrived*. The context for [$John$ PAST₇ smile] is c_2 ; the denotation of the sentence is presented in (46).

(46) *John* PAST₇ *smile* is true in c relative to w iff $\exists g[g_c \subseteq g \ \& \ \llbracket John \text{ PAST}_7 \text{ smile} \rrbracket^{c,g,w} = 1]$

- a. $\llbracket \text{John PAST}_7 \text{ smile} \rrbracket^{c,g,w}$
- b. $= \llbracket \text{smile} \rrbracket^{c,g,w}(\llbracket \text{PAST}_7 \rrbracket^{c,g,w})(\llbracket \text{John} \rrbracket^{c,g,w})$
- c. $= \llbracket \text{smile} \rrbracket^{c,g,w}([g_{c_2}(7), \text{if } g_{c_2}(7) < \text{time}_c])(\text{John})$
- d. $= [\lambda t. \lambda x. x \text{ smiles at } t \text{ in } w]([g_{c_2}(7), \text{if } g_{c_2}(7) < \text{time}_c])(\text{John})$
- e. $= 1$ if John arrives at $g_{c_2}(7)$, if $g_{c_2}(7) < \text{time}_c$ in w
 $= 0$ if John doesn't arrive at $g_{c_2}(7)$, if $g_{c_2}(7) < \text{time}_c$ in w
 (undefined if $g_{c_2}(7) \not< \text{time}_c$)

(45) shows one way of updating c_{SAL} . Adverbials like *yesterday* add the times they denote to c_{SAL} . Elements of c_{SAL} could also be given in the beginning of the discourse as part of the shared knowledge between the interlocutors. An index on a tense which is in the domain of g_c is mapped onto an element in c_{SAL} , time_s . Unlike the indefinite interpretation of tense, the definite interpretation is indexical, in that a tense morpheme denotes a particular time time_s in c_{SAL} via g_c .

Let us have the distinction between definite and indefinite tenses as summarized in (47). If an index of a tense morpheme is in the domain of g_c , the tense morpheme is definite; in the case of indefinite tenses, we want to say that its denotation is determined not by g_c but by an appropriate g due to existential closure, since the index on an indefinite tense is not in the domain of g_c . If the value of a time variable is only determined by g_c , such a rule will only account for a definite or indexical reading of tense. The salience condition (47) looks similar to Heim's familiarity condition in (14). The difference, however, is that (14) constrains the interpretation of NPs whose syntactic definition is already characterized, while (47) serves as a semantic definition of definite and indefinite tenses.

- (47) Salience condition: For any temporal expression α_i and context c ,
- a. If $i \in \text{dom}(g_c)$, α_i is definite.
 - b. If $i \notin \text{dom}(g_c)$, α_i is indefinite.

We now have a system in which the interpretation of tense is determined by features of the context and contextual salience. The context dependence of tense is more explicitly shown in terms of temporal indices and their value assignments. Notice that such a system is also advanta-

geous for a language whose definiteness of tense is not overtly marked because both readings of tense are assigned by the same kind of semantic operation, which is g_e or g . Additionally, by allowing both quantificational and indexical interpretations of tense, we are able to account for more data, which was not so in the theories that have only one type of interpretation, as reviewed in Chapter 2. Coreference of variables over salient time intervals will be tackled in more detail in the next chapter, along with temporal anaphora in a discourse.

CHAPTER 4

TEMPORAL ANAPHORA

In this chapter I will show how the semantics proposed in the previous chapter with both definite and indefinite interpretations of tense account for temporal anaphora. As you can anticipate from the term, temporal anaphora is associated with anaphora or anaphora resolution of DPs. Anaphora resolution concerns what DPs, especially anaphors, in a discourse refer to in relation to other DPs. Coindexation or coreference of variables due to pronouns and definite descriptions is an issue of anaphora resolution, along with how these variables are bound. Since both quantificational and referential uses of tense are allowed in our tense system, it is worth investigating how time variables that enter into a discourse are bound and how coindexed variables and their values are accounted for.

I will also show in this chapter that tenses are interpreted within a limited domain, as well as how this domain is selected and shifted in the course of conversation. In relation to temporal domains, I will propose a new version of an anchoring condition for tenses. *When*-clauses will also be discussed, along with a pragmatic constraint in tense interpretation. As I demonstrated in the previous chapter, multiple salient time intervals are allowed in my tense semantics, which is an advantage over previous theories, as reviewed in Chapter 2. For these purposes, I will mostly use excerpts from TV interviews I transcribed and adapted specifically for this chapter.

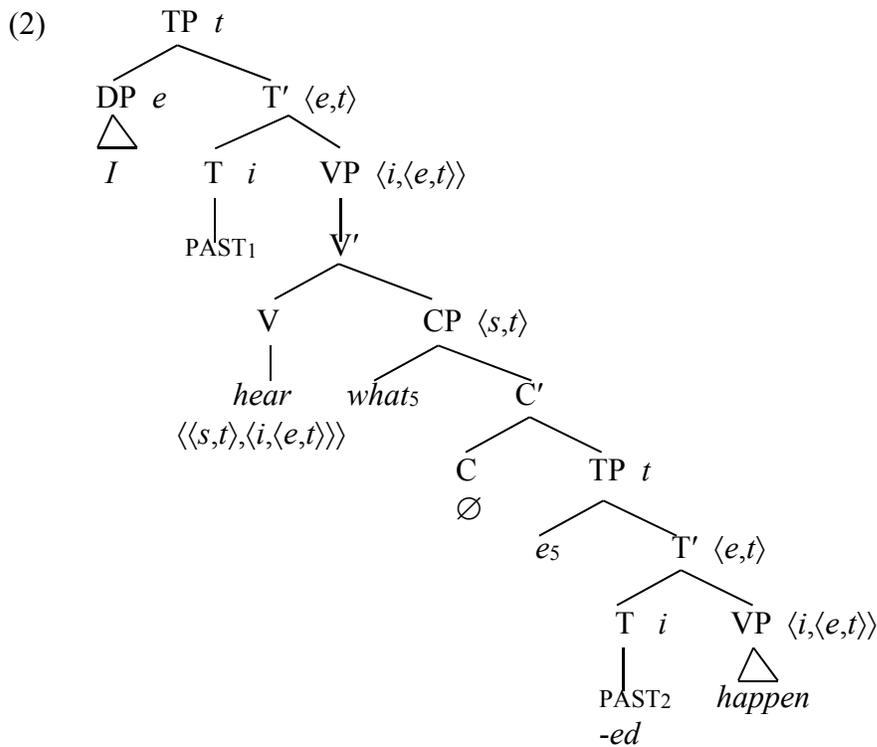
4.1 Selection of Approximate Time Domain

4.1.1 Chronologically Sequenced Utterances

Normally, events are recounted in the order they occurred unless interlocutors are confused or have a particular conversational goal. This is based on Grice's Cooperative Principle, as the maxim of manner, among his maxims of conversation, states that interlocutors are expected to be as orderly as possible. For example, when you hear a sentence such as, *I heard what happened, and I went to the hospital*, you assume that the speaker first heard what happened and then went to the hospital, and you may further infer that the speaker's hearing what happened might have caused her to go to the hospital.

For the above example, we need to add a few more rules for interrogative clauses and traces. First, traces are treated like variables, as presented in (1). The LF structure of $[I \text{ PAST}_1 \text{ hear } [what \text{ PAST}_2 \text{ happen}]]$ is provided in (2) with the type of each node marked, except for the semantically vacuous, non-branching node. (3) offers the non-branching nodes rule for such nodes on a syntactic tree. We also need a rule for embedded interrogatives like *what PAST₂ happened*. I follow Karttunen's (1977) analysis of interrogatives and provide the denotation of *what happened* in (4) following Karttunen. He treated questions and embedded questions as a set of propositions (p is a variable over propositions), which are true answers for the questions. Adopting Karttunen's analysis, I will also have interrogative clauses denote a set of true propositions.

(1) $[[e_i]]^{c,g,w} = g(i)$



(3) Non-branching nodes: If α is a non-branching node of type a consisting of β of type a , then $[[\alpha]]^{c,g,w} = [[\beta]]^{c,g,w}$.

(4) The denotation of *what* PAST₂ *happen* in *c* relative to *w* (based on Karttunen 1977):

$$\llbracket \textit{what PAST}_2 \textit{ happen} \rrbracket^{c,g,w} = \{p \mid \exists x[p = x \textit{ happen at } g_{c_1}(2), \textit{ if } g_{c_1}(2) < \textit{time}_{c_1} \textit{ in } w \wedge p = 1]\}.$$

(undefined if $g_{c_1}(2) \not< \textit{time}_{c_1}$)

Since the interlocutors are talking about a particular incident about which they already know, PAST₂ denotes a salient time in the context *time_s*. Let us say we have the parameters of the initial context as follows: $c_1 = \langle \textit{John, Mary, 5:00 pm 6/16/2017, Urbana, time}_s (= 5:00 \textit{ pm 4/16/2017}), \langle 2, 5:00 \textit{ pm 4/16/2017} \rangle \rangle$. Semantic derivations of (2) are represented in (5).

(5) [*I* PAST₁ *hear* [*what e₅* PAST₂ *happen*]] is true in *c*₁ relative to *w*

$$\textit{iff } \exists g[g_c \subseteq g \wedge \llbracket \textit{I PAST}_1 \textit{ hear what } e_5 \textit{ PAST}_2 \textit{ happen} \rrbracket^{c_1,g,w} = 1]$$

a. $\llbracket \textit{I PAST}_1 \textit{ hear what } e_5 \textit{ PAST}_2 \textit{ happen} \rrbracket^{c_1,g,w}$

b. $= \llbracket \textit{hear} \rrbracket^{c_1,g,w}(\{p \mid \exists x[p = x \textit{ happen at } g_{c_1}(2), \textit{ if } g_{c_1}(2) < \textit{time}_{c_1} \textit{ in } w \wedge p = 1]\})$

$(\llbracket \textit{PAST}_1 \rrbracket^{c_1,g,w})(\llbracket \textit{I} \rrbracket^{c_1,g,w})$

c. $= [\lambda p_{\langle s,t \rangle}. \lambda t. \lambda y. y \textit{ hear } p \textit{ at } t \textit{ in } w](\{p \mid \exists x[p = x \textit{ happen at } g_{c_1}(2), \textit{ if } g_{c_1}(2) < \textit{time}_{c_1} \textit{ in } w \wedge p = 1]\})([g(1), \textit{ if } g(1) < \textit{time}_{c_1}](\textit{John}))$

d. $= \textit{John hear } \{p \mid \exists x[p = x \textit{ happen at } g_{c_1}(2), \textit{ if } g_{c_1}(2) < \textit{time}_{c_1} \textit{ in } w \wedge p = 1]\} \textit{ at } g(1), \textit{ if } g(1) < \textit{time}_{c_1} \textit{ in } w$

We now have for *I* PAST₃ *went to the hospital* an updated context $c_2 = \langle \textit{John, Mary, 5:00 pm 6/16/2017, Urbana, } \{ \textit{time}_{s1} (= 5:00 \textit{ pm 4/16/2017}), g(1) \}, \{ \langle 2, 5:00 \textit{ pm 4/16/2017} \rangle, \langle 1, g(1) \rangle \} \rangle$. The sentence is true if there is a time prior to *time_{c₂}*, *g*(3), such that John went to the hospital at *g*(3). If we assume that the speaker was uttering the two sentences in chronological order, *g*(1) is prior to *g*(3). Note also that these time intervals *g*(1) and *g*(3) should be placed within an approximate time domain.

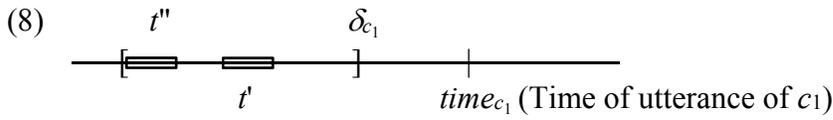
As we have discussed with the example, *I didn't turn off the stove*, quantification over times occurs in a limited domain, in the same manner as other types of quantification in natural language. This also holds true for the short discourse we are discussing: each tense denotes a time interval in a restricted domain, which is some time in the approximate past, after the particular incident of interest. Moreover, in this example, the sequenced acts of hearing and going to

the hospital also happened within an approximate time domain that is contextually relevant, with not much temporal distance. I will use δ_c to represent the temporal domain in the context. Thus, δ_c is now part of c , whose definition is updated, as in (6). The definition of δ_c is provided in (7a), and (7b) stipulates that what TENSE_{*i*} denotes should be a member of δ_c . (7b) works as a pragmatic constraint rather than as a part of semantic derivations. For instance, the temporal domain of (5) would be relevant to the topic, “what happened,” and $g(1)$ ($= t'$) in (5) is placed within the approximate domain around $g_{c_1}(2)$ ($= t''$), as illustrated in (8).

$$(6) c = \langle \text{speaker}_c, \text{addressee}_c, \text{time}_c, \text{place}_c, c_{\text{SAL}}, g_c, \delta_c \rangle$$

(7) a. $\delta_c \subseteq I$ is a set of contextually relevant and limited time intervals.

$$\text{b. } \llbracket \text{TENSE}_i \rrbracket^{c,g,w} \in \delta_c$$



Often, when people recall a story from the past, their utterances are not always chronologically in order. Times, denoted by the tenses in a discourse, may go back and forth when the speaker is confused or has something to add, for example. Restriction on time domain still seems effective in a partly disorganized discourse.

4.1.2 Within a Restricted Time Domain

Time domain for tense interpretation, regardless of the chronological order of tenses, is still limited, depending on the context. Tenses in a discourse denote times within a restricted domain. Let us take the example of (9). The interlocutors are discussing a particular party that the speaker was invited to. Tense (a) denotes a salient time in the context, the night that the party took place and (b) denotes some time interval within this party time. (c) and (d) are ambiguous. They could either be the times when or after the speaker received the invitation, in which case we have a domain shift from the party time to the invitation; or, they coincide with (b), in which case we

have an anaphor-like usage of tense. Obviously, (e) denotes some time between the invitation and the party.

- (9) It (a) was a strange night and I (b) thought I (c) didn't know why I (d) was invited. So I (e) did research.

