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Minglang Zhou

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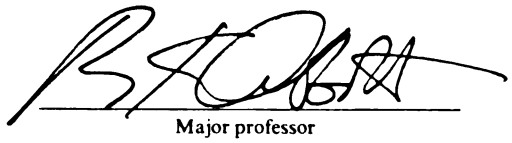

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A STUDY OF TEMPORAL RELATIONS IN NATURAL LANGUAGES WITH SPECIAL REFERENCE TO CHINESE AND ENGLISH

By

Minglang Zhou

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ABSTRACT

A STUDY OF TEMPORAL RELATIONS IN NATURAL LANGUAGES WITH SPECIAL REFERENCE TO CHINESE AND ENGLISH

By

Minglang Zhou

It is tempting to assume that the study of temporal relations in natural languages begins with verbs, but this is simply not true. Studies have been focused on verbs in terms of theories of action rather than temporal properties since Aristotle. In modern linguistics and philosophy, how temporal relations are represented in natural languages is generally ignored, while time is considered external as in possible world semantics, where truth conditions for sentences are obtained against possible worlds at a moment or interval of time. These approaches lead to paradoxes and puzzles with respect to the representation of time in natural languages.

This study focuses on temporal relations represented in natural languages. Linguistic evidence from Chinese, English and other languages suggests that there are three dimensions of representation of temporal relations in natural languages: Linear Time, Frame Time and Situation Time. Linear Time is a set of points of time without duration but with precedence ordered in relation to speech time in a linear structure. Frame Time is a set of intervals of time, which are denoted by temporal frame adverbials and within which a described event/activity takes place or

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a state holds. Frame Time represents temporal inclusion relations. Situation Time is a set of instants or intervals of time denoted by verbs, where intervals are designated as bound or non-bound by verb modifiers. Situation Time represents part-of relations. These three dimensions exhibit completely different logical behaviors that underlie entailment relations between sentences with different verbs, tenses, aspects and temporal adverbials.

The relations among Linear Time, Frame Time and Situation Time account for a large range of linguistic phenomena, such as aspect viewpoints, the present perfect puzzle, and the demonstrative use and anaphoric behaviors of temporal expressions. For example, linguistic evidence shows that the relations between Frame Time and Situation Time are universal in verbal aspect interpretations, though grammaticalization of those relations as aspect is subject to parameterization. This study claims that these three dimensions of temporal relations and the relations among them are universal in natural languages, though grammaticalization of a particular relation is parameterized in a particular language.

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My deepest gratitude goes to the chair of my dissertation committee, Barbara Abbott. She has provided consistent guidance and encouragement in my academic and professional life during my entire stay at Michigan State University. In her class in semantics on noun phrase interpretations, I began to get some ideas for this dissertation. It seems to be an unusual class in which one gets interested in temporal relations, but it is where fresh perspectives have arisen. In the whole process of writing this dissertation, I had timely guidance from her so that I was able to avoid pitfalls and to clarify myself. She read early drafts and revised drafts of each chapter, and made numerous comments and suggestions which have greatly improved this work.

I am grateful to Grover Hudson. He encouraged me in my professional development, reading my papers and making helpful comments. He was also supportive in his capacity as associate chair of the department. I am also grateful to Carolyn Harford, with whom my discussion about some syntactic phenomena in Chinese resulted in presentations and publications. Of course, I want to express my gratitude to Yen-Hwei Lin both as my committee member and as my graduate assistant supervisor for her encouragement and confidence in me. She not only gave

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My study at Michigan State University was made possible through graduate assistantships from the Department of Linguistics and Germanic, Slavic, Asian and African Languages, and a dissertation fellowship from the Graduate School and College of Arts and Letters.

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Finally and most important of all, I want to thank my wife Wanli for her love and support, and my daughter Mary for her understanding of my excuses not to leave my desk and computer as often as she liked.

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Chapter One
INTRODUCTION

1.1 TIME, ACTIONS AND VERBS: PRELIMINARIES

In a philosophical study of the relation between time and actions, I assume that the set of questions in (1) need to be answered.

(1) a. Does an action take time ?
b. If it takes time at all, does an action take a period of time or a moment of time ?
c. If an action takes a period of time, is the period of time open-ended or with well-defined end-points ?
d. How is the time that one action takes related to the time that another action takes ?
e. How is the time that an action takes related to the time of the utterance of a sentence describing the action?

The purpose of this study, however, is to answer the set of questions in (2) by investigating temporal relations in verb categorization and the representation of time in natural languages in a linguistically motivated approach with the questions in (1) underpinning the questions in (2). Eventually, answers to the set of questions in (2) are supposed to shed light on the questions in (1).

(2) a. Is there any linguistic evidence for (1a), (1b) and (1c) in natural languages ?
b. What is the linguistic evidence, if there is any, concerning whether a period of time is open-ended or with well-defined end-points ?
c. What is the linguistic evidence for (1d) and (1e) ?

d. How can the linguistic evidence regarding the above questions be (formally or informally) represented in the syntax and semantics of natural languages?

Temporal relations in different classes of verbs are of some interest in philosophy and linguistics, since verbs are used to describe human actions. We may naturally assume that our interests in verb classes begins with our interests in descriptions of our actions. This assumption is logical, but is not necessarily the reality in our inquiry of actions and verbs. It seems to me that, with regard to actions, philosophers focus their attention on the following aspects: the agent (WHO did it ?), the act-type (generic or specific), the modality of action (HOW did he/she do it ?), the setting of action (WHEN, WHERE, and UNDER WHAT CIRCUMSTANCES did he/she do it ?) and the rationale of action (WHY did he/she do it ?) (Rescher 1967:215-9). The question of the relation between time and actions is generally ignored. Few philosophers appear to ask the set of questions in (1), and even fewer philosophers appear to ask the set of questions in (2) , though several philosophers, such as Kenny (1963) and Vendler (1967), raise some questions regarding these aspects in one way or the other following the tradition of Aristotle. Linguists have begun to show interest in temporal expressions, temporal relations in different classes of verbs only in the last two decades (Dowty 1972). These questions deserve more attention than they have received so far, particularly from linguists in the classification of verbs, in the study of linguistic representation of time, and in providing truth conditions for sentences. I assume that those questions in (1) are the philosophical foundation of the present study, though this study focuses on the set of questions in (2) from the linguistic point of view. I look at the problem of temporal relations in verb classes and linguistic

representation of time in general with those philosophical questions as underlying guidelines, show how these aspects of actions are linguistically represented in natural languages, and try to provide informal and formal representations of these aspects of actions in verbs, which in turn can adequately characterize each category of verbs in terms of temporal relations, the truth conditions for sentences containing them, and ultimately the semantic relations between sentences in terms of temporal relations.

The interest in verb classes can be traced back to Aristotle, who probably pays more attention to the classes of verbs than any other philosopher or linguist. Aristotle basically categorizes verbs into two classes: process, and activity/stative verbs. In Metaphysics, Aristotle (1048b, translation 1966:188-90) discusses the distinction between a process and an act with regard to activities. He notices that a process verb involves changing from one state of affairs toward another state of affairs which is not yet present. One of the examples he uses is *reducing one's weight* which has slenderness as an end. In this process, there is a movement from fatness to slenderness. Such movement is not considered as an action, since it is not an end itself. If one is reducing his weight, he may become slender or he may not become slender, since the movement is not an end, i.e., slenderness in this case. On the other hand, an activity verb does not involve such a movement from one state of affairs to another state of affairs, but involves a movement with an end in itself. One of the examples given by Aristotle is *seeing*. In seeing, one has sight as an end. Thus, Aristotle calls the former 'a process' and the latter 'an act'. In Metaphysics, Aristotle lists *learning*, *house-building*, *reducing*, *healing* and *walking* as process verbs, and *thinking*, *knowing*, *living well*, *being happy* as activity verbs. In De Anima, Aristotle (417a - 417b, translation 1902:

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64-7) seems to distinguish a third class of verbs, stative verbs, from activity verbs, as pointed out by Kenny (1967:173). Aristotle talks about two senses of knowing: acquiring knowledge and possessing knowledge. Of the two senses, the former has an activity reading, while the latter has a stative reading. It is not entirely clear that what Aristotle discusses in De Anima is applicable to the differences between stative verbs and activity verbs, since his focus is on knowledge.

It seems that in his classification of verbs Aristotle does not explicitly raise the questions in (1). In other words, the notion of time is not explicitly employed in his criteria of verb categorization, since Aristotle is mostly concerned with verbs in terms of theories of actions. However, the notion of time seems implicitly to underlie Aristotle's verb categorization. For example, the definition of verb classes is definitely temporally oriented in that a process verb involves changing from one state of affairs toward another state of affairs which is not yet present. In fact, the two or three classes of verbs appear to be contrasted in a temporal frame, though Aristotle only looks into one aspect of the action denoted by a verb, namely, the end or goal of the action in question.

In short, the questions raised in (1) do not appear to have received enough attention in the study of actions in philosophy, and the questions in (2) are not satisfactorily answered in the study of linguistic representation of time in verb categorization and in linguistics in general, though the relation between the notion of time and actions seems to be implicitly underlying verb categorization in Aristotle. In fact, Aristotle is more interested in verbs in terms of theories of actions.

1. 2 PROBLEMS SINCE ARISTOTLE

In the study of verb categorization, I think that there are three general problems with previous approaches to the problem of verb classification and the semantics of each category of verbs. The first problem is the absence of uniform criteria in categorization and its consequence -- the absence of uniform results given such criteria, as indicated in the disagreement about the number of categories of verbs. The second problem is methodological in essence, characterized by attempts to classify each category of verbs in terms of the semantic relation between sentences in different tenses and aspects before the first problem is settled in an appropriate way. Thus, the criteria appear to be inadequate, and the methodology appears to be defective. These two problems appear to originate from the failure to acknowledge the two sets of questions raised in (1) and (2) as important aspects in the study of actions, verbs and verb categorization with respect to temporal relations. The third problem is a direct consequence of the first two problems. Without clear consideration of the notion of time in verb categorization and without uniformly categorized verbs, there have been problems for approaches to correctly represent temporal relations in semantics and in tense and aspect logic for natural languages, since these aspects of verbs in natural languages are essentially temporal relations. The first two of these three problems are discussed one by one in detail below, while the third problem deserves a full treatment in Chapter Two.

The first problem has its origin in Aristotle's classification of verbs. For example, Aristotle does not make a distinction between stative verbs and activity verbs in Metaphysics, though he seems to do so in De Anima. The confusion of these two classes of verbs appears to result from the lack

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of clearly formulated criteria in the categorization of the verbs. It seems that the main criterion Aristotle uses is whether the action denoted by the verb has an end (goal) in itself or not. When a verb has an end in itself, then it is complete and is an activity/stative verb. When a verb does not have an end in itself, then it is incomplete. An incomplete verb has its end outside it, and thus it involves a movement from one state of affairs to another state of affairs, the latter of which may be not yet present at all. Aristotle's label for this class of verbs is 'process verb'. Aristotle's approach apparently leaves much room for diversity in verb classification.

Among modern scholars, Ryle (1949) is one of the first authors to pay attention to verb classification, and notes that verbs like *win* and *find* from Aristotle's process verbs have logical behavior quite different from activity verbs or the other process verbs. Like process verbs, this class of verbs involves a movement from one state of affairs to another state of affairs. However, this class of verbs does not express the complete movement but only the achievement of the latter state of affairs. Thus, Ryle calls this class of verbs 'achievement verbs', which are often labelled 'resultative verbs' in traditional grammar. Achievement verbs always have a counterpart activity verb as a complement to part of the movement that changes from one state of affairs to another state of affairs. For example, there are pairs like *treat* and *heal*, *listen* and *hear*, and *look for* and *find*. Ryle does not make it clear that there are four categories of verbs, though he notices the difference between achievement verbs and process verbs, nor does he clearly realize that his achievement verbs represent a completely different temporal relation from that represented by other verbs in Aristotle's process class. Kenny (1963) calls the process verbs 'performance verbs', while still keeping Aristotle's activity verbs and state

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verbs. Vendler (1957, 1967) breaks away from Aristotle's tradition of dichotomy or trichotomy in verb categorization, and classifies verbs into to four classes in time schemata, though he still follows Aristotle's tradition in essence. Vendler's four categories are stative verbs, activity verbs, accomplishment verbs and achievement verbs. The last two classes of verbs are Aristotle's process verbs. Consequently, we see some diversity in verb category terminology which is briefly summarized in (3). In the literature on this topic, authors may choose to adopt some of these philosopher's terminology with or without arguments.

(3)

Aristotle:	activity	?state	process	
Ryle:	?	?	achievement	process
Kenny:	activity	static	performance	
Vendler:	activity	state	achievement	accomplishment

For a better illustration of the verbs involved in these categories, I present each author's categories with sample sentences below. First, Aristotle's three categories of verbs are represented by the following three English sentences respectively, though he focuses on Greek verbs in his study.

(4) a. John talked. (activity)
b. John loved Mary. (state)
c. John reduced his weight. (process)

Secondly, Ryle's distinction between his achievement verbs and process verbs within Aristotle's process verbs are illustrated in (5). However, it is not clear what he has to say about Aristotle's activity verbs and state verbs.

(5) a. John lost twenty pounds. (achievement)
b. John reduced his weight. (process)

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Verbs

(5') a.?John conscientiously lost twenty pounds. (achievement)
b. John conscientiously reduced his weight. (process)

The contrast between (5a) and (5b) is more clear when certain adverbs are added to these sentences, as in (5'), where, though, other aspects of the action are involved in addition to temporal relations. Thirdly, Kenny's three categories of verbs are the same as Aristotle's, as in (6), though his labels are different from Aristotle's.

(6) a. John talked. (activity)
b. John loved Mary. (static)
c. John lost twenty pounds. (performance)
e. John reduced his weight. (performance)

Finally, Vendler's four categories of verbs are demonstrated in the English sentences in (7).

(7) a. John talked. (activity)
b. John loved Mary. (state)
c. John lost twenty pounds. (achievement)
e. John reduced his weight. (accomplishment)

These examples show that the differences in terminology are mostly insignificant. However, the classification of Aristotle's process verbs into achievement verbs and process verbs by Ryle and into achievement verbs and accomplishment verbs by Vendler are of great significance in semantics and logic, since achievement verbs and accomplishment verbs have very different logical behaviors and involve completely different temporal relations. This will be illustrated in detail in the next chapter.

The second problem lies in the way the semantics of each category of verbs is characterized. The problem begins with Aristotle's work. In

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discussing the verb categorizing criterion, Aristotle arrives at his classes of process verbs and activity/stative verbs by calculating the entailment relation between the sentences with verbs in question in imperfective forms and the sentences with verbs in question in perfective forms. The distinction between a perfective verb form and an imperfective verb form lies in that the former presents the totality of the event or situation referred to without reference to its internal temporal constituency, while the latter makes explicit reference to the internal temporal constituency of the event or situation (cf. Comrie 1976:3-4). In English, for example, the imperfective is in the progressive form, while the perfective is in the non-progressive forms. A sentence with an activity verb in imperfective form entails a sentence with an activity verb in perfective form, whereas a sentence with a process verb in imperfective form does not entail a sentence with a process verb in perfective form. A typical example from Aristotle is (8), where (8a) is an example exhibiting the entailment relation, while (8b) is an example exhibiting the non-entailment relation (Metaphysics, 1048b, translation 1966:189).

(8) a. One who is living well has at the same time achieved the good living (lived well).
b. He who is learning has not yet learned.

This tradition is carried over in Kenny's approach in treating the semantics of each class of verbs. Kenny (1963:171-86) proposes (9), in which ϕ stands for a verb and *A* stands for a subject noun phrase:

(9) a. Performance verbs: "A is ϕing" implies "A has not ϕed".
b. Activity verbs: "A is ϕing" implies "A has ϕed".
c. Static verbs: "A has ϕed" implies "A ϕs".

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(10) a. If a man is building a house, then he has not yet built it.
b. If a man is living in Michigan, then he has lived in Michigan.
c. If a man has loved a woman for many years, then he still loves her.

Verbs in sentences corresponding to those in (9) are illustrated in (10). According to Kenny's proposal in (9), *build* is a performance verb, *live* is an activity verb and *love* is a stative verb, since the first clause is supposed to entail the second clause in (9). However, it is not clear in the literature since Aristotle that (9) is the definition for the classes of verbs or the methodology in identifying the classes of verbs. This ambiguous status of (9) may result from the lack of clear acknowledgement of the set of questions in (1) and (2), and has its consequence in approaches to semantics and to to tense and aspect logic.

The methodological problem lies in the inappropriate application of entailment relations in the categorization of verbs. In the literature on the topic of verb categorization (cf. Binnick 1991, Dowty 1979, Vendler 1967), on the one hand, it is claimed in the case of accomplishment verbs that a sentence with a verb or verb phrase **that denotes part of a situation** does not entail a sentence with a verb or verb phrase **that denotes a whole situation**, while, on the other hand, it is claimed in the case of activity verbs that a sentence with a verb or verb phrase **that denotes a whole situation** does entail a sentence with a verb or verb phrase **that denotes part of a situation**. Those authors fail to realize the semantic and temporal properties stated in the bold letters above, as I will discuss in detail in section 4.4. In addition, as criteria, the statements in (9) do not always work in verb categorization. For example, it is clear that (9) is inadequate to distinguish achievement verbs and accomplishment

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verbs, though it may be adequate to distinguish activity verbs from process verbs. Both Aristotle and Kenny rely on criteria or a method like (9) in verb categorization. As a result, neither of them was able to recognize the logical and temporal differences between achievement verbs and accomplishment verbs, and instead, they both classify achievement verbs and accomplishment verbs into one package with the label of 'process verbs'. In addition, (9c) may not always appropriately characterize the logic behavior of static verbs.

Ryle (1949) comes to grasp the difference between achievement verbs and the rest of process verbs from a completely different perspective. He notices that the action denoted by a process verb may be under deliberate control by the agent, while that denoted by an achievement verb is not under deliberate control by the agent, as is illustrated in (11).

(11) a. ?John carefully lost twenty pounds. (achievement)
b. John carefully reduced his weight. (process)

The perspective from which Ryle finds the difference between achievement verbs and the other process verbs does not necessarily indicate that his categorization is directly related to the different temporal relations between these two categories of verbs, though one can hardly find adverbs like *carefully* in the company of a verb that represents an instant of time. It is Vendler who finds that the logical difference between achievement verbs and accomplishment verbs (e.g. the rest of the process verbs) is directly related to temporal differences in these two classes of verbs, as shown in (12) on the next page (Vendler 1967:103-7).

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(12) a. At what time did John lose twenty pounds ?
b.?At what time did John reduce his weight ?

His observation indicates that achievement verbs are related to an instant of time, while accomplishment verbs are related to a period of time.

In summary, of the three problems related to previous approaches to verb categorization the first two are discussed in this section. The first is the lack of clearly formulated criteria and its consequences. The second is a methodological problem, in which the entailment relation between sentences in question seems to be the criterion in identifying verb category membership at one time, and to presuppose clear membership of a category of verbs at another time, resulting in circularity. Moreover, temporal relations were not seriously considered in verb categorization until Vendler's pioneering work (1957, 1967).

1. 3 AN OVERVIEW OF THE APPROACH IN THIS STUDY

To give a brief summary of what I have discussed so far in this chapter, I note that there is a set of questions in (1) to be answered in a philosophical study of actions and there is a set of questions in (2) to be answered in linguistic studies of verbs, verb categorizations and the representation of time in natural languages. I point out that there are three general problems with previous approaches to the study of verbs, verb categorization and temporal relations in natural languages. These three problems are the lack of uniform criteria and its consequences, methodological problems, and problems for semantics and for tense and aspect logic related to verbs, verb categorization and the representation of time.

In this study, as claimed at the beginning, I plan to investigate the relations among verbs, verb categorization and the representation of time

in natural languages in a linguistically motivated approach with the set of questions in (1) as the philosophical foundation and with the set of questions in (2) as the specific goal. Two of the three problems concerning verb categorization are discussed in this chapter, and the third problem, namely, the problem of verb categorization for semantics and for tense and aspect logic, is reviewed in detail in Chapter Two. With these three problems reviewed, I focus on the investigation of the representations of time in natural languages and the relation between such representations and the set of questions in (2). The linguistic representation of time is usually observed to appear in the form of tense and aspect (Comrie 1976, 1986, Dahl 1985, Smith 1991), in the form of time adverbials (Bennett & Partee, 1972, Heny 1982, Richards 1982) and in the form of adverbial clauses (Bennett & Partee 1972, Dowty 1982). Of course, I argue that the linguistic representation of time also occurs in verbs and verb phrases, as Vendler (1957, 1967), Parsons (1985, 1990) and others have observed but failed to recognize its importance.

Reichenbach (1947) has studied the temporal relations in natural languages from the perspective of logic. He puts forward three concepts: point of speech, point of event and point of reference. These three points involve all the above forms of linguistic representation of time. However, Reichenbach only considers the order of the three points to account for tense and aspect, with the assumption that these three are linearly ordered. Reichenbach's theory is both too strong (cf. Comrie 1981) and inadequate. This study will show that the temporal structure in natural languages is much richer than Reichenbach's theory assumes.

If real time is considered as linear, and if it develops from the past to the future, then it is usually represented as a line with an arrow pointing

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towards the right hand side, the left side being the past and the right side being the future, as in Benthem (1983), Comrie (1985), ter Meulen (1983), and Smith (1991). This linear representation of time usually provides temporal orders and locations, though some authors fail to realize the limitations of it. I consider, as the representation of Linear Time, the representation of the temporal order of occurrences of actions, relative to the point of time of utterance and relative to the occurrences of other actions, along this temporal line. The representation of Linear Time gives us relative locations or orders of the occurrences of actions and utterances along the temporal line.

First, how do tense and aspect represent time in this linear picture? For example, Comrie writes "Since tense locates the time of a situation relative to the situation of the utterance, we may describe tense as deictic." (1976:2). In this sense, tense locates points of time of occurrences of actions along the temporal line, relative to the time of the speaker's utterance. For example, (13a) indicates that *read a book* took place before the utterance of the sentence, while (13b) indicates that *read a book* is to take place after the utterance of the sentence.

(13) a. John read a book.
b. John will read a book.

In contrast to his view of tense, Comrie considers aspect different from tense in that "Aspect is not concerned with relating the time of the situation to any other time-point, but rather with the internal temporal constituency of the one situation."(1976:3). This seems to suggest that aspect does not locate points of time along the temporal line, but rather represents some temporal structure within points of time. Whether Comrie's view of

representation of time by tense and aspect is accurate and adequate is further discussed in Chapter Three and Chapter Five in relation to the set of questions in (2). For my purposes here, the two aspects in the sentences in (14) seem to indicate certain temporal order of the actions in question, though they do more than just present the temporal order, as Dahl (1981:23-5) points out.

(14) a. John had read a book when Mary came.
b. John was reading a book when Mary came.

The past tense in (14) shows that the actions described took place before the utterance of these sentences. The perfective aspect in (14a) indicates that *read a book* took place before *come*, while the imperfective in (14b) tells us that *come* took place in the middle of *read a book*. In short, both tense and aspect do represent the temporal order or temporal locations along the temporal line.

Secondly, temporal relations are found in temporal adverbial clauses. For example, *after* and *before* are frequently used to express the order of one action in relation to another action along the temporal line. Even *and* may express some temporal relations when it is used to conjoin two clauses or more, as in (15).

(15) John went home and watched television.

Moreover, tenses and aspects are usually involved in tense sequences in embedded clauses, which also indicate order along the temporal line. I think that these representations of temporal relations in languages belong to the representation of Linear Time.

How does my Linear Time compare to Reichenbach's (1947:288)

point of speech, point of the event and point of reference? I think that Linear Time definitely covers Reichenbach's point of speech, and may cover point of the event in a certain sense, as my discussion in the previous two paragraphs indicate. Does Linear Time cover Reichenbach's point of reference? I think that the answer is 'yes' and 'no'. This is because Reichenbach's point of reference sometimes is the same as point of speech and point of the event, in which case Linear Time covers point of reference. However, Reichenbach's point of reference sometimes is different from the point of speech and the point of the event, in which case Linear Time does not cover the point of reference, if it is not linguistically represented, as my discussion in Chapter Three will show. Essentially, Linear Time just covers linear temporal relations in Reichenbach's theory. In other words, Linear Time in my theory only represents precedence relations in natural languages.

Thirdly, temporal relations in natural languages are also represented by temporal adverbials. Temporal adverbials can be grouped into frame adverbials, e.g., *this morning*, frequency adverbials, e.g., *twice a year*, durative adverbials, e.g., *from two pm to five pm*, and punctual adverbials, e.g., *at eight am on Tuesday* (cf. Bennett & Partee 1978) Temporal relations specified by temporal adverbials may be also deictic in nature. *This morning* is an example of this kind. Then, what is the relation between temporal relations specified by tense and temporal relations specified by temporal adverbials, since both are deictic in some respects? This relation is studied in detail in Richards (1982), Heny (1982) and Dowty (1982). What concerns me here is the period of time denoted by temporal adverbials. Most of these adverbials contain interval-referring temporal expressions. For example, *this morning* not only specifies a temporal

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location along the temporal line but, as an interval-referring expression, also has a period of time along this line as its reference. I refer to such a period of time as Frame Time, a term used in Bennett and Partee (1978) and Smith (1991), in contrast to Linear Time.[1] Frame Time can be defined as the period of time denoted by a referring temporal expression, which may function as an adverb or adverbial, such as the ones that I have discussed above, and as a period of time within which actions and events take place. Frame Time is an important notion in this study, since it is a puzzle in interval semantics and is of particular interest in relation to the set of questions in (2). The nature and role of Frame Time in semantics and syntax is fully treated in Chapter Three. I believe that the notion of Frame Time is of importance in semantics and in tense and aspect logic.

Finally, temporal relations in natural languages are also represented by verbs and by verb phrases with noun phrases. Temporal relations in verbs do not get enough attention, as I have discussed in 1.2., while the representation of temporal relations in verb phrases with noun phrases in natural languages is generally ignored in linguistics and philosophy, though the relation between a noun phrase and a verb phrase containing it is frequently studied from other perspectives. Of all the previous approaches to the problem of verb categorization, it seems to me that only Vendler's (1957, 1967) work comes close to the realization of temporal relations by noun phrases in verb phrases, but fails to pursue these aspects of temporal relations further. Vendler's work is given a complete review in the next

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[1] Bennett and Partee (1978:22) use the term 'frame time' with a sense similar to what I am talking about here, but they dropped it without further development. Smith (1991:155) has mentioned the term 'frame time' in her discussion of temporal adverbials, but she does not seem to give it any theoretical significance. Parsons (1990:211-2) seems to take a more theoretical approach to frame adverbial phrases. I will give a detailed review of these approaches in section 3.4 in Chapter Three.

chapter. Intuitively, we know the answer to the question (1a), namely, 'actions take time', but linguistically it is not so clear in the literature as how the intuitive answer is represented in natural languages. I believe that temporal relations, as represented by noun phrases in verb phrases, are of more direct relevance to the questions in (2a) and (2b) than temporal relations represented by other linguistic forms that I have mentioned above. The noun phrases in question function grammatically as object or complement in verb phrases, and function thematically as patient/theme or goal, as shown in (16).

(16) a. Mary read *a book.*
b. Mary ran *some distance.*
c. Mary pushed *the cart.*

Temporally speaking, there is a relation between the action denoted by the verbs and references of the noun phrases. Intuitively, I think that for each and every chapter of a book that Mary read there is a period of time taken. The time taken in reading each chapter of a book makes up the time taken in *reading a book.* Similarly, for each and every part of some distance that Mary ran there is also a period of time taken. The time taken in running each part of some distance makes up the time taken in *running some distance.* The temporal relations in this kind of verb phrases are predictable in the sense that the period of time taken is specified by the noun phrases in some way. On the other hand, this relation does not seem to be found in (16c). First of all, Mary did not have to push each and every part of a cart in order to push a cart. Secondly, it is possible that Mary pushed a cart by just pushing an inalienable or unmovable part of a cart. Thirdly, Mary might have pushed a cart for a period of time of arbitrary length so that

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temporal relations in the latter kind of verb phrases are unpredictable in the sense that the period of time taken is not specified by the noun phrase, *the cart*, in (16c). In contrast to Linear Time and Frame Time, Situation Time covers the temporal relations in processes, states, events and activities that verbs and verb phrases denote in natural languages. Situation is a more general cover term for processes, states, events and activities (cf. Comrie 1976). Situations are considered instantiations of temporal properties represented in verbs and verb phrases (cf. Gabbay & Moravcsik 1980). A working definition for Situation Time is that Situation Time represents the temporal relations internal to an event, activity, process or state denoted by a verb or verb phrase. The linguistic representation of Situation Time and its properties is the main topic in Chapter Four. By studying linguistic representations of Situation Time, I think that I am able to provide answers to the questions in (2a) and (2b) and to some problems in verb categorization.

In semantics and logic, verb phrases are termed 'predicates'. Temporal relations in verb phrases, as shown in the discussion of (16), are important in marking the mass-count distinction in predicates -- a distinction which is parallel to that in terms as discussed by Hoepelman (1976), Hoepelman and Rohrer (1980), and ter Meulen (1980), among a number of authors, but it is, however, never made clear how such a distinction is made in predicates. I assume that predicates, depending on their category, are specified as count or mass by certain classifiers as some nouns are, provided the noun phrases in question specify a predictable temporal relation in the verb phrases. The parallelism is that if terms are specified as count and mass linguistically by the presence of certain classifiers or packages, then so are the predicates, as in (17) and (18).

(17) a. some water (mass)
b. a glass of water (count (package))
(18) a. John drank some water. (activity)
b. John drank a glass of water. (accomplishment)

The difference is that the distinction between references of count terms and references of mass terms is made along the dimension of space, whereas distinction between the extension of the count predicates and that of the mass predicates is made along the dimension of time in terms of boundness and nonboundness in situations if situations are instantiations of temporal properties. The topic of the mass-count distinction is also to be fully treated in Chapter Four in terms of bound and nonbound situations. The question of how Situation Time as one of the three dimensions of the representation of time is different from the other dimensions of the representation of time is also considered in Chapter Four.

How the three dimensions of time, that is, Linear Time, Frame Time and Situation Time interact with each other in natural languages is treated in Chapter Five, where I discuss, in light of the three dimensions of temporal structure, the consideration of aspect as viewpoints or perspectives (Comrie 1976, Smith 1991, Thelin 1990). This three-dimensional representation of time in natural languages will present a fresh view on the present perfect puzzle (Klein 1992) and the fallacy of structural analogies between tenses and pronouns (Partee 1973). Conclusions from this study will be presented in the last chapter, Chapter Six.

To review my main points briefly, I plan to distinguish Linear Time, Frame Time and Situation Time and investigate their relations with each other and their difference in linguistic representations. I believe that the

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differences in the linguistic representation of time along the three dimensions, Linear Time, Frame Time and Situation Time, are of great importance in semantics and in tense and aspect logic. Linear Time is commonly mentioned and adopted in semantics and in tense and aspect logic as well. However, there are misunderstandings concerning its relations with the other dimensions of time. Therefore, one of my tasks is to spell out clearly its properties so that Linear Time and its linguistic representation may be better understood. As for Frame Time, my task is to study linguistic representations of Frame Time and its theoretical significance in the representation of time in natural languages. I will focus on linguistic representations of Situation Time in relation to verb categorization and the characterization of the truth conditions for sentences with different classes of verbs in different tenses and aspects, since Situation Time is a dimension of temporal relations that are not fully treated in natural languages. The problem of verb categorization is eventually viewed in a temporal frame in this study.

Chapter Two

TIME, VERB CATEGORIZATION AND TRUTH CONDITIONS

2.0 INTRODUCTION

The purpose of this chapter is to review the problems of verb categorization for the characterization of truth conditions of related sentences in semantics, and in tense and aspect logic from the perspective of time. This is the last of the three general problems that previous approaches to time and verb categorization have, the first two of which have already been reviewed in the preceding chapter.

What is the relation between verb categorization and truth conditions for sentences or statements? In semantics, whether a sentence is true or false is usually evaluated against time. For example, in model-theoretic semantics, a sentence is evaluated against the pair of worlds and times (Dowty 1979). In interval semantics, a sentence is specifically evaluated *at* an interval of time, *in* an interval of time and *for/throughout* an interval of time for its truth conditions (Bach 1980) if possible worlds are put aside. A similar situation is found in logic. A statement is traditionally evaluated at moments of time, but is now often evaluated in terms of intervals of time (Benthem 1980). It is clear that time is a key condition for the truth of a sentence or statement in semantics and logic. On the other hand, verb categorization also involves the concept of time. For example, Aristotle's classification of process verbs and activity verbs depends crucially on the notion of time. If a process verb denotes an action that involves changing

from one state of affairs to another state of affairs, then a specific stretch of time is needed for the changing to take place. However, a period of time may not be required when no such changing of the state of affairs occurs as in case of actions denoted by activity verbs. In the latter case there may be only an arbitrary stretch of time involved. It is also apparent that time is an important dimension along which verbs, or more specifically verb phrases, are classified. If the truth of a sentence is evaluated in terms of time, an adequate characterization of the temporal structure of the verb phrases in question is necessary so that the relation between the time involved in the action denoted by a verb phrase and the time used as a measurement for the truth of the sentence can be fully considered. It seems that adequate characterization of the temporal structure of verb phrases is not yet available. Even available characterizations of temporal structures of verb phrases do not appear to be fully considered in the treatment of the semantics of sentences with the verb phrases in question. For example, some notion similar to that of Frame Time is raised in early work by Bennett and Partee (1978), but abandoned by themselves and others (cf. Bach 1981, Smith 1991). Another example is Vendler's (1957, 1967) observation of linguistic representation of distinctive temporal structures in verb phrases which has also been ignored in semantics and tense and aspect logic for a long time. This phenomenon of the ignorance of temporal relations in natural languages is seen in previous formal approaches to tense and aspect in natural languages. Of course, no consideration is ever given in semantics and logic to all the three dimensions of the representation of time, e.g., Linear Time, Frame Time and Situation Time that I have outlined in section 1.3, though much attention is paid to one of the three dimensions -- Linear Time in tense logic.

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2.1 PREVIOUS APPROACHES TO THE PROBLEM

The literature on verb categorization and on the characterization of truth conditions for sentences with different classes of verbs has grown rapidly in the past two decades, though the topic did not receive enough attention long after Vendler's (1957, 1967) pioneering work on the topic with emphasis from a linguistic perspective. This section does not present a review of all the literature but only to review major work on the topic in different approaches. The first author to be reviewed is Vendler, whose work (1957, 1967) not only draws linguists and philosophers' attention to the relation between verb categorization and the notion of time in verb categorization but also makes two important observations of linguistic representations of temporal relation in natural languages. The second author covered in this section is Montague (1970, 1973). Montague takes a model-theoretic approach to the semantics of natural languages treating natural languages like formal languages. In fragments of English, he analyzes the present tense, future tense and the progressive in an approach that has an impact on research on this topic, though he does not directly work on verb categorization. Work on this topic was further developed by Bennett (1977, 1981), and Bennett and Partee (1978) along the line that Montague had initiated. Part of this section will focus on Dowty's work (1977, 1979). Of all the recent authors on verb categorization, I believe that Dowty is the most influential author who examines the problem from a linguist's perspective and whose work draws more attention on this topic from linguists than anyone else's work. One of the last two authors covered in this section is Åqvist (1977), who, together with Günthner (1978), approaches the problem of verb categorization in tense logic based on Reichenbach's (1947) approach. The other author is Parsons (1985, 1989,

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1991) who looks at the problem from the philosophical perspective of action (Davidson 1968, 1980) and proposes an analysis in the form of classical tense logic.

2.1.1 VENDLER'S ANALYSIS AND HIS TWO OBSERVATIONS

Of all the approaches to verb categorization by modern authors, it seems to me that Vendler (1957, 1967) is the first author who appears to pay attention to some of the set of questions in section 1.1. Vendler (1967: 97) notes that verbs involve the concept of time in the commonly known form of verb tenses. He goes on pointing out that consideration of the concept of time in verbs is not limited to verb tenses like past, present and future, since the particular way in which verbs are used also involves or presupposes the notion of time. With this insight, Vendler classifies verbs, into four categories, activity verbs, state verbs, achievement verbs and accomplishment verbs, breaking away from the Aristotlian tradition of dichotomy/trichotomy in verb categorization. Vendler first of all uses progressive sentences as a criterion to distinguish some verbs from other verbs. For example, a question in progressive form like the one in (1a) may be answered with some verbs in progressive form as in (1b), but may not be answered with some other verbs in the progressive as in (1c).

(1) a. What is John doing?
b. John is running/writing a book.
c. ?John is knowing a friend/recognizing a friend.

Vendler's explanation for the the difference between (1b) and (1c) is that verbs in (1b) denote processes that are going on in time, while verbs in (1c) are not processes that are going on phase by phase in time (1967: 99-100).

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Vendler makes a further distinction between the kind of verbs in (1b) in meaning relative to the notion of time as in (2).

(2) a. John is running.
b. John is writing a book.

The distinction, according to Vendler, is that for (2a) John may stop running the next moment but it is still true that John did run, whereas for (2b) it may not be true that John did write a book if John stops writing the next moment. Accordingly, Vendler labels the former kind of verbs as activity verbs and the latter kind of verbs as accomplishment verbs. We see that Vendler uses the entailment relation between sentences in progressive form and sentences in simple past tense in the classification of verbs, though he does not make it explicit. It is apparent that if a sentence with a verb in progressive form implies a sentence with the same verb in perfective form then the verb in question is an activity verb. This becomes a common practice in identifying verb classes in the literature, though it is methodologically problematic, as I will argue in section 4.4. As for the kind of verbs in (1c), Vendler (1967:102) realizes that some of the verbs (e.g. *recognize*) may be predicated of a subject only for a single moment of time while others (e.g. *know*) may be predicated of a subject for shorter or longer periods of time. Thus, he calls the former achievement verbs and the latter state verbs.

It seems to me that the most significant aspect of Vendler's approach lies in his full use of linguistic evidence in his analysis of the verb classes. In classifying verbs in time schemata, Vendler (1967) has made two significant observations, which unfortunately he does not take full advantage of to develop a more comprehensive theory of verb classifica-

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tion. One of the observations is that verbs of different classes appear to go with different adverbial phrases of time in sentences. For example, activity verbs may occur with temporal adverbial phrases such as *for how long* and *for half an hour*, whereas accomplishment verbs may occur with temporal adverbial phrases like *how long* and *in half an hour*, as shown below.

(3) a. *For how long* did he push the cart?
b. ?*For how long* did he draw the circle?
(3') a. ?*How long* did it take him to push the cart?
b. *How long* did it take him to draw a circle?
(4) a. He pushed it *for half an hour.*
b. ?He drew it *for half an hour.*
(4') a. ? He pushed it *in half an hour.*
b. He drew it *in half an hour.*
(4") a. ?It took him *half an hour* to push it.
b. It took him *half an hour* to draw it.

Given a verb like *push*, it sounds odd to ask a question like (3'a) and odd to reply to (3'a) with answers like (4'a) and (4"a), as Vendler (1967:100-1) notices. Given a verb like *draw*, it is equally odd to ask (3b) and to answer with (4b). Vendler (1967:100) explains that the difference between the (a) sentences and the (b) sentences lies in the difference between *push* and *draw*. The verb *push* does not have a set terminal, which is typical of activity verbs, whereas the verb *draw* has a set terminal or climax, which is characteristic of accomplishment verbs. Vendler also finds that state verbs appear to behave like activity verbs with regard to the adverbial phrases of time in (5) and (5') ,but he fails to notice that they behave differently with the adverbial phrases of time in (5").

(5) a. *For how long* did you push the cart?
b. *For how long* did you love her?

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(5') a. ?*How long* did it take you to push the cart?
b. ?*How long* did it take you to love her?
(5") a. *At what time* did you push the cart?
b. ?*At what time* did you love her?

In addition, Vendler notices that achievement verbs, accomplishment verbs and activity verbs behave differently with regard to a number of adverbial phrases of time. For example, achievement verbs like *reach* in (6a) seem to behave differently from accomplishment verbs like *draw* in a sentence with the adverbial phrase *at what time*, and also differently from activity verbs, such as *push* , with the adverbial phrase *how long*, as in (7b).

(6) a. *At what time* did you reach the top?
b. ?*At what time* did you draw the circle?
(7) a. *How long* did it take you to reach the top?
b. ?*How long* did it take you to push the cart?

However, it appears that Vendler did not realize that achievement verbs may behave similarly to accomplishment verbs and activity verbs with regard to the choice of some other time adverbials. For example, an achievement verb like *reach* may behave similarly to an activity verb (e.g. *push*) in sentences with adverbial phrases like *at what time*, as in (8).

(8) a. *At what time* did you reach the top?
b. *At what time* did you push the cart?

At the same time, an achievement verb (e.g. *reach*) and an accomplishment verb (e.g. *draw*) appear to be found to behave similarly in (9a & 9b) with the adverbial phrase *for how long*, in contrast to the behavior of an activity verb like *push* in (9c).

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(9) a. ?*For how long* did you reach the top?
b. ?*For how long* did you draw the circle?
c. *For how long* did you push the cart?

In spite of Vendler's failure to recognize the similarities, his observations appear to suggest some linguistic evidence pertinent to answers to two philosophical questions and one linguistic question raised in Chapter One: the question whether actions take time in (1a) in section 1.1; the question whether some actions take a period of time, some actions take a moment of time, and some actions may take either a period of time or a moment of time in (1b) in section 1.1; and the question whether there are linguistic representations of temporal relations in natural languages, which is of concern in the above two questions .

The other significant observation of Vendler's is that verb phrases with an object noun phrase may completely change the behavior of an activity verb in relation to the notion of time, as is contrasted in (10) and (11) below.

