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AN EVENT RESTRICTION INTERVAL THEORY OF TENSE

BY

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DISSERTATION

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## **Abstract**

This dissertation presents a novel theory of tense and tense-like constructions. It is named after a key theoretical component of the theory, the event restriction interval.

In Event Restriction Interval (ERI) Theory, sentences are semantically evaluated relative to an index which contains two key intervals, the evaluation interval and the event restriction interval. The evaluation interval marks the present relative to context, and the event restriction interval defines temporal boundaries on events. Various constituents, called *R*-modifiers, operate on these two intervals compositionally, such that each verb is evaluated relative to values which yield correct temporal restrictions.

This dissertation develops ERI Theory to present an analysis of independent clauses as well as embedded clauses of various types. One of the positive aspects of ERI Theory is that it offers a purely semantic analysis of the sequence of tense phenomena which occur in the latter. Also, a pragmatic component is presented which accounts for a number of intuitions regarding the usage of tense, while simultaneously providing a solution to some problems related to tense and quantification over times.

To my parents, who taught me to think and to learn,  
And to my wife, who taught me to smile.

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## Chapter 1 Introduction

I aim to present a novel theory of English tense and tense-like constructions. It is based on a theoretical object which I call the *event restriction interval*. As such, the theory may be called *Event Restriction Interval Theory* or *ERI Theory* for short.

As the phrase *theory of English tense* is somewhat unclear, and quite broad, I should probably clarify exactly what I mean. *Theory of English tense* is unclear because the term *tense* is unclear. *Tense* might denote a property which is assigned to sentences and/or utterances, for instance, when one says, “John was speaking in the past tense.” *Tense* might denote a very specific set of morphemes, such as the past tense morpheme *-ed* and the present tense morpheme *-s*. *Tense* also might denote a class of operators on propositions or other logical formulae which modify the temporal truth conditions in their scopes, such as the *P* and *F* operators from Priorean tense logic (Prior, 1967). And while there is ambiguity as to what *tense* denotes, it is also not immediately clear what about these things a theory of them would address. As *tense* free of context is not a technical term, it has grown to be used in a great number of ways which leaves me with the task of explaining exactly what ERI Theory is a theory of.

ERI Theory is a linguistic theory, specifically, a formal semantic theory which defines the denotations of various linguistic elements which have temporal consequences when calculating truth conditions of assertions. These *temporal linguistic elements* include, but are not limited to those which the linguistic community has decided to call *tense*, and therefore ERI Theory may be called a theory of *tense*. ERI Theory also defines the meanings of the perfect aspect morpheme (viz. *have*), temporal adverbials (e.g. *yesterday*, *since Thursday*), and temporal complementizers (e.g. *after*, *while*), and therefore ERI Theory may be called a theory of tense-like constructions. A significant portion of this dissertation is also devoted to the investigation of the behavior of tense constructions in embedded clauses, and therefore ERI Theory may be called a theory of subordinate tense as well.

But why do we need a new theory of tense? Tense and its semantic impact has been recognized as an important target of academic inquiry at least since Aristotle wrote *de Interpretatione* (Aristotle, c. 300 B.C.). Since then, no shortage of ink has been spilled on the topic. As such, I (like all academics) am charged with the task of bringing something new to the table, and I believe in this respect I succeed. While ERI Theory has plenty of room to grow, there are already some nice features which it has to offer.

One of the general properties of ERI Theory—I will leave whether this is an accomplishment or not for others to decide—is that, we might say, it *unifies* tense with other tense-like constructions. What do I mean by this? Well, one of the first things we might notice about tense and human language is that many languages do *not* have tense. For example, I am told that Chinese is one such language. The fact that Chinese lacks tense, however, does not stop Chinese speakers from talking about events and their temporal properties in a sophisticated manner. Lacking tense does not make a language *deficient* in any way. It simply means that other tools are employed to do the same job. What should a semanticist take from this observation? The main lesson to be learned here, I believe, is that tense is not *special*, or privileged, in any formal respect. I interpret this claim in a couple of different ways.

One way of interpreting tense as not special is that any linguistic theory of temporal items should not depend on the presence of tense in order to be well-defined. In other words, *mutatis mutandis*, any tense theory should be generally applicable to languages which do not have tense morphemes. Also, if we *remove* tense from the target language, and assume a minimally different grammar which allows such removal, the formalism should not break. If it did, then we would be charged with the task of describing a different semantics for languages which do not have tense, as well as the task of explaining why we cannot or chose not to construct a formalism which accounts for the behavior of both language types. For example, (1.1-a,b) seem to be semantically equivalent, though (1.1-a) is a sentence of English and (1.1-b) is a sentence of a hypothetical English which lacks obligatory tense inflection:

(1.1) *English vs. English without tense:*

- a. John built a house.
- b. In the past, John build a house.

The past tense morpheme in (1.1-a) seems to be doing the same job as the adverbial *in the past* in (1.1-b). Indeed, “In the past, John built a house” seems somewhat temporally redundant. One of the nice features of ERI Theory is that it analyzes (1.1-b) just as well as (1.1-a). In fact, ERI Theory assigns the exact same semantic content to the adverbial in (1.1-b), as it does to the past morpheme in (1.1-a) (viz. the set of moments preceding the time of evaluation).

This is related to another way in which we might interpret the claim that tense is not semantically special. If two constructions, within or across languages, do the same job, they should be treated in the same way by the semantics. The past morpheme in (1.1-a) and the adverbial in (1.1-b) are observed to have essentially the same effect, so it seems natural to formalize their meanings in the same way. This is actually how ERI Theory treats the basic tense morphemes and temporal adverbials. They both simply denote time intervals. *Yesterday*, *before 5 o'clock*, and the past tense morpheme, all denote the same kind of thing. This is an example of what I mean when I say that ERI Theory unifies tense and tense-like constructions.

Another nice feature of ERI Theory is that it offers a purely semantic analysis of the classic “sequence-of-tense” phenomena (in section 6.4). I believe most would agree that this could be considered progress, as previous successful analyses of these phenomena tend to rely on syntactic rules lacking independent motivation.

Other advantages which ERI Theory has over other formalisms are borne out in the following pages. By the end, we will have a clearer understanding of the various properties which ERI Theory has, as well as a better understanding of the different kinds of tense theories which already exist. While it is favorable that ERI Theory does not share some of the better known issues with other kinds of theories, which are pointed out in chapter 8, ultimately, the success of ERI Theory will be measured by its ability to adapt to and account for future data.

This dissertation is designed to be read in order, as later chapters tend to build upon concepts defined in earlier ones. Chapter 2 provides a review of aspectual categories. This chapter is in-

cluded mostly because I make heavy use of the terminology defined therein. However, those who are familiar with Vendler's (1957) terminology and with Dowty's (1979) discussion of aspectual class can most likely skip ahead. Chapter 3 introduces the metalanguage of ERI Theory. The main goal of this chapter is to define the various notations used throughout this dissertation, as well as to formalize the ontological commitments of ERI Theory, define the assumed set of compositional semantic rules, and so forth. Chapter 4 defines the meanings of the basic temporal components of ERI Theory, and provides analyses of independent clauses, lacking any notion of subordinate tense. Chapter 5 addresses a concept which, in my experience, is rather uncommon in tense semantics: namely, that the past tense is ambiguous between a reading involving past times and a reading not involving past times. This hypothesis becomes critical in later discussions, particularly those involving tense in embedded environments, which is the focus of chapter 6. Such environments include temporal subordinate clauses, relative clauses, and the complements of intensional verbs. Chapter 7 presents a sketch of a pragmatic theory which restricts temporal quantification. This chapter includes a number of discussions aimed at applying pragmatic principles to account for an array of implicatures we observe involving tense. Finally, Chapter 8 provides a brief tour of some of the themes which pervade the tense semantics literature. In this chapter, some particular theories are discussed as well as some very broad theoretical questions. This chapter is relatively devoid of conclusions. Rather, its purpose is to provide the reader with suggestions for further reading, as well as paint a theoretical landscape of tense semantics in general.

## Chapter 2 Verbs, Predicates, and Aspectual Class

The term *aspect*, like *tense*, has come to be used in a great number of ways. Though in the context of modern linguistic theory, we can safely narrow our attention down to two senses. The first refers to a set of morphological entities. We can call these *morphemes*, *affixes*, or *markers*, which are morphosyntactic elements. As Comrie (1976, p.3) puts it, these elements distinguish “different ways of viewing the internal temporal constituency of a situation”. Slavic languages such as Polish are often used to demonstrate this type of aspect, as the aspectual morpheme inventory for these languages is quite extensive. In English, as Dowty (1979) observes, we only have two such markers. One of them is the progressive aspect morpheme *-ing*, the other is the habitual quasi-auxiliary *used to* ([’justə]). Some might consider the perfect morpheme *have* as aspectual, but as I will show in later chapters, ERI Theory treats this morpheme as a tense-like construction, in a quasi-Reichenbachian fashion, so I omit it from the list of aspectual morphemes here. Whereas tense markings tend to indicate the time at which events occur, aspectual markings indicate other details about the event, such as whether an event is repeated, whether it has a culmination point, etc.

The usage of such markings however, in Polish and in English, is not unrestricted. For example, we can apply the progressive aspect suffix to verbs such as *run* with no issue, but may not apply it to verbs such as *know*:

- (2.1) a. John is running a marathon.  
b. \*John is knowing the answer.

Also, the interpretation of different kinds of verbs can be altered in different ways as a result of combining them with the *same* aspectual marker. For example, (2.2-a) is understood to mean that John is currently involved in a running action, but (2.2-b) is not understood to mean that John is currently involved in a winning action—at least not in the same sense of *currently involved* that we

are using with respect to (2.2-a).

- (2.2) a. John is running the race.  
b. John is winning the race.

(2.2-b) has a number of readings, one of them is something like, “John is almost finished with the race and is currently in the lead”. Another one (sometimes called the futurate progressive reading), is something like, “Current plans are in effect that guarantee John’s victory”. At any rate, the important observation here is that different types of verbs 1) have different restrictions concerning which aspectual markers they may be combined with, and 2) can yield different aspectual interpretations even when combined with the same aspectual marker. These phenomena suggest the existence of what grammarians and linguists today call *aspectual class*. Verbs which belong to the same aspectual class are predicted to behave the same way when placed in identical aspectual environments.

Historically, aspectual class has often been referenced by the term *Aktionsart*, which is German roughly translated as “manner of action”. I intentionally avoid the use of this term for the following reason: The term *aspectual class* as I use it in this dissertation and as most other linguists use it today, refers to a classification of verbs (or as we will see, of predicates or possibly even sentences, but linguistic elements nevertheless), and it is problematic and confusing to think of the term as referring to a classification of actions or events. Also, while the German equivalent of the term *manner* is actually not used in the term *Aktionsart*<sup>1</sup>, it often comes up in English translations like the one above due to its association with *action*, and aspectual class really has nothing to do with *manner* in the sense that linguists use it today.

The literature which documents the quest to identify aspectual categories is very extensive, and very old (dating back to Aristotle). For an introduction to the history of this literature, see section 2.2.1 *The Development of the Verb Classification* in (Dowty, 1979). For our purposes, we can begin our discussion with the aspectual classification system proposed by Vendler (1957),

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<sup>1</sup>*Aktionsart* could be literally glossed as *action type* or *action kind*.

who is generally credited for developing the basic classes used by linguists today, and whose terminology seems to have been adopted as standard, or at least more standard than anyone else's. Before I begin I wish to credit Dowty (1979) for the general structure of the following introduction to aspectual class. Many of the ideas, examples, and tests are borrowed from chapter 2 of his book, though I have taken the liberty on a number of occasions to modify and/or omit certain things. In general if the reader would like a more comprehensive introduction to aspectual class I refer her to the above-mentioned publication.

Vendler proposed four basic aspectual classes, listed below in no particular order:

(2.3) *Vendler's aspectual classes:*

1. State
2. Activity
3. Accomplishment
4. Achievement

His choice of terminology, specifically *accomplishment* and *achievement*, which are near synonyms in English, is unfortunate. But as I mentioned above, this terminology has become quite standard and as such we are committed to it at this point. While the terms *state*, *activity*, etc., seem to describe different sorts of events or actions (states of affairs), I would like to make clear that, in fact, they refer to different sorts of linguistic constructions, and that these two concepts do not correspond to each other in a one-to-one fashion. The following examples illustrate my point.

(2.4) *Two constructions which belong to distinct aspectual classes may describe the same event:*

- a. John drank wine for 10 minutes.
- b. John drank a glass of wine in 10 minutes.

The truth of both examples above hinges on facts of the matter concerning what could be the exact same event, namely John's wine-drinking event. However, as we will see below, (2.4-a) is an activity while (2.4-b) is an accomplishment. It is of course also possible (as far as I am

concerned) that two events may have happened simultaneously and involved the same agent and context; the metaphysical nature of events is not a topic of discussion I intend on addressing here. It is precisely the fact that I can be oblivious to the nature of events and yet speak accurately about aspectual classes which shows that aspectual class and real-world events do not have a one-to-one correspondence.

The rest of this chapter presents the four aspectual classes proposed by Vendler. This discussion includes tests for identifying them as well as intuitive explanations of the sorts of events they instantiate. The final section of this chapter discusses observations which have led linguists to conclude that aspectual class is not limited to verbs, but should be thought of as applying to entire predicates, and possibly even sentential phrases. The relevance of this discussion of aspectual class will be apparent in later chapters; the reader will observe that ERI Theory must respect the aspectual class of target constructions, and that aspectual class is integral in the calculation of truth conditions.

## 2.1 States

We begin a focused discussion of aspectual classes with the state class. States intuitively instantiate a duration of time throughout which a particular property or way-of-things<sup>2</sup> obtains. States include verbs such as *know* and *love* as well as adjectival predicates such as *be happy* and *be tall*.

One of the most transparent tests for identifying a state is to observe the grammaticality of the construction resulting from combining it with the progressive affix *-ing*. States are the only aspectual class for which such a construction is unacceptable:

(2.5) *Stative predicates are incompatible with the progressive affix:*

- a. John knew the answer.
- b. \*John was knowing the answer.
- c. John loved Mary.

---

<sup>2</sup>I would like say “state of affairs” here but would also like to avoid circularity.

- d. \*John was loving Mary.
- e. John was happy.
- f. \*John was being happy.

Compare these data to the following cases, where we apply the progressive suffix to verbs of other aspectual classes and observe that they are indeed compatible:

(2.6) *Non-stative predicates are compatible with the progressive affix:*

- a. John drank wine.
- b. John was drinking wine.
- c. John drank a glass of wine.
- d. John was drinking a glass of wine.
- e. John finished the wine.
- f. John was finishing the wine.

I will refer to this type of test as the *comp.prog.* test below for brevity. States are also unique in that they are the only aspectual class which cannot be used in pseudo-cleft constructions:

(2.7) *Stative predicates are incompatible with pseudo-cleft constructions:*

- a. \*What John did was know the answer.
- b. \*What John did was be happy.
- c. What John did was drink wine.
- d. What John did was finish the wine.

States may also not occur in the imperative mood, or as the complement of verbs like *force* or *persuade*:

(2.8) *Stative predicates are incompatible with imperative constructions:*

- a. \*Know the answer!
- b. \*Mary forced John to know the answer.

- c. \*Mary persuaded John to know the answer.

These sorts of tests are centered around the requirement that the verb can be agentive, and as such I will refer to them as *agentive* tests. I should note here that agentivity and lack of stativity are not necessarily the same thing. Stativity seems to imply a period of time without change, and agentivity implies a period of time where something is under the control of an agent, as such is subject to change. Because of this, lack of stativity and agentivity seem to correspond to each other. One can present examples like the following which seem to instantiate agentive states:

(2.9) *Agentivity and lack of stativity are not equivalent:*

- a. Be good/prepared!
- b. John is being good/?prepared.
- c. Mary persuaded John to be good/prepared.
- d. ?What John did was be good/prepared.

While I do not intend to provide a discussion about it here, I will briefly note that the examples above do not seem like states to me, because they require some sort of active involvement by the agent. Specifically, an agent cannot ‘be good’ without *behaving* a certain way, nor can an agent ‘be prepared’ without *preparing*. Both *behave* and *prepare* are activities, which are discussed next.

## 2.2 Activities and Accomplishments

Activities and accomplishments intuitively instantiate events which have duration and internal dynamism. Activities and accomplishments differ only in their telicity. Specifically, accomplishments have, and activities lack, culmination points. Most verbs which instantiate activities can also instantiate accomplishments and vice versa. Verbs like this include *run*, *sing*, and *paint*. The difference, again, is whether the verb phrase requires a culmination point. Usually, in their bare forms, such verbs require no culmination point and as such instantiate activities. Culmination points may be introduced, for example, by adding goal points or certain kinds of objects (e.g. *John*

walked to the store, John painted a picture). Though ultimately the aspectual nature of a phrase depends on the semantics of its components, not its structure. For example, by itself, *drink* is an activity. We can add an object to make it an accomplishment, for example, *John drank a glass of wine*. Though not all kinds of objects make it an accomplishment—*John drank wine* is still an activity. The definiteness of the object phrase does not matter either, as *John walked* and *John walked the dog* are both activities.

Unlike states, activities and accomplishments both pass the prog.comp. and agentive tests:

(2.10) *Activities and accomplishments pass the prog.comp. and agentive tests:*

- a. What John did was paint (a picture).
- b. Mary forced/persuaded John to paint (a picture).
- c. Paint (a picture)!
- d. John was painting (a picture).

In addition to the agentive and prog.comp. tests, activities and accomplishments have complementary entailment relationships between the present progressive and the simple past and between *stop* constructions and their bare forms. The following examples illustrate the paradigm:

(2.11) a. Entailments of the progressive:

- (i) John is painting  $\rightarrow$  John painted.
- (ii) John is painting a picture  $\rightarrow$  John has not painted a picture. (at least not the same one)

b. Entailments of *stop* constructions:

- (i) John stopped painting  $\rightarrow$  John painted.
- (ii) John stopped painting a picture  $\rightarrow$  John has not painted a picture. (at least not the same one)

Examples like these illustrate the following facts:

(2.12) *Assuming  $\phi$  refers to only one event per example...*

- a. Where  $\varphi$  is an activity:
  - (i) X is  $\varphi$ -ing  $\rightarrow$  X  $\varphi$ -ed
  - (ii) X stopped  $\varphi$ -ing  $\rightarrow$  X  $\varphi$ -ed
- b. Where  $\varphi$  is an accomplishment:
  - (i) X is  $\varphi$ -ing  $\rightarrow$  X has not  $\varphi$ -ed
  - (ii) X stopped  $\varphi$ -ing  $\rightarrow$  X has not  $\varphi$ -ed

Another test which distinguishes activities from accomplishments is to analyze their patterns of compatibility with *for* and *in* adjuncts (henceforth the *comp.for* and *comp.in* tests respectively). Activities are compatible with *for* adjuncts but not with *in* adjuncts, while accomplishments have the opposite paradigm:

(2.13) *Activities and accomplishments pattern oppositely with 'for' and 'in' adjuncts:*

- a. John walked for an hour.
- b. \*John walked in an hour.
- c. \*John painted a picture for an hour.
- d. John painted a picture in an hour.

These tests formalize our intuitions that accomplishments, which have culmination points, have not occurred unless the culmination point has occurred. Contrastively, activities can be said to have occurred immediately after they begin.

## 2.3 Achievements

Achievements intuitively describe events which are instantaneous. Sometimes they are viewed as marking the point where a state changes from obtaining to not obtaining. Verbs which are classified as achievements include *notice* and *finish*. Achievements are grammatically compatible with both *in* and *for* adjuncts, but not with the a durative sense. The result is usually a shifted reading where *in* adjuncts tend to denote a time span before the achievement occurs, and where *for* adjuncts yield

States	Activities	Accomplishments	Achievements
$\neg comp.prog.$	<i>comp.prog.</i>		
$\neg agentive$	<i>agentive</i>		
<i>durative</i>			$\neg durative$
$\neg telic$	<i>telic</i>		$\neg telic$
<i>comp.for</i>	$\neg comp.for$		? <i>comp.for</i>
$\neg comp.in$	<i>comp.in</i>		? <i>comp.in</i>

Table 2.1: A break-down of the properties of Vendler's four aspectual classes.

a sense of repeated action. For example, (2.14-a) sounds quite strange because it seems to require that John notice Mary over and over again, as if he had short-term memory problems. (2.14-b) also has a shifted reading, meaning that 5 minutes passed before John noticed Mary, rather than the durative reading where the noticing process actually took 5 minutes. This is forced because achievement verbs necessarily have no duration.

(2.14) *Achievements are exceptional with 'for' and 'in' adjuncts:*

- a. ?John noticed Mary for 5 minutes.
- b. John noticed Mary in 5 minutes.

Because achievement verbs have no duration, it is difficult to say that they can culminate. As such, constructions in which achievement constructions serve as the object of verbs like *finish* and *stop* tend to be unacceptable, unless of course you force a repetitive reading as in (2.14-a) above:

(2.15) *Achievements are incompatible as arguments to 'finish' and 'stop':*

- a. \*John finished noticing Mary.
- b. \*John stopped noticing Mary.

From all of the data above, we can organize the four aspectual classes in the manner illustrated in table 2.1.

Vendler's aspectual categories were originally meant to be a classification of verbs. However, it is clear now that the verb itself is not enough to determine aspectual class. We have already

seen that activities and accomplishments are closely related such that one can be formed from the other. We looked at examples which illustrate how e.g. the activity *run* can be transformed into an accomplishment by adding a goal, as in *run a mile* or *run to the store*. We also saw how achievements receive exceptional readings when combined with *for* adjuncts. For example, *notice Mary* is an achievement but in the special case where John has no short-term memory *notice Mary for 5 minutes* behaves essentially like an activity. States such as *(be) happy* are incompatible with the progressive marker *-ing*, but when we force the construction as in *John was being happy*, we are forced to construe *happy* is an agentive action (an activity) as if John must *act* happy.

These sorts of exceptional readings and transformations are not limited to playing with the objects and adjuncts of verbs. Aspectual class can shift with varying types of subjects as well. For example, when a mass noun or count noun is in subject position, accomplishments and achievements can be shifted to have activity readings (c.f. (Dowty, 1979)):

- (2.16)
- a. \*John discovered that quaint little village for years.
  - b. Tourists discovered that quaint little village for years.
  - c. \*A gallon of water leaked through John's ceiling for six months.
  - d. Water leaked through John's ceiling for six months.

The semantics responsible for the composition of these aspectual classes is not at issue here. For an in-depth discussion and compositional treatment of aspectual class, I refer the reader to (Dowty, 1979).

## 2.4 Why Aspectual Class is Relevant to ERI Theory

ERI Theory is a theory of tense and tense-like constructions, not aspect. So, why provide the reader with a background on aspectual class? Why introduce aspectual class at all? There are two reasons which motivate the introduction above.

The first is a matter of clarifying terminology. As I mention above, the terminology adopted in this dissertation is that of (Vendler, 1957), but there are many others. Some of the other classifi-

cations are essentially the same, but use different terms. For example, (Bach, 1980) uses the term *process* instead of *activity*, and categorizes all non-stative constructions as *events*, but otherwise sticks to an ontology just like Vendler's. (Kenny, 1963), uses *performative* instead of *accomplishment*. (Ryle, 1949) uses *achievement with an associated task* to refer to what we are calling accomplishments, and *achievement without an associated task* or *purely lucky achievement* to refer to what we are calling achievements. And then there are also classifications which utilize different ontological structures as well.

The second, and probably more important reason for introducing aspectual class, is that different aspectual classes have different temporal constraints when the same tense-like constructions are applied to them. We have already seen some interesting entailment paradigms, such as how present progressive activities entail their past forms, while present progressive accomplishments entail the negation of their past (or present perfect) forms. In a similar vein, past forms of accomplishments entail that they are no longer occurring, while past forms of activities have no such entailment:

- (2.17) a. John built a house  $\rightarrow$  The house is already built.  
b. John ran  $\nrightarrow$  John is finished running.

Atelic constructions, like states and activities, and telic constructions, like accomplishments, adopt different restrictions when used with temporal adverbials like *yesterday*. Namely, telic constructions are required to both begin and end within the adverbial's time span, while activities merely need to overlap with it. For example, *John ate a sandwich yesterday* implies that the sandwich-eating event started and ended yesterday. However, *John ate yesterday*, with the activity interpretation of *eat*, merely implies that at some point yesterday, John was involved in an eating event. It is clear from these observations that any theory of tense and tense-like constructions must be aware of aspectual class if it is to be robust.

## Chapter 3 Technicalities

### 3.1 Time and Intervals

I begin my exposition of ERI Theory with a brief discussion of time itself. This section briefly lays out some theoretical assumptions regarding time and intervals, and also introduces the notation I use to talk about them.

ERI Theory, like most tense theories, models the timeline with the set of real numbers  $\mathbb{R}$ , and the precedence relation  $<$ . Each real number corresponds to an infinitely short *moment* in time. To say that  $t_1 < t_2$ , where  $t_1$  and  $t_2$  are moments, is to say that  $t_1$  occurs earlier than  $t_2$ . The set of all moments, or the timeline itself, is denoted by the metalanguage constant  $\mathcal{T}$ .

ERI Theory refers to and manipulates time via *intervals*. An interval is a convex set of moments and can be specified in the usual interval notation. For example,  $[t_1, t_2] = \{x : t_1 \leq x \leq t_2\}$ . Intervals in ERI Theory may also be closed or open depending on whether their boundaries belong to the interval. The open counterpart to the previous example is  $(t_1, t_2) = \{x : t_1 < x < t_2\}$ . And of course we can write  $[t_1, t_2)$ , and  $(t_1, t_2]$  as well. In ERI Theory, no linguistic expression ever denotes a moment. If something seems to denote a moment, it is actually considered to denote a singleton interval, which is an interval containing exactly one moment (e.g.  $[t_1, t_1]$ ). This is more of a technical convenience than anything else. The set of all intervals is denoted by the metalanguage constant  $\mathcal{I}$ . For convenience, I also use a few other short-hand notational conventions, which are summarized below:

$X_0$  , for any interval  $X$ , denotes the lower bound of  $X$ . For closed intervals, this is the earliest (initial) moment in  $X$ .

$X_f$  , for any interval  $X$ , denotes the upper bound of  $X$ . For closed intervals, this is the latest (final) moment in  $X$ .

$X_+$  , for any interval  $X$ , denotes the set  $\{t : t \in X \vee (\forall t' \in X) t > t'\}$ ; the interval obtained by extending  $X$  to include all subsequent moments.

$X_-$  , for any interval  $X$ , denotes the set  $\{t : t \in X \vee (\forall t' \in X) t < t'\}$ ; the interval obtained by extending  $X$  to include all prior moments.

## 3.2 Context and Indices

Many temporal expressions are context sensitive. These sorts of expressions include the tense morphemes themselves (PAST, PRES, FUT), as well as myriad other examples (*now*, *yesterday*, *to days ago*, etc.) What these sorts of expressions denote is dependent on, particularly, when they are said, and possibly other parameters as well. Questions like “When was this token said?”, “Where was this token said?”, and “What standards of precision are being applied to this token?”, are answered by referring to the context.

ERI Theory uses the metalanguage constant  $\mathcal{C}$  to denote the set of all possible contexts. ERI Theory models contexts as  $n$ -tuples of values. Exactly what  $n$  is, and exactly what sorts of values some of the elements of such a tuple are, is an involved and complicated question which I plan on avoiding here. Fortunately, *some* of the elements of context tuples, including all of those in which ERI Theory is interested, *are* fairly easily modeled. As the theoretical ordering of such elements within a context tuple is completely arbitrary and, to me, completely uninteresting, I shall refer to certain privileged contextual elements via particular letter subscripts on context variables. Given a context variable  $c \in \mathcal{C}$ , some of the specific letters I use to pick out contextual elements are listed below, others will be introduced as they become necessary.

(3.1) *Names of some contextual elements:*

- a.  $c_A$  denotes the agent of context.
- b.  $c_L$  denotes the listener of context.
- c.  $c_S$  denotes the time (interval) of context.
- d.  $c_P$  denotes the position/location of context.

- e.  $c_W$  denotes the possible world of context (the actual world from the point of view of the agent).

The critical property (for our purposes) of a complete sentence in context is whether it is true in that context. However, a sentence which is part of a larger linguistic construction in context might not satisfy the same condition. For example, in the sentence “John thinks Mary is a witch,” the truth value of “Mary is a witch” is unimportant insofar as the compositional construction of the sentence as a whole is concerned. What is important is whether “Mary is a witch” is compatible with John’s thoughts. Thus, in a sense, “Mary is a witch” must be evaluated relative to a number of contexts. The usual method of formalizing this involves quantifying over the world parameter of context, looking at those worlds which are compatible with John’s thoughts, and accepting the construction just in case all those worlds are worlds in which Mary is a witch.

But as (Lewis, 1981) notes, those circumstances in which we are evaluating “Mary is a witch” are not at all guaranteed to be possible contexts. Some of the worlds that are being quantified over are certainly worlds in which “Mary is a witch” is never uttered, nor written, nor communicated in any way, ever, by anyone. And thus these worlds are worlds in which there is no possible context for the sentence “Mary is a witch.” Nevertheless, Mary is certainly a witch in some of these worlds. But if the truth of a sentence is contingent on the *context* in which it is evaluated, we run into a problem here, as in some of these worlds which we need to include in our domain of quantification, there *is* no context relative to which we can evaluate the sentence. Lewis approaches this problem by making an ontological distinction between contexts and *indices*.

If a context  $c \in \mathcal{C}$  is an  $n$ -tuple of the form  $\langle x_1 \in X_1, \dots, x_n \in X_n \rangle$ , then I define an index to be any member of the set  $X_1 \times \dots \times X_n = \mathcal{X}$ . In other words if  $\mathcal{X}$  is the space of values of context-type  $n$ -tuples, then an index is any given coordinate in that space. A context then, is just a coordinate which is possible. Thus all contexts are indices ( $\mathcal{C} \subset \mathcal{X}$ ), but not vice versa. Now, this is not exactly the definition that Lewis proposed. Lewis was clear in suggesting that an index is a tuple composed only of those elements of context which are shifted (or quantified over) by linguistic operators. Contexts are not generally *shiftable*. That is, given a context, it is not guaranteed that

one can arrive at another context by modifying exactly one of its elements. Indices however, being only a coordinate in context space, are generally shiftable. So, I suppose the rationale is, if we are defining these things called indices whose main virtue is that the set is closed under shifting, then what is the point in including in indices items which are never shifted in language? Fair enough, but it is difficult to surely claim that any given contextual element is never shifted by language. In a manner of speaking, the task of identifying a given element as shiftable in language is undecidable; if you find a language that quantifies over it, you can say ‘yes’, but one can never really say ‘no’, because there are always more languages to check. For example, (Kaplan, 1989) claims with an air of certainty that the agent of a context (that which *I* denotes), never gets quantified over (in his terms, that *I* is *directly referential*), but (Schlenker, 2003) provides evidence from Amharic that it actually does. Furthermore, Schlenker also provides examples which demonstrate that some elements of context which have not traditionally been viewed as targets of quantification, such as standards of measurement, may also be quantified over:

(3.2) *Evidence that measurement standards may be targets of quantification (Schlenker, 2003, p. 97):*

- a. #John’s height is 1.5m and he is thus short, and rather unhappy. But if he were the same height but were tall, he would be much happier.
- b. John’s height is 1.5m and he is thus short. But although his mother knows his real height she thinks he is tall.

In fact, Schlenker’s main thesis is that no element of context is safe from quantification, that contexts in general, are targets of quantification. I do not want to make any claims on whether languages actually quantify over contexts or not. ERI Theory can be integrated into either type of semantic system, since ERI Theory will only touch the world and temporal elements of a context (or index).

So, for the purposes of presenting ERI Theory, I will stick to a more expressive interpretation of indices, in which the dimensionalities of contexts and indices are equivalent, and thus in which,

it makes sense to assert an identity relationship between a context and an index.

If the principle of compositionality is to be preserved, then we arrive at one of Lewis’s main theses, that an adequate semantic treatment requires a notion of truth of a sentence given a context *and* index (my wording). In the metalanguage, I denote the semantic value (denotation) of an arbitrary linguistic constituent  $\varphi$ , at context  $c \in \mathcal{C}$  at index  $i \in \mathcal{X}$  (and relative to a variable assignment function  $g$ ) in the following manner:

$$[[\varphi]]^{c,i,g}$$

and define truth of a (complete) sentence  $\psi$  like so:

(3.3) *Definition of sentential truth:*

A sentence  $\psi$  in context  $c$  is true iff, given any assignment function  $g$ ,  $[[\psi]]^{c,c,g} = 1$ .

That is, a sentence is true iff its denotation relative to context  $c$  and (an identical) index  $c$  is 1.

### 3.3 Semantic Rules and Types

Like most modern semantic theories, ERI Theory is based on a process of interpreting the logical form (LF) of a sentence via the recursive application of compositional rules. The bread and butter of most compositional semantic theories seems to be the semantic rule duo of predicate modification and function application (and I suppose a percolation rule which defines a constituent’s denotation as that of its only child just in case it has exactly one child).

Supposing a local syntactic tree of the form:



predicate modification applies just in case  $B$  and  $C$  both denote sets of the same sort of thing, and results in defining the denotation of  $A$  as the intersection of these sets. Function application

applies just in case one of the children denotes a function, and the other denotes something in that function's domain. But these rule application conditions are defined in terms of this concept of the *type* of the denotation of a constituent. Thus, to make sense of these sorts of definitions, we must first define what it means for a constituent to denote something of a certain type, what these types are, and what the conventions in the metalanguage are which keep track of such things.