Semantic derivations of sentences containing (a) and (e) in (9) are given in (11) and (13), respectively. I use X_i, Y_i, Z_i to indicate subsets of the set of all intervals I , and there is no gap within these subsets of time intervals. If X is the interval between t_1 and t_2 inclusive, we write $X = [t_1, t_2] = \{t: t_1 \leq t \leq t_2\}$; intervals with exclusive end points are represented as $(t_1, t_2) = \{t: t_1 < t < t_2\}$; $(t_1, t_2] = \{t: t_1 < t \leq t_2\}$ and $[t_1, t_2) = \{t: t_1 \leq t < t_2\}$ are also possible. Conceptually, an open-ended time interval like $\{t: t_1 < t\}$ is possible; but, since I argue that tense is interpreted within a limited time domain, it will not be used much in this dissertation. If an interval t overlaps with another interval X , we write $t \circ X$; if t is a subinterval of X , $t \subset X$; if X is a subinterval of t , $t \supset X$. I will treat the expletive *it* and the copula *be* as semantically vacuous, hence $\llbracket it \rrbracket^{c,g,w} = [\lambda f_{\langle e,t \rangle}. f]$ and $\llbracket be \rrbracket^{c,g,w} = [\lambda f_{\langle e,t \rangle}. f]$, where f is a variable over functions; for present purposes, I will disregard the lexical semantics of the attributive adjective *strange*. The common noun *night* here denotes a time that is night as represented in (10). The temporal identification rule in (11) applies especially for time-denoting common nouns that are not used as an adverbial. The derivation in (12) shows that due to (11), (10) is identical with the salient time denoted by $PAST_1, g_{c_1}(1)$. In (13), the tense should denote some time within the domain between t_1 and t_2 , which are the time when the speaker received her invitation, and the time when the party started, respectively; that is, $\delta_{c_5} = (t_1, t_2)$.

- (10) $\llbracket night_8 \rrbracket^{c,g,w} = g(8)$, provided that $g(8)$ is a night.

- (11) Temporal identification rule:

For any time-denoting expressions of type i , if α a complex expression consisting of β of type i and γ of type i , then $\llbracket \alpha \rrbracket^{c,g,w} = \llbracket \beta \rrbracket^{c,g,w} = \llbracket \gamma \rrbracket^{c,g,w}$.

(12) *It PAST₁ is a strange night₈* is true in c_1 relative to w

iff $\exists g[g_c \subseteq g \ \& \ \llbracket it \text{ PAST}_1 \text{ be a strange night}_8 \rrbracket^{c_1, g, w} = 1]$

a. $\llbracket it \text{ PAST}_1 \text{ be a strange night}_8 \rrbracket^{c_1, g, w}$

b. $= \llbracket \text{PAST}_1 \text{ be a strange night}_8 \rrbracket^{c_1, g, w}$

c. $= \llbracket \text{PAST}_1 \text{ a strange night}_8 \rrbracket^{c_1, g, w}$

d. $= \llbracket \text{PAST}_1 \rrbracket^{c_1, g, w} = \llbracket a \text{ strange night}_8 \rrbracket^{c_1, g, w}$ [Due to (11)]

e. $= g_{c_1}(1) = g(8)$, provided that $g(8)$ is a night in w (undefined if $g_{c_1}(1) \not\prec \text{time}_{c_1}$)

(13) *I PAST₅ do research₉* is true in c_5 relative to w

iff $\exists g[g_c \subseteq g \ \& \ \llbracket I \text{ PAST}_5 \text{ do research}_9 \rrbracket^{c_5, g, w} = 1]$

a. $\llbracket I \text{ PAST}_5 \text{ do research}_9 \rrbracket^{c_5, g, w}$

b. $= \llbracket do \rrbracket^{c_5, g, w}(\llbracket research_9 \rrbracket^{c_5, g, w})(\llbracket \text{PAST}_5 \rrbracket^{c_5, g, w})(\llbracket I \rrbracket^{c_5, g, w})$

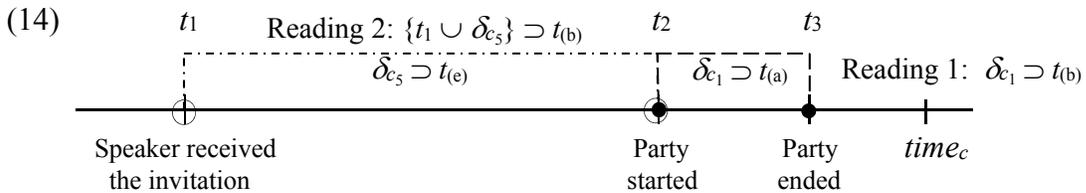
c. $= [\lambda y. \lambda t. \lambda x. x \text{ does } y \text{ at } t \text{ in } w](\llbracket \lambda x. \lambda t. x \text{ is research at } t \text{ in } w \rrbracket)([g(5), \text{ if } g(5) < \text{time}_{c_5}])(\text{speaker}_{c_5})$

d. $= [\lambda t. \lambda x. x \text{ does research at } g(9) \text{ in } w \text{ at } t \text{ in } w](\llbracket g(5), \text{ if } g(5) < \text{time}_{c_5} \rrbracket)(\text{speaker}_{c_5})$

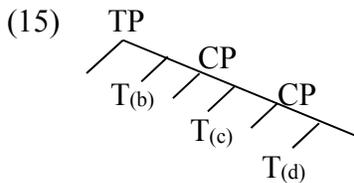
e. $= \text{speaker}_{c_5}$ does research at $g(9)$ in w at $g(5)$, if $g(5) < \text{time}_{c_5}$ in w

f. $g(5) \in \delta_{c_5}$, where $\delta_{c_5} = (t_1, t_2)$ (undefined if $g(5) \not\prec \text{time}_{c_5}$)

Let us look into the time domains in which the tenses of (b), (c), and (d) in (9) are interpreted. These times, along with the times denoted by (a) and (e) and their time domains, are diagrammed in (14). Interval δ_{c_5} is the domain for (e), as mentioned above, between t_1 at which the speaker got the invitation and t_2 at which the party started. Interval δ_{c_1} is the domain for (a) and starts from t_2 and ends at t_3 when the party ended; that is, $\delta_{c_1} = [t_2, t_3]$.



There are two options for interpreting (b): it could either be that the speaker did the thinking some time in $\{\delta_{e_5} \cup t_1\}$ or in δ_{e_1} . In this example, the domain for its first reading includes t_1 , one end of the relevant time domain for the entire discourse (9), because the speaker's thinking action is in regard to invitation she received at t_1 . Time domains for tenses (c) and (d) in the subordinate clauses are determined in accordance with (b); the subordinate past tenses should denote a time interval in the domain either preceding or overlapping with the domain for the past tense in the main clause. That is, if $t_{(b)}$ denotes some time in δ_{e_5} , $t_{(c)}$ and $t_{(d)}$ cannot denote a time in δ_{e_1} . The hierarchical structure of the tenses schematized in (15) gives an explanation for this precedence constraint on the subordinate tenses. $T_{(b)}$ in the tree diagram indicates the tense node for the past tense due to (b), *thought*, and so on. Syntactically, $T_{(c)}$ is in the c-command domain of $T_{(b)}$, and so is $T_{(d)}$. When the main and subordinate clauses are all in past tense, the subordinate tense is not interpreted in the domain which appears later than the main tense domain, unless the subordinate clause contains *would*. In (9), when the temporal domain for (b) is δ_{e_1} , then the domain for (c) is δ_{e_1} or δ_{e_5} ; when the domain for (b) is $\{\delta_{e_5} \cup t_1\}$, the domain for c is also $\{\delta_{e_5} \cup t_1\}$, but not δ_{e_1} .



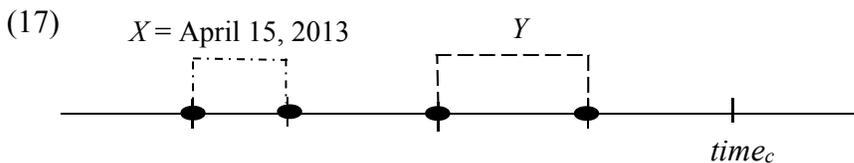
Let us move on to (c) and (d). Again, $t_{(d)}$ cannot be interpreted in the domain later than the domain for $t_{(c)}$. If $t_{(c)}$ is interpreted in δ_{e_1} , $t_{(d)}$ is interpreted in δ_{e_1} or δ_{e_5} ; if $t_{(c)}$ is interpreted in δ_{e_5} , $t_{(d)}$ should be placed within δ_{e_5} or denote t_1 . Here, $t_{(d)}$ has two possible temporal domains, and it is due to the two possible readings of *was invited*: it could refer to the action of the speaker receiving the invitation or the fact that the speaker is on the guest list. With the one-time activity reading, $t_{(d)}$ denotes t_1 regardless of the domain for $t_{(c)}$; with the state reading, it is possible that the domains for $t_{(c)}$ and $t_{(d)}$ overlap. Since (9) is part of the larger discourse about the party and the speaker's invitation to the party, the event or the state that the speaker was invited to the party is already salient in the context. Thus, when (d) has the activity reading of receiving the invitation, we have a definite, indexical reading of the tense. The sequence of (b), (c), and (d) is an ex-

ample of phenomena known as *sequence of tense*. I will discuss more about sequence of tense with past tenses and their ambiguous readings in the system of ambiguous tense.

In summary, although each tense in (9) denotes a different, or in some cases, overlapping time interval, it is all interpreted within a limited domain. Overall, the domain for tense interpretation in (9) shifted from δ_{c_1} to δ_{c_5} . Also, as you have seen in the cases of (c) and (d) in (9), we have different readings of sentences depending on through which domain the tenses are interpreted.

Domain shift is also observed in a discourse when there is a topic change. There are three sentences in (16), which are part of a larger discourse. In the first two sentences the interlocutors are discussing the Boston Marathon bombing that occurred in 2015. As the speaker mentions the movie about the bombing that the hearer is part of, the topic is now the movie and its production. The temporal domain for the first two sentences is the day that the Boston Marathon took place (represented by X in (17), April 15, 2013), which is made more obvious due to *that day*. On the other hand, the underlined past tense (e) denotes some time between the marathon and the time utterance, more specifically, in the time period during which the movie was being made (Y in (17)). As the topic of the discourse changes, the temporal domain for tense interpretation also changes. It may be that if there is an overt expression that indicates time like *that day*, the interval denoted by that expression is chosen as the temporal domain for the sentence and hence becomes available for the following sentences, until a new domain is selected.

- (16) There (a) were people **that day** who (b) ran a marathon, and then (c) ran another two miles to a hospital to give blood. Boston (d) was a beautiful place **on that terrible day**. I understand that you almost (e) didn't make this movie.



Specifically, the domain for (d) is *that day*, similar to (9a). The predicate *was a beautiful place* indicates a *state* in that what the verb describes lasts for some period of time, and thus we have a reading that its temporal domain overlaps with the time denoted by *that day* ($t_{(d)} \circ X$).

Classifying the predicate as a state is based on word-internal time structure of verbs, according to Vendler’s (1957) verb classification system. This is a topic that I will discuss in more detail in a later chapter.

Tenses (a), (b), and (c) in (16) are interpreted in X like (d), but in terms of their temporal domain, they are distinguished from (d). (a) in *there*-construction is related to the noun *people*, and the temporal index on *people* is related to the indices on (b) and (c) because (b) and (c) are describing the people’s actions. The two predicates, *ran a marathon* and *ran two miles*, are classified as *accomplishments* in Vendler’s system—that is, what the predicates describe last for a certain amount of time and have a culmination point. One person, for example, ran a marathon and two miles, and the temporal domain for these two actions is not likely to overlap with the entire duration of X . Of course, each individual who ran both a marathon and an additional two miles could have done so at different times, and if you collapse all these times that each individual may have run a marathon and plus two miles, there is a possibility that the entire duration of these actions of every individual denoted by *people* would coincide with X . Recall Enç’s example, *All rich men were obnoxious children*, repeated in (18a). Time arguments involved with each individual are quantified to capture the natural reading of the sentence, and the relation between the two time arguments of both nouns is also part of the representation in (18b). (19a) is a simplified representation of (a), (b), and (c) in (16). (19b) indicates the temporal domain for (19a).

(18) a. All rich men were obnoxious children.

b. $\forall t_1 \exists t_2 [\forall x [[\text{rich-man}(x) \text{ at } t_1] \rightarrow [\text{obnoxious-child}(x) \text{ at } t_2]] \wedge [t_2 \leq t_1]]$

(19) a. $\forall t_2 \forall t_3 [\exists x [[\text{run-a-marathon}(x) \text{ at } t_2] \wedge [\text{run-two-miles}(x) \text{ at } t_3]] \wedge [t_2 \leq t_3]]$

b. For all t_2 and t_3 , $\{t_2 \cup t_3\} \subseteq X$

Sometimes, the chronological order of utterances is not clear. For instance, the sentences in (20) concern the same topic, the presidential election in 2017. Interlocutors may presume that the temporal domain for the utterances in (20) is the election period δ_e , possibly from Election Day back to a few months prior. Both tenses denote some time interval within δ_e due to contextual relevance. They are still interpreted within the same limited domain though their precedence relation may not be clear.

(20) We didn't vote for dirty air, dirty water. We didn't say let's make America dirty again.

In summary, there is a restriction on the temporal domain through which tenses in a discourse are interpreted. Tenses involved in related actions and events are interpreted in the same or approximate temporal domain δ_c . A domain for tense interpretation is determined based on contextual considerations such as how occurrences normally develop and how shared knowledge between the interlocutors should include all relevant time intervals in a discourse, whether or not the utterances are sequenced in a chronological order. A topic of a discourse is also a factor to be considered—when the speaker introduces a new event—for example, changes the topic—the domain for tense interpretation also changes. The temporal domain is fixed as an approximate time period to the main events discussed in a discourse, and though its boundaries may not always be precisely determined, it seems that a naturally settled chunk of time is at work for temporal interpretation. As the events that the interlocutors discuss move back and forth in terms of the time they took place, a relevant temporal domain also shifts accordingly. Interlocutors are effective at shifting and fixing temporal domains, and the context also provides appropriate values to time variables within a limited domain.

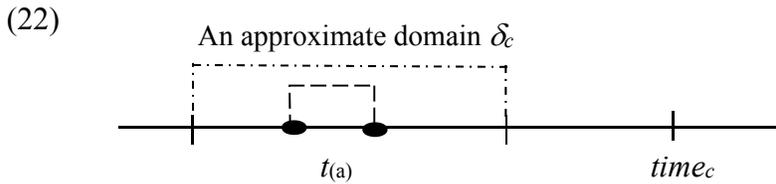
4.1.3 Salience Ranking of Time Intervals

It is possible that there is more than one salient time interval in c_{SAL} . As we have discussed the adaptability of the salience theory of definite descriptions for definite tenses, we have seen that salience is a gradable notion and that there is a hierarchy among salient objects in the context. Also, there may be a hierarchy among salient time intervals in the context that one interval is more salient than another. As with salient objects in the context, the interval at the top of the salience ranking is the most salient time interval in the context and it is selected as the value of a definite tense.