(10) a. ? How long did it take John to run?
b. ?It took John half an hour to run.
(11) a. How long did it take John to run *a mile*?
b. It took John half an hour to run *a mile.*

The same phenomenon is found in verb phrases with prepositional complements, as is contrasted in (12) and (13) below.

(12) a. ?How long did it take John to walk?
b. ?It took John five minutes to walk.
(13) a. How long did it take John to walk *across the street*?
b. It took John five minutes to walk *across the street.*

Vendler's explanation for the difference between (10) and (11) and between

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(12) and (13) is an Aristotelian one. In (11) and (13), there is a set terminal or climax as opposed to (10) and (12), respectively. Given this explanation, we find that the verbs in (11) and (13) have the same explanation as accomplishment verbs have for their behavior in relation to the notion of time, and in fact they behave exactly like accomplishment verbs in relation to time and in terms of some entailment relations. This phenomenon observed by Vendler is later known as verb category switch (cf. Dowty 1979, Zhou 1991). Verb category switch is the kind of linguistic evidence that is of direct relevance to questions of temporal relations in verbs phrases. For example, the linguistic evidence involved in verb category switch seems to be relevant to answers to two questions raised in section 1.1: the question whether the period of time may be open-ended or may be with well-defined end-points, and the question whether there are linguistic representations of open-ended period of time and of well-defined end-points in natural languages. In sentences with *a mile*, as in (11), and sentences with *across the street,* as in (13), the period of time appears to have well-defined end-points. On the other hand, the period of time seems to be open-ended in sentences in (10) and sentences in (12) without those phrases.

In short, Vendler focuses on linguistic evidence in his Aristotlian style approach to verb categorization. In his analysis, he not only has reached four categories of verbs, which is well-known in the literature, but has also made two important observations: different temporal structures in different categories of verbs, as seen in the behavior of temporal adverbials with verb classes, and verb category switch, as witnessed in adding certain noun phrases to the verbs phrases in question. It seems to me that his two important observations do not draw as much as attention as his four categories of verbs in the study of verbs.

2.1.2 PUZZLES OF MONTAGUE'S TENSE/ASPECT OPERATORS

Montague approaches natural languages from the the perspective of mathematics and logic, generalizes metamathematics to comprehend natural languages, and treats natural languages, such as English, as formal languages (Thomason 1974). His approach to the semantics of natural languages may be characterized as truth conditional, model theoretic, possible worlds (Dowty, Wall and Peters 1981) as well as compositional (Abbott 1992). Montague has not worked directly on the topic of verb categorization, but his approach to tense logic and its application to fragments of English has an impact on the research on this topic of verb categorization in the same way as it has on the study of temporal relations in natural languages in general.

Montague (1970,1973) has worked on the simple present tense, the future tenses and the present perfect tense/aspect for fragments of English.[1] Let us see how his analysis works. Montague considers the truth-value of a sentence in relation to a point of reference, which is an ordered pair of a possible world (*w*) and a moment of time (*i*).[2] The set of moments of time (J) is linearly ordered. Let ϕ be *Bill walks*. Let a set of operators be W, H, and N, where W is read as 'it will be the case that', H as 'it has been the case that', and N as 'it is being the case that' (Montague 1970:125, 1973:257). Then, the truth condition for Hϕ or ϕ in the present perfect tense may be stated informally as (14) .

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[1] Montague does not seem to distinguish tenses and aspects here. This may be one of the reasons that his analysis fails in this respect. In this study, I will use 'tense' just for tense, and use 'tense/aspect' for aspect where such distinction is not made in the original work.

[2] For current purposes, I just consider the coordinate of a moment of time, and drop that of the possible world in this chapter.

(14) **It has been the case that Bill walks** is true at *i* if and only if there exists *j* such that $j < i$ and **Bill walks** is true at *j*.
(14') Bill has walked.

(14) is supposed to capture the truth conditions for (14') in idiomatic English. The truth condition for $W\phi$ or ϕ in the future tense may be informally represented in (15) in a similar fashion.

(15) **It will be the case that Bill walks** is true at *i* if and only if there exists *j* such that $i < j$ and **Bill walks** is true at *j*.
(15') Bill will walk.

(15) should be able to provide a sufficient truth condition for the semantics of (15') in idiomatic English. As Bennett (1977:492) notes, progressive tenses/aspects are conspicuously absent in Montague's treatment of tenses/aspects in the fragment of English in The Proper Treatment of Quantification in Ordinary English (PTQ)(Montague 1973), though Montague (1970:125) does discuss the issue. The truth condition for $N\phi$ or ϕ in the present progressive tense/aspect may be informally stated in (16).

(16) **It is being the case that Bill walks** is true at *i* if and only if there exist J such that $i \subset J$ and **Bill walks** is true throughout J, where J is a set of moments of time.
(16') Bill is walking.

(16) is expected to capture the truth conditions for the idiomatic English sentence in (16'). In addition to the few tenses/aspects involved in the fragment of English, Montague's analysis is supposed to be applicable, in principle, to other tense/aspect operators in natural languages. It is clear that consideration of verb categorization or consideration of the temporal structure of verb phrases is not given in Montague's treatment of tenses/

aspects. I believe that Montague's analysis just involves one of the three dimensions of time, Linear Time only.

In Montague's approach to tenses/aspects, there are two main puzzles remaining to be solved, as pointed out by Bennett and Partee (1978) and Bennett (1977). Let us examine the first puzzle. In his approach, Montague uses a sentence in simple present tense, like *Bill walks*, as the base formula underlying analyses of sentences in all other tenses and aspects. Generally speaking, a sentence in simple present tense has two readings: a timeless/ habitual reading and a reportive reading (Jespersen 1965:258-60, Bennett 1977:493-4). The former reading involves a large stretch of Frame Time including the 'past, 'present' and 'future', while the latter reading says something just about Bill at present. 'Present' is considered durationless, what goes before 'present' is the past and what is after 'present' is the future, since time is considered as an ever flowing river so that no one can bathe in the same river twice, as the ancient Greeks claim. According to Bennett and Partee (1978), and Bennett (1977), it is apparent that Montague uses simple present tense in the sense of the reportive reading in his fragments of English. It is noticed that not every sentence with every class of verbs in simple present tense may be used in the reportive sense, as shown in (17) and (18).

(17) a. (Look.) Bill walks.
b. (Look.) Bill runs.
(18) a. (Look.) ?Bill walks to the bookstore.
b. (Look.) ?Bill writes a book.

Sentences in (17) with the activity verb phrases are fine with the reportive reading as used in Montague's analysis. However, it is questionable that

sentences in (18) with the accomplishment verb phrases may be used in the reportive sense. These sentences can not be used to report a particular occurrence of Bill's walking to the bookstore or Bill's writing of a book, as Galton (1984:11-2) claims. Such an occurrence may be either in the past, as expressed by sentences like *Bill wrote a book* or *Bill has written a book*, or in the future, as in the form *Bill will write a book*. When we have the sentence *Bill writes a book*, its habitual reading is predominantly available. The limitation of the simple present tense is not only seen in English but also seen in Chinese and other languages. For example, a sentence with an accomplishment verb phrase without any adverbial of time (19a) in Chinese is unacceptable for a reportive reading, as in (19b), and is forced to be read as a sentence in the present progressive aspect, as in (19c).[3]

(19) a. Kan, Lisi kan yi ben shu.
Look Lisi read a M(easure) W(ord) book.
b. Look, ?Lisi reads a book.
c. Look, Lisi is reading a book.

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[3] I have presented (19a) to a number of native speakers of Chinese, who claim that they interpret it as the present progress, as in (i), when they hear it.

(i) Kan, Lisi zai kan yi ben shu.
Look, Lisi Asp. read a MW book
Look, Lisi is reading a book.
(ii) Zuotian Lisi kan yiben shu.
Yesterday Lisi read a book
Yesterday Lisi was reading a book.
(iii) Zuotian Lisi kan *le* yiben shu.
Yesterday Lisi read Asp. a book
Yesterday Lisi read a book.

In addition, it is claimed that in Chinese a sentence's tense is usually determined by temporal adverbials or contexts, and that the marked *le* functions as an aspect mark rather than a tense mark, as in (ii) and (iii). However, I will argue in Chapter Three that *le* and *guo* function more like tense markers than aspect markers in section 3.3.

(19') a. Lisi tiantian kan yi ben shu.
Lisi every day read a MW book
b. Lisi reads a book every day.

On the other hand, the corresponding sentence with a time adverbial, as in (19'a), is acceptable for a habitual reading (19'b). Then, what is the difference between (17) and (18)? I think that the difference lies in the different temporal structures that the verb phrases in (17) and (18) have. The actions denoted by the verb phrases in (17) may just take an instant of time that is compatible with the durationless 'present', whereas the actions denoted by the verb phrases in (18) take a period of time which is too long for the durationless 'present'. With this understanding, we see that it is difficult for sentences like (18) and (19a) to be assigned 'a reportive reading', since 'present' is a instant of time of very short duration.

The second puzzle also involves accomplishment verbs, as noted by a number of authors (Bennett and Partee 1972, Bennett 1977, Parsons 1989), and leads to what Dowty (1979:133) calls the 'imperfective paradox'. In Montague's analysis, a sentence in present progressive tense/aspect is true at a moment *i*, if and only if there exists a neighborhood about *J* such that the corresponding sentence in present simple tense is true throughout *J*. In this analysis, the sentence in present progressive tense/aspect implies that the corresponding sentence in simple present tense is true too. This is where the paradox arises in Montague's analysis.

(18') a. Bill is walking to the bookstore.
b. Bill is writing a book.

Given a scenario in which Bill is writing a book or is walking to a bookstore, but he is to be killed in an accident before he finishes the book

or reaches the bookstore, we find that (18') is true at *i* without (18) being true throughout *J*. This is the imperfective paradox.

In summary, Montague's rule of tenses/aspects is inadequate when it is applied to the analysis of tenses/aspects in natural languages such as those in English. There are two problems with his analysis. The first is the use of sentences in simple present tense as the base formula from which corresponding sentences in other tenses/aspects are derived by simply adding tense/aspect operators. Sentences with activity verb phrases may be used in simple present tense in the reportive sense without problems, while sentences with accomplishment verb phrases and achievement verb phrases may not be used in simple present tense in the reportive sense, according to Bennett (1977) and Bennett and Partee (19978). The second problem is the imperfective paradox in which a sentence in the present progressive tense/aspect implies a corresponding sentence in simple present tense, which is a wrong prediction for sentences with accomplishment verb phrases and achievement verb phases. I believe that these two problems result from the negligence of the two sets of questions raised in section 1.1.

2.1.3 BENNETT AND PARTEE'S INTERVAL SEMANTICS

Bennett and Partee (1978) are among the first authors to point out problems in Montague's analysis of tenses/aspects in fragments of English. In addition to the two puzzles discussed in the above section, Bennett and Partee also find that Montague's treatment of the simple future tense in English is inadequate and his analysis of the present perfect tense/aspect in English incorrect. According to Bennett and Partee (1978:7-8), the inadequacy of Montague's analysis of the simple future tense is shown in the treatment of a pair of sentences like (20) on the next page.

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(20) a. Bill will walk to the bookstore.
b. Bill will walk to the bookstore some time.

On Montague's analysis, (20a) and (20b) are logically equivalent. Both (20a) and (20b) are true sentences at *i* if and only if there exists *j* such that *i* precedes *j*, and *Bill walks to the bookstore* is true at *j*. In any context, linguistic or extralinguistic, (20a) is taken to assert that the event is to obtain in a definite time in the future, as explicitly expressed below.

(20) a'. Bill will walk to the bookstore *today*.
a". Bill will walk to the bookstore *next Saturday*.

On the other hand, (20b) asserts that the event is going to obtain in an indefinite future time. Montague's analysis of the simple future tense is not able to capture the difference. The next problem seems to be more serious. Bennett and Partee believe that Montague's analysis of the present perfect tense/aspect makes wrong predictions.

(21) a. Bill has walked to the bookstore.
b. Bill walked to the bookstore.

In Montague's analysis, (21a) and (21b) are logically equivalent. They are true sentences at *i* if and only if there exists *j* such that *j* precedes *i*, and Bill walks to the bookstore is true at *j*. This is simply incorrect, as clearly shown in the idiomatic English sentences in (21a') and (21a"). (21a') includes a temporal adverbial referring to a period of time that includes the event and the utterance of the sentence, while (21a") does not.

(21) a'. Bill has walked to the bookstore today.
a". *Bill has walked to the bookstore yesterday.

The problem lies in the temporal structures of *i* and *j* for the present perfect tense/aspect and for the simple past tense. *i* and *j* are points of time and are linearly ordered that, say, $j > i$, where *i* is the moment of utterance. I think that the interval of time for the present perfect tense/aspect includes both *i* and *j*, but the interval of time for the simple past tense does not include *i*, though (21b) is evaluated at *j*. It is apparent that Montague did not consider this temporal relation in his analysis of tense/aspect.[4]

Bennett and Partee (1978) propose to rescue Montague's analysis by using interval semantics. An interval of time is a set of moments of time. For interval semantics, a point of reference is an ordered pair of a possible world and an interval of time, instead of Montague's ordered pair of a possible world and a moment of time. This proposal appears to solve Montague's two puzzles together with other problems. The problem of the first puzzle is that a base sentence in the reportive simple present tense with accomplishment and achievement verb phrases can not be evaluated in terms of a moment of time as to its truth conditions. The true base sentence is used in the description of the truth conditions for sentences in other tenses/aspects. This puzzle is readily accounted for in interval semantics, as in informally stated in (22) (Bennett and Partee 1978:38-9, Bennett 1977: 499-500).

(22) **Bill has written a book** α is true at interval of time *I* if and only if *I* is a moment of time, α refers to an interval of time *I'*, *I* is a member of *I'*, and there exists a subinterval of time *I'*, *I"* such that *I* is a final point for *I"* or $I'' < I$, and **Bill writes a book** is true at *I"*.

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[4] The present perfect puzzle is discussed in detail in section 5.2.

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Their intuition underlying this interval analysis is that Bill starts to write a book at the initial of *I*", he is writing the book through *I*" and he finishes writing the book by the end of *I*". This first puzzle is thus solved. In (22), a clause is added to the truth conditions for the sentence in the present perfect tense/aspect, that is, there is a super-interval *I*', as represented by α, of which both *I* and *I*" are subintervals.[5] Let us see how the truth conditions for the corresponding sentence in the simple past tense are informally stated in (23).

(23) **Bill wrote a book** α is true at interval of time *I* if and only if *I* is a moment of time, α refers to an interval of time *I*' and there exists a subinterval of time *I*', *I*" such that *I*" < *I*, and **Bill writes a book** is true at *I*".

It is clear in (23) that *I* is not a subinterval of *I*', thought *I*" is a subinterval of *I*'. In other words, the difference between the present perfect and the simple past in English lies in that *I* and *I*" are subintervals of *I*' the super-interval for the present perfect, as in (22), while *I* is not a subinterval of *I*' the super-interval, though *I*" is a subinterval of *I*', as in (23). Given this distinction, Bennett and Partee's analysis claims that a sentence in the present perfect tense/aspect and its corresponding sentence in the simple past tense are not logically equivalent. Bennett and Partee propose to account for Montague's second puzzle, the imperfective paradox, in similar fashion. Let us look at the same set of sentences (18) and (18') used in the discussion of Montague's analysis in subsection 2.1.2.

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[5] Bennett and Partee (1978: 26-7) seem to take α for Frame Time in their analysis, but they do no make it explicit in their work. I think that α certainly has its linguistic motivation if it is taken to refer to Frame Time. Unfortunately, Bennett and Partee do not elaborate this idea in their later work on this topic. This question will be fully treated in Chapter Three.

(18) a. Bill walks to the bookstore.
b. Bill writes a book.
(18') a. Bill is walking to the bookstore.
b. Bill is writing a book.

In interval analysis (Bennett and Partee 1978:13), the base sentence in the simple present tense (18) that underlie sentences in all other tenses/aspects are supposed to refer to events that occur within an interval of time. An event starts at the initial point of the interval, if it has an initial point, and stops at the final point of the interval, if it has a final point. For example, the truth conditions for (18'b) may be informally represented with (18b) as the underlying sentence, as in (24).

(24) **Bill is writing a book** is true at *I* if and only if *I* is a moment of time, there exists an interval of time *I'* such that *I* is in *I'*, *I* is not an endpoint for *I'*, and **Bill writes a book** is true at *I'*.

In (24), the key clause that is different from Montague's analysis is about the super-interval *I'* and the relation between the super-interval *I'* and subinterval *I*, the latter of which is not the final point of the super-interval. Bennett and Partee's (1978) analysis seems to have solved the paradox. Moreover, the interval analysis of the progressive aspect appears to provide some new criteria for the categorization of verbs (Bennett and Partee 1978). In relation to the progressive aspect and truth conditions for sentences in the progressive aspect, verb phrases may be classified into three categories: + stative, + subinterval, and - stative & - subinterval. Simply put, + stative verb phrases may not be used in the progressive aspect, as shown in (25).

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(25) a. ? Bill is believing that John is wrong.
b. ? John is being happy.

+ Subinterval verbs may be used in the progressive aspect. If used as the main verb of a sentence in the progressive aspect that is true at a super-interval, then the sentence is true at each and every subinterval of the super-interval, as in (26), so that (26a) entails (26b) and (26c), *I'* and *I"* are members of *I*.

(26) a. Bill is walking at *I*.
b. Bill walks at *I'*.
c. Bill walks at *I"*.

-Stative - subinterval verb phrases may also be used in the progressive aspect, but they have logical behavior different from + subinterval verbs. If a - stative & - subinterval verb is used as the main verb in a sentence in the progressive aspect that is true at a subinterval *I'*, the sentence is not true at the subinterval's the super-interval *I*, as in (27), where (27a) does not entail (27b).

(27) a. Bill is building a house at *I*.
b. Bill builds a house.

However, Bennett and Partee's (1978) analysis does not escape the imperfective paradox, as Dowty (1979:145-146) and Parsons (1989:214-215) note, among a number of authors. In particular, on Bennett and Partee's analysis as stated in (24), (18') entails (18").

(18) a. Bill walks to the bookstore.
b. Bill writes a book.
(18') a. Bill is walking to the bookstore.
b. Bill is writing a book.

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(18") a. Bill has walked to the bookstore.
b. Bill has written a book.

Specifically, if the sentences in (18') are true at 10 o'clock today, there is an interval around 10 o'clock at which the sentences in (18) are true. There will be some moment later than that interval. At that later moment, (18") will be true. This is of course incorrect. We know that there is no guarantee, for example, that Bill will reach the bookstore if he is walking to it now. Bill may have an accident before he gets there, and he may end up in a hospital.

To remedy Bennett and Partee's (1978) analysis, Bennett (1981:15) proposes (24') as the truth condition for sentences in the progressive aspect in English:

(24') **Bill is writing a book** is true at interval of time *I* if and only if *I* is a moment of time, and there exists an interval of time *I'* such that *I'* is an open interval, *I* is included in *I'*, and Bill is in the extension of **writing a book** at *I'*.

In this analysis, Bennett makes a distinction between an OPEN interval and a CLOSED interval; the former has no end-points whereas the latter has end-points. Without end-points, an OPEN interval describes a process which is going on without ending. This is intended for sentences with activity verb phrases, and also for sentences with accomplishment and achievement verb phrases in the present progressive aspect. With end-points, a CLOSED interval describes an event since end-points indicate the inception and completion of the action. Therefore, the fact that (18'b) is true does not imply that (18"b) is true. As Parsons (1989:215) comments, an OPEN interval does not culminate so that Bennett's analysis eventually avoids the imperfective problem. However, Bennett's analysis does not answer the

question of how one can tell if an interval is OPEN or CLOSED when facing it (Parsons 1989:231-2). Bennett himself admits that almost everyone finds it mysterious initially (1981:13). Does the distinction between OPEN interval and CLOSED interval have any linguistic motivation? Bennett does not try to answer this question. The question may not be fully answered without appropriate consideration of the questions raised in section 1.1.

In short, Bennett and Partee's analysis of tense/aspect has solved, in terms of interval semantics, the puzzle of the reportive use of the simple present tense sentence with an accomplishment verb as the base sentence in Montague's approach, and also remedied several other problems, such as inaccurate analysis of the simple past tense and the present perfect tense/ aspect, in Montague's approach. However, the puzzle of the imperfective paradox is not solved until Bennett comes up with the distinction between OPEN interval and CLOSED interval in his later work. In addition, I believe that Bennett and Partee put forward a significant notion of a dimension of time α or frame adverbial, but fail to explore its linguistic and logical significance in the study of the representation of time in natural languages.

2.1.4 DOWTY'S LOGICAL OPERATORS AND INERTIA WORLDS

The two important observations by Vendler (1957, 1967) virtually had gone unnoticed in linguistic research until Dowty (1972, 1977, 1979) treated these problems first in generative semantics and later in model theoretical semantics. In Dowty's (1979: 62) opinion, Vendler's attempt to classify verbs, once and for all, is misguided because his approach can only takes surface verbs into account, though he notices that verb phrases may be relevant. This is because problems arise when verbs take objects. The same verb may behave like an activity verb when it takes a zero object or

zero complement, or takes a mass noun or indefinite plural noun as object or complement as in (28a) and (28b), and behave like an accomplishment verb when it takes those nouns with appropriate determiners or numerals as in (28'a & 28'b) and when appropriate noun phrases ares added as object or complement. As a matter of fact, Vendler (1967:102) has noticed the difference between the same verb phrases with and without object nouns, but he does not provide any account for this observation except different labels for them.

(28) a. John ate popcorn *for/*in an hour.*
b. John built houses *for/*in a month.*
(28') a. John ate a bag of popcorn *in/*for an hour.*
b. John built three houses *in/*for a month.*

As observed by Vendler (1957, 1967), an *in* -time-phrase can only modify an accomplishment verb, whereas a *for*-time-phrase only modifies an activity verb, as shown in (28) and (28'). Dowty's first solution to the problems in (28) and (28') is along the line of generative semantics: to postulate a single homogeneous class of predicates -- state predicates plus sentential operators, DO and BECOME, and connectives so that (28) and (28') have different underlying structures. DO is the highest operator underlying activity verbs and allows *for*-time-phrases directly under it, but does not allow *in*-time-phrases directly under it. On the other hand, BECOME may be the highest operator underlying both accomplishment and achievement verbs and permits *in*-time-phrases directly under it, but does not allow *for*-time-phrase directly under it, though DO may also be the highest operator in the logical structure of some of non-intensional agentive accomplishment verbs. For example, the following underlying

structures may be postulated to account for the the difference between (28a) and (28'a) respectively.

(29) [DO [John ate [CAUSE [BECOME [pop corn is eaten]]]] for an hour]
(30) [DO [John ate [CAUSE [BECOME [a bag of pop corn is empty] in an hour]]]]

The underlying structure in (29) indicates that the agent did the eating for an hour, and for an hour is directly under the operator DO. On the other hand, the underlying structure in (30) shows that in (28) the agent brought the state that a bag of popcorn became empty in an hour, and *in an hour* is directly under the operator BECOME. This seems to account for the observation by Vendler (1957, 1967) that different verbs or verb phrases go with different temporal adverbials. With these logical operators, Dowty is able to give logical structures, in terms of the aspect calculus, to Vendler's four categories of verbs, which Dowty further divides into eleven groups, according to their logical representations in the aspect calculus (1979:123-5).

In his first attempt to account for the semantics of the progressive sentences, Dowty (1972) gives tenseless sentences with accomplishment verb phrases the analysis in (31) and progressive sentences with same verb phrases the corresponding analysis in (31').

(31) a. [ϕ CAUSE [BECOME ψ]]
b. [[Bill write] CAUSE [BECOME [there is a book]]]
(31') a. [PROG [ϕ CAUSE [BECOME ψ]]]
b. [PROG [Bill write] CAUSE [BECOME [there is a book]]]

In this analysis, ϕ and ψ are sentences. In (31), a sentence [BECOME ψ] is

true at a moment of time *t* if and only the sentence ψ is true at *t* and false at a moment of time *t'* before *t*. Dowty suggests that the difference between (31) and (31') is that in (31') PROG ϕ can be inferred but [BECOME ψ] can not be, whereas in (31) both ϕ and [BECOME ψ] can be inferred. Realizing that this suggestion is rather arbitrary and the analysis in terms of moments of time is problematic, Dowty (1977:57, 1979:146-7) provides (32) as the truth conditions for progressive sentences with accomplishment verbs and other verbs as well.

(32) [PROG ϕ] is true at $\langle I, w\rangle$ if and only if there is an interval I' such that $I \subset I'$ and I is not a final subinterval for I' and there is a world w' for which ϕ is true at $\langle I', w' \rangle$, and w is exactly like w' at all times preceding and including I.

In (32), Dowty adopts Bennett and Partee's (1973) interval semantics, and replaces the traditional moment of time, that is, a point of time, with intervals of time in the ordered pair of times and worlds in model-theoretic semantics. This does not seem to guarantee that the imperfective paradox does not exist in this analysis. Therefore, Dowty (1979:148-9) proposes the notion of inertia worlds -- a set of possible worlds, which are thought to be exactly like the given world up to the time in question, and in which the event's future course of development may mostly be compatible with the past course. Given this function of inertia worlds, *Inr* in short, (32) is restated as (32').

(32') [PROG ϕ] is true at $\langle I, w\rangle$ if and only for some interval I' such that $I \subset I'$ and I is not a final subinterval for I', and for all w' such that $w' \in Inr\ (\langle I, w\rangle)$, ϕ is true at $\langle I', w' \rangle$.

According to (32'), PROG ϕ, such as (33b) and (34b), is not evaluated as

true in any possible worlds but only in inertia worlds in which ϕ is most likely to be true. This amounts to say that in all worlds like that actual one at that time, John would eventually finish reading or writing the book, if in those worlds nothing out of the ordinary happened. This of course does not guarantee that (33a) and (34a) are true when (33b) and(34b) are true. If something unexpected happened, say, John found that he did not like the topic, he might have abandoned reading or writing the book at the end.

There appear to be two major problems with Dowty's approach, as pointed out by Bennett (1977), Declerck (1979) and Parsons (1989), among a number of authors. The first problem is the way that underlying logical structures are represented in the generative-semantics like approach. For example, given Dowty's solution, it is not clear what distinctive underlying structures can be postulated for (33) and (34) (Declerck 1979: 270-1), though both *read* and *write* are accomplishment verbs.

(33) a. John read a book.
b. John was reading a book.
(34) a. John wrote a book.
b. John was writing a book.

[BECOME ψ] expresses the transition from an interval of time and a world where ψ is not true to an interval of time and world where ψ is true (Dowty 1979:140). When accomplishment verbs in progressive sentences are concerned, there are two kinds of verbs: one presupposes the pre-existence of the object (33), and the other does not (34).[6] Given Dowty's characterization of the semantics, it is easy to postulate an underlying

[6] It is commonly discussed in the literature that the second kind of verb gives rise to what is called the 'imperfective paradox' (Dowty 1977, 1979, Parsons 1989). In a broader sense, verb phrases like the one in (33b) also involve the 'imperfective paradox'.

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logical structure for (34), while it is not clear what appropriate underlying logical structures may be given (33). First, it seems that there is no causative relation in (33). Second, there always exists a book in the non-progressive sentence, as in (33a), and there always exists a book in the progressive sentence, as in (33b), as well. Any analysis that allows the inference of the existence of a book in (33a) but not in (33b) is simply wrong, though it may be correct in the case of (34). It appears that Dowty's analysis has difficulty to postulate uniform underlying structures to account for the difference between sentences with an accomplishment reading and sentences with an activity reading as well as the difference in meaning between sentences with the same verb category reading.

The second problem involves the proposal of inertia worlds. The proposal (32') seems to be both too strong and too weak. It is too strong (Parsons 1989:215-6) in that it predicts that things actually develop in ways most compatible with the past course of development. If this happens, then the actual world becomes an inertia world for that interval of time. Then, (32') requires that a progressive sentence is not true at that interval of time unless its corresponding non-progressive sentence is true then or later. This revives the 'imperfective paradox' for that interval of time (Parsons 1989:215). The proposal in (32') is also too weak (Bennett 1977:503-4, Parsons 1989:237). It fails to account the fact that (35a) implies (35b) and (35c). Intuitively, we know that if (35a) is true at a moment of time *t* then it is also true at a moment of time *t'* if *t'* is immediately following *t*.

(35) a. John is running.
b. John will be running.
c. John will run.

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(35') a. John is running to the bookstore.
b. John will be running to the bookstore.
c. John will run to the bookstore.

Similarly, (35'a) implies (35'b) in case of accomplishment reading, though (35'a) does not imply (35'c).

In summary, Dowty's generative-semantics underlying structures for different verb classes have difficulty in representing progressive sentences with some verb phrases appropriately and have difficulty in representing appropriately some sentences with the same verb category reading. At the same time, truth conditions provided in model-theoretic semantics seem to suffer from problems of either being too strong or too weak.

2.1.5 PARSONS' EVENT SEMANTICS

Parsons (1989, 1990) tackles the problem of verb categorization and truth conditions for the progressive aspect in English with a combined approach (1980:40-4). This combined approach adopts both Davidson's (1968, 1980) event theory of action sentences and what Parsons calls the operator approach. In Davidson's event theory, it is assumed that a sentence contains a covert reference to an event. Events are thus introduced as entities about which an indefinite number of things can be said (Davidson 1968:90-1). This point is illustrated in the logical representation of the following example.

(36) a. John pushed the cart.
b. Push (j, c)
c. ($\exists e$) (Push (e) & Of (c, e) & Agent (j, e))

Instead of being symbolized as (36b), (36a) has a logical form of (36c) in event theory. (36c) states that there is an event of pushing, which is about

the cart and of which John is the agent.

In the operator approach, any modifiers of the verbs are treated as part of complex predicates, which are formed by the verbs and their modifiers, as in (37').

(37) a. Mary runs
b. R (m)
(37') a. Mary runs slowly
b. S (R) m

The simple verb phrase in (37a) is represented as a simple predicate in (37b), while the verb phrase with an adverbial in (37'a) is represented as a complex predicate in (37'b), in which the modifier is symbolized as an operator. The representation of (37'a) in (37'b) avoids unwanted inferences like (38c), as Parsons (1980) notes.

(38) a. Mary walks, and Mary runs slowly.
b. W m & S (R)m
c. Mary walks slowly.

(38c) is not available in the logical form in (38b), since the operator may not be transferred from one predicate to another predicate. In combining the two approaches, Parsons' approach gives (37'a) the logical form in terms of event semantics in (37").

(37") a. Mary runs slowly.
b. $(\exists e)$ (R(e) & S(e) & Agent (m, e))

(37"b) may be read 'there is an event which is running which is slow and of which Mary is the agent'.

Parsons argues that the difference between an activity verb phrase

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and an accomplishment verb phrase can be represented in the same fashion, that is, the difference can be represented by introducing an operator as he does in the above sentences. Specifically, he treats *to* in *to the bookstore* as an operator symbolized by *T* in the representation of the distinction between an activity verb phrase and an accomplishment verb phrase in (39) and (39').

(39) a. John walked.
b. $(\exists t)$ $\{t <$ now & $(\exists e)$ [W(e) & Agent (j, e)]$\}$
(39') a. John walked *to the bookstore*.
b. $(\exists t)$ $\{t <$ now & $(\exists e)$ [W(e) &T(e, b) & Agent (j, e)]$\}$

The difference in logical forms for (39b) and (39'b) is that (39'b) has the clause $T(e$, b) which may be read 'the event is toward the bookstore', while (39b) does not have such an operator. The *T* operator in (39'b) indicates that there is a terminal so that (39'b) represents an event instead of an activity. However, Parsons' approach has a problem in the representation of the distinction between many activity verb phrases and accomplishment verb phrases, where operators of Parsons' type may not be conveniently introduced, as shown in (40) and (41) below.

(40) a. John read a book.
b. $(\exists t)$ $\{t <$ now & $(\exists e)$ [R(e) & Obj (b, e) & Agent (j, e)]$\}$
(41) a. John pushed a cart.
b. $(\exists t)$ $\{t <$ now & $(\exists e)$ [P(e) & Obj (c, e) & Agent (j, e)]$\}$

No distinction in logical forms may be found in the representations of (40a), a sentence with an accomplishment verb phrase, and of (41a), a sentence with an activity verb phrase.

Ontologically, Parsons (1985) believes that the problem of verb

categorization should be examined in terms of eventualities. Eventualities (Parson 1985:238-40) are classified into two categories: one that culminates in time and one that holds in time. The former is represented as *Cul* (*e*, *t*), which is read '*e* is an event that culminates at *t*', while the latter is symbolized as *Hold* (*e*, *t*), which may be read '*e* is a state and *e*'s agent is in state *e* at *t*, or *e* is a process that is going on at *t* or *e* is an event that is in development at *t* '. In *Hold* (*e*, *t*), *t* is the set of times at which *e* holds and which is an open interval. In *Cul* (*e*, *t*), *t* is the moment of time at which *e* culminates and which is the end of an interval. With this ontology, Parsons represents the distinction between (40) and (41) in (40') and (41').

(40') a. John read a book.
b. $(\exists t)$ $\{t <$ now & $(\exists e)$ [R(e) & Object (b, e) & Agent (j, e) & *Cul* (e, t)]$\}$
(41') a. John pushed a cart.
b. $(\exists t)$ $\{t <$ now & $(\exists e)$ [P(e) & Object (c, e) & Agent (j, e) & *Hold* (e, t)]$\}$

In an analysis of the progressive in English with the approach outlined above, Parsons (1989, 1990) proposes that the difference between a progressive sentence and a non-progressive sentence may be represented as a difference between *Hold* (*e*, *t*) and *Cul* (*e*, *t*) in logical forms, as illustrated in (42) and (42').

(42) a. John was reading a book.
b. $(\exists t)$ $\{t <$ now & $(\exists e)$ [Writing (e) & Subject (e, John) & Object (e, a book) & *Hold* (e, t)]$\}$
(42') a. John read a book.
b. $(\exists t)$ $\{t <$ now & $(\exists e)$ [Writing (e) & Subject (e, John) & Object (e, a book) & *Cul* (e, t)]$\}$

The difference between the progressive sentence in (42a) and the non-

progressive sentence in (42'a) with accomplishment verb phrases is a difference between *holding* and *culminating* in (42b) and (42'b) respectively. Parsons (1989:235) claims that the difference between accomplishment verbs and activity verbs (event verbs and process verbs in Parsons' terms) lies in that the latter is a series or amalgam of events. Thus, process verbs are treated as a special kind of event verbs. The progressive sentence (43a) and the non-progressive sentence (43'a) with activity verbs are represented by *holding* and *culminating*, respectively, as shown in (43b) and (43'b).

(43) a. John was running.
b. $(\exists t)$ $\{t <$ now & $(\exists e)$ [Running (e) & Subject $(e$, John) & Hold $(e , t)]\}$

(43') a. John ran.
b. $(\exists t)$ $\{t <$ now & $(\exists e)$ [Running (e) & Subject $(e$, John) & Cul $(e, t)]\}$

An apparent problem with Parsons' approach to the progressive in English is that given the similarity between representations of (42a) and of (43a) in (42b) and (43b), we can not tell from these logical forms why (43a) entails (43'a), while (42a) does not entail (42'a). It seems to me that Parsons' theory fails to make correct predictions about the semantic relation between progressive and non-progressive sentences with accomplishment verb phrases and progressive and non-progressive sentences with activity verb phrases.

To briefly review this section, I notice that Parsons adopts both Davidson's event semantics and the operator method to present the logical structures of sentences with the assumption that a sentence contains a covert reference to an event. In his approach, verbs/verb phrases are classified as

event verbs/verb phrases and non-event verbs/verb phrases, the former of which are represented using the operator *Cul* (*e*, *t*), while the latter of which are symbolized using *Hold* (*e*, *t*). The same approach is taken to represent the difference between the progressive and the non-progressive sentences with different categories of verb phrases in logical forms. As a matter of fact, this approach seems to fail to capture the semantic difference between progressive sentences and non-progressive sentences with accomplishment and with activity verbs.

2.1.6 ÅQVIST'S TENSE LOGIC APPROACH

Åqvist and Günthner (1978) develop an improved tense-logic to provide a logical analysis of verb aspect and events. In the syntax of their logic, the formal language contains a number of operators that specify what takes place uninterruptedly throughout bound intervals of time, and what takes place at designated or fixed moments of time. In the semantics of their logic, models with multiple indexing are developed and applied to characterize the interpretations of these operators. The truth or falsity of a sentence is determined in a model or a family of models with at least three indices, say, t_0, t, and t', which are members of a non-empty set of times or moments. This system of indexing is in fact similar to Reichenbach's three-reference-point account of tenses and aspect, except that it is enriched with models (Åqvist, 1976).

Specifically, Åqvist (1977) proposes three imperfective operators to account for accomplishment verb phrases and a simple operator to account for activity verbs. The three imperfective operators together with **A**, which is a sentence, yield the truth conditions for the sentences in (44). The present perfective progressive operator for a sentence like (44a) is

HasBecomeMoreAndMoreA, which is read 'it has **up to this moment** become more and more the case that **A**'. The future progressive operator is *IsGoingToBecomeMoreAndMoreA*, and is read 'it is **from this moment on** going to become more and more the case that **A**', which accounts for the sentence in (44b). The operator, *IsBecomingMoreAndMoreA*, is for the present progressive, as in (44c). This operator reads 'it is **in this moment** becoming more and more the case that **A**'.

(44) a. John has been drawing a circle.
b. John will be drawing a circle.
c. John is drawing a circle.

Let us look at the operator, *IsBecomingMoreAndMoreA*, in detail. By the definition of *IsBecomingMoreAndMoreA*, the sentence A is interpreted as it was at least once the case that A at t, it is the case that A at t_0 and is going to be the case that A at t'. This means that there is an open interval around which A is evaluated, and in which t is the immediate past, t_0 is this moment and t' is the immediate future. By definition, the sentence A is true throughout this open interval. To avoid the 'imperfective paradox, Åqvist (1977) further enriches the improved tense logic with quantifiers. Thus the present progressive operator for accomplishment verb phrases, by definition, gives (44c) this logical form:

(44') c. $\exists$x (j HasBeenDrawing x InSuchAWayThatItHasBecome-MoreAndMoreTheCaseThat x IsA*Circle* & Draw(j, x) & $\neg$ *Circle* (x)) & j IsGoingToBeDrawing x InSuchAWay-ThatItIsGoingToBecomeAndMoreTheCaseThat x IsA*Circle*).

The existential quantifier binds all the occurrences of the variable x to

guarantee that there is the one and the same object denoted by x. The agent has been drawing that object in such a way that it was developing more and more into a circle (Åqvist 1977:39). Given the logical form of (44c) in (44'c), (44c) does not imply that there was a circle, and there is a circle and there is definitely going to be a circle.

The logical operator for sentences with activity verb phrases is *BeingA*, where A is a sentence. By definition, *BeingA* means that it was at least once the case that A at t, it is the case that A at t_0, and it is going to be the case that A at t', where t is the immediate past, t_0 this moment and t' the immediate future. It is apparent that *BeingA* asserts that A is true throughout an open interval around the point of evaluation. The operator *BeingA* with an existential quantifier gives (45a) the much simpler logical form in (45b).

(45) a. John is pushing a cart.
b. ∃x (Being (Push (j, x) & Cart (x))

In contrast to (44'c), (45b) implies that there was a cart, there is a cart and there will be a cart.

One obvious advantage of Åqvist's approach is that his analysis correctly captures the intuition that when we say (44c) and (44a) we know there is a longer period than the evaluation point, e.g. this moment, around which (38c) and (39a) must be true if (38c) and (39a) is true at the moment evaluated. This is the intuition that Bennett has talked about and Dowty's approach fails to capture. However, as Parsons (1989:229-30) notes, Åqvist's analysis has several drawbacks. I think that the most serious drawback is that Åqvist's approach is not able to provide a uniform analysis for progressive sentences. In the above discussion two different

analyses, a complicated one for the progressive sentence with accomplishment verb phrases and a simpler one for the progressive sentence with activity verbs, are mentioned. For example, in case of the complicated operator, a third analysis is required to account for the meaning of (46a), as in (46b) (Åqvist 1978:49).

(46) a. Mary is closing the door.
b. Being (Door (x) & m IsClosing x InSuchAWayThatItIs-BecomingMoreAndMoreTheCaseThat x IsAClosedDoor)

It is noticed that the last part of the logical form in (46b) is completely different from those in (44'c) and (45b). In this fashion, Åqvist's analysis may require many different analyses based on the meaning of the verb phrases involved. For instance, I believe that different analyses are needed to correctly characterize the meaning of the sentences in (47) if they are treated in Åqvist's approach.

(47) a. Mary is reading a book.
b. Mary is eating a bag of pop corn.

(47) are progressive sentences with accomplishment verb phrases. (47a) involves something that exists, while (47b) involves something that exists and that may not exist in the future. In (47a), nothing happens to the book in (47a), and it only happens that Mary learns something by reading. In (47b), on the other hand, something happens both to Mary and to the bag of pop corn; Mary will be full and the bag will be empty.

To summarize briefly, we note that Åqvist's improved tense logic with quantifiers seems to characterize some aspects of the semantics of the progressive sentences correctly in terms of the notion of open intervals,

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where, for example, Dowty's inertia worlds fail. On the other hand, Åqvist's approach suffers from the drawback that it is not able to provide a uniform analysis of progressive sentences.