Let's start with defining the set of semantic types. It's a relatively simple task, I do it recursively in (3.4):

(3.4) *Recursive definition of semantic types:*

- $e$  is a type.
- $t$  is a type.
- If  $\alpha$  is a type and  $\beta$  is a type, then  $\langle \alpha, \beta \rangle$  is a type.
- If  $\alpha$  is a type, then  $\langle s, \alpha \rangle$  is a type.

A semantic type labels a class of linguistic denotations. I use  $\tau$  to denote that function which maps a given valid semantic type into classes of denotations (the type interpretation function). In terms of  $\tau$ , to say that a denotation is of a given type  $\alpha$ , is to say that the denotation is a member of the set  $\tau(\alpha)$ . Thus, if we define  $\tau$ , we also define the denotation class any valid type labels. As with the types themselves,  $\tau$  can be defined in a recursive manner:

(3.5) *Recursive definition of the semantic type interpretation function  $\tau$ :*

- a.  $\tau(e) = U$  (the set of all individuals).
- b.  $\tau(t) = T = \{0, 1\}$  (the set of truth values).
- c. If  $\alpha$  and  $\beta$  are types, then  $\tau(\langle \alpha, \beta \rangle) = \tau(\beta)^{\tau(\alpha)}$ .
- d. If  $\alpha$  is a type, then  $\tau(\langle s, \alpha \rangle) = \tau(\alpha)^{\mathcal{X}}$

(3.5-a) states that denotations of type  $e$  are members of  $U$ , the set of individuals. (3.5-b) states that denotations of type  $t$  are members of  $T$ , the set of truth values  $\{0, 1\}$ . (3.5-c) states that a denotation of type  $\langle \alpha, \beta \rangle$  is a member of the set of functions which map things in  $\tau(\alpha)$  into things

in  $\tau(\beta)$ . In other words,  $\langle \alpha, \beta \rangle$ -type denotations are functions from  $\alpha$ -type things to  $\beta$ -type things. Lastly, (3.5-d) states that denotations of type  $\langle s, \alpha \rangle$  are functions which map *indices* into the set of  $\alpha$ -type denotations.

Now that we have a collection of types and a function  $\tau$  which interprets what they mean, we can put them to work. We can begin by defining function application and predicate modification. Both of the semantic rule definitions below contribute to the definition of  $\llbracket A \rrbracket^{c,i,g}$ , given a local tree of the following structure:



(3.6) *Definition of (extensional) function application:*

- For any types  $\alpha$  and  $\beta$ , if  $\llbracket B \rrbracket^{c,i,g} \in \tau(\langle \alpha, \beta \rangle)$  and  $\llbracket C \rrbracket^{c,i,g} \in \tau(\alpha)$ , then  $\llbracket A \rrbracket^{c,i,g} = \llbracket B \rrbracket^{c,i,g} (\llbracket C \rrbracket^{c,i,g})$ .
- For any types  $\alpha$  and  $\beta$ , if  $\llbracket C \rrbracket^{c,i,g} \in \tau(\langle \alpha, \beta \rangle)$  and  $\llbracket B \rrbracket^{c,i,g} \in \tau(\alpha)$ , then  $\llbracket A \rrbracket^{c,i,g} = \llbracket C \rrbracket^{c,i,g} (\llbracket B \rrbracket^{c,i,g})$ .

(3.7) *Definition of predicate modification:*

- For any type  $\alpha$ , if  $\llbracket B \rrbracket^{c,i,g} \in \tau(\langle \alpha, t \rangle)$  and  $\llbracket C \rrbracket^{c,i,g} \in \tau(\langle \alpha, t \rangle)$ , then  $\llbracket A \rrbracket^{c,i,g} = \lambda x. \llbracket B \rrbracket^{c,i,g} (x) = 1 \wedge \llbracket C \rrbracket^{c,i,g} (x) = 1$ .

We will also need to define one more type of function application. This semantic rule is analogous to the intensional function application rules in other formalisms. Rules of this nature usually construct a lambda abstraction of the argument of the function so that the content of the function-denoting constituent can evaluate its argument relative to an arbitrary world. In ERI Theory, we need to quantify over more than worlds. Specifically, we need to quantify over the temporal index elements, of which ERI Theory assumes there are more than one. So, I make the strategic decision to redefine intensions as functions whose domain is the set of *indices* rather than the set of worlds, and define the intensional function application rule in the following way:

(3.8) *Definition of (intensional) function application rule:*

- For any types  $\alpha$  and  $\beta$ , if  $[[B]]^{c,i,g} \in \tau(\langle\langle s, \alpha \rangle, \beta \rangle)$  and  $[[C]]^{c,i,g} \in \tau(\alpha)$ , then  $[[A]]^{c,i,g} = [[B]]^{c,i,g} (\lambda x. [[C]]^{c,x,g})$ .
- For any types  $\alpha$  and  $\beta$ , if  $[[C]]^{c,i,g} \in \tau(\langle\langle s, \alpha \rangle, \beta \rangle)$  and  $[[B]]^{c,i,g} \in \tau(\alpha)$ , then  $[[A]]^{c,i,g} = [[C]]^{c,i,g} (\lambda x. [[B]]^{c,x,g})$ .

Now that we understand what it means for a constituent to denote something of a given type, we need to define our metalanguage conventions for stipulating such facts. The metalanguage I employ here is quite loose. I will routinely use plain English in the metalanguage to summarize truth conditions which ERI Theory is not interested in analyzing. Of course I also employ a variety of mathematical and logical notations, which I summarize below:

(3.9) *Other formal notations utilized in the metalanguage:*

- *Logical Connectives:*  $\wedge, \vee, \neg, \rightarrow, \leftrightarrow$
- *Variables:* English and Greek, lowercase and capital letters, possibly including alphanumeric subscripts and/or superscripts and prime (') marks. The interpretation function is  $g$ .
- *Functions:* Functions are denoted in a typed lambda notation. A function taking an argument it binds to a variable  $x$ , and whose domain is  $\tau(\alpha)$ , is denoted by  $\lambda x_\alpha \dots x \dots$
- *Function Modification:*  $f[x \rightarrow y]$  denotes the function:

$$\lambda a. \begin{cases} y & , \text{ where } a = x \\ f(a) & , \text{ otherwise} \end{cases}$$

- *Index Modification:* Similar to function modification, but in terms of indices. For any index  $i$ , let  $i[x \rightarrow y]$  denote the index  $j$  s.t.  $j_x = y$  and  $(\forall a \neq x) j_a = i_a$ .

### 3.4 The Temporal Elements of Context

In section 3.2, I introduce the usual temporal context element  $c_S$ , and specifically define it to be a time interval rather than the usual vague notion of context or speech *time*. ERI Theory actually hypothesizes the existence of two critical temporal elements of context:  $c_S$  and  $c_R$ , which I may informally refer to henceforth as simply  $S$  and  $R$  for convenience.  $S$  and  $R$  are analogous to the *point of speech* and *point of reference* introduced by Reichenbach (1947) and used in numerous other theories based thereon, such as (Hornstein, 1990) and (Nerbonne, 1984). I refer to  $S$  as the *evaluation interval*, and to  $R$  as the *event restriction interval*, after which the theory is named.  $S$  and  $R$  never refer to specific moments, though singleton and empty intervals are perfectly acceptable.

$S$  will most often and by default refer to a singleton interval containing a moment which is in some way anchored to the speech time. The details of the anchoring process are not very important. Despite how  $S$  is usually set, I intentionally avoid the term *speech* in the name of  $S$  because there are cases in which  $S$  might not refer to the speech time. One possible example of this is the historical present tense, e.g. “Yesterday I go to the store and John is there. He tells me ...” Another example of  $S$  not anchoring to speech time would be those cases in which operators quantify over  $S$ , or cases involving operators whose scope is evaluated relative to a different  $S$ .

$R$  restricts when events may occur for statements about them to be true.  $R$  differs from Reichenbach’s point of reference in a number of key ways. First and foremost, Reichenbach’s point of reference is a specific time, or moment in our terminology, whereas  $R$  is an interval. Second, Reichenbachian theories allow events to occur before, during, or after the point of reference depending on the tense of the sentence, whereas ERI Theory stipulates that events always must occur within  $R$  (in English). That is, the interval over which an event occurs must be a subset of  $R$ , otherwise the statement is false. Rather than various linguistic constructions defining relationships between the event time and reference time, ERI Theory treats these linguistic constructions as operating on  $R$  (or its index counterpart), to yield an event restriction interval which defines temporal boundaries of the event. The details of how this occurs is explained in section 3.5 below.

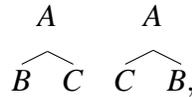
Unless another interval of evaluation is provided by the context, such as in the case of the historical present narrative style, we anchor  $S$  to the speech time by default. Similarly, unless there is a particular event restriction interval provided by context (and sometimes there are), we let  $R = \mathcal{T}$ , which is the set of all moments—the least restrictive event restriction interval possible.

### 3.5 $R$ -modification

I refer to constructions which operate on  $R$  as  $R$ -modifiers. There are two types of  $R$  modifiers, which I refer to as *extensional*  $R$ -modifiers and *intensional*  $R$ -modifiers. Extensional  $R$ -modifiers are constructions which themselves denote time intervals. Temporal adverbials like *yesterday* and *before 5 o'clock* are examples of this class, as well as the three basic tense morphemes *PAST*, *PRES*, and *FUT*.  $R$ -modifiers of this type operate on  $R$  via an ERI Theory-specific semantic rule called  $R$ -modification.  $R$ -modification is defined as follows.

(3.10) *Definition of  $R$ -modification:*

- Given a local syntactic tree of one of the following forms:



If  $C$  is an extensional  $R$ -modifier, then

$$\llbracket A \rrbracket^{c,i,g} = \llbracket B \rrbracket^{c,i} [R \rightarrow i_R \cap \llbracket C \rrbracket^{c,i,g}]_g .$$

$R$ -modification is a temporal extension to the predicate modification rules that exist in many compositional semantic theories. At the basic level, temporal adverbials and basic tense morphemes simply result in intersective modification of  $R$ , which has the effect of generating a localized temporal index for the constituents which the  $R$ -modifier c-commands.

Intensional  $R$ -modifiers modify  $R$  (and sometimes  $S$ ) in unique ways which depend specifically on the  $R$ -modifier. These are implemented with functions which explicitly evaluate their arguments

relative to modified indices. Among the intensional  $R$ -modifiers is the perfect morpheme  $PERF$ . ERI Theory defines the perfect morpheme as follows:

(3.11) *Denotation of PERF:*

$$\text{a. } \llbracket \text{PERF} \rrbracket^{c,i,g} = \lambda \varphi_{\langle s, \langle e, t \rangle \rangle} . \lambda x_e . (\exists I \in \mathcal{I}) I \subseteq i_R \wedge \varphi(i[R \rightarrow I_-])(x).$$

Recalling that  $I_-$  denotes the interval which includes all moments of  $I$  as well as all moments prior to  $I$ , we can summarize the formal definition above by saying that the perfect morpheme modifies  $R$  by extending it to include all prior moments.

For convenience and reference, I summarize the basic  $R$ -modifiers discussed so far and their denotations below, most of which I expect to be quite intuitive:

(3.12) *Summary of basic R-modifiers:*

- $\llbracket \text{PAST} \rrbracket^{c,i,g} = \{t : t < i_{S_0}\}.$
- $\llbracket \text{PRES} \rrbracket^{c,i,g} = i_S.$
- $\llbracket \text{FUT} \rrbracket^{c,i,g} = \{t : t > i_{S_f}\}.$
- $\llbracket \text{PERF} \rrbracket^{c,i,g} = \lambda \varphi_{\langle s, \langle e, t \rangle \rangle} . \lambda x_e . (\exists I \in \mathcal{I}) I \subseteq i_R \wedge \varphi(i[R \rightarrow I_-])(x).$
- $\llbracket \text{yesterday} \rrbracket^{c,i,g} = \text{the day immediately prior to the day in which } c_S \text{ occurs.}$
- $\llbracket \text{before 5 o'clock} \rrbracket^{c,i,g} = \{t : t < \llbracket \text{5 o'clock} \rrbracket^{c,i,g}_0\}.$

## 3.6 The Semantics of the Verb

Verbs, in ERI Theory, describe *events*, and assert the existence of intervals over which they occur. The term *event*, in ERI Theory, is the real world manifestation of any and every type of aspectual class that verbs (or the predicates that result from saturating verbs with arguments) might belong to. Note that this terminology differs with how many others use *event*, which is often in contrast to states.

Built into all English verbs is a sensitivity to the index element  $i_R$ , specifically, a condition that the interval over which the described event occurs must be subsumed by it. For example, we might

write the content of the transitive verb *eat* as follows:

(3.13) *Denotation of transitive ‘eat’:*

$$[[\text{eat}]]^{c,i,g} = \begin{cases} \lambda y_e. \lambda x_e. (\exists I \in \mathcal{I}) x \text{ eats } y \text{ over } I \text{ and } I \subseteq i_R, & \text{if } i_R \neq \emptyset \\ \text{undefined,} & \text{otherwise} \end{cases}.$$

I use the metalanguage paraphrasing “*x eats y over I*” to stipulate that the event’s duration is exactly that of *I*, and that the event begins at  $I_0$  and ends at  $I_f$ . Because events are stipulated to start and end at specific moments, any interval over which an event occurs must be a closed interval. It is also important to note that, though I talk about events and their duration, ERI Theory never directly deals with events, or event variables, and therefore does not commit itself to any particular formal treatment of them.

Achievement-type (i.e. non-durative, telic) predicates are a little tricky, because given an achievement and any particular moment, it is either the case that the achievement has already happened or has not happened yet; it is never the case that the achievement is *happening*. So, we will run into problems with a naïve application of the rules stated thus far, since achievements lack duration, which is another way of stating that they occur over the null interval, which is a subset of all sets, which leads to the ridiculous conclusion that achievements are immune to temporal restrictions. To get around this theory-internal hurdle, ERI Theory adopts the convention of stipulating that achievements occur over singleton intervals, where the unique moment belonging to such an interval is the earliest moment at which it is the case that the achievement has occurred. For example, *John won the race* describes a *john-winning-the-race* event which occurs over the interval  $[t_1, t_1]$  such that  $[[\textit{John has won the race}]]^{c,i[S \rightarrow t_1, R \rightarrow c_R],g} = 1$  and  $(\forall t < t_1) [[\textit{John has won the race}]]^{c,i[S \rightarrow t, R \rightarrow c_R],g} = 0$ . Of course, there is also the restriction that in all of these expressions “the race” refers to the same contextually relevant race, but this restriction should be taken care of automatically, since the definition evaluates both sentences relative to the same context.

The content of a verb is undefined if it is evaluated relative to a null event restriction interval. This is designed to make a distinction between constructions which are false and constructions

which are unacceptable. I defer my discussion on null event restriction intervals to section 4.3, after I provide concrete examples of the event restriction interval being manipulated by *R*-modifiers. I expect that a discussion on null event restriction intervals will be clearer at that time.

At this point, with the above concepts in this chapter introduced and clarified, we are finally ready to analyze some example sentences with basic temporal components. Chapter 4 presents some such examples to demonstrate ERI Theory as it has been constructed thus far. Chapter 4 then concludes with some final notes concerning critical syntactic considerations.

## Chapter 4 Tense in Independent Clauses

The framework laid down in chapter 3 allows us to start analyzing some simple examples right away. In this chapter, we will look at example sentences which contain at most one clause (and therefore one tense morpheme), any number of temporal adverbial phrases, and possibly the perfect aspect morpheme. Applying ERI Theory to these less-complicated examples first will help illustrate what up until this point has merely been a set of formal definitions and assertions.

To help illustrate ERI Theory, I employ a new notation which illustrates the LF of a sentence, as well as the event restriction interval  $i_R$  relative to which each node is being evaluated. Tree structures have node labels of the form “NodeLabel :  $R$ ” where *NodeLabel* is the syntactic category of the node (e.g. *VP*), and  $R = i_R$  is the event restriction interval relative to which that constituent is being evaluated. For example, a subtree of the form:



indicates that  $A$  is semantically evaluated relative to the event restriction interval  $R$ . Additionally, I draw the reader’s attention the syntactic nodes at which  $R$  modification occurs, by drawing a box around those constituents. Also, the value of  $R$  is not indicated for constituents whose content does not depend on the value of  $R$ . All of the example sentences in this section are assumed to have been uttered in a context in which  $c_R = \mathcal{T}$ , which is the default case. For now,  $i_S$  can be assumed to always anchor to the speech time. Thus,  $i_S = c_S$  in these examples. In the more complicated examples further below however,  $i_S$  is no more immune to manipulation than  $i_R$  is.

### 4.1 The Basic Tense Morphemes

Let’s begin by evaluating a very basic case: “John built a house.” Figure 4.1 illustrates the logical form of this sentence. The box around the VP indicates that it has undergone  $R$ -modification.

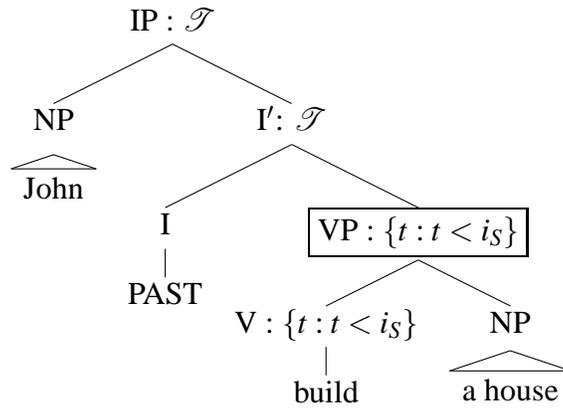


Figure 4.1: The logical form of the sentence, “John built a house.” The value of the event restriction interval has been indicated in the node labels. Nodes which have undergone  $R$ -modification are boxed.

Recall that  $R$ -modification is triggered in a local tree when one of the children is an extensional  $R$ -modifier. In this case the local tree under the  $I'$  node is triggered due to the PAST morpheme. By definition of the  $R$ -modification rule, the content of the VP constituent is  $[[\text{build a house}]]^{c, i[R \rightarrow \mathcal{T} \cap \{t : t < i_S\}], g}$ . Note how the VP constituent is evaluated relative to a set of indices other than than the IP as a whole. These new contextual indices are represented graphically in the figure. Notice the modified  $R$  relative to which the verb *build* is being evaluated.

Given this event restriction interval, the content of the verb *build* can be represented as follows:

(4.1) *The denotation of ‘build’ in ‘John builds a house’:*

$$[[\text{build}]]^{c, i[R \rightarrow \{t : t < i_S\}], g} = \lambda y_e. \lambda x_e. (\exists I \in \mathcal{I}) x \text{ builds } y \text{ over } I \text{ and } I \subseteq \{t : t < i_S\}.$$

In other words, the building event must occur over an interval which is a subset of the past moments. This is exactly the right reading. At this point, we can see that sentences involving the present and future tense morphemes have a very similar structure, and would also yield correct interpretations.

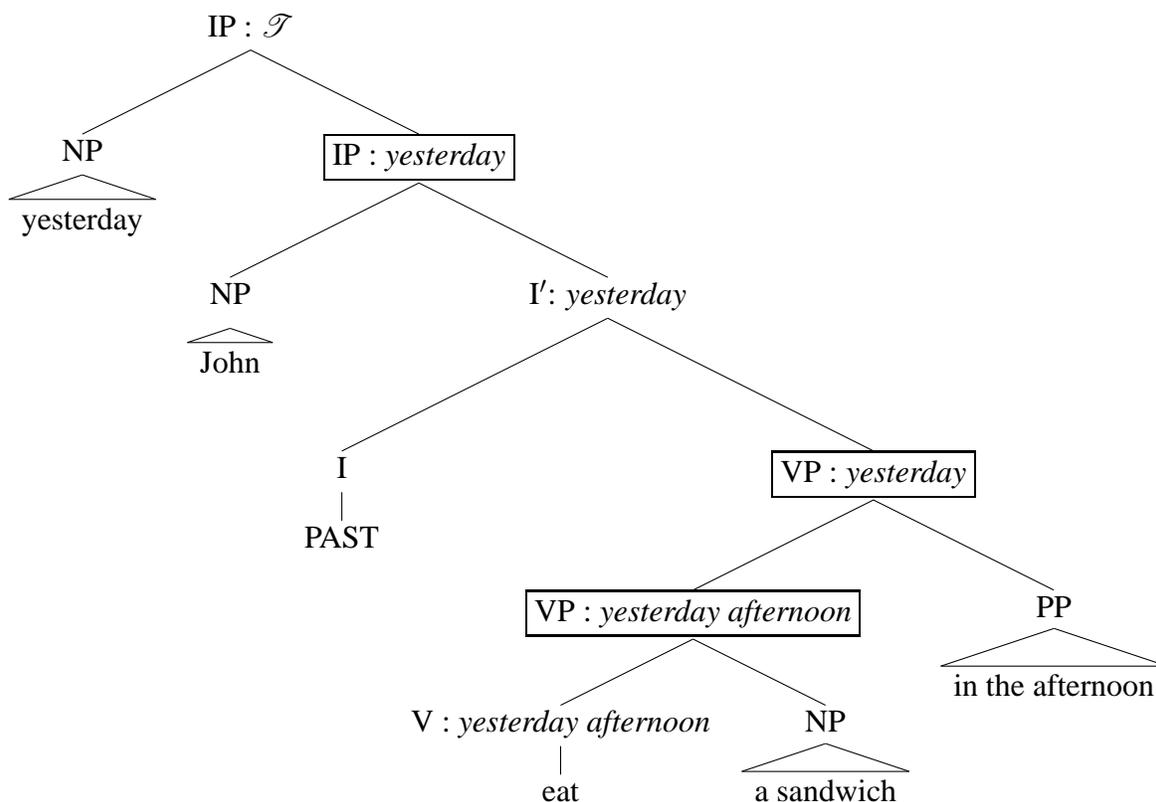


Figure 4.2: The logical form of the sentence: “Yesterday, John ate a sandwich in the afternoon.” The constituents are evaluated relative to an event restriction interval value which is indicated in their node labels. Boxes represent nodes at which *R*-modification takes place. Intervals written in English (e.g. *yesterday*) can be interpreted as shorthand for the corresponding intervals one would expect. For example, *yesterday* is shorthand for *the day prior to that day in which  $c_S$  occurs*.

## 4.2 Temporal Adverbials

Temporal adverbials, like basic tense morphemes, are extensional *R*-modifiers. As such, they behave formally in the very same way that the basic tense morphemes do. The difference between temporal adverbials and tense morphemes is merely one of syntax. Semantically though, both types of constituent merely denote intervals.

Figure 4.2 provides an example sentence containing temporal adverbials. There are a few things to note about figure 4.2. First, the figure demonstrates adverbials in both the pre-sentential position as well as the verb adjunct position. Second, note that the past tense morpheme has no

actual effect in this example. *R*-modification is still triggered by the past tense morpheme but it results in the intersection of the current *R* (*yesterday*) with a superset (*the past moments*). The reading represented in figure 4.2 asserts that the sandwich-eating event took place over an interval which is a subset of the *yesterday afternoon* interval, meaning the sandwich was both started and completed yesterday afternoon. This, again, is the desired reading.

### 4.3 Null Event Restriction Intervals

In section 3.6, I state that the content of a verb is undefined if the event restriction interval relative to which it is being evaluated is the null set  $\emptyset$ . In this section, I discuss why this is the case and provide examples in defense of this claim.

Null event restriction intervals are ERI Theory's method of dealing with temporal adverbial agreement. It has long been recognized that adverbs in English must agree both with each other as well as the tense morpheme. That is, if a past tense morpheme is used, then only "past" adverbials are allowed. If a future tense morpheme is used, then only "future" adverbials are allowed. Failure to abide by these rules results in infelicitous sentences such as "\*John ate grapes tomorrow," and "\*John will eat grapes yesterday," and "\*Yesterday, John will eat grapes today."

It is not just the case that these sentences are false, they are unacceptable. Different theories formalize this observation in different ways. For example (Hornstein, 1990) defines a rule called the *CDTS* (constraint on derived tense structures), which places restrictions on the types of relationships elements may have in tense structures. (Enç, 1981) deals with such cases by positing semantic rules which are explicitly undefined if the times which temporal adverbials denote do not overlap.

One of the nicer things about ERI Theory is that no extra equipment needs to be added in order to deal with these sorts of observations. ERI Theory is already set up to flag these cases as exceptional; these cases occur exactly when the event restriction interval relative to which the verb is being evaluated is the null set  $\emptyset$ . See figure 4.3 for an example of how this turns out to

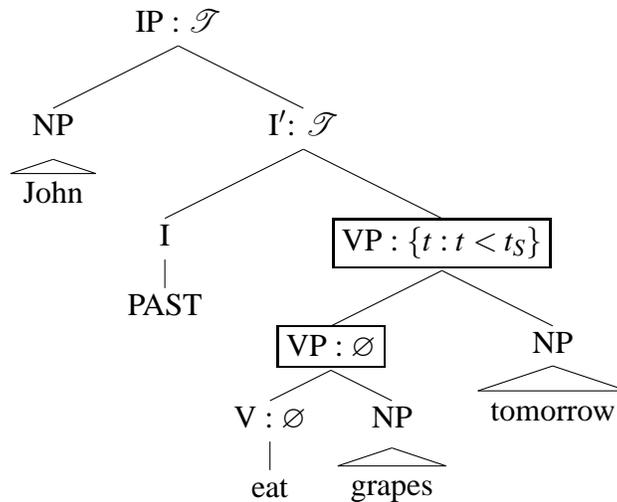


Figure 4.3: Tree representation of the sentence, “\*John ate grapes tomorrow.” The past tense morpheme and the adverbial *tomorrow* intersect to yield the empty set  $\emptyset$ . Evaluating the verb relative to this event restriction interval results in the verb not denoting.

be the case. The only extra thing that needs to be a part of the theory is an intuitive interpretation of a null event restriction interval as a bad thing; all events take place over time, so no event could ever take place over the empty interval. That an event can occur over the empty interval is a contradiction, which is exactly what sentences like “\*John ate grapes tomorrow” sound like. But note that “\*John ate grapes tomorrow” is not merely a contradiction. If it were a contradiction, then “\*It is not the case that John ate grapes tomorrow” would be a tautology, but it isn’t. This sentence is still unacceptable. Verbs only have content when evaluated relative to a non-null event restriction interval. If evaluated relative to a null event restriction interval, it is not the case that the (satisfied) verb trivially denotes falsity. Rather, it does not denote at all.

## 4.4 The Perfect

The perfect morpheme is an *intensional R*-modifier, which means rather than simply denoting an interval and triggering *R*-modification, it denotes a function which operates on the temporal index

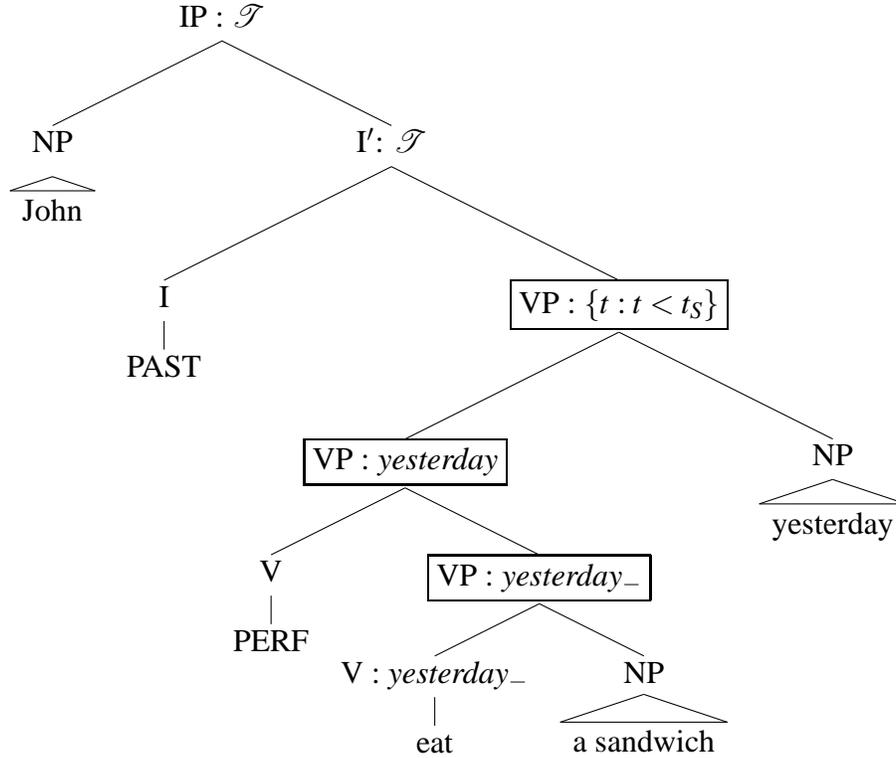


Figure 4.4: Logical form of the sentence: “John had eaten a sandwich yesterday.” The event restriction interval relative to which constituents are evaluated is indicated in the node label. Boxed nodes indicate that *R*-modification has occurred.

elements of its argument. Recall that the content of PERF is

$$\llbracket \text{PERF} \rrbracket^{c,i,g} = \lambda \varphi_{\langle s, \langle e, t \rangle \rangle} . \lambda x_e . (\exists I \in \mathcal{I}) I \subseteq i_R \wedge \varphi(i[R \rightarrow I_-])(x).$$

Which essentially means that PERF extends the event restriction interval of its argument indefinitely into the past. Figure 4.4 demonstrates the perfect morpheme in action.

When one works through the series of *R*-modifications in figure 4.4, she will see that the verb in this case is evaluated relative to the event restriction interval *yesterday\_*, which is the interval containing all the moments of yesterday as well as all the moments prior. This is the desired reading; “John had eaten a sandwich yesterday” is true if John ate the sandwich yesterday as well as if he ate it the day before. But there is more to say here.

There are two interesting observations that I would like to make regarding the use of the per-

fect in English. First, many have a strong intuition that, in sentences involving a perfect morpheme, pre-sentential adverbials (sometimes called “frame adverbials”) modify the reference time (in Reichenbachian terms), while sentence-final, or VP adverbials modify the event time (again, in Reichenbachian terms). That is, a sentence like “John had eaten a sandwich yesterday” means that John actually ate the sandwich yesterday, not before, and a sentence like “Yesterday, John had eaten a sandwich”, means that John either ate the sandwich yesterday, or prior to yesterday. This observation is made an explicit part of e.g. Hornstein’s (1990) theory. While I don’t agree that “John had eaten a sandwich yesterday” is false if he ate it the day before, I do recognize that there is a strong bias toward this interpretation.

Another interesting observation is that past adverbials are not acceptable in present perfect sentences. For example, “\*Yesterday, I have eaten a sandwich” and “\*I have eaten a sandwich yesterday” are both unacceptable constructions. At first it seems strange that present perfect sentences, which can describe past events, cannot include past adverbials. However, careful examination of the syntax at LF will reveal why both of these observations are the case. Figure 4.5 displays the basic structure of a sentence with a perfect morpheme. The valid syntactic positions where adverbials may be inserted are marked with labels of the form  $ADV_n$ , where  $n$  is a positive integer. By studying figure 4.5, we see that sentential adverbials correspond to the  $ADV_1$  position, and that VP adverbials may correspond to either the  $ADV_2$  position or the  $ADV_3$  position. The syntactic structure forces  $R$ -modification to occur in a predictable order. This order is given below:

$$ADV_1 \rightarrow \textit{tense/infl} \rightarrow ADV_2 \rightarrow \textit{PERF} \rightarrow ADV_3.$$

With this ordering in mind, let’s revisit the first observation I state above, that sentential adverbials seem to modify a reference time while VP adverbials seem to modify the event time, or in non-Reichenbachian terms, that sentential adverbials do not specify an exact event time, while VP adverbials do seem to (or at least have readings where this is prominent). First of all, note that the reference-time readings correspond to adverbials triggering  $R$ -modification *before* the perfect morpheme, and event-time readings corresponding to adverbials triggering  $R$ -modification *after* the perfect morpheme. This is the case because the perfect morpheme extends  $R$ , while adver-

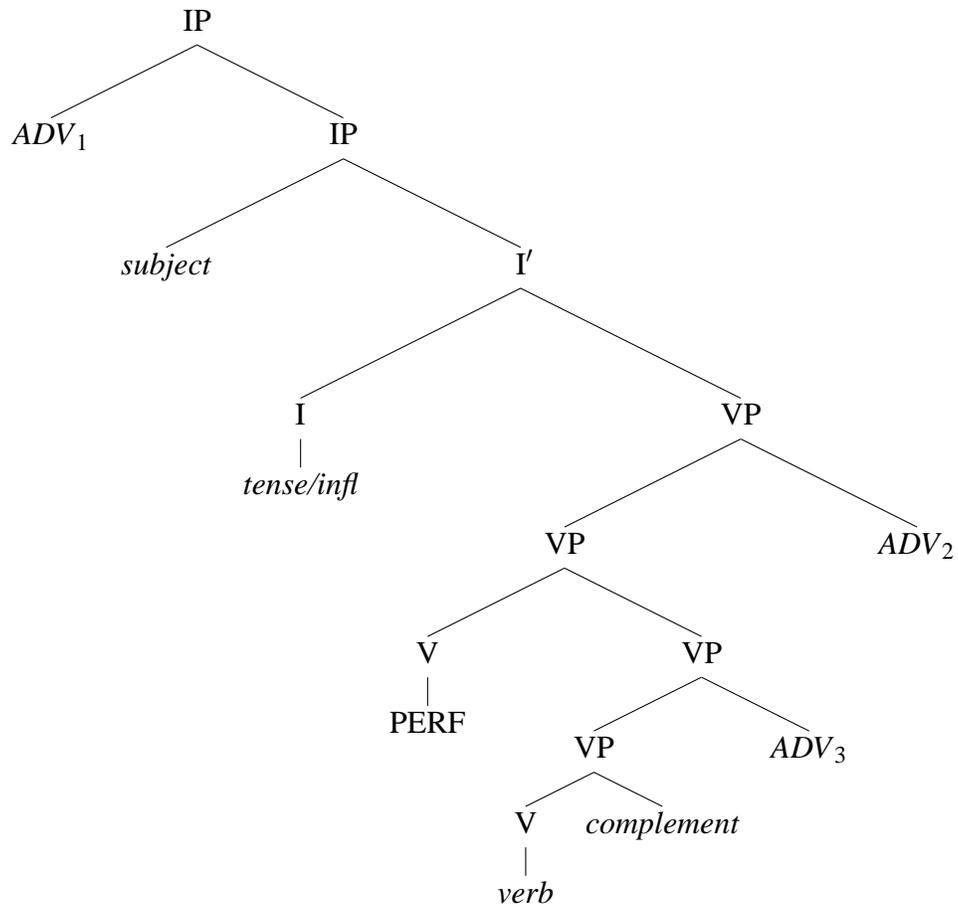


Figure 4.5: A skeleton structure for an English sentence with a perfect morpheme. Valid locations for temporal adverbials are marked with labels of the form  $ADV_n$ , where  $n$  is a positive integer.

bials intersect  $R$ . Sentential adverbials occur in the  $ADV_1$  position, which always triggers before the perfect morpheme. This is why sentential adverbials result in reference-time readings. VP adverbials, however, are syntactically ambiguous between the  $ADV_2$  and  $ADV_3$  positions.  $ADV_2$  triggers before the perfect morpheme, and  $ADV_3$  triggers after the perfect morpheme. So, some people (like me) interpret VP adverbials as reference-time adverbials, because when parsing such sentences, they place VP adverbials in the  $ADV_2$  position. Other people interpret VP adverbials as event-time adverbials because they assign VP adverbials to the  $ADV_3$  position.

