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**Author:** Sun, Hongyuan

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## Chapter 2 Tense semantics

This chapter reviews the theoretical background on tense and aspect.

In Section 2.1, we first examine two analyses of the semantics of tense - the traditional *tense logic semantics* introduced by Prior (1957, 1967) and later adopted by Montague (1973), and the *referential approach* developed by Partee (1973) and Heim (1994) - then we explain the advantage of a tense semantics based on intervals. Our analysis of the temporal interpretation of bare predicates in Mandarin (Chapter 3) will adopt a referential approach to tense.

In Section 2.2 we introduce two relevant notions of aspect: lexical aspect or *aktionsart* referred to as *situation aspect* (Smith 1991) and grammatical aspect referred to as *viewpoint aspect* (Comrie 1976, Smith 1991). Concerning situation aspect, we give an overview of Vendler's aspectual classification of predicates based on their syntactic and semantic properties, and we review tests to distinguish them and the limitations of these tests. Viewpoint aspect as presented in Section 2.2.2 concerns the temporal perspective of the speaker on the described eventuality. In particular, the distinction between perfective and imperfective aspect follows from how the described eventuality relates to a time, the "reference time", a notion proposed by Reichenbach (1947) and developed by Klein (1994) under the name of "topic time". The theories Reichenbach and Klein (1994) on tense and aspect have inspired a number of theoretical accounts for tense and aspect, including Kratzer (1998) and Katz (2003) that lay the theoretical foundations of our account of the temporal interpretation of bare predicates in Mandarin.

Section 2.3 presents the event semantics largely used in recent literature on tense and aspect. The analysis that we adopt to account for the contrast between temporal interpretations of stative BPs vs. eventive BPs in Mandarin is on the basis of the event semantics. Stative predicates differ from eventive predicates in their argument structure: stative predicates lack the "event argument" that eventive predicates have.

Section 2.4 recapitulates the notation used in this thesis.

## 2.1 Tense

In this section, we introduce two theoretical frameworks for analyses of tense: *tense logic semantics* and the *referential approach* to tense. We will discuss the limits of tense logic treatments, and we will give reasons for abandoning an approach based on tense logic in favor of the referential approach. We will adopt a version of the referential approach in our analysis of temporal interpretations of bare predicates in Mandarin.

### 2.1.1 The ontology of time

Concerning how to conceptualize time, there are two opposing views: time is either *discrete* or *continuous*. Both views suppose that there is a time line that is made up of linearly ordered moments. That is, for any moments  $m_1, m_2$ , either  $m_1$  precedes  $m_2$  ( $m_1 < m_2$ ) or  $m_1$  follows  $m_2$  ( $m_2 < m_1$ ) or  $m_1$  and  $m_2$  are identical ( $m_1 = m_2$ ). The views differ in that, on the *continuous* view but not on the *discrete* view, time is *dense* and these moments thus behave like real numbers (Klein 2009). The density of the time line is defined in (1), where  $M$  is the set of moments (see also von Stechow 2009):

$$(1) \forall m, m'' \in M [m < m'' \rightarrow \exists m' [m < m' < m'']]$$

We take the position that time is continuous.

### 2.1.2 Tense logic semantics

One of the classic treatments of tense is the tense logic approach, introduced by Prior (1957, 1967), and adopted by Kamp (1971) and Montague (1974) in their analysis of tense in natural language.

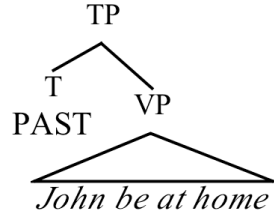
Being an extension of propositional logic, tense logic makes the following assumptions: the denotation of a sentence is obtained from an interpretation function, which is time-dependent. The basic idea is that sentences may contain sentential operators (“semantic tenses”) that shift the index at which a sentence is interpreted. Past tense (PAST) moves the index to the past and future tense (FUT) moves the index to the future. The semantics of the past tense (PAST) and the future tense (FUT) are given in (2) below, where  $t$  is a temporal index:

- (2) For any sentence  $\phi$ ,  
 $\llbracket \text{PAST}\phi \rrbracket^t = 1$  iff there is a time  $t'$  such that  $t' < t$  and  $\llbracket \phi \rrbracket^{t'} = 1$   
 $\llbracket \text{FUT}\phi \rrbracket^t = 1$  iff there is a time  $t'$  such that  $t < t'$  and  $\llbracket \phi \rrbracket^{t'} = 1$

Since tense logic considers time as moments, the term “time” used in (2) should actually be understood as “moment”.

According to the approach based on tense logic, natural language sentences have structures that include these operators, and these structures are evaluated at the utterance time. To say that a sentence is true is to say that its structure evaluated at the utterance time yields the value 1. A past tensed sentence like (3) would thus have a structure as in (7) and be interpreted as in (4):

- (3) John was at home.  
 (4)  $\llbracket \text{PAST John be at home} \rrbracket^t = 1$  iff there is a time  $t'$  such that  $t' < t$   
 and such that John is at home at  $t'$   
 (5)



A future tensed sentence like (6) has an analogous structure with FUT and the truth conditions given in (7):

- (6) John will be at home.  
 (7)  $\llbracket \text{FUT John be at home} \rrbracket^t = 1$  iff there is a time  $t'$  such that  $t < t'$   
 and such that John is at home at  $t'$

On this approach, only past and future tenses are assumed to contribute something to the truth conditions of a sentence. If present tense reflects the presence of a sentential operator at all, then it is one with a semantics that makes it vacuous, cf. (9).