2. 2 GENERAL PROBLEMS WITH PREVIOUS APPROACHES

As the discussion in the previous sections indicates, approaches to verb categorization and the truth conditions for sentences in different tenses and aspects suffer from serious inadequacies or drawbacks, which arise either in the way they view the relation between verb categorization and truth conditions for sentences or in the specific techniques that they have adopted. Generally speaking, how one views a problem determines in one way or the other his or her approach to the problem. It is in this sense that I believe that most authors have problems with their approaches, since they fail to take the set of questions in section 1.1 into consideration. In section 1.3, I have outlined the three-dimensional linguistic representations of time in languages as responses to the set of questions in section 1.1. If we view the problems that previous approaches have in terms of the three-dimensional linguistic representation of time, e.g., Linear Time, Frame Time, and Situation Time, we find that authors of previous analyses fail to recognize one or the other dimension of linguistic representations of time, though they all use the dimension of Linear Time. For example, in Montague's (1970, 1973) analysis of tense/aspect, Frame Time is not taken into consideration. As a result, Montague's approach incorrectly gives logically equivalent analyses to (48a) in the present perfective tense/aspect and to (48b) in the simple past tense, as repeated below on the next page, as pointed out by Bennett and Partee (1978).

(48) a. Bill has read a book.
b. Bill read a book.

The incorrect analyses result from a model in which the description of truth conditions is given only in terms of Linear Time. According to this model, the event of Bill's reading of a book takes place at a time *t* which precedes the speech time or the evaluation time *t'*. When truth conditions are given based on the condition that *t* precedes *t'*, then (48a) and (48b) are logically equivalent. This analysis is incorrect, because intuitively we know that both sentences in (48) have implicit time adverbials, which may be explicitly stated in the sentences in (48').

(48') a. Bill has read a book (today/this week/this month/this year).
b. Bill read a book (yesterday/yesterday afternoon/last week).

In (48a), both the event of Bill's reading of a book and the utterance of (48a) take place within one frame of Frame Time, that is, the period of time specified by one of a number of potential Frame Time adverbials in (48'a). In (48b), on the other hand, the event of Bill's reading of a book and the utterance of (48b) take place in two different frames of Frame Time. If Bill's reading of a book takes place in the first frame of time which may be specified by any of the adverbials in (48'b), the speech or evaluation takes place in the second frame of time which is implicit in both (48b) and (48'b). This is a simple example that illustrates one of the three dimensions of linguistic representations of time where previous approaches fail. A full treatment of the English present perfect will be presented in Chapter Five.

Another dimension of linguistic representations of time where the previous approaches fail is Situation Time. Generally speaking, the failure is seen in the repeated emergence of the 'imperfective paradox' in

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Montague's (1970, 1973) analysis, in Bennett and Partee's (1978) analysis, and in Dowty's (1972, 1977, 1979). Authors who seem to realize that there is a dimension of linguistic representations of time, Situation Time, still fail to present an accurate characterization of Situation Time in semantics, and tense and aspect logic. A typical example of this kind is in Parsons' analysis of the progressive sentences with accomplishment verb phrases (42a) and with activity verb phrases (43a) in subsection 2.1.5, which are repeated here.

(42) a. John was reading a book.
b. $(\exists t)\ \{t < \text{now} \ \&\ (\exists e)$ [Writing (e) & Subject $(e$, John) & Object $(e$, a book) & *Hold* $(e, t)]\}$

(42') a. John read a book.
b. $(\exists t)\ \{t < \text{now} \ \&\ (\exists e)$ [Writing (e) & Subject $(e$, John) & Object $(e$, a book) & *Cul* $(e, t)]\}$

(43) a. John was running.
b. $(\exists t)\ \{t < \text{now} \ \&\ (\exists e)$ [Running (e) & Subject $(e$, John) & Hold $(e, t)]\}$

(43') a. John ran.
b. $(\exists t)\ \{t < \text{now} \ \&\ (\exists e)$ [Running (e) & Subject $(e$, John) & Cul $(e, t)]\}$

On Parsons' analysis, (42a) and (43a) have logical forms with identical operators as in (42b) and (43b) respectively. The problem with the analysis lies in that (42a) does not entail (42'a), whereas (42a) entails (42'a). Where does Parson's analysis fail? I think that his analysis fails in not correctly characterizing the bound and unbound nature of Situation Time. Specifically speaking, the event of writing a book takes a period of time of designated length, as represented by the relation between the verb write and the noun phrase *a book*. On the other hand, the event of running takes a period of time of arbitrary length, as represented by the relation between

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the verb *run* and the zero complement. Parsons' analysis does not capture this distinction.

It seems that full considerations of the three dimensions of linguistic representations of time is required in providing an adequate analysis of the truth conditions for sentences in different tenses and aspects and with different categories of verbs. Lack of consideration of any aspects of these representations of time results in inadequacy or in incorrect analysis.

2.3 SUMMARY OF CHAPTER TWO

In this Chapter, I have examined the relation between verb categorization and truth conditions for sentences in different tenses and aspects. This relation exists, since both of them involve the notion of time. I have reviewed a number of approaches to verb categorization or to the description of truth conditions for sentences in different tenses and aspects, or to both. As I noted in the review of previous approaches, this relation between verb categorization and truth conditions for sentences in various tenses and aspects is not considered at first in semantics, and tense and aspect logic, regardless of Vendler's (1957, 1967) observations of different temporal structures in verbs or verb phrases. The emergence of intervals of time as the reference point, replacing the traditional moment of time, is an indication that linguists and logicians finally recognize the existence of this relation. However, interval semantics does not solve all the problems concerning verb categorization and truth conditions for sentences in various tenses and aspects, since linguistic representations of time are much richer and more complicated than ever considered. If linguistic representations of time are classified along the three dimensions: Linear Time, Frame Time and Situation Time, as I propose in section 1.3,

problems of previous approaches are generally found along the dimensions of Frame Time and Situation Time. This indicates that we need further research on the linguistic representations of time in natural languages, particularly alone the lines of Frame Time and Situation Time, before we can offer an adequate analysis of verb categories and of truth conditions for sentences in various tenses and aspects in semantics, and tense and aspect logic.

3.0

Chapter Three
LINEAR TIME AND FRAME TIME

3.0 INTRODUCTION

In this chapter, I focus on two dimensions of the structure of time in natural languages and formally define the two notions Linear Time and Frame Time that I informally put forward in Chapter One. I mainly investigate time as represented by tense, aspect and temporal adverbials in natural languages, and discuss how the linguistic representations of time by tense, aspect and temporal adverbials relate to these two dimensions of time, Linear Time and Frame Time, since these two dimensions of the structure of time are essential in a description of the truth conditions for sentences that involve temporal relations represented by tense, aspect and temporal adverbials. In this chapter, I try to answer some of the questions in (2) in section 1.1. with linguistic evidence from English and Chinese. I believe that an understanding of the relationship between these two dimensions of the structure of time and their linguistic representations eventually contributes to the answers to the set of questions in (1) in section 1.1. The concepts of tense and aspect are ambiguous. It is particularly the case when tense and aspect in English and Chinese are concerned. Some authors (Montague 1970, 1973, Hornstein 1991) do not distinguish tense and perfect aspect in English, while others (Bennett and Partee 1978, Comrie 1976, 1985) treat tense and aspect differently. However, I think that my study of Linear Time and Frame Time will contribute to the

understanding of tense and aspect, and that tense and aspect are eventually definable in terms of the three dimensions of time: Linear Time, Frame Time and Situation Time.

In my discussion of linguistic representations of Linear Time and Frame Time, I make particular reference to temporal adverbials in English and Chinese. I note that there is a lot of differences among languages in their syntactical representations of time. However, I think that a theory developed in terms of the three dimensions of time, Linear Time, Frame Time and Situation Time, is essentially adequate to capture truth conditions for sentences that exhibit different temporal relations in all languages.

3.1 LINEAR TIME: ONE DIMENSION OF TIME

Philosophically speaking, the structure of time has long been a controversy since Aristotle, and the problem may not be settled for a long time to come. In this section, therefore, I simply consider one dimension of the structure of time as represented in natural languages, though my discussion may involve some properties of the structure of time that are popular topics in the philosophical study of time. This discussion may reveal that time as represented in natural languages does exhibit some universal properties.

Time, as I have already mentioned in the previous two chapters, is conventionally represented as a straight line with an arrow on the right side indicating its development from past to future (cf. Reichenbach 1947), though it may well be represented in other ways, such as open time, branching time and cyclic time (Newton-Smith 1980), depending on authors' philosophical commitment to the notion of the structure of time. I adopt the linear representation of time as a straight line in my discussion of

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Linear Time, as in Comrie (1985:2), Jespersen (1965:256-7), Reichenbach (1947:290-2) and Smith (1991:136-7). This is graphically illustrated in Figure 1 below.

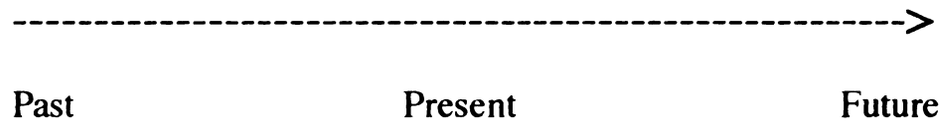

Figure 1: A Linear Representation of Time

One view of this linear representation of time is that time is a set of points without duration but with precedence (cf. Benthem 1983), as expressed in tense and aspect in natural languages (Comrie 1985, Reichenbach 1947, Smith 1991). Comrie (1985) treats points in time as location in time, which may be grammaticalized in the form of tense. Reichenbach (1947) considers the relationship among points of time as a linear ordering of point of speech, point of reference and point of the event, which underlies all the temporal relations expressed in tense and aspect. Hornstein (1991) adopts Reichenbach's linear ordering view and incorporates it in the Government-Binding (GB) framework. Basically following Reichenbach, Smith (1991) treats the relationship among points of time as that among Speech Time, Reference Time and Situation Time.

My notion of Linear Time shares one common ground with previous approaches mentioned above, in that time is a set of points without duration but with precedence. In this sense, Linear Time is concerned with location in time, as Comrie's (1985) approach is. The notion of points of time without duration but with precedence is a relational view of time. A

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temporal expression related to a point of time may well have a duration, but its duration is not of relevance when location in time is concerned, as illustrated in (1).

(1) a. John came *before yesterday.*
b. John left school *after the spring.*

Yesterday in the expression of *before yesterday* in (1a) denotes a period of time, and so does *the spring* in *after the spring.* However, the duration of the temporal expressions is irrelevant in (1), since the temporal relation represented in (1) is one between the occurrence of John's coming or leaving and the point of time *yesterday* or *the spring.* The relationship is one of precedence. This is true with tense, as the examples in (2) indicate.

(2) a. John read a book.
b. John will read a book.

The sentence in past tense in (2a) shows a temporal relation between the time of the utterance of (2a) and the time of the event of John's reading of a book, that is, the event precedes the utterance of the sentence. A similar relation is found in (2b), where the event follows the utterance of the sentence. The event of John's reading a book and the utterance of the sentence are both of some duration, but the duration is irrelevant here either, since only the precedence relation is involved.

My notion of Linear Time departs from Reichenbach's (1947), Hornstein's (1990) and Smith (1991) approaches in avoiding introducing event time into the picture, and avoiding linearly ordering event time with speech time and other point of time in location in time, since event time belongs to another dimension of the representation of time, Situation Time.

Reichenbach (1947:288-297) assumes that point of speech , point of reference and point of the event are linearly ordered in determining the temporal relations in tenses and the perfect aspect in English, as in (3) where point of speech is symbolized as S, point of reference as R and point of the event as E.

(3)

Structure	Examples
a. E--R--S-->	John had read a book.
b. R, E--S-->	John read a book.
c. E--S, R-->	John has read a book.
d. S, R, E-->	John reads a book.
e. S, R--E-->	John will read a book.
f. S--E--R-->	John will have read a book.

Hornstein (1990:14-5) further argues for the linearity of S, R, E, making it explicit that the left point is interpreted as temporally earlier than the right point when they are separated by a line, and that the points are interpreted as contemporaneous when they are separated by a comma. I believe that this linear representation of points of time makes wrong predictions about location in time. For example, the sample sentence in (3f), as repeated in (4) below, may describe two scenarios: one fits the temporal structure in (3f) and one does not.

(4) John will have read a book.

In the first scenario, John may start to read a book after speech time, and then finish reading it before reference time. This is the temporal structure that Reichenbach's and Hornstein's theories predict. In the other scenario, John may start to read a book before speech time, and then finish reading it after speech time but before reference time. The second temporal structure

is where Reichenbach's and Hornstein's theories make wrong predictions.

A second piece of evidence against introducing event time into this linear picture lies in the problem of the reportive use of a sentence, as pointed out in Bennett and Partee (1978), and Bennett (1977).[1] In Reichenbach's (1947:290) and Hornstein's (1990:14-5) theories, event time, speech time and reference time may be contemporaneous in addition to the linear structure. First let me show the problem of event time and speech time being contemporaneous. It seems that sentences in (5) are fine with the reportive use.

(5) a. (Look.) Bill moves.
b. (Look.) Bill runs.

It appears that it is acceptable for event time and speech time to be contemporaneous, when the verbs do not represent a definite period of time, as *walk* and *run* do not. However, it appears to be difficult for event time and speech time to be contemporaneous, when the verbs or verb phrases do represent a definite period of time, as *walks to the bookstore* and *write a book do* in (6)

(6) a. (Look.) ?Bill walks to the bookstore.
b. (Look.) ?Bill writes a book.

The sentences in (6) do not readily allow a reportive interpretation but are more readily available for a habitual interpretation. In Chinese, such sentences always get a progressive reading, instead of a reportive reading, as I have illustrated in section 2.1.1. The same problem exists in the temporal relationship between event time and reference time. Event time

[1] Subsection 2.1.2 contains a detailed discussion on this topic.

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and reference time may be contemporaneous, if the verbs involved in the sentences are verbs that do not represent a definite period of time, as in (7).

(7) a. Bill moved when John came.
b. Bill ran when John came.

The *when*-clause in (7) is considered reference time in Reichenbach (1947:293). It is possible to have an interpretation in which the point of the event is concurrent with the point of reference in (7). However, an interpretation of concurrent point of event and point of reference does not exist, when the sentences involve verbs or verb phrases that represent a definite period of time, as in (8).

(8) a. Bill walked to the store when John came.
b. Bill read a book when John came.

In (8), only the interpretation is available that the event of Bill walking to the store follows the event of John's coming, and that the event of Bill reading a book follows the event of John's coming.

In the above, I have illustrated my common ground with some previous approaches about location in time. I have particularly argued against the introduction of event time in the linear picture of location in time. With my discussion and argument about the linear representation of the structure of time in natural languages, I think that I am now in a position to define more precisely the concept of Linear Time in (9).

(9) Linear Time is a set of points of time without duration but with precedence ordered in relation to speech time in a linear structure.

In Linear Time > is used to represent the temporal relation 'earlier than'. Temporal order in Linear Time may be represented as in Figure 2, where S stands for speech time and *t* with indexes for points of Linear Time.[2]

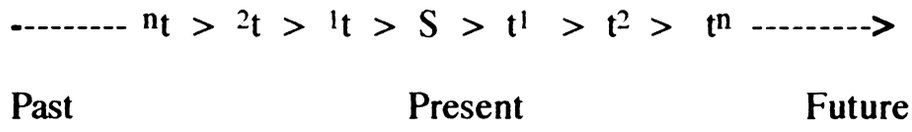

Figure 2: A Representation of Linear Time

In this linear picture, any *t* stands in relation to S time and other *t*s, establishing a relation between *t* and S, and between *t* and *t*. Formally, *t* > S (past), t= S (present), S > *t* (future). Past, present and future are simply temporal orders relative to S time in this linear representation of time in natural languages. These relations are all expressible in natural languages. I think that the differences between languages regarding Linear Time are a problem of degree of grammaticalization of Linear Time. For example, Linear Time is grammaticalized in the form of tenses and probably in the form of 'aspects' as well, and is expressible in the form of temporal adverbials in English. It is apparent that Linear Time is of deictic nature, since temporal orders expressed by tense, aspect and temporal adverbials are relative to S.

What formal properties does temporal order exhibit in Linear Time

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[2] I symbolize points of time earlier than S by indexing on the left upper side of *t*, and symbolize points of time later than S by indexing on the right upper side of *t*. This system of indexing is to be used henceforth in this study when it is needed. When indexing does not involve speech time, I simply symbolize by indexing on the right lower side of *t*.

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in natural languages? Temporal order or precedence in natural languages exhibits a number of formal properties. Those properties may be defined in relation structures ⟨T, R⟩, where R stands for a temporal relation such as *earlier than*, and T for a linear representation of a set of points of time. Following Benthem (1983) and Landman (1991), I present the formal definitions of those properties in (10).

(10) a. R is **transitive** iff $\forall t_1, t_2, t_3 \in T: R(t_1, t_2) \wedge R(t_2, t_3) \rightarrow R(t_1, t_3)$
b. R is **asymmetric** iff $\forall t_1, t_2 \in T: R(t_1, t_2) \rightarrow \neg R(t_2, t_1)$

In (10), I assume that each temporal reference point is indexed with a natural number. The sequence of natural numbers are discrete, since for any number in the sequence there is a unique next number (Newton-Smith 1980:112). Temporal order with such index exhibits the characteristic of discreteness. The notion that time is discrete is, of course, controversial in the philosophical study of time. However, Linear Time as represented in the structure of time in natural languages may exhibit the characteristic of discreteness, since only the precedence relation is considered on this dimension of the representation of temporal relations.

One of the formal properties in Linear Time, transitivity, as defined in (10a), is shown in the implications among the sentences in (11).

(11) a. John came earlier than Mary did.
b. Mary came earlier than Bill did.
c. John came earlier than Bill did.

If (11a) and (11b) are true sentences, then (11c) is necessarily a true sentence, simply because of the transitivity property of the linear

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representation of temporal order. The event *John came* precedes the event *Mary came* which precedes the event *Bill came*, as expressed by the linguistic structure *earlier than* in English. Therefore, the event *John came* precedes the event *Bill came*. One formal relation of transitive relations in the representation of temporal order is **converseness**. Converseness is formally defined in (12), following Allwood, Anderson and Dahl (1977:90) .

(12) A relation R is said to be the converse of another relation S, if R (x, y) is true whenever S (y, x) is true. The converse of a relation R is written $\breve{R}$.

The converse of the temporal relation *earlier-than* is the *later-than* relation, which is illustrated in the sentences in (13).

(13) a. Mary came later than John did.
b. Bill came later than Mary did.
c. Bill came later than John did.

These sentences in (13) have the same type of implications and the same truth conditions as the corresponding sentences in (11) have. The converse relation in Linear Time uniquely underlies certain entailment relations in sentences in natural languages. A third property of Linear Time is asymmetry, which is exhibited in the relations between the sentences in (14), where (14a) does not imply (14b) nor does (14b) imply (14a).

(14) a. John came earlier than Mary did.
b. Mary came earlier than John did.

Given the asymmetrical temporal relation expressed in the pair of sentences in (14), either (14a) is true or (14b) is true at a particular point of time. If

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(14a) is a true at a point of time, then (14b) is not a true at the same point of time, assuming, of course, that the same events of John's coming and Mary's coming are referred to in both sentences. These formal properties of Linear Time are important in distinguishing Linear Time from Frame Time and Situation Time.

It is apparent, as my discussions and definition indicate, that Linear Time is different from Reichenbach's (1947) temporal structure. Linear Time is completely linguistically motivated, while Reichenbach's temporal structure is not. In the manipulation of S (speech time), R (reference time), and E (event time), Reichenbach needs R to represent the temporal structures, such as those in the English past perfect (E -- R -- S) and future perfect (S -- E -- R), while R seems to be redundant and have no linguistic motivation in the representation of temporal structures in other tenses like simple past (E, R -- S), present (S, R, E) and simple future (S --R, E). Hornstein (1990:10-5) argues for Reichenbach's tense theory. On the one hand, he recognizes that the temporal relationship between S and E remains the same for the simple past tense, with or without R. On the other hand, he argues that R obtains in syntactic relations even when it is not semantically visible. In addition to the existence of R in the past perfect and future perfect, Hornstein (1990:90-1) argues that the existence of R accounts for the upper limit of two temporal adverbs per sentence and the interaction between the adverbs, and for the formation of complex tensed sentences. I think that those problems can be accounted for more naturally from the perspectives of Linear Time and Frame Time without R.

In short, I started with the common ground and the difference that my notion of Linear Time has with other approaches to location in time. I have particularly pointed to problems in introducing event time in the

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linear representation of time, as in Reichenbach (1947) and Hornstein (1990). I have defined Linear Time in (9), and discussed some formal properties of Linear Time. In my approach, Linear Time represents the dimension of temporal precedence relations in the structure of time in natural languages, and is linguistically motivated, as compared with Reichenbach's tense theory and theories along his line.

3.2 REPRESENTATION OF LINEAR TIME IN ENGLISH

I believe that Linear Time, as defined in (9), is represented in English by three means, namely, tense, aspect and temporal adverbials, while only the former two are grammaticalized morphologically. I first examine the distinction between finite clauses and nonfinite clauses, which is a result of the grammaticalization of Linear Time. It is generally accepted that in English there are two types of clauses: finite and nonfinite (Hornstein 1990:8). The difference between a finite clause and a nonfinite clause lies in the fact that the former bears a tense marker while the latter does not, as in (15).

(15) a. Bill visit*ed* John.
b. Bill plan*s* to visit John.

(15a) is a finite clause, which is marked by *-ed*. On the other hand, there is a finite clause *Bill plans* and an nonfinite clause *to visit John* in (15b). In (15b), the finite clause is marked by a tense marker *-s*, while the nonfinite clause is not. The tense marker in (15a) simply indicates that the event occurred at a time earlier than S. The tense marker in (15b) indicates that the state of having a plan holds during S. The question is whether there are any temporal relations between the nonfinite clause's *t* and S? The answer

to this question depends on the verb forms (i.e. simple or perfective) in the nonfinite clause. With respect to the simple verb form in nonfinite clauses, the answer is affirmative, so long as the finite clause that a nonfinite clause is related to has a temporal relation with S. However, the temporal relation between the infinitival clause with simple verb forms and S is indirect in the sense that a nonfinite clause has to establish a temporal relation with the finite clause before its temporal relation with S is established. For example, the event denoted by a nonfinite clause in the simple form (as in (15b)) is to occur later than the event denoted by the finite clause. If the event denoted by the finite clause occurs later than S, as in (15b), then the nonfinite clause's event is also later than S. This is generally the situation with nonfinite clauses in the simple form in English. On the other hand, with respect to the perfective form in nonfinite clauses, the answer is not so affirmative, since the temporal relation between the nonfinite clause and S is ambiguous in some cases. An event denoted by a nonfinite clause in the perfect form, such as *to have met Mary* occurs earlier than the event denoted by the finite clause dominating it. If the event denoted by the finite clause occurs earlier than S, then the event denoted by the nonfinite clause also precedes S, as in (16a). If the event denoted by the finite clause occurs contemporaneously with S, then the event denoted by the nonfinite clause precedes S, as in (16b).

(16) a. Bill was very happy to have met Mary there.
b. Bill is very happy to have met Mary there.
c. Bill will be very happy to have met Mary there.

However, when the event denoted by the finite clause follows S, the event denoted by the nonfinite clause may precede S or follows S, as in (16c),

where exist two interpretations: i) Bill has already met Mary and he will be happy, and ii) Bill will be happy after he meets Mary. In the first reading, the event denoted by the nonfinite clause precedes S, while in the second reading the event denoted by the nonfinite clause follows S.

Given the above observations, temporal relations in nonfinite clauses depends on temporal relations between finite clauses and S in most cases. It is in this sense that only finite clauses in English are considered in the representation of Linear Time in this section.

3.2.1 TENSE, THE PERFECT AND LINEAR TIME

A finite clause in English is morphophonologically marked with respect to tense in most cases. Generally speaking, tense is considered a grammatical notion in the sense that tense is grammaticalized location in time in English (cf. Comrie 1985:9-13). As for the number of tenses in English, there seems to be a disagreement.[3] Three tenses representing three times appears to have become a part of the Western grammatical tradition since Aristotle (Binnick 1991:8). These three tenses are past tense, present tense and future tense, corresponding to the three times, as exemplified in (17) respectively.

(17) a. Bill loved Mary.
a' (t > S)
b. Bill loves Mary.
b' (t = S)
c. Bill will love Mary.
c' (S > t)

[3] I believe that the disagreement about number of tenses in English results from the lack of a clear and specific definition of tense, as I argue later in this subsection.

On the other hand, some linguists and philosophers (Montague 1970, Hornstein 1990:15) implicitly or explicitly hold the view that there are six tenses in English, namely, past, present, future, past perfect, present perfect and future perfect, the last three of which are shown in (18).

(18) a. Bill had loved Mary.
b. Bill has loved Mary.
c. Bill will have loved Mary.

There is a great disagreement as whether the last three are tenses at all. I will come back to this problem in the following. Let me first introduce the controversy over the first three tenses: past, present and future in English. Given Comrie's (1985) definition that tenses are grammaticalized location in time, past tense and present tense in English are well accepted, since both are represented by verbal inflections, as in (19) and (20) respectively, in contrast to a verb's nonfinite form.

(19) a. Bill plans to study for the meeting.
a' (t = S)
b. Bill studi*es* to plan the meeting.
b' (t = S)
(20) a. Bill plann*ed* to study for the meeting.
a' (t > S)
b. Bill studi*ed* to plan for the meeting.
b' (t > S)

Given the representation of the temporal relations in (19) and (20) in Linear Time, past tense not only represents a point of time, but also represents a relation: the point of time precedes S, as in (20a') and (20b').

However, linguists and philosophers disagree as to whether there is a future tense in English. The argument that future tense does not exist in

English runs as follows. First, auxiliary verbs in the so called future tense sentences are not tense markers (Binnick 1991, Comrie 1985), as in (21).

(21) a. Bill *will* go there tomorrow.
a' (S > t)
b. Bill *shall* go there tomorrow.
b' (S > t)
c. Bill *can* go there tomorrow.
c' (S > t)

Go in (21) is a nonfinite verb. In contrast to the past forms *would*, *should* and *could*, *will*, *shall* and *can* do not have future forms. In addition, *will* in (21a) expresses willingness, *shall* in (21b) obligation and *can* in (21c) possibility or ability. These are modals instead of tense markers (cf. Partee 1973). Secondly, the notion of future can be expressed without the above auxiliaries, as in (22).

(22) a. Bill is about to go there tomorrow.
a' (S > t)
b. John is going to go there tomorrow.
b' (S > t)

(21) and (22) seem to suffice to show that future in English is not a tense in the sense of the definition in Comrie (1985). Extreme cases of the non-existence of a future tense in English are exemplified in the following sentences in (23), where the verbs are in the present tense form but the events denoted by these sentences are understood to take place in future.

(23) a. The sun rises at 6 o'clock tomorrow.
a' (S > t)
b. The train arrives at noon tomorrow.
b' (S > t)

The time adverbials seem to determine the temporal relations in (23) instead of the present tense marker.

However, McGilvray (1991) argues that sentences like (23) are limited to a small number of verbs. The sentences in (23) are related to 'reduced future' construction which are semantically or pragmatically conditioned in a scheduling state (McGilvray 1991:41-2). 'Reduced future' sentences may be hedged, as in (23').

(23') a. The sun rises at 6 o'clock tomorrow, I guess/think/believe.
a'. (S> t)
b. The train arrives at noon tomorrow, I guess/think/believe.
b' (S > t)

In terms of scheduling, for example, (23b) may have the form in (24a).

(24) a. The train is scheduled to arrive at noon tomorrow.
b. (S < t)

Therefore, McGilvray argues that there is a future tense marked by *will* in English. He supports his argument with the following pairs of sentences, where the sentences in the progressive form contrast those with *will* in acceptability, as in (25), (26) and (27).[4]

(25) a. *John is thinking tomorrow.
a' (S > t)
b. John will be thinking tomorrow.
b' (S > t)
(26) a. *The engine is misfiring tomorrow.
a' (S > t)
b. The engine will be misfiring tomorrow.
b' (S > t)

[4] Barbara Abbott suggests that *be going to* may also be a future marker if *will* is a future marker, as McGilvray argues. *Is going to* may replace *will* in (25), (26) and (27).

(27) a. *The rock is falling tomorrow.
a' (S > t)
b. The rock will be falling tomorrow.
b' (S > t)

When we compare the ungrammatical a-sentences with the grammatical b-sentences, we find that verb types seem to be irrelevant with regard to the progressive forms. It is apparent that generally speaking the progressive forms can not be used to express future in English.

It should be stressed that in my approach tense is a grammaticalized representation of temporal orders in Linear Time. By grammaticalization, I mean the function-specific morphophonological marking of temporal orders, such as the past tense and present tense morphemes in English. Given this definition, it is clear that future that is specified by semantic and pragmatic conditions is not future tense. In McGilvray's argument for the existence of a future tense in English, it appears that future tense and future are not distinguished. It is noticed that there are two verb forms, finite and nonfinite, in (22) and (24). As I pointed out at the beginning, in most cases, nonfinite clauses depend on finite clauses with regard to temporal relations with S. Events and activities denoted by simple nonfinite verbs without an aspect marker generally take place at a time later than the time at which events and activities denoted by dominating finite verbs occur. I believe that the nonfinite verb forms contribute to the specification of future time in (22) and (24), in addition to time adverbials. On the other hand, I argue elsewhere that grammaticalization is not categorical, but a matter of degree (Zhou 1993a, 1993b). The evidence suggests that *will* in the sentences in (26b) and (27b) is used as a tense marker and represents future, since the agentless situations are less likely to express any willing, and future can not

be represented by other means except by *will* and probably *be going to* as well. On the other hand, *will* not only just marks the temporal order but also represent willingness. Thus, the future tense in English may be only partly grammaticalized if it is compared with present tense and past tense that are completely grammaticalized.

Another way in which Linear Time is grammaticalized in English is in the perfect. What is traditionally called perfect 'aspect' in English actually functions as tense and as aspect as well. This may be one of the reasons that some authors (e.g. Montague 1970, Hornstein 1990) simply treat perfect in English as tense, while others (e.g. Comrie 1976:52) seem to treat it as a special kind of aspect, and still others (Smith 1991:242-6) hold that the perfect in English may function both as aspect and as tense. I think that the perfect in English does function both as tense and as aspect if it is viewed from the perspectives of Linear Time and Situation Time. I argue that the English perfect is a tense when it represents Linear Time, and it is an aspect when it involves Situation Time. For my purposes here, I only look at the representation of Linear Time by the perfect in English, and treat it as tense in this sense. The perfect involving Situation Time as aspect will be dealt with in Chapter Five.

First, let me show how the present perfect functions as tense. In terms of Linear Time as defined in (9) and represented in Figure 2, tense is a grammaticalized representation of Linear Time. It is apparent that the English present perfect or the perfect in general is grammaticalized in the form of a bound morpheme *-ed* or phonological alternations with a variety of allomorphs, including ∅, in addition to *have*, as in (28).

(28) a. Bill has cleaned (cf. clean) the table.
b. Bill has broken (cf. break) a glass.

The present perfect in (28) functions as tense in the sense that the past participle of the main verb represents *t*, while the present form of *have* represents the relation of *t* being earlier than S, in Linear Time. This is formally represented in (28').[5]

(28') (t > S)

The representation of Linear Time in (28') clearly reflects the intuition that the events of *Bill clean the table* and *Bill break a glass* take place before S (cf. Smith 1991:146-7). The linear representation of (28) in (28') is not any different from the linear representation of time in past tense. This is exactly what Linear Time represents.[6] Further linguistic evidence for this representation of temporal relations comes with questions and answers concerning the same situations, as illustrated in (29) and (30), which are *when* questions of the statements in (28) and are answers to the questions of the statements in (28) (cf. Comrie 1976:54-55).

(29) a. *When has Bill cleaned the table ?
b. When did Bill clean the table ? (t > S)
c. Bill cleaned the table at three o'clock. (t > S)
(30) a. *When has Bill broken a glass ?
b. When did Bill break a glass ? (t > S)
c. Bill broke a glass earlier this morning. (t > S)

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[5] In Linear Time, forms of auxiliary verbs represents two kinds of temporal relations: precedence relations with S and precedence relations with another point of time.

[6] It is noticed that the English present perfect represents more than Linear Time. It involves the dimension of Frame Time as well. I will discuss how Linear Time, Frame Time and Situation Time work together to account for the so-called viewpoint analysis of tense and aspect in semantic approaches to tense and aspect (cf. Smith 1991) and in discourse approaches to tense and aspect (cf. Thelin 1990).

The *when*-question and its answer in English clearly indicate that the present perfect has a Linear Time representation similar to that of the simple past. Then, what is the difference in temporal structures between the sentences in the present perfect in (28) and those in the simple past in (29) and (30)? The answer is straightforward. There is no difference in temporal relations between those in (28) and those in (29 & 30) in terms of Linear Time, since Linear Time only represents precedence relations. This is the tense perspective of the perfect in English. It is obvious that there are differences in temporal structures between the sentences in the present perfect in (28) and the sentences in the simple past in (29 & 30). The differences do not lie in Linear Time but in Frame Time, as I will discuss later in Chapter Five. This is where previous approaches (e.g. Montague 1970, 1973) fail to account for the differences between sentences in the present perfect and simple past.

The representation of Linear Time is also found in past perfect sentences, as in (31).

(31) a. Bill had cleaned the table when John called.
b. Bill had broken a glass when John called.

In (31), the events/activities of *Bill clean the table* and *Bill break a glass* take place at a time before the event of *John call.* For this reason, the past perfect is called anterior past (Reichenbach 1947:296) or past in the past (Jespersen 1965:262-3). The past forms of the verbs in (31) indicate that the events/activities all take place before the time when the sentences in (31) are uttered. The temporal relations in (31) may be represented in (31') in terms of Linear Time, where ^{2}t is the point of time represented by the past participle in the main clause and ^{1}t is represented by the simple

past in the subordinate clause, while the relation of being earlier than is represented by the auxiliary of the past perfect.

(31') $(^2t > {}^1t > S)$

(31') correctly predicts the intuition native speakers have about the past perfect sentences in contrast to simple past tense sentences, as in (32).

(32) a. Bill had broken a glass yesterday.
a' $(^2t > {}^1t > S)$
b. Bill broke a glass yesterday.
b' $(t > S)$

(32a) implies that Bill broke a glass before a particular point of time during yesterday, since the past participle represents a point of time in the past and the auxiliary *had* represents a relation of this point (^2t) being earlier than another point (^1t) which is not linguistically covert in this sentence. The representation of Linear Time in (32a') correctly characterizes the relationship among ^2t , ^1t and S in (32a). However, (32b) does not have this implication (cf. McGilvray 1991:46-8), since simple tense only represents the relation of t being earlier than S, as in (32b').

A similar relationship is found in the future perfect in contrast to the simple future in English, as in (33).

(33) a. John will have cleaned the tables.
b. John will clean the tables.

(33a) implies that John will have cleaned the table before a particular time or a particular event in the future but after S, while (33b) simply says that the event of cleaning will takes place after S. This implication with the

future perfect is correctly characterized in the representation of Linear Time in (33').

(33') a. $(S > t^1 > t^2)$ or $(^1t > S > t^2)$
b. $(S > t)$

Linguistically, t^1 is represented by past participle, and the relation of t^1 being earlier than t^2 is represented the auxiliary of the perfect, while the relation of t^2 being later than S is represented by *will*. It must be stressed that it does not specify any temporal relation between t^1 and S.[7] Though *t2 is* linguistically covert in (33a) t^2 can be linguistically expressed, as in (34).

(34) a. John will have cleaned the tables *by two o'clock this afternoon.*
b. John will have cleaned the tables *by the time/when* Mary brings the food .

The temporal adverbials in (34) explicitly represent t^2 in Linear Time.

The above examples illustrate that the perfect in English represents Linear Time. It is by the perfect's function along the dimension of Linear Time that the English perfect may be classified as tense. However, the English perfect's role in Situation Time and relation with Frame Time should not be neglected, if a complete picture of temporal relations is to be considered. This picture will be presented in Chapter Five.

3.2.2 LINEAR TIME AND TEMPORAL ADVERBIALS

It was noticed in section 3.1 that the linear nature of the temporal structure in language may be represented by temporal adverbials. This

[7] The event of cleaning may well be started before S or after S, and definitely ends after S. This is what Reichenbach's (1947) tense theory fails to predict.

linear dimension of the temporal structure in natural languages is Linear Time as defined in (9) and graphically illustrated in Figure 2. In English, the representation of Linear Time is exemplified in the sentences in (35).

(35) a. *Today* John has asked Mary to have lunch with him *tomorrow*.
b. *This morning* John told Bill that he is going to watch a movie *this evening*.
(36) a. (^{1}t > S > t^1)
b. (^{1}t > S > t^1)

One of the functions that these temporal adverbials have in (35) is to specify the temporal sequence of the activities expressed by the verbs relative to S, as illustrated in (36). The relation of ^1t being earlier than S is specified by the present perfect, as discussed in section 3.2.1. t^1 and the relation of t^1 being later than ^1t is specified by the nonfinite clause, but it does not specify how much later t^1 is than ^1t. The relation of how-late is specified by the temporal adverbial *tomorrow*. Other temporal relations relative to S are found in the following examples.

(37) a. John left here *a week ago yesterday*.
a' (^{2}t > ^{1}t > S), where ^{2}t = past tense, ^{1}t = yesterday
b. John will leave here *in a week from tomorrow*.
b' (R= S > t^1 > t^2), where t^1 = tomorrow, t^2 = future tense

In general, temporal adverbials in English may represent the kind of temporal relations that tenses and the perfect in English represent. They never replace tense and aspect's function in English, but play the role of specification in the sense that, for example, they specify how far in the future or in the past a situation holds, as in (36). However, in some Bantu languages such as Makaa and Nugunu, this role is played by tenses in the

form of near and far future and near and far past (cf. Heath 1991, Orwig 1991).

However, temporal adverbials have more than one function in the temporal structure of natural languages. In addition to their role in the representation of Linear Time, temporal adverbials also represent Frame Time. For example, in (35) and (36) both ^{l}t and S are included in the interval of time denoted by *today* and *this afternoon* respectively. This is more clearly illustrated in (38), where $\in$ means 'temporal inclusion'.

(38) a. Mary left *at three today.*
b. (t > S) (t = at three; F= Today; t $\in$ F)

This kind of temporal inclusion relations belongs not to the domain of Linear Time, but to the domain of Frame Time. This double function of temporal adverbials in representing Linear Time and Frame Time is not distinguished in the studies of temporal relations (Prior 1967, Kamp 1979, Dowty 1982), where both tense and temporal adverbials are treated as sentential operators involving different scopes. This confusion results in the so-called 'Adverbial Scope Paradox ' (Binnick 1992:310-9).

3.3 REPRESENTATION OF LINEAR TIME IN CHINESE

It is well accepted that there is no tense in Chinese. In other words, verbs are not marked as to tense in Chinese. 'The language does not use verb inflections to signal the relation between the time of the occurrence of the situation and the time that the situation is brought up in speech' (Li and Thompson 1981:184). Moreover, there is a notion that the kind of temporal relations that tense represents do not seem to exist if a language does not have tense markers. For instance, Wang (1985:151) holds that

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there are two ways in which speakers treat the relations between time and situations; focus on WHEN without regard to duration; and focus on DURATION, its beginning and completion without regard to WHEN. Wang regards Chinese as representative of the latter of the two. It is acknowledged that Chinese is a language which is not rich in affixation, though the language is developing from one with predominantly monosyllabic words to one with an increasing proportion of disyllabic words (cf. Chao 1968:194-198, Li and Thompson 1981:36). Chinese does not represent plurality and gender morphologically either. However, the lack of the affixation in Chinese does not necessarily mean that the WHEN type of temporal relation, plurality and gender are neglected in Chinese.

However, the fact that Chinese does not have verb inflections to express tense gives wrong impressions to linguists and philosophers as well. For example, on tense, Russell (1956:248) made the following comment in his 1918 lecture.

> (39) The occurrence of tense in verbs is an exceedingly annoying vulgarity due to our preoccupation with practical affairs. It would be much more agreeable if they had no tense, as I believe is the case in Chinese, but I do not know Chinese.

Russell intends to use language in a tenseless way in logic. However, to use language in a tenseless way can not avoid the problem of temporal relations. For example, Montague (1970, 1973) follows Russell's tenseless way in treating language and runs into trouble, as Bennett and Partee (1972) criticize, and I have reviewed in section 2.1.2. Moreover, a language without tense inflections like Chinese is not used in a tenseless way as Russell may expect, as is illustrated in the sentences in (40). The temporal

relations in (40) can be expressed in (41) in terms of Linear Time.

(40) a. Wo kan le bao qu xuexiao.
I read Asp. newspaper go school
I will go to school after I read the newspaper.
b. Zuotian wo kan le bao qu xuexiao.
Yesterday I read Asp. newspaper go school
Yesterday I went to school after I read the newspaper.
(41) a. $(S > t^1 > t^2)$,
b. $(^2t > {}^1t > S)$

In the utterance of (40a), S is anchored at NOW, *kan bao* takes place at t^1 and *qu xuexiao* at t^2. In (40b), S is anchored at NOW, *kan bao* takes place at ^2t and *qu xuexiao* at ^1t. The event denoted by the main verb tends to follow S, unless temporal adverbials like *zuotian* indicate otherwise. I argue that a sentence in Chinese expresses temporal relations relative to S when they are uttered, as the sentences in (40) do, though Chinese does not have regular morphological tense markers. The problem is only to what degree temporal relations are grammaticalized in Chinese. I argue, however, that some aspect markers in Chinese have a dual function as aspect markers and as tense markers, as I show in the next two subsections.

3.3.1 THE DUAL FUNCTIONS OF ASPECT MARKERS IN CHINESE

The lack of regular morphological tense markers in Chinese appears to render the distinction between finite clauses and nonfinite clauses practically impossible. However, Tai (1985:50) argues that temporal relations between clauses are represented in terms of the principle of temporal sequence, which is stated as follows: 'the relative word order between two syntactic units is determined by the temporal order of the states which they represent in the conceptual world'. In other words, in the

unmarked case, temporal relations between clauses are reflected in the syntactic order of the clauses, as in (42) and (43).