Similar syntactic arguments can explain the phenomenon with the present perfect as well. To restate the observation, present perfect sentences seem to be incompatible with past adverbials (in English), despite their ability to describe past events. The critical property to note about present perfect sentences is that adverbials in positions  $ADV_1$  and  $ADV_2$  are intersected with the interval denoted by the tense morpheme, which is normally a singleton interval containing the speech time. Hence, an adverbial in one of these positions which does not overlap with the speech time results in  $R$  being set to the null interval  $\emptyset$ . As I state in section 3.6, the semantic content of the verb is undefined when evaluated relative to a null event restriction interval. This explains the unacceptability of past adverbials in the  $ADV_1$  and  $ADV_2$  positions, but what about  $ADV_3$ ? A past tense adverbial should be acceptable in the  $ADV_3$  position of a present perfect sentence. Semantically speaking, it is, but there are a couple factors which contribute to the unacceptability of such constructions.

One factor working against temporal adverbs in the  $ADV_3$  position of present perfect sentences is that the surface forms of such constructions are syntactically ambiguous with the adverb being in the  $ADV_2$  position, which is unacceptable. This is a somewhat rare case where there are two *grammatical* parses of a sentence, but only one of them is semantically well-defined. Such constructions can be acceptable when the listener thinks about them, but even after realizing what the speaker meant, the sentence still does not sound good. To illustrate my point, imagine a scenario where two roommates are moving out of an apartment, and going their separate ways. They are now tackling the task of dividing up the furniture. In the room are exactly four tables and two

chairs. John says, “The four tables and chairs are mine.” Traditionally, the use of *the* presupposes some kind of uniqueness or familiarity with the reference of the complement NP. In this case, the NP “the four chairs” seems to not refer, or have undefined or otherwise exceptional behavior in the case where only two chairs are in the relevant context of discourse. John’s statement, “the four tables and chairs are mine”, is syntactically ambiguous between a non-exceptional parse and an exceptional one. Specifically, “the [four tables] and chairs are mine” is acceptable and “the four [tables and chairs] are mine” is not. Despite the fact that a perfectly acceptable parse exists, the syntactically ambiguous sentence is not good. The fact that only one of the parses is acceptable seems to hinder acceptability, rather than aide it. This seems to be the same situation that comes up with past VP adverbials in present perfect sentences. One of the parses is acceptable, and the other exceptional.

Another problem with past VP adverbials in present perfect sentences is that such constructions seem to violate the Gricean maxim of manner (Grice, 1989). This topic among others is discussed in chapter 7.

## Chapter 5 Past Tense and World/Words Correspondence

### 5.1 The Ambiguity of the Past Tense

There are linguistic data which suggest that the past tense morpheme has a sense which has nothing to do with past times. While the existence of this secondary sense has a historical explanation involving past times, in modern English this temporal reference no longer persists. Consider the past tense forms in the following examples<sup>1</sup>:

(5.1) *Examples of past morphology not denoting past times:*

- a. If John *was* a dog, he would be a collie.
- b. If John *bought* a dog, it would be a collie.
- c. John wishes that Mary *was* here.
- d. John is behaving like he *was* a dog.

Explaining what is going on in examples like those above requires a preliminary discussion to establish some prerequisite notions. This prerequisite discussion begins by introducing the subjunctive mood. (James, 1986) presents an excellent, albeit informal, analysis of the English subjunctive, and most of the following discussion should be accredited to his work.

The subjunctive mood is dying in modern English. Whereas earlier forms of English had subjunctive morphology which was both productive and distinct, today the (semantic) subjunctive mood survives only in certain restricted environments and, in the case of the past subjunctive, the morphology that marks it is almost never distinguishable from that of the past indicative. The following example illustrates a partial paradigm of environments in which subjunctive morphology

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<sup>1</sup>Some readers may immediately notice that these examples, except for (b), are *wrong*! The proper form to use here is the past subjunctive, not the past indicative, right? Well, it depends on what one considers to be “proper”. If the proper form is the form that most English teachers would chose, then these examples are wrong. However, if the proper form is the form that most speakers of English tend to use, then these examples are correct. As I consider my job as a Linguist to describe the language as it exists—or equivalently to me, how it is used/spoken—I subscribe to the latter perspective on what is proper, and whether English teachers like it or not, it is a *fact* that forms like these are widespread.

still occurs:

(5.2) *Examples of subjunctive morphology in Modern English (c.f. (James, 1986)):*

- a. Present Subjunctive:
  - (i) So be it.
  - (ii) God bless you.
  - (iii) Enter Hamlet reading a book.
  - (iv) They insist that it be so.
- b. Past Subjunctive:
  - (i) If only it were so.
  - (ii) He wishes it were so.
  - (iii) Suppose it were so.
  - (iv) He would rest if he were sick.
  - (v) It looks as if he were sick.

The semantic contribution of the subjunctive mood is a topic which is a little bit slippery. Since earlier forms of English have pervasive subjunctive morphology, and modern English does not, subjunctive morphology seems to most (non-highly educated) present-day English speakers to be nothing more than fossilized idioms from long ago, or special verb forms which sound archaic. Indeed, subjunctive forms usually have to be *taught* in school, and it is safe to say that many if not most high school graduates do not know what subjunctive marking does, why it exists, or how to use it properly.

Because subjunctive marking is only allowed in certain syntactic (or maybe semantic) environments, and therefore we only observe the subjunctive mood when it interacts with those environments, it is not straight-forward to account for the semantic contribution of subjunctive marking; the usual content attributed to subjunctive morphology seems to often be redundant with the content contributed by the environments in which it is licensed. Typical descriptions of the semantic contribution of subjunctive marking include vague explanations involving wishes, or hypothetical

worlds, or unreal circumstances, though none of these kinds of explanations seem to hold in general. To formulate his analysis, James had to conduct a comparative study of the subjunctive in modern and earlier forms of English dating back to Old English. While his process is not discussed here, his findings are.

One of the key conclusions of James's analysis of the subjunctive is the recognition of two basic categories of modality. He calls these *theoretical modality* and *practical modality*. He cites a number of philosophers and linguists to explain the difference. (Harris, 1751) distinguishes two "powers of the soul" which he calls *perception* and *volition*. (Anscombe, 1957) employs a metaphor distinguishing between a detective's list and a shopper's list. (Searle, 1972) categorizes illocutionary acts by the nature of the correspondence between the words and the world; the two possibilities are either that the words are intended to match the world, or that the world is intended to match the words. James, himself, employs yet another metaphor, distinguishing between *records* and *blueprints*. Records serve as his metaphor for *theoretical modality* and correspond to perception, detective's lists, and the words-to-world correspondence relation. Blueprints serve as his metaphor for *practical modality* and correspond to volition, shopper's lists, and the world-to-words correspondence relation. In his words:

Consider, for example, an architect's sketch of a house he plans to build. He intends for the world to match the sketch, which is his 'blueprint'. Now consider an artist's sketch of that house after it is built. He intends for the sketch, which is his 'record', to match the world. The sketches may look exactly alike, but they differ in their manner of representation. If the same person had occasion to draw both kinds of sketches, he might choose to do 'blueprints' on blue paper and 'records' on yellow paper, to help keep orderly files. The colors would then serve to signify the manner of representation. Modal forms are the linguistic analogue of this color-coding, and modality is just a linguistic term for manner of representation. Manner of representation is the relation (of which there are two kinds) between a representation and what is represented.

His analysis concludes that the subjunctive mood, both how it was originally used and where it survives today, marks *practical modality* and nothing more. Hence, the present subjunctive can be thought of as presenting a blueprint with the intention of making the circumstances match it. Why is this interesting to us? If James is right in his analysis of the subjunctive, and it does not seem unreasonable that he is, then the alternate sense of the past tense morpheme can be traced back to its use in earlier forms of English in which free use of the past subjunctive mood was grammatical.

If the present subjunctive functions in a way analogous to presenting a blueprint with the intention of matching the world to it, then the past subjunctive can be thought of in one of two ways. Either a) the past subjunctive presents an *old* blueprint, or b) the past subjunctive presents a blueprint *of a past time*. Either of these cases implies that the blueprint is not “in effect”, or equivalently, it is no longer intended that world match it. In James’s words, “the question of correspondence [between words and world] is closed”. This does not mean that the state of affairs described in the past subjunctive is contrary to fact or impossible, it may very well be possible and even real, but it is not *presented* as an actual possibility. Hence, past subjunctive clauses tend to denote counterfactual situations, or idle wishes. Idle wishes are situations which we *know* we cannot make the world match (blueprints of a past time), and counterfactual situations are situations which we do not intend to make the world match (old blueprints). While in older English forms, the present subjunctive *implied* that the question of correspondence was open, and the past subjunctive *implied* that the question of correspondence was closed, the past tense in modern English has come to *mean* in the right circumstances what is used to only imply. Hence, we are left with a past tense morpheme which has a temporal and non-temporal reading. Under the temporal reading, the past tense morphology denotes what we normally expect: past times. Under the non-temporal reading, the past tense morphology denotes non-past times and a *closed* question of world/words correspondence.

As past subjunctive morphology utters its last breath, modern English has employed a number of auxiliary verbs and other constructions which pick up the slack. For example, we can express counterfactual situations (one specific interpretation of the old past subjunctive) with explicit *if* ...

*then ... constructions, and we can express idle wishes by literally asserting a wish as in I wish that ... In such environments which present counterfactual situations or idle wishes, the non-temporal interpretation of the past tense morpheme is licensed.*

(5.3) *Environments which have interpretations once attributed to the past-subjunctive license the non-temporal reading of PAST:*

- a. I wish that Mary was here (right now).
- b. If Mary was here (right now), she would be laughing.

Our discussion so far has been rather informal, relying on metaphors to explain concepts and describing semantics in a very non-rigorous manner. While in 5.3, I do attempt to make these concepts more concrete, and describe the concept of an open vs. closed question of world/words correspondence in terms with which we are familiar, a complete formalization of the issue is left for future work. Further below, it becomes critical that we recognize the polysemy of the past tense morpheme. And it is clear from empirical evidence that some kind of polysemy exists. “I wish Mary was here” makes no reference to any past time, and we cannot blame the inflection on the copula on sequence-of-tense, because there are no other past tense *forms* in the sentence either. So, henceforth when it is necessary to recognize the secondary reading of the past tense, I denote the two readings in the following manner, in which  $PAST_T$  denotes the temporal reading and  $PAST_M$  denotes the non-temporal (modal) reading. Each morpheme denotes a time interval (ironically  $PAST_M$  denotes non-past times), and marks the nature of the question of world/words correspondence:

(5.4) *Notational convention for distinguishing between past tense readings:*

- a.  $[[PAST_T]]^{c,i,g} = \{t : t < i_S\}$  (and open question of world/words correspondence)
- b.  $[[PAST_M]]^{c,i,g} = \{t : t \geq i_S\}$  (and closed question of world/words correspondence)

While the PAST morpheme being ambiguous between denoting past times and denoting non-past times may seem confusing (or ludicrous), remember that  $PAST_M$  is restricted to contexts which

explicitly express idle wishes, counterfactual situations, imagined possibilities, and the like.

## 5.2 The Ambiguity of *Would*

Having established the ambiguity of the past tense morpheme, it seems reasonable to turn our attention to *would*. If past tense is ambiguous, then it stands to reason that *would* is also ambiguous. This should be so either because it is constructed by inflecting *will* with past tense morphology, or because it used to be constructed in such a fashion, and by now its meaning, though perhaps no longer truly compositional, reflects that history.

In older varieties of English, *will* denoted intention rather than futurity. However, since intention leads to future action (assuming nothing exceptional occurs), *will* came to imply future action and eventually, came to mean what it used to imply. Today, *will* seems to denote future times, but can still carry connotations of intention, as in the following example:

(5.5) *'Will' may carry a connotation of intention:*

I will help you now.

Similarly, *would* at one point denoted intention, though inflected for the past tense. Since it is impossible to have intentions regarding the past, it must have been that *would* denoted past intentions. Past intentions are not necessarily present intentions, and therefore might describe merely imagined or possible states of affairs. And indeed *would* came to imply exactly that. Like *will* and so many other modal verbs, *would* eventually came to *mean* what it used to imply. And hence we have what is usually referred to as the *modal* sense of *would*. This sense of *would* is used in constructions denoting counterfactuals and imagined states of affairs, and elsewhere. Consider the examples below which provide a partial paradigm of the distribution of modal *would*:

(5.6) *Partial paradigm of the modal sense of 'would':*

- a. I would go to the movies if you bought my ticket.
- b. If John were a dog, he would be a collie.

- c. John *would* do something like that.

(5.6-a,c) are expressing imagined possibilities, and (5.6-b) is expressing a counterfactual scenario. While (5.6-a,b) are probably obvious to analyze as such, (5.6-c) might be a little less clear. In this case, the semantic analysis is that *would* quantifies over possible hypothetical worlds. The accessibility relation to those worlds is unspecified however, and so they can be described just as hypothetical worlds which the speaker finds reasonable. The statement as a whole, then, is asserting that in those worlds, John does “something like that”. The implication is that doing such a thing is John’s nature, and cannot be attributed to the whatever state of affairs John finds himself in.

Because modal *would* presents imagined or hypothetical states of affairs, the question of world/words correspondence in such clauses is closed. Again, the question is not closed due to an assertion of non-actuality, it is closed because the clause is not *presented* as a possible actuality.

It is also common practice in modern semantics to assume the existence of a temporal (non-modal) reading of *would*. Such readings are compatible with examples like the following:

(5.7) *Some examples of temporal (non-modal) would:*

- a. Johnny would grow three inches that year. (e.g. while watching a home video)
- b. John bought a dog that would die of rabies.

It is critical to notice that, if we maintain the sense of *would* as used above, the sentences in (5.7) *cannot* refer to future events (from the speaker’s point of view). Consider (5.7-a), where two parents are watching a video of their son Johnny, who is still a child. In this case (5.7-a) is felicitous, but a sentence like “Johnny would grow up to become president” is not. Similarly, (5.7-b) may only be felicitously uttered if the dog is known to have already died of rabies. If one utters (5.7-b), and the dog is known to be alive, the sentence is awkward and if felicitous forced into a reading where the speaker is imagining a scenario that seems likely to her. But this imagined state of affairs is exactly what the modal *would* seems to create. And hence we have the critical link between the temporal *would* and the modal *would*. Temporal *would* picks out the future from the

point of view of a past time. This future might temporally overlap with the future of the speaker. But the future of a past time which overlaps with the future of the speaker is not necessarily the same future as the future of the speaker. At least it is not *presented* as the same future as the future of the speaker; it could be a different future than the speaker's future. In other words, once temporal *would* points out times which are no longer in the past, the question of correspondence between world and words becomes closed. But, a closed correspondence relation coupled with a non-past temporal interpretation are exactly the criteria which identify the *modal* sense of *would*.

These obviously related yet distinct interpretations of *would* are not only compatible, but predicted by our treatment of the PAST morpheme as ambiguous. If *will/woll* is inflected with PAST<sub>T</sub> (past and open question of world/words correspondence), we get our temporal interpretation of *would*, which picks out past times only and has an open question of correspondence. If we inflect *will/woll* with PAST<sub>M</sub> (non-past and closed question of world/words correspondence), we get our modal interpretation of *would*, which picks out non-past times and has a closed question of correspondence. With this in mind, I assign the two senses of *would* the following denotations:

(5.8) *Denotations of temporal and modal 'would':*

- a.  $[[\text{would}_T]]^{c,i,g} = \lambda \varphi_{\langle s \langle e, t \rangle \rangle} . \lambda x_e . (\exists I \in \mathcal{I}) I \subseteq \{t : t < i_S\} \wedge \varphi(i[R \rightarrow i_R \cap \{t : t > I_f \wedge t < i_{S_0}\}]) (x)$   
(and open question of correspondence)
- b.  $[[\text{would}_M]]^{c,i,g} = \{t : t \geq i_{S_0}\}$  (and closed question of correspondence)

From this definition we can also derive the expected difference in meaning between *would<sub>M</sub>* and *will*. *Would<sub>M</sub>* implies a closed world-words correspondence relation, which can be the case only in possibilities which are not presented as actual possibilities (imagined/hypothetical scenarios), and *will* implies an open world-words correspondence relation, which can be the case only in possibilities which *are* presented as actual possibilities.

### 5.3 On the Question of World/Words Correspondence

The above sections in this chapter introduce the concept of a correspondence relation between the words (of an utterance) and the world. In summary, utterances may have a world-to-words correspondence relation or a words-to-world correspondence relation. According to James (1986), this relation marks the two possible top-level categories of modality (viz. practical modality and theoretical modality). Then, given this distinction of modality, there is also a notion of whether the “question” of this correspondence relation is open or closed. But what exactly does it mean for the question of correspondence between the words and the world to be open or closed? In the above sections, this concept is employed rather loosely and informally, described as having to do with the manner in which a sentence is presented. Idle wishes and hypothetical situations, for example, correspond to the question being closed. But this kind of description is rather unsatisfying. Here, I aim to address this informality, and attempt to define the concept in (at least slightly) more concrete terms.

We have seen already that  $PAST_M$  marks a closed question of world/words correspondence, and that  $PAST_T$  marks an open question of world/words correspondence. It also seems to be the case that, when the speaker has a choice between  $PAST_M$  and  $PAST_T$ , her choice gives the listener some clues regarding an agent’s epistemic state. These clues give rise to certain kinds of implicatures. Note the example sentences below, which are minimally different regarding the status of the question of world/words correspondence (in the antecedent):

(5.9) *Some examples of  $PAST_T$  vs.  $PAST_M$  in a conditional antecedent:*

a. *Examples with an open question of correspondence:*

- (i) If Mary was in Boston (yesterday), she was happy.
- (ii) If Mary was an olympian (in her youth), her sport was curling.

b. *Examples with a closed question of correspondence:*

- (i) If Mary was in Boston (right now), she would be happy.
- (ii) If Mary was an olympian, her sport would be curling.

In (5.9-a), the antecedent clauses are marked as having an open question of world/words correspondence (by the usage of  $PAST_T$ ), while in (5.9-b), the antecedent clauses are marked as having a closed question of correspondence (by the usage of  $PAST_M$ ). From our intuitions, it would seem that one of the main differences between the readings in (5.9-a) and in (5.9-b), is that in (5.9-a), the speaker seems to be entertaining the possibility that Mary, actually, has the properties attributed to her in the antecedent, while in (5.9-b), the speaker is entertaining no such possibility. We can back up this intuition with linguistic data in a number of ways. One such way would be to note the validity of certain epistemic inferences. The examples in (5.10) illustrate that  $PAST_M$  and  $PAST_T$  have opposite paradigms regarding the pragmatic validity of inferring epistemic possibility:

(5.10) *PAST<sub>T</sub> and PAST<sub>M</sub> allow different kinds of epistemic inferences:*

a. *Examples of inference to epistemic possibility:*

- (i) John believes that if Mary was in Boston (yesterday), she was happy. Therefore, John believes that Mary might have been in Boston (yesterday).
- (ii) #John believes that if Mary was in Boston (right now), she would be happy. Therefore, John believes that Mary might be in Boston (right now).

b. *Examples of inference to epistemic non-possibility:*

- (i) #John believes that if Mary was in Boston, she was happy. Therefore, John believes that Mary was not in Boston.
- (ii) John believes that if Mary was in Boston, she would be happy. Therefore, John believes that Mary is not in Boston.

The examples above show that usage of  $PAST_M$  in conditional antecedents is pragmatically incompatible with the belief that the antecedent condition might be the case. And, usage of  $PAST_T$  in conditional antecedents is incompatible with the belief that the antecedent condition is *not* the case. This sort of paradigm is predicted if we suppose that we tend to not entertain possibilities which we do not believe to be true, and that we tend to entertain possibilities which we believe may be true.

Another way we can back up our intuitions regarding  $PAST_T$  and  $PAST_M$  is by looking at the felicity of introducing new information with *and/but* conjuncts. The examples in (5.11) are parallel to those in (5.10):

(5.11) *PAST<sub>T</sub> and PAST<sub>M</sub> seem to contribute different amounts of information to the discourse:*

a. *Examples contributing epistemic possibility as new information:*

(i) #John believes that if Mary was in Boston, she was happy. And/but John believes that Mary might have been in Boston.

(ii) John believes that if Mary was in Boston, she would be happy. And/but John believes that Mary might be in Boston.

b. *Examples contributing epistemic non-possibility as new information:*

(i) John believes that if Mary was in Boston, she was happy. And/but John believes that Mary was not in Boston.

(ii) #John believes that if Mary was in Boston, she would be happy. And/but John believes that Mary is not in Boston.

(5.11-a-i) and (5.11-b-ii) are pragmatically awkward, supposedly because the information contributed by the second sentence can already be inferred from the first. This is not the case in (5.11-a-ii) and (5.11-b-i), however, in which the second sentence seems to genuinely provide new information (which might cancel an inference we might have made given just the first sentence).

The data in (5.10) and (5.11) suggest a link between the choice of  $PAST_T$  or  $PAST_M$  in the antecedent of a conditional, and the belief that it might be true. This link is not limited to the conditional, but occurs in all contexts which license the use of both  $PAST_M$  and  $PAST_T$ . Thus, we can say that this link is present whenever the speaker has a choice between  $PAST_M$  and  $PAST_T$ . Other environments which allow both  $PAST_M$  and  $PAST_T$ , and therefore present the speaker with a choice between them, include the complements of the verbs *suppose* and *assume*. (5.12) illustrates the case of *suppose*:

(5.12) *PAST<sub>T</sub> and PAST<sub>M</sub> have similar behavior in the complement of 'suppose' as they do in*

*conditional antecedents:*

- a. John is supposing that Mary was in Boston (yesterday).
  - (i) Therefore, John believes that Mary might have been in Boston (yesterday).
  - (ii) #Therefore, John believes that Mary was not in Boston (yesterday).
  - (iii) #And/but, John believes that Mary might have been in Boston (yesterday).
  - (iv) And/but, John believes that Mary was not in Boston (yesterday).
- b. John is supposing that Mary was in Boston (right now).
  - (i) #Therefore, John believes that Mary might be in Boston right now.
  - (ii) Therefore, John believes that Mary is not in Boston right now.
  - (iii) And/but, John believes that Mary might be in Boston right now.
  - (iv) #And/but, John believes that Mary is not in Boston right now.

We should keep in mind, though, that these sorts of inferences regarding the agent's beliefs are just that, inferences. A better term might be implicature, since they are cancelable. For instance, (5.12-b) has been shown to be generally compatible with John believing that Mary is *not* in Boston, but this can be canceled by the information in (5.12-b-iii). Hence, the openness of the question of world/words correspondence gives the listener *clues* about an agent's epistemic state, but not any hard evidence. Then, there must be something else which represents the semantic contribution of the openness of the question of world/words correspondence, which tends to *correlate* with the pattern of epistemic states observed above.

At the beginning of this section, I suggest that these observations are the result of the speaker *entertaining the possibility* that the statements of interest are actually the case. I believe we can make this concept more concrete if we suppose that to entertain the possibility that  $\varphi$  is true, is to include the actual world among the set of worlds relative to which  $\varphi$  might be evaluated in the utterance.

Note that PAST<sub>M</sub> and *would*<sub>M</sub>, our two morphemes which mark a closed question of world/words correspondence, always occur in intensional environments of one sort or another—*would*<sub>M</sub>, actually, is capable of standing by itself and creating its own intensional environment. A basic way of

interpreting an *if A, then B* conditional is to say that the (minimally different) worlds in which *A* is true is a subset of the worlds in which *B* is true. Hence, the world parameter relative to which *A* is evaluated is quantified over. It is also quite standard to interpret intensional verbs like *wish*, *hope*, *think*, and *suppose*, as also quantifying over worlds (e.g. *John wishes A* is true in  $w_a$  just in case the worlds compatible with John's wishes in  $w_a$  is a subset of the worlds in which *A* is true).

Let's suppose that there are two basic types of quantification over worlds. Let the first type (O-type quantification) quantify over all possible worlds—this is generally how things are done—and let the second type (C-type quantification) quantify strictly over *non-actual* possible worlds. We can then formalize the openness of the question of world/words correspondence by stipulating that, given a sentence  $\varphi$ , the question of world/words correspondence for  $\varphi$  is closed just in case it exists in a C-type quantificational environment, and that the question of correspondence is open otherwise. Thus, since *wish* forces a closed question of correspondence upon its argument, we might represent its content as the following:

(5.13) *Sketch of the content of 'wish' (for simplicity, all parameters other than the world of evaluation are ignored):*

$[[\text{wish}]]^w = \lambda \varphi_{\langle s,t \rangle} . \lambda x . (\forall w' \in W_C) [wRw' \rightarrow \varphi(w')]$ , where *R* is the relevant accessibility relation, which in this case picks out the worlds compatible with what *x* wishes, and where  $W_C$  is the set of non-actual, possible worlds (which is equivalent to  $W_O - \{c_W\}$  and thus creates a C-type quantificational environment).

*Hope*, on the other hand, forces an open question of world/words correspondence, and as such might be defined like so:

(5.14) *Sketch of the content of 'hope':*

$[[\text{hope}]]^w = \lambda \varphi_{\langle s,t \rangle} . \lambda x . (\forall w' \in W_O) [wRw' \rightarrow \varphi(w')]$

*If ... then ...* construction antecedents allow either a closed or open question of world/words correspondence, and as such the speaker can choose between two representations, which are indicated

to the listener by the presence or absence of  $PAST_M$  or  $would_M$ . We can represent the content of *if ... then ...* constructions in the following way. In the definitions below, the open question case corresponds precisely to Lewis’s (1973) treatment of conditionals, while the closed question case corresponds to a slightly modified version of his treatment, which excludes  $c_W$  (the actual world) from the domain of quantification.

(5.15) *Lewis-style Sketch of the content of ‘if ... then ...’ constructions ( $x \prec_w y$  should be read “world  $x$  is more similar to world  $w$  than world  $y$  is):*

- a. (open question)  $[[\text{if } \varphi \text{ then } \psi]]^w = \text{if } \varphi \text{ is possible, then}$   
 $(\exists w \in W_O)[\varphi(w) \wedge \psi(w) \wedge (\forall w' \in W_O)[(\varphi(w') \wedge \neg\psi(w') \rightarrow w \prec_{c_W} w')]]$
- b. (closed question)  $[[\text{if } \varphi \text{ then } \psi]]^w = \text{if } \varphi \text{ is possible, then}$   
 $(\exists w \in W_C)[\varphi(w) \wedge \psi(w) \wedge (\forall w' \in W_C)[(\varphi(w') \wedge \neg\psi(w') \rightarrow w \prec_{c_W} w')]]$

Note that excluding the actual world from a domain of quantification does not entail the scope being false of the actual world, just as including the actual world in the domain of quantification does not entail the scope being true of the actual world. To exclude the actual world from the domain of quantification is to not even consider the actual state of affairs in the first place. As such, C-type quantificational environments mark situations as hypothetical or imagined (even though they may be actually be possible or even real), while O-type quantificational environments mark situations as non-hypothetical (even though they may clearly be false of the actual world).

Representing the question of world/words correspondence as a particular of modal quantification also allows us to account for *who* our epistemic clues correlate with. For example, if the speaker says “If Mary was in Boston right now ...”, we might suppose that the speaker thinks that Mary is not in Boston. But, if the speaker says “John believes that if Mary was in Boston right now...”, we instead tend to suppose that *John* believes that Mary is not in Boston. This difference in interpretation falls naturally out of the given hypothesis. We make an assumption about John, rather than the speaker, in the latter case because the modal quantification is embedded in the *believe* predicate, which is attributed to John.

One worry that some might have is that, by removing the actual world from the domain of quantification in conditionals with a closed question of world/words correspondence, we are no longer able to consider arguments of the following form valid:

(5.16) *A problematic argument form for the current treatment of the question of world/words correspondence:*

If  $\phi$  was/were the case,  $\psi$  would be the case.

$\phi$  is the case.

Therefore,  $\psi$  is the case.

The problem illustrated in (5.16) is that the conditional is of the closed variety, which directly says nothing about the actual world except for assertions of which non-actual worlds are more similar to it than others. Most importantly, it seems to say nothing about facts concerning  $\phi$  in the actual world. Yet, it seems that given the first two statements in (5.16) as premises, the third should be a valid conclusion. How can we account for this?

We can account for arguments like (5.16) by noticing that the conditional does not *need* to make any direct statements about the actual world, in order to use it to rationally draw conclusions about the actual world. To see that this is the case, let us assume the existence of a counterexample, and see where such reasoning takes us. A counterexample to (5.16) would be a world in which the following statements are all true:

(5.17) *A counterexample to (5.16):*

If  $\phi$  was/were the case, then  $\psi$  would be the case.

$\phi$  is the case.

$\psi$  is not the case.

Given our Lewis-style analysis of closed *if ... then ...* constructions, what situation does the truth of these three statements put us in? Figure 5.1 illustrates such a situation. The truth of the first statement guarantees the existence of a sphere  $S$  around  $c_W$  which, ignoring the actual world,

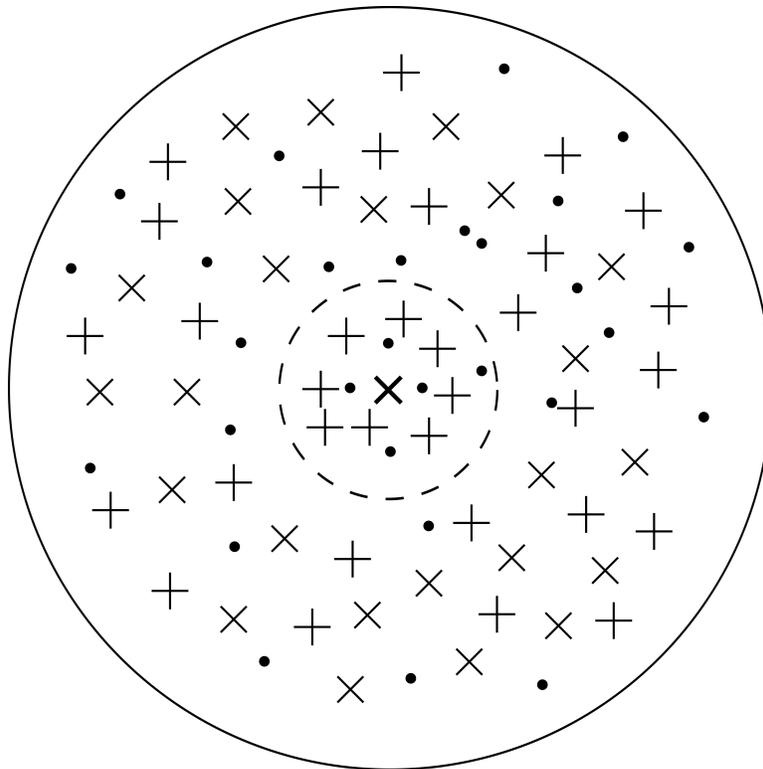


Figure 5.1: A diagram of the set of possible worlds consistent with the assumptions in (5.17) and our Lewis-style (1973) analysis. Where  $\varphi$  is the antecedent of the counterfactual premise, and  $\psi$  is the consequent, dots ( $\cdot$ ) represent worlds in which  $\varphi$  is false, pluses (+) represent worlds in  $\varphi$  and  $\psi$  are both true, and crosses ( $\times$ ) represent worlds in which  $\varphi$  is true, but  $\psi$  is false—the darker  $\times$  in the center of the diagram represents the actual world, in which it is presumed that  $\varphi$  is true and  $\psi$  is false. The solid circle bounding the diagram represents the entire space of possible worlds, while the dashed circle presents a Lewis “sphere” of worlds around  $c_W$  which is  $\varphi \wedge \psi$ -permitting, but not  $\varphi \wedge \neg\psi$ -permitting. Note that our modified Lewis-style treatment of (counterfactual) conditionals allows an  $A$ -world in a sphere which is not  $A$ -permitting if that  $A$ -world is the actual world  $c_W$ .

contains no worlds in which  $\varphi$  is true and  $\psi$  is false. The second and third statements stipulate that, in fact,  $\varphi$  is true and  $\psi$  is false in the actual world. But what kind of modal universe is this? Is such a situation even possible? It seems to me that no, it isn't. Assuming that this sort of modal universe is possible leads us to some fairly outrageous conclusions.