The discourse in (21) involves a random experience of the speaker. Though the speaker probably knows when the event she is describing took place, this is not clearly presented in the context or to the hearer. As the first sentence is uttered, (a) denotes some time in the past, $t_{(a)}$ in (22) which is now contextually salient, and a temporal domain δ_c is set up including the intervals approximate to the time selected by (a). Tense (b) denotes some time interval within δ_c set by (a)

and becomes salient in the context. Since the time denoted by (b), $t_{(b)}$, is added to the discourse later than $t_{(a)}$, $t_{(b)}$ is higher in the salience ranking than $t_{(a)}$. (c) is related to an action that is concurrent with (b) and thus $t_{(b)}$ overlaps with $t_{(c)}$ ($t_{(b)} \circ t_{(c)}$). $t_{(d)}$ is almost adjacent to $t_{(c)}$ because the woman’s action of looking at the speaker seems to start immediately after her action of saying something about her life. I will use ‘ $\}$ ’ to indicate that two intervals are adjacent or one interval immediately follows another ($t_{(c)} \} t_{(d)}$). After $t_{(d)}$ is added to the context, it is now the most salient time, higher in ranking than $t_{(c)}$ and $t_{(b)}$. The first *and* between (b) and (c) seems to indicate the concurrency of (b) and (c); the second *and* before (d) cues adjacency of the events related to (c) and (d); the *and* between (d) and (e) could either be an adjacent or concurrent one—in the concurrent reading, $t_{(d)}$ overlaps with $t_{(e)}$ ($t_{(d)} \circ t_{(e)}$).

(21) There (a) was a homeless woman one time. I (b) saw her and she (c) was saying something terrible about her life, and she (d) looked up and (e) nodded.



This is how c_{SAL} is updated as the discourse in (21) continues. Let us call the initial c_{SAL_1} , which does not have any member. After the first sentence in (21) is uttered, we have the updated c_{SAL_2} (23a): $t_{(a)}$ and *a woman*, whose denotation is represented as w in (23), are introduced to the discourse, and $t_{(a)}$ and w become a salient time interval and a salient object in the context. As the speaker continues with *I saw her...*, *her* denotes w which is in c_{SAL_2} as the most salient individual in the context. At this point, no rule in the system prevents a pronoun from denoting a mismatching individual in gender and number. Let us require that pronouns should be assigned their value via g_c as long as they match in person, number, and gender. Tense (b) is assigned its value via g rather than g_{c_2} —the speaker’s action of seeing the woman took place as a new action without any overlap with other intervals in the context, and thus (b) introduces a new time interval, which gains salience, becoming the most salient one in the context. The most salient time intervals and objects are boldfaced in (23). c_{SAL} is to be a partially ordered set. The most

salient time intervals and objects are boldfaced in (23). The order of time intervals and the order of individuals are not correlated with each other. After *she was saying...* is uttered, we have (23c). Again, the value of the tense (21c) is assigned via g or g_{c_4} : (21c) denotes a time interval that is already added to the context with *and* indicating concurrency of the actions described by the verbs connected with it, and $t_{(c)}$ denotes $t_{(b)}$, the most salient time interval in (23b). As *she looked* is uttered, we have (23d). Depending on whether *nodded* is concurrent with or adjacent to *looked*, (21e) either denotes $t_{(d)}$ via g_{c_6} or an adjacent time interval $t_{(e)}$ which immediately $t_{(d)}$ follows via g .

- (23) a. $c_{SAL_2} = \{\mathbf{t}_{(a)}, \mathbf{w}\}$
 b. $c_{SAL_3} = \{\mathbf{t}_{(b)}, t_{(a)}, \mathbf{w}\}$
 c. $c_{SAL_4} = \{\mathbf{t}_{(c)} = \mathbf{t}_{(b)}, t_{(a)}, \mathbf{w}\}$
 d. $c_{SAL_5} = \{\mathbf{t}_{(d)}, t_{(c)} = t_{(b)}, t_{(a)}, \mathbf{w}\}$

We have examined the range of the intervals denoted by tenses in a discourse and multiple intervals that are salient in the context. Specifically, we have seen how new intervals are added to c_{SAL} and how the value of the following tense is determined depending on concurrency or adjacency of the action associated with the tense as the discourse continues. Selection of temporal domains for tenses and of the most salient interval in the context is quite unpredictable and depends heavily upon the context. I have set the domain for tenses as a restriction on their assignment functions. It is influenced by the lexical aspect of the verbs, pragmatic factors, and extralinguistic factors such as encyclopedic knowledge. Interlocutors seem able to track such unpredictable and dynamic parts of tense interpretation in a discourse, and tenses in a discourse are interpreted in a constrained manner.

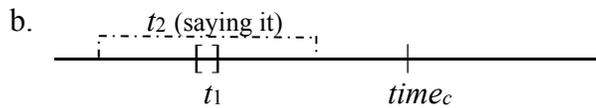
4.2 *When*-Clauses

Temporal domains are more obviously selected with clauses starting with *when* or *as*: the time interval that the verb of a *when*-clause denotes is a central point. The temporal domain for the tense in the *when*-clause, and possibly in following tenses, is formed around this point. At a glance one may think that *when* indicates the simultaneity of the verbs in the two clauses, con-

nected with *when*. Interestingly, however, a tense in a post-*when*-clause does not always have an anaphor-like, definite reading: tenses involved with *when* show slightly different behaviors in temporal domain selection and simultaneity of the intervals that they denote, depending on factors like *aktionsart*.

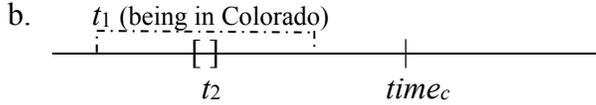
Let us view the examples. The past tenses in (24a) seem to denote overlapping time intervals and thus PAST₂ denotes t_1 , which is the value of PAST₁. However, upon closer examination, times t_1 and t_2 , denoted by the tenses in (24a), do not completely overlap. Strictly speaking, there is a particular time interval (t_1) that is quite short, during which the speaker's action of getting up is completed, and it is possible that the speaker's speech began before she reached to the point of getting up there and continued for a while after she arrived there, as illustrated in (24b). t_1 and t_2 might not even overlap, but t_1 could immediately follow t_2 if she began saying something after she completed her action of getting up there. All these possible scenarios are covered by *when*, and the two actions are grouped together with some indication of simultaneity, although the times during which the two actions took place may not be completely overlapping.

(24) a. When I got₁ up there, I said₂ it.

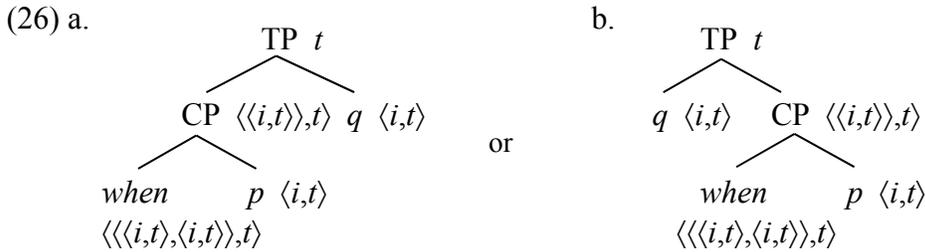


Interestingly, t_3 , during which the speaker and his family were in Colorado, forms a temporal domain, possibly for the following utterances found in (25). The actions that the verbs in (25) describe are of different types: according to Vendler's classification, being in Colorado indicates a state, and placing Georgia behind the wheel is an achievement, in that the action is completed at an instantaneous interval, which is similar to (24b), illustrated as in (25b). *When* indicates that the two actions in the clauses it connects are related, and the two actions involve some concurrency, but it is not the case that one of the tenses always works as an antecedent for the other, as we can see in (25). It is likely that the interlocutors talk more about what happened in Colorado, in which case t_1 becomes a temporal domain for the following tenses associated with events that took place in Colorado.

(25) a. We were₁ in Colorado when we first put₂ Georgia behind the wheel.



I now offer a denotation of *when*, based on (24) and (25) (I only considered a reading that t_1 is within t_2). (26) is a simplified syntactic structure of $[[when\ p]\ q]$, where p and q are variables over sentential elements of type $\langle i, t \rangle$. Both (26a) and (26b) are possible options for the sentence. (27) is the initial denotation of *when*. In (27), t of p is a subinterval of t' of q because in both (24) and (25) t , which corresponds to t_1 in (24) and to t_2 in (25), is placed within t' . The derivation of (25) is given in (28). It is a simplified version; *first* indicates that the action of putting Georgia behind the wheel continued afterward, and this occasion is the first one among the actions that followed, an action that is dropped in the derivation in (28). Also, the denotations of *in Colorado* and *behind the wheel* are omitted for present purposes.



$$(27) \llbracket when \rrbracket^{c,g,w} = \lambda p_{\langle i,t \rangle}. \lambda q_{\langle i,t \rangle}. [p(t) \wedge q(t') \wedge t \subset t' \text{ in } w]$$

(28) We₃ were₁ in Colorado when we₃ put₂ Georgia behind the wheel.

a. $\llbracket we_3 \text{ PAST}_1 \text{ be in Colorado} \rrbracket^{c,g,w}$

b. $= \lambda t_i. g_c(3) \text{ be in Colorado at } t \text{ in } w$

c. $\llbracket we \text{ PAST}_2 \text{ put Georgia behind the wheel} \rrbracket^{c,g,w}$

d. $= \lambda t_i. g_c(3) \text{ PAST}_2 \text{ put Georgia behind the wheel at } t \text{ in } w$

e. (26): $\lambda p_{\langle i,t \rangle}. \lambda p_{\langle i,t \rangle}. [p(t) \wedge p(t') \wedge t \subset t' \text{ in } w] (\llbracket \lambda t_i. g_c(3) \text{ put Georgia behind the wheel at } t \text{ in } w \rrbracket (\llbracket \text{PAST}_2 \rrbracket^{c,g,w})) (\llbracket \lambda t_i. g_c(3) \text{ be in Colorado at } t' \text{ in } w \rrbracket (\llbracket \text{PAST}_1 \rrbracket^{c,g,w}))$

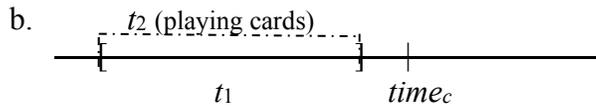
f. $[g_c(3) \text{ put Georgia behind the wheel at } g(2), \text{ if } g(2) < time_c \text{ in } w] \wedge [g_c(3) \text{ is in Colorado at } g(1), \text{ if } g(1) < time_c \text{ in } w] \wedge g(2) \subset g(1) \text{ in } w$

g. (Due to existential closure) (26) is true in c relative to w iff $\exists g [g_c \subseteq g \wedge \llbracket g_c(3) \text{ put}$

Georgia behind the wheel at $g(2)$, if $g(2) < time_c$ in w] \wedge [$g_c(3)$ is in Colorado at $g(1)$, if $g(1) < time_c$ in w] \wedge $g(2) \subset g(1)$ in w] = 1] (undefined if $g(1) \not\subset time_c$)

Now, $t \subset t'$ in (27) is due to the lexical aspect of the verbs in (24) and (25). (29) is another [q [*when p*]] example. In here, t' of q , which is t_1 , is a subinterval almost completely overlapping with t_2 , and t_2 seems to form the temporal domain. Unlike (24), t_1 is not allowed to be outside of the domain of t_2 . Thus, according to the types of verbs, (30) is also a denotation of *when*, along with (27).

(29) a. He didn't₁ even want to eat meals when he played₂ cards.



(30) $\llbracket when \rrbracket^{c:g:w} = \lambda p_{\langle i,t \rangle}. \lambda q_{\langle i,t \rangle}. [p(t) \wedge q(t') \wedge t' \subset t$ in w]

Here is another example with *as*. The verbs in (31a) have a very short interval during which the actions they describe take place. There is a moment that the speaker finished a sentence and felt something. *As* indicates that these two intervals overlap ($t_1 \circ t_2$), or at least, t_2 should be placed within a highly proximate interval to t_1 . (31b) also connects two clauses with *as*, but the verbs in (31b) describe longer processes: the activities of telling stories and going along were taking place for a certain period time, which is distinguished from (31a) in that it is at a short interval that finishing a sentence and feeling occurred. We do not know from (31b) exactly how long he was telling stories, but it is clear that t_3 and t_4 mostly overlap. Alternatively, to say the least, t_3 and t_4 should be placed within the same temporal domain.

(31) a. As I finished₁ the sentence, I felt₂ myself being lifted up.

b. He told₃ us stories as we went₄ along.

As we have seen in the above examples, *when/as* indicates a loose simultaneity between the verbs it connects, rather than perfect overlap in times they denote. In other words, time inter-

vals denoted by the tensed verbs are within the approximately same domain, though how these time intervals precisely overlap may be different. We use *when* to connect two actions or events that not only completely overlap, but also partially overlap and even successively occur.

Lasersohn (1999) dubbed this *pragmatic slack*. It is a pragmatic assumption among interlocutors or a tacit constraint on discourse that as long as the details of information they share are close enough, they are felicitous though not perfectly accurate. Lasersohn employed a *pragmatic halo*, assigned on an expression α to account for regulations on such pragmatic slack, according to similarity to the denotation of α . The pragmatic halo of α , as formalized in (32), is a partially ordered set of elements of the same logical type, with the denotation of α . A set of objects $H_C(\alpha)$ has the denotation of α and other objects different from the denotation of α , with pragmatically ignorable details in C . $\leq_{\alpha,C}$ indicates an ordering of $H_C(\alpha)$, which puts the denotation of α in the middle of the halo.¹² Precise, not-allowing-margins types of truth-conditional semantics would not allow *when* to be licensed under such a loose concurrency environment, which is contradictory to actual language use. Therefore, as we have observed in the examples thus far, we accept pragmatic slack in time intervals, which tenses denote and stipulate as in (33)—that pragmatically close enough time intervals in the context are qualified to be coindexed. However, at this juncture I will not propose a new device to account for pragmatic slack in temporal anaphora. (33) allows a case like (24), where there may be actually no overlap between the two time intervals. Once a time interval becomes salient, the following coindexed tenses will have a definite reading, denoting the contextually salient time interval. The constraint in (33) makes it possible to keep the anaphoric use of tense, an approach that was discarded in the later work of Partee (1984) because of the imprecision of the time intervals as denoted by the consecutive clauses using *when*.

(32) The halo of α relative to context C : $\langle H_C(\alpha), \leq_{\alpha,C} \rangle$ (Lasersohn 1999)

(33) Pragmatic constraint on tenses in discourse: when t_i and t_j are close enough with pragmatically ignorable discrepancies, $t_i \circ t_j$.

¹² See Lasersohn (1999) for more detail and for further issues such as truth conditions with inaccurate details and how much pragmatics should be read into grammar.