(42) a. [$_S$[$_{S1}$ Zhangsan qu shudian] [$_{S2}$ mai san ben shu]].
Zhangsan go bookstore buy three C(lassifier) book
Zhangsan will go to the bookstore to buy three books.
b ($S > t^1 > t^2$), where t^1 = go, and t^2 = buy

(43) a. ?[$_S$[$_{S1}$ Zhangsan mai san ben shu] [$_{S2}$ qu shudian]].
Zhangsan buy three C. book go bookstore
b. *($S > t^2 > t^1$), where t^1 = go, and t^2 = buy

(42a) indicates that *qu shudian* syntactically and temporally precedes *mai san ben shu*. Chinese relies on the match between syntactic order and temporal order to correct represent Linear Time, as in (42b), since Chinese lacks any morphological means. When the syntactic order in (42a) is reversed as in (43a), the sentence seems to be odd. This oddness results from the violation of the representation of the temporal relations in Linear Time, as indicated in (43b). It is conceptually or semantically unacceptable to reverse the temporal order, though it is not completely ungrammatical. Thus, the unacceptability of (43a) is conceptual or semantic rather than syntactical. The match between syntactic order and temporal order is not of significance, when there are other grammatical means that may represent the temporal order, as in English. Given the distinction between finite and nonfinite clauses, English has more room for syntactical manoeuvre, as in (44), than Chinese does, in contrast to (43).

(44) a. To buy three books, John will go to the bookstore.
b. ($S > t^1 > t^2$)

The morphological tense markers in English correctly represent the temporal relation (44b) in the sentence in (44a), while syntactic order of

constituents is of less importance.

Chinese has a few verbal aspect markers (Li & Thompson 1981, Smith 1991). Of these aspect markers, *le* is considered to be a perfective marker and *guo* as a perfective/experiential marker (Li & Thompson 1981:185, Smith 1991:344). I think that these two morphemes are related to the notion of Linear Time as well. For example, both *le* and *guo* may indicate that the event/activity in question takes place at a time earlier than S, as in (45) and (46).[8]

(45) a. Zhangsan kan *le* zhe ben shu.
Zhangsan read Asp. this C. book
Zhangsan (has) read this book.
b (t > S)

(46) a. Zhangsan kan *guo* zhe ben shu.
Zhangsan read Asp. this C. book
Zhangsan read this book.
b (t > S)

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[8] *Guo* is also a verb and means 'to pass'. It is generally acknowledged that there are two *le*'s in Chinese. One of them is a verbal *le* (perfect aspect), and the other is a sentential *le* . The latter is also considered to be a manifestation of the perfect aspect (Li, Thompson & Thompson, 1982). The sentential *le*, depending on the meaning of the matrix verb, has a number of meanings, such as inchoative in (i) and present perfect in (iii), while the verbal *le* generally represent past tense and the perfect, as in (ii) and (iv).

(i) Zhangsan kan shu *le*.
Zhangsan read book
Zhangsan began to read.
(ii) Zhangsan kan *le* shu.
Zhangsan read book.
Zhangsan read the book.
(iii)Zhangsan hui jia *le*.
Zhangsan return home
Zhangsan has returned home (He is home.).
(iv) Zhangsan hui *le* jia.
Zhangsan return jia.
Zhangsan returned home/has been home (He is not home.)

(45a) with *le* and (46a) with *guo* appear to represent the same type of temporal relations, as in (45b) and (46b) respectively, where the event occurs before the utterance. However, *le* and *guo* differ in a number of ways in representing temporal relations. First *le* behaves more like a perfect aspect marker in that it does not necessarily determine any temporal relation relative to S, as in (47), in contrast to (48).

(47) a. Zhangsan kan *le* shu qu xuexiao.
Zhangsan read Asp. book go school
Zhang will go to school after he reads the book.
b. ($S > t^1 > t^2$)
(48) *Zhangsan kan *guo* shu qu xuexiao.
Zhangsan read Asp. book go school

In (47a), *le* simply represents a temporal relation between a sequence of two events so that the event *kan le shu* precedes the event *qu xuexiao*. (47a) is taken to be anchored at NOW without any contrary context. On the other hand, (48) does not have the temporal interpretation that (47a) has. The fact is that *guo* does not represent a temporal relation between a sequence of two events. (48) may be grammatically rendered as (49) by means of a lexical item, such as *yiqian* (before), which express a sequential temporal relation.

(49) a. Zhangsan qu xuexiao yiqian kan *guo* shu.
Zhangsan go school before read Asp. book.
Zhangsan read the book before he went to school.
b. ($^2t > {}^1t > S$)
(50) a. Zhangsan kan *guo* shu.
Zhangsan read Asp. book
Zhangsan read the book.
b. ($t > S$)

Second, *guo* is not a simple perfect marker in the sense that it does not

specify a time following S, as in (48), but systematically specifies a time that precedes S, as in (49) or (50). *Guo* has a past tense function. *Guo* and *le* represent temporal relations that differ in relation to S, as noted in Smith (1991:348-53). *Le* may represent a continuity of an interval of time extending from past to S, while *guo* involves a reference point that is discontinuous with S.

(51) a. Zhangsan qu *guo* xuexiao.
Zhangsan go Asp. school
Zhangsan went to the school.
b. Zhangsan qu *le* xuexiao.
Zhangsan go Asp. school
(i) Zhangsan has gone to the school.
(ii) Zhangsan went to the school

(51a) gives the interpretation that Zhangsan went to the school and he is no longer at the school, while (51b) may have the interpretation that Zhang is not back from school yet, though it may also have an interpretation similar to that in (51a).[9] Discontinuity is characteristic of Linear Time as defined in (9), while continuity belongs to the domain of Frame Time, which will be discussed in the next section. Given the evidence that *guo* represents a

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[9] However, the difference between (51a) and (51b) does not seem to exist or at least is not obvious in the sentences below.

(i) Zhangsan kan ***guo*** zhe ben shu.
Zhangsan read Asp. this C. book
Zhangsan read/has read this book.
(ii) Zhangsan kan ***le*** zhe ben shu.
Zhangsan read Asp.this C. book
Zhangsan read/has read this book.

Both sentences in (i) and (ii) may have a present perfect interpretation and a simple past interpretation, though *read this book*, like *go to the school*, is considered an accomplishment verb and denotes a temporally bound situation. I think that the difference in interpretations may originate from something other than temporal properties, but I do not have an account now.

temporal relation that a time precedes S and is discontinuous with S, *guo* functions more like a tense marker than an aspect marker. In addition, *le* may function like a tense marker as well, since it also represents the order of a sequence of situations and the order of a situation and S in Linear Time.

3.3.2 TENSE AND TEMPORAL ADVERBIALS IN CHINESE

Chinese lacks regular tense morphemes so that temporal adverbials appear to play a more important role in determining temporal relations in Chinese. In this section, I examine the ways in which *guo* and *le* and temporal adverbials interact in representing Linear Time.

These two morphemes, *guo* and *le*, may co-occur with a large range of temporal adverbials, since they have a dual function for tense and aspect. They may co-occur with a temporal adverbial that denotes a period of time in which both S and *t* are anchored, as in (52).

(52) a. Jintian Zhangsan kan *le* yi ben shu.
Today Zhangsan read Asp. one C. book
Today Zhangsan has read a book.
b. (t > S), where t, S $\in$ F , where $\in$ = temporal inclusion and F = today

(53) a. Jintian Zhangsan kan *guo* yi ben shu.
Today Zhangsan read Asp. one C. book
Today Zhangsan has read a book.
b. (t > S), where t, S $\in$ F, where $\in$ = temporal inclusion and F = today

(52a) and (53a) show that *guo* and *le* occur with a temporal adverbial that is related to S. (52a) and (53a) have an present perfect interpretation, since there is a temporal continuity between *t* and S, as (52b) and (53b)

indicate.[10] What is of interest here is that both *guo* and *le* occur with adverbials that are not continuous with S, as in (54), if we assume that *today*, *this week*, *this month*, etc. are continuous with S.

(54) a. Zuotian Zhangsan kan *le* yi ben shu.
Yesterday Zhangsan read Ts. one C. book
Yesterday Zhangsan read a book.
a' (t > S)
b. Zuotian Zhangsan kan *guo* yi ben shu.
Yesterday Zhangsan read Ts. one C. book
Yesterday Zhangsan read a book.
b' (t > S)

The occurrences of *le* in (54a) and *guo* in (54b) are like the English past tense in the sense that the event/activity takes place in the past and is complete, relative to S. In addition, the occurrence of temporal adverbials discontinuous with S requires the occurrence of *guo* or *le* in some contexts, as the sentences in (55) indicate.

(55) a. ?Zuotian Zhangsan kan yi ben shu.
Yesterday Zhangsan read one C. book
Yesterday Zhangsan read a book.
b. ?Qunian Zhangsan qu xuexiao.
Last year Zhangsan go school
Last year Zhangsan went to school.

The above evidence supports the argument that *le* and *guo* function like tense markers. On the other hand, some sentences in Chinese may occur with temporal adverbials discontinuous with S without *le* or *guo*, as in (56) on the next page.

[10] Temporal continuity belongs to the domain of Frame Time, since Frame Time concerns the duration of time and inclusions in time.

(56) a. Zuotian Zhangsan kan shu.
Yesterday Zhangsan read book
Yesterday Zhangsan read a book.
b. Qunian Zhangsan zai meiguo.
Last year Zhangsan be-in America
Last year Zhangsan was in America.

The sentences in (56) without *le* or *guo* are acceptable. These examples suggest that the two tense morphemes *le* and *guo* together with temporal adverbials represent temporal relations in Linear Time, and that the grammaticalization of $t > S$ in Chinese is not as complete as that in English. With two tense morphemes, temporal adverbials in Chinese do not play as important a role in the representation of $t > S$ as they do in representing $S > t$ for the future.

Chinese does not have any future tense markers, though there are a few modal verbs that may express the notion of future. One of these modals is *yao*, which is like the English *will* in terms of function and meaning. *Yao* expresses the notion of future and the willingness of the agent, if there is an agent, as in (57a).

(57) a. Zhangsan yao qu xuexiao.
Zhangsan will go school.
(i) Zhangsan will go to the school.
(ii) Zhangsan wants to go to the school
b. Jintian yao xia yu.
Today will fall rain
It will rain today

Hui is another modal that expresses possibility and also involves the notion of future, as in (58).

(58) a. Zhangsan *hui* qu xuexiao.
Zhangsan may go school.
Zhangsan may go to the school.
b. Jintian *hui* xia yu.
Today may fall rain
It may rain today

These are modals rather than future tense markers, but *yao* is similar to the English *will* in its function in representing relation in Linear Time. *Yao* may be grammaticalized as a tense marker to some degree. The notion of future can be expressed simply by temporal adverbials without these modals, in contrast to the notion of past.

(59) a. Mingtian Zhangsan qu xuexiao.
Tomorrow Zhangsan go school
Tomorrow Zhangsan will go to the school.
b. Houtian xia yu.
The day after tomorrow fall rain
It will rain the day after tomorrow.

The temporal adverbials may determine the representation of Linear Time with respect to future, but not as often in the case of past, in which case both temporal adverbials and tense/aspect markers contribute to the representation of Linear Time.

The above evidence shows that Chinese is not used in a tenseless way nor is it as tenseless in the grammatical sense, as it is considered in the literature. Chinese has some degree of grammaticalization of the temporal relation $t > S$, but has no grammaticalization of the temporal relation $t = S$, and probably some degree of grammaticalization of the temporal relation $S > t$ in Linear Time.

3. 4. FRAME TIME: THE SECOND DIMENSION OF TIME

Another aspect of the structure of time in natural languages is the representation of the duration of time. Speakers impose frameworks on the duration of time in terms of seconds, minutes, hours, days, weeks, months, years, etc. in relation to events and activities. In the measurement of time there are two distinctive temporal relations, one of which is temporal order and the other of which is temporal inclusion. The former is the dimension of Linear Time, and the latter is the dimension of Frame Time. Frame Time is related to what are called 'frame adverbials' in Bach (1981), Bennett and Partee (1978), Parsons (1990) and Smith (1991).

In classifying temporal adverbials, Bennett and Partee (1978: 22-30) label a group of adverbials like *this morning*, *yesterday*, *in 1973*, etc. as 'frame adverbial phrases', as compared to other groups, such as 'durative adverbial phrases' and 'adverbial phrases of number and frequency'. In their definition (Bennett and Partee 1978: 22), 'Frame adverbial phrases refer to an interval of time within which the described event is asserted to have taken place'. They also include *now*, *at noon*, etc. in frame adverbial phrases. However, they do not give their classification of temporal adverbials any theoretical significance in their study of tense and aspect. Smith (1991:155) has also mentioned frame adverbials in her treatment of temporal adverbials. She gives frame adverbials the term 'locating adverbials', which contribute to the specification of her Reference Time and Situation Time. Smith considers the relation between the time specified by locating adverbials and Situation Time vague. However, she does not elaborate on the significance of frame or locating adverbials theoretically either.

An in-depth treatment of frame adverbials is found in Parsons

(1990:209-23), who includes both 'temporal' and 'locative' adverbials, such as *in 1939* and *in a dream*, in this group. I just review his treatment of the temporal frame adverbials here. What is a frame adverbial? Parsons (1990:209) thinks that frame adverbials 'set a context within which the rest of the sentence is to be interpreted'. On the other hand, Parsons (1990:212) notes that it is difficult to recognize and distinguish frame adverbials from others, since these adverbials can function as frames (60a), as predicates of time intervals (60b) and as predicates of eventualities (60c).

(60) a. *From May to August* Mary ran every day. (Frame)
b. *From 2:00 to 3:00*, Mary ran. (Pred. of interval)
c. Mary ran *from 2:00 to 3:00.* (Pred. of event)

(60') a. $\underline{(x)\ [Day(x) \& After(x, May) \& Before(x, August)}$ → $(\exists \mathbf{I})[\mathbf{I} < now \& On(\mathbf{I}, x) \& (\exists e)(\exists t)[t \in \mathbf{I} \& Running(e) \& Agent\text{-}Theme(e, Mary) \& Cul(e,t)]]]$

b. $(\exists \mathbf{I})[\mathbf{I} < now \& \underline{From(2{:}00, \mathbf{I}) \& To(3{:}00, \mathbf{I})} \& (\exists e)(\exists t)[t \in \mathbf{I} \& Running(e) \& Agent\text{-}Theme(e, Mary) \& Cul(e,t)]]$

c. $(\exists \mathbf{I})[\mathbf{I} < now \& (\exists e)(\exists t)[t \in \mathbf{I} \& Running(e) \& Agent\text{-}Theme(e, Mary) \& \underline{From(2{:}00, e) \& To(3{:}00, e)} \& Cul(e,t)]]$

The frame adverbial in (60a) constrains the noun phrase *every day*, as shown in (60'a), while the predicate of the interval in (60b) constrains an interval of time, as in (60'b). The predicate of event in (60c) constrains the event, as in (60'c), which tells how long the event lasts. I think that Parsons' distinction between frames and predicates of intervals is semantically unnecessary, since both of these two temporally constrain some period of time, whether they syntactically constrain a noun phrase denoting time or not.

On the other hand, Bennett and Partee (1978:22) note that many of these frame adverbials are indexical in character. They have a dual

function: they not only locate temporal orders, but also they locate temporal inclusions. This dual function is exemplified by some temporal adverbials that denote a period of time and express temporal order, as shown in (61).

(61) a. *Yesterday morning* John read a book
b. John read a book at t, (t > S).
c. John read a book within f, (f ∈ F), where ∈ = temporal inclusion, f = morning and F = yesterday.

The properties and linguistic representations of temporal order have been treated as Linear Time in sections 3.1, 3.2 and 3.3.. In this section, I just look at the single dimension of Frame Time which deals with temporal inclusion relations in natural languages.

It is apparent that my concept of Frame Time originates from the above authors' classification and treatment of frame adverbials. However, my Frame Time is different from the previous authors' frame adverbials in that it is viewed as one of the three dimensions of the representation of time in natural languages, instead of simply a subclass of adverbials. Frame Time may be defined as (62).

(62) Frame Time is a set of intervals of time, which are denoted by temporal frame phrases and within which a described event/ activity takes place or a state holds.

In contrast to Linear Time which is treated as a set of nondurative points, Frame Time is a set of intervals of duration. In the measurement of the duration of time, a relation exists among the units of measure that a smaller unit of the duration of time *f* is temporally included in a larger unit of time F, symbolically as $f \in F$, where F symbolizes Frame Time and $\in$ stands

for temporal inclusion. Temporal inclusion is formally defined in (63) (cf. Newton-Smith 1980:144).

(63) F includes *f* just in case *f* does not begin earlier than F and *f* does not end after F.

Temporal inclusion in Frame Time may be graphically illustrated in Figure 4 below, where F stands for Frame Time, f stands for a frame of Frame and / ‾\ stands for temporal inclusion.

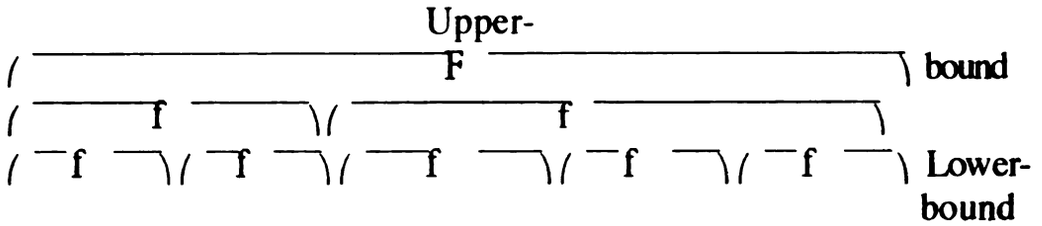

Figure 3: Temporal Inclusion in Frame Time

Within a frame of Frame Time, the largest interval of time denoted by a temporal frame phrase may be said to be the upper-bound of Frame Time, while the smallest possible subinterval of time is considered the lower-bound of Frame Time. The bounds are context-relative. For example, in a Frame Time expression like *at 8 o'clock in the morning*, *at 8 o'clock* is considered the lower bound and *in the morning* the upper bound. Each interval of time denoted by a temporal expression is a frame of Frame Time, and may temporally include another frame or be included in another frame. What relations does the temporal inclusion in Frame Time show in natural languages? One of the most important relations in Frame Time as

represented in the structure of time in natural languages is **transitivity**, as defined in (64), where **I** = being temporally included, f= frame, and F = Frame Time.

(64) **I** is transitive iff $\forall f_1, f_2, f_3 \in F$: **I**$(f_1, f_2) \wedge$ **I**$(f_2, f_3) \rightarrow$ **I** (f_1, f_3)

Given that **I** is transitive, (64) says that if f_1 is temporally included in f_2, and f_2 is temporally included in f_3, then f_1 is temporally included in f_3. The transitivity property of the inclusion relation in Frame Time underpins the entailment relationship in the sentences in (65).

(65) a. Mary walked to school at about 8 am yesterday morning.
b. Mary walked to school yesterday morning.
c. Mary walked to school yesterday.

Certain implications exist among the sentences in (65). (65a) implies (65b) and (65c), and both (65a) and (65b) imply (65c). If (65a) is a true sentence, then (65b) and (65c) are true sentences and so on. This entailment exists, because *8 am* is temporally included in *yesterday morning*, and *yesterday morning* is temporally included in *yesterday*. I called this inferential pattern 'increasing' in the sense that a sentence with a small frame of Frame Time implies one with a larger frame of Frame Time. However, the reverse is not necessarily true. For example, if (65b) is true, (65a) may not be a true sentence, since it is possible that Mary walked to school at any time in yesterday morning other than at about 8 am. This interesting aspect of temporal inclusion is also seen in (66).

(66) a. John read a book Tuesday morning.
b. John read a book Tuesday.

c. John read a book this week.

The sentences in (66) exhibit the same properties as those in (65) do. If (66a) is true, then (66b) and (66c) are true. If (66b) is a true sentence, then (66c) is a true sentence too. However, converse implications do not exist in Frame Time. For example, (66c) does not entail (66b) and (66a), and (66b) does not entail (66a). In contrast to the entailment relations in Linear Time which can be reversed, as discussed in section 3.1, the entailment relations in Frame Time can not be reversed. I think that the difference in inferential patterns between Linear Time and Frame Time lies in the difference between linear ordering in Linear time and nonlinear ordering in Frame Time, though I am not able to discuss the formal nature of linear ordering and nonlinear ordering in this study. In the case of (66), if (66c) is true, John may have read a any time during this week, not necessarily on Tuesday or on Tuesday morning. The entailment relation in Frame Time may be symbolically represented as (67).

(67) sf --> sF; sF -/-> sf, iff f $\in$ F, where sf = a sentence with a smaller frame of Frame Time, sF = the same one with a larger frame of Frame Time which contains the smaller frame of Frame Time, --> =implies, and -/-> = not imply

(67) characterizes an important relation that distinguishes Frame Time from Linear Time, the latter of which exhibits entailment relations that can be reversed.

3.4.1. FRAME TIME AND FRAME TIME EXPRESSIONS

Interval-referring temporal expressions may be categorized into two classes depending on their relationship with S, since some of these

expressions have a dual function in locating Linear Time and Frame Time, as discussed above. The two classes are indexical expressions and non-indexical expressions (Binnick 1991:307). The indexical expressions have the dual function, while the non-indexical expressions do not have this dual function. Indexical interval-referring temporal expressions are exemplified in (68).[11]

(68) a. *this morning, this afternoon, this evening,* etc.
b. *today, yesterday, tomorrow, the day before yesterday,* etc.
c. *this week, next week, this month, last month,* etc.
d. *this year, last year, the year before last year,* etc.

These indexical interval-referring temporal expressions may form larger units of expressions, such as *since last Tuesday, before next month*, etc.. These indexical interval-referring temporal expressions not only refer to an interval of time but also locate the temporal order relations with S, as their dual function. On the other hand, non-indexical interval-referring temporal expressions, like those in (69), do not represent any temporal relations with S.

(69) a. *on May 15, on Christmas day, in a sunny afternoon*, etc.
b. *in March, in spring, in the fourth quarter,* etc.
c. *in 1993, in the 20th century*, etc.

When expressions in (69) are used in sentences, Linear Time is usually determined by tenses, as in (70).

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[11] I only give the English examples here for both indexical and non-indexical interval-referring temporal expressions, since their Chinese counterparts are similar. When they are different, I will provide Chinese examples. I believe that natural languages generally have these two classes of temporal expressions.

(70) a. John went to Washington D. C. on May 15.
a' (t > S)
b. John will go to Washington D. C. on May 15.
b' (S > t)

In (70a), *May 15* precedes S, as represented by past tense, while in (70b) *May 15* follows S, as represented by future tense. The expression *May 15* itself does not represent any temporal order relations with S. In the following, I refer to both indexical and non-indexical interval-referring expressions as 'Frame Time expressions', since I am not interested in the Linear Time function of these temporal expressions in this section.

There is an upper-bound and a lower-bound in Frame Time, as illustrate in Figure 3 above. Frame Time bounds involve the definition of Frame Time and the classification of Frame Time expressions. What concerns me most is the lower bound of Frame Time, since larger intervals of time may not be a problem for Frame Time. How small is an interval of time that constitutes a frame of Frame Time? I plan to examine whether a temporal expression is a frame of Frame Time or not with the definitions provided in (62) and the properties in (64) and the relation in (67).

According to (64), Frame Time exhibits a temporal inclusion relations, that is, a smaller frame is included in a larger frame. These inclusion relations are transitive in the sense that a smaller frame is temporally included in larger frames all the way upstairs towards the upper bound, and this relation underpins the entailment relation of sentences with Frame Time expressions, as stated in (67). Within such a frame denoted by a Frame Time expression an event or activity takes place, given the definition of (62). If this kind of temporal relation exists, a temporal expression represents Frame Time and is a frame of Frame Time. I will

look at *now* and *at 8 o'clock* with respect to (62), (64) and (67). *Now* may refer to point of time or an extended point of time (Binnick 1991:126 and 473, Richards 1982:91). For example, the sentences in (71) involves the extended *now*.

(71) a. John works at Michigan State University *now*.
b. Then, John was poor, but *now* he is rich.

The extended *now* in the sentences in (71) is not merely a point of time, but a longer interval of time that covers some time past and some time to come (Binnick 1991:126). There is no question that the extended *now* can function as a frame of Frame Time. I like to look into the *now* that refers to an instant of time or to a short interval of time, as in (72), since I am interested in the lower bound of a subinterval in a frame of Frame Time.

(72) a. John is reading a book *now* (now= at this moment in this morning).
b. John is reading a book *this morning*.
c. John is reading a book *today*.
(73) ($f_1 \in f_2 \in F$), where f_1= now, f_2= this morning, and F= today

Intuitively, we know that (72a) entails (72b) and (72c), and (72b) entails (72c). This intuition is supported by the formal representation of Frame Time in (73), which shows that temporal inclusion relations exist in the frame of Frame Time in the three sentences in (72). *Now* is a Frame Time expression, though it is the lowest bound of a frame in Frame Time, as the evidence indicates. Similar temporal relations are found in (74), where at *8 o'clock* occurs. *At 8 o'clock* refers to an instant of time, which may be the smallest subinterval or the lowest bound of a frame of Frame Time in any context, if it logically behaves like a frame of Frame Time.

(74) a. John arrived at 8 o'clock (in the morning on that day) .
b. John arrived in the morning (on that day).
c. John arrived on that day.

(75) ($f_1 \in f_2 \in F$), where f_1= at 8 o'clock, f_2= in that morning, and F= on that day

(75) indicates that temporal inclusion relations formally exist among the three frames of Frame Time, *at 8 o'clock*, *in the morning* and *on that day.* This conforms with our intuition that (74a) entails (74b) and (74c), while converse entailment does not hold. In this sense, *at 8 o'clock* is the lower bound of a frame of Frame Time, which may be the smallest frame or the lowest bound of Frame Time.

I have argued in the above that points of time are temporally included in a frame of Frame Time, though points do not temporally include any frames of Frame Time. In this sense, points of time may be considered the lowest bound of Frame Time. A point in Frame Time is different from a point in Linear Time in that the former is treated in terms of temporal inclusion, while the latter is treated in terms of temporal precedence. Frame Time and Linear Time represent two different dimensions of the representation of time in natural languages.

3.4.2. SYNTACTIC FUNCTIONS OF FRAME TIME EXPRESSIONS

In the previous section, I have examined a number of temporal expressions and illustrated their semantic properties in representing Frame Time, but I have not had a chance yet to discuss the relation between their syntactic functions and their semantic representation of Frame Time. I focus on this question in the present section.

Temporal expressions as adverbials are generally classified into sentential adverbials and verb-phrase adverbials according to their

syntactical functions (Dowty 1979:323-36), as in (76) respectively.

(76) a. *Yesterday* John read a book.
b. John read a book *from 2:00 to 3:00.*

In (76), it seems that in English the temporal adverbials that occur in sentence-initial positions are sentential and those that occur in verb phrase positions are verb-phrase adverbials. However, mere syntactical positions may not provide a complete picture, as shown in (76'), where *yesterday* is moved to the non-sentence-initial position, while *from 2:00 to 3:00* is moved to the sentence-initial position.

(76') a. John read a book *yesterday.*
b. *From 2:00 to 3:00,* John read a book.

Is *yesterday* still a sentential adverbial? Is *from 2:00 to 3:00* a sentential adverbial? In his treatment of adverbials as frames, predicates of intervals and predicates of events, Parsons (1990:212) seems to take a semantic approach to a syntactical problem. Adverbials that semantically function as frames and predicates of intervals syntactically appear to be sentential adverbials, as in (76a) and (76').[12] *Yesterday* is a frame both in (76a) and (76'a), regardless of its positions. *From 2:00 to 3:00,* however, is a predicate of an event in (76b) and a predicate of an interval in (76'b). This suggests that some temporal adverbials like *from 2:00 to 3:00* are position-sensitive, while others like *yesterday* is not. However, Parsons concedes that he is not aware of any operational tests that distinguish them. Therefore, what is a sentential temporal adverbial and what is a verb-

[12] I treat temporal adverbials that function as frames and as predicates of intervals both as Frame Time adverbials, since my definition of Frame Time (62) holds for both of Parsons' types of adverbials.

phrase adverbial remain an open question for now. His problem, I think, lies in a semantic approach to a syntactical problem.

In Dowty's categorization, sentential temporal adverbials belong to the category (t/t), forming sentences from sentences, while verb-phrase temporal adverbials belong to the category (IV/IV), forming verb phrases from verb phrases. Such categorizations appear to be supported by syntactic tests like *do-so* pronominalization (cf. Binnick 1991:303). It is said that only syntactic items that belong to one constituent may be pronominalized in *do-so* pronominalization. This test suggests that the verb and the verb-phrase temporal adverbial may form one constituent, as in (78), compared with the sentences in (77).

(77) a. John ran *for an hour* and Bill *did so* for half an hour.
b. John ran for an hour and Bill for half an hour.
c. John ran for an hour and *Bill *did so* half an hour.
d. John ran for an hour and ?*Bill half an hour
(78) a. John *ran for an hour* and Bill *did so* too.
b. John *ran for an hour* and Bill *did* too.
c. John *ran for an hour* and ? Bill too.

(78) shows that *ran* and *for an hour* may constitute one constituent, though they do not have to be treated as one, as in (77). Thus, temporal adverbials like *for an hour* are supposed to be verb-phrase temporal adverbials. However, it is already noticed that sentential temporal adverbials such as *yesterday* may occur in verb-phrase position while verb-phrase temporal adverbials may occur in sentence-initial position (Binnick 1991:303-4), as in (76')

(76') a. John read a book *yesterday*.
b. *From 2:00 to 3:00*, John read a book.

The sentences in (76') are different from those in (76) in the positions of temporal adverbials. Do we say that *yesterday* becomes a verb-phrase temporal adverbial and *for an hour* becomes a sentential temporal adverbial? *Yesterday* seems to become a verb-phrase temporal adverbial, if *do-so* pronominalization test really reveals what it is supposed to, as indicated in (79).

(79) a. John read a book *yesterday*, and Bill *did so* too.
b. John read a book *yesterday*, and ?Bill too.

In (79), *read a book* and *yesterday* appear to form one constituent, when they undergo *do-so* pronominalization. I think that the *do-so* pronominalization test may not really tell the difference between sentential temporal adverbials and verb-phrase temporal adverbials, as it is expected.

I believe that the actual positions in a sentence may not matter much in English with regard to the categorizations, as long as a temporal adverbial is syntactically directly under an S node in terms of generative grammar. Here, I propose a frequency-adverbial test for the distinction between sentential temporal adverbials and verb-phrase temporal adverbials. Frequency adverbials as sentential adverbials are unproblematic in syntax. Frequency adverbials are treated as sentential operators in representing temporal relations in semantics (Åqvist, Hoepelman and Rohrer 1980, Richards 1982). Semantically, a temporal adverbial that has a wider scope than a frequency adverbial should be considered sentential. Syntactically, a temporal adverbial that is ordered outside the scope of a frequency adverbial should considered sentential. First, I show what temporal adverbials may appear within the scope of a frequency adverbial, as in (80) and (81).

(80) a. ?John ran *yesterday* ***twice***.
b. John ran *for an hour* ***twice***.
(81) a. ?John read a book *yesterday* ***twice***.
b. ?John read a book *in an hour* ***twice***.

The sentences in (80) and (81) indicate that only the *for*-temporal adverbial that functions as a predicate of an event may naturally occur with the scope of a frequency adverbial, as in (80b), while other temporal adverbials may not occur naturally within the scope of a frequency adverbial. Second, I show what temporal adverbials may occur outside the scope of a frequency adverbial, as in (82) and (83).

(82) a. John ran ***twice*** *yesterday* .
b. John ran ***twice*** *for an hour* .
(83) a. John read a book twice *yesterday* .
b. John read a book ***twice*** *in an hour*.

The sentences in (82) and (83) suggest that *for*-, *in*- and other temporal adverbials may all occur outside the scope of a frequency adverbial semantically as Frame Time adverbials. The test indicates that all those temporal adverbials may appear in the sentence-final position syntactically as sentential adverbials outside the scope of a frequency adverbial in English. However, a *for*-temporal adverbial is ambiguous when it occurs in the sentence-final position and there is no constituent between it and the verb phrase. In such a case, a *for*-temporal adverbial may function as a predicate of an event, if it is parsed as part of the verb phrase or function as a frame of Frame Time, if it is parsed as a constituent directly under the S node.

The above analysis provides a viable account for some observations concerning the interpretation of *for*-temporal adverbials. For example,

Dowty (1979:250-60) notes that the sentence in (84) has three interpretations, namely, a durative reading, an internal reading and an iterative reading, as in illustrated (84').

(84) The Sheriff of Nottingham jailed Robin Hood *for four years.*
(84') a. The Sheriff of Nottingham spent *four years* bringing it about that Robin Hood was in jail.
b. The Sheriff of Nottingham brought it about that Robin Hood was in jail *for four years.*
c. *For four years* the Sheriff of Nottingham brought it about several times that Robin Hood was in jail.

The durative reading (84'a) and internal reading (84'b) are irrelevant here, since they involve the different interpretations of the verb *jail*, where the temporal adverbial is a verb-phrase temporal adverbial. When a *for*-temporal adverbial functions syntactically as verb-phrase temporal adverbial, the *for*-temporal expression represents temporal relations within Situation Time, involving the temporal duration of an event or activity in question, as in (84'a) and (84'b), and involving perfective and imperfective interpretations.[13] That is what Parsons (1990) calls 'predicate of event'. In (84'c), the temporal adverbial *for four years* functions syntactically as a sentential adverbial in the sentence and semantically as a frame of Frame Time so that it allows a 'reduced' frequency adverbial with the scope of the *for*-temporal adverbial. This is how the iterative reading arises in (84'c).

Now I look at *for*-expressions as sentential in relation to the formal definition of Frame Time in (62) and formal properties of Frame Time in

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[13] *For*-temporal expressions as verb-phrase temporal adverbials representing Situation Time are seen in the following sentences, where perfective readings (i) and imperfective readings (ii) are concerned. This topic will be fully treated in Chapter Four.

(i) John read a book. (John finished reading it.)
(ii) John read a book *for an hour.* (John did not finish reading it.)

(64) and (67). Does a *for*-temporal expression exhibit the properties of Frame Time defined in (64) and (67) when it functions as a sentential temporal adverbial and as a frame of Frame Time? I answer this question with an observation of the entailment relations in the sentences in (85).

(85) a. John walked at 8 o'clock on Tuesday morning.
b. John walked at 8:30 on Tuesday morning.
c. John walked twice *for an hour* on Tuesday morning, .
d. John walked Tuesday morning.

(85a), (85b) and (85c) all entail (85d). (85a) and (85b) together imply (85c). This kind of entailment relation exists, because the temporal relations in (85) exhibit the properties of Frame Time, as illustrated in (86).

(86) a. ($f_1 \in f_2 \in F$), where f_1 = 8 o'clock, f_2 = an hour, F = Tuesday morning.
b. ($f_1 \in f_2 \in F$), where f_1= 8:30, f_2= an hour, F= Tuesday morning.
c. ($f_1 \in f_3 \in F$ & $f_2 \in f_3 \in F$), where f_1= 8 o'clock, f_2= 8:30, f_3= an hour, F=Tuesday morning.
d. ($f_1 \in F$), where f_1 = some time, F= Tuesday morning.

(86) characterizes the temporal inclusion relations in the sentences in (85), where smaller intervals of time are temporally included in a frame of Frame Time. The entailment relations that build on the temporal inclusion relations can not be reversed, as stated in (67). Thus, it is predictable that reverse entailment relations do not exist in the sentences in (85).

I have shown that in English Frame Time expressions function syntactically as sentential temporal adverbials, while sentential temporal adverbials function temporally as frames of Frame Time. This point is best illustrated with the *for-temporal* expression which usually functions

syntactically as verb-phrase temporal adverbials in representing Situation Time but which may function syntactically as sentential temporal adverbial in representing frames of Frame Time.

In Chinese, sentential temporal adverbials occur in preverb or sentence-initial positions only, while verb-phrase adverbials show up in post-verb positions only.[14] Syntactically sentential temporal adverbials may appear in the immediately preverb position, as in (87a), or in the sentence-initial position, as in (87b).

(87) a. Zhangsan *yi xiaoshi* kan le yi ben shu.
Zhangsan one hour read Asp. a C. book
Zhangsan read a book in an hour.
b. *Yi xiaoshi* Zhangsan kan le yi ben shu.
One hour Zhangsan read Asp. one C. book
Zhangsan read a book in an hour.

It is straightforward in Chinese that sentential temporal adverbials uniformly occur in pre-verb positions, and only those kinds of Frame Time expressions that I list in (68) and (69) may grammatically occur in pre-verb positions.

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[14] Verb-phrase temporal adverbials appear in two forms: as object modifiers and as unaccusative object , as in (i) and (ii).

(i) Zhangsan kan le *yi xiaoshi de* shu.
Zhangsan read Asp. one hour M(odifier) M(arker) book.
Zhangsan read one hour's book (Zhangsan read a book for an hour).

(ii) Zhangsan kan shu *kan le yi xiaoshi.*
Zhangsan read book read Asp. one hour
Zhangsan read the book for an hour.

Their syntactic and temporal functions are more straight forward, as I will discuss in detail in section 4.3.

3.5. SUMMARY OF CHAPTER THREE

In this chapter, I have examined two dimensions of the temporal structure in natural languages, namely, Linear Time and Frame Time. Linear Time represents temporal orders or locations along a temporal line, focusing on precedence relations. Frame Time represents temporal inclusion relations, though it has a temporal order aspect. Each dimension of these temporal relations has its formal properties. Temporal order relations in Linear Time are transitive and have converses, as formally defined in (10) and (13). Temporal inclusion relations in Frame Time are transitive but the entailment relations with temporal inclusion underpinning can not be reversed, as formally defined in (64) and (67). In other words, the difference in the formal properties between Linear Time and Frame Time leads to completely different inferential patterns in these two dimensions of temporal relations in natural languages.

In English, Linear Time is linguistically represented by tenses, the perfect and temporal adverbials, only the first forms are grammaticalized representations of Linear Time. In Chinese, Linear Time is linguistically represented by temporal adverbials and two 'aspect' markers, where the latter forms are grammaticalized representations of Linear Time, while the former forms are not. Both may function as tense markers, the latter of which appear to behave more like tense markers than aspect markers, regardless of the claim that Chinese is a tenseless language. Chinese sentences are definitely not used in a tenseless way, though some of them do not have any degree of grammaticalization of temporal relations in Linear Time. Approaches that use tenseless sentences in capturing their truth conditions are challenged (Bennett and Partee 1978). The evidence that Chinese is not used in a tenseless way may support this challenge, since

the use of tenseless sentences in philosophical and linguistic study appears to be justified by the belief that some natural languages like Chinese are indeed used in a tenseless manner.

Frame Time is linguistically represented by Frame Time expressions which are interval-referring temporal expressions, as listed in (68) and (69). Frames of Frame Time have both upper bound and lower bound. Their upper bound is the largest frame of Frame Time that is denoted by a Frame Time expression, while its lower bound can be as small as point of time. Syntactically, the upper bound and the lower bound exhibit a modifying-and-modified relationship, as in *at 8 o'clock in the morning*, where *in the morning* modifies *8 o'clock*. In terms of syntax, Frame Time expressions function as sentential temporal adverbials in both English and Chinese, though the syntactic function of a *for*-temporal phrase is ambiguous in English. Frame Time expressions as sentential temporal adverbials exhibit certain scope properties, which has implications for approaches that treat temporal adverbials and tenses as sentential operators, and that treat Frame Time as Situation in interval semantics.

Chapter Four
SITUATION TIME

4.0 INTRODUCTION

Philosophical studies of actions have generally ignored the temporal properties of action, as I have discussed in sections 1.1 and 1.2.. For example, Aristotle studied actions in terms of process, change and goal in relation to verb categories, without any explicit reference to the notion of time. In modern analyses of tense and aspect, for instance, Reichenbach (1947:287-98) assumes, without examination of the temporal properties of actions, that events play a role in his famous tense theory that consists of speech time, event time and reference time. Thus, his tense theory has unwanted consequences, as I have discussed in section 3.1. In section 2.1.1, I have pointed out that it is Vendler (1957, 1967) who first made explicit reference to the notion of time with supporting linguistic evidence in his study of verbs. In this chapter, I will follow Vendler's tradition in studying the temporal properties of verbs by examining linguistic evidence regarding those properties and with explicit reference to the notion of time. On the other hand, I will study the role of events, or more generally, of situations in temporal representation in language, though I will not make assumptions as Reichenbach (1947) did. I will not simply assume the existence of time involved in linguistic representation of actions, activities, processes and states, but support its existence with linguistic evidence. Following Comrie (1976) and Smith (1991), I will use 'situation' as a

general term for 'event', 'activity', 'process' and 'state' that are denoted by verbs or verb phrases, since I do not limit my study to action verbs. With focus on the notion of time, I consider a situation as an instantiation of temporal properties, following Gabbay & Moravcsik (1980). Thus, I will use 'Situation Time' in making reference to the temporal properties of a situation.

In philosophical and logical studies, there are three ways to treat the assignment of denotations of verbs and nouns (Gabbay & Moravcsik 1980:60): i) verbs denote situations and nouns denote objects with a problem of how to link the two domains; ii) situations that are denoted by verbs are the basic domain and objects that are denoted by nouns function as modifications of situations; and iii) objects that are denoted by nouns are the basic domain and verbs denote properties of objects. I will study verbal denotations in the spirit of the second approach: situations denoted by verbs are the basic domain and objects denoted by nouns function as modifiers, though I will not work on a formal apparatus in the representation of this relation. As a result, I will study verbal reference to situations, how situations are bound or nonbound in time and what objects temporally bind a situation and what objects do not temporally bind a situation. Further, I assume that situation boundaries are Situation Time boundaries, since situations are instantiations of temporal properties. I will examine the relationship between temporal properties of situations and verb categories. I believe that verb categories depend on the temporal structures of the situations involved, if verbs refer to situations. By doing this, I assume that the questions in (2a), (2b) and (2c) are answered.