What does it mean for there to be a sphere  $S$  around  $c_W$  which contains no worlds (with the actual world being a possible exception) in which  $\varphi$  is true and  $\psi$  is false? It means that it is *impossible* for  $\varphi$  to be true and  $\psi$  to be false in any non-actual world which is at least as similar to our own as any other world in  $S$ . Since there are no non-actual  $\varphi \wedge \neg\psi$ -worlds in  $S$ , it follows that there are also no such worlds in any sub-sphere of  $S$ . Let us image a sphere  $S'$  around  $c_W$  which contains only those worlds which differ from  $c_W$  in only the most minute degree.<sup>2</sup>  $S'$  is guaranteed to be a sub-sphere of  $S$ , since the differences in the contained worlds are stipulated to be much more minute than the differences in the other worlds in  $S$  (which are not in  $S'$ ). For example, one world in such a sphere might be a world which is just like ours except on one particular occasion long ago, my grandmother's grandmother's grandmother rocked 1 nanometer futher back in her chair than she actually did. Another world might be a world which is just like ours except that 1 year ago when I was putting up a shelving unit, I turned one of the screws one millionth of a radian further than I actually did. We can come up with examples like this seemingly without end. Certainly such counterfactual situations are possible, certainly we can have worlds like this in our model.

What is interesting is that given our assumptions (*if  $\varphi$  then  $\psi$ ,  $\varphi$ ,  $\neg\psi$* ), in *all* of these worlds, either  $\varphi$  has a different truth value than it actually does, or  $\psi$  has a different truth value than it actually does. Remember that we are assuming the truth of a counterfactual conditional of the form "if  $\varphi$ , then  $\psi$ ", which is true just in case there is a sphere around  $c_W$  which is  $\varphi \wedge \psi$ -permitting but not  $\varphi \wedge \neg\psi$ -permitting. This is just to say that at every world in this sphere, either  $\varphi$  is false,

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<sup>2</sup>I do not mean to use the phrase *most minute* to literally imply that there are such worlds, since it is reasonable to assume that for any such world, we might be able to find a more similar one. For instance we might imagine a world where I am 1mm taller, but of course we could also imagine a world where I am 0.5mm taller. In fact, we might imagine a world where I am *any* amount taller, and describe this amount with a real number. But, there is no world in which I am a minimal amount taller, since there is no real number closest to 0.

or  $\phi$  and  $\psi$  are both true. Since in the actual world,  $\phi$  is presumed true and  $\psi$  is presumed false, it follows that at every other world in this sphere, either  $\phi$  has a different truth value (false), or  $\psi$  has a different truth value (true). They cannot both keep the same truth value since that would falsify the conditional. Another way of saying this is to say that it is *impossible* for these kinds of worlds to exist, while maintaining the truth of both  $\phi$  and  $\psi$ . Let's consider a real example, say "If Mary was in Boston, she would be happy". If this were true, and if Mary were in Boston, and if she were unhappy, then we are forced to draw the following kinds of conclusions:

- (5.18) a. When I was putting up my shelving unit one year ago, if I had turned the 5th screw one millionth of a radian further, then either Mary wouldn't be in Boston right now, or she would be happy right now.
- b. If, in the afternoon on April 12, 1830, my grandmother's grandmother's grandmother had rocked 1 nanometer further back in her chair (on her 6th rock), then either Mary wouldn't be in Boston right now or she would be happy right now.

The truth of the assertions in (5.18) seems dubious at best, and certainly does not follow from our original assumptions. The reason why we now find ourselves in this ridiculous metaphysical corner is that we assumed it was possible that for some  $\phi$  and  $\psi$ , "If  $\phi$  was/were the case then  $\psi$  would be the case" and  $\phi$  could simultaneously be true while  $\psi$  is false. It seems our only option then is to reject this counterexample. Thus, even though closed varieties of conditionals (counterfactuals) are not formalized as saying anything directly about the actual world, arguments of the sort in (5.16) are nevertheless valid.

## Chapter 6 Tense in Embedded Clauses

Were we to blindly apply the semantics of tense-like constructions as they have been presented thus far, it would soon become obvious that the system as it exists fails in cases of embedded tense. This failure however is not due to an inconsistency in the semantics presented, but rather is due to simply not having provided the semantics for the environments in which embedded tenses find themselves. While some minor (compatible) tweaks to existing definitions may be necessary, the main task here is to define the semantics of those elements responsible for creating environments in which we embed finite clauses. In this chapter I define the semantics of these critical elements, and then provide a discussion of the various phenomena which seem to arise when tenses interact.

### 6.1 Temporal Subordinate Clauses

This section addresses the treatment of temporal subordinate clauses. These are clausal arguments (or adjuncts) headed by temporal adverbials such as the following:

(6.1) *Some examples of temporal subordinate clauses*

- a. before John found the answer
- b. when John went home
- c. after John lost his job
- d. since John moved to Texas.

We should also note that the future tense morpheme *will* does not appear in temporal subordinate clauses. The following examples illustrate attempts to use the future tense morpheme in such clauses, with a variety of verb classes. All of them are ungrammatical:

(6.2) *The future tense morpheme in temporal subordinate clauses is ungrammatical.*

- a. \*When John will find the answer, he will celebrate.

- b. \*When John will go home, he will choose to drive.
- c. \*When John will love Mary, he should tell her.
- d. \*When John will run, he needs to be wearing special shoes.

The grammatical way to formulate these types of sentences is with the present tense morpheme in the temporal subordinate clause. In temporal subordinate clauses, the present tense acts instead as a non-past tense morpheme. Hence, tense in temporal subordinate clauses is a binary past/non-past distinction. For the purposes of this dissertation, I will posit a new tense morpheme which is syntactically restricted to temporal subordinate environments, and whose surface form is identical to PRES. I call this morpheme the *NPAST* morpheme and assign to it the following content:

$$[[NPAST]]^{c,i,g} = \{t : t \geq i_{S_0}\}.$$

I recognize that this is not the only way to generate the past/non-past tense distinction that English imposes on temporal subordinate clauses. It is not my intention to argue for or against any particular explanation for this special behavior of what appears to be the present tense morpheme at this time. And it is worthy of note that other languages in general do not share this restriction, and do allow future tense in such environments, like the German example below:

(6.3) *German, as well as other many other languages, allow future tense in temporal subordinate clauses:*

Wenn John auf sein Theaterstück führen werden, werden die Zuschauer jubeln.  
 when john PART his play perform will, will the audience cheer  
 “When John will perform his play, the audience will cheer.”

Intuitively, temporal subordinate clauses seem to denote intervals defined in terms of the interval over which the event they describe occurs. For example the following two subordinate clauses seem to both denote the interval over which John builds his house. The only difference between them is that the first temporally locates the house-building event in the past, and the second temporally locates the house-building event in the non-past:

(6.4) *Denotations of temporal subordinate clauses are anchored to the intervals over which their events occur.*

- a. When John built his house, he got only 5 hours of sleep every night.
- b. When John builds his house, he will get only 5 hours of sleep every night.

However, this is not quite right, because we are assuming that there is only one event which matches the sentence description. Actually, there could be any number of events of the same type. Suppose John is a pianist who performed twice on the same day, once in the morning and once in the afternoon. Then, it does not seem definite that “when John performed” refers to any particular interval. It seems that such a clause could refer to *any* interval over which John performed. We can see this because the following two examples are both acceptable and well-defined:

- (6.5) a. In the morning, when John performed, the crowd was totally silent.  
 b. In the afternoon, when John performed, the crowd was rude.

(6.5-a) seems true just in case there is *any* interval over which John performs and that interval is in the morning and the crowd was totally silent there during. (6.5-b) is similar, though picks out an interval which must be in the afternoon.

Thus, we need a mechanism for extracting these intervals from a sentence. It is possible to do this using the tools we already have available. Let  $I_E$  denote a function in our metalanguage which I call the *event interval function*.  $I_E : \tau(\langle s, t \rangle) \times \mathcal{X} \rightarrow \mathcal{P}(\mathcal{I})$  is defined in the following way:

(6.6) *Definition of the event interval function  $I_E$ :*

$$I_E(\varphi, i) = \left\{ I \in \mathcal{I} : \begin{array}{l} (\forall r \subseteq I) \varphi(i[R \rightarrow r]) \wedge (\forall r \supset I) (\exists s \subseteq r) \neg \varphi(i[R \rightarrow s]) \\ \vee \\ \varphi(i[R \rightarrow I]) \wedge (\forall r \subset I) \neg \varphi(i[R \rightarrow r]) \end{array} \right\}$$

$I_E$  maps sentence-index pairs into sets of intervals. Given a particular sentence-index pair, it denotes the set of intervals where each member of that set is an interval over which the event described in the sentence occurs, subject to the contextual constraints and parameters provided

by the index. The function works by quantifying over event restriction intervals and including particular ones in the event interval set. The first disjunct states that, given an event restriction interval  $r$ , the sentence is true when evaluated relative to it and relative to all subsets of it, but that this is not the case for any of  $r$ 's proper super intervals. The second disjunct states that, given an event restriction interval  $r$ , the sentence is true relative to  $r$ , but false relative to every subset of  $r$ . States and activities might satisfy the first disjunct, but never the second (because states and activities have the subinterval property). Accomplishments might satisfy the second disjunct, but never the first (because accomplishments lack the subinterval property or, you might say, have an anti-subinterval property). Achievements happen to always satisfy both disjuncts if they satisfy either, due to them being instantaneous and the vacuous nature of universal quantifiers when applied to subsets of singleton intervals. All of the quantifiers in the definition of  $I_E$  exclude  $\emptyset$  from their domains of quantification.

With  $I_E$  in our tool belt, we are ready to define some of the basic temporal complementizers. In the definitions below, the subordinate clauses are treated as adjuncts of sentences, and so the complementizers take two sentential arguments, the first being the subordinate clause, and the second being the main clause. In other words, if  $\varphi$  and  $\psi$  are sentences, then the following definitions correspond to statements of the form  $\psi$  COMP  $\varphi$ , where COMP is a temporal complementizer.

(6.7) *The denotations of several temporal complementizers.*

- a.  $\llbracket \text{while/when} \rrbracket^{c,i,g} = \lambda \varphi_{\langle s,t \rangle} . \lambda \psi_{\langle s,t \rangle} . (\exists I \in I_E(\varphi, i)) \psi(i[R \rightarrow i_R \cap I])$
- b.  $\llbracket \text{before} \rrbracket^{c,i,g} = \lambda \varphi_{\langle s,t \rangle} . \lambda \psi_{\langle s,t \rangle} . (\exists I \in I_E(\varphi, i)) \psi(i[R \rightarrow i_R \cap \{t : t < I_0\}])$
- c.  $\llbracket \text{after} \rrbracket^{c,i,g} = \lambda \varphi_{\langle s,t \rangle} . \lambda \psi_{\langle s,t \rangle} . (\exists I \in I_E(\varphi, i)) \psi(i[R \rightarrow i_R \cap \{t : t > I_f\}])$
- d.  $\llbracket \text{since} \rrbracket^{c,i,g} = \lambda \varphi_{\langle s,t \rangle} . \lambda \psi_{\langle s,t \rangle} . (\exists I \in I_E(\varphi, i)) \psi(i[R \rightarrow i_R \cap \{t : t > I_f \wedge t < i_{S_0}\}])$

The temporal complementizers above all assert the existence of an interval in the event interval set of the sentence, such that an appropriate event restriction interval can be constructed relative to it, which when used as an  $R$ -modifier yields a true main clause. Let's look at some examples and see how the truth conditions pan out. First, we consider some simple examples, such as the ones we

used to introduce this section:

(6.8) *Simple examples of temporal subordinate clauses:*

- a. John worked for years before he found the answer.
- b. John saw a car accident when he went home.
- c. John started drinking after he lost his job.
- d. John hasn't worn a coat since he moved to Texas.

Let's first consider the case where there is only one compatible event which matches the subordinate description. So, in (6.8-a), John only found whatever answer the speaker is talking about once in the past, in (6.8-b), John only went home once in the past, and so on. Then, in the case of (6.8-a),  $I_E(\lambda j. \llbracket \text{John found the answer} \rrbracket^{c,j;g}, i)$  denotes a set containing one interval, which itself is a singleton set containing the moment at which John has just found the answer. Therefore because the event interval set contains just one interval, *before* asserts that "John worked for years" is true when the event restriction interval is constrained to the moments preceding that moment when John finds the answer. (6.8-b-d) work in a similar fashion, but differ in what the temporal complementizer does with the only interval in the event interval set. (6.8-b) asserts that "John saw a car accident" is true when the event restriction interval is constrained to the moments *during* his trip home. (6.8-c) constrains the event restriction interval of the main clause to those moments which *follow* that moment when John loses his job. Lastly, (6.8-d) constrains the event restriction interval of the main clause to those moments which both follow his trip to Texas, and which precede the utterance time.

What happens when we consider the more complicated (and more realistic) cases in which multiple events might be described by the subordinate clause? To investigate, I refer to the earlier examples concerning John performing a piano concert twice in a day. John performs once in the morning, and once in the afternoon. That evening, the speaker utters one of the following:

(6.9) *Examples involving temporal subordinate clauses which might describe multiple events:*

- a. When John performed, the room was silent.

- b. After John performed, the crowd went wild.
- c. While John performed, his fingers got a cramp.
- d. Before John performed, John peeked to see how big the audience was.

If John performed twice that day, then “when/while/before/after John performed” seems capable of referring to time spans defined relative to any performance. Ignoring the possible effect of pragmatic preferences, “when John performed,  $\varphi$ ” seems true if  $\varphi$  is true at some time during *any* of John performances. The speaker might have a particular one in mind, but strictly speaking it does not matter (as far as non-cancelable entailments are concerned). The room might have been rowdy during John’s second performance, but if it was silent during the first, then (6.9-a) is true. The room might have hated the first performance, but if the cheered after the second, then (6.9-b) is true, and similar stories exist for (6.9-c-d).

The treatment of temporal complementizers as generating existentially quantified assertions matches our intuitive judgements. The usage of temporal quantification is actually crucial if we want to consider cases in which the subordinate clause describes a particular *relevant* event, because it provides a place for the pragmatic module to exert influence. See chapter 7 for details.

## 6.2 Intensional Arguments

Properly accounting for the temporal restrictions which verbs place on their arguments will require a slight modification of the idealized example of a verb denotation presented originally in section 3.6. For convenience, this example is repeated below:

(6.10) *Basic (idealized) semantics of a verb*

$$[[\text{eat}]]^{c,i,g} = \begin{cases} \lambda y_e. \lambda x_e. (\exists I \in \mathcal{I}) x \text{ eats } y \text{ over } I \text{ and } I \subseteq i_R, & \text{if } i_R \neq \emptyset \\ \text{undefined,} & \text{otherwise} \end{cases}$$

This example was originally presented to demonstrate that verbs inherently quantify over intervals which they “occur over” and that it is stipulated that these intervals are subsumed by the event

restriction interval  $i_R$ . The treatment of the arguments however is largely glossed over, and it is easy to see that the current treatment is inadequate. Consider, for example, the following example:

(6.11) John said he will leave for New York tomorrow.

Under the current treatment, “he will leave for New York tomorrow”, is evaluated relative to the event restriction interval  $\{t : t < i_S\}$ , which when modified by the embedded future tense generates a null event restriction interval and thus is predicted as infelicitous. Of course the sentence is fine, and therefore we need some special semantics for sentential arguments.

In this section, I focus on verbs which take sentential arguments. I utilize the verb *say* throughout this section as my canonical example of an attitude verb (verbs which select sentential arguments). All verbs of this type are treated in the same manner by ERI Theory. These verbs include, for example, *say*, *think*, *insinuate*, etc. Also, as brief remark on terminology, I will often use the phrase “saying event” to refer to the event which is described by the verb *say* in the following examples. If I mean to refer to the time at which the whole sentence is uttered, I will use either  $i_S$  or *utterance time* to denote that.

While the temporal aspects of the semantics of *say* are the main topic of interest, it will be necessary to remark briefly on what it means to say something, and how I denote this property in the metalanguage. As has been common practice so far, I will abbreviate the semantics of a saying event with English paraphrasing. Specifically “ $x$  says( $\varphi, i$ ) over  $I$ ” denotes that an individual  $x$  stands in a saying relationship to a sentence intension-index pair (that is, a tuple containing a sentence intension, and an index), and that the saying event occurs over the interval  $I$ . *Say*, as well as all other attitude verbs, asserts that a relationship holds between an individual and *both* a sentence intension and an index. This is simply a way of indicating that whatever it means to say something, it is dependent at least on a sentence and an index; obviously the meaning has something to do with the embedded sentence intension, and it must also involve an index because sentences are evaluated relative to external parameters.

The complete (non-temporal) details of what “ $x$  says( $\varphi, i$ ) over  $I$ ” means is outside the scope of this dissertation. But one aspect of the content of *say* should be made clear: for an individual to stand in the say relation to a sentence intension-index pair  $\langle \varphi, i \rangle$ , what the individual says (at whatever time), must *entail*  $\varphi$  (relative to index  $i$ ), but not necessarily vice versa. For example, consider the following dialog:

(6.12) *Dialog demonstrating the entailment relationship between what is said and an indirect quotation:*

John: I bought a dog.

Mary (later): John said he bought an animal.

Mary’s statement in (6.12) is felicitous because buying a dog entails buying an animal. This may seem like an obvious point being over-stressed, but I feel it is important, since particularly when it comes to the verb *say*, there are a lot of preconceptions regarding indirect quotations and *faithful* reports. Faithful-to here can be regarded as a relationship for which unidirectional entailment at least is a necessary condition, but which is weaker than logical equivalence.

This entailment requirement between what was said is a good heuristic for measuring faithfulness of reports, but it also has limits. It is a necessary condition, but it is not sufficient. The acceptability of reports which are entailed by the original speech act seem to dwindle as the form of the report becomes further removed from that of the original statement. For example, consider (6.13) and notice how the acceptability drops in the later examples:

(6.13) *Acceptability of reports dwindle with increased discrepancy between their content and that of the original statement:*

John: I bought a dog.

a. Mary (later): John said he bought a dog.

b. Mary (later): John said he bought an animal/pet.

c. Mary (later): ?John said he purchased a member of *Canis lupus familiaris*.

- d. Mary (later): ??John said that he exchanged money in return for a mammal capable of barking.
- e. Mary (later): \*John said that  $0 = 0$ .

For the most part, these limitations are pragmatic in nature, and therefore cancelable. For example, if Mary made the claim in (6.13-d) to someone that remembers the exact words that John used, then she might argue with Mary about what John said. But, assuming they are both rational, the argument should end with Mary’s discourse participant conceding though disagreeing with her style. There do seem to be truth-conditional limitations to the entailment heuristic though. For example, the report in (6.13-e) is simply false, even though what John said entails it (logical truths are entailed by all statements). So, ignoring examples like (6.13-e), which are clearly exceptional but hard to formally define as such, the entailment heuristic is in general a good way to measure faithfulness of reports.

Returning to our introductory example, “John said he will leave for New York tomorrow”, we can see that the intuitive problem is that the event restriction interval is propagating into the subordinate clause, but it should not be allowed to. We can solve this problem by making a slight modification to the contents of intensional verbs. This modification consists of us enforcing a “reset” rule which evaluates intensional arguments relative to the original event restriction interval  $c_R$ , rather than the result of  $c_R$  interacting with the  $R$ -modifiers of the matrix clause. Using *say* as an example, we can define the content of *say* as such:

(6.14) *Items with intensional arguments carry R-reset semantics:*

$$\llbracket \text{say} \rrbracket^{c,i,g} = \lambda \varphi_{\langle s,t \rangle} . \lambda x_e . (\exists I \in \mathcal{I}) x \text{ says}(\varphi, i[R \rightarrow c_R]) \text{ over } I \text{ and } I \subseteq i_R$$

Notice that the  $R$  element of the index which is used in the semantics of *say* is *reset* to  $c_R$ .

With this basic rule in place, we have solved the basic problem of temporal conflict between intensional arguments and the matrix clause. Because matrix  $R$ -modifiers no longer influence intensional arguments, the following sentences are no-longer incorrectly predicted as anomalous:

(6.15) *Some examples which can now be dealt with due to our ‘reset’ rule:*

- a. John will say he bought a dog last year.
- b. John said he will buy a dog next year.
- c. John said he is buying a dog right now.

Some English speakers will not accept (6.15-c), but there is a dialect (which I speak), which allows such “double-access” constructions. A full explanation of why we get double-access readings and why some speakers might not like them is provided in section 6.4, along with a discussion of many other sequence-of-tense phenomena.

The basic rule we have applied thus far solves the immediate problem at hand. However, there are some other issues which apply particularly when the matrix clause is in the future tense. Consider the following examples and notice the times at which John claims he buys a dog:

(6.16) *Some examples with the matrix clause in future tense:*

- a. Next week, John will say he bought a dog yesterday.
- b. Next week, John will say he bought a dog tomorrow.
- c. Next week, John will say he will buy a dog the next day.
- d. \*Next week, John will say he will buy a dog tomorrow.

When the saying event takes place in the future, the tense morphemes of the embedded clause seem to be evaluated relative to the time of the saying event, rather than the utterance time. The key piece of evidence which demonstrates this is that (6.16-b) is acceptable, but (6.16-d) is not. In (6.16-b), *tomorrow* refers to a time between the utterance and the saying event, and is compatible with embedded past tense (the past of the future time). In (6.16-d), *tomorrow* is not compatible with embedded future tense, which we would expect it to be if it were evaluated relative to the utterance time.

The intuition is that, when the saying event occurs in the future, we get a *forward-shifted* reading. This forward-shifted reading is the effect of setting the evaluation interval  $i_S$  to the event interval of the verb. This is demonstrated by the fact that all of the tense morphemes are sensitive

to it:

(6.17) *Forward-shifted readings affect the interpretation of all tense morphemes:*

- a. John will say that he is sick at the time.
- b. Next week, John will say that he was sick tomorrow.
- c. John will say that he will be sick the next day.

(6.17-c) is also compatible with the base reading, since the future relative to the forward-shifted evaluation interval is subsumed by the current future, but I include the example nevertheless for the sake of completeness.

To account for forward-shifted readings, we need to modify the semantics of the future tense morpheme (and possibly make an analogous change to *would<sub>M</sub>* as well). The new definition of FUT is presented below:

(6.18) *Definition of FUT which accounts for forward-shifted readings:*

$$[[\text{FUT}]]^{c,i,g} = \lambda \varphi_{\langle s, \langle e, t \rangle \rangle} . \lambda x_e . \begin{cases} \text{undefined, if } \{t : t > i_{S_f}\} \cap i_R = \emptyset \\ (\exists I \subseteq i_R \cap \{t : t > i_{S_f}\}) (\forall r \subset I) \varphi(i[S, R \rightarrow I])(x) \wedge \neg \varphi(i[S, R \rightarrow r])(x) , \text{ otw.} \end{cases}$$

The spirit of the above definition is that the future tense morpheme asserts the existence of a *minimal* interval over which the event the verb describes occurs. The second conjunct enforces this minimal quality by asserting that all proper subsets of the interval make the sentence false. The *key* change made to the definition of FUT is that it does not just adjust  $i_R$ , but also  $i_S$ . Thus, every temporal construction within the scope of FUT is interpreted relative to an  $i_S$  in the future.

The definition of FUT in (6.18) coupled with the reset rule we already have for intensional verbs results in correct readings for sentential arguments of verbs in future tense constructions. Consider the sentences that were presented just recently above:

(6.19) *Some examples of sentential arguments in future tense constructions:*

- a. John will say that he is sick at the time.

- b. Next week, John will say that he was sick tomorrow.
- c. John will say that he will be sick the next day.

The new definition of FUT existentially quantifiers over minimal future intervals, and evaluates its scope relative to an index in which  $i_S$  and  $i_R$  are both set to that interval. In the case of the simple future, the existential quantification in the verb content is superfluous, since  $i_R$  is already as narrow as possible by that point. If the verb is intensional, its arguments are evaluated relative to a “reset” event restriction interval  $c_R$ . So, within the argument,  $i_R$  is reset *but*  $i_S$  has been shifted to a future which must coincide with the interval over which the matrix event occurs. Thus, the tense morphemes within the intensional arguments will be relativized to that interval. Applying this analysis to (6.19), in (6.19-a), the being-sick event is then forced to be simultaneous with the saying event. In (6.19-b), the being-sick event is restricted to intervals before the saying event. And in (6.19-c), the being-sick event is restricted to times after the saying event. As a visual aid, a diagram illustrating the derivation of (6.19-c) is provided in figure 6.1.

Modifying the definition of FUT in this way has other benefits as well. For example, this analysis also provides correct predictions regarding future perfect constructions; In (6.20), the embedded tense morphemes are evaluated relative to the time at which John *has* said that he is sick, which can be *after* the saying event:

(6.20) *Some examples of sentential arguments in future perfect constructions:*

- a. Next Tuesday, John will have said that he is sick.
- b. Next Tuesday, John will have said that he will be sick.
- c. Next Tuesday, John will have said that he was sick.

In (6.20-a), John says something (possibly before next Tuesday) which entails that he is sick at some time next Tuesday. This construction reads similarly to the PRES-under-PAST double-access readings, but shifted into the future (double-access readings are discussed further in section 6.4.2). (6.20-b) has a subtle restriction which prevents the being-sick event from happening between the saying event and the future time that *will* picks out. Lastly, the interpretation of (6.20-c) is interest-

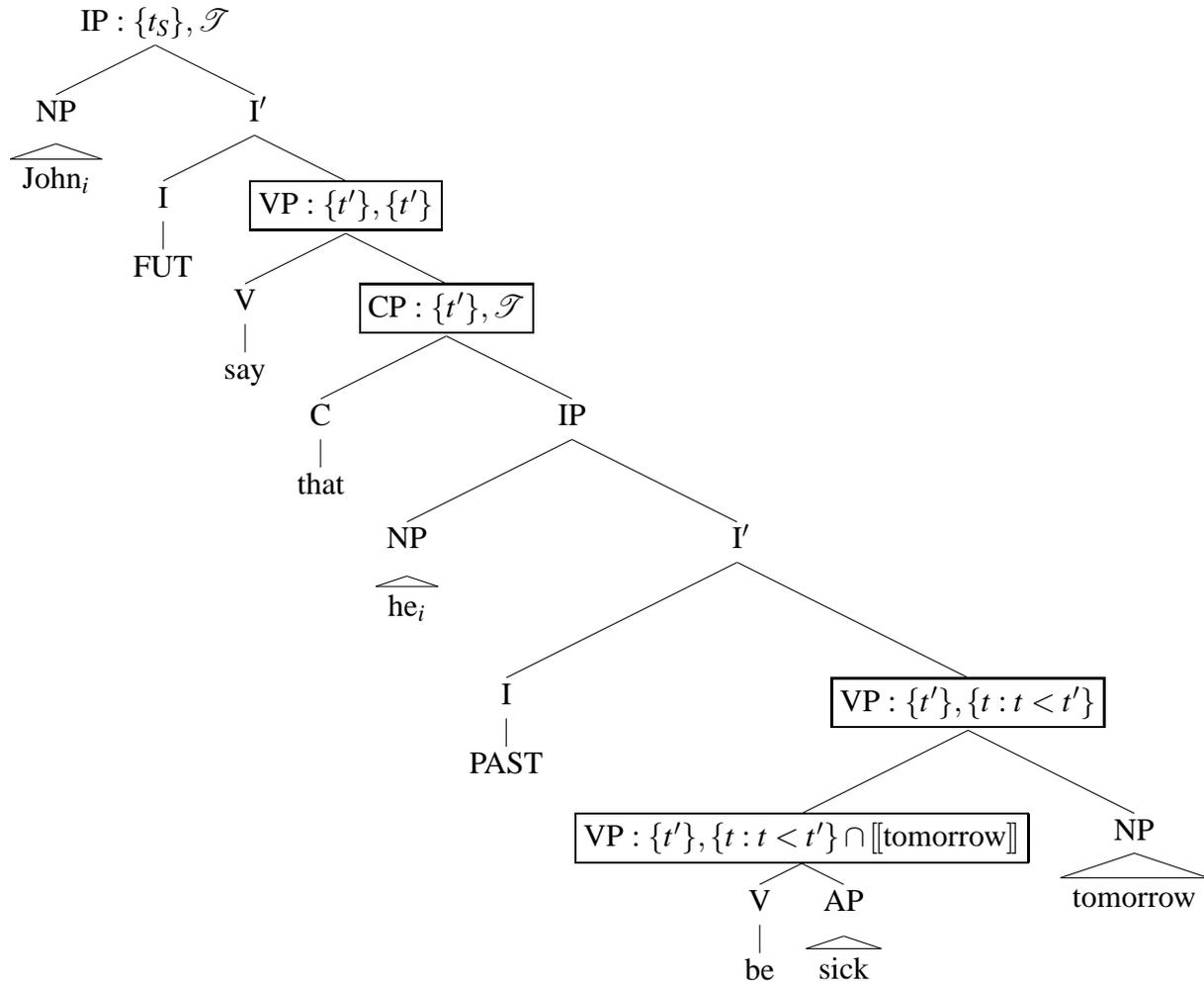


Figure 6.1: Derivation of “John will say that he was sick tomorrow.” Nodes are labeled in the format: NodeLabel :  $S, R$  where  $S$  corresponds to the value of  $i_S$  relative to which that constituent is evaluated, and  $R$  is its event restriction interval. Nodes in which  $S$  and/or  $R$  are modified have been boxed. In this figure it should be understood that  $t' > t_S$ , since FUT only quantifies over future intervals.

ing because the being-sick event and the saying event might actually be simultaneous, even though they are in the scope of different tenses. This is because *will* picks out a future time, then PERF extends the event restriction interval into the past relative to that time. Any time within that interval, the saying event can occur. *Be sick* is in the scope of PAST, but that PAST morpheme is being evaluated relative to the future time that *will* picked out, the same interval which was extended by PERF in the matrix clause. Hence, the saying event and the being-sick event may overlap.

Before moving on to relative clauses, there is one more critical observation to make. The present tense is always capable of referring either to  $i_S$ , or  $c_S$ . That is, the present tense is ambiguous between referring to the present relative to the index and the present relative to the context. This ambiguity is demonstrated in (6.21):

(6.21) *'John will say that he is sick' is ambiguous between the following two readings:*

- a. Reading 1: John will say that he is sick right now.
- b. Reading 2: John will say that he is sick at the time.

One could offer a number of casual explanations of this fact. I honestly do not know if any of them would be more explanatory than simply “that’s how English works”. At least there is a precedent for holding the present tense to a slightly different set of rules than the other English tenses. For example, in (Ogihara, 1989), the present tense *always*, refers to the utterance time, while the past and future constructions may have shifted readings as we have observed—Ogihara analyzes forward-shifted present-under-future constructions as having a semantically null embedded tense, resulting from his tense deletion rule. We will see more evidence of this present tense ambiguity in the following sections.

To summarize, we have made the following additions to ERI Theory in this section:

(6.22) *Additions to ERI Theory made in this section:*

1. Arguments of intensional verbs undergo a “reset” rule, which results in them being evaluated relative to the contextual event restriction interval  $c_R$ .
2. The future tense morpheme has the effect of *shifting*  $i_S$  into the future. We re-defined

FUT to reflect this property.

3. The present tense is always ambiguous between the the value of  $i_S$  relative to which it is evaluated, and  $c_S$ . In other words, the present tense undergoes shifted effects like all other  $i_S$ -relative temporal constructions, but also always has the capability of simply referring to the utterance time.

### 6.3 Relative Clauses

To properly account for the temporal semantics of relative clauses, we will employ techniques from the previous section as well as call upon a syntactic transformation known as quantifier raising (May, 1977). Quantifier raising (henceforth QR) is one of many ways to account for observed scope ambiguities which can occur between NP quantifiers. For example, the following sentence is ambiguous between asserting that everyone bought their own black dog or that everyone bought the same black dog (they got a group-ownership discount):

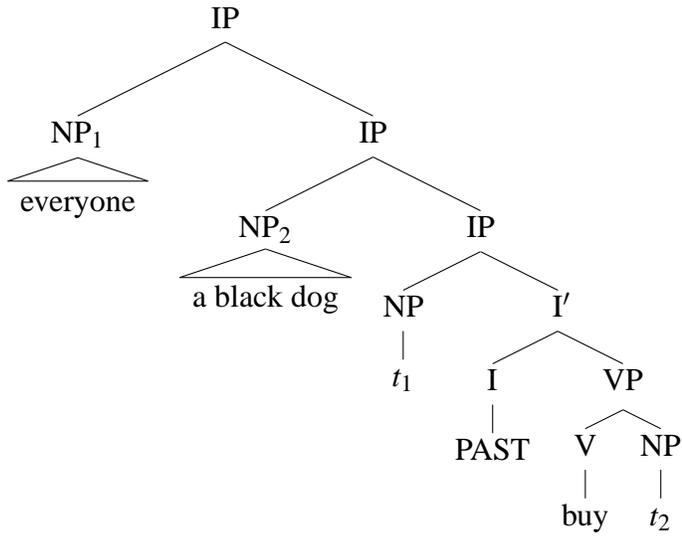
(6.23) *Example of quantifier scope ambiguities:*

Everyone bought a black dog.