The revised denotation of *when* is given in (34). The relation between t and t' is not an instance of an either-way inclusion, but rather, an overlap. Such overlap includes a case in which t immediately follows t' or vice versa. This revision is based on (33). (34) accounts for (31)—both (31a) and (31b)—if we ignore possible on-and-offs of his telling stories along the way, according to pragmatic slack; (29) and (24) are also explained by (34). (35) is a derivation of (24).

$$(34) \llbracket \textit{when} \rrbracket^{c,g,w} = \lambda p_{\langle i,t \rangle}. \lambda q_{\langle i,t \rangle}. [p(t) \wedge q(t') \wedge t \circ t' \text{ in } w]$$

(35) When I got₁ up there, I said₂ it₇.

a. $\llbracket [I \text{ PAST}_1 \textit{ get up there}] \rrbracket^{c,g,w}$

b. = $\lambda t_i. \textit{ speaker}_c \textit{ get up there at } t \text{ in } w$

c. $\llbracket [I \text{ PAST}_2 \textit{ say it}_7] \rrbracket^{c,g,w}$

d. = $\lambda t_i. \textit{ speaker}_c \textit{ say } g_c(7) \text{ at } t \text{ in } w$

e. (35): $\lambda p_{\langle i,t \rangle}. \lambda q_{\langle i,t \rangle}. [p(t) \wedge q(t') \wedge t \circ t' \text{ in } w]([\lambda t_i. \textit{ speaker}_c \textit{ get up there at } t \text{ in } w]$

$(\llbracket \text{PAST}_1 \rrbracket^{c,g,w}))([\lambda t_i. \textit{ speaker}_c \textit{ say } g_c(7) \text{ in } w](\llbracket \text{PAST}_2 \rrbracket^{c,g,w}))$

f. $[\textit{ speaker}_c \textit{ get up there at } g(1), \text{ if } g(1) < \textit{ time}_c \text{ in } w] \wedge [\textit{ speaker}_c \textit{ say } g_c(7) \text{ at } g_c(2), \text{ if } g_c(2) < \textit{ time}_c \text{ in } w] \wedge g(1) \circ g_c(2) \text{ in } w$

g. (Due to existential closure) (35) is true in c relative to w iff $\exists g[g_c \subseteq g \wedge [[\textit{ speaker}_c \textit{ get up there at } g(1), \text{ if } g(1) < \textit{ time}_c \text{ in } w] \wedge [\textit{ speaker}_c \textit{ say } g_c(7) \text{ at } g_c(2), \text{ if } g_c(2) < \textit{ time}_c \text{ in } w] \wedge g(1) \circ g_c(2) \text{ in } w] = 1]$ (undefined if $g(1) \not\prec \textit{ time}_c$)

Now, the problem is (25). The duration of the actions described by each tensed verb is quite different: *were* describes a state that may last for a long duration, but *put* is a one-time event with an instantaneous culmination point. In a way, what actually matters in *when*-clauses is that there exists an overlap between the times denoted by the tensed verbs in the clauses. So, we ignore unnecessary and inaccurate details like at what time t_1 starts and ends, but only look into the section that overlaps with t_2 . And of course, inclusion entails overlap. Also, due to pragmatic slack, *when* seems to be licensed as long as t_1 is in close-enough proximity to t_2 . And thus, (34) is maintained. Alternatively, however, it might be reasonable not to forcefully apply (34) and retain (27), which may be maintained if one of the intervals of a *when*-clause is too much longer than another.

It is likely that *when*-clauses more evidently indicate a temporal domain. Between the two intervals connected with *when*, a relatively long, not-instantaneous interval tends to be chosen as the domain for tense interpretation unless the sentence is uttered under a clear topic in context or with another overt temporal expression, as mentioned above. For example, in (25), t_1 seems to be the domain rather than t_2 .

4.2.1 Question-Answer Pairs

A few examples of question-answer pairs will be examined in this section. As you may anticipate, in addition to an extremely limited type of question-answer in which both question and answer are about the same action and have the same verb, there are other patterns in which a question and its answer do not necessarily coincide. First of all, a question and its answer describing the same event involve with an overlapping time interval, and the times denoted by the tenses in the question and the answer are coindexed. In many such cases, the verb in the answer is realized as a proform *do/does/did*. Whether it is the verb as is or a proform, the tensed verb in the answer denotes a salient time interval due to the tensed verb used in the question. Judging by the question in (36), a temporal domain for the discourse in (36) is limited to the night prior to the context time during which the party took place. The past tense in the question denotes a time interval t_1 by which it becomes salient in the context, and the past tense in the answer denotes t_1 with a definite interpretation. The time denoted by *came* is also in the domain of last night.

(36) A: Did_i you go to the party last night?

B: Yes, I did_i. More than 20 people came_j.

Interestingly, (37) includes a negation as part of the answer to the question. The action of *saying*, which is relevant to the tense, did not take place as indicated by the negation. Nevertheless, the tense in B's response refers to the same time, denoted by the past tense in A's question, which is similar to (36).

(37) A: Did_i you say, "I'm the chef"?

B: I did_n't even have to.

The next example, in (38), is a bit more complicated. As we saw in the previous section, the tense in the *when*-clause of the question denotes a time within the time interval denoted by *were* in the main clause. Negation is again part of the answer in this example, and the past tenses of *was* and *were* are coindexed. The time index on *happened* in the question is identical with the time index on *happened* in the answer. Now, *immediately* in the next sentence is sensitive to the overt temporal domain (*day*) and the covert one (the time of Boston Marathon bombing) in the discourse. Temporal adverbials including *immediately* will be discussed in more detail in the next chapter.

(38) A: Where were_i you when that happened_j?

B: I was_i not in Boston, and then I heard_k what happened_j, and then I immediately went_l to Boston the next day.

Take a look at the verbs in example (39) below. The verbs in the question and the answer are different, but they seem to denote some overlapping time interval. The conversation concerns the accent that B's mother had when she was alive. The verb *sound* in the question and *was* in the answer both describe a state that lasted for a long time. It seems that both tensed verbs denote a relatively long time interval, while B's mother was alive and probably that B was aware of her mother's accent. Coindexation is a possible option for the tenses in (39) and thus the past tense in *was* has a definite interpretation.

(39) A: How did_i your mother sound?

B: It was_i lovely.

As with relative clauses, for example in the case of *when* discussed above, tenses in question-answer pairs are, to say the least, in the same temporal domain. Furthermore, when a question and its answer share the same verb, as we saw in the examples above, the tenses associated with the verbs are coindexed whether or not the verbs are negated. When the tenses are coindexed, the second tense is indexically interpreted because the interval it denotes has already become salient by the question in the context.

4.2.2 Lexical Aspect

As in the examples presented thus far, lexical aspect or *aktionsart* has been repeatedly mentioned. While (grammatical) aspect concerns “different ways of viewing the internal temporal constituency of a situation,” (Comrie 1976), lexical aspect is about the internal temporal structure of a situation, denoted by a predicate; tense decides where the interval denoted by a tensed verb should be placed, relative to the time of utterance. Since Vendler (1957) has classified predicates into four categories, people like Comrie (1976), Dowty (1979), and Smith (1991) also give a classification of predicates with more categories and features. In this dissertation, I will use Vendler’s system and terms, although Vendler did not use the term *aktionsart* in his article.

The four categories of Vendler’s classification are activity, state, accomplishment, and achievement. Such a classification is based on questions such as whether or not an action or a situation a predicate denotes has an endpoint, or whether or not an action lasts for some time. His classification and examples are given in (40). Activity predicates do not have an endpoint in the action they describe; the actions described by activity terms are also dynamic and continuously happening at the subintervals of the time during which the actions occur. State terms describe static and durative situations, including habits or jobs. Activity verbs can be used with the progressive, but state verbs cannot, as shown in (40b). Accomplishments indicate a process occurring for a period of time, short or long, up to its culmination. As with activity terms, the actions predicated by accomplishment terms are continuous at their subintervals, disregarding pragmatically ignorable short breaks. As to achievements, their actions take place at a particular moment. And thus, accomplishments and achievements are used with different types of temporal adverbials, as you can see in (40c) and (40d). Accomplishments work well with durative adverbials like *for an hour*, but achievements do not.

(40) Aspectual classes of Vendler (1957)

- a. Activity: *They chatted, I was running*
- b. State: *She knows (/ *is knowing) my sister, Sue is tall*
- c. Accomplishment: *John ran a mile, He drew a tree for an hour (/ *at one).*
- d. Achievement: *You reached the top, Mary won the race (*for an hour)*

We have some cases in the examples above that state verbs are selected for a temporal domain. *It was a strange night* in (9) describes a static state that lasted for some period of time, which in this example is night. The time that *night* denotes actually overlaps with the time of the topic (interlocutors are discussing a party), and more specifically ‘night’ would mean the party night, the time during which the party was taking place. In *Boston was a beautiful place on that terrible day* in (15), *was* is also a state term and *day* delimits the time that *was* denotes.

In a way, the copula *be* is tricky because sometimes it is coupled with a temporal NP like the examples in (9) and (15), with the time it denotes overlapping with the time that the temporal NP denotes, and sometimes it is coupled with an NP that is also correlated with the following verbs, with the thematic role of its agent. This pattern was observed in (15), whose relevant part is repeated in (41) in its formal representation. As I stated above, *X* in (41c) is also a domain for t_1 ; and, not only that, $\{t_2 \cup t_3\}$ actually overlaps with t_1 .

- (41) a. There (a) were₁ people that day who (b) ran₂ a marathon, and then (c) ran₃ another two miles.
- b. $\forall t_2 \forall t_3 [\exists x [[\text{run-a-marathon}(x) \text{ at } t_2] \wedge [\text{run-two-miles}(x) \text{ at } t_3]] \wedge [t_2 \leq t_3]]$
- c. For all t_2 and t_3 , $\{t_2 \cup t_3\} \subseteq X$

The tendency we observe, namely, that state predicates are more likely to be selected as a temporal domain is also observed in *when*-clauses, as in (25), and repeated in (42). Interlocutors are discussing how to teach their children to drive, and this story is now more limited to a temporal domain, which is the time during which the speaker and his family were staying in Colorado. While *putting Georgia behind the wheel* is an achievement predicate, *were in Colorado* predicates a state that lasted for some time. Domain selection is not a matter of to which predicate *when* is attached, but of which predicate’s lexical aspect is more stable and long enough to serve as a temporal domain. *When* merely connects the two intervals denoted by the tenses used in the clauses.

- (42) We were in Colorado when we first put Georgia behind the wheel.

Lexical aspect is a critical factor in the discussion of a temporal domain. Contextual factors and discorsal factors are also important for determining a temporal domain, but such factors cannot exclusively determine temporal domains, disregarding the aspectual type of predicates.

4.3 Anchoring Condition Revisited and Domain Anchoring

As we reviewed in Chapter 2, Enç (1986, 1987) treats tenses as referential expressions, not quantificational ones. Enç (1987) also provides anchoring conditions for matrix and embedded tenses. She first points out that tenses make an indexical reference to the time of utterance: “the truth of a tensed sentence is relative to the speech time.” Thus we have (43). She proposed the anchoring conditions in (44), similar to the Binding Principles. Basically, according to Enç, tense is anchored if it is governed by Comp(lementizer), and C (or Comp) is related to the time of utterance (or the speech time). C is anchored if it denotes the time of utterance, which is denoted by the index 0, as can be seen in (45), and thus the matrix tense in (45) is anchored, according to (44a) and (44c).

(43) Enç’s Anchoring Principle: Each tense must be anchored. (1987: 642)

(44) Anchoring Conditions (p. 643)

- 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.

(45) *John died*: [S' Comp₀ [S NP [I' PAST_i VP]]] (p. 644)

Embedded tenses are anchored in a different manner. Among different types of embedded tenses Enç discussed, let me focus in this section on complement tenses, PAST under PAST. Recall (9) above, whose part is repeated in (46). We have seen that (46) has two readings: the speaker either thought “I don’t know” or “I didn’t know.” Namely, times denoted by the tenses

either overlap ($t_1 \circ t_2$) or $t_2 < t_1$. Enç argues that the difference between the two readings lies in how the complement tense is anchored. Simply put, (44a) and (44b) make it possible for the complement tense to be anchored in two ways. First, as in (47a), since the lower Comp is bound by and coindexed with the matrix tense, the subordinate tense is anchored according to (44a) and it denotes a time prior to the time denoted by the lower Comp due to the definition of the past tense by Enç. The simultaneous reading (47b) is obtained when the subordinate tense is directly anchored, bound by the matrix tense in its governing category, the matrix clause. Thus, the subordinate tense is coindexed with the matrix tense, denoting the same time as the matrix tense.

(46) I thought₁ I didn't₂ know.

(47) Complement tenses Enç (1987: 646)

- a. [Comp₀ [NP [PAST_i [V [Comp_i [NP PAST_j
- b. [Comp₀ [NP [PAST_i [V [Comp [NP PAST_i

Whether one adopts a quantificational or indexical interpretation of tense, or both, it is uncontroversial that the interpretation of the (matrix) tense is determined relative to the time of utterance. If we revise the meaning of anchoring to this property of tense, making indexical reference to the time of utterance, not necessarily relying on government and a time-denoting complementizer, (43) is still acceptable because anchoring is now the essential part of the definition of tense. Examples of subordinate tenses discussed in this chapter are of a rather simple type; the interaction between the intervals denoted by matrix and subordinate tenses is merely overlap, due to *when*. As to complement past tenses under another past tense, I have made it clear that the time denoted by the complement preterit cannot be later than the time denoted by the matrix preterit, as discussed with regard to their syntactic structure. Based on the discussion so far, I will only adopt Enç's anchoring condition in the limited sense that tense is relatively defined by making reference to another time—matrix tenses indisputably to the time of utterance and embedded tenses in temporal adjunct clauses, complement clauses, and relative clauses to other times.

Again, I am not committing to Enç's proposal in its entirety, especially binding and governing categories and complementizers involved in tense interpretation. However, I will maintain

that every tense must be “anchored,” as stated in (48).¹³ In terms of this simplified type of anchoring, (46) has two readings because PAST₂ is anchored either to PAST₁ (the shifted reading is obtained) or to the time of utterance as the main tense (the simultaneous reading is obtained). In this account, anchoring is reduced to the issue of to what time interval a tense makes indexical reference.

(48) Anchoring of tense: every tense is relatively interpreted to another time.