In this study, the referential functions of verbs and verb phrases are considered inherent properties, while the quantification interpretation

involved is considered a noninherent property of verbs and verb phrases. I believe that this is important in considerations of temporal properties of situations.

Finally, I will define Situation Time and show how it is logically different from the other two dimensions of the representation of time: Frame Time and Linear Time. I will demonstrate that inferential relations between sentences should be considered in terms of part-and-whole relations.

4.1 SITUATION TIME: THE THIRD DIMENSION OF TIME

Intuitively we know that a verb or verb phrase refers to an action, activity, process or state and that an action, activity, or process takes a certain period of time and that a state holds for a certain period of time. Reichenbach (1947) refers to this time as the 'point of the event', which he assumes to be nondurative in his tense theory, but seems to treat it as durative with respect to aspect. Parsons (1989, 1990) refers to this time as 'event', while Smith (1991) refers to it as 'situation'. In this chapter, I consider this time 'Situation Time', as an instantiation of temporal properties. Instead of following Reichenbach's assumptions, I am concerned with the existence of situations and the temporal nature of situations, as represented in linguistic forms, in this section. First, I will try to answer the question 'Do verbs or verb phrases refer to situations in the same way that nouns or noun phrases refer to objects ?'. Second, I will try to explore the temporal nature of situations as whether they are instantaneous, durative, bound or nonbound.

4.1.1 NOMINALIZATION AND REFERENCE TO SITUATIONS

Verbs and verb phrases refer to situations in the same way that nouns and noun phrase do to objects. This view is explicit or implicit in some studies (cf. Davidson, 1968, 1980, Parsons 1985, 1989, 1990, Smith 1991). Evidence for verbal reference to situations is more clearly seen in the nominal use of verbal forms, as in (1), where verbal forms have similar referring functions as nouns do (cf. Parsons 1990).

(1) a. *Swimming* is an interesting sport.
b. *To walk* alone is dangerous.

In English, some verbs have morphological nominal forms as in (2) below, whereas in Chinese there is no morphological change between a verb as a verbal predicate and a verb as a nominal term.

(2) a. to destroy --> destruction
b. to move --> movement

The relationship between nouns and verbs has been a major question in syntactic studies at least since Chomsky's work in nominalization (1970), but little has been agreed upon about the similarities and differences with respect to the syntactic properties such as the argument structure and theta theory, probably except for case theory (cf. Grimshaw 1990:45-6). I will discuss only the referential properties of nominalization here. In nominal reference to situations, verbal forms in nominal use share a number of features with nouns in quantification interpretation. First, bare verbal forms in nominal use may have a generic interpretation as bare nouns do (cf. Carlson 1977), as shown in (3) on the next page.

(3) a. *Skiing* is popular.
b. *Dogs* are popular.

The nominal *skiing* refers to situations of skiing in general in (3a), and the noun phrase *dogs* refer to dogs in general too in (3b). Secondly, verbal forms in nominal us have an indefinite interpretation as nouns do, as in (4).

(4) a. *Skiing* was interesting last summer.
b. *A dog* was barking last night.

In (4), the nominal *skiing* does not refer to a particular situation of skiing, nor does the noun phrase *a dog* refer to a particular dog. Thirdly, verbal forms in nominal use have definite interpretations as nouns do, as in (5).

(5) a. *Swimming yesterday with my girlfriend* was fun.
b. *The dog with spots* was in the yard.

In (5), the nominal *swimming yesterday with my girl friend* refers to a particular situation of swimming, and the noun phrase *the dog with spots* refers to a particular dog.

In Chinese, nominal reference of verbs to situations is more straight forward. Nominalization adds nouns of behavior, activity, action, state or thing to a sentence that is nominalized, as in (6).

(6) a. Zhang sheng bing de *qingkuan*
John be ill Part(icle). situation/state
(the state of) John's being ill
b. Zhang youyong de *shi*
John swim Part. thing
(the activity of or thing of) John's swimming
c. Diren huimie zhege chengzheng de *xingwei*
enemy destroy this city Part. behavior
(the behavior of) the enemy's destruction of the city

The italicized nouns in (6) directly refer to the situations that those nominalized sentences refer to. The noun *shi* (thing/state) is most commonly used, though others may be used depending on the situation.

On the other hand, verbal forms in nominal use share a number of features with verbs in sentences in terms of modification. The exact syntactic nature of nominalization of verbs may still remain an open question (cf. Newmeyer 1986:107-110), but evidence that both nominals and verbs refer to situations appears to be very strong. Regardless of the controversy on the syntactic nature of nominalization, event structures are believed to underlie the relationship between nominals and verbs (cf. Grimshaw 1990, Parsons 1990:72). Thus, the structure of a nominal and that of a verb in a sentence are supposed to represent the structure of an event or situation. For example, verbal forms in nominal use share with verbs or verb phrases a number of features with respect to modification. First, verbs in both nominal use and predicative use may take nouns as modifiers. For example, they both take nouns as Agent, as in (7).

(7) a. *John*'s swimming
b. *John* swam.

John is the Agent both in (7a), where *swimming* is a nominal, and in (7b), where *swim* is a predicate of a sentence. Second, nominals and verbs both take noun phrases as Patient or Theme, as in (8).

(8) a. the enemy's destruction of *the city*
b. The enemy destroyed *the city*.

The noun phrase *the city* is considered to be the Theme in both (8a) and (8b). Third, nominals and verbs both take adverbials of time, as in (9).

(9) a. John's swimming *yesterday*
b. John swam *yesterday.*

Yesterday is the temporal adverbial in the nominal phrase in (9a) and in the sentence in (9b). Fourth, both nominals and verbs may take other phrases as modifiers, as in (10) and (11).

(10) a. John's swimming *across the river*
b. John swam *across the river.*
(11) a. John's swimming across the river *with a life-preserver*
b. John swam across the river *with a life-preserver.*

In (10), the prepositional phrase *across the river* functions as the adverbial of Path in the nominal phrase and in the sentence as well. On the other hand, the prepositional phrase *with a life-preserver* is the adverbial of Instrument in the nominal in (11a) and in the sentence in (11b).

In short, I have discussed two pieces of evidence that verbs refer to situations in the same way that nouns do to objects. First, verbal forms in nominal use share with nouns some common features in quantification interpretations with respect to reference. Second, verbal forms as nominals share some common features with verbs as predicates with respect to modification because of the structure of situations that they both refer to.

4.1.2 SITUATIONS AND THEIR TEMPORAL PROPERTIES

The time of the event or situation is treated as nondurative and is not considered to show a lot of temporal properties in Reichenbach's (1947) tense theory. On the other hand, situations are considered instantiations of temporal properties in Gabbay and Moravcsik (1980). Linguistic evidence indicates that situations exhibit a range of temporal properties. Situations that are denoted by verbs may be instantaneous or durative, the latter of

which may be with or without gaps, and may be bound (telic) or nonbound (atelic) (cf. Binnick 1991:189-97, Dahl 1981, Smith 1991). I will examine relevant linguistic evidence regarding situations that exhibit those temporal properties.

First, some verbs denote instantaneous situations. This category of verbs covers what Vendler (1957, 1967) calls 'achievement' verbs. I will refer to this category of verbs as 'instantaneous' verbs, since I am concerned with the temporal properties of verbs, but not concerned with theories of actions. The temporal properties of the situation denoted by an instantaneous verb is seen in the relationship between that verb and some Frame Time adverbials (cf. Vendler 1957, 1967). In section 3.3, I have discussed the upper and lower bounds of Frame Time, and shown with linguistic evidence that the lower bound can be an instant of time as represented by Frame Time adverbials such as *at six o'clock* in English or *liudian* (six o'clock) in Chinese. A verb that denotes an instantaneous situation can occur with a Frame Time adverbial that denotes an instant of time or an interval of time, as shown in (12), which are in the non-progressive form with a reportive reading.

(12) a. John noticed the cat *at six o'clock.*
b. John noticed the cat *yesterday.*

In (12a), the verb *notice* may cooccur with the Frame Time adverbial *at six o'clock* which denotes an instant of time. In (12b), at the same time, it may also cooccur with the Frame Time adverbial *yesterday*, which denotes an interval of time, since an instant of time may be temporally included in an interval of time. Instantaneous verbs may cooccur with temporal adverbials as long as they represent Frame Time. Dowty (1979:58) notes that *notice*

may not cooccur with a temporal adverbial with *for*, as in (13a), though he does not elaborate on an account for it.

(13) a. ??John noticed the cat *for a few minutes.*
b. John noticed the cat twice *for a few minutes.*

However, (13b) is acceptable with the repetition interpretation marked by the frequency adverbial *twice* (cf. Dowty 1972, Carlson 1979:421-2). A temporal adverbial phrase with *for* has two functions: it may represent Frame Time and it may be predicated of Situation Time, as I have argued in section 3.4.2. The verb *notice* denotes an instantaneous situation, while the adverbial phrase *for a few minutes* denotes an interval of time. The sentence is unacceptable if *for a few minutes* functions as what is called 'event predicate' (cf. Parsons 1990:212).[1] The sentence is acceptable if *for a few minutes* function as a Frame Time adverbial, as in (13b), where the function of the *for*-phrase is disambiguated by inserting a frequency or count adverb like *twice* between the verb phrase and the *for*-phrase for reasons that I have raised in section 3.4.2. The above evidence indicates that verbs that denote instantaneous situations take Frame Time adverbials but not situation-predicate temporal adverbials. This distinction is a better criterion than the traditional progressive form test (cf. Dowty 1979, Kenny 1963, Vendler 1967), since the progressive form may be used with some instantaneous verbs, as in (14).

(14) a. John is arriving at the station at six o'clock.
b. John is coming at six o'clock.

[1] I may refer to an event predicate as a situation predicate, and regard it as representing Situation Time, as I argue in section 4.3 below.

Those verbs in the progressive in (14) denote situations that are temporally different from the ones normally denoted by instantaneous verbs. The progressive forms in (14) may represent future tense, and may refer to situations that form a chain of situations, in which case the progressive forms refer to non-resultative part of the chain, whereas the non-progressive form refers to the resultative part of the chain (cf. Binnick 1991, Dowty 1979, McGilvray 1991:252-4, Parsons 1990, Smith 1991:33-6). Therefore, this usage is limited to verbs that may denote a chain of situations, and is not acceptable with verbs that do not refer to a chain of situations, as in (15)

(15) a. ??John is spotting a bird at six o'clock.
b. ??John is discovering a bird at six o'clock.

(15) are not acceptable as sentences in future tense nor as sentences in the progressive aspect, since those verbs are instantaneous verbs and do not refer to the initial part of a chain of situations. It is clear that whether a verb can occur in the progressive form is not determined by temporal properties only of that verb, but rather by other properties in addition, at least in English. Thus, progressive form is not a reliable test of the temporal properties of a verb.

Second, some verbs denote situations that are durative. These verbs include Vendler's activity verbs, accomplishment verbs and state verbs. I will refer to these verbs as 'durative' verbs for the same reason as stated above. Traditionally, a verb that denotes a durative situation is supposed to be able to occur in the progressive form, but it is also noted that state verbs may not occur in the progressive form, as in (16), though they denote durative situations (cf. Dowty 1979:55-60, Kenny 1963, McGilvray

1991:245-55, Vendler 1967).

(16) a. ??John is knowing the answer.
b. ??John is understanding me.
(17) a. John is a fool.
b. John is being a fool.
(18) a. The desk is square.
b. ??The desk is being square.

Of course, there is the idiosyncrasy in the usage of verbs. For example, the verb phrase *be a fool* in (17a) refers to a state, but it may also appear in the progressive form, while the verb phrase *be square* in (18a) also refers to a state but can not occur with the progressive form in (18b) (cf. McGilvray 1991:255). The use of progressive forms involves other aspect of theories of actions, such as agency and dynamics, which are not temporal properties.

Thus, I think that the relationship between verbs and temporal adverbials is a better indicator of whether a verb denotes a durative situation or not. For example, in contrast to instantaneous verbs, durative verbs in non-progressive forms do not cooccur with a Frame Time adverbial denoting an instant of time, since such verbs refer to situations that are durative, as in (19) and (20).

(19) a. John ran *yesterday*.
b. ?John ran *at six o'clock*.
(20) a. John read a book *yesterday*.
b. ?John read a book *at six o'clock*.

(19b) and (20b) are unacceptable, if a completive reading is not available. In English, this seems to be unlikely with most of the durative verbs. In some Mandarin dialects, a completive reading may be forced upon durative verbs in such sentences, though there is a completive marker, as in (21).

(21) a. Zhang *liu dian* kan *wan* le yi ben shu.
John six o'clock read Asp. Tns. one M book
John finished reading a book at six o'clock.
b. ?Zhang *liu dian* kan le yi ben shu.
John six o'clock read Asp./Tns. one M book
John finished reading a book at six o'clock.

(21a) has a completive marker *wan* and a completive reading, whereas (21b) does not have a completive marker but still has a completive reading, which is acceptable to some speakers. Thus, a Frame Time adverbial denoting an instant of time may force a completive reading in Chinese. In addition, durative verbs may cooccur with temporal adverbials functioning as situation predicates, as in (22a), but instantaneous verbs may not cooccur with temporal adverbials functioning as situation predicate, as in (22b).

(22) a. John ran *for half an hour.*
b. ??John arrived *for half an hour.*

Situation predicates denote a period of time. Thus, situation predicates can only modify a verb denoting a durative situation.

Third, some verbs denote situations that are considered to have gaps, and, on the other hand, other verbs refer to situations that are believed not to have gaps (Binnick 1991:180-2, Gabbay & Moravcsik 1980, Mourelatos 1981). For example, (23a) is considered to denote a situation with gaps, while (23b) refers to a situation without gaps.

(23) a. John read a book from Monday to Wednesday.
b. John was sick from Monday to Wednesday.

It is said that John could not be reading every minute within those three days, whereas John might be sick every minute within those three days.

Thus, (23a) does not entail that John was reading at each and every subinterval of those three days, but (23b) does entail that John was sick at each and every subinterval of those three days (cf. Binnick 1991:181-8, Gabbay & Moravcsik 1980). I want to argue that such an analysis is based more on extralinguistic evidence than on linguistic evidence. Such an analysis can not guarantee that (23a) is not true at each and every subinterval of those three days nor does it guarantee that John was sick at each and every subinterval of those three days. For example, we may have a scenario in which John is one of those Buddhist monks studying Buddhist scripts without sleeping and eating for quite a long time. If (23a) refers to this situation, then it could be true that John was reading at each and every subinterval of those three days. Similarly, we may have a scenario in which John had some stomach trouble on Monday and recovered, had a headache on Tuesday and recovered, and had something else on Wednesday and recovered. If (23b) refers to this situation, it is not necessarily the case that John was sick at each and every subinterval of those three days, though it is true that John was sick from Monday to Wednesday. To provide a viable account of these differences, I think that we need an analysis based on the distinction between Frame Time adverbials and situation predicates. I informally represent the distinction in terms of syntactic positions in (24), with the capital letters as a metalanguage to represent the difference, where Frame Time adverbials appear in the sentence-initial position while a situation predicate occurs at the verb phrase position, .

(24) a. FROM MONDAY TO WEDNESDAY, John read a book.
a' John read a book FROM MONDAY TO WEDNESDAY.
b. FROM MONDAY TO WEDNESDAY, John was sick.
b' John was sick FROM MONDAY TO WEDNESDAY.

Linguistically speaking, (23a) has two interpretations as in (24a) and (24a'). When the temporal adverbial in (24a) functions as a Frame Time adverbial, (24a) allows the interpretation of a series of (sub)situations. Therefore, it is not true that John was reading a book at each and every subinterval of those three days, according to (24a). (24a) denotes a situation with the so called gaps, in which we find a layman John. However, the temporal adverbial in (24a') functions as a situation predicate and is a representation of Situation Time. Thus, (24a') allows the interpretation of a continuous situation. It is true that John was reading a book at each and every subinterval of those three days, according to (24a'). (24a') refers to a situation without gaps, in which we find a Buddhist John. (23b) has two interpretations too, as in (24b) and (24b'). The analysis of (23a) applies to (23b). The temporal adverbial functions as Frame Time in (24b), and an interpretation of a series of situations is available. In contrast, the temporal adverbial functions as situation predicate in (24b'), and only an interpretation of a continuous situation is available. Given this analysis, gaps are taken to mean the boundaries between (sub)situations.

In English, *in*-temporal adverbials and *for*-temporal adverbials seem to exhibit completely different functional behavior to gaps. *In*-temporal adverbials function as Frame Time adverbials that require verbs to denote bound situations, as in (26a). Thus, the verb *walk* which refers to an unbound situation can not cooccur with *in an hour*, as in (26b).

(26) a. John wrote a letter in an hour.
b. *John walked in an hour.

In addition to its function as a situation predicate, on the other hand, a *for*-temporal adverbial may function as a Frame Time adverbial which requires

a multi-gap interpretation, as illustrated in (27).

(27) a. ?John read the letter *for a whole day.*
b. John read the letter again and again *for a whole day.*

For a whole day in (27a) can not function as a Frame Time adverbial without an explicit expression to indicate multi-gaps, but can do so in (27b) with an explicit expressions to indicate multi-gaps. Thus, gaps are accounted for by the distinction between Frame Time adverbials and situation predicates, instead of extralinguistic evidence regarding situations. Linguistically, gaps appear to be represented between situations as situation boundaries but not within situations. This explains some of the observations of the *in*-temporal expressions and *for*-temporal expressions in English.[2]

Finally, verbs are observed to refer to situations that are temporally bound (telic) and nonbound (atelic) (cf. Binnick 1991:179-83, Dahl 1981, Dowty 1979, Smith 1991:28-33, Vendler 1967). As I have discussed above, situations are either durative or instantaneous. Only durative situations appear to exhibit temporal properties of boundness and nonboundness. In Vendler's categorization, verbs that denote bound situations are called 'accomplishment' verbs, as in (28a), while verbs that denote nonbound situations are called 'activity' verbs, as in (28b).

(28) a. John read a book.
b. John ran.
(29) a. John was reading a book.
b. John was running.

In (28a), the situation is said to have an inherent beginning and ending in its

[2] In section 3.4.2, I have presented a detailed discussion on *for*-temporal expressions as Frame Time Adverbials from a syntactical perspective.

temporal structure, when one starts to read a book and finishes reading a book. In (28b), on the other hand, the situation is not considered to have an inherent beginning and ending in its temporal structure, when one runs. In the literature on this topic, the distinction is made on the basis that (29a) does not imply (28a) so that the verb phrase denotes a bound situation, whereas (29b) implies (28b) so that the verb phrase refers to a nonbound situation.[3]

Syntactically, the distinction between boundness and nonboundness is shown in the cooccurrence of verbs and Frame Time adverbials. It is observed that *in*-temporal adverbials can cooccur with verbs denoting bound situations but not cooccur with verbs denoting nonbound situations, as shown in (30).

(30) a. John read a book *in an hour.*
b. *John ran *in an hour.*

The verb phrase *read a book* refers to a bound situation so that (30a) is acceptable. On the other hand, the verb *ran* refers to a nonbound situation and can not cooccur with in-temporal expression.

Semantically, the distinction between boundness and nonboundness is seen in the logical behaviors of sentences with these two types of verbs. For example, (29a) does not entail (28a), whereas (29b) entails (28b). This does not seems to be determined by extralinguistic reality of situations, but rather by the way situations are viewed and represented in language. Given a situation, we may describe it in (31a) or in (31b).

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[3] This approach has problems and makes incorrect prediction in verb categorization, as I will shown in section 4.4.

(31) a. John is reading a book.
b. John is reading.
(32) a. John has read a book.
b. John has read.

(31a) does not entail (32a), though (31b) entails (32b). This further suggests that bare verbs refer to more general situations and may be modified to denote more specific situations. Further examples in this regard are seen in the phenomenon of 'verb class switch or shift' (Dowty 1979:62-4, Vendler 1967:101-2, Vlach 1981:276-7, Zhou 1991). A verb that usually denotes an nonbound situation may be modified to refer to a bound situation, as shown in (33) and (34).

(33) a. John ran.
b. John ran two miles
(34) a. John walked.
b. John walked to the store.

Two pieces of evidence show that (33b) and (34b) behave like any other verbs that refer to bound situations. First, (33b) and (34b) may cooccur with *in*-temporal expressions as Frame Time adverbials, as in (33b') and (34b'), though (33a) and (34a) can not, as in (33a') and (34a').

(33') a. *John ran *in an hour.*
b. John ran two miles *in an hour.*
(34') a. *John walked *in an hour.*
b. John walked to the store *in an hour.*

Second, there are different entailment relations between sentences in the progressive forms and sentences in the non-progressive forms with respect to reference to bound situations and nonbound situations. For example, (35a) does not imply (33b), nor does (35b) imply (34b).

(35) a. John is running two miles.
b. John is walking to the store.

The above evidence indicates that verbs that denote bound situations exhibit syntactical and logical behaviors different from those of the verbs that refer to nonbound situations.

In short, I have discussed inherent temporal properties of situations like instantaneousness, duration, gaps, boundness and nonboundness, as are represented linguistically in English and Chinese. Based on temporal properties, verbs may be categorized as instantaneous verbs and durative verbs, the latter of which may further classified as bound and nonbound durative verbs.

4.2 QUANTIFICATION AND SITUATIONS

In a comparison of reference to situations by verbs and reference to objects by nouns in section 4.1.1, I have shown that they share a number of features in terms of quantification. Reference to situations by verb phrases may have generic interpretations, definite and indefinite interpretations exactly as reference to objects by noun phrases. As I have argued in section 4.1.1, bare verbs refer to more general situations as bare nouns do to objects (cf. Carlson 1977), while object noun phrases, subject noun phrases, temporal adverbials, etc. modify bare verbs so that they may refer to more specific situations, as reviewed here in (36).

(36) a. John reads.
b. John reads *a book.*
c. John read *a book every evening in those days.*
d. John read *a book yesterday evening.*

It is apparent that (36a) refers to a most general situation among the four

in (36); (36b) refers to a more specific situation than (36a) does but less specific than (36c) and (36d) do; (36c) refers to a situation less general than those in (36a) and (36b) but less specific than (36d) does; whereas (36d) refers to the most specific situation. This is discussed in Dowty (1979:84-88) in terms of the distinction between universal and existential interpretations, following a discussion on this topic by Carlson (1977). The object noun phrase in a verb phrase appear to play an important role in quantification interpretation.[4]

However, I am mainly concerned with the distinction between inherent and noninherent temporal properties of boundness and nonboundness of situations denoted by verbs phrases. By inherent temporal properties, I mean verbs or verb phrases referentially designate boundness and nonboundness of situations, as I have discussed in section 4.1.2. By 'noninherent' temporal properties, I mean the effects of quantification interpretation on boundness and nonboundness of situations. I will discuss how quantification interpretation will affect the temporal properties of inherently bound situations in section 4.2.1. In section 4.2.2, I will show the relationship between quantification interpretation and inherently nonbound situations.

4.2.1 INHERENTLY BOUND SITUATION AND QUANTIFICATION

Carlson (1977) argues for two types of predicates: individual and stage, the former of which is of permanent nature while the latter of which is temporally bound in nature. Carlson (1977:448) thinks that stages are

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[4] Hoop (1992) considers the relation between noun phrase interpretation and grammatical cases, and argues that the interpretations of object noun phrases are related to cases and weak case is related to verbs denoting nonbound situations while strong case is related to verbs referring to bound situations.

conceived of as being more related to events (i.e., bound situations). There are a few examples involving the interpretation of object noun phrases in Carlson's work, as in (37), though he is more concerned with bare plurals and other noun phrases grammatically functioning as subjects in sentences.

(37) a. John repairs a car for a living.
b. John repaired a car yesterday.

In (37a), *a car* has a generic interpretation and does not refer to a particular car. Thus, the verb phrase *repairs a car for a living* is considered an individual predicate. On the other hand, *a car* in (37b) has a specific interpretation and denotes a particular car. Therefore, the verb phrase *repaired a car* is considered a stage predicate. Carlson's study clearly suggests that there is a relationship between the quantification interpretation and temporal properties of situations, though Carlson's attention is not on the topic of time. I think that the difference between generic and specific interpretations lies in referentiality in the sense of Fodor and Sag (1982), since the indefinite expression in (37a) does not have a referential reading while that in (37b) does. Referentiality appears to be important in reference to bound and nonbound situations. The repairing of a particular car takes a definite interval of time, whereas the repairing of a nonparticular car does not take a definite interval of time.

A noun phrase with a generic interpretation appears to be universal, but it is not exactly universal (Allan 1986:136-7). Regardless of the differences, the scope phenomenon between universal interpretation and existential interpretation is seen to be involved in temporal properties of situations (cf. Carlson 1977:419, Dowty 1979:), as shown in (38) on the next page.

(38) Every student read a book on linguistics.
(39) a. (∀x)(S (x)-->(∃y) (B (y) & x read y))
b. (∃y)(∀x) (B(y) & (S(x)-->x read y))

Two interpretations are available for the sentence in (38): the universal quantifier has a wide scope and the existential quantifier has a narrow scope, as in (39a), or the universal quantifier has a narrow scope and the existential quantifier has a wide scope, as in (39b). (38) with the interpretation in (39a) seems to denote a nonbound situation involving reading one or some book on linguistics, while (38) with the interpretation in (39b) appears to denote a bound situation involving reading a particular book. In the interpretation of (39a), it is unclear how the reading is carried out temporally, while in the interpretation of (39b), there is a sequence of single events of reading the book in question and there is a beginning and end of each reading and of this sequence. In English, this distinction is not morphologically or syntactically clear. However, in Russian where the perfective occurs with verbs denoting bound situations and imperfective with verbs referring to nonbound situations, the perfective can only occur in a sentence with the interpretation of a sequence of single events, as in (39b), but not in a sentence with the non sequential interpretation, as in (39a), in relation to universal quantification (cf. Merrill 1985). This seems to suggest that referentiality indeed plays a role in the boundness and nonboundness distinction, where scopes of universal and existential quantifiers are involved.

If referentiality underlies the effects of interpretation of noun phrase quantification on the distinction between bound and nonbound situations, it may explain the interpretation of bare nouns as object noun in a verb phrase. Bennett (1981:22-8) observed that the verb phrase in (40a)

functions like an activity verb while that in (40b) does not, regardless of the fact that the verb phrase *build a house* inherently denotes a bound situation.

(40) a. John is building *houses*.
b. John is building two houses
(41) a. John has built *houses*.
b. John has built one house.

These two sentences logically behave differently. Bennett (1981:22) pointed out that (40a) implies (41a) but (40b) does not imply (41b). Bennett tried to provide truth conditions for sentences like (40a) and (40b) in interval semantics to account for the semantic difference, but failed to explain what underpins the intervals and subintervals. I think that a more explanatory account of (40a) and (40b) lies in referentiality. The bare noun *houses* in (40a) has a generic interpretation, where the noun *houses* does not refer to any particular group of houses (cf. Carlson 1977). It is in this interpretation that (40a) may imply (41a). If the noun *houses* in (40a) refers to a particular group of houses, say John is in charge of a housing development project in a suburb, John may not have finished building any houses in the project, though he is building houses. Referentiality underlies the logic behavior of (40b), in which *two houses* refer to particular houses so that (40b) does not imply (41b).

In short, verbs that denote inherently bound situations may refer to nonbound situations when the object noun phrase has a nonreferential interpretation. Thus, referentiality is related to temporal properties represented in natural languages.

4.2.2 INHERENTLY NONBOUND SITUATIONS AND QUANTIFICATION

Quantification plays a role in the bound-nonbound distinction in the interpretation of inherently nonbound situations as well. Link (1983) proposes in his theory of plurality that some verbs may contribute a distributive reading while other verbs may contribute a collective reading, as illustrated in (42).

(42) a. The children built the raft.
b. The children read a book.

(42a) involves what is called collective predication, where it is understood that the children built the raft collectively. On the other, distributive predication is seen in (42b), which means that each child read a book. I will refer to verb phrases like *build the raft* as 'collective predicates' and to verb phrase like *read a book* as 'distributive predicates'. In fact, (42b) is ambiguous between a collective reading and a distributive reading. Thus, (42b) may mean that the children read a book together in its collective reading, which refers to a bound situation. Even in its distributive reading, (42b) may either refer to bound situations in which each child read the same book one after another or refer to nonbound situations in which each child read a different book. In his study, Link is more concerned with the interpretation of the plural terms in the subject position than in the predicates themselves.

In my study, I am interested in the interpretation of noun phrases in the object position so that I will restrict the subject noun phrases in my examples to singular terms. In spite of the difference in focus, a collective predicate refers to a single event, whereas a distributive predicate refers to

a sequence of situations or just a set of situations. As I have discussed in section 2.1, a sequence of situations always gets a bound situation interpretation.

I want to demonstrate here that some durative verb phrases that denote inherently nonbound situations may have a collective reading or a distributive reading when they cooccur with appropriate quantifiers. For example, the durative verbs in (43) denote inherently nonbound situations, as in (43).

(43) a. John pushed a cart.
b. John moved a desk.
(44) a. John is pushing a cart.
b. John is moving a desk.

These verbs denote situations that may last a few minutes or a few hours and that are not linguistically represented with respect to their terminus. In the literature (cf. Dowty 1979, Kenny 1963, Vendler 1967), the temporal nonboundness is said to exhibit the implications between (43) and (44) : (44a) implies (43a), and (44b) implies (43b). The question of concern in this section is about the sentences in (45).

(45) a. John pushed two carts
b. John moved five desks.

(45a) may refer to two different situations: John pushed two carts at once or John pushed one cart after the other. The same can be found in (45b): it is possible that John moved five desks at once, if he is strong enough, or he moved one after another. It appears that no account is ever provided for the difference in meaning in (45). I think that this difference in meaning can be accounted for in terms of distributive and collective predicates.

When the verb phrases function as a distributive predicate, there is a distributive reading: each pushing of a cart by John or each moving of a desk by John is counted in terms of the cardinals in the object noun phrase. When the verb phrases function as collective predicates, there is a collective reading: pushing of two carts by John or moving five desks by John are not counted in terms of those cardinals. Countability is an important feature of bound situations, since it is basic to event predication (Armstrong 1981:10-11). Thus, each pushing or moving is viewed as a single event and the pushing of the two carts or moving of five desks is viewed as a sequence of single events. Sequences of single events are considered temporally bound situations, as I have discussed in section 4.2.1. As compared with the nonboundness in (43), the temporal boundness of the situations denoted in (45) is supported by linguistic evidence regarding the cooccurrence of verbs referring to bound situations and *in*-temporal expressions as Frame Time adverbial, as in (46) and (47).

(46) a. John pushed a/the/one cart for an hour/*in an hour.
b. John pushed two carts for an hour/in an hour.
(47) a. John moved a/the/one desk for an hour/*in an hour.
b. John moved five desks for an hour/in an hour

In the b-sentences, the object noun phrases with a cardinal number larger than one can occur with *in*-temporal adverbials, since those verb phrases with cardinals larger than one allow a distributive reading. Of course, the b-sentences can occur with *for*-temporal adverbials, since those verb phrases have a collective reading. However, in the a-sentences, the object noun phrases with quantifiers like *a*, *the* and *one* do not allow any distributive reading and only allow a collective reading so that they can

only occur with *for*-temporal expressions as situation predicates.

If countability is a basic property of bound situations, cardinal count adverbials should give a verb phrase a distributive interpretation, as they do in Greek (cf. Armstrong 1981). I think that this is the case in both Chinese and English. The English case is shown in (48) and (49).

(48) a. *John ran *in an hour.*
b. John ran twice *in an hour.*
(49) a. *John was reading a book *in an hour.*
b. John read a book *in an hour.*

(48b) not only patterns with (46b) and (47b) but also with (49b) in term of cooccurrence with *in*-temporal expressions as Frame Time adverbials. The predicate becomes a distributive predicate with the cardinal count adverbial, in which case either running is viewed as a single event taking place in a temporal sequence. The same phenomenon is found in Chinese too.

(50) a. *Zhang *yi xiaoshi* pao le.
John one hour run Asp.
*John ran in an hour.
b. Zhang *yi xiaoshi* pao le *liangci*
John one hour run Asp. twice
John ran twice in an hour.

Frame time adverbials like *yi xiaoshi* (an/one hour), which syntactically appear in pre-verb positions, do not grammatically cooccur with verbs denoting nonbound situations, as in (50a). When a cardinal count adverbial like *liangci* (twice) is added, this kind of verbs can grammatically cooccur with *yi xiaoshi* (an/one hour), as in (50b).

The above evidence suggests that countability in verbal reference is as basic to bound situations as countability in nominal reference is to

objects. The parallelism in the mass-count distinction between verb phrases and noun phrases is discussed in Hoepelman and Rohrer (1980) and ter Meulen (1980, 1981, 1984). Ter Meulen proposes the notion of mass-count distinction among verbs that coincide the distinction between 'accomplishment verbs' (+ count) and 'activity verbs' (- count), but she does not consider the mass-count distinction in terms of temporal properties, nor do Hoepelman and Rohrer. As an extension of Hoepelman (1976), Hoepelman and Rohrer (1980:85) propose that the accomplishments and achievements be put in one main category, and the activity and states in another, the division of which seems to have a parallel in the mass-count distinction in nouns. However, they stopped short of linking the temporal properties of bound and nonbound situations to the mass-count distinction, but tried to explain the mass-count distinction in grammaticality of the sentences in (51) in terms of properties of mass terms in a model theory .

(51) a. *John drank water in an hour.
b. John drank a glass of water in an hour.

In their theory, informally speaking, water is the name of an individual concept. The extension of the individual concept at any point (i, j), where i is a world and j a moment of time, is the union of all things which are water, at (i, j). To form the union of them, the individuals are considered as sets. Of course, (47a) does not mean that John drank the individual concept of water, but part of the extension of this concept. They propose a condition of distributivity, which states that one and the same thing happens to some subparts of, say, water and to all its subparts as well, and under which for all parts of this part, John drank them all. Hoepelman and Rohrer claim that this makes (51a) unacceptable, since it cannot be the case

that John drank all the subparts of this subpart in an hour if he drank a subpart of water in an hour (cf. Hoepelman & Rohrer 1980: 89-90).

I believe that the unacceptability of (51a) can be more satisfactorily accounted for in terms of the distinction of the temporal properties between bound and nonbound situations. The verb phrase *drink water* does not denote a situation that is bound and that is well framed in a Frame Time adverbial. (51a) can be completely acceptable if cardinal count adverbials are added to give bound-situation interpretation, as in (52).

(52) a. John drank water just *once* in an hour.
b. John drank water *twice* in an hour.

The sentences in (52) indicate that the interpretation of mass terms is not as crucial as Hoepelman & Rohrer thought, since *water* is still a mass term in (52). What is important is whether a verb phrase or predicate denotes a bound or nonbound situation. I think that the mass-count distinction in predicates lies in the boundness and nonboundness of situations. Predicates that denote bound situations are count, while those that denote nonbound situations are mass. A large range of linguistic phenomena may be accounted for if the mass-count distinction in predicates is considered in terms of temporal properties.

To sum up, I have shown that quantification interpretation plays a very important role in verb phrases that inherently denote nonbound situations, which is generally ignored in the study of verb classes and their temporal properties. Some phenomena concerning the mass-count distinction in predicates can be satisfactorily accounted for in terms of collective and distributive interpretations. Such interpretations are

temporally related to referentiality and situation types.

4.3 SITUATION PREDICATES

In section 3.4, I argued for a distinction of *for*-temporal expressions as Frame Time adverbials and situation predicates, following Parsons (1990:211-2). My discussion in section 3.4 was focused on *for*-temporal expressions as Frame Time adverbials. In sections 4.1 and 4.2, I have assumed this distinction in my discussion of temporal properties of situations. In this section, I will further discuss some syntactical and semantic properties of situation predicates in English and Chinese.

The double function of *for*-expressions as Frame Time adverbials and as situation predicates is not adequately recognized in the literature on tense, aspect and temporal expressions. Binnick (1991) and Moltmann (1992) treat the distinction as a problem of scope phenomena. Dowty (1979:332-6) treats the distinction as one of different syntactic categories in some cases but not in other cases.[5] On the other hand, Carlson (1981) treats temporal expressions as some sort of measure of time without such a distinction. For example, in Carlson's analysis, the distinction between *for*-temporal expressions or others as Frame Time adverbials or as situation predicates, as in (53), is not considered important to the semantics of aspect .

(53) a. John worked *for a week/all the time.*
b. John was in the room *for a day/all the time.*

(53a) does not tend to refer to a continuous situation that last for a week or all the time. On the other hand, (53b) tends to refer to a continuous

[5] Dowty (1979) distinguishes temporal expressions like *this week* and *for*-temporal expressions syntactically, but not *in*-temporal expressions and *for*-temporal expressions.

situation that may last for a day or all the time. Carlson argues that this difference should be left to pragmatics. I believe that is wrong. I have argued in section 3.4.2 that this should be accounted in terms of the distinction between Frame Time adverbials and situation predicates.

I recognize that there is an ambiguity between *for*-temporal expressions as Frame Time adverbials and *for*-temporal expressions as situation predicates, as in (53). The ambiguity does not exist at all in the semantics of temporal relations in natural languages. Moreover, this ambiguity may be simply a language-specific problem in English, since it does not exist in other languages like Chinese. Two pieces of evidence firmly support this view. First, situation predicates logically pattern with Situation Time in entailment relations. Second, situation predicates unambiguously function as verbal predicates in Chinese, in contrast to Frame Time expressions which syntactically function as pre-verb temporal adverbials only. I will concentrate on the second piece of evidence in this section, and leave the first to section 4.4.

In section 3.4, I pointed out that temporal expressions as Frame Time adverbials only appear syntactically in pre-verb positions in Chinese. I review this syntactical phenomenon with two more examples in (54), before I start to discuss temporal expressions as situation predicates.

(54) a. *Zhege xingqi* Zhang kan le liangben shu.
This week John read Asp. two book
This week John (has) read two books.
b. Zhang *zhege xingqi* kan le liangben shu.
John this week read Asp. two book
?John this week (have) read two books.
c. *Zhang kan le liangben shu *zhege xingqi* .
John read Asp. two book this week
John (has) read two books this week.

The temporal expression *zhege xingqi* (this week) grammatically appears in the sentence-initial position in (54a), and in the pre-verb position in (54b), but its occurrence in the sentence-final position in (54c) is ungrammatical. Semantically, this kind of temporal expression is classified as a Frame Time adverbial, since it designates an interval or instant of time within which the asserted situation holds, as defined in section 3.4. In Chinese, some temporal expressions may occur in the sentence-final positions. In a sentence with an intransitive verb, the temporal expression simply appears right after the verb as in (55).

(55) a. Zhang pao le *liang xiaoshi.*
John ran Asp. two hours
John ran for two hours.
b. Zhang zou le *yi tian.*
John walk Asp. one day
John walked for a whole day.

In a sentence with a transitive verb, the verb is copied and placed after the object noun phrase, as in (55), where the temporal expression occurs following the copy of the verb (cf. Li & Thompson 1981:442-50).

(55) a. Zhang ***da*** lanqiu ***da*** le *yige xiashi.*
John play basketball play Asp. one hour
John plaid basketball for an hour.
b. Zhang ***kan*** shu ***kan*** le *yige xiawu.*
John read book read Asp. one afternoon.
John read a book/books for a whole afternoon.

In these structures, the temporal expressions must appear close to the verb so that no elements may occur between the verb and the temporal expressions in sentences with intransitive verbs, as in (56a), nor can the copy of a verb be deleted, as in (56b).

(56) a. *Zhang pao le *yi quan* liang xiaoshi.
John ran Asp. a round two hours
John ran a round (of something) for two hours.
b. *Zhang ***da*** lanqiu le yige xiashi.
John play basketball Asp. one hour
John plaid basketball for an hour.

(56a) is ungrammatical when *yi quan* (a round) is inserted between the verb and the temporal expression. (56b) is ungrammatical when the copy of the verb *da* is deleted, in which case the temporal expression and the verb are separated by the object noun phrase. It is important to point out that this pattern of verb copying is also seen in the cases of instruments and locatives, as in (57).

(57) a. Zhang ***xie*** xin ***xie*** *gangbi.*
John write letter write fountain pen
John writes letters with fountain pens
b. Zhang ***chi*** wufan ***chi*** *shitang.*
John eat lunch eat cafeteria.
John eats his lunch at cafeterias

Instrument and locative are thematic roles that form part of the argument structure with event structures underlying (Grimshaw 1990:25-9). Thus, instrument and locative noun phrases may appear after a copy of a verb as some kind of unaccusative object noun, since they are arguments in the argument structure.[6] Given my assumption that time is an inherent dimension of an event structure or situations are instantiations of temporal properties, it is natural that situation predicates pattern after instrument

[6] This kind of object is more like what Jespersen (1965:159-80) refers to as 'object of result' than accusative object in the sense of affectedness, though some such objects may undergo passivization. However, passivization is not a reliable test of objecthood, since the subject of a passive sentence in Chinese exhibits both properties of subjecthood and topichood (cf. Zhou 1993a).

and locative nouns as part of the argument structure. After all, event structures underlie argument structures.

In summary, I think that the ambiguity between Frame Time adverbials and situation predicates in English is an accident. Frame Time adverbials and situation predicates represent two completely different dimensions of temporal relations in natural languages. The distinction between the two is necessary to capture the semantics of aspect and to provide truth conditions for related sentences. Therefore, it can not be left to pragmatics, as Carlson (1981) claims. My position is supported by evidence in Chinese that situation predicates form part of the argument structure, and will be further supported in section 4.4 by evidence that the two dimensions of time have completely different logical behaviors.