QR is a syntactic transformation which optionally moves NP constituents from their in situ positions and adjoins them either to the IP node or the VP node. This transformation occurs after the PF/LF branch in the transformation pipeline, on the LF side, which is why the surface form does not observe the NPs to be in a raised position, but that we interpret them as if they were. Hence, the two ambiguous readings in (6.23) correspond to the two logical forms in figure 6.2, which correspond to the two possible orderings in which the QR transformations might have occurred.

With regard to relative clauses, we observe many of the same phenomena that we do with sentential arguments of intensional verbs. Relative clauses are prone to forward-shifted readings, and also seem immune to conflicts with  $R$ -modifiers in the matrix clause. The next few examples illustrate some of these observations:

a. *Everyone bought their own dog:*



b. *Everyone bought the same dog*

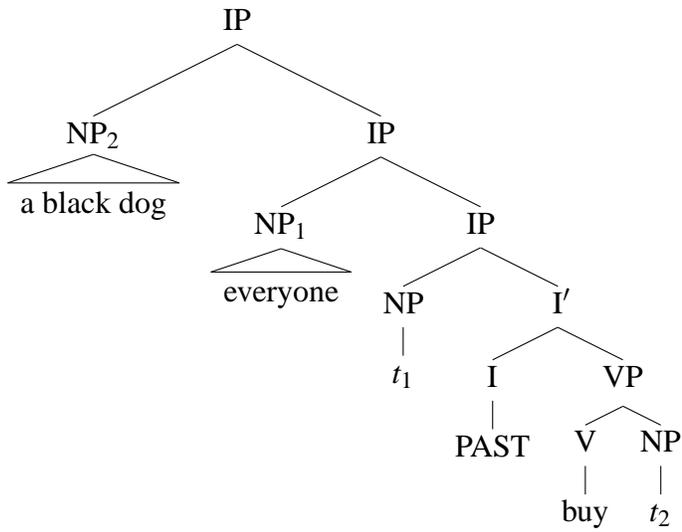


Figure 6.2: Two logical forms are possible for the sentence “Everyone bought a black dog”, due to the QR transformation rule.

(6.24) *Some properties of relative clauses:*

a. *Non-interaction with matrix R-modifiers:*

- (i) Yesterday, John bought a dog which will lose a leg tomorrow.
- (ii) Tomorrow, John will buy a dog which lost a leg yesterday.

b. *Forward-shifted readings:*

- (i) Next Tuesday, John will buy a dog which will lose a leg the next day.
- (ii) Next Tuesday, John will buy a dog which lost a leg the day before.

c. *Not forward-shifted readings:*

- (i) Next Tuesday, John will buy a dog which will lose a leg tomorrow.
- (ii) Next Tuesday, John will buy a dog which lost a leg yesterday.

d. *Ambiguous present tense:*

- (i) Next Tuesday, John will buy a dog which is shedding at the time.
- (ii) Next Tuesday, John will buy a dog which is shedding right now.

The examples in (6.24) demonstrate that relative clauses as extensional arguments (rather than intensional) have many of the same temporal properties as intensional arguments. Unlike intensional arguments, however, relative clauses seem to be *compatible* with forward-shifted readings under the future tense, but for relative clauses the shift is not mandatory. Note that each sentence in (6.24-b) has a corresponding not forward-shifted counterpart in (6.24-c). The observation that extensional relative clauses only *sometimes* have forward-shifted readings, while intensional arguments always do (when in the scope of FUT), can be analyzed as an effect of QR.

QR leaves an *e*-type trace behind, where the NP was base-generated. Hence, extensional verbs which take *e*-type arguments require a QR transformation in order to properly combine with their arguments (quantified NPs are  $\langle\langle e, t \rangle, t\rangle$ -type constituents). NPs which undergo QR are adjoined either to the VP node or the IP node. That there are two landing sites for such NPs explains why we can get both forward-shifted and not forward-shifted readings of such NPs. When FUT is involved, if the NP adjoins to the VP, then it is within the scope of FUT and therefore is evaluated relative to a shifted  $i_S$ . If the NP adjoins to the IP, then it is outside the scope of FUT (and all other

*R*-modifiers, for that matter), and therefore is evaluated relative to the non-shifted  $i_S$ . QR, like many other types of syntactic movement, is subject to “island” constraints as well (Ross, 1967). Hence, in (6.25) with the most natural reading (in which the buying precedes the losing, which precedes the scaring), the shedding event may be simultaneous with the scaring event or leg-losing event, but not the buying event. Since PRES may always denote  $c_S$  however, it may be simultaneous with the utterance time.

(6.25) *Some temporal interpretations are unavailable due to restrictions on QR:*

John will buy a dog which will lose a leg which will scare a cat which is shedding.

This is the case because the shedding-simultaneous-with-scaring interpretation is the result “a cat which is shedding” landing on the *scare* VP. The shedding-simultaneous-with-leg-losing interpretation is the result of the same NP landing on the *scare* IP. The shedding-simultaneous-with-buying interpretation, however, would require the same NP to land somewhere outside the leg-NP. This sort of movement is forbidden by general syntactic movement constraints, which is why the reading is not available.

Appealing to QR provides us with an analysis of why extensional relative clauses *may* be forward-shifted, but without some kind of reset rule, we will run into *R*-modifier conflicts. For example, the non-interaction examples in (6.24) would not be well-defined. In this case, we cannot rely on the verb to provide us with such a reset rule, because only the *e*-type trace is serving as the argument to the verb, which is immune to intensional operations. So, instead, we will integrate a similar reset rule into the semantics of complementizers:

(6.26) *Complementizers have a reset rule similar to intensional verbs:*

$$[[\text{COMP}]]^{c,i,g} = \lambda \varphi_{\langle s \langle e,t \rangle \rangle} . \text{comp}(\varphi, i[R \rightarrow c_R])$$

The above definition represents the semantic content of a (generic) complementizer as a *comp* function in the metalanguage. This function is meant as a paraphrase in the same style as we defined *say*. Whatever this content is, it is a function of a sentential argument  $\varphi$  and an index  $i$ . We

simply assert that *i* has its *R* element reset before it gets fed into *comp*.

Aside from dealing properly with extensional relative clauses, this treatment of complementizers has independent motivation. We need a reset rule anyway to prevent *R*-modifier conflicts in sentential subjects:

(6.27) *Complement clauses need a reset rule to avoid R-modifier conflicts in sentential subjects:*

That John bought a dog will surprise Mary.

While it may not seem like sentential subjects are within the scope of the matrix verb (they surface in the SpecIP position like all other subjects), there is reason to suppose that indeed they are. For example, (6.27) is compatible with John buying a dog in the future, but before Mary's surprise. We might analyze this by hypothesizing that subjects are base-generated in the SpecVP position and move into SpecIP only as part of the PF derivation.

QR is also a common means of explaining de dicto/de re ambiguities in cases involving intensional verbs. For example, the following sentence is ambiguous:

(6.28) *Example of de re/de dicto ambiguity:*

John seeks a unicorn.

- a. Reading 1: There is a unicorn which John seeks. (de re)
- b. Reading 2: John seeks a unicorn, but not any one in particular. (de dicto)

When QR is adopted as an analysis of de dicto/de re ambiguity, de dicto interpretations are said to correspond to the argument NP being interpreted in situ, and de re interpretations correspond to the NP undergoing QR movement. Hence, interpretations affected by scope interaction can be checked against the predictions generated by the QR analysis. For ERI Theory, a QR analysis of de dicto/de re ambiguity predicts that de dicto interpretations *only* have forward-shifted readings when in the scope of FUT (whereas de re interpretations may or may not be forward-shifted depending on their landing site). Looking at some examples confirms that this is indeed the case:

(6.29) *De dicto interpretations only have forward-shifted readings when in the scope of FUT:*

- a. Next week, John will buy a dog which died tomorrow.
- b. Next week, John will seek a dog which died tomorrow. (de dicto/de re)
- c. Next week, John will buy a dog which will die tomorrow.
- d. Next week, John will seek a dog which will die tomorrow. (\*de dicto/de re)

The design of the sentences in (6.29) force either a forward-shifted or not forward-shifted reading, but never both. Because *tomorrow* refers to a time between the matrix and subordinate event, only one of the two possibilities is ever felicitous. (6.29-a,c) contain extensional verbs much like we have see above in this section, provided for comparison. (6.29-b,d) contain intensional verbs and are therefore eligible to have de dicto readings. The QR analysis of de dicto/de re ambiguity predicts that de dicto interpretations *always* forward shift because they *must* be in the scope of FUT. (6.29) verifies this prediction. (6.29-b) forces a forward shifted reading, and both a de dicto and re interpretation are available. (6.29-d) forces a not forward-shifted reading, which also has the effect of forcing only a de re reading.

## 6.4 Discussion

This discussion of tense in embedded clauses is mainly a presentation of various phenomena traditionally labeled as *sequence-of-tense* (henceforth SOT) phenomena, and an explanation of how ERI Theory can account for our intuitions regarding them without the need for any syntactic SOT rules. Among the various attempts to account for SOT phenomena, those which employ syntactic rules have been more successful than those which do not. So, I begin by introducing the basic idea common to all syntactic SOT approaches. I then continue by introducing some of the more well-known alternatives. The seemingly unsolvable problems with the alternatives are the main motivation for the current consensus that syntactic SOT rules are necessary. After this introduction, I discuss each SOT phenomenon in turn, and explain how ERI Theory provides us with the apparatus we need to account for both our intuitions concerning them and the truth conditions associated with them.

The origin of SOT rules can be traced back to traditional analyses of indirect quotations. In some older analyses, indirect quotations are hypothesized to be related in some way to their direct counterparts. The surface form of a construction containing an indirect quotation, then, is the result of starting with a direct quotation, and applying certain systematic changes. In slightly more modern syntactic terminology, we might say that a direct quotation exists in the deep structure of a sentence and then, after some transformations have been applied, the surface form with its indirect counterpart is generated. For example, (6.30-a) is the surface form of something like (6.30-b):

(6.30) *Original analyses of indirect quotations posit actual quotations in the deep structure:*

- a. Surface Form: John said he was sick.
- b. Possible Deep Forms:
  - (i) John said I am sick.
  - (ii) John said I was sick.
  - (iii) \*John said I will be sick.

Such analyses contain syntactic SOT rules which replace some tense morphemes with other tense morphemes at some point between the deep form and surface form. One such rule in the case of (6.30) is that PRES becomes PAST if it occurs under PAST. This rule accounts for the derivation from (6.30-b-i) to (6.30-a). Then another rule (or possibly lack thereof) would result in PAST in the deep structure being unmodified if it surfaces under another PAST, which would account for the derivation from (6.30-b-ii) to (6.30-a). (6.30-b-iii) is then determined to not be a valid underlying form due to the lack of a rule that can transform *will* into *was*.

Analyses which posit quotations in the deep structure do not scale very well. They may or may not be a reasonable way to deal with indirect quotational verbs like *say*, but other intensional verbs do not require there ever to have been a quotation in the deep structure. For example *think* works in almost the same way as *say*, insofar as tense phenomena are concerned, but does it make sense to assume that the agent thought something of the same type as a quotation? Maybe. What about *insinuate*, which also generates the same tense phenomena as *say* and *think*, but almost certainly

does not take a quotation as an argument, since it explicitly describes things which were *not* said, but implied.

So, positing “real” quotations in the underlying sentence structure is probably not the way to go, but the intuitions that tenses are being interpreted in ways unlike how they surface survives. A more modern and well-received treatment of SOT phenomena can be found in (Ogihara, 1989), which is similar in spirit to a number of others, e.g. (Ladusaw, 1977; Abusch, 1988). Ogihara hypothesizes a syntactic tense-deletion rule which takes place after the PF/LF split on the LF side. Basically, the rule optionally deletes tense morphemes which share the same tense features as the tense morpheme immediately dominating them. When tenses are deleted, they leave behind a “null” tense, which does not manipulate any time variables, and therefore has the effect of allowing the immediately dominant tense morpheme to also pick out the time in subordinate clauses. So, in (6.30-a), if the tense deletion rule does not apply, then we are left with a *shifted* reading which is compatible with John originally saying “I was sick” in the past. If the tense deletion rule does trigger (since the subordinate *was* shares the same features as the matrix *was*), then we are left with a *simultaneous* reading which is compatible with John originally saying “I am sick” in the past. See figure 6.3 for an illustration of Ogihara’s tense deletion rule.

There are a variety of syntactic approaches to SOT phenomena, but they are all similar to Ogihara’s in that they rely on syntactic transformation rules of one form or another. Analyses of this kind are not very satisfying because the syntactic transformations they posit have no independent motivation. Thus, some have pursued alternatives which do not posit such rules. We might call this other class of theories the purely semantic theories or perhaps the non-SOT theories. An example of such a theory is (Enç, 1987).

Enç (1987), following (Partee, 1973) in supposing that tense morphemes are referential rather than quantificational, constructed a partial theory to try to explain phenomena like the simultaneous/shifted PAST-under-PAST ambiguity. In her theory, the ambiguity can be attributed to the fact that the subordinate past tense might either be coreferential with the matrix past tense, or it might not. Such behavior is analogous to how pronouns might either be coreferential or deictic in nature,



and each possibility seems to generate an independent reading.

It can be shown, however, that (Enç, 1987) simply is not correct, and other purely semantic SOT theories will share similar trouble. An example of a kind which is particularly troublesome for these theories is provided below:

(6.31) *An example which is troublesome for purely semantic explanations of SOT phenomena:*  
(cf. (Ogihara, 1989))

John said that he would buy a fish (tomorrow) which *was* still alive.

In (6.31), the emphasized tense morpheme is inflected for past, yet as indicated by the felicity of inserting *tomorrow*, the sentence is compatible with the fish-being-alive event occurring in the speaker's future. This kind of sentence is problematic because the fish-being-alive event occurs at least as late as any other event in the sentence, and therefore *was* cannot be treated as asserting any kind of relative past time. A semantic explanation which interprets *was* as having a temporal interpretation would have to end up asserting that the past tense here denotes simultaneity with the the future auxiliary *woll/would*. But justifying such a claim is difficult, since the two tenses do not share the same semantic features; it would be analogous to claiming that in a certain sentence, *he* and *she* are coreferential. *Would* of course exhibits past tense inflection and therefore they share syntactic features, but resorting to syntactic environments licensing different interpretations of tense morphemes is exactly what purely semantic (non-SOT) theories want to avoid.

And so, syntactic SOT theories are currently the most popular, simply because they work, and other kinds of approaches fall short. ERI Theory, however, has posited no such syntactic SOT rules so far, and I claim that it does not need to. The semantics presented thus far are adequate to explain the various SOT phenomena. In the subsections below I discuss each SOT phenomenon one-at-a-time.

### 6.4.1 The PAST-under-PAST Simultaneous/Shifted Ambiguity

When a past tense morpheme is interpreted within the scope of another past tense morpheme, such as in the case of intensional verbs taking arguments inflected for past, an ambiguity seems to arise. The two available readings are usually referred to as the *simultaneous* reading and the *shifted* reading. An example which illustrates this ambiguity is provided below:

(6.32) *'John said he was sick' is traditionally said to be ambiguous between the following two readings:*

- a. Reading 1: (Compatible with) John said, "I am sick."
- b. Reading 2: (Compatible with) John said, "I was sick."

(6.32-a) represents the simultaneous reading of PAST-under-PAST, and (6.32-b) represents the shifted reading of PAST-under-PAST. The intuition is that, since (6.32) is compatible with John having said two possible things, we should interpret the embedded past tense as having two possible interpretations. One interpretation, then, results in the shifted reading and the other results in the simultaneous reading.

This is the traditional analysis of PAST-under-PAST constructions, which is often taken without criticism by SOT theories, but it simply is not correct; it is far too restrictive. A simultaneous and a shifted reading are *actually* only two possible readings among many. And the plethora of other possibilities are often simply ignored. For example, (6.32) is compatible with *many* things that John might have said, not just two. Consider (6.33):

(6.33) *'John said he was sick' is compatible with John having said:*

- a. "I am sick."
- b. "I was sick."
- c. "I have been sick."
- d. "I had been sick."
- e. "I'm not feeling good."

- f. “I have not been feeling well.”
- g. “I have the flu.”
- h. (etc.)

*John said he was sick* is a faithful report of John saying any of (6.33-a-g) at some past time. John might have used a number of tense constructions including PRES, PAST, PRES PERF, and PAST PERF, and he might have used any number of possible ways of expressing his illness, including *sick*, *not feeling good*, and *not feeling well*. His statement does not even need to be of the same form as *AGENT TENSE COPULA ADJECTIVE*. He might have said “I have the flu” or even something more metaphorical such as “The flu has moved into my lungs.” As I have stressed in section 6.2, faithful reports need *not* be logically equivalent. As I mention in the beginning of this chapter, faithful reports require an entailment relationship from what is being reported to the report, but not vice versa. *John is/was/has been/had been sick*, *John is not feeling good/well*, and *John has the flu* all entail that *John was sick*, as spoken by the speaker at the utterance time.

Focusing on the temporal aspects of the relevant phrases, John might have used any combination of present or past tense with or without the perfect, and all such constructions temporally entail constructions the speaker might use which are in the simple past, as long as the saying event is in the past. This is so because the use of any of these particular tense constructions guarantees an event restriction interval which is a subset of the event restriction interval the speaker generates with the past tense alone. This *temporal entailment* between a given event restriction interval and its supersets is the same phenomenon responsible for the entailment relationship between the examples in (6.34), and all examples appearing below them:

(6.34) *Each example sentence temporally entails all sentences occurring below it:*

- a. John bought a dog this morning.
- b. John bought a dog today.
- c. John bought a dog this week.
- d. John bought a dog this month.

- e. John bought a dog this year.

Assuming no other (non-temporal) factors prevent such an entailment, constructions which generate a given event restriction interval  $R$  entail all constructions which generate an event restriction interval  $R'$  if  $R \subseteq R'$ .

We can take this idea even a step further. Suppose on Tuesday, John says (6.35). We might then (accurately) say on Friday any of the subexamples.

(6.35) *The following are all valid reports of John saying ‘I will work tomorrow evening’ on Tuesday:*

- a. (On Friday): John said he worked Wednesday evening.
- b. (On Friday): John said he worked this week.
- c. (On Friday): John said he worked.

Remember that *say* is an intensional verb and therefore applies temporal “reset” semantics to its arguments. The definition of the content of *say* is repeated here for convenience:

(6.36) *Definition of the semantic content of ‘say’:*

$$[[\text{say}]]^{c,i,g} = \lambda \varphi_{\langle s,t \rangle} . \lambda x_e . (\exists I \in \mathcal{I}) x \text{ says}(\varphi; i[R \rightarrow c_R]) \text{ over } I \text{ and } I \subseteq i_R$$

Therefore, the PAST morpheme in the matrix clause has no influence over the content of the embedded clause, and then *Wednesday* need not be in the past relative to the saying event, but only in the past relative to the utterance time.

Examples like (6.35) show that we can construct examples in which the reported event was expressed in the future tense, and report it in the past tense. But we can go a step further. The spirit of ERI Theory is that, insofar as temporal constructions are concerned, it does not matter which constructions were originally used in cases of indirect reports. If the report the speaker constructs is entailed by the claim being reported, then it can (probably) be considered an accurate report—remember, the entailment relationship is necessary but not sufficient. It might be pragmatically anomalous for a number of reasons, but accurate nevertheless.

At first glance, sentences like (6.35-a-c) might seem bad. Many might prefer constructions with *would* instead, such as “John said he would work Wednesday evening.” There is a reason for this preference, which is discussed in chapter 7, and which is pragmatic in nature. For now, suffice it to say that, when presented with examples like those in (6.35), people tend to imagine scenarios in which the time of John’s saying event is pragmatically relevant, and thus *would* is preferred because there is a pragmatically relevant past time it can refer to. But suppose a scenario in which neither the time of John’s saying event, nor even its existence, is particularly relevant. Suppose it is Friday, and Mary and Jane are two managers who are frantically trying to reconstruct their weekly employee work log, after carelessly losing it. Their boss will fire them if they do not deliver an accurate work log, and so they are asking each other about when various employees worked that week. John happens to have told Jane (on Tuesday), “I will work tomorrow evening.” The following discourse then seems at least a little bit more natural:

(6.37) Mary: OK, that takes care of Bill. Do you know when John worked this week?

Jane: Oh! John said he worked Wednesday evening!

Mary: OK great. Now what about Lucy?

And it is also not necessary for Mary to prime Jane with a simple past tense question. She could have simply said, “What about John?”, and we still get the desired effect. The reason why this is so, and why our need to use *would* instead of PAST has diminished, is that neither the time of nor the existence of the John-saying event is what is at issue. Only when he worked is at issue. In most cases where we report what someone said, that particular saying event is in the center of the pragmatic stage, and so we prefer to use constructions which take advantage of as much pragmatic information as possible, and which match the form of what was said as much as possible—it is strange to report “I bought a dog” as “He bought a member of *Canis lupus familiaris*”. In this example, however, Mary only says “John said” to mark her statement as hearsay, rather than as her own assertion. In fact, in an example like this, “John said he would work Wednesday evening” has its own pragmatic problems. If Jane replied in this manner, Mary might not be satisfied, and

follow up with, “Well did he or didn’t he?!” “John said he worked Wednesday evening” sounds more like an assertion, and “John said he would work Wednesday evening” sounds more like an old prediction. The situation does not call for predictions though, the situation calls for facts; their jobs are on the line!

And so I come to the conclusion that the traditional simultaneous/shifted ambiguity of PAST-under-PAST constructions is nothing more than two of the more likely possibilities given a context in which the speaker has the usual motive to simply relay what someone else said (or thought, or insinuated or whatever). In contexts where the speaker has other motives, however, what was *actually* said might be any number of things, including constructions which differ in their choice of tense morpheme. Thus, the simple event restriction interval “reset” rule that we implement for arguments of intensional verbs does not pose a problem when it comes to generating accurate reports. And simultaneous/shifted ambiguities do not require the reporter to use any particular temporal constructions when crafting her report.

One possible objection to this argument, which is based on temporal entailment, is that the notion of temporal entailment—that a construction which generates an event restriction interval  $R$  temporally entails all constructions which generate an event restriction interval  $R'$  if  $R \subseteq R'$ —does *not* hold in negative constructions. In positive examples, tense-like constructions could be said to exist in an *upward-entailing* environment and thus replacing them with constructions which denote supersets is a truth-preserving operation. But in negative examples, tense-like constructions exist in a *downward-entailing* environment, and thus the same sort of substitution should not be adequate. Consider (6.38):

(6.38) *‘John said he was not sick’ is an accurate report of the following (as well as others):*

- a. (At some past time) John: “I am not sick.”
- b. (At some past time) John: “I was not sick.”

Neither (6.38-a) nor (6.38-b) temporally entail that John was not sick from the point of view of the speaker (at the utterance time). John might have become sick after John’s statement but before the

utterance. So why is it acceptable for the speaker to make such a report?

These sorts of negative examples present problems not just for ERI Theory, but for most other tense theories as well. As is demonstrated by Partee's (1973) now oft-cited example below, we cannot get the right reading of these kinds of examples without some kind of mechanic which limits the times which can be picked out by tense morphemes.

(6.39) *Tense morphemes cannot simply mean existential quantification over all compatible times:*

I didn't turn off the stove.

(6.39-a) neither means the speaker *never* turned off stove before, nor does it merely mean that there is some time in the past at which the speaker does not turn off the stove (the only way for this to not be trivially true is if the speaker was constantly engaged in stove-turning-off events at all past times). Similarly, "John said he wasn't sick" does not mean that John said he has never been sick in the past (from any point of view). That would almost certainly be false. And it does not mean that John merely said that one can find a past time (again, from either point of view) at which he is not sick. That would almost certainly be true. Even if we had a mechanism which *exactly* picked out the same event restriction interval which was generated by the original statement, the entailment relationship still would not hold. But the reason it does not hold is not because we are mis-calculating intervals denoted by critical constructions. The reason it does not hold is because we are *mis-interpreting* critical constructions.

There must be something else which limits the times that tense morphemes pick out. Partee suggested that we treat tense morphemes as referential, where the specific tense morphology denotes something more like a constraint on the temporal reference. This would be analogous to treating tense morphemes like pronouns, but instead of referring to individuals they refer to times. In this case whether the tense morpheme is PAST, PRES, or FUT, would be analogous to the gender inflection a pronoun might take. I instead suggest that we deal with cases like this via pragmatically restricted quantification. I provide the details of this approach in chapter 7. Given a proper account

which correctly limits the quantificational force of tense-like constructions, replacing event restriction intervals with their supersets in negative constructions becomes a truth-preserving operation, since their quantificational force is going to be limited after the fact anyway.

So, these sorts of examples are certainly problematic. However, as the problem is pragmatic in nature, I address it in chapter 7. And it should be clear that in any case, examples like these are not arguments in favor of an SOT theory, since the syntactic transformations which are unique to SOT theories are not in and of themselves a solution to this problem.

### 6.4.2 The PRES-under-PAST Double-access Readings

Present tense morphemes surfacing under past tense morphemes generate *double-access* readings. In such double-access readings, it seems as if the subordinate clause is being evaluated simultaneously at the speaker's present time and at the time of the saying event. For example, consider the sentences in (6.40):

(6.40) *Examples of sentences which generate double-access readings:*

- a. John said that Mary is sick.
- b. John said that Mary is pregnant.

It seems that (6.40-a) is true just in case John said something which entails that Mary is sick both at the time of the past saying event and at the utterance time. Similarly, (6.40-b) seems to be true just in case Mary is pregnant both at the time of the past saying event and at the utterance time. However, similar to the case with the PAST-under-PAST simultaneous/shifted ambiguity, this double-access interpretation does not represent the truth conditions of such a construction, rather it is merely a very likely pragmatic story which accounts for the truth conditions.

The truth conditions of (6.40-a) are that John said something which entails that Mary is sick at the utterance time. Similarly, the truth conditions of (6.40-b) are that John said something which entails that Mary is pregnant at the utterance time. This analysis provides some clues concerning both why some speakers do not consider the sentences in (6.40) to be acceptable, and why those

who do, interpret such sentences as having a double-access quality.

It is likely that those speakers who do not like constructions like those in (6.40) reject them because the typical double-access readings they generate are not cases of actual entailment. Double-access interpretations are interpretations in which the statement being reported was constructed in the present tense, and due to the nature of the event described in the statement, it is reasonable to assume that whatever was the case, still is. However, this assumption is the result of reasoning and world knowledge, and therefore is an implicature, not an entailment. Consider (6.41):

(6.41) *Example dialog demonstrating how double-access readings are not entailments:*

Carl: John said Mary is sick.

Steve: Really? When did he say that?

Carl: Yesterday.

Steve: Have you talked to him since?

Carl: No.

Steve: So, we are just assuming then that Mary is still sick.

Carl: Well, yes.

Even if, in (6.41), Carl had talked to John only a few minutes ago, it is still possible that Mary got better between then and now and thus her present status of being sick is still just a probable conclusion. Thus, double-access interpretations require a little bit of lenience with regard to the entailment requirement between what was said and what is reported as having been said. Since one of the key factors which decides how probable it is that a past state still holds is the amount of time which has elapsed between the saying event and utterance time, we would suspect the acceptability of double-access interpretations to vary with that parameter. And indeed this is exactly what we observe. Consider (6.42):

(6.42) *Acceptability of PRES-under-PAST constructions varies with the time elapsed since the saying event:*

a. Just a moment ago, John said that Mary is sick.

- b. A few hours ago, John said that Mary is sick.
- c. ?Yesterday, John said that Mary is sick.
- d. ?A couple days ago, John said that Mary is sick.
- e. ??A couple weeks ago, John said that Mary is sick.
- f. \*Earlier this year, John said that Mary is sick.
- g. \*\*A couple years ago, John said that Mary is sick.

So, PRES-under-PAST constructions generate an *implicature* that a state was said to hold (at the time), and due to the nature of the state and the amount of time that elapsed since, it probably still does hold. Some states of course better lend themselves to double-access interpretations than others. For example, “John said that his dog is dead” should be fairly acceptable, due to the pragmatic unlikelihood of dogs resurrecting. Even so, through pedantic argumentation, PRES-under-PAST constructions with double access readings can generally be shown to be false. But, some use these constructions anyway, and rely on the implicatures they generate to carry the communicative burden.

As with PAST-under-PAST constructions there is actually a wide range of interpretations that PRESENT-under-PAST constructions lend themselves too. For instance, there are other things that John might have said which *do* actually entail that a state holds at the utterance time. While the traditional analysis of PRES-under-PAST constructions is that the agent said something in the present tense and the speaker is reporting it also in the present tense, John might have said something in the future tense, constructed in such a manner so as to guarantee entailment with what the speaker says at the utterance time. For example, consider (6.43):

(6.43) *PRES-under-PAST constructions can report future statements as well as present ones:*

John (to Carl, at 5pm): I will be at the bar from 8pm to 9pm tonight.

Carl (at 8:30pm): John said that he is at the bar.

In (6.43), the PRES-under-PAST construction *is* actually an entailment because John indeed did make a direct statement regarding his location at the utterance time. Again, some might prefer

to use *would* here. But, as with the unorthodox PAST-under-PAST examples, we can construct situations in which our urge to use *would* is lessened. The key is to consider cases in which neither John's statement, nor the time of it, are particularly relevant. Rather, what is relevant is *what* John said. For this task, we can once again consider our two managers, Mary and Jane, frantically reconstructing their weekly employee work log. They are reconstructing the log on Friday, and on Tuesday (or last week or whenever), John said to Mary, "I will work on Friday evening." Mary and Jane are in the regional office though, away from the actual work place and so they cannot directly observe who is working at the moment. In this case, the following discourse seems reasonable:

(6.44) Mary: Is that the whole log?

Jane: No, we're still missing today's shift.

Mary: Oh, I remember. John said he's working right now.

(6.44) is reasonable because the fact that John is working is what the discourse participants are interested in. Mary only formulates her statement with indirect discourse to communicate its hearsay nature. In general, we like to report past statements using either *was* or *would*, because these choices more closely match the form of the original construction (just like "John said he bought a dog" is preferred over "John said he bought a member of *Canis lupus familiaris*"), and generally when we make such reports the goal is to allow the listener to re-create the event of the original statement being made. In other words, when we make reports we are more interested what was said than what was communicated. By constructing situations in which what was said is of little interest, such as our employee work log examples, we can tease apart the truth conditions of reports from their pragmatic conventions.

### 6.4.3 Non-temporal PAST Constructions

The main topic of this discussion is those cases in which the temporal features of PAST are not interpreted. I abbreviate non-temporal past as *NTP* throughout this section. An example is provided below (cf. (Abusch, 1997)):

(6.45) *A Non-temporal past (NTP) construction:*

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

Examples like (6.45) are usually the nail in the coffin for tense theories which do not employ syntactic SOT rules. The problem is that the most deeply embedded verb (*were having*) is inflected for past tense, but the event the verb picks out takes place after the speech time and also after any other time mentioned in the sentence. So, the general conclusion is that if you interpret the temporal features of the past morpheme in cases like this, your theory is doomed.

To properly account for sentences like this, we need to refer back to chapter 5. Recall that in that chapter, I provide evidence which illustrates that the past tense morpheme is ambiguous between two readings. These two readings are repeated below for convenience:

(6.46) *PAST is ambiguous between two readings:*

- a.  $[[\text{PAST}_T]]^{c,i,g} = \{t : t < i_{S_0}\}$  (and open question of world-worlds correspondence)
- b.  $[[\text{PAST}_M]]^{c,i,g} = \{t : t \geq i_{S_f}\}$  (and closed question of world/words correspondence)

$\text{PAST}_T$ , the “temporal” reading, denotes the set of past times and that the question of world/words correspondence is open. That is, the clause the morpheme is in is *presented* with intent to compare to the actual world.  $\text{PAST}_M$ , the “modal” reading, denotes the set of non-past times, and that the question of world/words correspondence is closed. That is, the morpheme’s clause is *not* presented with any intent to compare to the actual world.  $\text{PAST}_M$  is only licensed in those environments which present their scopes as having a closed question of world/words correspondence. One such linguistic item is *would\_M*, which denotes non-past times and presents its scope as a hypothetical state of affairs—others include *wish* and conditional antecedents. The following sentences provide examples of  $\text{PAST}_M$  being licensed by some different constructions:

(6.47) *‘Would\_M’ and ‘wish’ license the non-temporal reading of PAST:*

- a. John would be the guy who was always late.

- b. John wishes that Mary was here.
- c. If John was here, he would be the life of the party.

In (6.47), the non-temporal readings of PAST are preferred, if not forced. That is, (6.47-a) does not interpret the being-late event as occurring in any relative past, rather the contribution of PAST here is that the being-late event is part of a hypothetical situation. Similar hypothetical interpretations are presented in (6.47-b,c).

Hence, given the analysis in chapter 5, we can account for the non-temporal reading of PAST in (6.45) by observing that it occurs within the scope of  $would_M$ , which licenses such a reading. Hence, there should be a normal temporal interpretation and a specialized, non-temporal interpretation. Indeed, we do observe that (6.46) is ambiguous. In one reading, John is informing his mother that they *were* having their last meal together at some previous time. This reading corresponds to the use of  $PAST_T$ . In the other reading, John is informing his mother that they *are* having their last meal together *at the time*. This reading corresponds to the use of  $PAST_M$ . Note that the second reading is essentially truth conditionally equivalent to (6.48-b). (6.48) demonstrates that  $PAST_M$  can sometimes be replaced with PRES to yield similar (temporal) truth conditions, but a different mode of presentation:

(6.48) *PAST<sub>M</sub> and PRES are sometimes truth-conditionally interchangeable:*

- a. John decided a week ago that in ten days at breakfast he would say to his mother that they *were* having their last meal together.
- b. John decided a week ago that in ten days at breakfast he would say to his mother that they *are* having their last meal together.