I would also like to expand anchoring to temporal domains. As noted in (7) and repeated in (49), tense is interpreted in a restricted domain, determined by context. When a time interval enters into a semantic computation, a temporal domain is formed around the interval unless the interval itself functions as a domain; the subsequent tenses are interpreted in this domain, or *anchored* to this domain, until a new one is formed. Then, for example, the time denoted by the tense in *when we were in Colorado* in (42) is selected as a temporal domain in the context of being a relatively long interval, and highlighted by *when*. As to the famous stove example, *I didn't turn off the stove*, a temporal domain is tentatively formed surrounding the time denoted by the tense, which is in the approximate past, as summarized in (50). As long as there exists a time within this domain at which the speaker did not turn off the stove, the sentence is true and the quantificational interpretation can account for it.

(49) Domain anchoring:

$[[\text{TENSE}_i]]^{c,g,w} \in \delta_c$, where $\delta_c \subseteq I$ is a set of contextually relevant and limited time intervals.

(50) Temporal domain formation

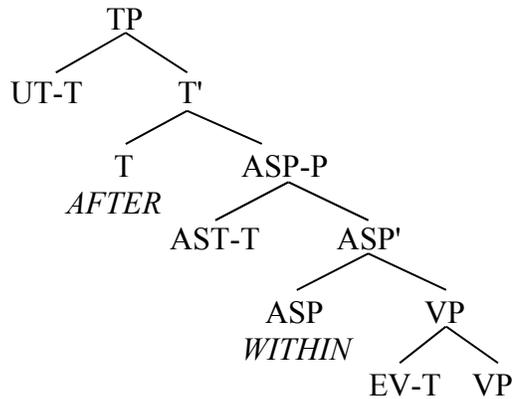
- a. δ_c is a relevant time interval in the context, if there is one.
- b. If not, δ_c is formed around a time interval denoted by a new tense.

Demirdache and Uribe-Etxebarria (2005, 2007) also propose their versions of anchoring conditions, along with the syntax of temporal expressions in terms of spatiotemporal predicates and a few particular time intervals. Intervals of importance in their analysis are the utterance time

¹³ See Ogihara (1989, 1996) for detailed arguments against Enç (1987).

(UT-T), assertion time (AST-T), and event time (EV-T). These intervals are similar to Reichenbach's three time indices (AST-T being roughly analogous to Reichenbach's reference time), but in Demirdache and Uribe-Etxebarria's system, these times reside in the specifier positions, being an external argument of TP, ASP-P (aspectual phrase), and VP, respectively, whose precedence relations determine various tenses and aspects. Their relations are regulated by the heads T and ASP, with spatiotemporal predicates such as *WITHIN*, *AFTER*, and *BEFORE*. (51) is the syntactic representation of *Maddi was drawing a house*—T puts the UT-T after the AST-T and ASP orders the AST-T within the EV-T, characterizing the progressive aspect.

(51) *Maddi was drawing a house.* (Demirdache and Uribe-Etxebarria 2005: 193)



What governs the anchoring of various temporal subordinate clauses are the economy/optimality principles found in (52). They explicate the mismatch (and match) between tenses and aspects connected with expressions like *after*, *before*, and *when*. Anchoring processes of such clauses are illustrated in (53). We have non-contradictory orderings between the times according to the steps observed in (53), and thus (52a) is maintained, but (53c) violates the economy principle (52b): *after* redundantly specifies the ordering between the times, which is already spelled out in (53a), and (53b), therefore, is semantically vacuous.

(52) Economy/optimality constraints (Demirdache and Uribe-Etxebarria 2005: 207)

- a. Anchoring a subordinate clause into a matrix clause is optimal iff it yields an ordering of their Assertion Times relative to each other.

- b. No step in a given temporal derivation can be semantically vacuous: every step in the derivation must be temporally informative (that is, must yield a temporally distinct interpretation).

(53) Illustration of the ungrammaticality of **Max will leave after Sue arrived.* (p. 208)

- a. Step 1: Compute the temporal interpretation of the matrix *Max FUT leave*

UT-T___AST-T1

- b. Step 2: Compute the temporal interpretation of the adjunct *Sue PAST arrive*

AST-T2___UT-T

- c. Step 3: Compute the temporal contribution of the connective *after*

AST-T2___UT-T___AST-T1

Economy constraints in (52), however, do not account for complement tenses like (46). This rather simple and highly frequent case is explained by an additional series of complex computations. They begin with a familiar technique to resolve the simultaneous and shifted ambiguity. This is done in terms of different anchoring patterns: either the complement is anaphorically anchored to the matrix tense (and thus the time denoted by the complement tense is prior to the time denoted by the matrix tense) for the shifted reading, or it is deictically anchored to the UT-T for the simultaneous reading. However, due to (52a), anchoring of the complement past to the UT-T is problematic: both AST-T's of the tenses are prior to the UT-T, but the ordering of the AST-T's is not specified. Not only that, other past-under-past cases connected with *before* and *after* are also troubling when the subordinate tense is anaphorically anchored to the matrix tense. As can be seen in (54) and (55), *before* violates (52b), and *after* violates (52a). To fix this, they proposed a set of resetting rules, in particular, in the case of the simultaneous reading of the past-under-past complement tense, the complement AST-T is anchored not to the UT-T in step 2, but to the matrix AST-T, which is the reset anchor time, so that the output is optimal.

(54) Anchoring the external argument of subordinate T to matrix AST-T (pp. 212-213)

Max left before Sue arrived.

- a. Step 1: Compute the temporal interpretation of the matrix *Max PAST leave*

AST-T1___UT-T

b. Step 2: Compute the temporal interpretation of the adjunct *Sue PAST arrive*
AST-T2___ AST-T1

c. Step 3: Compute the temporal contribution of the connective *before*
AST-T1___ AST-T2

(55) Anchoring the external argument of subordinate T to matrix AST-T (p. 213)

Max left after Sue arrived.

a. Step 1: Compute the temporal interpretation of the matrix *Max PAST leave*
AST-T1___ UT-T

b. Step 2: Compute the temporal interpretation of the adjunct *Sue PAST arrive*
AST-T2___ AST-T1

c. Step 3: Compute the temporal contribution of the connective *after*
AST-T2___ AST-T1___ UT-T

However, I do not see how such a resetting obtains the desired, but omitted, simultaneous reading. By resetting the problematic anchor time, optimality is checked, as shown, but how is the outcome different from that of shifted reading while the simultaneous reading is still quite robust? Putting aside other types of subordinate (or *dependent*, in their terms) tenses for present purposes, I would like to compare their economy principles with the structure shown in (11) for the past-under-past complement clauses. I highlighted the c-command relation between the tenses in (11); due to this structure the complement past tense cannot denote times later than the times denoted by the higher past tense. The difference between the two readings may still be dependent on divergent anchoring patterns—the complement past tense anchored either to the time of utterance (that is, prior to *time_c*) or to the time denoted by the higher past tense.

I agree with Demirdache and Uribe-Etxebarria that time intervals denoted by tenses are ordered with respect to each other because tenses are relatively defined, which means that tenses are intrinsically susceptible to other relevant time intervals. The anchoring principle of this dissertation, (48) also assures that tenses make indexical reference to other times like *time_c*, relatively defined, not necessarily referring to abstract spatiotemporal predicates in the syntax. Thus, Demirdache and Uribe-Etxebarria's intuitive idea that intervals are related to each other and that their ordering is determined relative to each other is consistent with (48), although its implemen-

tation is different from mine. I also apply anchoring as a restriction on intervals denoted by tense, namely, a restriction on the assignment g , as in (49).

Demirdache and Uribe-Etxebarria's theory covers a variety of examples and consequently becomes complicated, with several additionally conditioned rules and exceptions. In particular, they must appeal to another set of resetting rules in order to address why their economy principles cannot account for the simple case of past-under-past complement tenses. I wonder how their resetting rules are related to the intrinsic properties of tense or aspect. My complaint is that even with the resetting rules the simultaneous reading of the past-under-past complement tense is still not clearly elucidated.

Ogihara's (1989, 1996) tense deletion is known as a prominent solution to the sequence of tense (SOT) examples like (46). He opposes Enç's position on tense and her account for SOT phenomena, maintaining that tense interpretation is quantificational. (56) is the conclusive example that Ogihara presents against previous scope-induced analyses. He argues that the reading that John's purchase of a fish takes place later than the utterance time is obtained only through his optional tense deletion rule, as applied to the relativized NP. (57) shows how both simultaneous and shifted readings of past-under-past complement clauses are obtained. The tense deletion rule is optionally applied at the LF; when applied, the tense node is empty, not being able to have its own features, and hence we have the simultaneous reading. We have the shifted reading when the rule is not applied, as in (57b), and the subordinate past denotes a shifted interval farther toward the past. With Ogihara's treatment, you do not have to refer to the relation between time intervals and thus are free from the question of why the tenses should be anchored either to the speech time or to the matrix time—not to other times if they may exist, or to other expressions.

(56) John said that he would buy [_{NP} a fish that was still alive]. (Ogihara 1989: 106)

(57) Ogihara's ST or tense deletion rule applied to (46), *I thought I didn't know*.

- a. Simultaneous reading: [John PAST think [I \emptyset do not know]]
- b. Shifted reading: [John PAST think [I PAST do not know]]

If we adopt Ogihara's deletion rule, the two readings of tense would be employed to both (57a) and (57b). In case of (57a), the subordinate tense denotes the same time as the matrix tense

and thus is assigned its value from g_c , which is a definite interpretation. As to the shifted reading (57b), it is likely that the subordinate tense has an indefinite interpretation of tense, whose value is assigned by g .

In summary, what I would like to propose about anchoring is that anchoring of tenses is now limited, first of all, to the point that tenses make some kind of indexical reference to a certain time interval, such as the time of utterance. Further, that the relation between the times in a discourse is also important, in that a tense is anchored relative to other time intervals, as denoted by the relevant tense. Also, a tense is interpreted within a restricted domain, which represents another aspect of anchoring. There are cases in which the time denoted by a tense is selected as a temporal domain including the surrounding intervals, which are contextually relevant. Of course, as we have seen, domain anchoring is loosely done due to pragmatic slack.

4.4 Conclusion

In this chapter, we have discussed a few temporal phenomena in a discourse: temporal domain, coindexation of tenses, lexical aspect, and anchoring of tense. Temporal domain is intriguing: we maintain that temporal quantification occurs within a limited domain, in the same manner as quantification over nouns/objects, and here we have seen how such a limited domain is selected in the context. When there is an overt temporal adverbial, a time interval it denotes is a possible temporal domain for tense interpretation. Covertly, when we have a clear topic or an incident of interest throughout a discourse, tenses in the discourse are interpreted within the domain with rather clear temporal boundaries. If none of the above is clear in the context, then an indefinite tense introduces an interval and a domain—that is, a temporal domain approximate to the time denoted by a tense is formed, and the tense is anchored to the domain.

We have discussed that tenses are relationally defined with respect to another time interval. As seen in Chapter 2, several people have pointed this out, particularly in relation to the reference time. Different opinions about the nature of this third type of time, reference time, exist. Further, how the reference time is selected and what role it plays, especially in the interpretation of temporal anaphora and temporal adverbials are of great interest of many researchers. In this dissertation, I have included a temporal domain in the picture, namely, that the reference time is not the only player that determines temporal relations. Additionally, as the discourse continues, salient times are stacked up in c_{SAL} with a hierarchy, one of which will share the burden of the

reference times, for example, being the antecedent of the following anaphoric tense. This is also another aspect of contextual dependency of temporal interpretation, in that reference points or anchoring points are also provided by the context, c_{SAL} , that matrix tenses are basically determined in regard to their relation to the context time or the time of utterance. Further research is needed for how the hierarchy of the salient individuals/times in c_{SAL} is determined, how long they maintain their salient status, and what constraints exist with which to select time intervals for anchoring.

Tenses that denote times that are not completely overlapping are still qualified to be coindexed due to pragmatic slack. In natural language, even when tenses are connected with *when* or *as*, the actions related to the tenses are not precisely simultaneous. Nevertheless, if the times are close enough to each other in the minds of language users, the tenses denoting those times are coindexed in a *loose* sense, and thus reoccurring tenses are eligible for definite interpretation. We have also looked at how aspectual classes work in this process; the internal temporal constituency of verbs determines the duration of the action denoted by the tensed verb, which is relevant to domain selection. Surely the boundaries of temporal domains are set accordingly.

My tense system allows for both quantificational and indexical interpretations, and this chapter shows how the idea is implemented in a discourse. Tenses are interpreted in a limited domain and coindexed in a pragmatically constrained manner, either due to *when* or not, in which case indexical reading is involved. Tense is anchored to a time or to a temporal domain. Allowing a definite interpretation of tense is advantageous for temporal anaphora resolution: when a previously mentioned time interval is later referred to, it now bears a definite reading—parallel to anaphora resolution of nominals.

CHAPTER 5

TEMPORAL ADVERBIALS

In this chapter I will show how the semantics proposed in Chapter 3, with definite and indefinite interpretations of tense, account for temporal adverbials. Specifically, temporal locating adverbials and the intriguing adverb, *immediately*, will be tackled.

5.1 Temporal Locating Adverbials

I will start with temporal locating adverbials, like *yesterday*. Such adverbials serve as a temporal domain for tense to be anchored to, as proposed in the previous chapter. *That day* was an example from Chapter 4, and the time denoted by *that day* was a restricted domain in which a series of past tenses in a discourse were interpreted. In this section I will review selected studies of temporal locating adverbials and point out some of the issues to be addressed. I will also propose my analysis using the framework laid out in the previous chapters.

5.1.1 Inclusion Relation and Temporal Domain

Temporal adverbials like *yesterday*, *today*, and *last week* restrict the time frame within which the action they describe occurs. For example, (1a) tells us that the event occurred at some time interval in the past and that the temporal domain is not represented; but in (1b) the time interval is now overtly restricted in the set of all sets containing an interval denoted by *yesterday*. *Yesterday* is also deictic in that it denotes different time intervals, depending on the utterance time, *time_e*. If the sentence above was uttered during the day of November 5, 2013, then John ran a marathon on the 4th of the same month; if it was uttered on October 5, 2013, John did so on October 4th.

- (1) a. John ran a marathon.
b. John ran a marathon yesterday.

Challenges for a temporal adverbials analysis lie in that temporal adverbials are interpreted in concordance with tense interpretation: tense morphemes do not seem redundant when there is a time adverb within the sentence, and time intervals denoted by temporal adverbials must

match with the time denoted by the tensed predicate. An operator system in which tense is treated as a sentential operator also introduces an operator for a temporal adverb. The adverbial scope paradox due to the interaction between the two scope-taking operators was already discussed in Chapter 2. Also, in such a system, there is no apparatus that can prevent sentences such as **John will run a marathon yesterday*.