4.4 SOME LOGICAL PROPERTIES OF SITUATION TIME

In the above two sections, I have shown that verbs denote situations in the same way that nouns denote objects, and also shown that situations are instantiations of temporal properties, such as instantaneousness, duration, boundness and nonboundness. In this section, I will discuss how Situation Time is logically or semantically different from the other two, in particular from Frame Time, as one of the three dimensions of Linear Time, Frame Time and Situation Time.

I think that I can now informally define Situation Time as (58), after I have demonstrated with linguistic evidence for the existence of and some properties of Situation Time.

(58) Situation Time is an instant or interval of time denoted by verbs, where intervals of time are designated as bound or nonbound by verb modifiers.

The definition in (58) is based on the discussions in previous sections on instantaneousness, duration, boundness and nonboundness exhibited in the temporal properties of situations. Situation Time may have a number of logical properties. I am interested here in the properties that distinguish Situation Time from Frame Time in particular. One such property is the existence of the part-whole relation in Situation Time. In Situation Time, the part-whole relation is **transitive**, as formally represented in (59), where ≤ means the part-whole relation or part-of relation (cf. Abbott 1992, Bunt 1985:56).

(59) $(\forall x, y, z)(x \leq y \ \& \ y \leq z) \rightarrow x \leq z)$

(59) means that if *x* is part of *y*, and *y* is part of *z*, then *x* is part of *z*. I am not going to go into the formal apparatus of part-whole relations. Instead, I intend to discuss some semantic properties of Situation Time with transitivity as the background. Situation Time differs from Frame Time not only in that the former is an instantiation of temporal properties of the denotation of verbs while the latter is the denotation of some temporal expressions, but also in that Situation Time and Frame Time have completely different inferential patterns with respect to transitivity. In Frame Time, for example, we see the following inferential pattern, as in (60), where a sentence with a smaller frame of Frame Time entails one with a larger frame of Frame Time.

(60) a. John read a book *this morning*.
b. John read a book *today*.
c. John read a book *this week*.

(60a) implies (60b) and (60c), and (60b) implies (60c). I refer to this

inferential pattern as 'increasing', since we can inference from a sentence with a smaller frame of Frame Time to one with a larger frame of Frame Time which contains it, as illustrated in (60). However, the reverse is not true, since John may have read the book on any day of this week or any time during the day.[7] In Situation Time, we see an inferential pattern that is the reverse of that of Frame Time, as in (61) and (62).

(61) a. John read part of a book.
b. John is reading a book.
(62) a. John ran.
b. John is running.

Here, I assume that the verb phrases like *read part of a book* and *ran* denote a subsituation of the situation that the verb phrases like *is reading a book* and *is running* denote. This assumption is supported by the fact that the b-sentence imply the a-sentence in (61), as the b-sentence does to the a-sentence in (62). I will refer to this entailment relation in Situation Time as 'decreasing', since inference is made only from whole to part or larger part to smaller part.

The question is why the reverse of the transitive property in Situation Time underlies the entailment relations so that they are decreasing, in contrast to the inferential pattern in Frame Time which is increasing. I think that the answer lie in the distinction between linear ordering in Linear Time and part-whole relations in Situation Time. In part-whole relations, it is universal that sentences referring to part never imply those referring to wholes, since certain parts may have some property, while other parts of the whole do not. This relation in part-whole

[7] A detailed discussion on the logical properties of Frame Time is found in section 3.4.

relations can be formally represented in ensemble theory (Bunt 1985:56-9), as in (63)

(63) a. [z ≤ x | P (z)]
b. y ≤ [z ≤ x | P (z)] -/-> y ≤ x & P (y)
c. y ≤ [z ≤ x | P (z)] --> y ≤ x

(63a) states that *z* is the part of *x* including all *x*-parts for which *P* is true. (63b) says that if *y* is a part of *x* , it is not necessary that *P* is true for *y*, though it can be deduced that *y* is a part of *x*, as in (63c). Therefore, temporally speaking, sentences with verbs denoting larger Situation Times entail ones with verbs denoting smaller Situation Times, while sentences with verbs denoting smaller Situation Times do not entail ones with verbs denoting larger Situation Times. This is clearly reflected in that the a-sentences do not imply the b-sentences in (61) and (62) but the b-sentences do imply the a-sentences in (61) and (62). In b-sentences parts of a situation are realized in time, while parts of it have yet to be realized in time, as indicated by the present progressive markers. On the other hand, in a-sentences, parts of a situation or subsituations are realized in time, as indicated by the past tense markers.

In the literature, studies focus on the entailment of the a-sentence by the b-sentence in (62), while they ignore the entailment of the a-sentence by the b-sentence in (61), but emphasize the non-entailment of the a-sentence by the b-sentence in (64) (cf. Chesterman 1991:133-8, Dowty 1979:57, Kenny 1963:175, among many others on this topic).

(64) a. John read a book.
b. John is reading a book.

This approach may be due to the ontological distinction between homogeneity and heterogeneity in analyses of the logical relations between the b-sentences and a-sentences (cf. Declerck 1979, Dowty 1979, Moltmann 1992, Mourelatos 1978, 1981, Verkuyl 1989). (62b) implies (62a), because (62b) is said to refer to a homogeneous situation, while (64b) does not imply (64a), because (64b) is said to denote a heterogeneous situation. I think that the distinction between homogeneity and heterogeneity in situations may be related to theories of actions, but are not directly related to the temporal properties in question. In (61) and (62), the b-sentences entail the a-sentences, since there is a part-whole relation or smaller-part and larger-part relation. In other words, the verb phrases in the b-sentences refer to a whole situation while the verb phrases in the a-sentences refer to a subsituations which is part of the whole situation. This accounts for the reason why the a-sentences do not entail the b-sentences in (61) and (62). On the other hand, this also explains why (64b) does not entail (64a). This explanation is the same for the reason why a-sentences do not entail b-sentences in (61) and (62): the verb phrase in (64a) refers to a whole situation, whereas the verb phrase in (64b) only refers to part of a situation.

Further evidence for this part-whole relation in temporal properties of Situation Time is found in Finnish (Cf. Chesterman 1991, Hoop 1992). In Finnish, verbal representation of the distinction of part of a situation and whole situation may be seen in the grammatical cases that the object noun phrases bear, as illustrated in (65) on the next page, where the partitive case is marked by the suffix *a* to the object noun. The partitive case that the object noun phrase bears in (65a) indicates that the situation referred to by *build a house* is not complete and is partitive. The accusative case that the

object noun phrase bears in (65b) shows that the situation is complete.

(65) a. John rakensi talo*a*
John built house$_{PART}$
John was building a/the house
b. John rakensi talon
John built house$_{ACC}$
John built a/the house.

We can say that (65b) implies that (65a) is true at a subinterval of the Situation Time denoted by (65b), since there is a part-whole relation.

In Chinese bare nouns have a partitive interpretation (cf. Zhou 1991). In progressive sentences, bare nouns occur more grammatically than nouns with an indefinite quantifier, as in (66).

(66) a. Zhang zai kan *shu.*
John Asp. read book
John is reading a book.
b. Zhang zai kan *naben shu*
John Asp. read that/the book
John is reading that book.
c. ??Zhang zai kan *yiben shu.*
John Asp. read a book
John is reading a book.

A bare noun with a partitive reading in (66a) is more acceptable than a noun with an indefinite quantifier in (66c), though a noun with a definite is also grammatical in (66b), which also has a partitive reading.[8]

The part-whole relation may be further extended to other partitive constructions as object noun phrase (cf. Abbott 1992 on partitive constructions). For example, (67a) with a partitive construction does not

[8] I am not sure if the partitive interpretation here is related to the relation between partitive structures and definiteness and indefiniteness (cf. Abbott 1992, Hoop 1992).

imply (67b), whereas (67b) implies (67a).

(67) a. John read some of each book.
b. John read each book.

This entailment relation exists, since there is a part-whole relation between (67a) and (67b). *Some of each book* is part of *each book*. The same relation is found in (68).

(68) a. Five of those ten boys came.
b. Those ten boys came.

(68a) does not entail (68b), since (68a) only refers to a part, while (68b) refers to the whole. On the other hand, (68b) implies (68a).

In short, Situation Time, as instantiations of temporal properties of verb denotation, exhibits completely different logical behaviors from those of Frame Time which is the denotation of some temporal adverbials, though the two may denote intervals or instants of time. Entailment relations concerning Situation Time may be best captured in terms of part-whole relations. In this approach, it is suggested that the entailment relation between sentences with verbs in progressive form and sentences with verbs in non-progressive form may be accounted for in terms of part-whole relations. In this analysis, sentences with verbs referring to bound situations or ones with verbs denoting nonbound situations are equally seen to have the same logical behavior.

4.5 SUMMARY OF CHAPTER FOUR

This chapter begins with the assumption that verbs refer to events or more generally to situations in the same way that nouns refer to objects,

which is vaguely seen in Reichenbach but made more clearly obvious in Parsons (1985, 1990). Within the approach that situations denoted by verbs are the basic domain and objects denoted by nouns function as modification of situations (cf. Gabbay & Moravcsik 1980), this assumption is supported by evidence in nominalization, similarities between nominals and nouns, and similarities between nominals and sentences. Situations are considered instantiations of temporal properties of verb denotations. Linguistic evidence indicates that verbs may refer to instantaneous situations, or to durative situations which may be bound or nonbound in their temporal nature. A distinction between inherently bound situations and inherently nonbound situations is made which is the basic referential function of verbs and verb phrases. A further distinction is made between inherently bound/nonbound situations and noninherently bound/nonbound situations. I consider the latter as effects of quantification interpretations, which is viewed in terms of distinctions between individual predicates and stage predicates (cf. Carlson 1977) and collective predicates and distributive predicates (cf. Link 1983). It is observed that there is a parallelism between the mass-count distinction in predicates and that in nouns (cf. Hoepelman & Rohrer 1980, ter Meulen 1980, 1984), which is often viewed in terms of homogeneity and heterogeneity. I have tried to demonstrate that this distinction is temporally related to the distinction between bound and nonbound situations, rather than to mass terms in predicates per se.

Situation Time, as a dimension of the representation of time in natural languages, exhibits distinctive logical behaviors that are different from those of Frame Time and Linear Time. The primary relation in Situation Time is in fact one between part and whole, as suggested by linguistic evidence in Chinese and Finnish. A part-and-whole approach

opens up a more broad view of semantic relations among sentences in different tenses and aspects.

Chapter Five

SOME IMPLICATIONS OF THE THREE-DIMENSIONAL TEMPORAL THEORY

5.1 INTRODUCTION

I have claimed in the Chapter One that we need a three dimensional representation of the temporal relations in natural languages, after I briefly reviewed some of the problems in the study of verbs and times. In Chapter Three, I have treated two of the three dimensions that I have proposed. One of them is Linear Time, which is defined as a set of points of time without duration but with precedence ordered in relation to speech time in a linear structure. Linear Time precisely characterizes tense systems in natural languages: tenses only represent temporal precedence relations to speech time and other points of time. Thus, Linear Time avoids some of the pitfalls of being too rich and too strong as in Reichenbach's tense theory and other tense theories (cf. Comrie 1981). The other dimension of the two is Frame Time, which is defined as a set of intervals of time, which are denoted by temporal adverbials and within which a described event/activity takes place or a state holds. Frame Time has its origin in frame adverbials, a class of temporal adverbials mentioned in Bach (1981:72-75), Bennett and Partee (1978:22-30), Parsons (1990:209-223) and Smith (1991:155). However, they all fail to give any theoretical significance to this class of temporal adverbials. Frame Time, as I have demonstrated with linguistic evidence from Chinese and English, represents

temporal inclusion relations which are logically different from precedence relations in Linear Time. In Chapter Four, I have proposed Situation Time, as a third dimension of the representation of time in natural languages, which is defined as a set of instants or intervals of time denoted by verbs, where intervals are designated as bound and nonbound by verb modifiers. Situation Time has its origin in events (cf. Bach 1986b, Davidson 1968, 1980, Parsons 1980, 1985, 1989, 1990, Reichenbach 1947, Smith 1991), but is only one dimension of events in the sense of instantiations of temporal properties (Gabbay & Moravcsik 1980). Thus, Situation Time not only represents temporal inclusion relations but also part-of relations. Analysis in terms of part-of relations in Situation Time may avoid unwanted consequences like the 'imperfective paradox' (cf. Declerck 1979, Dowty 1977, 1979, Parsons 1989).

In those chapters, the three dimensions are viewed in their own merits respectively in light of linguistic evidence and against problems in representing and interpreting time in natural languages. In this chapter, I will discuss how two or all three dimensions of the representation of temporal relations interact to represent and interpret some temporal phenomena in natural languages. In section 5.1, I will attempt to provide an account of the mechanisms for verbal aspect as viewpoints or perspective, which are approaches to verbal aspect in syntax and semantics (cf. Comrie 1976, Smith 1991) and in discourse studies (cf. Hopper 1982, Thelin 1990) but are not fully justified. I will tackle the present perfect puzzle (cf. Klein 1992) by illustrating how the three dimensions interact to underlie the temporal relations in section 5.2. Finally, in section 5.3, I will show that the structural analogies between tenses and pronouns (cf. Partee 1973) are problematic when we view temporal relations in natural languages in terms

of this three dimensional theory.

5.1 MECHANISMS FOR VERBAL ASPECT AS VIEWPOINTS

Verbal aspect seems to be unknown and full of pitfalls and mazes, compared with tense, though tense is confusing, as is seen in logical and linguistic analyses (Binnick 1991). Aspect appears to lie in the fact that a situation may be viewed differently. Thus, aspect is considered to consist of viewpoints or perspectives in syntactic and semantic studies (cf. Binnick, 1991, Comrie 1976, Smith 1991) and in discourse studies (cf. Hopper 1982, Thelin 1990).

Figuratively, Smith (1991:91) provides the most vivid description that a linguist has made about verbal aspect:

> Aspect viewpoints function like the lens of a camera, making objects visible to the receiver. Situations are the objects on which viewpoint lenses are trained. And just as the camera lens is necessary to make the object available for a picture, so viewpoints are necessary to make visible the situation talked about in a sentence.

What does the lens of an aspect camera focus on if aspect indeed functions like the lens of a camera? There appear to be some different opinions. Citing Holt's (1943) definition of aspect, Comrie (1976:3) seems to hold the view that 'aspects are different ways of viewing the internal temporal constituency of a situation'. On the other hand, Binnick (1991:136) writes that 'the very same situation (event or state of affairs) may be viewed either imperfectively or perfectively'. Binnick's point is illustrated in the verbal forms in the English sentence in (1).

(1) John was reading a book when Mary came

The situation of reading a book is viewed internally, as the progressive form indicates. However, the situation of coming is not viewed internally but externally, since both its initial stage and ending stage are in the view. In the former case, the situation is only viewed in part, while in the latter case the situation is viewed in its totality. Moreover, aspects like the habitual view even more than one situation in relation to Frame Time. The next question is how the aspect camera adjusts its lens to get different viewpoints. More specifically, what are the mechanisms? These two questions do not seem to be answered in the approaches mentioned above.

5.1.1 IN SEARCH OF MECHANISMS FOR ASPECT AS VIEWPOINTS

Grammatical morphemes that mark aspects definitely play a role in presenting viewpoints, if aspect is considered as such. However, I think that grammatical morphemes may play a passive role in this system, in the sense that they simply mark viewpoints of situations as grammaticalized. For example, we may get viewpoints of situations without any grammatical morphemes marking aspects, as illustrated in (2).

(2) Zhang lai deshihou, wo kan shu.
John come when I read book
a. When John came, I was reading a book.
b. When John comes, I will begin to read a book.

Without any grammatical morpheme, the sentence in (2) may have two interpretations: (2a) in which the situation of John's coming is viewed temporally within the situation of my reading a book, and (2b) in which the situation of John's coming is viewed as temporally being followed by the situation of my beginning to read a book (cf. Dahl 1985:24-5). The Chinese

sentence has the potential to present both views, since it is not grammatically marked by any aspect morpheme. Grammaticalization of aspect markers may be accounted for in terms of parameters (cf. Smith 1991). That is to say that the presentation of viewpoints may be parameterized in terms of grammaticalization. However, I think that the mechanisms which underlie viewpoints may be more universal. For example, there are two ways to specify the interpretation of (2), as in (3).

(3) a. Zhang lai deshihou, wo *zheng* kan shu.
John come when I Asp.(progressive) read book
When John came, I was reading a book.
b. *Wanshang ba dian* Zhang lai deshihou, wo kan shu.
Evening eight o'clock John come when I read book
When John came at eight o'clock in the evening, I was reading a book.

In (3a), a progressive marker is added to the verb *kan* (read) so that (3a) has the same interpretation as (2) does in (2a). On the other hand, (3b) has the same interpretation as (2) has in (2a) too, when a Frame Time adverbial is added. I believe that this is not an accident. In Chinese, Frame Time adverbials always play a role in the interpretation of tense and aspect, when there are no grammatical morphemes for them, as I have discussed in section 3.3.2.

Frame Time adverbials represent Frame Time, while those verb phrases refer to Situation Time. Are there any relations between Frame Time and Situation Time? What are the relations between these two dimensions of the representation of time if there are any? I think that there is no doubt that those dimensions of the representation of time in natural languages are related to each other. Let us look at (3b) again. It is noticed that in (3b) the Frame Time adverbial *wanshang ba dian* (eight o'clock in

the evening) denotes an instant of time, which is the lowest bound of a frame of Frame Time. Within an instant of time, we may find two situations contemporaneous, but may not find two situations ordered one after another, since an instant is not considered durative (cf. Benthem 1983). However, a precedence interpretation is available when a Frame Time adverbial referring to a larger frame of Frame Time is added to (2), as in (4) in contrast to (3b).

(4) *Wanshang* Zhang lai deshihou, wo kan shu.
Evening John come when I read book
a. When John came in the evening, I was reading a book.
b. When John comes in the evening, I will began to read a book.

Like (2), (4) has two temporal interpretations: in (4a) the two situations are interpreted as contemporaneous, where the instantaneous situation denoted by the verb *come* is viewed in its totality, while the durative situation denoted by the verb phrase *read a book* is viewed internally; in (4b) the two situations are viewed as temporally ordered, where the instantaneous situation of coming precedes the durative situation of reading. The point here is not the relation between the two situations but that between the Frame Time adverbial and the situations. Why can the durative situation be viewed either internally or externally in (4) with the Frame Time adverbial of *wanshang* (in the evening)? Why is the durative situation subject to only the internal view in (3b) with the Frame Time adverbial of *wanshang ba dian* (eight o'clock in the evening)? The evidence clearly points to the relations between Frame Time and Situation Time, since the interpretations in (3) and (4) involve situations types like instantaneous ones and durative ones and sizes of frames of Frame Time.

Further evidence concerning the effects of Frame Time adverbials on sentences with unmarked aspect and tense is seen in Mofu-Gudur, a Chadic language spoken in Cameroon (cf. Hollingsworth 1991). In Mofu, verb phrases may occur without any grammatical morphemes for aspect and tense, though there are such morphemes in the language. The unmarked sentences occur in conversations when Frame Time is known to the speakers (linguistically covert), as in (5a), or with a Frame Time adverbial, as in (5b) (Hollingsworth 1991:241-3).

(5) a. A cá zána.
He weave cloth
He is weaving cloth.
b. Mándaw mándaw a cá zána.
Tomorrow tomorrow he weave cloth
Every day he weaves cloth.

Given the context of utterance, the covert Frame Time adverbial in (5a) is taken to mean 'now' so that (5a) is understood in the progressive. On the other hand, (5b) is interpreted as in the habitual aspect, since the temporal adverbial denotes a large frame of Frame Time.

I have illustrated with evidence from Chinese and Mofu-Gudur that Frame Time plays an important role in specifying aspect interpretation in sentences without marked grammatical morphemes for tense and aspect. However, this does not mean that Frame Time does not play a role in determining aspect interpretation in sentences with marked aspect or tense morphemes. For example, the a-sentences in (6) and (7) are unacceptable, since there seems to be a conflict between the interpretation of the marked aspect morpheme and the Frame Time adverbials.

(6) a. ?John has built a house *early this morning.*
b. John has read a book *early this morning.*
(7) a. ?John read a book *at six o'clock.*
b. John arrived *at six o'clock.*

In (6), (6b) is completely acceptable, while (6a) is not. It is noticed that (6a) and (6b) have the same Frame Time adverbial *early this morning.* Thus, there is no problem for the cooccurrence of the perfect with the Frame Time adverbial *early this morning.* The difference between (6a) and (6b) lies in that the verb phrase in (6a) refers to a much larger situation than that in (6b) refers to. Given that situations are instantiations of temporal properties (Gabbay & Moravcsik 1980), there is a problem of the relations between Frame Time and Situation Time in respect to aspect. In the case of (6a), the size of Situation Time is too large for the frame of Frame Time, when the perfective aspect is marked. A similar problem is found in (7), where (7a) is not acceptable but (7b) is acceptable. The frame of Frame Time is too small, while the size of Situation Time is too large, when a perfective interpretation is indicated by the past tense. Therefore, the relations between Frame Time and Situation Time should be considered as the mechanisms for the lens of the aspect camera in the presentation of viewpoints, whether a sentence is or is not marked as to its aspect. Markedness and unmarkedness in tense and aspect may be subject to parameterization, as suggested in Smith (1991). However, the relations between Frame Time and Situation Time may be universal in the representation of aspect as viewpoints.

5.1.2 MECHANISMS: RELATIONS BETWEEN FRAME TIME AND SITUATION TIME

I claim that the relations between Frame Time and Situation Time are the mechanisms for the aspect camera to focus its lens on viewpoints, in order to answer the questions raised about those approaches to aspect as viewpoints, and to account for the phenomena observed in (2), (3), (4), (5), (6) and (7). Let us briefly review the concept of Frame Time (cf. (62) in section 3.4) and Situation Time (cf. (58) in section 4.4) by repeating the definitions here in (8) and (9).

(8) Frame Time (FT) is a set of intervals of time, which are denoted by temporal frame phrases and within which a described event/activity takes place or a state holds.

(9) Situation Time (ST) is a set of instants or intervals of time denoted by verbs, where intervals are designated as bound or nonbound by verb modifiers.

By relations between Frame Time and Situation Time, I mean the temporal inclusion relations between these two dimensions of the representation of time. I look at the relations between the two dimensions from the point of view of how Frame Time relates to Situation Time. Specifically, I view Frame Time as adjustable like a lens, while Situation Time is the object to be viewed. This is compatible with the traditional view that situations may be viewed from different perspectives (cf. Binnick 1991:135-9, Comrie 1976:3-6, Smith 1991:91-4).

First, let us look at the relations between Frame Time and Situations in the opposition between the perfective aspect and the imperfective aspect. The relations between Frame Time and Situation Time are completely

different in the perfective aspect and the imperfective aspect. In the perfective, Frame Time temporally includes Situation Time, as defined in (10a) and as formally represented in (10b).

(10) a. Frame Time temporally includes the Situation Time of a situation, iff Situation Time does not begin earlier nor end later than Frame Time
b. PERF: ST$\in$ FT, where $\in$ symbolizes temporal inclusion

This temporal relation is clearly illustrated in the English sentences in (11).

(11) a. John read a book *yesterday.*
b. John read a book *yesterday afternoon.*
c. ?John read a book *at three yesterday afternoon.*

In (11a) and (11b), the Frame Time adverbials *yesterday* and *yesterday afternoon* denote frames of Frame Time that temporally include the Situation Time referred to by the durative verb phrases. Therefore, a perfective viewpoint is presented. In (11c), the Frame Time adverbial *at three yesterday afternoon* denotes an instant of Frame Time that does not temporally include the Situation Time referred to by the durative verb phrase, since an instant of time is too short to temporally include an interval of time. As a result, a perfective view point is not available. This does not mean that a Frame Time adverbial referring to an instant of Frame Time can not cooccur with the perfective aspect. A perfective viewpoint is available when such a Frame Time adverbial cooccurs with an instantaneous verb referring to an instantaneous situation, as in (12).

(12) a. John *began* to read a book *at three yesterday afternoon.*
b. John *killed* someone *at three yesterday afternoon.*

The two sentences in (12) both have a perfective interpretation, since Frame Time includes Situation Time. Given the definition of temporal inclusion in (10a), an instant of time temporally includes another instant of time, when the latter does not begin earlier nor end after the former, regardless of the nondurative nature of an instant of time. Therefore, the perfective viewpoint is presented in (12). In addition to the presentation of viewpoints, the temporal relation between Frame Time and Situation Time constrains semantic interpretations of the temporal relations between clauses, as in (13).

(13) a. ??*Yesterday*, John read a book, but did not finish reading it.
b. *Yesterday*, John read a book, but did not finish reading it *until eleven o'clock in the evening.*

In (13a), the temporal adverbial *yesterday* functions as a frame of Frame Time for both clauses.[1] The first clause in the perfective clearly states that the frame of Frame Time *yesterday* temporally includes the Situation Time denoted by the verb phrase *read a book*, but the second clause denies what the first clause represents. Thus, the two clauses in (13a) are semantically contradictory, as illustrated in terms of temporal relations in (13'a).

(13') a. $ST \in FT \ \& \ ST \notin FT$
b. $ST \in FT \ \& \ ST \in FT$

On the other hand, the sentence in (13b) is semantically acceptable, when the second clause is modified by adding a temporal adverbial within the bound of the frame of Frame Time, as in (13'b).

In the imperfective aspect, Frame Time only partially includes

[1] This function of Frame Time adverbials is fully treated in section 5.3.2.

Situation Time temporally, as is defined in (14a) and formally represented in (14b) below.

(14) a. Frame Time (FT) partially includes the Situation Time (ST) of a situation temporally, iff Situation Time begins earlier and ends later than Frame Time or begins earlier than Frame Time or ends later than Frame Time.
b. IMPERF.: ST $\propto$ FT, where $\propto$ symbolizes partial temporal inclusion.

This partial temporal inclusion relation is clearly seen in the sentences in imperfective aspect in (15).

(15) a. John was reading a book *yesterday*.
b. John was reading a book *last year*.

In (15a), the frame of Frame Time *yesterday* only partially includes the Situation Time referred to by the verb phrase *read a book*. The same is found in (15b), where the frame of Frame Time *last year* just partially includes the Situation Time. The absolute size of a frame of Frame Time is irrelevant in respect to the upper bound, as in (15), where (15a) has *yesterday* as its Frame Time, while (15b) has *last year* as its Frame Time. What matters is the relation between Frame Time and Situation Time. It is not clear whether Situation Time begins earlier or later than Frame Time, but it is definite that Situation Time ends later than Frame Time, as illustrated in the sentences in the imperfective in (16).

(16) a. *Yesterday*, John was reading a book (, which he started *in the morning* but didn't finish *until today*).
b. *Yesterday*, John was reading a book (, which he started *the day before* but didn't finish *until today*).
c. ??*Yesterday*, John was reading a book (, which he started *in the morning* and didn't finish until the evening).

When we look at the relative clauses in the parenthesis, (16a) suggests that Situation Time starts earlier than Frame Time and ends after Frame Time, while (16b) indicates that Situation Time starts within Frame Time but ends after Frame Time. Thus, (16a) and (16b) suggest that Situation Time may or may not begin earlier than Frame Time, which does not seem to be important in the imperfective. However, (16c) clearly shows that Situation Time does not end earlier than Frame Time in the imperfective aspect. In fact, sentences in the imperfective in Chinese and English always imply that a situation is incomplete in the sense of something being unfinished.

Given the definition of partial temporal inclusion in (14a), there are more variations in temporal relations than represented by the relatively simple imperfective aspect in English. Some languages are finely tuned as to those variations in temporal relations, while other languages are coarsely tuned to those variations in temporal relations. This is a problem of grammaticalization of temporal relations, and may be subject to parameterization (cf. Smith 1991). In a partial temporal inclusion, we may find the relation stated in (17), where the initial of Situation Time is focussed on, as in the inchoative aspect in Chinese.

(17) a. Frame Time (FT) partially includes the Situation Time (ST) of a situation temporally, when Situation Time begins at the same time as Frame Time does or later than Frame Time, but ends later than Frame Time.
b. INCH.: ST ≥ FT, where ≥ symbolizes temporal inclusion by Frame Time of the initial stage of Situation Time but not the end of Situation Time.

The temporal relation stated in (17) is seen in the inchoative aspect in Chinese, as in (18) on the next page, where *qi*(*lai*) is an inchoative aspect

marker (cf. Chao 1968:251, Wang 1985:156-7).[2]

(18) a. Zhang zuotian kan *qi* zheben shu.
John yesterday read Asp. this book.
John began to read this book yesterday.
b. Zhang jintian zaoshang pao *qi*.
John today morning run Asp.
John began to run this morning.

(18a) means that John started the reading of the book yesterday and didn't finish reading it yesterday. (18b) means that John started running this morning and is still running up to the moment of speech. The temporal relation is clearly seen in the sentences in (19), which are unacceptable, since the second clause is a contradiction of the first.[3]

(19) a. ??Zhang zuotian kan *qi* zheben shu, erque kan wan le.
John yesterday read Asp. this book and read finish Asp.
b. ??Zhang jintian zaoshang pao *qi*, erque pao dao le.
John today morning run Asp and run destination Asp.

I am not able to provide English translations for the two sentences in (19),

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[2] The inchoative aspect has two morphemes *qi* and *lai*. When used with intransitive verbs, *qi* and *lai* appear together after the verb, as in (i). When used with transitive verbs, *qi* occurs between the verb and the object noun while *lai* appear after the object noun, as in (ii). In the latter case, *lai* may be omitted, as in (iii), but *lai* can not be omitted in the case of intransitive verbs, as in (i).

(i) Zhang ku qilai.
John cry Asp.
John began to cry.
(ii) Zhang chang qi ge lai.
John sing Asp. song Asp.
John began to sing songs.
(iii) Zhang chang qi ge.
John sing Asp. song
John began to sing songs.

[3] *Wan* is an completive aspect marker, which I translate as *finish* here in English. The lexical items do not necessarily represent the same temporal relations as grammaticalized aspect markers do, as I will discuss below.

because the meaning of the inchoative aspect is represent by lexical items like *begin* or *start* in English. The lexical items do not exactly represent the temporal relations defined in (17a), since the translation of (19) in English with lexical items is not a contradiction, as in (20).

(20) a. Yesterday, John *began* to read this book, and finished reading it.
b. This morning, John *began* to run, and reached his destination.

This is true in Chinese too, when lexical items are also used, as in (21).

(21) a. Zhang zuotian *kaishi* kan zheben shu, erque kan wan le.
John yesterday begin read this book and read finish Asp.
Yesterday, John began to read this book, and finished reading it
b. Zhang jintian *kaishi* pao, erque pao dao le.
John today begin run and run arrive Asp.
Today, John began to run, and reached his destination.

The sentences in (21) are not contradictions either. This further supports my view that the temporal relation represented by the inchoative aspect, as defined in (17) is different from that represented by lexical items. By definition, a sentence in the inchoative refers to an incomplete situation in respect to the frame of Frame Time denoted by a Frame Time adverbial. I think that the difference between English and Chinese regarding the inchoative aspect also provides evidence for temporal relations as universals in aspect. Whether all types of temporal relations are grammaticalized as verbal aspects is a problem of parameterization (cf. Smith 1991), which I am not going to discuss in this study.

In short, the above evidence suggests that the relations between

Frame Time and Situation Time provide the mechanisms for the focusing on viewpoints, and correctly predict the meaning of aspect in the cases that I have examined.

5.1.3 SITUATIONS VIEWED EXTERNALLY

With the relations between Frame Time and Situation Time as the mechanisms for verbal aspect as viewpoints, I think that I am in a position to examine the question whether aspects are only ways to view the internal temporal constituency of a situation (cf. Comrie 1976:3). Given the definition of the imperfect in (14) and one of its variations, the inchoative in (17), it is clear that those aspects are ways of viewing the internal temporal constituency of a situation. However, this is not the case when a situation denoted by a verb is viewed in the perfective aspect, since by definition (cf. (10) above), the situation is viewed as a whole. In this subsection, I will examine a more clear case, the habitual aspect, in which situations are viewed externally.

The habitual aspect is traditionally considered as an aspect viewing the internal temporal constituency of a situation, since a verb in the habitual aspect is considered referring to one single situation (cf. Comrie 1976, Smith 1991). In Smith's (1991:38-42 and 86-9) classification of situations, situations denoted by verbs in the habitual aspect are classified as stative situations. I have claimed in section 4.1 that classification in this manner is not based on the temporal properties of situations but on other properties of situations in terms of theories of actions. Smith (1991:42) recognizes that habitual situations are different from other stative situations, again, in terms of theories of actions but not in terms of their temporal relations. Therefore, her classification does not necessarily bear

directly on the temporal relations in situations. Temporally speaking, the so-called stative verbs and verbs in the habitual aspect do differ, though both refer to durative situations, as in (22).

(22) a. John was sick *yesterday.*
b. ??John used to watch TV many times *yesterday.*

(22a), which refers to a stative situation, is acceptable, but (22b) in the habitual aspect is not acceptable, though it is claimed to refer to a stative situation. Thus, the so-called stative reading is not available. I think that the unacceptability of (22b) lies in the relations between Situation Time and Frame Time. The frame of Frame Time is simply too small for (22b) to get a habitual interpretation. This relation is not recognized in Comrie (1976) either. In arguing for the distinction between the iterative aspect and the habitual aspect, Comrie (1976:27) uses the evidence in (23) for his argument.

(23) a. The lecturer stood up, coughed five times, and said ...
b. *The lecturer stood up, *used to* cough five times, and said ...

(23a) is grammatical but (23b) is not. Comrie's argument is based on the claim that a limited number of repetitions of a situation is not considered a single situation. I want to point out that the number of repetitions of a situation alone is irrelevant to the habitual aspect, if it is not considered in terms of the relations between Situation Time and Frame Time, as in (24).

(24) a. *The lecturer stood up, *used to* cough *a hundred times*, and said ...
b. *The lecturer stood up, *used to* cough *thousand times*, and said ...

The number of repetitions of a situation may be increased to a hundred times, as in (24a), or to thousand times, as in (24b). However, the sentences in (24) are still not acceptable. I believe that (23b) is not acceptable for one single reason: there must be an agreement for the aspects involved in all three clauses in (23b), since the covert frame of Frame Time has a syntactic scope over all the three clauses, as in (25).[4]

(25) (In those days,) the lecture *used to* stand up, (*used to*) cough five times, and (*used to*) say ...

When *used to* is added to each of those coordinated clauses, (25) is completely acceptable. I think that the above evidence suffices to show that the habitual aspect does not involve the concept of stative situations nor a series of situations as one, but that the habitual aspect involves the relation between the number of repetitions of a situation and the size of a frame of Frame Time.

When looking closely, I find that the relation between the number of repetitions of a situation and the size of a frame of Frame Time in the habitual aspect exhibit these two features: i) the number of repetitions is relative, i.e. it may be large or small, and ii) size of a frame of Frame Time is absolute, i.e. it must be large. First, let us look at the size of a frame of Frame Time for the habitual aspect.

(26) a. ???John used to get up at six *last week.*
b. ?? John used to get up at six *last month.*
c. ?John used to get up at six *in the first half of the year.*
d. John used to get up at six *last year.*

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[4] The covert Frame Time adverbial and its syntactic scope is treated as demonstrative use and anaphoric behaviors of Frame Time adverbials in section 5.3.2.

In (26), (26b) is more acceptable than (26a), and (26c) is more acceptable than both (26a) and (26b), while (26d) is completely acceptable. Thus, a greater acceptability is found in (26), when a frame of Frame Time becomes larger. Now, let us look at the relative number of a repeated situation.

(27) a. *Last year*, John used to walk to the market once a month. (12 repetitions of a situation)
b. *Last year*, John used to read a book *every day*. (nearly 365 repetitions of a situation)

When counted, there are only twelve repetitions of the situation of walking to the market in (27a), and, on the other hand, there are almost three hundred and sixty-five repetitions of the situation of reading a book in (27b). I think that the number of repetitions may be even smaller when a frame of Frame Time becomes larger, as in (28).

(28) a. John used to go to his grandparents' house for Christmas, during the years when he was in elementary school.
b. John used to celebrate his birthday with both his parents before he was five. (Then, he either went to his mother's or father's after they got divorced.)

In (28a), there are fewer than ten repetitions of the situation of going to grandparents' house in six or five years of elementary school. Moreover, there are fewer than five repetitions of the situation of celebrating his birthday with both his parents in (28a). The evidence in (26), (27) and (28) further supports my claim that the mechanism underlying the habitual aspect is the relation between the number of the repetitions of a situation and the size of a frame of Frame Time. Given this kind of temporal relation, the habitual aspect clearly does not view a situation internally, as

claimed in Comrie (1976:3), but externally, as I have argued above.

5.1.4 SUMMARY

Aspect is considered to consist of viewpoints or perspectives in syntactic and semantic studies (cf. Binnick, 1991, Comrie 1976, Smith 1991) and in discourse studies (cf. Hopper 1982, Thelin 1990), and different ways of viewing the internal constituency of a situation (Comrie 1976:3). However, these approaches leave two questions unanswered: what mechanisms underlie the aspect camera's lens for viewpoints and whether aspects only view a situation internally. I have illustrated with evidence from Chinese, English and some Bantu languages that the temporal inclusion relations between Frame Time and Situation Time are the mechanisms for verbal aspect as viewpoints. For example, Frame Time temporally includes Situation Time in the case of the perfective aspect, while Frame Time only partially includes Situation Time temporally in the case of the imperfective aspect. I think that the relations between Frame Time and Situation Time are universal in verbal aspect. On the other hand, the evidence from the difference between the grammaticalized inchoative aspect in Chinese and lexical items expressing the inchoative meaning in English seems to suggest that the grammaticalization of aspect in natural languages is subject to parameterization. There is also the difference between grammaticalized temporal relations and nongrammaticalized ones. In examining the temporal relation between Frame Time and Situation Time in the habitual aspect, I have demonstrated with linguistic evidence in English that verbal aspects do not only view situations internally but also externally in relation to the size of a frame of Frame Time and to the number of repetitions of a repeated situation. In the habitual aspect in

English, the size of a frame of Frame Time has to be absolutely large, while the number of the repetitions of a situation is relative in the sense that it does not have to be large. If the size of a frame of Frame Time is marginal, the number of repetitions of a situation needs to be large, whereas the number of repetitions of a situation can be very small, when the size of a frame of Frame Time is absolutely large.

5.2 THE PRESENT PERFECT PUZZLE

The puzzle of the English present perfect is the apparent temporal contrast between what tense the auxiliary *have* bears and what the verb phrase refers to (cf. Brinton 1988:6-14, Comrie 1976:52-56, Klein 1992), as shown in (29).

(29) a. John has read the book this week/*two days ago this week.
b. John has left school today/*at ten o'clock this morning.

In (29), the verbs refer to situations that occurred in the past. It is clear to us that the situation of John's reading a book and the situation of John's leaving happened in the past or before speech time. For example, if speech time is Friday, the situation of John's reading of a book could have occurred on Monday, Tuesday, Wednesday, Thursday or Friday. It is quite a few days ago, if it happened on Monday. However, the auxiliary verb *have* is in the present, and these sentences can only occur with temporal adverbials denoting a time related to the present. Thus, it is ungrammatical for *two days ago* and *at ten o'clock* to cooccur with those sentences in the present perfect, as in (29). This perplexity gives linguists, logicians and philosophers a difficult time to determine whether the English present perfect is a tense or an aspect (cf. Brinton 1988:10, Comrie 1976:52). It is

claimed that no successful treatment of the present perfect in English has been formulated, though a few intuitive observations are available (cf. Günthner 1977).

In this section, I will first briefly review four previous approaches to the English present perfect: the current relevance theory, the indefinite past theory, the extended now theory, and the so-called pragmatic theory (cf. Binnick 1991, Brinton 1988, Klein 1992, McCoard 1978).[5] After the brief review, I will examine the temporal relations in the English present perfect in terms of the three dimensional temporal theory developed in this study. I will classify the English present perfect as a combination of tense and aspect, since it represents temporal relations in Linear Time and between Frame Time and Situation Time, as defined in this study. In addition, I think that the English present perfect represents a relation among the three dimensions, Linear Time, Frame Time and Situation Time, which makes the English present perfect different from the perfect in other languages, such as German.

5.2.1 PREVIOUS APPROACHES

The current relevance theory is one of the four theories about the English present perfect (cf. Comrie 1976:56-61, McCoard 1978:31-73). In this theory, 'relevance' is technically understood to refer to certain implications or suggestions (cf. McCoard 1978:31-32). How is the present perfect relevant to the present? There are at least four ways that the present perfect is considered to be relevant to the present (cf. Comrie 1976:56-61).

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[5] As a matter of fact, there is a fifth theory called the embedded past theory (cf. Binnick 1991, McCoard 1978). This theory covers what was developed in Bach (1967), Huddleston (1969) and McCawley (1971) in the generative grammar. I will not discuss this theory here, since it is not directly related to my discussion on this problem here.

First, a present situation is the result of some past event, as in (30).

(30) a. John has come here.
b. John came here.

(30a) in the present perfect implies that John is here, while (30b) in the simple past does not imply that John is here. This is what Comrie (1976:56) and Leech (1971:31-2) refer to as 'perfect of result' or 'resultative past'. Secondly, present experience is related to past situations, as in (31).

(31) a. John has been to China twice.
b. John has never been to China.

(31a) indicates that John has first-hand experience and information about China, which results from past events, while (31b) suggests that John does not have any first-hand experience or information about China, because of his inaction in the past. This is termed 'experiential perfect' or 'perfect of experience' (Comrie 1976:58). However, (31b) is considered a problem for current relevance theory (McCoard 1978:34). Thirdly, a present situation is a continuation of a past situation, as in (32), which is referred to as 'perfect of persistent situation' or 'universal perfect' (cf. Comrie 1976:60, McCawley 1971:104).

(32) a. John has lived here for two years.
b. John has studied at Michigan State University since 1990.