## Chapter 7 Pragmatic Discussions

Chapters 3–6 present a truth-conditional, semantic theory of tense and tense-like constructions. This could be considered a theory of *what is said* insofar as tense-like structures are concerned. It is not difficult though, to see that this is not equivalent to a theory of *what is meant* by the use of tense-like constructions. This difference between what is said and what is meant (or communicated) is of course one of the common ways of introducing the difference between the descriptive realms of semantics and pragmatics. While I do not intend to go in-depth into actual pragmatic theory, I feel it is worthwhile to discuss how such a pragmatic theory might interface with ERI Theory. This chapter provides some discussion on this topic.

### 7.1 Pragmatically Restricted Quantification

One of the phenomena firmly planted in pragmatics territory is placing appropriate restrictions on quantifiers. It is clear that such pragmatic restrictions occur very often. Consider the following examples:

(7.1) *The pragmatic module restricts domains of quantification:*

- a. A: Did you go to the party last night? B: Yes, everyone did.
- b. A: Did you find who you were looking for? B: No, I didn't see anyone.
- c. A: Have you always been this picky of an eater? B: Yes, always.
- d. A: Did you eat lunch? B: No.

All of the examples above are easy-to-see, clear-cut examples of pragmatically restricted quantification. (7.1-a) does not entail that *everyone* went to the party, but rather than everyone who is relevant did. (7.1-b) does not entail that B saw nobody at all, but rather nobody she was looking for. (7.1-c) cannot possibly range over all times, because B did not even exist at some past times and thus the question would be trivially false (those who do not exist cannot possibly be picky).

(7.1-d) is not inquiring about whether B has *ever* eaten lunch, but rather whether she has probably that day. I infer that, since this kind of quantification restriction occurs in so many other places, it is reasonable to assume that items defined under ERI Theory are no exception. I begin here by providing a formal notation for the restrictions we observe, and then continue by showing how some necessary assumptions illuminate some truths.

Let  $Q : \mathbb{N} \rightarrow \mathcal{P}(\mathcal{I})$  be the function which represents the influence of pragmatic quantifier restriction over times. Given a quantifier in the logical form, which we are assuming is uniquely indexed by a natural number,  $Q$  maps it to a set of intervals. This set of intervals can be considered the relevant set of intervals, over which that particular quantifier quantifies. Given  $Q$ , we then make the following modifications to some semantic definitions:

(7.2) *Pragmatically restricted versions of some semantic definitions:*

- a.  $[[\text{PERF}_n]]^{c,i,g} = \lambda \varphi_{\langle s, \langle e, t \rangle \rangle} . \lambda x_e .$   
 $(\exists I \in Q(n)) I \subseteq i_R \wedge \varphi(i[R \rightarrow I_-])(x)$
- b.  $[[\text{would}_{Tn}]]^{c,i,g} = \lambda \varphi_{\langle s, \langle e, t \rangle \rangle} . \lambda x_e .$   
 $(\exists I \in Q(n)) I \subseteq i_R \wedge \varphi(i[R \rightarrow \{t : t > I_f \wedge t < i_{S_0}\} ])(x)$
- c.  $[[\text{VERB}_n]]^{c,i,g} = \lambda x . \lambda y . \dots . (\exists I \in Q(n)) I \subseteq i_R \wedge \text{VERB}'(x, y, \dots)$  occurs over  $I$
- d.  $[[\text{FUT}_n]]^{c,i,g} = \lambda \varphi_{\langle s, \langle e, t \rangle \rangle} . \lambda x_e .$   
 $(\exists I \in Q(n)) (\forall r \subset I) I \subseteq i_R \cap \{t : t > i_{S_f}\} \wedge \varphi(i[S, R \rightarrow I]) \wedge \neg \varphi(i[S, R \rightarrow r])$

The only modification made in the definitions above is a replacement of  $\mathcal{I}$  with  $Q(n)$ , and an associated index on the definiendum. Hence, cases of unrestricted interval quantification are now restricted by the pragmatic module. Also, though I neglect to explicitly write it above in the interest of avoiding excessive verbosity, we stipulate that each of these above definitions is undefined just in case it is evaluated relative to  $i_R = \emptyset$ .

I also assume that  $c_S$  and  $c_R$  are pragmatically determined given myriad variables such as topic of discourse, context, and world knowledge. Let  $c_S$  by default contain the moment of utterance, and let  $c_R$  denote the entire *conceivable* timeline.  $c_R$  is thus a global limit on temporal quantification

for the entire utterance. In a theoretically “empty” pragmatic environment, the above definitions reduce to their original forms.

I use the language  $Q$  selects a domain  $D$  for a quantifier  $N$  to denote  $Q$  mapping  $N$  to  $D$ , where  $D$  is generally the set of subintervals of a particular interval. I denote the set of subintervals of an interval  $I$  as  $\mathcal{P}_{\mathcal{I}}(I) = \mathcal{P}(I) \cap \mathcal{I}$ .  $Q$  selects a time for each quantifier based off of the following general algorithm:

(7.3) *Q's strategy for domain selection*

1. If there is a compatible *salient* domain in the discourse or context, and selecting it would be informative and not misleading, select it. Otherwise ...
2. If selecting  $\mathcal{P}_{\mathcal{I}}(c_R)$  would be informative and not misleading, select it. Otherwise ...
3. Select a domain which is *reasonable*.

In (7.3-1) above, salient domains are domains which are pragmatically relevant due either to explicit mention in the discourse or due to implicit reference by the context, and which are on-topic (though it may be unnecessary to stipulate that they are on-topic since the discourse itself is part of the context). A salient domain is compatible (with the quantifier) iff mapping that quantifier to it yields a defined semantic content (i.e. if  $i_R$  is not reduced to  $\emptyset$  as a result). In (7.3-3), reasonable domains are domains which are selected out of necessity, because selecting  $\mathcal{P}_{\mathcal{I}}(c_R)$  would yield an uninformative or misleading result. Whether a domain is reasonable is dependent upon world knowledge and rational inference.

Lastly, before looking at how the concepts in this section apply to actual examples, I make the following statement relating temporal quantification and the cooperativity principle (Grice, 1989).

(7.4) *Applying the cooperativity principle to Q:*

1. Application to Maxim of Quantity: *Ceteris paribus*, utterances which temporally quantify over contextually salient domains are more informative than those which do not.

2. Application to Maxim of Manner: *Ceteris paribus*, utterances with more temporal quantifiers are less perspicuous than those with fewer, unless the extra temporal quantifiers select unique contextually salient domains.

To make sense of (7.4-1), note that utterances which do *not* temporally quantify over salient domains, quantify over either  $\mathcal{P}_{\mathcal{J}}(c_R)$  or an inferred domain (cases 2 and 3 in the selection algorithm respectively). Quantifying over a salient domain is more informative than quantifying over  $\mathcal{P}_{\mathcal{J}}(c_R)$  because a salient domain includes only *some* members of  $\mathcal{P}_{\mathcal{J}}(c_R)$  and is thus more restrictive. Quantifying over a salient domain is more informative than quantifying over an inferred domain because when quantifying over an inferred domain, the listener is burdened with the task of finding a suitable domain precisely *because* suitable information is lacking in the utterance.

(7.4-2) is almost a direct analog of what it means to be perspicuous in more general contexts. If one can communicate the same content in either fewer words or with a less complicated construction, then she is obliged to do so by the Gricean maxim of manner. Similarly, if one can communicate the same content with fewer instances of pragmatically restricted temporal quantification, she is compelled to do this as well. The one caveat is that *if* there are pragmatically relevant domains which the extra quantifiers can bind to, the more complicated construction is OK, due to its increased informativeness.

In the following sections, I illustrate how  $Q$ 's selection algorithm, coupled with the statements concerning cooperativity immediately above relate to our intuitions concerning actual examples.

## 7.2 Pragmatically Restricted Quantification as an Alternative to Referential Tense

An unrestricted quantificational tense semantics has immediate problems when applied to cases involving negation—actually problems of the same origin occur in non-negative examples too, but negative examples tend to be more illustrative. (Partee, 1973) provides the following example

which illustrates the problem:

(7.5) *While driving down the freeway, the speaker utters the following:*

I didn't turn off the stove.

- a.  $*\neg$  PAST (I turn off the stove)
- b.  $*\text{PAST} \neg$  (I turn off the stove)

Partee notes that, given a standard analysis of negation (false when its scope is true and vice versa), that when we treat tense operators as unbounded existential quantifiers over times, there is no scope relative to the tense operator which negation can take which properly describes the truth conditions of (7.5). If negation scopes over the tense, as in (7.5-a), then the resulting truth conditions assert that the agent has never turned the stove off before, which is almost certainly trivially false, and obviously not the intended meaning. If negation scopes under the tense, then the resulting truth conditions assert merely that there is a past time at which the agent did not turn the stove off, which is trivially true, since the only way it could be falsified is if the agent has been constantly turning off stoves since the beginning of time.

Partee's line of argumentation eventually leads to the hypothesis that tenses actually are not quantificational but referential in nature. (Partee, 1973) draws an analogy between tenses and personal pronouns, and observes that tenses seem to share some properties with pronouns, such as the capacity for being interpreted deictically, anaphorically, and so on. (Partee, 1984) later abandons the hypothesis of tenses being purely referential in favor of an analysis based on Discourse Representation Theory (Kamp, 1981; Kamp and Reyle, 1993).

ERI Theory is not a referential theory of tense. Tense morphemes in ERI Theory have quantificational force, and so there needs to be a way of properly accounting for examples like (7.5). The solution I adopt is to assume that the pragmatics module, like it does in so many other circumstances, restricts domains of quantification in tense-like constructions. I express this restriction with the function  $Q$  introduced in above. Given this assumption, an analysis of (7.5) would proceed as follows:

In the example, the agent suddenly utters this sentence while driving down the freeway. Hence, there are no salient domains provided either by the context (which is too general) or by the discourse—no previous discourse exists. Therefore, case 1 in the selection algorithm does not apply. We have already shown that *not* restricting the domain of quantification (i.e. selecting  $\mathcal{P}_{\mathcal{I}}(c_R)$ ) yields an uninformative (trivial) result. Therefore, case 3 in the selection algorithm applies. Case 3 calls upon world knowledge and rational inference for selecting a *reasonable* domain of quantification. World knowledge stipulates that people generally turn stoves off (if they are on) before leaving the house. Hence, a reasonable domain of quantification for a stove-turning-off event would be just before leaving the house. So, in (7.5), the existential quantification within the verb is restricted to times which are just before leaving the house. In this case, an informative statement is generated if negation takes wide scope, which asserts that there is no time just before leaving the house over which the agent turned off the stove. There really is no reason to suppose that negation takes narrow scope, but if it did, the result would still be uninformative, asserting merely that one can find a time just before leaving over which the agent did not turn off the stove. Due to the uninformative nature of this second reading, the first reading is highly preferred.

Moreover, it is possible to explain some of the pronoun-like behavior observed by Partee, given that temporal quantification is pragmatically restricted in this manner. For example, Partee provides the following example to illustrate the similarities between tenses and anaphoric pronouns:

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

The normal interpretation of (7.6) is that Sam got drunk *last Friday*, and not just at some arbitrary past time. A purely semantic interpretation of (7.6) does not generate this reading, since *last Friday* does not scope over *got drunk*. However, we can explain this apparent anaphoric behavior of the past tense by running through the temporal domain selection algorithm. This discourse explicitly mentions a salient temporal domain, namely *last Friday*. Therefore, case 1 in the selection algorithm applies. Case 1 instructs  $Q$  to select a salient time in the discourse or context if one exists which is compatible and yields a statement which is informative and not misleading. *Last Friday*

is salient since it has been explicitly mentioned, and selecting *last Friday* results in an informative, not misleading statement. So, the interval over which Sam gets drunk in (7.6) is restricted to subintervals of *last Friday*.

Partee also notes that there are cases in which tenses seem to behave very similarly to *bound* variables. One of the examples she provides for comparison is reproduced below:

(7.7) *One of Partee's examples likening tenses to bound variables:*

- a. If Susan comes in, John will leave immediately.
- b. If one of the arrows hits the target, it's mine.

Partee analyzes (7.7-a) as:  $(\exists t) \varphi(t) \supset \psi((\text{Imm}(\text{Fut}))((\text{it})\varphi(t)))$ , where  $\varphi$  is “Susan come in” and  $\psi$  is “John leave”. The way the time variable  $t$  is treated in this analysis is directly analogous to a standard why of treating *it* in (7.7-b) (viz. as an e-type anaphor). In (7.7-b), *it* could be analyzed as standing in for “the arrow that hits the target”, and in (7.7-a), Partee is claiming that the tense variable in the second clause could be analyzed as standing in for “the time at which Susan comes in”. Partee also provides a number of other examples which display similar time variable binding properties, some of them are reproduced below:

(7.8) *Some more of Partee's bound-tense examples:*

- a. When you eat Chinese food, you're always hungry an hour later.
- b. John never answers when I call his home.
- c. Richard always gave assignments that were due the next day.

While I do not provide a full-fledged analysis of temporal quantifiers here, it would seem that examples like those that Partee is pointing out could be handled in ERI in a way that is indeed very much like her analysis. In her analysis, a variable over times to which tenses refer is being quantified over in a number of ways. In ERI Theory, we could represent these readings by quantifying over  $i_S$  and/or  $i_R$ , the index elements relative to which the tenses are defined. In (7.9), I provide ERI Theory-compatible analyses of two of the examples above:

(7.9) *ERI Theory-compatible analyses of Partee's examples:*

- a. If Susan comes in ( $\varphi$ ), John will leave immediately ( $\psi$ ).

$$(\exists I \in \mathcal{I})\varphi(i[S \rightarrow I]) \rightarrow (\exists I \in \mathcal{I})\psi(i[S \rightarrow I])$$

- b. When you eat Chinese food ( $\varphi$ ), you're always hungry an hour later ( $\psi$ )

$$\forall I \in \mathcal{I}(\varphi(i[S \rightarrow I]) \rightarrow \psi(i[S \rightarrow I]))$$

The analysis in (7.9-a) is essentially a translation of Partee's above. The main difference is that Partee quantifies over times that tenses refer to, while I quantify  $i_S$ , relative to which tenses get their denotation. Note that the analysis in (7.9-b) differs slightly from the analysis I provide for temporal subordinate clauses. I suspect this is because *when* in this example has a different reading than the *when* I analyze in section 6.1. *When* seems to be ambiguous between the *when* in that section and the *when* encountered here, which could be read as *whenever*. So, in this particular case, it seems that quantified temporal variables indeed may be involved in these sorts of variables, and this idea is not incompatible with ERI Theory.

### 7.3 Pragmatically Restricted Quantification and Past Events

Without pragmatically restricting temporal quantification, it would be hard to account for our choice of tense constructions in different situations for describing past events. For example, without  $Q$ , ERI Theory predicts that, as long as there are no temporal adverbials present, simple past tense constructions and parallel past perfect constructions are logically equivalent. Also, ERI Theory would predict that these two constructions would be *practically* logically equivalent to their present perfect versions, which would generate an infinitesimally different event restriction interval—past and past perfect constructions evaluate the verb relative to  $i_R = \{t : t < i_{S_0}\}$ , while present perfect constructions evaluate the verb relative to  $i_R = \{t : t < i_{S_0}\} \cup \{t_S\}$ . Obviously, these three types of construction are not equivalent in usage, and so the question is how do we account for the interpretive differences we perceive as speakers of English? In the subsections below I apply the notion of pragmatically restricted quantification to analyze these intuitions.

### 7.3.1 The Simple Past and the Past Perfect

The meaning difference between the simple past and the past perfect can be informally explained in a few different ways. One of the common approaches to such an explanation is to call the past perfect an *iterated past* operator. For example, if the past tense has the effect of moving some evaluation time into the past, and then evaluating the untensed (or present tense) sentence at that past time, then the past perfect is sometimes explained as moving into the past, then doing it again, before finally arriving at the past time relative to which the sentence should be evaluated. This sort of intuition is made explicit in early tense logics in the style of (Prior, 1967). Such logics have a  $P$  operator, such that e.g. “John ate a sandwich” is logically represented as  $P(\text{John eats a sandwich})$ . The representation of a simple past form of a proposition  $\phi$  would be  $P\phi$  while the past perfect form would be  $PP\phi$ , with an iterated  $P$  operator. There is some linguistic evidence which supports this kind of interpretation. For example, in Korean, the form of the past perfect actually looks as if the simple past were applied twice:

(7.10) *Korean past perfect looks like a double-applied past:*

- a. con-un cemsim mek-ess-ta  
john-TOP lunch eat-PAST-IND  
“John ate lunch.”
- b. con-un cemsim mek-ess-ess-ta  
john-TOP lunch eat-PERF-PAST-IND  
“John had eaten lunch.”

Another strategy for explaining the difference between the simple past and the past perfect is to state that the simple past describes the time of an event as in the past relative to the utterance time, while the past perfect describes the time of an event relative to some other time—let’s call it a *reference time*—which is in the past relative to the utterance time. This is the main intuition presented in (Reichenbach, 1947) and works based thereon. In a Reichenbachian framework, the tense describes the temporal ordering of the utterance time and a reference time, while the presence or absence of the perfect describes the temporal ordering of the event time relative to this reference

time. Linguistic evidence which supports this kind of approach includes examples in which adverbials seem to be capable of explicitly modifying the reference time, rather than the event time. For instance, in (7.11), *yesterday* can describe either the event time or the reference time:

(7.11) *In English past perfect constructions, adverbials can sometimes modify the Reichenbachian reference time:*

- a. Last Tuesday, John had eaten a sandwich.

The critical difference between simple past and past perfect is not *just* that we take two hops to get to the event time instead of one (à la Prior), or that we express the event time relative to a reference time (à la Reichenbach), but rather that the Priorean pit stop and the Reichenbachian reference time *are not arbitrary*. For a past perfect construction to be felicitous is a discourse, it is not enough that we *can* describe the event time in terms of two hops, or in terms of a reference time, but that there is already some obvious time where we make the temporal pit stop, or which we can name as the reference time. By pragmatically restricting all temporal quantification, this sort of intuition can be made somewhat formal. To show this, I first demonstrate why, in a context with no suitable salient times mentioned, the simple past is preferred. Then I demonstrate why, in a context in which such a salient time does exist, the past perfect is preferred if the event time precedes it.

Suppose a discourse where no events related to the one John is about describe have yet been mentioned. John might be either initiating the discourse, or changing topic perhaps. If John simply wanted to inform the discourse participants that he went to a party, he would prefer to say (7.12-a), but not (7.12-b):

- (7.12) a. I went to a party.  
b. #I had gone to a party.

The difference between (7.12-a) and (7.12-b) is that (7.12-b) involves one more instance of temporal quantification than (7.12-a). Hence, (7.12-b) involves one more instance of *Q*. To restate

our earlier claim regarding the Gricean maxim of manner: *Ceteris paribus*, utterances with more temporal quantifiers are less perspicuous than those with fewer, unless the extra temporal quantifiers select contextually salient domains. We can defend this claim by observing that, if there is no contextually salient domain for a temporal quantifier to quantify over, then it either defaults to  $\mathcal{P}_{\mathcal{J}(c_R)}$ , or burdens the listener with *finding* a domain as a last resort. Neither of these options are preferable to simply omitting this quantifier in the first place. (7.12-a) has a minimal number of temporal quantifiers—quantification in the verb is unavoidable—but (7.12-b) has an extra quantifier in the content of PERF. There is no salient domain in the discourse which this quantifier can select, which results in a violation of manner.

Now suppose John continues to say either (7.13-a) or (7.13-b):

- (7.13) a. I went to a club.  
 b. I had gone to a club.

If John says (7.13-a), the prominent reading is that going to a club happened around the same time as the party. Perhaps the party was at a club, or maybe everyone at the party went to the club. If John says (7.13-b), the prominent reading is that John went to a club before the party. These readings are predicted by applying the domain selection algorithm.

If we apply the algorithm to (7.13-a), the result is that the quantifier in PERF selects the party time, and the quantifier in the verb selects a reasonable domain (e.g. not too long beforehand). The analysis proceeds as follows: there are two temporal quantifiers, and one salient domain in the discourse—let’s call it  $I_P$ , the set of party intervals. There are then four possibilities: 1) both quantifiers select  $I_P$ , 2) neither quantifier selects  $I_P$ , 3) only the verb quantifier selects  $I_P$ , and 4) only the PERF quantifier selects  $I_P$ . Case 1 is a violation of manner, because the resulting meaning is equivalent to what the simple past would deliver; the verb selects the party time and whatever PERF selects is superfluous. Case 2 goes against the selection algorithm, because step 1 in the algorithm is to select a salient domain if possible, yet nothing has selected  $I_P$ . Case 3 is a violation of manner for the same reason that case (1) is; if the verb selects  $I_P$ , then PERF becomes

superfluous. This leaves us with case 4, in which PERF selects  $I_P$ , and the verb does not. In this case, since the verb selecting  $\mathcal{P}_{\mathcal{J}}(C_R)$  would be quite uninformative, the quantifier defaults to step 3 in the selection algorithm, which says to select something reasonable. And indeed this is the interpretation we expect.

### 7.3.2 The Present Perfect

Our notion of pragmatically restricted temporal quantification and how it interacts with discourse and context also provides some explanations regarding present perfect constructions. In English, situations which call for use of the present perfect are numerous, and at first seem rather disjoint. Sometimes the various usages are linked together by some vague concept of *current relevance*. I will show, however, that the various interpretations of the present tense are implicatures, which we can predict given how we have chosen to treat pragmatically restricted quantification.

Some of the various readings that have been attributed to the present perfect are listed below:

(7.14) *Some common interpretations of the present perfect:*

a. *The Continuous Interpretation*

John has lived in Urbana for 5 years.

b. *The “Hot News” Interpretation*

Aliens have attacked Washington!

c. *The Existential Interpretation*

John has been to Antarctica.

The continuous interpretation generates the implicature that a state described by the event still obtains at the utterance time. For example, (7.14-a) explicitly is talking about a state (viz. living in Urbana) and carries the implicature that it still holds (i.e. that John *still* lives in Urbana). Hot news interpretations are called for when, for lack of a better term, the events described in the sentence are hot news. Events described by present perfect sentences with this reading are usually very recent, and exciting or unexpected. Lastly, we have the existential uses of the present perfect.

These readings are generally formalized with unrestricted existential quantification over past times, leading to an interpretation which is true just in case the event has *ever* happened. For example, (7.14-c) seems to assert that, at some past time, John has been to Antarctica, and only the fact that this trip has taken place at all seems to be at issue.

There are two unique properties of the present perfect (when compared to the simple past and the past perfect) which are responsible for the various readings we observe: 1) the present perfect is the only past construction which includes the utterance time in the event restriction interval, and 2) the present perfect is the only past construction which is pragmatically incompatible with selecting salient quantificational domains.

The first property is simple to show: The present perfect is the result of the present tense combining with PERF. The present tense denotes  $i_S$  (or  $c_S$ ), and PERF denotes an interval  $I_-$  where  $I \subseteq i_R$ . Since in the case of the present perfect,  $i_R$  is a singleton interval when fed into PERF, the result is that the present perfect sets the event restriction interval to  $i_{S_-}$ . Also, neither simple past nor past perfect constructions include the moment of utterance; simple past constructions set  $i_R$  strictly to the past moments, and PERF is only capable of extending  $i_R$  further into the past.

We can see that the second property holds by applying our earlier statements concerning the cooperativity principle. Let's start by assuming that there *is* a salient domain provided by the discourse. We first notice that the quantifier in PERF cannot select it, since the event restriction interval relative to which PERF is evaluated contains only the utterance time. So unless it is the trivial case in which the salient domain *is* the utterance time, PERF is unable to select a salient domain. This leaves us with the verb selecting the salient domain. But, this would be a violation of manner, since this would be equivalent to a corresponding simple past construction (which is more perspicuous than the present perfect). In other words, in this case, PERF is adding a superfluous temporal quantifier. Hence, the only way for the present perfect to not be a manner violation is if neither PERF nor the verb select a salient temporal domain.

The first property, that the present perfect is the only past construction which includes the utterance time, is responsible for the continuous reading and the hot news reading. The analysis

of the continuous reading is fairly straight-forward. Since the present perfect is the only past construction which includes the utterance time, it is also the only past construction suitable for expressing that a past event overlaps with the utterance time (i.e. that a past state still obtains). So, if the speaker wishes to communicate that an *event* overlaps with the utterance time, she is compelled to use the present perfect. Hence a listener is justified in inferring, given that the speaker has used the present perfect, that the speaker is communicating that an event still obtains. The hot news reading is borne out of the same reasoning. Hot news is news which is extremely recent. Hence, the present perfect is the most well-suited construction for communicating such news. While it may not be literally true that the described event overlaps with the utterance time, hot news readings advertise events as if they do. For example, (7.14-b) (“Aliens have attacked Washington!”) sounds as if the aliens *just* finished their attack.

The second property, that the present perfect is pragmatically incompatible with selecting salient quantificational domains, is responsible for the existential reading. Given this property, the analysis is almost self-explanatory. Because the present perfect is pragmatically incompatible with selecting salient quantificational domains, the event restriction interval in such cases tends to have no lower bound—PERF extends  $i_S$  indefinitely into the past. If the present perfect is used cooperatively, then the temporal quantifier in the verb selects no salient domain, and quantifies instead over all past times (as well as the utterance time). But, quantifying over all past times is exactly how we represent existential readings; quantified statements like this are true just in case the event being described *ever* took place.

## **7.4 Pragmatically Restricted Quantification and Indirect Discourse**

In sections 6.4.1 and 6.4.2, we discussed indirect discourse, specifically PAST-under-PAST and PRES-under-PAST constructions. In these sections I make the claim that the main heuristic for determining the acceptability of indirect discourse is whether what is being reported entails the

report. This accounts for why reports like (7.15) are valid, even though in the example, John never used the phrase “*Canis lupus familiaris*”.

(7.15) *Example illustrating the entailment heuristic for indirect discourse:*

John: I bought a dog.

Mary (later): John said he bought a member of *Canis lupus familiaris*.

The entailment heuristic is also the main tool I use in explaining our choice of tense in indirect discourse. This accounts for our intuition that John might, for example, formulate his statement in the simple past, or past perfect, or even present perfect, and we can later report either of these choices in the simple past. This is a nice outcome, since the syntactically-based SOT theories—which we are competing against—tend to make much narrower predictions of acceptability (e.g. that John using the present perfect ought to be reported with the past perfect).

Though, in addition to providing an explanation as to why our choice of tense in indirect discourse may not be as restricted as we might think, the entailment heuristic also makes some predictions which, for some, might be a little hard to swallow. The clearest examples which illustrate the issue are examples in which what is being reported was formulated in the *future* tense, and the report contains neither *will* nor *would*. (7.16) contains some concrete examples:

(7.16) *Examples of indirect discourse reporting future tense statements, without using ‘will’ or ‘would’:*

a. John (on Tuesday): I will work on Wednesday.

Mary (on Friday): John said he worked on Wednesday.

b. John (on Tuesday): I will work on Friday.

Mary (on Friday): John said he is working right now.

In (7.16), the entailment heuristic holds between what John says at the time John says it, and what Mary reports at the time she reports it. However, there is still a decreased acceptability for these reports. Much preferred would be Mary saying, “John said he *would* work on Wednesday”, in the

case of (7.16-a), and “John said he *would* work right now”, in the case of (7.16-b). In an attempt to show how discourses like those in (7.16) *can* be acceptable, I engineer examples which lessen the relevance of the time of John’s claim, or the fact that John made an earlier claim, and which instead focus on the content of the claim itself—these were the employee work log examples. One such example is repeated below for convenience:

(7.17) *Reproduction of ‘employee work log example’:*

*On Friday, Mary and Jane are discussing when John said he was going to work that week...*

Mary: OK, that takes care of Bill. Do you know when John worked this week?

Jane: Oh! John said he worked Wednesday evening!

Mary: OK great. Now what about Lucy?

While I do have an intuition that the badness of these kinds of reports is reduced when the attention is shifted away from the original statement event, it may or may not be that others share this intuition, and an empirical investigation may be in order to settle the matter. It is obvious, however, that whether or not examples like (7.17) are acceptable, they are still worse than their counterparts which use *would* constructions. And I believe I am capable of offering an explanation as to why this is.

Let’s assume that, in the case of indirect discourse, the original statement event (i.e. that which is being reported), is available as a salient temporal domain in the discourse. This assumption is consistent with our definition of salient domain: one which is explicitly mentioned in the discourse or implicitly referenced by the context. Sentences containing indirect discourse include an intensional verb like *say*, and thus the time of the event which is being described by that verb is salient due to being explicitly mentioned. Given this assumption, our preference to use *would* in reports like those above, as well as some other preferences of a similar nature, can be explained by appealing to pragmatically restricted temporal quantification.

In cases in which what was originally said was formulated in the future tense, we prefer to report the event using *would* because, in a sense, such reports are more informative than their simple past tense alternatives. Recall our interpretation of the Gricean maxim of quantity regarding pragmatically restricted temporal quantification: *Ceteris paribus*, utterances which temporally quantify over contextually salient domains are more informative than those which do not.

With this in mind, let's revisit one of our examples:

(7.18) *Reproduced from above:*

John (on Tuesday): I will work on Wednesday.

a. Mary (on Friday): John said he worked on Wednesday.

b. Mary (on Friday): John said he would work on Wednesday.

In (7.18-a,b), John's statement is salient in the discourse, as a result of being explicitly mentioned in the report. (7.18-b) is generally preferable to (7.18-a). Recall the definition of *would<sub>T</sub>*:

(7.19) *Definition of 'would<sub>T</sub>':*

$$[[\text{would}_{Tn}]]^{c,i,g} = \lambda \varphi_{\langle s, \langle e, t \rangle \rangle} . \lambda x_e . (\exists I \in Q(n)) I \subseteq i_R \wedge \varphi(i[R \rightarrow \{t : t > I_f \wedge t < i_{S_0}\}]) (x)$$

Looking at (7.18-b), *would<sub>T</sub>* existentially quantifies over subintervals of  $i_R$ , and denotes the interval between that interval and the utterance time. Since John's saying event is salient in the discourse,  $Q$  in this case selects it as its domain of quantification, which is step 1 in the selection algorithm. Hence, the working event is restricted to the times after John's saying event and before the utterance. In the case of (7.19-a) though, PAST is used instead of *would*, and hence the only temporal quantification taking place in this example occurs in the verb. John's saying event is still salient, since it was still mentioned, but it is not a suitable domain for the quantifier in the verb, since selecting it would yield the wrong reading (viz. that John was working when he made his statement). In either case, the interval over which the working event occurs is restricted to Wednesday, due to the explicit temporal adverbial, though the *would* construction quantifies over more salient intervals than the simple past construction does, and as such could be considered more

informative.

This line of reasoning also might say something about our intuitions regarding (7.20):

(7.20) *Comparing simple past and past perfect reports of past tense statements:*

John (on Tuesday): I bought a dog on Monday.

- a. Mary (later): John said he bought a dog on Monday.
- b. Mary (later): John said he had bought a dog on Monday.

If we apply the same line of reasoning to (7.20), we conclude that one of the ways in which our interpretation of (7.20-b) might differ from (7.20-a) is that (7.20-b) is, in a similar way, more informative. This is because the quantifier in the embedded PERF can select John's saying event as its domain.

More work needs to be done on this topic, however. For a number of reasons, the analysis given here still leaves something to be desired. First of all, the pragmatic theory adopted here is a first approximation at best. The actual manner in which temporal quantification is restricted is surely not as simple as the 1-2-3 process presented in this chapter. Also, the reasoning applied in this section may explain a difference in interpretation between simple past and *would* reports of future tense statements, and between simple past and past perfect reports of past tense statements, but it still fails to explain why the difference in acceptability between *would* reports and simple past reports in the relevant examples seems to be so much greater than the difference in acceptability between past perfect reports and simple past reports in the relevant examples.

## Chapter 8 Themes in the Literature

In this chapter, I discuss some of the overarching themes in the literature of tense semantics. I would like to emphasize *some*, in that there are a great number of such themes to potentially discuss. And the specific topics I have chosen are based as much on personal interest as anything else. In general, if a specific approach or implementation is being discussed, I try to limit the presentation of formal details as much as possible, providing merely enough so that the reader can get a “feel” for how the specific formalism is set up. More interesting to me are the broad-based questions which center more on the theoretical assumptions of a particular class of theories, rather than the technical problems borne out of any particular theory. I try to provide references which function as good “seeds” for the interested reader. In section 8.1, I look at the philosophical commitments of ordering time as an A-series vs. a B-series. In section 8.2, I look at the Reichenbachian program in general, including one specific implementation of it, and discuss Hornstein’s (1990) take on it, which I believe deserves special attention. Finally, in section 8.3, I investigate the origins, merits, and weaknesses of *referential* tense theories.

### 8.1 Time and Ontological Commitments

One of the things that all human languages seem to have in common is the ability to represent temporal properties of events (or propositions about them), and of course English is no exception. English has a number of tools which may be employed to this end. These tools include the adjectives *early* and *late*, and the the corresponding comparative and superlative forms (e.g. *earlier/earliest*), an adverb inventory which include temporal ones like *before* and *after*, temporal nominals such as *yesterday* and *the past*, and of course, an elaborate tense system which has been the main topic of discussion throughout this dissertation. Hence, a complete semantics of any natural language cannot escape talking about time. But, we cannot talk about time without making some assumptions about its properties, and it is a mistake to consider these fundamental

assumptions either superficial, obvious, or merely contained in the realm of philosophical debate.