5.1.1.1 Dowty (1979, 1982) and double indices

To deal with the scope paradox, Dowty (1979) proposes that a time adverb denoting a time interval in the past or in the future is combined with a present tense sentence, introducing with the adverb the past or the future tense as a single, mingled element. He asserts, “tenses in English are primarily parasitic on time adverbials” (p. 323). Take *John left yesterday* as an example: *yesterday* combines with *John leaves* in the derivation, changing the verb into *left*. In this system, three rules for the past, present, and future temporal adverbs/tenses are posited as shown in (2), with Dowty’s notation. *Yesterday* belongs to the temporal adverbial category (TmAv) and denotes the set of all sets of intervals within yesterday, as translated in (3a); after lambda conversion and other logical processes we have the translation of the entire sentence, as stated in (3b). Sentences without temporal adverbials are interpreted by a separate set of rules for tenses. That is, when there is a time adverb within a sentence, one of the rules in (2) is applied; when there is no time adverb, rules like (4) apply.

(2) Dowty’s (1979: 327-328) rules for temporal adverbials

- a. If $\alpha \in \text{TmAv}$, $\phi \in t$, then $F_{36}(\alpha, \phi) = \phi'\alpha$, where ϕ' is the result of changing the main verb in ϕ to past tense.

Translation: $\alpha'(\lambda t[\text{PAST}(t) \wedge \text{AT}(t, \phi)])$

- b. If $\alpha \in \text{TmAv}$, $\phi \in t$, then $F_{37}(\alpha, \phi) = \phi'\alpha$.

Translation: $\alpha'(\lambda t[\text{PRES}(t) \wedge \text{AT}(t, \phi)])$

- c. If $\alpha \in \text{TmAv}$, $\phi \in t$, then $F_{38}(\alpha, \phi) = \phi'\alpha$, where ϕ' is the result of inserting **will** before the main verb of ϕ .

Translation: $\alpha'(\lambda t[\text{FUT}(t) \wedge \text{AT}(t, \phi)])$

- (3) a. $\lambda P_i \exists t [t \subseteq \mathbf{yesterday}' \wedge P_i \{t\}]$ (p. 328)
 b. $\exists t [\text{PAST}(t) \wedge t \subseteq \mathbf{yesterday}' \wedge \text{AT}(t, \mathbf{leave}'(j))]$ (p.325)
- (4) Dowty's tense interpretation rules (pp. 353, 359)
 a. $\llbracket \text{AT}(\tau, \varphi) \rrbracket_{M,w,i,g} = 1$ iff $\llbracket \varphi \rrbracket_{M,w,i',g} = 1$, where $i' = \llbracket \tau \rrbracket_{M,w,i,g}$.
 b. $\llbracket \text{PAST}(\tau) \rrbracket_{M,w,i,g} = 1$ iff there is some non-empty $i' \in I$ such that $\llbracket \tau \rrbracket_{M,w,i,g} < i' < i$.
 c. $\exists t [\text{PAST}(t) \wedge \text{AT}(t, \mathbf{sleep}'(j))]$

This “syntactic solution” resolves the scope paradox because there is no scope interaction anymore, in that the time adverb and the tense are introduced to the system together as a single unit; but it seems syntactically odd and counterintuitive. This analysis gives the impression that the temporal interpretation is derived from the temporal adverbial, not the tense morpheme. More significantly, tense seems redundant, as a tense morpheme becomes optional, “like an agreement marker,” even becoming mingled with it, depending on the presence or absence of time adverbials. Rather, the intuition is that a tense morpheme is a major player and time adverbs are optional. A normal syntactic rule would introduce a tense morpheme into a derivation as an autonomous unit. Another disadvantage is that, as Dowty (1982) himself points out, this system brings out two different sets of rules for tenses, again, depending on the presence or absence of a temporal adverbial.

Binnick (1991) discusses another problem for this analysis. To select a proper rule from (2), it should be assumed that temporal adverbials are categorized as past, present, and future adverbs. However, not only is it unclear how these time adverbs are categorized, but also it is uncertain how the selection of rules in accordance with the matching tense is obtained. Will (2a) properly apply with *yesterday*, for example? Also, consider the following adverbs, as exemplified in (5). “Neutral adverbs” like *today*, or *this afternoon* are difficult to classify because they can occur with two or even with all three tenses, past, present, and future, and thus it is not clearly circumscribed how to select the correct rule in order to generate the proper tense.

- (5) a. This afternoon she worked very hard.
 b. This afternoon she is working very hard.
 c. This afternoon she will work very hard.

Once we separate time adverbs from tense, rejecting Dowty's (1979) earlier style, the more crucial question becomes how we formally and compositionally connect the time interval that is denoted by a temporal adverbial with that of the main tense. Dowty's (1982) later work suggests a semantic solution employing Kamp's (1971) idea of doubling indexing for time. Kamp's examples in (6), which were already introduced in Chapter 2 as a counterexample to tense operators, have N, as in (6d), which is roughly translated as *relative to the time of utterance*, or *anchored to the time of utterance*, which obtains the troubling reading of (6b), that a child's becoming king takes place later than the time of utterance, hence lying outside the scope of past tense. As I made clear in Chapter 4, tenses are interpreted relative to some other times relevant in the context. Truth conditions for tense interpretation are not dependent on a single time interval, but truth or falsity of tensed sentences is relative to two time indices now, which include the time of utterance.

- (6) a. A child was born who would become king.
 b. A child was born who will become king.
 c. P[a child is born and F[it becomes king]]
 d. P[a child is born and NF[it becomes king]]

In Dowty (1982: 32), tense operators or predicates are interpreted in terms of a pair of time indices $\langle i, j \rangle$ where i refers to the reference time and j the speech time, similar to Reichenbach. But the way Dowty employs those indices is different from Reichenbach. Definitions of three tense predicates are shown in (7). Sentence ϕ is true relative to $\langle i, j \rangle$ and for the past, for example, the reference time i precedes the speech time j , as you see in (7b).

- (7) a. $\llbracket \text{PRES } \phi \rrbracket^{ij} = 1$ iff $\llbracket \phi \rrbracket^{ij} = 1$ and $i = j$.
 b. $\llbracket \text{PAST } \phi \rrbracket^{ij} = 1$ iff $\llbracket \phi \rrbracket^{ij} = 1$ and $i < j$.
 c. $\llbracket \text{FUT } \phi \rrbracket^{ij} = 1$ iff $\llbracket \phi \rrbracket^{ij} = 1$ and $j < i$.

Now the reference time is not dependent on the evaluation time but more to the context, and a similar effect is found in the interpretation of time adverbs. The denotation of *yesterday* is

presented in (8a), and *John left yesterday* is interpreted as in (8b) (Dowty 1982: 32, 36). t^* indicates the reference time. John's leaving takes place at t^* within the interval denoted by *yesterday*, which is prior to the speech time j , according to (7b) and (8a). The time adverb is interpreted in terms of the reference time and the speech time, not directly in relation to the tense. Time adverbials, especially locating adverbs, place the reference time i within a particular time interval they denote. This technique is intuitive and explanatory for solving the problems previously posed.

- (8) a. $\llbracket \text{yesterday} \rrbracket^{i,j} = (\text{the set of all sets containing})$ an interval within the day preceding the day containing j .
- b. $\llbracket \text{John left yesterday} \rrbracket^{i,j} = \text{yesterday}'(\lambda t[t = t^* \wedge \text{PAST}[\text{leave}'(j)]])$

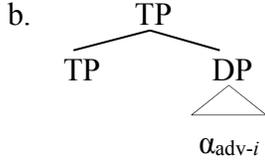
5.1.1.2 An analysis

According to the definition I presented in Chapter 3, the past tense is defined only if it denotes some time prior to the time of utterance; and I have also posited that there may be several salient time intervals in the context. In Chapter 4, a common noun that denotes a time interval, like *night*, is defined as in (9); it denotes a time that is night. This rule worked for a sentence such as *it was a strange night*. However, it cannot account for sentences like (8b), in which *yesterday* modifies the entire action of John's leaving, due to type mismatch. Thus, we first offer two separate entries for time-denoting nouns that are adverbially and non-adverbially used: an example of time-denoting nouns α_i , whose value is $g(i)$, is (9), and an adverbially used time-denoting noun is represented as $\alpha_{\text{adv-}i}$. The denotation of adverbially used time-denoting nouns is given in (10a) and its LF structure is represented in (10b). Such adverbials are of type $\langle\langle i, t \rangle, t\rangle$, a function from a sentence of type $\langle i, t \rangle$ (whose temporal argument should be filled in) to another sentence. Now, (9) applies only to time-denoting nouns that are nominally used.

- (9) $\llbracket \text{night}_i \rrbracket^{c,g,w} = g(i)$, provided that $g(i)$ is a night.

- (10) a. For a time-denoting noun α adverbially used,

$$\llbracket \alpha_{\text{adv-}i} \rrbracket^{c,g,w} = \lambda p_{\langle i, t \rangle}. \lambda t_i. [p(t) \wedge g(i) \supseteq t]$$



Now we can tackle the sentence, *John left yesterday*. In accordance with (10a), the denotation of *yesterday* is given as in (11). The definition of *yesterday* redundantly means that it denotes a time prior to the time of utterance. The inclusion relation, which works almost exactly like a temporal domain, between the time denoted by *yesterday*, the day immediately preceding the day which contains $time_c$, and t' denoted by the tense of the sentence p , represents the core of the meaning of the temporal locating adverbial *yesterday*. The time denoted by *yesterday* is relatively long, and thus it may serve as a temporal domain for the discourse in which it appears. The derivation of *John PAST₁ leave yesterday₂* is provided in (12). “ $g(2) \supseteq g(1)$ ” captures the meaning of *yesterday*, as the time denoted by the tense should be within the time denoted by *yesterday*. Sentences like **John left tomorrow* are not allowed, because *tomorrow* denotes the day immediately *following* the day which contains the time of utterance, while the tense denotes some time *prior* to the time of utterance: the inclusion relation between the intervals is incongruous, as they do not even overlap.

(11) $\llbracket yesterday_i \rrbracket^{c,g,w} = \lambda p_{\langle i,t \rangle}. \lambda t_i. [p(t) \wedge g(i) \supseteq t \text{ in } w]$, provided that $g(i)$ is the day preceding the day containing $time_c$.

(12) John left₁ yesterday₂.

a. $\llbracket yesterday_2 \rrbracket^{c,g,w}(\llbracket John \text{ PAST}_1 \text{ leave} \rrbracket^{c,g,w})$

b. $\llbracket John \text{ PAST}_1 \text{ leave} \rrbracket^{c,g,w}$

c. = $\lambda t_i. \text{ John leave at } t \text{ in } w$

d. $\llbracket yesterday_2 \rrbracket^{c,g,w}([\lambda t_i. \text{ John leave at } t \text{ in } w])$

e. = $\lambda p_{\langle i,t \rangle}. \lambda t_i. [p(t) \wedge g(2) \supseteq t]([\lambda t_i. \text{ John leave at } t \text{ in } w])$

($\llbracket \text{PAST}_1 \rrbracket^{c,g,w}$), provided that $g(2)$ is the day preceding the day containing $time_c$

f. = $[\lambda t_i. \text{ John leave at } t \text{ in } w \wedge g(2) \supseteq t](\llbracket \text{PAST}_1 \rrbracket^{c,g,w})$, provided that $g(2)$ is the day preceding the day containing $time_c$

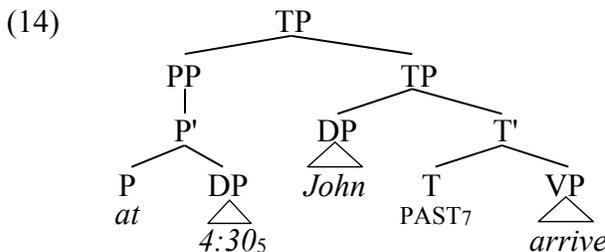
g. = John leaves at $g(1)$, if $g(1) < time_c$ in $w \wedge g(2) \supseteq g(1)$, provided that $g(2)$ is the day

preceding the day containing $time_c$

- h. (Due to existential closure) (12) is true in c relative to w iff $\exists g[g_c \subseteq g \wedge [\text{John leaves at } g(1), \text{ if } g(1) < time_c \text{ in } w \wedge g(2) \supseteq g(1)] = 1]$, provided that $g(2)$ is the day preceding the day containing $time_c$ (undefined if $g(1) \not\prec time_c$)

How about adverbials neutral to the time of utterance like *this afternoon* in (5) or *at 4:30*? For example, when you hear *John arrived at 4:30*, you place the time 4:30 prior to the time of utterance, and so on. Of course, pragmatic slack is assumed here: though John's arrival may not occur precisely at 4:30, if it is close enough with pragmatically ignorable discrepancies in minute temporal detail, *at 4:30* is qualified to make the sentence true. The denotation of *at* is given in (13), whose type is $\langle i, \langle \langle i, t \rangle, t \rangle \rangle$. Like other temporal locating adverbials, the two time intervals of interest are in an inclusion relation.¹⁴ The LF structure of *John arrived at 4:30* is presented in (14); (15) shows its semantic derivation. If there is an assignment function that maps the index on *arrived* to a time prior to $time_c$, and this time and the time denoted by *4:30* overlap, the temporal part of the conditions for the sentence to be true is met.

$$(13) \llbracket at \rrbracket^{c,g,w} = \lambda t_i. \lambda p_{\langle i,t \rangle}. \lambda t' i. [p(t') \wedge t \supseteq t' \text{ in } w]$$



(15) At 4:30₅, John arrived₇.

- a. $\llbracket at \ 4:30_5 \ John \ PAST_7 \ arrive \rrbracket^{c,g,w}$
- b. $= \llbracket at \rrbracket^{c,g,w}(\llbracket 4:30_5 \rrbracket^{c,g,w})(\llbracket John \ PAST_7 \ arrive \rrbracket^{c,g,w})$
- c. $\llbracket John \ PAST_7 \ arrive \rrbracket^{c,g,w}$
- d. $= \lambda t_i. \text{John arrive at } t \text{ in } w$

¹⁴ Particularly for short intervals such as those denoted by *arrived* or *4:30*, it would be more precise to state that the intersection between the two intervals is not a null set ($t \cap t' \neq \emptyset$) instead of the inclusion relation.