Both (32a) and (32b) indicate that the situations in question started in the past and continue to the present. By the time of the utterance, the situations still hold. Finally, a past situation is considered to be close to the present, as shown in (33) on the next page.

(33) a. John has recently bought a new car.
b. John has just left.

(33a) suggests that the event of buying a new car is so close that John still has a brand new car (cf. McCoard 1978:35). (33b) appears to suggest that the event of John's leaving is a few minutes from the present.

However, the current relevance theory as reviewed above does not provide any clue to the puzzle in (29) in terms of any or all four ways that 'relevance' is viewed. The current relevance theory does not account for why the present perfect cooccurs with certain temporal adverbials and not with others nor does it account for the existence of the implications or suggestions. It simply lists the implications. In addition, 'relevance' as defined still appears to be too subjective and too vague. Given a situation where John and Mary are bragging about their first-hand knowledge and information about China, John went to China twice, once two years ago and once a year ago, and Mary came back from China yesterday.

(34) a. I (John) have been to China twice.
b. I (Mary) just came back from China yesterday.

Doesn't (34b) suggest that Mary has more recent first-hand experience than (34a) suggests that John does? Thus, it is clear that the current relevance theory of the present perfect can not solve the present perfect puzzle.

The next theory in question is the indefinite past theory. In this theory, it is claimed that the present perfect locates situations somewhere before speech time without specifying a particular point of time in the past (cf. McCoard 1978:75-6). This theory draws a parallel between the definiteness and indefiniteness opposition in noun phrases and that in temporal expressions. Proponents of one or another version of this theory

are Allen (1966) and Diver (1963). In addition, according to McCoard (1978:88-96), Reichenbach's (1947) tense theory and Bull's (1960) tense theory both turn out to be variations of the indefinite past theory.

When definiteness and indefiniteness are understood in Hawkins' (1978) location theory of definiteness, a temporal expression is definite if it locates a particular point in a set of points of time shared by the speaker and the hearer, and otherwise, the temporal expression is indefinite. The indefinite past theory provide some clue to the present perfect puzzle in accounting for why some temporal adverbials may not cooccur with the present perfect, as in (35).

(35) a. John hasn't seen Mary *for some time.*
b. *John hasn't seen Mary *at six o'clock.*

The temporal expression *for some time* in (35a) does not locate a point of time that is known to the hearer/reader. Therefore, (35a) is grammatical. On the other hand, (35b) is ungrammatical, since the temporal expression *at six o'clock* locates a point of time that is identifiable by the hearer/reader. Further evidence is found in (36).

(36) a. *John has left *yesterday.*
b. *John has come *on Friday.*

This theory may be extended to account for the grammaticality of the sentences in the present perfect in (37).

(37) a. John has arrived.
b. John has been to China.

The sentences in (37) do not have any overt temporal expressions. Covert

temporal expressions do not seem to locate any known point of time that is not compatible with the present perfect, if we assume that there is any in (37). However, the indefinite past theory has a problem, given the definitions of definiteness and indefiniteness in Hawkins' location theory. In (38) below, the sentences in the present perfect occur with definite temporal expressions, and they are grammatical.

(38) a. John has left *today*.
b. John has been here *since last Friday*.

The temporal expressions *today* and *since last Friday* are definite in the sense that they locate a point or interval of time that is known to the hearer/reader. The theory can not explain the phenomenon observed in (38), unless it adopts a theory of definiteness and indefiniteness that excludes those temporal expressions as definite. That theory of definiteness and indefiniteness may not be parallel to any theory of definiteness and indefiniteness about noun phrases, if it is developed.

The third theory that I will review in this section is the extended now theory (cf McCoard 1978, Mittwoch 1988). In this theory, the present perfect is analyzed as the marker of prior events which are included within the overall period of the present, the 'extended now' (cf. McCoard 1978:123). More specifically, Bryan (1936:366-7) notes that the present perfect includes an action or state within a certain limit of time, which is a period that began in the past and extends up to or into the present. This theory pays particular attention to temporal adverbials with respect to their relationship with 'now'. Temporal adverbials are categorized according to their cooccurrence capabilities with the present perfect and the simple past in terms of the features of +THEN, -THEN and +/-THEN, as in (39)

(cf. McCoard 1978:135, Koziol 1958).

(39) a. -THEN: *at present*, *up till now*, *so far*, *lately*, *since ...*, *during ...*, etc.
b. +/-THEN: *today*, *in my life*, *for three days*, *recently*, *just now*, *already*, etc.
c. +THEN: *long ago*, *yesterday*, *those days*, *at six o'clock*, *after ...*, *last night*, etc.

The adverbials of the category of -THEN in (39a) are supposed to require the cooccurrence of the present perfect, as in (40).

(40) a. John *has written* three novels *up till now.*
b. *John *wrote* three novels *up till now.*

(40a) is grammatical, since there is a cooccurrence of the present perfect and the -THEN adverbial, *up till now*, whereas (40b) is ungrammatical, since the -THEN adverbial, *up till now*, may not cooccur with the simple past. On the other hand, temporal adverbials of the category of +/-THEN are supposed to appear in sentences in either the present perfect or the simple past, as in (41).

(41) a. John *has left* Detroit *today.*
b. John *left* Detroit *today.*

Both sentences in (41) are grammatical, though the +/-THEN adverbial *today* cooccurs with the present perfect in (41a) and the simple past in (41b). Finally, temporal adverbials of the category of +THEN is supposed not to cooccur with the present perfect but the simple past, as in (42).

(42) a. *John *has left* Detroit *long ago.*
b. John *left* Detroit *long ago.*

It is clear that it is ungrammatical for the +THEN adverbial *long ago* to cooccur with the present perfect in (42a).

The major problem for the extended now theory comes from temporal adverbials of the category of +/-THEN, as in (41), since the temporal opposition of the present perfect and the simple past may not be captured in terms of binary features. Adding the category of +/-THEN to temporal adverbials does not reveal the differences in temporal relations between the present perfect and the simple past, though in formal terms this category resolves the apparent conflict in cooccurrence phenomenon. From the cooccurrence compatibility between temporal adverbials and the present perfect, the extended now theory seems to point to the right direction of solving the present perfect puzzle, but it stops short of providing a final solution.

The last theory about the present perfect to be reviewed is the so-called pragmatic theory of the present perfect. Klein (1992:525) argues that the incompatibility of the present perfect and most past tense adverbials has neither syntactic nor semantic causes, but follows from a pragmatic constraint -- the position-definiteness constraint. In his theory, Klein proposes a distinction of three types of time spans in the interpretation of the English present perfect:

(43) a. TU: the time at which the utterance is made
b. Inf(inite)-time: the time which is related to whatever is expressed by the nonfinite component of the utterance, i.e. time of the event or situation (TSit for short)
c. Fin(inte)-time: the time which is related to whatever is expressed by the finite component, i.e Topic Time (TT for short), the time for which a claim is made

Klein's TU is equal to Reichenbach's (1947) point of speech, while his TSit

is equal to Reichenbach's point of the event. Thus, the first two types of time spans in Klein's theory are straightforward, but his TT needs some elaboration. According to Klein (1992:535), a witness in court may truthfully provide the answer in (44b), when he is asked the question in (44a).

(44) a. What did you notice when you checked the cellar?
b. The door was open. It was wooden.

The witness makes a claim only for a limited span of time in the past, namely, the time for which he is asked to make a claim, though the door may have been open for a long time and may be still open. The span of time in (44b) is the time when the witness checked the cellar. This span of time is Klein's TT. TU, TSit and TT are supposed to interact with each other to represent temporal relations in Klein's theory. For example, Klein distinguishes three temporal relations regarding the simple past, the present perfect and the future, when the relations between TT and TU are concerned, as illustrated in (45).

(45) a. John was in Detroit.
a' PAST: TT before TU (symbolized as TT < TU or TT< for short)
b. John is in Detroit.
b' PRESENT: TT includes TU (symbolized as TT_o)
c. John will be in Detroit.
c' FUTURE: TT after TU (symbolized as TT>TU or TT< for short)

In (45a), a claim is made about John at a time before TU, as (45a') indicates. In (45b), a claim is made about John at a time that includes TU, as represented in (45b'), while in (45c) a claim is made about John at a

time after TU as represented in (45c'). Klein notes that given two TT_os, TT_o' and TT_o", they may differ in duration, but TT_o' can not be before or after TT_o", while given two TT<s or TT>s, say TT<' and TT<", TT<' may be before TT<", after TT<" or they may overlap. Klein thinks that the present tense form specifies the former temporal relation. Thus, he refers to the present tense form as 'position-definite or p-definite', while he considers the past tense form and the future tense form non-position-definite or non-p-definite. In my understanding, the present tense form is p-definite, because TT includes TU in his theory. In addition, Klein treats some lexical expressions representing TSit as p-definite, as in (46).

(46) a. P-definite expressions: <John be in Detroit at six>,
<John be in Detroit on May 24th, 1993>, etc.
b. Non-p-definite expressions: <John be in Detroit>,
<John leave Detroit>, etc.

According to Klein (1992:544), the lexical content of the expressions in (46a) explicitly specifies the time span (TT) in relation to TU so that those expressions are p-definite, whereas the lexical content of the expressions in (46b) does not specify the time span (TT) in relation to TU so that they are not p-definite.[6]

In Klein's (1992:546) theory, the English present perfect puzzle is accounted for by what he refers to as a pragmatic principle, the p-definiteness constraint, as stated in (47) on the next page.

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[6] It seems to me that what are p-definite in (46a) are those temporal expressions *at six* and *on May 24th, 1993*, which are supposed to represent TT. Klein does not make this concept clear in his paper, though he refers to such temporal expressions as p-definite in passing (see Klein 1992:546). The relation between TT and TU specified lexically in (46a) is apparently different from that specified in the present perfect form.

(47) P-definiteness Constraint:
In an utterance, the expression of TT and the expression of TSit can not both be independently p-definite.

(47) is supposed to explain why the sentence in (48) is not acceptable.

(48) ??John has left Detroit at six.

In (48), the present tense form of *has* is p-definite, whereas the expression of TSit <John leave Detroit at six> is independently p-definite, as specified by the lexical content of *at six* in the expression. Thus, (48) violates the pragmatic principle in (47). Why does Klein refer to (47) as a pragmatic principle? According to Klein (1992:547), semantically it is not false to have both TT and TSit expressed by p-definite expressions and syntactically no rule forbids the coocurrence of two p-definite expressions. Therefore, in Klein's theory, (48) simply does not make sense, but it does not violate any syntactic or semantic rules.

It seems to me that Klein's theory has at least three problems. The first problem is his definition of p-definiteness. With regard to tense, he classifies the present tense form as p-definite, where TT includes TU, as shown in (45b'), while he classifies the past tense and future tense forms as non-p-definite, because TT and TU exhibit precedence relations, as shown in (45a') and (45c'). However, with regard to lexical expressions, he classifies a lexical expression as p-definite, if it specifies any relation between TT and TU at all, as in (46a). It is difficult to say that the expressions with *at six* and *on May 24th 1993* in (46a) specify the same temporal relation as the present tense form does in (45b'). Thus, it is clear that Klein does not have a single definition for p-definiteness that is applied universally. Second, his pragmatic account of the present perfect is not

viable. I think that (48) has a semantic problem, as decompositionally shown in (49), where (48) is repeated.

(49) ??John has left Detroit at six.
a. John has left.
b. John left at six.

The problem is that (49a) does not entail (49b), though (49b) may entail (49a), given an appropriate context. Specifically, if John has left, it is possible that he left at seven o'clock, eight o'clock or any time that is related to the present. There is no guarantee that John left at six, when the sentence *John has left* is true. Thus, there is a problem of semantic incompatibility when (49a) and (49b) are incorporated into one sentence as in (48) and (49).[7] Simply, if it is true that John has left, it is not necessarily ture that John left at six. Thirdly, Klein's theory does not provide any clue to implications or suggestions that the present perfect carries for recency, result, and experience related to the present. I believe that those features of the present perfect are pragmatic in nature, while the representation of temporal relations are not pragmatic but semantic or probably syntactic when they are grammaticalized. I think that Klein's theory is also developed along the line of the indefinite past theory without full recognition of the temporal relations represented in the English present perfect.

To sum up, I have reviewed four previous theories, the current relevance theory, the indefinite past theory, the extended now theory and the so-called pragmatic theory, about the present perfect in English. Each theory provides some insight into the present perfect puzzle from its own

[7] The semantic nature of this problem will be further discussed in subsection 5.2.3.

perspective, but none of these four theories provides a complete solution to the questions about it, such as the questions of the cooccurrence of the present perfect with temporal adverbials and of its current relevance.

5.2.2 RELATIONS AMONG THE THREE DIMENSIONS: SOLUTIONS

Like tense and aspect, the present perfect in English can also be accounted for in terms of the relations among the three dimensions of the representation of temporal relations in natural languages. I have shown in sections 3.1, 3.2 and 3.3 that tense is a grammaticalized representation of temporal relations in Linear Time, and shown in section 5.1 that aspect is a grammaticalized representation of temporal relations between Frame Time and Situation Time. I believe that the present perfect is a combination of a tense and an aspect, when temporal relations are considered in terms of Linear Time and in terms of Frame Time and Situation Time. I think that the present perfect in English represents more than those temporal relations. A solution to the present perfect puzzle and a full account for the meaning and implicatures of the present perfect rests on the relation between Linear Time and Frame Time, i.e. Frame Time temporally includes both *t* and S in Linear Time.

First, let's look at the temporal relations in the present perfect in terms of Linear Time. I have pointed out in section 3.2 that in English temporal relations in Linear Time are grammaticalized in the form of verb inflections. In the English present perfect, temporal relations in Linear Time are grammaticalized in the verb inflections too, as in (50).

(50) a. John has br*oken* a glass.
b. John and Mary have mov*ed*.

In (50), the past participle morphemes attached to the verbs represent the relation of *being earlier than*. However, unlike the morpheme of the past, the past participle morpheme does not specify what the point of time they represent is earlier than. It is like the infinitive in the sense that it depends on others for a specific relation, as in (51).

(51) a. *Being moved*, John donated five hundred dollars.
b. *Having moved*, John and Mary have lost some mail.

In both (51a) and (51b), the past participle morphemes indicate that the situations referred to by those verbs *being moved* and *having moved* precede the situation referred to by the verbs in the main clauses, and thus precede the speech time. In the present perfect, the earlier-than relation represented by the past participle morpheme is specified by the auxiliary *have* as being earlier than S, since *have* is in the present form. Thus, the temporal relation in (51) may be represented as (52) in Linear Time.

(52) $(t < S)$

The present perfect is similar to the simple past in Linear Time, since sentences in the simple past represent exactly the same temporal relation in Linear Time. This is the tense perspective of the present perfect in English.

Now, we can look at the aspect perspective of the present perfect in English. Verbal aspect represent the temporal relations between Frame Time and Situation Time in terms of temporal inclusions, as I have discussed in section 5.1. What is the relation between the present perfect and the perfective aspect? First, I review the definition for the perfective aspect in (53), which is repeated from (10), and that for the imperfective in

(54), which is repeated from (14).

(53) a. Frame Time temporally includes the Situation Time of a situation, iff Situation Time does not begin earlier nor end later than a frame of Frame Time
b. PERF: ST$\in$ FT, where $\in$ symbolizes temporal inclusion

(54) a. Frame Time (FT) partially includes the Situation Time (ST) of a situation temporally, iff Situation Time begins earlier and ends later than a frame of Frame Time or begins earlier than a frame of Frame Time or ends later than Frame Time.
b. IMPERF.: ST $\propto$ FT, where $\propto$ symbolizes partial temporal inclusion.

In English, the present perfect has two forms, the simple and the progressive. I examine the simple form and the progressive form in relation to the definition in (53). The present perfect in its simple form clearly shows a perfective interpretation, in contrast to its progressive form, when it is used with verbs referring to inherently bound situations, as in (55a).

(55) a. John has written a book. (ST$\in$ FT)
b. John has been writing a book. (ST $\propto$ FT)

The present perfect in its progressive form does not have a perfective interpretation but an imperfective interpretation, as in (55b). Therefore, we may say that the present perfect in its simple form is related to the perfective aspect, while it is not when it is in its progressive form. This seems to be fine with verbs referring to inherently bound situations (cf. McCoard 1978:141-145). How does it fare in the case of verbs that refer to inherently nonbound situations? Comrie (1976:60) refers to this type of present perfect as 'perfect of persistent situation', as in (56).

(56) a. Mary has shopped here for three years.
b. Mary has lived here for ten years.

The situations in (56) are said to continue from the past up to the present. Will those situations continue to the future? I think that the present perfect in its simple form does not represent any temporal relations that indicate it is the case, nor do those verbs indicate so. This is illustrated in (57).

(57) a. Mary has shopped here for three years, but she begins to shop in the new mall today.
b. Mary has lived here for ten years, and today she is moving to Ohio.

The added clauses in (57) apparently do not contradict what are stated in the clauses in the present perfect. Thus, we can say that the present perfect in those sentences represents a temporal inclusion relation, as stated in (53). However, the present perfect in its simple form does not indicate either that the situations will not continue, as in (58).

(58) a. Mary has shopped here for three years, and she will still do so for another year.
b. Mary has lived here for ten years, and she will live here for the rest of her life.

The added clauses state that the situations will continue, but the statements do not contradict what are stated in the clauses in the present perfect either. This is in a sharp contrast with the sentence in (55a), which is in the present perfect in its simple form with a verb referring to an inherently bound situations, as in (59).

(59) a. John has written a book, and he is reading it now.
b. ?John has written a book, and he is writing it now.

(59a) shows that the situation is complete so that John may read the book, which is the result of the situation of writing a book. (59b) further indicates that the situation is complete so that John can not continue it. Therefore, I think that I can state that in terms of grammaticalization Frame Time temporally includes Situation Time in the present perfect in its simple form, regardless of the distinction in the inherently bound and nonbound situations. In the case of the present perfect in its progressive form, as in (55b), Frame Time only partially includes Situation Time temporally.

What makes the English present perfect different from the simple past is not the temporal relations in Linear Time nor those between Frame Time and Situation Time. The English present perfect represents a temporal relation between Linear Time and Frame Time, as stated in (60).

(60) a. Frame Time (FT) temporally includes $t < S$ in Linear Time, when neither point occurs earlier or later than one single frame of Frame Time.
b. PRE(sent) PERF(ect): $t \in FT$ & $S \in FT$, where $t < S$, two FTs are identical and $\in$ symbolizes temporal inclusion

With (60), I can account for the syntactical cooccurrence puzzle of the present perfect with temporal adverbials, where previous approaches fail. They fail, since they do not recognize the grammaticalization of the temporal inclusion relation between Frame Time and Frame Time, as stated in (60). (60) can predict what temporal adverbial may or may not cooccur with the present perfect. For example, (60) correctly predict that the sentences in the present perfect in (61) are acceptable, since they do not represent the kind of temporal relations stated in (60).

(61) a. John has written a book *this year.*
a' t ∈ FT & S ∈ FT, where t < S and FT = *this year*
b. John has seen Mary *this morning.*
b' t ∈ FT & S ∈ FT, where t < S and FT = *this morning*

The sentence in (61a) is necessarily uttered within the interval of *this year* for it to be true. The sentence in (61b) is necessarily uttered within the interval of *this morning*, not even with other intervals of *today* like *this afternoon* and *this evening*. On the other hand, (60) correctly predicts that the sentences in the present perfect in (62) are not acceptable, since they do not represent the kind of temporal relations stated in (60).

(62) a. ??John has written a book *last year.*
a' t ∈ FT & S ∉ FT, where t < S and FT = *last year*
b. ??John has seen Mary *yesterday.*
b' t ∈ FT & S ∉ FT, where t < S and FT = yesterday

In (62), S(peech time) is not temporally included in the frame of Frame Time. S is in the present, while the frame of Frame Time is in the past. There is a discontinuity between *t* and S in terms of Frame Time. Thus, (60) accounts for part of the puzzle: the problem of the cooccurrence of the present perfect and the temporal adverbials.

Two other questions about the present perfect also pose problems for some of the previous approaches. These two questions are why sentences may occur in the present perfect without any Frame Time adverbials and why sentences in the present perfect may cooccur with temporal adverbials like *recently*, *lately*, *just* and *before*. I think that these two questions can be satisfactorily answered in my approach. First, let us look at some sentences that may occur in the present perfect without any Frame Time adverbial, as shown in (63).

(63) a. John has written a book.
b. John has seen Mary.

I want to argue that the sentences in (63) do not have overt Frame Time adverbials but have covert Frame Time adverbials. The contexts in which the sentences in (63) may occur must have established Frame Time that is compatible with the present perfect. In other words, it may be said that the Frame Time adverbials are omitted, because of the demonstrative use of the Frame Time adverbials.[8] In this sense, appropriate Frame Time adverbials are recoverable from the contexts where the sentences in (63) may occur. This is illustrated in (64) and (65), where (63b) occurs in an appropriate context and an inappropriate context respectively.

(64) a. Why is John so happy this evening?
b. He (John) has seen Mary (this evening/today).
(65) a. Why was John so happy yesterday?
b. ??He (John) has seen Mary *yesterday/*last night.

Given the context in (64a), Frame Time adverbials like *this evening* and *today* may be recovered so that (64b) may occur appropriately in the present perfect tense. On the other hand, given the context of (65a), no appropriate Frame Time adverbials may be recovered so that (65b) does not occur appropriately in the present perfect. Second, the observation that the present perfect cooccurs with *recently*, *lately*, *just* and *before* , as in (66), poses a problem for some of the above authors' accounts of the present perfect (cf. Klein 1992:547-9, McCoard 1978:129-35).

(66) a. John has *recently/lately/just* written a book.
b. John has been to Detroit *before*.

[8] I will discuss the demonstrative nature of Frame Time adverbials in section 5.3.

I argue that this observation can also be accounted for in my approach. The first three adverbials indicate a certain immediacy or closeness in precedence relations. As a combination of tense and aspect, the present perfect represents precedence relations as I have discussed above and illustrated in (52). It is acceptable for the present perfect to cooccur with adverbials that do not refer to a frame of Frame Time that is discontinuous with the frame of Frame Time which includes S.[9] The bare *before* in (66b) also represents some precedence relation, which is allowed in the present perfect, as I have argued above. Similarly, in (66b), the bare *before* does not refer to a frame of Frame Time that is discontinuous with the frame of Frame Time that temporally includes S. However, it is ungrammatical for the present perfect to occur with a *before* expression, when that expression denotes a frame of Frame Time that is discontinuous with the frame of Frame Time temporally including S, as in (67).

(67) ??John has been to Detroit *before five o'clock/yesterday.

In (67), the expressions *before five o'clock* and *before yesterday* indicate that the frame of Frame Time referred to is discontinuous with the frame

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[9] For example, we can see a discontinuity with two frames in Frame Time in (62a), which is repeated here as (i).

(i) ??John has written a book *last year.*
(ii) ??*This year*, John has written a book *last year.*
(iii) *$t \in FT^1$ & $S \in FT^2$, where $t < S$, FT^1 = *last year* and FT^2 = this year

The sentence in (i) has a covert Frame Time adverbial that temporally includes S, as is the case in a sentence in the present perfect without an appropriate Frame Time adverbial. Given a context, the sentence in (i) may recover *this year* as its Frame Time adverbial, as shown in (ii). The temporal relations in (i)/(ii) are represented in (iii), which indicates that *t* and S are temporally included in two discontinuous frames of Frame Time, *last year* and *this year*, respectively. (iii) clearly shows that (i)/(ii) violates (60).

of Frame Time temporally including S. Thus, (67) is ungrammatical.

In short, I have shown that the present perfect in English is a combination of tense and aspect, since it represents temporal relations in Linear Time and relations between Frame Time and Situation Time. I have pointed out that the English present perfect is unique in that it represents a temporal relation between Linear Time and Frame Time, in which case a frame of Frame Time temporally includes both *t* and S. This temporal relation is grammaticalized in the present perfect in English. This type of temporal relation stated in (60) accounts for the cooccurrence of the present perfect and different temporal adverbials. In a sentence, the present perfect can cooccur with referring temporal expressions that denote frames of Frame Time including both *t* and S in Linear Time. In addition, the present perfect can cooccur in a sentence with non-referring temporal expressions that do not indicate discontinuity in the frame of Frame Time temporally including *t* and S. Thus, there is only one problem left unanswered about the present perfect: the current relevance. This is to be answered in the following subsection.

5.2.3 SEMANTICS VS. PRAGMATICS IN THE PRESENT PERFECT

It appears to me that there is a confusion about the present perfect. Some theories, such as Klein's (1992) try to account for the present perfect in terms of pragmatics and to deny its semantic significance. On the other hand, others, such as the current relevance theory (cf. Comrie 1976, McCoard 1978) try to explain it in terms of its semantic and pragmatic consequences. In this section, I plan to sort out what are semantic problems and what are pragmatic problems with respect to the present perfect.

First, I argue that the problem with the sentence in (68) is semantic

in nature, while Klein (1992:545-47) argues is pragmatic since it just violates his p-definiteness constraint that he considers a pragmatic constraint.

(68) a. ??*Today*, John has read a book *at six*.
b. ??*Today*, John has seen Mary *yesterday*.

I think that the problem is semantic, since temporal relations are truth-conditional. Both sentences in (68) violate (60) which defines what temporal relations the present perfect represents. For example, (68a) involves two Frame Time adverbials which refer to two discontinuous frames of Frame Time respectively. The Frame Time adverbial *at six* refers to a smaller frame that is temporally included in a larger frame of Frame Time referred to by the Frame Time adverbial *today*. In section 3.4, I have shown in detail that temporal inclusion relations in Frame Time exhibit some logic behaviors as defined in (69), which is repeated from (67) in section 3.4.

(69) sf --> sF; sF -/-> sf, iff f $\in$ F, where sf = a sentence with a smaller frame of Frame Time, sF = the same one with a larger frame of Frame Time which contains the smaller frame of Frame Time, --> = implies, and -/-> = not imply

In addition to the violation of (60), the sentence in (68a) also has a problem with (69). In (68a), the Frame Time adverbial *today* temporally includes both *t* and S, while the Frame Time adverbial *at six* also temporally includes *t*. According to (69), if it is true that John has read a book today, it is not necessarily true that John read a book at six, though it is true that

John has read a book today, if he read a book at six today.[10] There is an incompatibility in truth conditions, if (68a) is decomposed. In (68b), the Frame Time adverbial temporally *today* includes S, but the Frame Time adverbial *yesterday* temporally includes *t*. If (68b) entails that John has seen Mary today, then (68b) does not entail that John saw Mary yesterday or vice versa, since those two Frame Time adverbials refer to two discontinuous frames of Frame Time.

Second, current relevance associated with the present perfect appears in the form of recency, result and experience related to the present (cf. Comrie 1976:56-60, McCoard 1978:31-44). Current relevance is used to explain the present perfect in some approaches (McCoard 1978, Comrie 1976). I think that those theories approach the present perfect in the wrong direction. I believe that current relevance is some kind of generalized conversational implicature associated with the present perfect (cf. Levinson 1985:126-32). This implicature is based on the grammaticalized temporal relation that a continuous frame of Frame Time temporally includes both *t* and S. Figuratively speaking, we tend to think that everything is related in a big building when we have that building in our mind. We tend not to consider that everything in that building is related when we have a room or some rooms in that building in our mind. More specifically, there is a parallelism between the deictic nature of temporal expressions and place-deictic expressions (Lyons 1977). A Frame Time expression that refers to a frame of Frame Time temporally including both *t* and S is like the deictic expression *here*, while a Frame Time expression that refers to a frame of

[10] The sentence *John has read a book today* does not imply that John has read a book this morning, since John could have read the book during any time of the day before the utterance.

Frame Time temporally only including *t* is like the deictic expression *there*. When we use *here*, there is the implicature that everything within the domain of *here* is physically closer to us and more related to us than everything within the domain of *there* is. This is also true for temporal expressions. Thus, there is the implicature that *t* and S are more related and temporally closer, when one frame of Frame Time temporally includes both of them in a grammaticalized form, as in (70a). They appear less related and temporally less close when the temporal inclusion relation is not grammaticalized, as in (70b), and even less related and temporally less close when they are temporally included in different frames of Frame Time, as in (70c).

(70) a. John has read a book *this week.*
b. John read a book *this week.*
c. John read a book *last Monday.*

Grammaticalization of this kind of temporal relation is very important to the implicature of the current relevance, as shown in (71) (cf. Brinton 1988:11-12).

(71) a. ??Today, John has read a book, but forgot what it says.
b. Today, John read a book, but forgot what it says.

The two sentences in (71) have the same truth conditions, but (71a) has the grammaticalized present perfect form with the implicature of recency, while (71b) does not. However, (71a) is not acceptable, since the speaker violates pragmatic maxims in uttering those two clauses in a sequence (cf. Grice 1975, 1978, Levinson 1983:100-18). (71b) is acceptable, since there is no such implicature from the simple past. Chinese provides further

evidence that grammaticalization of the temporal relation in question makes a difference, as in (72).

(72) *Jintian* Zhang kan le yiben shu, ke wan le shu de neirong.
Today John read Asp. one book but forget Asp. book 's content
Today, John read a book, but forgot the content of the book.

(72) is as acceptable in Chinese as (71b) is in English. In Chinese, there is no present perfect in the grammaticalized form, but only a simple past with an aspect marker indicating completion.

In short, I have discussed the semantic-pragmatic distinction with respect to the present perfect. I have argued that the unacceptability in a sentence in the present perfect with two frames of Frame Time results from a semantic incompatibility, in contrast to the claim (Klein 1992) that it is pragmatic. On the other hand, I have argued that current relevance associated with the present perfect is an implicature from the grammaticalization of the temporal relation that a continuous frame of Frame Time temporally includes *t* and S.

5.2.4 SUMMARY

The present perfect in English has been a puzzle for linguists, logicians and philosophers. Among many theories about it, I have briefly reviewed the current relevance theory, the indefinite past theory, the extended now theory, and a so-called pragmatic theory (cf. Brinton 1988, Comrie 1976, Klein 1992, McCoard 1978). I think that the current relevance theory does not provide any insight into the temporal relations represented in the present perfect, since current relevance is just an implicature from the grammaticalization of the temporal relations in the

present perfect. In the indefinite past theory, advocators seem to realize that a definite temporal expression does not cooccur with the present perfect, but they do not recognize that it is a definite temporal expression representing a discontinuous frame from the one that temporally includes S. As a result, they have to assign definite temporal expressions like *today*, *this week*, and *this year* an indefinite feature, giving up their parallelism between definiteness and indefiniteness in noun phrases and those in temporal expressions. I think that the extended now theory provides some insight into the temporal relations in the present perfect in relating *t* to *S*. However, this theory does not realize the exact nature of how *t* and S are related, as witnessed in the categorization of temporal expressions in terms of -THEN, +THEN, +/-THEN, the last of which includes *today*, *recently*, and *now*. This last category is adopted to account for the cooccurrence of those temporal adverbials with both the present perfect and the simple past. The extended now theory does not recognize that the distinction between the present perfect and the simple past lies in the grammaticalization of the temporal inclusion of both *t* and S by one single frame of Frame in the former and the lack of the grammaticalization of that relation in the latter. Klein's (1992) pragmatic theory does not recognize either the importance of the grammaticalization of the temporal inclusion of both *t* and S by one single frame of Frame Time in the present perfect, since his solution to the present perfect puzzle is basically developed along the line of the indefinite past theory. In addition, Klein does not correctly distinguish what is semantic and what is pragmatic with respect to the present perfect in his theory.

Unlike all previous theories (cf. Brinton 1978, Comrie 1976, Klein 1972, McCoard 1988), my account of the present perfect does not create

any ad hoc categories or notions for that purpose only, but is based on the three dimensions of the representation of temporal relations in natural languages. These three dimensions, Linear Time, Frame Time and Situation Time account for a large range of linguistic phenomena concerning temporal relations in languages. Temporal relations among the three dimensions are universal in all natural languages, though grammaticalization of the relations among the three dimensions may be subject to parameterization (cf. Anderson 1982, Smith 1991). In my three-dimensional theory, the present perfect is considered a combination of tense and aspect, since it represents precedence relations in Linear Time and temporal inclusion relations between Frame Time and Situation Time. What makes the present perfect different from the simple past is the grammaticalization of the temporal inclusion of both *t* and S in Linear Time by a one single frame of Frame Time in the present perfect. This grammaticalized temporal relation is associated with an implicature in the form of recency, result, experience, etc. that are considered to be related to the present (cf. Brinton 1988, Comrie 1976, Hirtle 1975, McCoard 1978). Moreover, the theory developed in this study shows that problems of cooccurrence of some temporal adverbials and the present perfect result from semantic incompatibility concerning truth conditions for the sentences in question (cf. Klein 1992, McCoard 1978).

5.3 THE PROBLEM OF STRUCTURAL ANALOGIES BETWEEN TENSES AND PRONOUNS

It is generally agreed upon that tense in natural languages has a deictic function (cf. Binnick 128-9, Comrie 1985:13-8, Heny 1982:109-13, Mellor 1981:1-12, Partee 1973, Richards 1982, Smith 1991:36-9). Tense is

considered deictic or indexical in the sense that tense locates situations to a point of time as reference, such as speech time, as a deictic system relates entities to a reference point (Comrie 1985:14-5).

Analogies are generally made between tenses and English *here* and *there* in their deictic function. *Here* refers to the location where the speaker is, and *there* refers to any location that is away from the speaker. In the tense system, the present tense refers to the location in time where the speaker is at that point, while other tenses refer to any location of time that is away from where the speaker is in time. It is noticed that in some languages, such as Tuscan Italian (Comrie 1985:14), there is a second *there* which refers to a location away from two speakers who are in different locations. The English *there* may have this function as well. When two people talk on the phone and refer to a third person's physical location, *there* may be used to refer to a location away from both speakers. With *here* and two *there*s, the analogy may better fit in the tense system, where the present tense refers to a temporal location where the speaker is now, the past tense refers to a temporal location away in the past and the future tense refers to a temporal location away in the future. Thus, we may safely say that there is an analogy in deictic functions between *here-there-there* and *now-then-then* in tenses, since *then* can refer to a temporal location away from *now* either in the past or in the future. There appears to be no problem for that analogy in deictic functions.

Further, Partee (1973) proposes that some structural analogies can be made between tenses and pronouns. I think that this notion is problematic. I will briefly review Partee's proposal, and show in terms of the three dimensional temporal theory that Partee's analogies are problematic. I think that the deictic function of tenses is limited to the *here-*

there analogy discussed above. In addition, I will show that structural analogies may be made between Frame Time adverbials and pronouns along the dimension of Frame Time, instead of between tenses and pronouns along the dimension of Linear Time.

5.3.1 PARTEE'S PROPOSAL

Partee (1973) claims that some structural analogies can be made between tenses and pronouns. In her proposal, she notes that parallels exist between tenses and pronouns in demonstrative use and anaphoric use.

In the demonstrative use, the parallelism of tenses and pronouns is said to be found in the pair of sentences in (73), when *he* and the past tense are considered.

(73) a. *He* shouldn't be in here.
b. I *did*n't turn off the stove.

According Partee, *he* in (73a) does not refer to simply anybody, but to a particular person. The referent of the pronoun *he* may be either identified by a gesture to point out the person or by the (linguistic or extralinguistic) context that the hearer shares with the speaker. By the same token, in Partee's analysis, (73b) does not simply refer to some point in the past at which (73b) holds or (73b) does not hold, when (73b) is uttered. Rather, (73b) refers to a particular point or interval of time whose identity is clear from the extralinguistic context. Thus, the past tense in (73b) refers to the interval of time before the speaker left his or her house, when it is uttered halfway down the turnpike. In its deictic use, the present perfect tense is said to have a unique and unambiguous referent, like the pronoun *I*, while the past tense, like the pronoun *they*, appears to be vaguer in its referent, as

in (74).

(74) a. *They* haven't installed my cable TV yet.
b. John *went* to a private school.

In (74a), the pronoun *they* does not refer to some particular referents but to whoever it is supposed to install the cable. The past tense in (74b) is said not to refer to a particular interval of time, but to refer to whenever it was that John went to school. Partee thinks that a temporal adverbial is like a based-generated topic structure, when it occurs, as in (75).

(75) a. *The woman in red, she* almost ruined my life.
b. John *visited* her *last Monday.*

In (72a), the pronoun is redundant, while in (75b) the past tense is redundant, since nominal expressions have already specified their referents.

In the anaphoric use, the parallelism of tenses and anaphors is said to be found in the pair of sentences in (76).

(76) a. Mary bought *a new car*, and John wrecked *it.*
b. Mary had a party *last weekend*, and John *got* drunk.

The pronoun *it* anaphorically refers to the referent designated by the noun phrase *a new car* in the previous clause in (76a), where the noun phrase *a new car* serves as the antecedent for the pronoun *it.* In (76b), it is said that the past tense in the second clause refers anaphorically to the interval of time that is denoted by the temporal expression *last weekend* in the first clause. Further, Partee notes that tenses and pronouns function as bound variables in (77).

(77) a. If any arrow hits the target, *it* is mine.
a' ∀x (x hits the target --> x is mine)
b. If Mary *comes* in, John *will leave immediately.*
b' ∀t (Mary comes in (t) --> John will leave (Imm(fut))(t)))

In (77a), *any arrow* is not interpreted as referential but as universal. Thus, the pronoun *it* is a variable bound by a universal quantifier, as in (77a'). In (77b), in a universal interpretation, the *if*-clause present tense does not refers to a particular time, but to every time when Mary comes. Partee treats the future tense in the main clause in (77b) as *the present tense + will*, the former of which is bound, as a variable, by the present tense in the *if*-clause, as in (77b'). In Partee's analysis, the same phenomenon can be found in similar sentences with an existential interpretation.

In the above, I have briefly presented Partee's analysis in which a parallelism is drawn between tenses and pronouns in terms of deictic functions and anaphoric behaviors. I believe that it is problematic to compare tenses to pronouns in this way, though a parallelism between tense and *here-there-there* is generally right.

5.3.2 ANALOGIES ON THE DIMENSION OF FRAME TIME

In the three-dimensional temporal theory developed in this study, tense belongs to the dimension of Linear Time. In Linear Time, tense represents relations between points of time with speech time as the anchor. Thus, tense does not refer to intervals of time nor instants of time, since it does not have any referential function. Tense only represents temporal relations, as defined in (78), which is repeated from (9) in section 3.1.

(78) Linear Time is a set of points of time without duration but with precedence ordered in relation to speech time in a linear structure.

The notion that tense represents relations between pairs of times is not new (cf. Binnick 1991:128), though I have argued for a unique dimension of representation of this type of temporal relation. The idea is clearly illustrated in the sentences in (79).

(79) a. John left Detroit (yesterday).
a' (t < S)
b. John will leave Detroit (tomorrow).
b' (S > t)

The past tense and the future tense in (78) are not referring expressions but represent relations of being-earlier-than or being-later-than. The question may be what refers to *t* and S. The referential function belongs to the dimensions of Frame Time and Situation Time, as I have argued in sections 3.4 and 4.1. From the point of view of Situation Time, verbs refer to situations that instantiate *t* in terms of instants or intervals of time depending on the type of verb involved. From the point of view of Frame Time, Frame Time adverbials are referring temporal expressions that refer to *t* , S or intervals of time including *t*, S or both, depending on the context. Therefore, tenses do not have referential functions. This is where Partee's (1973) proposal goes wrong. What exhibits the demonstrative and anaphoric behaviors in Partee's sample sentences if tenses do not ? I argue that Frame Time adverbials have a demonstrative function and anaphoric behaviors that are structurally parallel to those of pronouns in some degree.

In the demonstrative use, Frame Time adverbials and pronouns are generally omitted in *here*-and-*now* situations, as in (80) and (81).

(80) a. (You) wash the dishes (now).
b. (You) turn down the radio (now).
(81) a. Where are you going (*now*) ?
b. (I am going) to school (now).

In (80) and (81), the pronouns are omitted, and so are the Frame Time adverbials, as shown in the parenthesis. This omission is limited to *here-and-now* situations, since interpretation of those pronouns and Frame Time adverbials have already been established. When need arises, those pronouns and Frame Time adverbials occur to specify *who* and *when*, as in (80') and (81'), which are the emphatic forms of the sentences in (80) and (81).

(80') a *You* wash the dishes *now*!
b *You* turn down the radio *now*!
(81') a. Where are you going *now* ?
b. *I* am going to school *now*.

In addition, the missing pronouns and Frame Time adverbials in (80) and 81) are grammatical constituents of those sentences so that they can be recovered in questions, since Wh-expressions are underlying grammatical elements of either the main clause, or a subordinate clause, if there is one, in those questions (cf. McCawley 1988:468-469). The questions in (82) and (83) are made from those statements in (80) and (81).

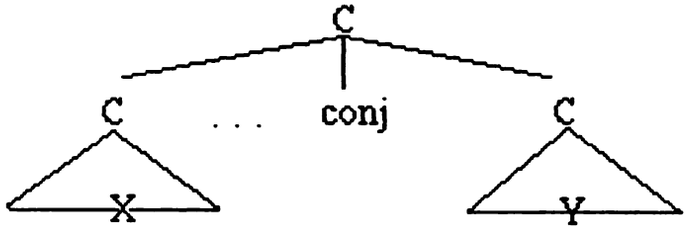
(82) a. *Who* do you ask to wash the dishes ?
b. *You*.
(83) a. *When* do you ask me to wash the dishes ?
b. *Now*.

In response to (80a), the hearer may ask the speaker to specify *who* he asks to wash the dishes, as in (82a), if the hearer is not sure *who* the speaker asks. The missing pronoun is recovered in the question form and then in

the answer in (82). The Frame Time adverbial can be recovered in the same manner, as in (83), where the hearer simply asks the speaker *when* he asks him to do it in response to (80a). Thus, the evidence appears to indicate that the missing pronoun and Frame Time adverbial in (80) are at least underlying grammatical elements of those sentences in question. The examples show that in demonstrative use Frame Time adverbials and pronouns share a number of features in syntax and semantics.