Modern philosophical wisdom would suggest that time (if it exists at all) can be modeled as an ordering relation between events (or maybe between propositions). This ordering relation can come in one of two general flavors. These two types of orderings are due to J. M. E. McTaggart (1908). McTaggart categorizes one ordering relation, the *A-series*, in terms of our notion of past, present, and future. The other ordering relation, the *B-series*, is defined in terms of temporal precedence (i.e. earlier and later). The ramifications of treating time as an A-series or a B-series (or both) are vast, but certain critical consequences of each hypothesis have been mapped out.

In a reality where time forms an A-series, all that exists exists *now*. For this reason, theories which are based on the assumption that time forms an A-series are sometimes called *presentist* theories (and those who subscribe to them *presentists* or *A-theorists*). In such theories, it does not make sense to talk about future or past times in a rigorous way, because there are no such objects. It might be the case that there *will* be such objects, or that there *were* such objects, but not that there *are* such objects which exist in the future or past. An event which is not occurring at the present can be described as either occurring in the future or the past (if it occurs at all), and can be ordered relative to other events by virtue of being more or less past or future than others. If time forms an A-series, then the concepts of past and future, and the various gradations of these concepts, are fundamental. The semantic ramifications of this sort of view is that truth conditions are tensed, and that temporal expressions other than tense should be reduced to notions of tense.

In a reality where time forms a B-series, all that has, does, or will ever exist, is equally real. Theories based on a B-series conception of time are sometimes called *eternalist* theories. Such theories reduce our notions of past, present, and future events to notions of the present time being after, simultaneous with, or before event times respectively. If we adopt a B-series conception of time, we might imagine events existing on a timeline (which exists), and ourselves as observers traveling this line as natural law dictates, capable of observing only those things which are collocated with us on the timeline. The semantic ramifications of this sort of view are that truth conditions are untensed, and therefore that notions of tense should be reduced to notions of moments and their

precedence-based ordering, which are fundamental.

The main concern of (McTaggart, 1908) is whether time forms an A-series as well as a B-series. This work draws two famous conclusions on the matter. The first is that the A-series is necessary, the second interestingly enough, is that the A-series is incoherent. The basic reasoning behind concluding that an A-series is necessary is that a world without an A-series is a world without change. Without an A-series, everything would exist at a fixed (unchanging) temporal point. But this is contrary to our observations. Indeed, events at one point are future events, then they *become* present events, and then past events. That events can have these properties and that those properties can change suggests that an A-series is necessary. The conclusion that an A-series is incoherent comes from the claim that an event can be past, present, *and* future, which is contradictory. The obvious response to this claim is that events may have all these properties, but not at the same time; an event which *is* past, *was* present and future, and so on. McTaggart notes that this line of reasoning is doomed to infinite regress, as we have enlisted the notions of *past*, *present*, and *future* to explain our notions of *past*, *present*, and *future*. McTaggart's eventual conclusion is that time is unreal, an illusion. Those that do not wish to share his conclusion, then, are burdened with the task of consolidating their theories with McTaggart's observations. Today, philosophers of language are generally divided into two camps (insofar as tense is concerned), the A-theorists and the B-theorists. Each camp is charged with the task of reducing the other camp's theory to the terms of their own, and each is faced with their own challenges.

### **8.1.1 The Challenge of an A-series Semantics**

One of original champions of A-series temporal semantics is Arthur Prior (1967). In Prior's system, the semantics of tenses are represented by operators on propositions. A proposition  $\phi$  inflected for past tense is of the logical form  $P\phi$ , a proposition inflected for future tense is of the logical form  $F\phi$ , etc. The definitions of the basic tense operators are presented below:

(8.1) *The semantics of the basic tenses in (Prior, 1967):*

- $P\varphi$  is true iff it was the case that  $\varphi$ .
- $F\varphi$  is true iff it will be the case that  $\varphi$ .

Prior represents complex tenses by iterating these basic tense operators. For example, a past perfect proposition has the form  $PP\varphi$ , and a future perfect proposition has the form  $FP\varphi$ . Propositions of this form are analyzed in the following manner:

(8.2) *The semantics of the complex tenses in (Prior, 1967):*

- $PP\varphi$  is true if it was the case that  $P\varphi$ .
- $FF\varphi$  is true if it will be the case that  $P\varphi$ .

Prior's system has gotten plenty of criticism, especially where the complex tenses are concerned. One of the unfortunate predictions it makes is that, if time is dense, then the simple past and the past perfect would be logically equivalent (or practically equivalent, if time is composed of finite units). This illuminates one of the main problems for A-theorists: if past and future times are not real, then a semantics cannot make reference to them, but proper interpretation of complex tenses seems to require such reference. Our intuitions regarding the truth of past perfect utterances is that they are expressing the temporal location of an event as prior to a *specific* past time. We do not interpret past perfect sentences simply as being *more* past than simple past sentences.

A modern attempt at accounting for our intuitions while preserving an A-series semantics is presented in (Ludlow, 1999). Ludlow's general strategy is to suppose the existence of something like a temporal analog of E-type anaphora. E-type anaphora are anaphors which stand proxy to linguistic *descriptions* which can be recovered from the context or discourse. Some examples are below:

(8.3) *Some examples of E-type anaphora:*

- a. Every farmer who owns a donkey beats it.
- b. A dog entered the room. It bit me.

In (8.3), the two instances of *it* are instances of E-type anaphora. They cannot be bound anaphora, since the truth conditions under such an analysis are wrong. For example, if *it* were interpreted as a bound anaphor in (8.3-a), then the sentence would have one of the meanings in (8.4):

(8.4) *Possible bound-anaphor interpretations of (8.3-a):*

- a.  $(\exists x : \text{donkey } x)(\forall y : \text{farmer } y) [y \text{ owns } x \rightarrow y \text{ beats } x]$ .
- b.  $(\forall y : \text{farmer } y)(\exists x : \text{donkey } x) [y \text{ owns } x \rightarrow y \text{ beats } x]$ .

However, neither of these interpretations are correct. In (8.4-a), there need be only one donkey who gets beaten by its owner, whereas (8.4-b) is compatible with there being a donkey-owner who beats none of his donkeys. The preferred interpretations of (8.3-a,b) are closer to the following:

(8.5) *Correct interpretations of (8.3):*

- a.  $(\forall y : \text{farmer } y)(\exists x : \text{donkey } x) y \text{ owns } x \rightarrow y \text{ beats } \textit{the donkey that } y \text{ owns}$ .
- b.  $(\exists x : \text{dog } x) x \text{ entered the room. } \textit{The dog that entered the room}$  bit me.

In (8.5), the anaphors are interpreted as definite descriptions of entities previously introduced in the discourse.

The other main theoretical move that Ludlow makes is to follow (Russell, 1911) in drawing a distinction between *singular* and *general* propositions. Singular propositions are about an object while general propositions “strictly speaking, are not about anyone or anything” (p. 112). In other words, singular propositions make claims about an object while general propositions make claims about the world. He follows Russell in claiming that definite descriptions generate general propositions, rather than singular ones, and builds his theory around E-type *temporal* anaphors—temporal analogs of E-type anaphora. E-type temporal anaphors take the form of implicit *when/before/after* clauses which, like PAST, PRES, and FUT, are fundamental notions in an A-series semantics.

E-type temporal anaphora do not involve reference, they are based on definite descriptions which yield general (not singular) propositions. Yet, their intrinsic meaning is to evaluate truth of a proposition *relative* to the temporal interpretation of another proposition. This forms the crucial

building block that Ludlow exploits to present an A-series semantics which properly accounts for perfect forms, as well as other temporal constructions which seem to involve reference. I will not provide a detailed discussion of his approach here, however; the interested reader should refer to (Ludlow, 1999).

### 8.1.2 The Challenge of a B-series Semantics

For any number of possible reasons, B-series semantic theories seem to have a wider representation in the literature (at least in the Linguistic literature) than A-series ones. This might be due in part to the way in which we are educated about time from an early age; our common way of diagramming time (timelines) would seem to contain the implicit assumption that past and future times exist—otherwise, what is the timeline supposed to represent? For many (myself included) it seems rather unsatisfying to present a tensed metalanguage (i.e. to not reduce tense to something more fundamental). It may also be due to technical reasons, as it does seem that there are fewer technical hoops to jump through if one gives herself the power to refer to, or quantify over, non-present times and events. Of course, these are not valid arguments for adopting a B-series conception of time, or a semantics of tense based thereon.

Modern semantics can, in many ways, be traced back to Richard Montague—though of course Montague’s system in turn can be traced back to many others. While not overly concerned with tense, his treatment of it in (Montague, 1974) serves as a good foundation for tense discussion in general, and can probably be considered the “classical” treatment of tense today. Indeed, when presenting time-sensitive truth conditions, a formalism in the style of Montague can often be presented without any prerequisite discussion. Montague’s semantics of tense follows that of (Prior, 1967) in strategy, though not in interpretation. Like Prior, Montague represents tenses as propositional operators, but unlike Prior, he interprets them in a model theoretic system which considers as fundamental the notion of a present tensed proposition being true *at* a given time index. In Montague’s system, if  $\varphi$  is a well-formed formula (or a *meaningful expression* in his terms), then so are  $W\varphi$  and  $H\varphi$ , which are respectively read as “it will be the case that  $\varphi$ ” and “it has been the

case that  $\varphi$ ". His definitions of the  $W$  and  $H$  operators are provided below. Saving for very minute differences,  $W$  and  $H$  can be considered the B-series implementation of Prior's  $F$  and  $P$  operators respectively:

(8.6) *Definitions of Montague's  $W$  and  $H$  operators:*

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

In (8.6),  $\mathfrak{A}$  is a formal model and  $i$ ,  $j$ , and  $g$  are indices relative to which the expressions are being evaluated in that model. Specifically,  $j$  represents the time of evaluation and so one might read a formula of the form  $[\varphi]^{\mathfrak{A},i,j,g} = 1$  as " $\varphi$  is true in  $\mathfrak{A}$  at  $j$ ". Of course, the truth of  $\varphi$  is determined relative to  $i$  and  $g$  as well, but our present discussion allows us to ignore these indices.

This method of formalizing the semantic content of tenses boils down to existential quantification over times, and assertions concerning the truth of formulas at those times. Truth of a formula in general, then, is merely a special case in which the formula is true if it is true relative to the present time. For example, if we apply the treatment of tense in (8.6) to the sentence "John married Mary", we would get a logical representation of the form:  $H(\text{John marries Mary})$  which is true just in case there is some past time at which "John marries Mary" is true.

Purely quantificational approaches to tense semantics have their share of problems. For one, they have the same difficulty in representing the truth conditions of complex tenses like the past perfect as Prior's (1967) system does; the past perfect *collapses* to the simple past. Also, as (Kamp, 1968) shows, a tense logic which has only  $W$  and  $H$  as tense operators is actually not expressive enough to represent the truth conditions of certain temporal constructions, such as " $\varphi$  since  $\psi$ " (read:  $\varphi$  has been true ever since  $\psi$  was true) and " $\varphi$  until  $\psi$ " (read:  $\varphi$  will be true until  $\psi$  is true). Actually, Kamp's conclusion is that no logic with only 1-place tense operators is capable of expressing such propositions. There are also problems deriving from the scope effects that tense operators like  $W$  and  $H$  generate, which are brought to light in (Enç, 1981), and which are discussed later in this chapter. For now, I will push all of these issues aside, since they are not

necessarily direct consequences of adopting a B-series conception of time.

The main overarching problem which any B-series tense semantics must face is, according to (Ludlow, 1999), that such a semantics is unable to account for temporal indexicality. To illustrate this problem, he provides an example:

Now suppose I am in my office late in the afternoon one day next March. I may say to myself: “My fifth anniversary is March 12. I should think about buying my wife an anniversary present.” I might then wonder how much time I have. I take out a calendar to find today’s date and discover to my horror that it is March 12! I shout “My fifth anniversary is today!” (p. 6)

In the above example, two statements are made regarding the time of the narrator’s fifth anniversary. At one point he claims that his anniversary is on March 12. Then, after acquiring more information that the current date *is* March 12, he claims that his anniversary is ‘today’. The problem is that a B-series tense semantics is unable to account for the difference in content between the two statements. According to Ludlow, a B-series semantics assigns to both statements the same content, namely that the narrator’s fifth anniversary is on March 12. But this analysis does not seem to be right. How can both statements have the same semantic content? There are at least two reasons to believe that these statements should *not* have the same content: First, the second statement elicited a completely different reaction than the first one did (one would think that two statements with equivalent content should elicit the same reaction); and second, the second sentence seems to represent more information than the first one does (one would think that two statements of equivalent content should communicate equivalent amounts of information). To further make his point, he provides another example which is uttered after “a dreaded visit to the dentists office”:

(8.7) *An example illustrating the need for temporal indexicality:*

I’m glad that’s over with. (Ludlow, 1999, p. 88) cf. (Prior, 1959)

The problem with (8.7) is actually the same as with the anniversary example. In (8.7), the speaker is supposedly glad that her trip to the dentist is over with. That is, she is glad that that her trip to

the dentist is *in the past*. Under a B-series semantics, the content of (8.7) would be something like: for some time  $t < t_S$ , the speaker is glad that her trip to the dentist occurred at  $t$ . If  $t_S$ , the speech time, is 5:00, then (8.7) amounts to saying that the speaker is glad that the trip culminated before 5:00. But this goes against our intuitions, the speaker is not glad that the trip culminated before 5:00, the speaker is glad that the trip culminated *in the past*.

One of the most popular strategies to deal with this issue is to introduce an idea of *token reflexivity* into the truth conditions. A token reflexive definition of *today* for example, would not simply be the time which *today* happens to denote, but rather something more like “the day on which *this token* is uttered.” This strategy can be applied to tense in general such that the present, for example, would be defined as “the time at which this token is uttered.” This is the sort of strategy suggested by (Reichenbach, 1947; Kneale, 1949; Smart, 1963, 1966). Ludlow notes however that token reflexive solutions are doomed, since you can construct examples like (8.8) to undermine their nature of being contingent:

(8.8) *A problematic example for token-reflexivity:*

There are no utterances.

(8.8) is a contingent claim. It might have been that there were no utterances. However, if tense and temporal indexicals are defined in a token-reflexive manner, then statements like (8.8) become self contradictory, since it is contradictory to claim that “There are no utterances at the time at which this token is uttered.” This is simply not what it means to say “there are no utterances”.

Ludlow concludes that these problems are insurmountable for any B-series semantics, since propositions seem to require indexical content to account for the proper interpretations of our anniversary and dentist examples, but propositions cannot contain indexical content if statements *about* this indexical content are to remain contingent. ERI Theory is firmly committed to a B-series conception of time and therefore is subject to these criticisms along with all other B-series semantic theories. I do not believe, though, that Ludlow is correct in claiming that these problems with temporal indexicality are a *result* of adopting a B-series semantics.

We should start by identifying the problem. The problem which has been attributed to the B-series is, basically, that a B-series cannot account for our intuitions regarding the meaning of *now*. But is this really a problem with treating time as ordered in a B-series rather than an A-series? Sure, if our semantics treated time as an A-series, then this particular problem would vanish, since the concept of *now* and *before*, etc., would be fundamental, but I do not think that this problem of temporal indexicality that B-series theories face can be *attributed* to the fact that they are B-series theories. The problem seems to reduce to the problem of indexicality in general.

For example, I might be unknowingly talking to Kurt Gödel, and utter “Kurt Gödel proved the incompleteness of arithmetic”. Then after discovering my interlocutor’s identity, I might utter “*You* proved the incompleteness of arithmetic!” This second sentence has the same truth conditions as the first; *Kurt Gödel* and *you* have the same reference in this context (the same *sense*, even). This example introduces the same temporal indexicality problem, but in a different, non-temporal, domain. But this is not an argument against our choice to model the world as including a set of individuals which can be referred to by names. This problem does not show that we need to model the universe of individuals in terms of *I*, and *YOU/HE/SHE* operators—which would be the analog of modeling time in terms of the present, and past/future operators. This analogy seems kind of silly at first, but it seems to me to be a faithful analog of arguing from the problem of temporal indexicality to the need to abandon a B-series temporal ordering. If modeling time as a B-series is the *cause* of our temporal indexicality problems, then why do we hesitate to claim that modeling the universe as including a set of existing individuals is the cause of our pronominal indexicality problems?

There is a wealth of literature on the nature of indexicality. And I do not presume to have closed any cases or even necessarily contributed any unique ideas in this area. I merely wish to note that problems with temporal indexicality do not seem to be decisive evidence for the abandonment of a B-series timeline. Even if we abandoned the B-series, we are *still* left with the problem of indexicality.

## 8.2 Reichenbachian Approaches

In 1947, Hans Reichenbach published a book entitled *Elements of Symbolic Logic* (Reichenbach, 1947). This work includes a comparatively brief chapter, “The Tenses of Verbs” (pp. 287–298), in which Reichenbach lays the foundation for a particular type of logical representation intended to capture the meaning of English tense forms. The ideas conveyed in these approximately 10 pages have had an almost unprecedented, pervasive, and radical effect on the the field of tense semantics (one other precedent I can think of are the few pages that Paul Grice wrote on cooperative discourse (Grice, 1989) which has uncontested influence in the field of Pragmatics today). Many have attempted to incorporate Reichenbach’s ideas into their formal accounts of tense, some more faithfully than others. I consider ERI Theory to be a tense theory which is *inspired* by Reichenbach, but it neither is nor was intended to be a faithful implementation. In this section, I begin by introducing the ideas actually written by Reichenbach, and continue by looking at two particular, and vastly different, attempts at formally implementing his ideas.

### 8.2.1 Reichenbach’s Ideas

The crux of Reichenbach’s system is that natural language tenses require three temporal points in order to be properly interpreted—English is the main topic of discussion but it is clear that Reichenbach intends for his claims to have a wider range of applicability. Reichenbach names these three points the *point of speech*, the *point of reference*, and the *point of the event*. He then refers to these points as *S*, *R*, and *E* respectively. The formal definition of the various complex tenses in this manner was a novel contribution at the time, as tense logics traditionally located events in time directly relative to the present.

Reichenbach defines three relevant relations which may hold between two temporal points. We can call these relationships *before*, *simultaneous with*, and *after*. For example, Reichenbach defines the simple past as asserting that the point of the event is simultaneous with the point of reference, which is before the point of speech. This differs from the present perfect in which the point of the

Structure	Reichenbachian Name	Traditional Name
$E—R—S$	Anterior Past	Past Perfect
$E,R—S$	Simple Past	Simple Past
$R—E—S$ $R—S,E$ $R—S—E$	Posterior Past	—
$S—S,R$	Anterior Present	Present Perfect
$S,R,E$	Simple Present	Present
$S,R—E$	Posterior Present	Simple Future
$S—E—R$ $S,E—R$ $E—S—R$	Anterior Future	Future Perfect
$S,—R,E$	Simple Future	Simple Future
$S—R—E$	Posterior Future	—

Table 8.1: The 9 fundamental tense forms defined by Reichenbach. *past*, *present* and *future* define relations between *R* and *S*, while *anterior*, *simple*, and *posterior*, define relations between *R*, and *E*. In the structural representations, commas (,) represent simultaneity and emdashes (—) represent temporal precedence where later times are assigned to the temporal point on the orthographic right side.

event is before the point of reference, which is simultaneous with the point of speech. Because any tense construction is defined in terms of two relationships, and each relationship may be one of three possibilities, Reichenbach recognizes 9 possible *fundamental forms*. He names these 9 fundamental forms using compositional terminology in which the three relations between *R* and *S* correspond to *past*, *present*, and *future*, and the three relations between *R* and *E* correspond to *anterior*, *simple*, and *posterior*. The full table he defines is provided in table 8.1. Some notable observations concerning the 9 fundamental Reichenbachian forms include that there there seems to be a paradigm gap when it comes to the posterior forms; we seem to not use such tense constructions. Reichenbach does note that the posterior past corresponds loosely to *would* (*would<sub>T</sub>* in our terminology); *would<sub>T</sub>* corresponds to the first two structures in the posterior past row but not to  $R—S—E$ . He also notes that languages which have future participles have direct forms for the posterior future. He provides an example from Latin, *arbiturus ero* which translates to “I shall be one of those who will leave”. It is also important to note that the *retrogressive* fundamental forms (in which the temporal relationship between *R* and *S* is opposite that of *R* and *E*, correspond to three structures each. This is an important property of Reichenbach’s treatment, as it predicts that

when using such tenses, the temporal relationship between the point of speech and the point of the event is inconsequential. For example, “John will have eaten a sandwich” enforces no temporal constraints between  $S$  and  $E$ .

Reichenbach justifies the existence of and specific reference to  $R$  by providing examples which demonstrate behavior which can be accounted for by applying simple rules regarding how  $R$  behaves. One such set of examples observes that, the natural temporal progression in stories and other sequential accounts of events is marked by progression of the point of reference, and not necessarily by the point of the event. In other words, we can tell stories in which the events happen out of order, as long as we use tense constructions which assign a natural progression to the point of reference. The implicit claim here is that we could also tell stories in which the events follow a natural progression but in which the point of reference does not, and these stories seem ill-formed. For example, the following excerpt is from W. Somerset Maugham’s *Of Human Bondage*. In this excerpt, a natural progression of the reference point can be assumed:

But Philip ceased to think of her a moment after he had settled down in his carriage. He thought only of the future. He had written to Mrs. Otter, the massière to whom Hayward had given him an introduction, and had in his pocket an invitation to tea on the following day.

Compare this excerpt to an engineered example which is compatible with a natural progression of the point of the event, but which forces an unnatural progression of the reference point. (8.9) is one such example, and it is almost uninterpretable:

(8.9) *An example which is compatible with a smooth progression of the event time, but not of the reference time:*

John will have woken up at 6 o’clock in the morning yesterday. He got out of bed and had gone downstairs to eat breakfast. He would eat some cereal and then he has gone to school.

Another observation that Reichenbach makes is that in cases of embedded clauses, the tense constructions which sound most natural are those constructions in which the reference point can be held constant between the matrix clause and the subordinate clause. He calls this principle the *permanence of the reference point*. (8.10) provides some of the sentences he uses to illustrate it:

(8.10) *Reichenbach's 'permanence of the reference point' is demonstrated in the following examples:*

- a. I had mailed the letter when John came and told me the news.
- b. I have not decided which train I shall take.
- c. He telephoned before he came.

In (8.10-a), due to the permanence of the reference point, the news-telling event clearly precedes letter-mailing event. Also it would be unnatural to say “I had mailed the letter when John has come”. (8.10-b) is similar to (8.10-a). In (8.10-b), the matrix clause restricts the point of reference to be simultaneous with the point of speech (present perfect = anterior present), and so the simple past being used in the subordinate clause is acceptable, because the simple future has an *S,R—E* interpretation. Reichenbach notes that “I did not decide which train I shall take” is dispreferred, presumably because the points of reference for the two clauses cannot be held simultaneous. Another alternative to (8.10-b) is “I did not decide which train I would take”, in which *would* is interpreted to have a posterior past interpretation. (8.10-c) demonstrates that acceptable examples do exist in which the points of reference are not simultaneous (the sentence stipulates that the telephoning event occurs before the coming-event), so the acceptability of (8.10-c) can be explained by observing that at least the two clauses have the same tense *structure*. Reichenbach calls this weaker principle the *positional use of the reference point*.

### 8.2.2 A “Faithful” Implementation

There is a lot of room for interpretation of Reichenbach’s original ideas. One such interpretation can be found in (Nerbonne, 1984). I utilize this work as an example of how Reichenbach might

be formalized. (Nerbonne, 1984) is a good example to use because it takes a minimal approach to making assumptions that Reichenbach (1947) does not discuss. Nerbonne (1984) was much more interested in providing an account of the *compositionality* of a Reichenbachian tense semantics, rather than providing detailed discussion on the technical and philosophical issues inherent in his implementation. After briefly providing the basics of Nerbonne’s (1984) implementation, I present a brief discussion of some of the issues inherent in a Reichenbachian framework.

(Nerbonne, 1984) implements a model-theoretic Reichenbachian tense semantics. His notation is summarized in (8.11):

(8.11) *Nerbonne’s notation of model theoretic satisfaction:*

- a. Read: A model  $A$ , relative to speech time  $s$ , event time  $e$ , and reference time  $r$ , satisfies formula  $p$ :

$$A_{s,e,r} \models p$$

- b. Read: A model  $A_{s,e,r}$  satisfies an atomic formula  $p$  iff the interpretation function  $I$  maps the pair  $\langle p, e \rangle$  onto 1:

$$A_{s,e,r} \models p \text{ iff } I(p, e) = 1$$

$s$ ,  $e$ , and  $r$  are time *intervals* which are provided by the context.  $I(p, e) = 1$  just in case the interval  $e$  is the interval over which  $p$  occurs. Because Nerbonne treats  $s$ ,  $e$ , and  $r$  as provided by context, his implementation could be considered a *referential* implementation, in which  $s$ ,  $e$ , and  $r$  are basically functioning like names for elements of the context. Reichenbach was not aware of the referential vs. non-referential tense debate as it exists today and so it is not possible to be sure which side he would pick. However, it seems that his usage of terms such as “*the point of reference*” suggest that he had specific (referential) temporal points in mind. Nerbonne’s implementation is not purely referential though. He employs a technique of quantifying over subintervals of  $r$  in cases where sentences seem to require more than one reference time, such as in (8.12):

(8.12) *Nerbonne quantifies over subintervals of an  $r$  which supposedly spans all events referred to when a sentence refers to multiple events:*

- a. Tom left school and got a job. (but not at the same time)
- b. Every one of my brothers and sisters graduated from high school. (but not at the same time)

Nerbonne deals with examples like these via a conjunction rule stated like so (cf. (Cresswell, 1977; van Benthem, 1983)). Note that in (8.13),  $\wedge_t$  denotes the semantic translation of temporal *and*:

(8.13) *Nerbonne's treatment of VP conjunction:*

$A_{s,e,r} \models p_1 \wedge_t p_2 \wedge_t \dots \wedge_t p_n$  iff:

(i) There exist subintervals  $e_1, \dots, e_n$  of  $e$  such that

$A_{s,e_1,r} \models p_1, A_{s,e_2,r} \models p_2, \dots, A_{s,e_n,r} \models p_n$ . And

(ii)  $\forall e' \subseteq e$  ( $e'$  is an initial or final subinterval in  $e \rightarrow (\exists i) e_i$  overlaps  $e'$ )

One of the main shortcomings of the above treatment is that it is critically based on conjunctive constructions. It is not clear that all examples which utilize multiple reference points will be constructed in this way. Nerbonne acknowledges this issue (and others), but sets it aside as it is not his intention to solve them.

So, putting multiple reference points aside, we can introduce Nerbonne's treatment of the simple past, which is indicative of the style of the rest of his semantic definitions. As I mention above, Nerbonne classifies logical formulae into two categories: atomic and non-atomic. Atomic formulae are those which include no temporal operators while non-atomic formulae do. Hence, all temporal operators are sentential operators in Nerbonne's logical representation.

(8.14) *Nerbonne's analysis of the simple past (note: 'PRET' is short for 'preterit' which is Nerbonne's terminology for simple past)*

$(\forall A, s, e, r, p) A_{s,e,r} \models \text{PRET}(p)$  iff  $(e = r < s) \wedge A_{s,e,r} \models p$

Note that no intervals relative to which  $p$  occurs are calculated. In Nerbonne's analysis (an effect of his referential treatment of  $s, e,$  and  $r$ ), a model  $A_{s,e,r}$  satisfies a formula  $\text{PRET}(p)$  just in case it satisfies  $p$  and  $s, e,$  and  $r$  stand in certain relationships. We can think of the past morpheme here

as *enforcing* that a certain relationship already holds, rather than performing any kind of interval calculation. The semantics of other basic temporal constructions operate in the same way. They enforce relationships between  $s$ ,  $e$ , and  $r$ , which are already set by the context of utterance. Many kinds of temporal constructions work in this way, and correspond to what Nerbonne calls *definite* temporal reference. He also recognizes the existence of *indefinite* temporal reference, which he attributes to the morpheme *mal* (German for “once”, as in “John once went to the store”).

(8.15) *Some other semantic rules implemented in (Nerbonne, 1984):*

a. Indefinite temporal reference:

$$A_{s,e,r} \models \text{mal}'(p) \text{ iff } (\exists e' \subseteq e) A_{s,e',r} \models p$$

b. Past perfect (note: PLUP is short for ‘pluperfect’, which is Nerbonne’s terminology for past perfect):

$$A_{s,e,r} \models \text{PLUP}(p) \text{ iff } (e < r < s) \wedge A_{s,e,r} \models p$$

c. Present (note: Nerbonne analyses the present tense as *implicating* that  $r = s$  where  $p$  is an atelic predicate):

$$A_{s,e,r} \models \text{PRES}(p) \text{ iff } (r = e \leq s) \wedge A_{s,e,r} \models p$$

d. Frame adverbials (note:  $f$  denotes a frame adverbial):

$$A_{s,e,r} \models f(p) \text{ iff } r \subseteq \llbracket f \rrbracket_{A_{s,e,r}} \wedge A_{s,e,r} \models p$$

As Nerbonne’s analysis is referential in nature, it is subject to criticisms of referential theories in general. Though I defer discussing such criticisms to section 8.3. There do, however, seem to be some problems with a Reichenbachian semantics (cf. (Ogihara, 1989)), which are not specific to (Nerbonne, 1984).

One main criticism of a compositional, Reichenbachian, treatment of tense constructions has to do with how the relationships between  $E$  and  $R$ , and between  $R$  and  $S$  can be set by the temporal morphemes in the logical form. It turns out that coming up with a treatment which is consistent with all of Reichenbach’s observations is not straight-forward at all. As a first approximation, let’s consider that the tense morphemes have the following contributions. In this analysis, we treat the

future morpheme *will* as being compositionally constructed from the present tense and the future auxiliary *woll* (i.e. *will* is *woll* inflected for present tense). This is consistent with *will* having the  $S, R-E$  structure (posterior present).

(8.16) *First attempt to attribute Reichenbachian contributions to tense morphemes:*

- PRES:  $R = S$
- PAST:  $R < S$
- *woll*:  $R < E$
- PERF:  $E < R$
- default: unless *woll* or PERF is present,  $E = R$

The problem with the above account is that future perfect constructions (*will have*) are predicted to be contradictory, since *woll* stipulates that  $R < E$  and PERF stipulates that  $E < R$ . So, the above analysis cannot be correct, it is inconsistent.

But what if we modified *woll* such that it stipulated a relation between  $R$  and  $S$ , rather than between  $R$  and  $E$ :

(8.17) *Second attempt to attribute Reichenbachian contributions to tense morphemes:*

- PRES:  $R = S$  (or maybe  $S \leq R$ )
- PAST:  $R < S$
- *woll*:  $S < R$
- PERF:  $E < R$
- default: unless PERF is present,  $E = R$

This analysis has no issue with the future perfect, but it does have a problem with *would<sub>T</sub>*. In an analysis where we treat *woll* as an auxiliary verb which can be inflected for tense, it is common to treat *would<sub>T</sub>* as *woll* inflected for past tense. But, this cannot be right because *woll* stipulates that  $S < R$  and the past tense stipulates that  $R < S$ , hence we should not be allowed to inflect *woll* for past tense. Perhaps we should analyze *would<sub>T</sub>* as an independent constituent, unrelated compositionally

to *woll*. The problem with doing this is that there is no relation we can assign to *would<sub>T</sub>* which gives the correct reading. If analyze *would<sub>T</sub>* as stipulating  $R < E$ , which might seem reasonable, it is inconsistent with constructions of the form *would have*, since PERF stipulates that  $E < R$ . If we analyze *would<sub>T</sub>* as stipulating that  $R = E$  or  $E < R$ , then it is predicted to be truth-conditionally equivalent to simple past and past perfect respectively, which it is not. Similarly, having *would<sub>T</sub>* stipulate any relationship between  $S$  and  $R$  other than  $R < S$  completely mis-represents the meaning of *would<sub>T</sub>*.

A separate problem with the analysis in (8.17) is that Reichenbach's *permanence of the reference point* principle relies on *will* being at least compatible with an  $S,R-E$  interpretation. Recall the preference of (8.18-a) over (8.18-b).

(8.18) *Reichenbach's 'permanence of the reference point' principle explains our preference of (a) over (b)*

- a. I have not decided which train I shall take.
- b. I did not decide which train I shall take.

According to Reichenbach, we prefer (8.18-a) over (8.18-b) because in (8.18-a), we can hold the reference point constant between the matrix and subordinate clauses, while in (8.18-b) we cannot. So, if we adopt an analysis in which *will* is incompatible with an  $S,R-E$  structure, we must abandon Reichenbach's principle of the permanence of the reference point (or least start stipulating exceptions), which is unattractive since this principle constitutes a major portion of Reichenbach's theory.