- e. $\llbracket at \rrbracket^{c,g,w}(\llbracket 4:30 \rrbracket^{c,g,w})(\llbracket \lambda t_i. \text{John arrive at } t \text{ in } w \rrbracket)$
- f. $= \lambda t_i. \lambda p_{\langle i,t \rangle}. \lambda t'_i. [p(t') \wedge t \supseteq t'](g(5))(\llbracket \lambda t_i. \text{John arrive at } t \text{ in } w \rrbracket)(\llbracket \text{PAST}_7 \rrbracket^{c,g,w})$, provided that $g(5)$ is 4:30
- g. $= \llbracket \lambda t_i. \text{John arrive at } t \text{ in } w \rrbracket \wedge g(5) \supseteq t \rrbracket(\llbracket \text{PAST}_7 \rrbracket^{c,g,w})$, provided that $g(5)$ is 4:30
- h. $= \text{John arrives at } g(7)$, if $g(7) < \text{time}_c$ in $w \wedge g(5) \supseteq g(7)$, provided that $g(5)$ is 4:30
- i. (Due to existential closure) (15a) is true in c relative to w iff $\exists g[g_c \subseteq g \wedge [\text{John arrives at } g(7)$, if $g(7) < \text{time}_c$ in $w \wedge g(5) \supseteq g(7)] = 1]$, provided that $g(5)$ is 4:30 (undefined if $g(7) \not< \text{time}_c$)

Since *at 4:30* denotes a relatively short time, a temporal domain is formed around 4:30. Actually, *4:30* could denote several times: 4:30 p.m. or 4:30 a.m. on the same day John arrived, and possibly other 4:30 timeframes in the days prior to the time of utterance. However, due to the domain anchoring we discussed in Chapter 4, and repeated in (16), possible times that are qualified to be considered as a denotation of *4:30* in (15) are limited to one or two 4:30 timeframes within the same day (containing the time at which John arrived—some time prior to the time of utterance).

(16) Domain anchoring:

$\llbracket \text{TENSE}_i \rrbracket^{c,g,w} \in \delta_c$, where $\delta_c \subseteq I$ is a set of contextually relevant and limited time intervals.

5.1.2 Types of Temporal Locating Adverbials and Ambiguity of Tense

Altshuler (2014) gives a more nuanced view of different types of temporal locating adverbs with respect to $[\pm\text{anaphoric}]$ and $[\pm\text{deictic}]$. The meaning of deictic adverbials like *yesterday* depends on context: the day denoted by *yesterday* changes according to the time of utterance and the day that contains it. The denotation of anaphoric adverbs is influenced by discourse-internal information: *the day after*, *that same day*, and *currently* are anaphoric—whose meanings are dependent on their previous utterances.

Another criterion Altshuler proposes is whether or not a temporal adverbial introduces a new time discourse referent (DREF), which serves as the reference time for the clause in which the adverbial occurs, following Partee (1984). The reference time, according to Altshuler (p. 7),

is “the time to where a story has thus far developed in the context of a narrative.” For example, Partee/Altshuler accounts for (17) as follows: *gave Fido a bath* introduces a new temporal DREF, the time “just after” the action of giving Fido a bath, and serves as the reference time for the action of cleaning the house; *cleaning the house* introduces a new time DREF, which serves as the reference time for (17b), as the “life span” of the initial DREF “cuts off.” Interestingly, in their analysis, temporal locating adverbials also introduce a time DREF. In (18a), *on May 12, 1984* introduces a new time DREF, which is May 12, 1984, and it serves as the reference time for cleaning the house. *Yesterday*, in (18b), is different from (17b): the adverbial introduces a new time DREF, which is May 11, 1984, and it serves as the reference time, or the temporal location as Altshuler asserts, for the hiring action.

- (17) a. Sue gave Fido a bath and cleaned our house. (p. 60)
b. My wife hired her and gave her a check for one month in advance.

- (18) a. On May 12, 1984, Sue cleaned our house. (p. 62)
b. Yesterday, my wife hired her and gave her a check for one month in advance.

What poses a problem for Partee/Altshuler is the adverbial *that same day* in (19). Altshuler explains that the life span of the time DREF introduced by *cleaned our house* is cut off or may not be the reference time for the following action, that is, the new time DREF introduced by *that same day*, and this new DREF becomes the reference time of the hiring action. What actually happens in the progression of discourse, however, is that we may have a reading that the hiring action took place just after the house cleaning action, among other possibilities of how the events in (19) are ordered within the same day. In other words, in natural language the life span of the DREF introduced by *cleaned our house* is not cut off, and the DREF still works as the reference time for the hiring action, unlike the prediction of the analysis.

- (19) a. On May 12, 1984, Sue cleaned our house.
b. That same day, my wife hired her.

To solve this problem, Altshuler proposed that *that same day* is *twice anaphoric* in the framework of Compositional Discourse Representation Theory: it retrieves two salient times which have already been introduced into the discourse, but does not introduce a new DREF. (19) has the syntactic structure found in (20) with Altshuler’s notations (p. 69). The indices *t* and *e* indicate time and eventuality, respectively; u_3 is a DREF associated with Sue. PFV is a covert perfective operator required by the simple past in English, adopted from Smith (1991) and Kratzer (1998).

- (20) a. $[TP[AdvP\ on\ May\ 12,\ 1984^{t_1}][TP\ PST[AspP\ PFV^{e_2,t_2}\ [VP\ Sue^{u_3}\ cleaned\ our\ house]]]]$
 b. $[TP[AdvP\ that\ same\ day_{t_1,t_2}][TP\ PST[AspP\ PFV^{e_4,t_4}\ [VP\ my\ wife^{u_5}\ hired\ her_{u_3}]]]]$

(21a) gives the denotation of *on May 12th 1984* and (21b) the denotation of the adverbial clause *that same day* with the indices, where *i, j, k* are variables over environments. *On May 12th 1984* introduces a new DREF t_1 corresponding to a particular day, which places the time of the clause within t_1 ; as for (21b), Altshuler explicates that *that same day* “checks in the input context whether there is a time antecedent t_1 that has the property of being a day and takes place throughout a previously introduced time t_2 within which the described event takes place.” ; in (21b) indicates sequencing of the two concatenated DRSs: $K; K'$ means K and K' are sequenced DRSs if and only if K can bring information from an input environment *i* to an intermediary environment *k*, and K' can bring information from *k* to an output environment *j*.

- (21) a. $\lambda Q\lambda i\lambda j.\exists k(i[t_1]k \wedge t_1k = \text{may.12.1984} \wedge Q(t_1)kj)$
 b. $\lambda Q.[\mid \text{day}\{t_1\}, t_2 \subseteq t_1]; Q(t_2)$

The reduced denotation of (20) is presented in (22). t_1 is a time DREF introduced by *on May 12th 1984*, which is prior to the speech time; the house-cleaning event (e_2) took place during t_1 . t_2 is a time after the house-cleaning event, introduced by PFV in (20a), which becomes the reference time for the hiring event ($e_4 \subseteq t_2$). One of the anaphoric DREFs of *that same day* is resolved to t_1 and the other is resolved to t_2 . (21) and (22) preserve the reading that the hiring action took place just after the house cleaning action.

(22) [t₁, e₂, t₂, u₃, e₄, t₄, u₅ |

a. t₁ = may.12.1984^o, t₁ < t₀, e₂ ⊆ t₁, u₃ = sue^o, clean.our.house{u₃, e₂}, e₂ < t₂

b. t₂ ⊆ t₁, e₄ ⊆ t₂, wife.of.speaker{u₅}, hire{u₅, u₃, e₄}, e₄ < t₄]

Despite the elegance of the analysis and the insight that the adverbial is *twice anaphoric*, the problem discussed above may also be solved in a less complicated manner if one recants the view that the length of time associated with *that same day* is not the reference time of the following VP. As I have been proposing in this dissertation, the time interval denoted by the adverbial serves as a domain for tense interpretation so that tenses may be interpreted in a constrained manner, as in natural language use, and anaphoric relations between the tenses in a discourse pertain to the times denoted by tenses, not those denoted by temporal adverbials.

One of the techniques that may solve the problem posed by *that same day* is double indexing. Among such analyses, Altshuler gives von Stechow's (2002) version as an example: von Stechow adopts the indexical interpretation of tense and defines $\llbracket \text{PAST}_j \rrbracket^{g,c}$ as $g(j)$ (it is defined only if $g(j)$ precedes the speech time) and provides an intersective analysis, which yields a good result for (19a). This time, however, (23b) with *the day before* instead of *that same day* is troubling because May 11th is "not previously established in the discourse," as the past tense in (23b) is assigned its value from the context assignment function, as is the case with pronouns.

(23) a. On May 12, 1984, Sue cleaned our house.

b. The day before, my wife hired her.

Neither (19) nor (23) is a problem in my system. We maintain that temporal locating adverbials provide a temporal domain for tenses in a discourse and that every tense is relatively interpreted to another time. Times denoted by temporal locating adverbs serve as a limited domain for tense interpretation, not necessarily playing as an antecedent. A temporal locating adverbial puts the time denoted by the tense in the sentence in which it occurs within the interval denoted by the adverbial. Inclusion or intersection will account for several phenomena, like (19) and (23), of temporal locating adverbials. Altshuler does mention temporal location as he discusses how temporal anaphora progresses in a discourse like (19)—but the difference is that his temporal location is synonymous with the reference time based on the indexical tense interpretation,

whereas temporal locating adverbials concern temporal domains, and are not directly involved in temporal anaphora resolution.

Essentially, the problems caused by *that same day* and *the day before* in Partee/von Stechow's analyses indeed stem from the proposal that tense is interpreted like pronouns. If your tense system has the quantificational or indefinite option, *the day before* as not previously established is not a problem anymore, since *hired* in (23) denotes a time that is not contextually salient; thus its tense is assigned its value via g , whose temporal domain is fixed by *the day before*. The ambiguity of tense with quantificational and indexical interpretations of tense is a compelling advantage not only to temporal anaphora but also to temporal adverbials of different types.

(19a) is interpreted as in (24). The denotation of *on* is given in (24), similar to that of *at*. $\llbracket on \rrbracket^{c,g,w}$ takes a time as its argument and a sentence of type $\langle i,t \rangle$; as part of its definition, *on* also regulates the relation between the time that its argument denotes and the time denoted by the tense of the sentence in which it occurs. We still lack a rule for a possessive DP such as *our house* in (24d), but for present purposes let us assume that *our house* denotes a particular object of type e , which is assigned by g_c . The time denoted by the adverbial *on May 12, 1984* is now a temporal domain (δ_c) and added to the context. Also, the time that has been mentioned in the previous utterances not only serves as a temporal domain but also is added to c_{SAL} as it becomes salient in the context. Let us say c_0 in (25a) is the initial context for (19a), adding 0 to the set of indices. After (19a) is uttered, we have the accordingly updated context c_1 as exemplified in (25b), which now provides the context for (19b). $g(1)$, which is represented as t_1 , is now a contextually salient time interval and a member of c_{SAL_1} , as the time *May 12, 1984* denotes.

- (24) a. $\llbracket on \rrbracket^{c,g,w} = \lambda t_i. \lambda p_{\langle i,t \rangle}. \lambda t' i. [p(t') \wedge t \supseteq t' \text{ in } w]$
 b. $\llbracket on \text{ May } 12, 1984_3 \text{ Sue PAST}_1 \text{ clean our houses}_5 \rrbracket^{c,g,w}$
 c. $= \llbracket on \rrbracket^{c,g,w}(\llbracket \text{May } 12, 1984_3 \rrbracket^{c,g,w})(\llbracket \text{Sue PAST}_1 \text{ clean our houses}_5 \rrbracket^{c,g,w})$
 d. $\llbracket \text{Sue PAST}_1 \text{ clean our houses}_5 \rrbracket^{c,g,w}$
 e. $= \lambda t_i. \text{ Sue clean } g_c(5) \text{ at } t \text{ in } w$
 f. $\llbracket on \rrbracket^{c,g,w}(\llbracket \text{May } 12, 1984_3 \rrbracket^{c,g,w})([\lambda t_i. \text{ Sue clean } g_c(5) \text{ at } t \text{ in } w])$
 g. $= \lambda t_i. \lambda p_{\langle i,t \rangle}. \lambda t' i. [p(t') \wedge t \supseteq t'](g(3))([\lambda t_i. \text{ Sue clean } g_c(5) \text{ at } t \text{ in } w])(\llbracket \text{PAST}_1 \rrbracket^{c,g,w})$, provided that $g(3)$ is May 12, 1984
 h. $= \llbracket [\lambda t_i. \text{ Sue clean } g_c(5) \text{ at } t \text{ in } w] \wedge g(3) \supseteq t \rrbracket(\llbracket \text{PAST}_1 \rrbracket^{c,g,w})$, provided that $g(3)$ is May 12,

1984

i. = Sue cleans $g_c(5)$ at $g(1)$, if $g(1) < time_c$ in $w \wedge g(3) \supseteq g(1)$, provided that $g(3)$ is May 12, 1984

j. = (Due to existential closure) (24b) is true in c relative to w iff $\exists g[g_c \subseteq g \wedge [\text{Sue cleans } g_c(5) \text{ at } g(1), \text{ if } g(1) < time_c \text{ in } w \wedge g(3) \supseteq g(1)] = 1]$, provided that $g(3)$ is May 12, 1984 (undefined if $g(1) \not\prec time_c$)

(25) a. $c_0 = \langle speaker_{c_0}, addressee_{c_0}, time_{c_0}, place_{c_0}, c_{SAL_0} = \{\mathbf{our\ house}\}, g_{c_0} = \langle 5, \text{our house} \rangle, \delta_{c_0} \rangle$

b. $c_1 = \langle speaker_{c_1}, addressee_{c_1}, time_{c_1}, place_{c_1}, c_{SAL_1} = \{\mathbf{t_1, Sue, May 12, 1984, our house}\}, g_{c_1} = \langle 1, t_1 \rangle, \langle 5, \text{our house} \rangle\}, \delta_{c_1} = \text{May 12, 1984} \rangle$

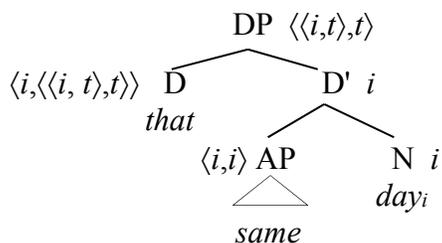
The more intriguing part of (19) is the second sentence (19b), which includes *that same day*. First, I would like to point out that *that same day* or *that day* as a whole function as a temporal adverbial of type, $\langle \langle i, t \rangle, t \rangle$, but not *day* alone. This is the difference between *day* and *yesterday*: *yesterday* is ambiguous because it is of type i in a sentence like *it was yesterday* and it is of the type $\langle \langle i, t \rangle, t \rangle$ in a sentence like (12), which by itself modifies the entire sentence. Therefore, let us assume that *day* is of type i , whether it is used as a noun or as an adverb in phrases such as *the day before/after* and *that day*. Since *day* alone cannot be used adverbially, the type-shifting rule for time-denoting nouns is not eligible for *day*.