In the anaphoric use, Frame Time adverbials exhibit anaphoric behaviors that are parallel to those of pronouns in several ways. In a coordinate structure, like (84a), an anaphor may not violated the condition stated in (84b), as is pointed out by McCawley (1988:336-40).

(84) a.



b. An anaphoric device X may not precede its antecedent Y if either (i) X is in one conjunct of a coordinate structure and Y in a later conjunct or (ii) X commands Y.

In a coordinate structure as described in (84a), Frame Time adverbials like pronouns observe (84b) for an anaphoric interpretation, as in the sentences in (76), which is repeated here as (85).

(85) a. Mary bought *a new car*, and John wrecked *it*.
b. Mary had a party *last weekend*, and John got drunk *f*.

In (85a), the nominal antecedent *a new car* precedes the anaphoric *it*, and in (85b) the nominal antecedent *last weekend* precede an anaphoric Frame

Time *f* which is not linguistically overt. Thus, the anaphoric *it* refers to the referent of *a new car*, and the anaphoric Frame Time *f* refers to the referent of *last weekend.* When (84b) is violated, this interpretation does not exist, as shown in (85').

(85') a. ?Mary bought *it*, and John wrecked *a new car.*
b. ?Mary had a party *f*, and John got drunk *last weekend.*

In (85'a), backward pronominalization is odd, if it is not ungrammatical (cf. McCawley 1988:338).The backward 'pronominalization' for the anaphoric Frame Time *f* and its antecedent *last weekend* is strange too in (85'b). In addition to the problem of acceptability in backward pronominalization, the pronoun *it* in (85'a) does not necessarily refer to the referent of *a new car* nor does the anaphoric Frame Time *f* in (85'b) necessarily refer to the referent of *last weekend.*

Like a pronoun, an anaphoric *f* of Frame Time adverbials may identify with its antecedent several clauses away in a discourse, as in (86).

(86) *John* lived in Massachusetts *during the thirties*. *He* was taken care of by *his* grandparents who wanted *him* to have a good education *f*. *He* went to a private school *f*.

In (86), *John* is the antecedent for *he*, *his* and *him* in the following sentences, while the Frame Time adverbial *during the thirties* is the antecedent for the anaphoric Frame Time *f* in the following sentences as well.[11] However, in discourse, an anaphoric *f* of Frame Time is not as

[11] In section 5.1, I have briefly reviewed approaches to verbal aspect as viewpoints in syntax and semantics (cf. Comrie 1976, Smith 1991) or as perspectives in discourse studies (cf. Hopper 1982, Thelin 1990). It still remains a question how syntactic and semantic studies of aspect and discourse studies of aspect may be unified at some level. In my study, the temporal relations between Frame Time and Situation Time are considered

vague as pronouns, as Partee (1973) claims in discussion of sentences like those in (74) above, which is repeated here as (87).

(87) a. *They* haven't installed my cable TV yet.
b. John went to a private school *f*.

The pronoun *they* is vague in its referents in (87a), but the anaphoric *f* of Frame Time is not vague at all given a context in which this sentence is uttered or written. For example, (87b) may occur in the context of (86), where the anaphoric *f* of Frame Time has a definite antecedent in discourse.

In short, I have demonstrated with evidence from English that Frame Time adverbials can be used demonstratively and anaphorically like pronouns. In the demonstrative use, omitted Frame Time adverbials like pronouns may occur overtly in emphatic forms or may be recovered in questions and answers. In the anaphoric use, anaphoric Frame Time *f* is constrained, by rules that govern the relation between an anaphor and its antecedent, in its relation with the antecedent referring Frame Time adverbial. On the other hand, anaphoric Frame Time *f* may establish an anaphoric relation with its antecedent several clauses away in discourse, as a pronoun does in the same context.

5.3.3 SUMMARY

I have briefly reviewed the notion that tense in natural languages has a deictic function (cf. Binnick 128-9), Comrie 1985:13-8, Heny 1982:109-

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the mechanisms for the aspect camera to get viewpoints. Given this assumption, Frame Time may be the missing link between verbal aspect proper (syntactic and semantic) and discourse functions of verbal aspect. This is a promising direction of study in verbal aspect, but I am not able to pursue this topic in the present study.

13, Mellor 1981:1-12, Partee 1973, Richards 1982, Smith 1991:36-9). It is generally agreed upon that the deictic function of tense exhibits a parallelism with *here-there-there* (cf. Comrie 1985:14-5). However, I do not agree with Partee (1973) on her proposal that structural analogies exist between tenses and pronouns in terms of demonstrative use and anaphoric behaviors. Her proposal is problematic for a single reason that tenses are not referential expressions but simply represent temporal relations, such as being earlier than or later than. In my theory of the three dimensions of representation of temporal relations, tenses belong to the dimension of representation of Linear Time. In fact, structural analogies do exist between pronouns and Frame Time adverbials in demonstrative use and anaphoric behaviors on the dimension of Frame Time.

5.4 SUMMARY OF CHAPTER FIVE

My concern in this chapter is the significance of the three dimensional theory of the representation of temporal relations in natural languages. Among many problems about temporal relations in natural languages, I have discussed three problems, i.e aspect as viewpoints, the present perfect puzzle and the fallacy of structural analogies between tenses and pronouns, within the framework of the three dimensional theory developed in the present study.

Aspect is considered to consist of viewpoints or perspectives in syntactic and semantic studies (cf. Binnick, 1991, Comrie 1976, Smith 1991) and in discourse studies (cf. Hopper 1982, Thelin 1990), and also as different ways of viewing the internal constituency of a situation (Comrie 1976:3). However, these approaches leave two questions unanswered: i) what mechanisms underlie the aspect camera's lens for viewpoints and ii)

whether aspects only view a situation internally. I have illustrated with evidence from Chinese, English and some Bantu languages that the the temporal inclusion relations between Frame Time and Situation Time are the mechanisms for verbal aspect as viewpoints. In the perfective aspect, Frame Time temporally includes Situation Time, while in the imperfective aspect, Frame Time only partially includes Situation Time temporally. I think that the relations between Frame Time and Situation Time are universal in verbal aspect. On the other hand, the evidence from the difference between the grammaticalized inchoative aspect in Chinese and lexical items expressing the inchoative meaning in English seems to suggest that the grammaticalization of universal temporal relations as aspect is subject to parameterization. Finally, I have demonstrated with linguistic evidence in the habitual aspect in English that verbal aspects do not only view situations internally but also externally in relation to the size of a frame of Frame Time and to the number of repetitions of a situation.

The present perfect in English has been a puzzle for linguists, logicians and philosophers. Among many theories about it, I have briefly reviewed the current relevance theory, the indefinite past theory, the extended now theory, and a pragmatic theory (cf. Brinton 1988, Comrie 1976, Klein 1992, McCoard 1978). The current relevance theory does not provide any insight into the temporal relations represented in the present perfect, since current relevance is just an implicature from the grammaticalization of the temporal relations in the present perfect. In the indefinite past theory, advocators seem to realize that a definite temporal expression does not cooccur with the present perfect, but they do not recognize that it is a definite temporal expression representing a discontinuous frame from the one that temporally includes S. I think that

the extended now theory provides some insight into the temporal relations in the present perfect in relating *t* to *S*. Unfortunately, this theory does not realize the exact nature of how *t* and S are related, as demonstrated in the categorization of temporal expressions in terms of -THEN, +THEN, +/-THEN, the last of which includes *today*, *recently*, and *now*. The extended now theory does not recognize that the distinction between the present perfect and the simple past lies in the grammaticalization of the temporal inclusion of both *t* and S by one single frame of Frame in the former and the lack of the grammaticalization of that relation in the latter. The last theory, Klein's (1992) pragmatic approach, does not recognize either the importance of the grammaticalization of the temporal inclusion of both *t* and S by one single frame of Frame Time in the present perfect, since his solution to the present perfect puzzle is developed basically along the line of the indefinite past theory. Klein does not appropriately distinguish semantics and pragmatics with respect to the present perfect in his theory.

Unlike previous approaches (cf. Brinton 1978, Comrie 1976, Klein 1972, McCoard 1988), my account of the present perfect does not create any ad hoc categories or notions for that purpose only, but is based on the three dimensional theory with Linear Time, Frame Time and Situation Time, which accounts for a large range of linguistic phenomena concerning temporal relations in languages. In my three-dimensional theory, the present perfect is considered a combination of tense and aspect, since it represents precedence relations in Linear Time and temporal inclusion relations between Frame Time and Situation Time. What makes the present perfect different from the simple past is the grammaticalization of the temporal inclusion of both *t* and S in Linear Time by a one single frame of Frame Time in the present perfect. This grammaticalized temporal relation

is associated with an implicature in the form of recency, result, experience, etc. that are considered to be related to the present (cf. Brinton 1988, Comrie 1976, Hirtle 1975, McCoard 1978). On the other hand, the theory developed in this study shows that temporal relations are semantic in nature so that problems of cooccurrence of some temporal adverbials and the present perfect result from a semantic incompatibility concerning truth conditions for the sentences in question (cf. Klein 1992, McCoard 1978).

Tense in natural languages has a deictic function (cf. Binnick 128-9), Comrie 1985:13-8, Heny 1982:109-13, Mellor 1981:1-12, Partee 1973, Richards 1982, Smith 1991:36-9). It is generally agreed upon that the deictic function of tense exhibits a parallelism with *here-there-there* (cf. Comrie 1985:14-5). However, I do not agree with Partee (1973) on her proposal that structural analogies exist between tenses and pronouns in terms of demonstrative use and anaphoric behaviors. Her proposal is problematic, since tenses are not referential expressions but simply represent temporal precedence relations in Linear Time. Structural analogies do exist between pronouns and Frame Time adverbials in demonstrative use and anaphoric behaviors on the dimension of Frame Time.

However, it does not mean that the three dimensional theory developed in this study is limited to those three problems, though I have just reviewed those three in this theory. Rather, I believe that this theory provides insights into universals in temporal relations in natural languages. Those three problems are simply samples dissected in the framework of this theory.

Chapter Six
CONCLUSIONS

6.1 CONCLUSIONS

In this study, I began with a set of philosophical questions about the representation of time in natural languages and a set of more specific linguistic questions about the representation of time in natural languages. Rather than answer the set of philosophical questions directly, I have tried to answer the set of specific linguistic questions in this study. I think that my answers to the set of specific linguistic questions shed light on the set of philosophical questions.

When considering the representation of time in natural languages, one would naturally think about verbs, tense and aspect. A review of research on this topic since Aristotle reveals that studies of verbs do not begin with the notion of time. In Aristotle's (cf. Metaphysics, translation 1966, De Anima, translation 1902) approach to verbs, the focus is on the modes of actions rather than on the temporal properties of actions. It is Vendler (1957, 1967) who first specifically points out the temporal nature of verbs in the linguistic cooccurrence compatibility between types of verbs and temporal adverbials, though he still follows an Aristotelian tradition. Thus, verbs are generally examined in terms of theories of actions rather than in terms of temporal theories. Even when the notion of time is applied in research on this topic in linguistics and semantics, it is used as an independent measure in terms of instants or intervals of time in possible

world semantics, where a sentence with a certain verb is measured against an instant or interval of time in a possible world for its truth conditions (cf. Abbott 1991, Åqvist 1976, 1977, Bennett 1977, 1981, Bennett & Partee 1978, Dowty 1977, 1979, 1982, Montague 1970, 1973, Parsons 1985, 1989, 1990).

Without proper consideration of time, previous approaches to verbs generally suffer from three problems. The first problem is the absence of uniform criteria in verb categorization and its consequence -- the lack of uniform result, as witnessed in the disagreement about the number of categories of verbs. For example, there are two or three classes of verbs in Aristotle's categorization, and there are three classes in Kenny's (1963), whereas there are probably four classes in Ryle's (1949) and definitely four classes in Vendler's (1967) categorizations. These are not just differences in terminology but in temporal relations and logical behaviors. The second problem is methodological, characterized by attempts to classify each category of verbs in terms of the semantic relation between sentences in different tenses and aspects before the first problem is settled in an appropriate way. The most problematic is the entailment relation approach, where given a pair of corresponding sentences with one in the past tense and one in the present progressive, a sentence with one class of verbs in the progressive referring to a whole or larger situation is measured against its corresponding sentence in the simple tense denoting a subsituation, while a sentence with another class of verbs in the progressive referring to a subsituation is measured against its corresponding sentence in the simple tense denoting a whole or larger subsituation. I think that the methodological problem is in essence an indication of lack of consideration of temporal properties of verbs. Without clear consideration of the notion

of time in verb categorization and without uniformly categorized verbs, there have been problems to represent adequately temporal relations in semantics and in tense and aspect logic for natural languages, since these aspects of verbs in natural languages are essentially temporal relations. A typical problem is the 'imperfective paradox' that has plagued theories about verbs, tenses and aspects in instant-semantics, interval-semantics and event semantics from Montague (1970, 1973), Bennett and Partee (1978), Dowty (1979) to Parsons (1989, 1990).

If linguistic representations of time are classified along the three dimensions: Linear Time, Frame Time and Situation Time, as I have argued for in the current study, problems of previous approaches are found along these three dimensions and the relations between the three. What are exactly those three dimensions of the representation of temporal relations? Linear Time is a set of points of time without duration but with precedence ordered in relation to speech time in a linear structure. Frame Time is a set of intervals of time, which are denoted by temporal frame phrases and within which a described event/activity takes place or a state holds. Situation Time is an instant or interval of time denoted by verbs, where intervals are designated as bound or nonbound by verb modifiers.

Each dimension of these temporal relations has its formal properties. Temporal order relations in Linear Time are transitive and reversable, as formally defined in (10) and (13) in section 3.1. Temporal inclusion relations in Frame Time are transitive but the entailment relations with temporal inclusion underpinning can not be reversed, as formally defined in (64) and (67) in section 3.4. In other words, the difference in the formal properties between Linear Time and Frame Time leads to completely different inferential patterns in these two dimensions of temporal relations

in natural languages. Situation Time exhibits distinctive logical behaviors that are different from those of Frame Time and Linear Time, as formally defined in (59) and (63) in section 4.4. The logical behaviors of Situation Time can be characterized by a transitive relation, of which the temporal inferential pattern is reversed. This temporal relation is in fact one between part and whole, as suggested by linguistic evidence in Chinese and Finnish. In addition to avoiding the imperfective paradox (cf. Declerck 1979, Dowty 1979), a part-and-whole approach opens up a more broad view of semantic relations among sentences in different tenses and aspects.

The set of linguistic questions in (2) in section 1.1, with the set of underpinning philosophical questions in (1) in section 1.1, are essentially answered in my analysis of temporal relations in natural languages in the three dimensional theory developed in this study. The first question in (2) in section 1.1 is whether there is any linguistic evidence regarding the philosophical questions whether action takes time, whether it takes a period of time or moment of time and whether a period of time it takes is open-ended or well-defined. In Chapter Four, I have demonstrated that situations as denotations of verbs instantiate temporal properties of verbs. Linguistic evidence in this regard suggests that actions as part of situations do take time. Further, in subsection 4.1.2, I have shown that the phenomenon of the cooccurrence between verbs and temporal adverbials indicates that some verbs denote instantaneous situations, while other verbs denote durative situations. Thus, I refer to verbs that denote actions or situations taking a moment of time as instantaneous verbs and to verbs that denote actions or situations taking a period of time as durative verbs. The second question in (2) in section 1.1 is what linguistic evidence there is regarding the nature of a period time that an action takes. I have discussed boundness

and nonboundness of Situation Time in terms of cooccurrence between verbs and *in*-temporal adverbials and *for*-temporal adverbials in section 4.1.2, and further in terms of referentiality and quantification in section 4.2. The third question in (2) in section 1.1 is what linguistic evidence there is for the relations between the time one action takes and that another action takes and between the time an action takes and the time of speech. In Chapter Three, I have shown that these relations are represented in Linear Time in terms of tense and in terms of relations between finite clauses and nonfinite clauses. The last question is how the linguistic evidence regarding all the above questions can be represented in syntax and semantics of natural languages. This study shows that linguistic evidence regarding the temporal relations in those questions can be considered in the three dimensional theory and in terms of relations among the three dimensions with respect to semantics and in terms of grammaticalization of the relations among the three dimensions with respect to syntax.

What is the significance of the three dimensional theory of the representation of temporal relations in natural languages? In Chapter Five of this study, I have discussed three problems, i.e aspect as viewpoints, the present perfect puzzle and the fallacy of structural analogies between tenses and pronouns, within the framework of the three dimensional theory developed in the present study.

Aspect is considered to consist of viewpoints or perspectives in syntactic and semantic studies (cf. Binnick, 1991, Comrie 1976, Smith 1991) and in discourse studies (cf. Hopper 1982, Thelin 1990), and also as different ways of viewing the internal constituency of a situation (Comrie 1976:3). However, these approaches leave two questions unanswered: i) what mechanisms underlie the aspect camera's lens for viewpoints and ii)

whether aspects only view a situation internally. I have illustrated with evidence from Chinese, English and some Cameroon languages that the the temporal inclusion relations between Frame Time and Situation Time are the mechanisms for verbal aspect as viewpoints and are not limited to situations internally. I think that the relations between Frame Time and Situation Time is universal in verbal aspect though the grammaticalization of those relations as aspect is subject to parameterization.

The present perfect in English has been a puzzle for linguists, logicians and philosophers with respect to the cooccurrence phenomenon of the present perfect and temporal adverbials and to its current relevance. Among many theories about it, I have briefly reviewed the current relevance theory, the indefinite past theory, the extended now theory, and a pragmatic theory (cf. Brinton 1988, Comrie 1976, Klein 1992, McCoard 1978). I have pointed out that all these approach fail to recognize an essential temporal relation between Frame Time and Linear in the present perfect. In the current theory, the present perfect is considered a combination of tense and aspect, since it represents precedence relations in Linear Time and temporal inclusion relations between Frame Time and Situation Time. What makes the present perfect different from the simple past is the grammaticalization of the temporal inclusion of both *t* and S in Linear Time by one single frame of Frame Time in the present perfect. This grammaticalized temporal relation gives rise to an implicature in the form of recency, result, experience, etc. that are related to the present (cf. Brinton 1988, Comrie 1976, Hirtle 1975, McCoard 1978).

Tense in natural languages has a deictic function (cf. Binnick 128-9, Comrie 1985:13-8, Heny 1982:109-13, Mellor 1981:1-12, Partee 1973, Richards 1982, Smith 1991:36-9). It is generally agreed upon that the

deictic function of tense exhibits a parallelism with *here-there-there* (cf. Comrie 1985:14-5). However, I do not agree with Partee (1973) on her proposal that structural analogies exist between tenses and pronouns in terms of demonstrative use and anaphoric behaviors. Her proposal is problematic, since tenses are not referential expressions but simply represent temporal precedence relations in Linear Time. Structural analogies do exist between pronouns and Frame Time adverbials in demonstrative use and anaphoric behaviors on the dimension of Frame Time. For example, Frame Time adverbials are constrained, in its anaphoric behavior, by anaphoric rules governing anaphors in coordinated structures.

However, it is not the case that the theory developed in this study is limited to the three problems just reviewed. I believe that this theory provides insights into universals in temporal relations in natural languages. Those three problems are samples dissected in the framework of this theory.

6.2 RECOMMENDATIONS

There are four things which I am not able to accomplish in the current study but I believe are of great significance for further study.

First, I am not able to incorporate systematically these three dimensions, Linear Time, Frame Time and Situation Time, of the representation of temporal relations in natural languages into one single logic system in representing temporal relations in any sentences. Thus, I think that further work can be done to provide a formal apparatus that may elegantly represent temporal relations revealed in the three dimensional theory.

Second, I have made claims that temporal relations along those three dimensions are universal and the grammaticalization of those relations are subject to parameterization in individual languages. Evidence for those claims mainly comes from Chinese and English, though I have occasionally cited evidence from Bantu languages and Finnish. It is desirable if further research within the framework of the three dimensional theory can be carried out in more languages or more extensively in a particular language.

Thirdly, I think that the theory that I have developed in the present study has broad implications for existing problems, puzzles and paradoxes on temporal relations in natural languages. For example, I have shown in the three-dimensional theory that it is fallacious to draw an analogy between tenses and pronouns (cf. Partee 1973) and that such analogy exists between Frame Time adverbials and pronouns instead. The insight provided by the current theory into the analogy problem has significant implications for the adverbial scope paradox originated in Pior's (1957, 1967, 1968) treatment of both tense and temporal adverbials as logic operators (cf. Binnick 1991:310-3, Dowty 1982). Solutions to this paradox are challenges to formal semantics (cf. Binnick 1991:311). Therefore, I think that further research on temporal puzzles and paradoxes can be carried out fruitfully in the three dimensional theory developed in this study.

Finally, I think that the current theory provides a missing link between semantic and syntactic studies of verbal aspect and discourse studies of verbal aspect. In discourse studies of verbal aspect, semantic and syntactic approaches are generally criticized for their failure and for their lack of significance for discourse studies (cf. Thelin 1990). In my discussion of aspect in section 5.1 and of structural analogies between

pronouns and tense in section 5.3, I have mentioned in passing that Frame Time adverbials are related to discourse. Given the observations that the relations between Frame Time and Situation Time are the mechanisms for verbal aspect as viewpoints and perspectives and that Frame Time adverbials are related to discourse, significant further study of the relations between semantic and syntactic perspectives of verbal aspect and discourse perspective can be done in this three dimensional theory.

BIBLIOGRAPHY

BIBLIOGRAPHY

Abbott, Barbara. 1991. Montague grammar. International encyclopedia of linguistics, ed. by William Bright, vol. 2, 438-440. New York: Oxford University Press.

Abbott, Barbara. 1992. Doing without a partitive constraint. ms. Michigan State University.

Allan, Keith. 1986. Linguistic meaning. London. Routledge & Kegan Paul.

Allen, Robert. 1966. The verb system of present-day American English. The Hague: Mouton.

Anderson, Lloyd. 1982. The 'perfect' as a universal and as a language-specific category. Tense-aspect: between semantics and pragmatics, ed. by Paul Hopper, 227-264. Amsterdam: John Benjamins.

Åqvist, Lennart. 1976. Formal semantics for verb tenses as analyzed by Reichenbach. Pragmatics of languages and literature, ed. by Tün A. van Dijk, 229-236. Amsterdam: North-Holland Publishing.

Åqvist, Lennart. 1977. On the analysis of some accomplishment and activity Verbs. On the logical analysis of tense and aspect, ed. by Christian Rohrer, 31-65. Tübingen: TBL Verlag Gunter Narr.

Åqvist, Lennart, and Franz Günthner. 1978. Fundamentals of a theory of verb aspect and events within the setting of an improved tense logic. Studies in formal semantics, ed. by Franz Günthner and Christian Rohrer, 167-200. Amsterdam: North-Holland publishing.

Åqvist, Lennart; Jaap Hoepelman and Christian Rohrer. 1980. Adverbs of frequency. Time, tense, and quantifiers: proceedings of the Stuttgart conference on the logic of tense and quantification, ed. by Christian Rohrer, 1-18. Tübingen: Niemeyer.

Aristotle. 1966. Metaphysics. Translated by Richard Hope. Ann Arbor, University of Michigan Press.

Aristotle. 1902. De anima. Aristotle's psychology: a treatise on the principle of life, translated by William Alexander Hammond, 1-143. London: Swan Sonnenschein & Co..

Armstrong, David. 1981. The ancient Greek aorist as the aspect of countable action. Syntax and semantics: tense and aspect, ed. by Philip Tedeschi & Annie Zaenen, 13-30. London: Academic Press.

Bach, Emmon. 1967. *Have* and *be* in English syntax. Language 43.462-85.

Bach, Emmon. 1980. Tense and aspect as functions on verb-phrases. Time, tense, and quantifiers: proceedings of the Stuttgart conference on the logic of tense and quantification, ed. by Christian Rohrer, 19-38. Tübingen: Niemeyer.

Bach, Emmon. 1981. On time, tense, and aspect: an essay in English metaphysics. Radical Pragmatics, ed. by Peter Cole, 63-81. New York: Academic Press.

Bach, Emmon. 1986a. The algebra of events. Linguistics and philosophy 9: 5-16.

Bach, Emmon. 1986b. Natural language metaphysics. Logic, methodology, and philosophy of science VII, ed. by Ruth Barcan-Marcus, George J. W. Don and Paul Weingartner, 573-595. Amsterdam: North Holland Publishing.

Bennett, Michael. 1977. A guide to the logic of tense and aspect in English. Logique et analysis. 20.491-517.

Bennett, Michael. 1981. Of tense and aspect: one analysis. Syntax and semantics: tense and aspect, ed. by Philip Tedeschi & Annie Zaenen, 13-30. London: Academic Press.

Bennett, Michael and Barbara Partee. 1978. Toward the logic of tense and aspect in English. Indiana University Linguistics Club.

Benthem, Johan van. 1980. Points and periods. Time, tense, and quantifiers: proceedings of the Stuttgart conference on the logic of tense and quantification, ed. by Christian Rohrer, 39-58. Tübingen: Niemeyer.

Benthem, Joan van. 1983. The logic of time. Dordrecht: Kluwer Academic.

Binnick, Robert. 1991. Time and the verb: a guide to tense and aspect. New York/Oxford: Oxford University Press.

Brinton, Laurel. 1988. The development of English aspectual systems: aspectualizers and post-verbal particles. Cambridge: Cambridge University Press.

Bryan, W. 1936. The preterite and the perfect tense in present-day English. Journal of English and Germanic philology 35.363-382.

Bull, William. 1960. Time, tense and the verb: a study in theoretical and applied linguistics with particular attention to Spanish. Berkeley: University of California Press.

Bunt, Harry. 1978. A formal semantic analysis of mass terms and amount terms. Amsterdam papers in formal grammar, Vol. II, ed. by Groenendijk en Stokhof, 81-93. Amsterdam: University of Amsterdam.

Bunt, Harry. 1985. Mass terms and model-theoretic semantics. Cambridge: Cambridge University Press.

Carlson, Greg. 1977. A unified analysis of the English bare plural. Linguistics and philosophy 1.413-457.

Carlson, Lauri. 1981. Aspect and quantification. Syntax and semantics: tense and aspect, ed. by Philip Tedeschi & Annie Zaenen, 31-64. London: Academic Press.

Chao, Yuen Ren. 1968. A grammar of spoken Chinese. Berkeley: University of California Press.

Chesterman, Andrew. 1991. On definiteness. Cambridge: Cambridge University.

Chomsky, Noam. 1970. Remarks on nominalization. Readings in English transformational grammar, ed. by R. Jacobs and P. Rosenbaum. Waltham, MA: Blaisdell.

Clifford, John. 1975. Tense and tense logic. The Hague: Mouton.

Comrie, Bernard. 1976. Aspect: an introduction to the study of verbal aspect and related problems. Cambridge: Cambridge University Press.

Comrie, Bernard. 1981. On Reichenbach's approach to tense. Papers from the 17th regional meeting of Chicago linguistic society, 24-30. Chicago: Chicago Linguistic Society.

Comrie, Bernard. 1985. Tense. Cambridge: Cambridge University Press.

Cresswell, M. J. 1977. Interval semantics and logical words. On the logical analysis of tense and aspect, ed. by Christian Rohrer, 7-29. Tübingen: TBL Verlag Gunter Narr.

Dahl, Osten. 1981. On the definition of the telic-atelic (bounded-nonbounded) distinction. Syntax and semantics: tense and aspect, ed. by Philip Tedeschi & Annie Zaenen, 79-90. London: Academic Press.

Dahl, Osten. 1985. Tense and aspect systems. New York: Basil Blackwell.

Davidson, Donald. 1968. The logical form of action sentences. The logic of decision and action, ed. by Nicholas Rescher, 81-95. Pittsburgh: University of Pittsburgh Press.

Davidson, Donald. 1980. Essays on action and events. Oxford: Clarendon Press.

Declerck, Renaat. 1979. On the progressive and the 'imperfective paradox'. Linguistics and philosophy 3.267-272.

Diver, William. 1963. The chronical system of the English verb. Word 19.141-181.

Dowty, David. 1972. Studies in the logic of verb aspect and time reference in English. Department of Linguistics, University of Texas, Austin.

Dowty, David. 1977. Toward a semantic analysis of verb aspect and the English 'imperfective' progressive. Linguistics and philosophy 1.45-78.

Dowty, David. 1979. Word meaning and Montague grammar: the semantics of verbs and times in generative semantics and Montague's PTQ. Boston: D. Reidel Publishing Company.

Dowty, David. 1982. Tenses, time adverbs, and Compositional Semantic Theory. Linguistics and philosophy 5. 23-55.

Dowty, David, Roberte Wall, and Stanley Peters. 1981. Introduction to Montague Semantics. Dordrecht: Reidel.

Fodor, Janet and Ivan Sag. 1982. Referential and quantification indefinites. Linguistics and philosophy 5. 355-398.

Gabbay, Dov and Julius Moravcsik. 1980. Verbs, events, and the flow of time. Time, tense, and quantifiers: proceedings of the Stuttgart conference on the logic of tense and quantification, ed. by Christian Rohrer, 59-84. Tübingen: Niemeyer.

Galton, Antony. 1984. The logic of aspect. Oxford: Clarendon Press.

Grimshaw, Jane. 1990. Argument structure. Cambridge, Mass: MIT Press.

Grice, H. P. 1975. Logic and conversation. Syntax and semantics 3: speech acts, ed. by P. Cole & J. L. Morgan, 41-58. New York: Academic Press.

Grice, H. P. 1978. Further notes on logic and conversation. Syntax and semantics 9: pragmatics, ed. by P. Cole, 113-28. New York: Academic Press.

Günthner, Franz. 1977. Remarks on the present perfect in English. On the logical analysis of tense and aspect, ed. by Christian Rohrer, 83-98. Tübingen: TBL Verlag Gunter Narr.

Hawkins, John. 1978. Definiteness and indefiniteness: a study in reference and grammaticality prediction. London: Cromm Helm.

Heath, Danial. 1991. Tense and aspect in Makaa. Tense and aspect in eight languages in Cameroon, ed. by Stephen Anderson and Bernard Comrie, 3-15. Texas: the Summer Institute of of Linguistics and University of Texas at Arlington.

Heny, Frank. 1982. Tense, aspect and time adverbials II. Linguistics and philosophy 5.109-154.

Hirtle, Walter. 1975. Time, aspect and the verb. Québec: Les Presses de L'université Laval.

Hoeksema, Jack. 1983. Plurality and conjunction. Studies in modeltheoretic semantics, ed. by Alice ter Meulen, 63-84. Dordrcht: Foris.

Hoepelman, Jaap. 1974. Tense logic and the semantics of the Russian aspects. Theoretic linguistics 1.158-180.

Hoepelman, Jaap. 1976. Mass nouns and aspects, or: Why we can't eat gingercake in an hour. Amsterdam papers in formal grammar, Vol. I. 137-153.

Hoepelman, Jaap. 1978. The analysis of activity verbs in a Montague-type grammar. Studies in formal semantics, ed. by Franz Günthner and Christian Rohrer, 121-166. Amsterdam: North-Holland publishing.

Hoepelman, Jaap, and Christian Rohrer. 1980. On the mass-count distinction and the French imparfait and passe simple. Time, tense and quantifiers, ed. by Christian Rohrer, 85-112. Tübingen: Niemeyer.

Hollingsworth, Kenneth. 1991. Tense and aspect in Mofu-Gudur. Tense and aspect in eight languages of Cameroon, ed. by Stephen Anderson and Bernard Comrie, 239-55. Arlington, TX: the Summer Institute of Linguistics and University of Texas at Arlington.

Holt, Jens. 1943. Études d'aspect. Acta Jutlandica 15.2.

Hoop, Helen de. 1992. Case configuration and noun phrase interpretation. Groningen: Grodil.

Hopper, Paul. 1982. Tense-aspect: between semantics and pragmatics. Amsterdam: John Benjamins.

Hornstein, Norbert. 1977. Toward a theory of tense. Linguistic inquiry 8. 521-557.

Hornstein, Norbert. 1990. As time goes by. Cambridge, Mass: MIT Press.

Huddleston, Rodney. 1974. Further remarks on the analysis of auxiliaries as main verbs. Foundations of language 11.215-229.

Jespersen, Otto. 1965. The philosophy of grammar. New York: Norton.

Kamp, Hans. 1979. Events, instants and temporal reference. Semantics from different points of view, ed. by Bäuerle et al. Berlin: Springer Verlag.

Kenny, Anthony. 1963. Action, emotion and will. London: Routledge & Kegan Paul.

Klein, Wolfgang. 1992. The Present perfect puzzle. Language 68.525-52.

Koziol, H. 1958. Zum Gebrauch des Present Perfect und des Past Tense. Die Neuren Sprachen 7.497-506.

Landman, Fred. 1991. Structures for semantics. Norwell, MA: Kluwer Academic Publishers.

Langacker, Ronald. 1982. Remarks on English aspect. Tense-aspect: between semantics & pragmatics, ed. by Paul J. Hopper. Amsterdam: John Benjamins.

Leech, Geoffrey. 1971. Meaning and the English verb. London: Longmans.

Levinson, Stephen. 1983. Pragmatics. Cambridge: Cambridge University.

Li, Charles and Sandra Thompson. 1981. Mandarin Chinese: a functional reference grammar. Berkeley: University of California Press.

Li, Charles, Sandra Thompson, and R. McMillan Thompson. 1982. The discourse motivation for the perfective aspect: the Mandarin particle *Le*. Tense-aspect: between semantics & pragmatics, ed. by Paul J. Hopper. Amsterdam: John Benjamins.

Link, Godehard. 1983. The logical analysis of plurals and mass terms: a lattice-theoretical approach. Meaning, use, and interpretation of Language, ed. by R. Bauerle, C. Schwarz, & A. von Stechow, 302-323. Berlin/New York: Walter de Gruyeter.

Lyons, John. 1977. Semantics. Cambridge: Cambridge University Press.

McCawley, James. 1971. Tense and time reference in English. Studies in linguistic semantics, ed. by C. J. Fillmore and D. T. Langendoen, 96-113. New York: Holt, Rinehart and Winston.

McCawley, James. 1988. The syntactic phenomena of English, vol. 1. Chicago: University of Chicago Press.

McCoard, Robert. 1978. The English perfect: tense-choice and pragmatic inferences. Amsterdam: North-holland.

McGilvray, James. 1991. Tense, reference, & worldmaking. Montreal & Kingston: McGill-Queen's University Press.

Mellor, D. H. 1981. Real Time. Cambridge: Cambridge University Press.

Merrill, Peter. 1985. Universal quantification and aspect in Russian. Issues in Russian morphosyntax, ed. by Michael S. Flier and Richard D. Brecht, 58-72. Columbus, OH: Slavica publishers.

Meulen, Alice ter. 1980. Substances, quantities, and individuals: a study in the formal semantics of mass terms. Bloomington: Indiana University Linguistics Club

Meulen, Alice ter. 1981. An intensional logic for mass terms. Philosophical studies. 40.105-125.

Meulen, Alice ter. 1983. The representation of time in natural language. Studies in modeltheoretic semantics, ed. by Alice ter Meulen, 177-192. Dordrcht: Foris.

Meulen, Alice ter. 1984. Events, quantities and individuals. Varieties of Formal semantics, ed. by Fred Landman and Frank Veltman, 259-280. Dordrecht: Foris.

Mittworth, Anita. 1987. Aspects of English aspect: on the interaction of perfect, progressive and durational phases. Linguistics and philosophy 11.203-254.

Moltmann, Friederike. 1992. Measure adverbials. Linguistics and philosophy 14. 629-660.

Montague, Richard. 1970. Pragmatics and intensional logic. Formal philosophy, ed. by Richmond Thomason, 119-147. New Haven: Yale University Press.

Montague, Richard. 1973. The proper treatment of quantification in ordinary English. Formal philosophy, ed. by Richmond Thomason, 119-147. New Haven: Yale University Press.

Moravcsik, Julius. 1973. Mass terms in English. Approaches to natural language, ed. by J. Hintikka, J. Moravcsik and P. Suppes. Dordrecht: Reidel.

Mourelatos, Alexander. 1981. Events, progresses, and states. Syntax and semantics: tense and aspect, ed. by Philip Tedeschi & Annie Zaenen, 191-212. London: Academic Press.

Newmeyer, Frederick. 1986. Linguistic theory in America. New York: Academic Press.

Newton-Smith, W. H. 1980. The structure of time. Boston: Routledge & Kegan Paul.

Orwig, Carol. 1991. Relative time reference in Nugunu. Tense and aspect in eight languages in Cameroon, ed. by Stephen Anderson and Bernard Comrie, 147-62. Texas: the Summer Institute of Linguistics and University of Texas at Arlington.

Parsons, Terence. 1970. Analysis of mass and amount terms. Foundations of language 6.362-388.

Parsons, Terence. 1980. Modifiers and quantifiers in natural languages. Canadian journal of philosophy, supplementary vol. 6. 29-60.

Parsons, Terence. 1985. Underlying events in the logical analysis of English. Actions and events: perspectives on the philosophy of Donald Davidson, ed. by Ernest Lepore and Brian Mclaughlin, 235-267. Oxford: Blackwell.

Parsons, Terence. 1989. The progressive in English: events, states and process. Linguistics and philosophy 12. 213-241.

Parsons, Terence. 1990. Events in the semantics of English: A study in subatomic semantics. Cambridge, Mass: MIT Press.

Partee, Barbara. 1973. Some structural analogies between tenses and pronouns in English. Journal of philosophy 69.601-690.

Prior, Arthur. 1957. Time and modality. Oxford: Clarendon Press.

Prior, Arthur. 1967. Past, present and future. Oxford: Clarendon Press.

Prior, Arthur. 1968. Papers on time and tense. Oxford: Clarendon Press.

Reichenbach, Hans. 1947. Elements of symbolic logic. New York: Macmillan.

Rescher, Nicholas. (ed.) 1968. Aspect of action. The logic of decision and action, ed. by Nicholas Rescher, 215-219. Pittsburgh: University of Pittsburgh Press.

Richards, Barry. 1982. Tense, aspect and time adverbials I. Linguistics and philosophy 5. 58-107.

Russell, Bertrand. 1956. The philosophy of logical atomism. Logical and Knowledge, ed. by Robert Charles Marsh, 175-282. New York: Macmillan.

Ryle, Gilbert. 1949. The concept of mind. London: Hutchinson's University library.

Scha, Remko. 1984. Distributive, collective and cumulative quantification. Truth, interpretation and information, ed. by Jeroen Groenendijik, Theo M. V. Janssen, and Martin Stockhof, 131-158. Dordrecht: Foris Publications.

Smith, Carlota. 1980. Temporal structures in discourse. Time, tense, and quantifiers: proceedings of the Stuttgart conference on the logic of tense and quantification, ed. by Christian Rohrer, 355-375. Tübingen: Niemeyer.

Smith, Carlota. 1981. Semantic and syntactic constraints on temporal interpretation. Syntax and semantics: tense and aspect, ed. by Philip Tedeschi & Annie Zaenen, 213-238. London: Academic Press.

Smith, Carlota. 1991. The parameter of aspect. Norwell, MA: Kluwer Academic Publishers.

Tai, James. 1985. Temporal sequence and Chinese word order. Iconicity in syntax. ed. by John Haiman, 49-72, Amsterdam/Philadelphia: John Benjamins.

Taylor, Barry. 1977. Tense and continuity. Linguistics and philosophy 1. 199-220.

Taylor, Barry. 1985. Modes of Occurrence. Oxford: Basil Blackwell.

Thelin, Niles. (ed.) 1990. Verbal aspect in discourse: Contributions to the semantics of time and temporal perspective in Slavic and non-Slavic languages. Amsterdam/Philadelphia: John Benjamins.

Thomason, Richmond. (ed.) 1974. Formal philosophy: selected papers of Richard Montague. New Haven: Yale University Press.

Tommola, Hannu. 1990. On Finnish 'aspect' in discourse. Verbal aspect in discourse: contributions to the semantics of time and temporal perspective in Slavic and non-Slavic languages, ed. by Niles Thelin, 349-64. Amsterdam/Philadelphia: John Benjamins.

Vendler, Zeno. 1957. Verbs and times. The Philosophical review. 66.143-160.

Vendler, Zeno. 1967. Linguistics in philosophy. Itbaca, NY: Cornell University Press.

Verkuyl, Henk. 1989. Aspectual classes and aspectual composition. Linguistics and philosophy 12.39-94.

Vet, Co. 1983. From tense to modality. Studies in modeltheoretic semantics, ed. by Alice ter Meulen, 193-206. Dordrcht: Foris.

Vlach, Frank. 1981. The Semantics of the progressive. Syntax and semantics: tense and aspect, ed. by Philip Tedeschi & Annie Zaenen, 271-292. London: Academic Press.

Vuyst, Jan de. 1983. Situation-descriptions: temporal and aspectual semantics. Studies in modeltheoretic semantics, ed. by Alice ter Meulen, 161-176. Dordrcht: Foris.

Wang, Li. 1985. Modern Chinese grammar. Beijing: Commercial Press.

Zhou, Minglang. 1991. Count nouns used as mass nouns in perfective sentences in Chinese: a study of verb category switch and and the 'imperfective paradox'. WECOL91, ed. by Katharine Hunt, Thomas Perry and Vida Samiian, 320-31. Fresno, CA: California State University.

Zhou, Minglang. 1993a. A lexical and cognitive view on language change: the relation between some predicate argument structure variations and change in Chinese. Paper presented at Kentucky Foreign Language Conference, University of Kentucky, Lexington, KY, April 22-24, 1993.

Zhou, Minglang. 1993b. The *bei*-construction in Chinese: a construction with multistage properties. The proceedings of the 1992 Mid-America linguistics conference & conference on Siouan/Caddoan languages, ed. by Evan Smith and Flore Zéphir, 287-301. Columbia, MO: University of Missouri-Columbia.