As one final attempt to salvage a Reichenbachian analysis of tense morphemes, we might abandon the assumption that *will* and/or *would* have *woll* as their root morpheme, and suppose a treatment in which PAST, PRES, and FUT are completely distinct:

(8.19) *Third attempt to attribute Reichenbachian contributions to tense morphemes:*

- PRES:  $R = S$
- PAST:  $R < S$

- FUT:  $S < R$
- PERF:  $E < R$
- $would_T$ :  $R < S$  and  $R < E$
- default: unless PERF or  $would_T$  is present,  $E = R$

But, this analysis has the same problem concerning  $would_T$  that our last one had; *would have* constructions are inconsistent. By looking more closely at what is going on, we can see that the underlying problem with *would have* constructions is that three temporal points *are not enough* to represent their meanings. Consider the original situation in which I introduce  $would_T$ . Two parents are watching a home video of their son. The mother then says, “Johnny would have grown 6 inches before the end of that year.” In this case, the reference time seems to be the time depicted in the video (which is before the utterance time). The event time (of growing 6 inches) is also in the past, but *not* necessarily ordered relative to the reference time. Rather, the event time is ordered relative to a *fourth* temporal point, which is in the past but after the reference time. (Ogihara, 1989) labels a point like this a *quasi-reference point*. It seems that, without reference to a fourth temporal point, we cannot accurately describe the semantics of  $would_T$  *have* constructions.

### 8.2.3 Reichenbachian Tense Structures

(Hornstein, 1990) is another implementation of Reichenbach’s ideas, though very unique. Rather than using structural diagrams like  $S-R,E$  to summarize the temporal relationship between  $S$ ,  $R$ , and  $E$ , Hornstein includes what he calls *tense structures* as actually part of the metalanguage (or perhaps as an intermediate syntactic stage before interpretation in the metalanguage). Hence, our interpretation of tenses reduces to our interpretation of these structures (and not the other way around). Tense morphemes, then, compositionally build these structures, and various phenomena are accounted for by placing restrictions on these tense structures. In this section, I briefly introduce the basics of Hornstein’s approach, and provide some of my own comments on his idea in general.

Hornstein uses  $S$ ,  $R$ , and  $E$  to denote the usual Reichenbachian points used to define tenses.

His tense structures are composed by ordering *S*, *R*, and *E* linearly, and then separating each letter with either a comma (,) or underlined distance (\_\_\_). Semantically, two points are simultaneous if separated by a comma (and said to be syntactically *associated*), and two points are in a precedence relationship if separated by an underlined distance. The resulting diagrams are very similar to the original diagrams that Reichenbach used. In Hornstein's notation, the 6 basic English tense structures are as follows:

(8.20) *Hornstein's tense structures for the 6 basic English tenses:*

<i>S,R,E</i>	present
<i>E,R__S</i>	past
<i>S__R,E</i>	future
<i>E__S,R</i>	present perfect
<i>E__R__S</i>	past perfect
<i>S__E__R</i>	future perfect

It is important to note that Hornstein is quite serious about tenses having a syntactic realization, and while *S,R,E* is a structure which can be interpreted to mean that *S*, *R*, and *E* are all simultaneous, that does not mean that *R,S,E* or *S,E,R* or any other permutation serves equally well as a structure of the present tense. Linear order matters, even among associated points. The basic tenses have the specific structures that Hornstein assigns to them, and other structures may be semantically identical, but they are still *other* structures. Rules Hornstein presents which account for various phenomena in more complicated situations rely on this property of tense structures.

The 6 structures in (8.20) constitute what Hornstein calls the *basic tense structures* or *BTSs*. BTSs can represent the structure of a basic tensed sentence with no other temporal modifiers. When temporal modifiers (adverbs, temporal subordinate clauses, etc.) need to be incorporated into a tense structure, a *derived tense structure* or *DTS* is created. Different kinds of temporal modifier come with different syntactic rules for incorporation, but one constraint must always hold between the state of a BTS before and after a structural derivation has occurred. Hornstein names this constraint the *constraint on DTS* or *CDTS*, which is presented below:

(8.21) *Hornstein's Constraint on DTS (CDTS):*

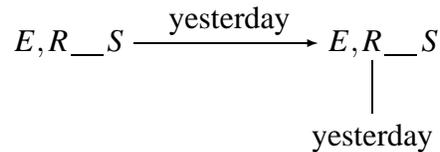
DTS must preserve BTS. BTSs are preserved iff

- a. No points are associated in DTS that are not associated in BTS.
- b. The linear order of points in DTS is the same as that in BTS.

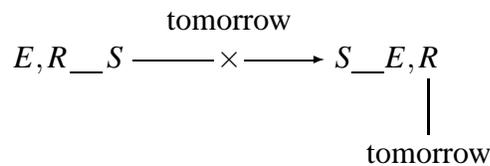
In other words, for any BTS in a DTS, the points in that BTS must have their linear order and underlined distances preserved. We can see some basic examples of this constraint in action by looking at simple adverbial modification. For Hornstein, adverbial modification occurs by associating *R* or *E* in the BTS with the temporal point the adverb denotes in the DTS. Hence, (8.22-a) is well-formed, but (8.22-b) is not:

(8.22) *Temporal adverbial modification occurs by associating R or E with the temporal point the adverb denotes:*

- a. John left yesterday.



- b. \*John left tomorrow



(8.22-a) is well-formed because both components of the CDTS are satisfied by modifying the BTS with *yesterday*. (8.22-b) is ill-formed because the linear order of the temporal points in the BTS was not preserved by modifying it with *tomorrow*.

Temporal adverbial clauses work in a similar way. The BTS of the matrix clause is modified by the subordinate clause to construct a DTS, which is subject to the CDTS. Incorporating a temporal subordinate clause into a BTS though involves a different algorithm. Hornstein names this process the *rule for temporal connectives* (RTC):

(8.23) *Hornstein's rule for temporal connectives (RTC):*

Given the following syntactic configuration, where TC is a temporal connective e.g. *when* or *after*:

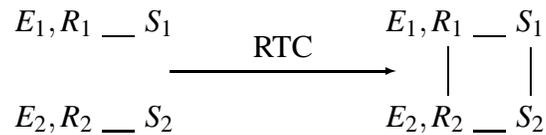
[<sub>S</sub> ... TNS<sub>1</sub> ... [<sub>adjunct</sub> TC [<sub>S</sub> ... TNS<sub>2</sub> ... ] ] ]

- (i) Write the BTS of TNS<sub>2</sub> under the BTS of TNS<sub>1</sub>. Associate the *S* points. Associate the *R* points by moving *R*<sub>2</sub> to *R*<sub>1</sub>, placing *E*<sub>2</sub> accordingly.
- (ii) The movement of *R*<sub>2</sub> to a position associated with *R*<sub>1</sub> must obey the CDTS.

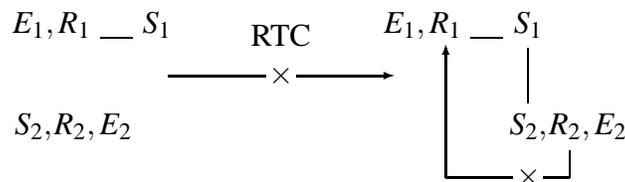
I conclude the introduction of Hornstein's system by providing some examples which demonstrate the RTC. Consider (8.24):

(8.24) *Example sentences demonstrating the RTC:*

- a. John came as Harry arrived.



- b. \*John came as Harry arrives.



The diagrams in (8.24) show how Hornstein's RTC correlates with our intuitions regarding the acceptability of certain tense structures embedded in other tense structures. Hornstein provides numerous other examples and detailed discussion as well, though I believe this introduction has served its purpose.

My main criticism of Hornstein's approach is that, it is not clear to me that representing tenses as structured objects within the metalanguage should be illuminating. In Hornstein's approach, the organization of the tense morphemes in all of the clauses build a determinate tense structure

for an utterance. Restrictions are then stipulated which mark some tense structures as valid, and others as invalid. Valid tense structures then have rules which can generate semantic (logical) interpretations of the type with which we are familiar, which make assertions concerning the times of various events and named temporal points and their relationships to each other.

But what does it *mean* to stipulate a restriction which allows some tense structures and disallows others? There are rules which generate logical assertions given a tense structure, and so it may also be possible to create rules which generate logical assertions given restrictions on these structures. Let's call these hypothetical rules *restriction translation rules*. But how do we know, assuming we even have such restriction translation rules, that the resulting logical assertions corresponding to our restrictions are illuminating? Perhaps the only way to form such restriction translation rules results in nothing more than a case-by-case elimination of those patterns we find infelicitous. If this were the case, then we could hardly say that such restrictions are illuminating when applied to Hornstein-style tense structures. Maybe that is not the case. Maybe it is possible to construct such restriction translation rules such that illuminating logical assertions are generated. I neither claim that it is or is not possible. My criticism with Hornstein's approach is he does not discuss this issue.

A number of useful intuitions are explainable in terms of Hornstein's system, including but not limited to our observation of certain linguistic phenomena and concerns regarding the feasibility of language acquisition. But explaining these intuitions in structural terms leaves something to be desired where the structures do not immediately seem to have any representation in logic, language, or cognition. It seems to me that if you are presenting an analysis which makes use of a new formal apparatus, then part of the presentation should be concerned with defending its ability to represent illuminating generalizations. Many semanticists take for granted the assumption that statements in their metalanguage represent illuminating generalizations, because they are using some sort of formal logic to represent these generalizations, and formal logics enjoy an extensive history of philosophical discussion which is concerned with the notion that logic is a valid means of representing thoughts or assertions. Therefore, if one can write a logical semantic formula which

is concise and asserts truth conditions which rule out many different cases, it can be regarded as academic progress. The case that corresponding concise assertions made regarding Hornstein's tense structures share this property is simply not made by Hornstein.

As a secondary concern, it seems that there is reason to believe that indeed it is not possible to construct our hypothetical restriction translation rules. The main observation which supports this claim is that multiple tense structures may share the exact same semantic interpretation, and Hornstein's approach relies on this property of tense structures for a number of reasons. For example, Hornstein's approach asserts and relies on the assumption that different *linear orderings* of simultaneous temporal points should be regarded as differences between tense structures (not two representations of the same structure). A rule might label a substructure  $S, R\_E$  valid, but  $R, S\_E$  invalid, even though both structures have the same semantic interpretation ( $S = R \wedge R < E$ ). This property has philosophical grounds in the assumption that  $S$ ,  $R$ , and  $E$  are *distinct* temporal points and therefore must be linearly ordered on a timeline; if two of these points were at the exact same place on the timeline then they would not be different points. Also, explanations of certain examples with embedded tense structures rely on interacting well with some tense structures and not with others, even where they might be interpreted identically. So, we are left with the question: If two distinct tense structures have the same interpretation, what does it *mean* to write a rule which disallows one and allows the other?" I do not know, and unfortunately, Hornstein does not say.

### 8.3 Referential Approaches

I conclude this brief tour of the tense literature by looking at another faction which has splintered off in recent history. The common claim which unites the all members of this faction, is that tenses (or at least, the temporal interpretations of events) are *referential* in nature. Two works that have a particular causal relation to the existence of this school of thought are (Partee, 1973) and (Enç, 1981). For a variety of reasons, this claim has lost most of its support, at least in its strong form (that tenses are *purely* referential). Nevertheless, the idea is a major part of the history of

tense semantics, and there are still some rebels out there which hold to it. In this section, I discuss reasons for supposing that tense might have this referential nature, as well as reasons for supposing that it might not.

The validity of the idea that we can treat tenses as referential stems from (Partee, 1973) and (Enç, 1981). The former introduces the general idea that tenses might be referential in nature, while the latter discredits the classical quantification-based alternative at the time and fully embraces a purely referential (indexical, in fact) account of tense constructions. Partee (1973) notices that the behavior of tense is similar to the behavior of pronouns in a variety of ways, while (Enç, 1981) is most famous for presenting a variety of examples which demonstrate that tense *cannot* have the kind of scoping effects we would predict given a quantificational operator theory. In this section I begin by reviewing Partee's analysis, then Enç's, and finally some arguments against treating tense as, at least purely, referential.

### 8.3.1 Pronominal-like Treatment of Tense

In (Partee, 1973), Partee points out a number of similarities between the interpretive behavior of tense, and that of pronouns. The idea is that, if the sole job of a pronoun is to refer (to something), then perhaps tenses have this quality as well. Partee begins by demonstrating a similarity between *deictic* uses of pronouns and a corresponding usage of the past tense:

(8.25) *Partee's deictic usage of tense:*

a. Examples of deictic pronouns:

- (i) *With referent fixed by a gesture:* He shouldn't be in here.
- (ii) *With referent fixed by context:* She left me.
- (iii) *With referent left vague:* They haven't installed my telephone yet.

b. Examples of deictic tenses:

- (i) *With referent fixed by context:* I didn't turn off the stove.
- (ii) *With referent left vague:* John went to a private school.

(8.25) demonstrates the parallels that Partee notes which exist between deictic pronouns and certain usages of the past tense. In (8.25-a-i), the utterance is accompanied by a gesture (such as pointing), and the referent of *he* is thus fixed. Partee notes that we are incapable of providing analogous gestures when it comes to time—we do not have anything like a temporal finger. However, she also notes that deictic pronouns need not always be accompanied by gestures. For example, they can be fixed by the context or even left vague. For example, in (8.25-a-ii), Partee sets the scene with the example being uttered by a man who has his head in his hands. Thus, *she* clearly refers to the girl he used to be with. (8.25-b-i) is supposed to be the temporal analog of this reading. (8.25-b-i) is neither asserting that the speaker has never turned off the stove, nor that there is merely some past time at which the speaker does not turn off the stove. These are the two possible readings resulting from a scope-based quantificational treatment; the first option corresponds to the tense scoping under negation, and the second option corresponds to the tense scoping over negation. Rather, (8.25-b-i) seems to be asserting that *at some contextually fixed past time*, the speaker does not turn off the stove. If (8.25-b-i) is uttered while the speaker is driving down the freeway, as Partee presents it, then such a contextually fixed time would probably be just before the speaker leaves the house. According to Partee, this is analogous to the contextually fixed referent of *she* in (8.25-a-ii).

Tenses do not *have* to be fixed to certain times though, Partee notes this in example (8.25-b-ii). Partee also notes, however, that this is yet another property of pronouns. Specifically, she draws an analogy between *vague* usages of the past tense and corresponding vague pronouns, such as *they* in (8.25-a-iii). The speaker of (8.25-a-iii) need not refer to any particular party. In fact, she might not even *know* who is supposed to install her phone. This does not stop *they* from referring, however. In (8.25-a-iii), *they* still refers; its referent is simply left vague. Partee notes that this seems to correspond to usages of the past tense such as that in (8.25-b-ii). Just as *they* in (8.25-a-iii) seems capable of referring to *whoever is supposed to install the speaker's phone*, PAST in (8.25-b-ii) seems to be refer to *whenever John went to the private school*.

Partee continues by noting that tenses, like pronouns, seem compatible with *anaphoric* interpretations with explicit antecedents:

(8.26) *Partee's anaphoric usage of tense:*

a. *Examples of anaphoric pronouns:*

- (i) Sam took the car yesterday and Sheila took it today.
- (ii) He who stole my cow, he will suffer the penalties.

b. *Examples of anaphoric tense:*

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

In the examples above, (8.26-b-i) is presented as analogous to (8.26-a-i) and also with (8.26-a/b-ii). In (8.26-a-i), *it* is anaphoric to *the car*. In (8.26-b-i), the past tense in the second conjoined clause is anaphoric to the past tense in the first. Hence, (8.26-b-i) seems to assert that Sam gets drunk *at the same time* that Sheila had a party, and not merely that he gets drunk at some time in the past. The analog between (8.26-a/b-ii) is that in (8.26-a-ii), the pronoun seems redundant, just as in (8.26-b-ii), the tense seems redundant. In (8.26-a-ii), the referent of *he* is spelled out in a topical clause, while in (8.26-b-ii), the referent of the past tense is spelled out in a temporal adverbial clause. The difference between pronouns like that in (8.26-a-ii) and tense usages like that in (8.26-b-ii) is that tenses are obligatory in English, while pronominal subjects are not. Hence, the slightly more belabored/archaic feel of (8.26-a-ii).

Another critical similarity between pronouns and tense that Partee points out is that tenses seem to be compatible with *bound variable* interpretations:

(8.27) *Partee's bound variable usage of tense:*

a. *Examples of bound variable pronouns:*

- (i) If one of the arrows hits the target, it's mine.
- (ii) Every student spoke to the student in front of him.

b. *Examples of bound variable tense:*

- (i) If Susan comes in, John will leave immediately.
- (ii) When you eat Chinese food, you're always hungry an hour later.

In (8.27-a-i), *it* seems to be interpreted as a bound variable, whose value is set and reset by the conditional clause—though other analyses are also possible, such as a pronoun-of-laziness à la (Geach, 1962). Partee is not particularly concerned with the exact formalism of the pronominal case, but rather with the observation that it seems applicable to the tense-based examples as well. For instance, (8.27-b-i) seems parallel to (8.27-a-i) in that, the time at which *leave immediately* is evaluated relative to seems *dependent* on the time at which Susan comes in. Moreover, the embedded clause in the conditional in (8.27-b-i) does not seem to refer to any particular time (vague or not), but rather seems to be quantifying over possible times at which Susan comes in. In this case, the time at which Susan comes in and the time at which John leaves immediately are seemingly bound by the same operator. Partee also provides examples such as (8.27-b-ii) in which this temporal quantification seems more overt. In (8.27-a-ii), it is quite standard to analyze *every student* as binding both a trace in the matrix clause as well as *him* in the prepositional phrase. This seems directly analogous to *always* in (8.27-b-ii) quantifying over a temporal variable and binding it to the time both at which Chinese food is eaten and relative to which one is hungry an hour later.

Partee also shows that scope interactions seem to occur when temporal quantifiers are in play:

(8.28) *Partee's demonstration of scope effects with temporal quantifiers:*

If John had married Susan, he would have had everything he wanted.

Partee notes that in (8.28), *everything he wanted* is ambiguous between a bound-variable reading, and a deictic reading (regarding the tense). Under the deictic reading, the past tense on *want* refers to some contextually salient past time (such as a time at which he might have married Susan). Under the bound variable reading, Partee hypothesizes a LF like “would have (*t*) have everything he (*t*) want”. Partee points out that this structure could generate (8.28) by having *would have* quantify-in, by substituting the first *t* with *would have* and substituting the second *t* with its pro-form, PAST. Partee also notes that this ambiguity between a bound and deictic interpretation of the

time at which *everything he wants* is interpreted mirrors the capability of pronouns to be interpreted deictically, even in contexts where bound-variable readings are available.

### 8.3.2 The Implausibility of Scope-based Tense Operators

(Enç, 1981) is a proposal to treat nouns and verbs as indexicals, that is, a proposal to treat the denotations of nouns and verbs as provided by the context, exactly like traditional indexicals like *I*, *here*, and *now*. While most of her presentation is concerned with analyzing the *times* at which nominal and verbal constructions are evaluated, it is clear that she intends for the general strategy to apply to locations and other contextually salient information as well. Part of her goal, then, is to show that the time at which nominals are evaluated is *not* dependent on tense in any way. Since the classical treatment of tense is to suppose that it is an operator over propositions, such an analysis should effect the temporal interpretation of nominals within these propositions as well. By showing that an NPs temporal properties are independent of tense, Enç argues that she has trivialized the scope of tense such that the only items it has any effect on are verbs. But, to say that only one thing within the scope of an operator is sensitive to the effects of that operator is to say that it has no scope at all. With scope-based tense operators shown to be problematic, Enç then hypothesizes that verbs are indexical in nature as well, just as nouns have been shown to be. Tense and temporal adverbials then, are treated by Enç as providing pragmatic well-formedness conditions. Hence, just as a pronoun *he* may refer to a contextually salient individual, but is only acceptable if that individual is male, Enç argues that verbs refer to denotations relative to a contextually salient time, but are only acceptable if that time agrees with the other temporal elements of the sentence.

(Enç, 1981) is most famous for its arguments against classical scope-based temporal operators. She provides a number of examples which are either impossible to express with traditional tense operators, or for which a logical form must be proposed which is so far disconnected from the linguistic form that it should not be taken as a valid *translation*. The first class of problems borne out by a classic treatment of tense are cases of, according to Enç, “quantifying over more than one tense slot”. Examples like those below illustrate the problem:

(8.29) *Enç's examples of 'quantifying over more than one tense slot':*

- a. All rich men were obnoxious children.
- b. Every member of our investment club will buy a house.
- c. Tom dated every Miss America.

The common issue among the examples in (8.29) is that each example has only one tense morpheme, but in order to get the right readings, the nominals in (8.29) need to be evaluated *both* at a time which seems compatible with the tense, as well as at times which are not. For example, if we apply a classical tense operator analysis to (8.29-a), then we can get only one of the two possible representations below:

(8.30) *Possible representations of (8.29-a) under a classic tense operator analysis:*

- a.  $P[\forall x(\text{rich-man}(x) \rightarrow \text{obnoxious-child}(x))]$
- b.  $(\forall x)\text{rich-man}(x) \rightarrow P[\text{obnoxious-child}(x)]$

But neither of these is right. (8.30-a) is making a claim about individuals who at some point in the past were both rich men and obnoxious children (at the same time), and (8.30-b) is making a claim only about present rich men, where we would like to talk about all rich men, past and present. The other examples in (8.29) demonstrate the same deficiency. (8.29-b) forces us to choose between only considering current members of the club, or making an assertion that those members who buy a house in the future are members *when* they buy the house, which is not actually asserted. Similarly, a classical analysis of (8.29-c) forces either an assertion that Tom dated every Miss America *while* they were Miss America, or else only consider those people who are Miss America at the present (by quantifying in).

Another class of problems with a classic analysis of tense are dubbed by Enç as cases of “the missing tense operator”. These sorts of examples seem to require the ability to evaluate nominals at times which are neither compatible with the tense operator, nor the present time:

(8.31) *Enç's examples of 'the missing tense operator':*

- a. John will meet every hostage at the president's party.
- b. Every fugitive is now in jail.

In (8.31-a), we are presented with a scenario in which the president is throwing a party for all of the recently-rescued hostages from a big international incident. The example sentence contains exactly one future tense morpheme, and therefore by playing with scope everything in the sentence should be either evaluated at some future time or at the utterance time. But, those who are coming to the party are neither hostages at the time of the utterance, nor are they hostages at any time in the future. Analyzing (8.31-a) with a classical tense theory would require an implicit *P* operator which scopes only over *every hostage*, a move which seems inconsistent with linguistic data, since tenses never occur overtly in such syntactic environments. Similarly, (8.31-b) is in the present tense and therefore would be analyzed as having no Priorean operators, yet *every fugitive* cannot be evaluated at the utterance time since it is referring to *past* fugitives—fugitives who *are* in jail are not fugitives, right?

Enç also provides compelling arguments for abandoning classical tense operators by illustrating cases of “scope clash”:

(8.32) *Enç's examples of 'scope clash':*

- a. Every congressman who remembers a president will be at the party.
- b. Every committee member will investigate an official in Reagan's administration.

In (8.32-a), there is no way we can organize the various operators involved to get the reading we want. This example is uttered about a future in which the presidency has been abolished, and it is being asserted that those congressmen who are old enough to remember a president will be at the party. In this example, we want *every congressman* to scope over *a president* (since we do not want to require every congressman to remember the *same* president), and we want the future tense to scope over *every congressman* (since we are talking about future congressmen), but this forces *a president* to be within the scope of the future tense, which we do not want since there will be no presidents at that time. The same problem crops up in (8.32-b). In this case, we are talking about

committee members of the administration *after* Reagan's. And so we want *committee member* to be in the scope of the future tense (they are future committee members), and we want *an official* to be in the scope of *every committee member* (they need not all investigate the same official), but this forces *Reagan's administration* to be within the scope of the future tense, which we do not want, since there will be no such administration at the time.

Examples of this sort lead Enç to conclude that the temporal interpretation of nominals is independent of tense operators. Moreover, the only items which seem to show any sensitivity to tense operators are verbs. But, again, to claim that only one kind of item is sensitive to an operator is to say that the operator really has no scope at all; the scope has been trivialized. Enç continues to provide a referential theory of tense in the footsteps of (Partee, 1973), though while Partee supposes that tenses are referential, Enç instead supposes that verbs themselves are referential (indexical). This small difference is due to Enç's concern that languages which do not have overt tense still seem capable of assigning contextual times to their verbs (with or without adverbials). A complete review of the details of Enç's implementation will not be provided here. Rather, I intend to make some general remarks on the idea of referential tense in general.

### **8.3.3 Some Challenges of a Referential Tense Theory**

The similarities between tense and pronominals pointed out by Partee (1973) are undeniable. But is *similarity* or *analogy* as far as it goes? Is it possible that tenses actually *are* temporal pro-forms? It looks like they are probably not. Under more scrupulous analysis, it seems that there are a number of problems with the hypothesis that tenses are (purely) referential. Partee herself, in (Partee, 1984), recognizes these problems and opts to implement her observations in a Discourse Representation Theory framework (Kamp, 1981; Kamp and Reyle, 1993) instead, in which the underlying interpretation of anaphora in general is quantificational in nature. I conclude this chapter by noting some of these problems. It should be noted that the following discussion is more or less parallel to that in (Ogihara, 1989); the main structure of the discussion comes from Ogihara, though I have taken a number of liberties with it.

Let's start with Partee's deictic examples. The famous sentence is reproduced below:

(8.33) *Partee's example of deictic tense:*

*While driving down the turnpike: I didn't turn off the stove!*

Partee notes that under a scope-based quantificational analysis of tense, we are unable to derive the correct reading of (8.33). This results from the only two options under such an analysis being (8.34-a) or (8.34-b):

(8.34) *Possible representations of (8.33) under a scope-based quantificational analysis of tense:*

- a.  $\neg P(\text{I turn off the stove})$
- b.  $P\neg(\text{I turn off the stove})$

(8.34-a) is true just in case it has never been the case that "[the speaker] turns off the stove" is true. (8.34-b) is true just in case "[the speaker] turns off the stove" is ever not true. (8.34-a) is too restrictive, and (8.34-b) is too forgiving. Partee's suggestion to treat the past tense morpheme as referential to a specific past time would yield a representation such as the one below:

(8.35) *A logical representation of Partee's stove example with referential tense:*

$\text{is-past}(t) \wedge \neg\text{turn-off-stove}(s, t)$

In (8.35), the referenced time is treated as a free variable, which is consistent with a standard analysis of deictic pronouns. The key here is to determine what  $\neg\text{turn-off-stove}(s, t)$  means. If we hold that a predicate is true at an interval  $t$  just in case, in ERI Theory terms, the event described by the predicate occurs over  $t$ , that is,  $t$  represents the exact temporal location and duration of the event, then we interpret  $\text{turn-off-stove}(s, t)$  as " $s$  turns off the stove over  $t$ ". Then, under a no-frills interpretation of negation,  $\neg\text{turn-off-stove}(s, t)$  is true just in case  $\text{turn-off-stove}(s, t)$  is false. If we assume a reasonable interval which might be contextually salient in this case, such as the couple minutes before leaving the house, then (8.35) is too strict. First of all, it does not take that long to turn off a stove, second of all, even if it did, the stove-turning-off event would have to *exactly* line

up with that interval to make (8.35) true. We could of course say that  $\neg\text{turn-off-stove}(s,t)$  is true just in case, at no subinterval of  $t$ , a  $\text{turn-off-stove}(s)$  event occurs. This would seem to yield the truth conditions we want, but this treatment is not purely referential, since “at no subinterval of  $t$ ” involves existential quantification ( $\neg\exists t' \subseteq t \dots$ ). So, at least with a standard implementation of the ideas involved, the deictic analysis of tense is in trouble.

Partee also supposes that tenses can have anaphoric interpretations, in which previous tenses or temporal constructions function as antecedents. This is supposedly the case in (8.36):

(8.36) *Some of Partee’s examples of anaphoric tense:*

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

The problem with supposing that the tenses in (8.36) are anaphoric is that they do not refer to the *same* intervals as their antecedents. At best we can say that the tenses are, as Ogihara (1989) puts it, *dependent*, on the items which Partee is treating like antecedents. For example, the past tense in the second conjoined clause of (8.36-a) cannot be anaphoric because the party is certainly longer than the getting-drunk event. In (8.36-b) the interval over which Susan walks in is not the *same* interval as that over which Peter leaves. It would be very standard to analyze (8.36-b) as asserting that the walking-in event actually *follows* the leaving event. But, there is no direct analogy between times following one another and pronominal referents following one another. This is because times are ordered in a semantically fundamental way, while individuals are not.

To summarize, it is difficult to draw a direct analogy between tenses and referential pro-forms because of some critical ontological differences between times and individuals. Specifically, a theory of temporal reference must account for notions of temporal duration, precedence, and inclusion, which are not issues for nominal pro-forms. And it is unclear how one would account for these innate features of times without quantification in one form or another.

## Chapter 9 Conclusion

At this point, many of the properties which distinguish ERI Theory from other theories should be clear. When viewed in isolation, of course, ERI Theory shares many properties with other theories. For instance, like Montague's (1974) treatment, tense in ERI Theory has quantificational force and scope. Unlike (Montague, 1974) however, tense in ERI theory is not an *operator* on propositions; ERI Theory does not treat tense as mapping propositions to other propositions, but rather modifies the environment relative to which its scope is evaluated. ERI Theory is also unlike (Prior, 1967) in this respect, though of course Prior's treatment of tense is *not* quantificational in nature. Like (Enç, 1981), ERI Theory supposes that the semantic content of verbs is inherently time-sensitive. The difference is that (Enç, 1981) supposes that verbs are indexical with respect to time, and that explicitly mentioned temporal constraints boil down to pragmatic well-formedness conditions, while ERI Theory has a reverse perspective, in which verbs are sensitive to explicit temporal constraints, and pragmatic well-formedness is accounted for by restricting temporal quantification. Comparing and contrasting those *individual* properties which ERI Theory has in common (or not) with other theories could go on and on. What makes ERI Theory unique, is that it has a unique *configuration* of properties, and that this configuration is one which does not have most of the major problems discovered with other kinds of theories.

ERI Theory does not suffer from the issues inherent in referential approaches (discussed in more detail in section 8.3), because ERI Theory is not referential in nature. However, ERI Theory also does not suffer from the problems Partee, for instance, pointed out with quantificational approaches (e.g. her stove example), because ERI Theory includes a pragmatic account of temporal quantification restriction. ERI Theory should be preferred to theories which treat tenses as propositional operators, like (Montague, 1974; Prior, 1967) for a couple reasons. First, (Enç, 1981) shows fairly convincingly that these kinds of approaches simply cannot account for various linguistic data. Second, when operator-oriented theories are interpreted linguistically, they either

ignore structural facts about language, or posit unconventional syntactic structures which have no grounding in syntactic theory.<sup>1</sup>

One of the challenges inherent in a project as ambitious, and broad, as presenting a new theory of tense, is keeping the scope under control. In a subject matter as broad as tense theory, it seems as though every question addressed raises new ones. And it is not even the case that these new questions are contained within the same discipline. With issues spanning Semantics, Pragmatics, Philosophy, Syntax, and Comparative Linguistics, the tense theorist's job is never complete.

At best, ERI Theory provides us with a new strategy and new tool set with which to investigate other matters, or even the ones discussed here, in a more in-depth manner. Immediately apparent to me are a number of different directions we can go from here. We have largely glossed over a number of technical topics, including a formal treatment of temporal quantification. For example, how might we apply ERI Theory to deal with adverbs like *always*, *never*, or *most of the time*? How might we deal with cases which seem to involve temporal quantification but have no overt temporal quantifiers, such as in “Every rich man was an obnoxious child”? As Enç (1981) notes, this statement does not just say something about present rich men or about rich men at any particular past time, but rather seems to reference all rich men at all past times, and evaluates “was an obnoxious child” relative to each of these past times. There are also a number of mysteries surrounding the present tense which are suitable for possible analysis within ERI Theory. These issues include uses of the present tense as something like a “timeless” tense as in “John drinks tea with breakfast”. We also observe so-called “futate” uses of the present tense which involve plans or natural law suggesting a future state of affairs as in “John leaves for Boston tomorrow”, and “The sun rises at 7:00 a.m. tomorrow”. Also, there is still much to be investigated concerning the pragmatic properties of the classic sequence-of-tense examples. Such an analysis would almost certainly involve refining the algorithm for restriction of temporal quantifiers, which was presented in chapter 7.

I am particularly interested in the viability of ERI Theory, or a suitably enhanced version thereof, as an analysis of tense in other languages. As I briefly mention in the introduction, overt

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<sup>1</sup>(Enç, 1981) could also be held guilty of glossing over syntactic facts.

tense is not universal and human languages temporally locate events in a variety of ways. These strategies include but are not limited to relying upon adverbial constructions, and overtly marking aspect (e.g. whether the described event is complete or in-progress). I would also like to see how ERI Theory might be applied to languages with different aspectual perspectives. For example, in English, unless we overtly mark a construction as imperfective (with *-ing*) there is a default perfective interpretation. This is the main intuition behind ERI Theory's stipulation that an event's interval must be *subsumed* by the event restriction interval. Other languages work the other way, though. My understanding is that Hungarian, for example, has a default *imperfective* interpretation, unless explicitly marked as perfective. For example, in Hungarian, a sentence equivalent to "John built a house at 5:00 yesterday" does not entail that John started and finished the house-building event within the interval denoted by *5:00 yesterday*. Rather, it entails merely that John *was building* a house at the time. Can we attribute this difference in interpretation by simply stipulating that languages must choose between  $\subseteq$  and  $\supseteq$  when relating an event's interval to the event restriction interval? My limited experience suggests that nothing is ever this simple, though I would be interested to see how such an analysis might be constructed in ERI Theoretic terms.

Suffice it to say that future applications of ERI Theory-based approaches are not in short supply. Hopefully, I have succeeded in presenting a coherent outline of the core intuitions upon which ERI Theory is based. And hopefully, these underlying ideas form a strong basis, from which ERI Theory can be extended and adapted, so that we might shine a new light on problems both old and new.

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