The distinction Altshuler makes between deictic and anaphoric adverbials is that deictic ones like (11) denote times in relation to contextual elements such as the time of utterance ($time_c$) while anaphoric ones are defined in relation to discursal elements previously established: *yesterday* denotes a day prior to the day containing $time_c$ and *that same day* denotes the day of interest that has been mentioned in previous utterances. The denotation of *yesterday* in (11) shows its dependence on the context as part of its definition along with the inclusive or intersective relation with the time denoted by the tense within the sentence containing *yesterday*, which correctly identifies the day before the day containing $time_c$. Anaphoric adverbials necessarily make reference to elements that have already been introduced by previous sentences, and in this way are

made salient in the context. Thus, I suggest that anaphoric adverbials denote a particular time that is a member of c_{SAL} , thereby matching the properties of the time they describe.

The anaphoric nature of *that same day* is due to *that* (which is intensified by *same*) rather than the lexical semantics of *day* by itself. The LF structure of *that same day* is shown in (26). *That* takes an expression denoting a time and connects it with another time in c_{SAL} ; and the resulting complex expression serves as a temporal adverbial—*that* is a type of $\langle i, \langle \langle i, t \rangle, t \rangle \rangle$. Figuratively speaking, *that* functions like “pointing”: it particularly denotes a time that has become salient in the context. Among many possible days that *day* could denote, a particular day in c_{SAL} is identified. Such property of the meaning of *that* in *that (same) day* is expressed as seen in (27a); that *that*, like a pointer, searches for a time in c_{SAL} which corresponds to a day, its argument, and marks such a time interval as relevant. This process is executed by POINT, defined in (27b). If there is no time interval in c_{SAL} that matches the property of the argument of POINT, this operator is not defined. I will define *same* as a function of type $\langle i, i \rangle$, which maps a time onto the same time.

(26) LF structure of *that same day*:



(27) a. $\llbracket \textit{that} \rrbracket^{c, g, w} = \lambda t_i. \lambda p_{\langle i, t \rangle}. \lambda t''_i. [\text{POINT}(t, t') \wedge p(t'') \wedge t' \supseteq t'' \text{ in } w]$

b. $\text{POINT}(t, t')$ iff $t' \in c_{\text{SAL}}$ and t' matches the properties of t (undefined if no such t' is in c_{SAL}).

c. $\llbracket \textit{same} \rrbracket^{c, g, w} = \lambda t_i. t$

We are now ready to present a compositional denotation of *that same day*. (28) shows the semantic composition of *that same day*. Refer to (25b) for the context for (28) and (29). (29) is the denotation of (19b).

- (28) a. $\llbracket \text{same day}_1 \rrbracket^{c_1, g, w} = \llbracket \text{day}_1 \rrbracket^{c_1, g, w}$
 b. $\llbracket \text{day}_1 \rrbracket^{c_1, g, w} = g(1)$, provided that $g(1)$ is a day
 c. $\llbracket \text{that same day}_1 \rrbracket^{c_1, g, w} = \llbracket \text{that} \rrbracket^{c_1, g, w}(\llbracket \text{same day}_1 \rrbracket^{c_1, g, w})$
 d. $= \llbracket \text{that} \rrbracket^{c_1, g, w}(g(1))$, provided that $g(1)$ is a day
 e. $= \lambda t_i. \lambda p_{\langle i, t \rangle}. \lambda t''i. [\text{POINT}(t, t') \wedge p(t'') \wedge t' \supseteq t'' \text{ in } w](g(1))$, provided that $g(1)$ is a day
 f. $= \lambda p_{\langle i, t \rangle}. \lambda t_i. [\text{POINT}(g(1), g(3)) \wedge p(t) \wedge g(3) \supseteq t \text{ in } w]$, provided that $g(1)$ is a day and $g(3)$ is May 12, 1984

(29) That same day₁, my wife₇ hired₂ her₈.

- a. $\llbracket \text{that same day}_1 \text{ my wife}_7 \text{ PAST}_2 \text{ hire her}_8 \rrbracket^{c_1, g, w}$
 b. $= \llbracket \text{that same day}_1 \rrbracket^{c_1, g, w}(\llbracket \text{my wife}_7 \text{ PAST}_2 \text{ hire her}_8 \rrbracket^{c_1, g, w})$
 c. $\llbracket \text{my wife}_7 \text{ PAST}_2 \text{ hire her}_8 \rrbracket^{c_1, g, w}$
 d. $= \lambda t_i. g_{c_1}(7) \text{ hire } g_{c_1}(8) \text{ at } t \text{ in } w$
 e. (29a) $= \lambda p_{\langle i, t \rangle}. \lambda t_i. [\text{POINT}(g(1), g(3)) \wedge p(t) \wedge g(3) \supseteq t \text{ in } w](\llbracket \lambda t' i. g_{c_1}(7) \text{ hire } g_{c_1}(8) \text{ at } t' \text{ in } w \rrbracket)(\llbracket \text{PAST}_2 \rrbracket^{c_1, g, w})$, provided that $g(1)$ is a day and $g(3)$ is May 12, 1984
 f. $= [\text{POINT}(g(1), g(3)) \wedge \llbracket \lambda t_i. g_{c_1}(7) \text{ hire } g_{c_1}(8) \text{ at } t \text{ in } w \rrbracket \wedge g(3) \supseteq t \text{ in } w](\llbracket \text{PAST}_2 \rrbracket^{c_1, g, w})$, provided that $g(1)$ is a day and $g(3)$ is May 12, 1984
 g. $\text{POINT}(g(1), g(3)) \wedge g_{c_1}(7) \text{ hires } g_{c_1}(8) \text{ at } g(2)$, if $g(2) < \text{time}_{c_1} \text{ in } w \wedge g(3) \supseteq g(2) \text{ in } w$, provided that $g(1)$ is a day and $g(3)$ is May 12, 1984
 h. (Due to existential closure) (29a) is true in c relative to w iff $\exists g[g_c \subseteq g \wedge [\text{POINT}(g(1), g(3)) \wedge g_{c_1}(7) \text{ hires } g_{c_1}(8) \text{ at } g(2)$, if $g(2) < \text{time}_{c_1} \text{ in } w \wedge g(3) \supseteq g(2) \text{ in } w] = 1]$ iff $g(3) \in c_{\text{SAL}}$ and $g(3)$ matches the properties of $g(1)$ (undefined if no such $g(3)$ is in c_{SAL}), provided that $g(1)$ is a day and $g(3)$ is May 12, 1984 (undefined if $g(2) \not\prec \text{time}_{c_1}$)

In summary, times denoted by deictic adverbials like *yesterday* are added to c_{SAL} in the context, are qualified to be a potential antecedent of anaphoric adverbials; and anaphoric ones such as *that same day* concern times that are already marked salient in the context via the operator POINT. Regardless of their types, temporal locating adverbials appeal to the context—and deictic ones appeal to the time of utterance, whereas anaphoric ones appeal to c_{SAL} .

5.2 *Immediately*

Look at the sentences in (30), which contain *immediately*. Possibly, (30a) is preceded by a sentence like *They heard a meow*. In this case, it may be that the time at which they heard a meow and the time at which they noticed their cat from its particular meow almost completely coincide. In (30b), explosions occurring and people's subsequent running do not exactly overlap, but there may be a very short interval in between, assuming that their nervous system processes the situation and in essence orders them to run. This time interval between these two actions would be the closest interval when we would normally say that an event *immediately follows* (symbolized as $\{$ in Chapter 4) another in a discourse. *Immediately* in (30c) also connects an event not known in this example with John's action of starting. This time, however, the gap between the two events that *immediately* connects might be several hours due to the inclusion of *on that very day*. Suppose that John heard about "them" at around 10 a.m. that day. After he received a sanction from his boss and gathered a research team, he finally was able to study them at around 3 p.m. the same day. In such a scenario, the size of the gap in between that is placed by *immediately* is fixed accordingly to a given temporal domain. The gap becomes slightly larger in (30d): though the speaker went *immediately*, it must have taken nearly one day. In (30e), the time frame is possibly two weeks, or even a month. However, it does not seem to go beyond a few months, as seen in (30f). This is probably due to the lexical semantics of *immediately*—however slowly we take it, a year later is not "without any delay or lapse of time; instantly," (which is the Oxford English Dictionary definition).

- (30) a. Immediately, they noticed their cat.
b. When the explosions went off, people ran immediately towards the problem.
c. John immediately started to study them on that very day.
d. I heard what happened, and I immediately went to Boston the next day.
e. The new watches immediately became the talk of the nation.
f. ?The new watches immediately became the talk of the nation the next year.

Using Altshuler's taxonomy, I suggest that *immediately* is an anaphoric temporal adverbial which makes reference to already existing times in the context. *Immediately* indicates that the interval between the events before and after it is quite short. But, unlike *that day*, it does not

refer to a previously mentioned time; rather, it denotes a time that follows its antecedent in such a way that the interval between the relevant events is considerably brief. Besides, as we have just seen in (30), the size of the interval changes flexibly in accordance with the size of the times in the context, and with common knowledge.

Immediately has a distinctive syntactic distribution from typical temporal locating adverbials such as *yesterday*. As seen in (30), it modifies not only sentences as a whole, but also VPs, as it signifies a temporal relationship among its many other lexical meanings. For the sake of simplicity, let us treat *immediately* as a sentential adverb, taking a sentence of type $\langle i, t \rangle$ as its argument, like *yesterday*: this would not cause much difference in terms of meaning, though *immediately* will have a different type and syntactic structure when it modifies a VP. Plus, since it shows a temporal relationship with a time denoted by a previous tense morpheme, this type of *immediately* will be $\langle i, \langle \langle i, t \rangle, t \rangle \rangle$. We begin with this rather rough denotation in (31). t is the most salient time in c_{SAL} , probably because it has just been mentioned. t' denoted by the tense in the argument sentence immediately follows t in c_{SAL} of the input context.

$$(31) \llbracket \textit{immediately} \rrbracket^{c,g,w} = \lambda t i: t \in c_{\text{SAL}}. \lambda p_{\langle i, t \rangle}. [p(t') \wedge t \} t' \text{ in } w]$$

Now, the question is how we characterize $\}$ in terms of the length of the gap between t and t' . From (30), we summarize the temporal specifications that *immediately* brings, as presented in (32). $/ /$ indicates the length of the set of the intervals within $/ /$. When there is an overt temporal adverbial, as in (30c) and (30d), the length of the set of intervals between t and t' approximates to (\approx) the length of the temporal domain set by the adverbial. In cases like (30b), times denoted by tenses connected with *when* overlap as we had defined them in Chapter 4; *immediately* confirms it. (30a) and (30e) fall into (32c): $/ (t, t') /$ may differ, depending on the lexical aspect of the verbs and how long it takes for the events described by the verbs to be completed. In any case, the gist of the meaning of immediately following is summarized as in (32c), $/ (t, t') / \approx$ small.

(32) Temporal specifications of $t \} t'$:

- a. When there is an overt temporal adverbial: $/ (t, t') / \approx / \delta_c /$
- b. When it is adjacent to a *when*-clause: $/ (t, t') / \approx \emptyset$

c. When there is no overt temporal adverbial: $/(t, t')/ \approx \emptyset$ or $/(t, t')/ \approx \text{small}$

Immediately picks out the most salient time in the context and connects it with the time denoted by the tense in the sentence in which it occurs. It specifies relationships between these two times; the length of the gap between the two times changes according to the size of temporal domains, as fixed by overt temporal adverbials or *when*-clauses. (30e) presents a difficult case in which to pinpoint the value of $/(t, t')/$. More detail in the discourse will feed the context, which in turn further specifies the length of the two time intervals involved with *immediately*.

CHAPTER 6

CONCLUSION

Before I presented my analysis, I made clear that we need both definite and indefinite interpretations of tense. The tense system in this dissertation achieves that by employing two different types of assignment function, g and g_c , as they fix the value of time variables of tense morphemes. The tense system established in this dissertation sets a quantificational interpretation of tense as default, which is said to be an empirically accurate analysis, and also accounts for the indexical character of tense—tenses which denote contextually salient times and anaphoric tenses via g_c which assigns a particular time in c_{SAL} to time variables. We have seen that tense interpretation is contextual not only in that matrix tenses are determined with respect to the time of utterance but also that sometimes tenses indexically denote salient times in the context.

It is possible that there is more than one salient time in the context that is involved in temporal relations, and therefore tense interpretation is not rigidly restrained by two or three time parameters. Keeping multiple time intervals available for temporal interpretation, we do not need to come up with a provisory time parameter as sentences become complex. Additionally, we do not risk overlooking an important time interval in context, for example, times denoted by temporal adverbials. My analysis maintains a tense theory that is more intuitive and explanatory.

Temporal domains and domain anchoring explicitly show that quantification over times occurs in a limited temporal domain. We have seen that temporal domains are dynamically changed and updated as discourse proceeds, and how such changes influence tense interpretation. My analysis, which allows definite and indefinite interpretations of tense, is particularly advantageous for temporal anaphora resolution, which draws similarities between tenses and nominals.

Temporal locating adverbials are mainly defined in terms of an inclusion relation between the time denoted by an adverbial and the time denoted by the tense of the sentence in which the adverbial occurs. Times denoted by temporal adverbials become a temporal domain for tense and a contextually salient time. If we have an anaphoric adverbial such as *that same day* in the sentence, one of the times in the context that fits the property of the time relevant to the adverbial serves as the antecedent of the anaphoric adverbial. *That same day* was also compositionally analyzed in this dissertation according to its syntactic composition. *Immediately*, intri-

guinely, places the time denoted by the tense in the sentence in which it occurs in accordance with the interval between the times of the tenses it connects, and in the process *immediately* shows sensitivity to the length of temporal domains.

One of the challenges in this dissertation concerns how we constrain the context. How many salient time intervals can c_{SAL} contain? How long do they stay in c_{SAL} ? We have posited that there is a hierarchy among the objects in c_{SAL} , but it is not explicitly stated how it is determined and how the most salient object is selected, other than being just introduced in a discourse. We have seen that our expectations and common sense about normal durations of events do play a role in the interpretation; how they are implemented in the context, however, must be left vague at this point.

This would be one of the remaining issues for future research. Also, this dissertation mostly deals with the simple past; obviously, the next step is to examine how the tense system advocated in this dissertation accounts for other tenses and aspects in their various combinations, particularly with subordination. Domain anchoring could play an interesting role in the interpretation of embedded tenses. This analysis may also be extended to some other languages, particularly Korean, whose tense marker brings much controversy in its nature and aspectual scope. Another question concerns habitual use of past tense. Accounting for sentences such as *They had a meeting every Friday* would be the next project. Also, discussion in this dissertation was limited to a small, narrow chunk of discourse, but temporal relationships in a more complex discourse deserve in-depth exploration.

These remarks conclude the dissertation, which began with the question of how language encodes time. Hopefully it is now clear that tense is relational and contextual. The context has salient times other than solely the time of utterance, and these elements specify and influence temporal relations. Such elements also include language users' knowledge about actions bound by time, although those were not explicitly portrayed in this analysis.

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