- (8) John is at home.

(9)  $\llbracket \text{PRES John be at home} \rrbracket^t = 1$  iff John is at home at  $t$

Some problems with this approach to tense based on tense logic have been pointed out by Dowty (1982), Galton (1984) and Partee (1984). Galton (1984) argues that the tense logic approach can be used to analyze sentences describing a state, but not sentences describing an event. Dowty (1982) provides a classic argument showing that this kind of analysis makes wrong predictions about the temporal readings of sentences with a time adverbial *yesterday*, like in (10):

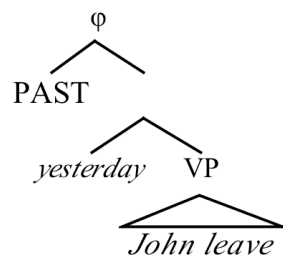
(10) John left yesterday.

If we treat the temporal adverb *yesterday* as a sentential operator just like tense, it will shift the temporal reference to a time that is included in the day before the utterance time, as shown in (11).

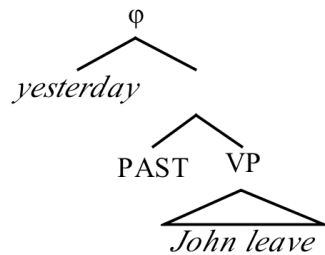
(11)  $\llbracket \text{yesterday } \phi \rrbracket^t = 1$  iff there is a time  $t'$  such that  $t'$  is on the day before the day including  $t$  and such that  $\llbracket \phi \rrbracket^{t'} = 1$

Thus a past tensed sentence containing an adverb *yesterday* should contain two operators: PAST and *yesterday*. The sentence in (10) will have two possible syntactic structures depending which operator (PAST or *yesterday*) takes wide scope:

(12)



(13)



When PAST scopes over *yesterday*, which is the case in (12), (10) should mean that the time of John's leaving is on the day before a time preceding the utterance time. When *yesterday* scopes over PAST, as illustrated in (13), the sentence should mean that John left at a time that precedes the day before the day including the utterance time. Neither of these two readings corresponds to the meaning of (10): the proposition *John left yesterday* means that there is a time  $t$  before the utterance time such that  $t$  is on the day before the day of the utterance and such that John's leaving is at  $t$ . Dowty then concludes that the Priorian analysis cannot capture the meaning of a sentence with a past time adverbial.

Another problem with the tense logic-inspired approach is pointed out by Partee (1984) with the example in (14):

(14) I didn't turn off the stove.

Following the denotation of the past tense given in (2) above, (14) should have two possible interpretations, depending on whether sentential negation NEG scopes above or below PAST: one according to which there is no time in the past at which I turned off the stove ('*I never turned off the stove in my life*') and another according to which there is (at least) a time before the speech time, at which I didn't turn off the stove. The truth conditions of the two readings are given in (15a-b).

(15) a.  $\llbracket \text{NEG} [\text{PAST} [ \text{I turn off the stove} ] ] \rrbracket^t = 1$   
iff  $\neg \exists t' [ t' < t \ \& \ \llbracket \text{I turn off the stove} \rrbracket^t = 1 ]$

$$\begin{aligned} \text{b. } \llbracket \text{PAST} [\text{NEG} [\text{I turn off the stove}]] \rrbracket^t &= 1 \\ &\text{iff } \exists t' [t' < t \ \& \ \llbracket \text{I turn off the stove} \rrbracket^{t'} = 0] \end{aligned}$$

Adapted from Kusumoto (1999:32)

(15b) is always true for a normal person who didn't spend all his time turning off the stove. Neither (15a) nor (15b) is the real meaning of (14) in the following scenario: imagine that (14) is uttered in a car halfway down the turnpike, and it means that in a *particular time interval* in the past (the interval during which I was making preparations to leave for example), I didn't turn off the stove. Thus, the Priorian system makes wrong predictions for the interpretation of (14).

Partee then suggests, as we show in the next section, that tenses are analogous to pronouns: both have referential, anaphoric and binding uses. Partee takes the analogy seriously and suggests that the interpretation of tenses works in just the same way as the interpretation of pronouns, and in particular that tenses are variables which may be bound or free – variables over times. Her treatment has become known as the 'referential treatment of tense'.

### 2.1.3 Referential approaches

The problem raised by Partee (1984) with a Priorian analysis of tense leads to a referential treatment of tense (Enç 1986, Heim 1994, Kratzer 1998): tenses are variables over times, and verbs take tenses as arguments.

The verb *love*, for instance, takes three arguments: an agent, a patient and a time, as shown in (17).<sup>9</sup> The logical form of a sentence like *John loved Mary* is represented in (18), where past tense PAST

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<sup>9</sup> We will imagine in the traditional way that the world is provided as a parameter of evaluation and that sentences are always evaluated with respect to the actual world. But we will generally omit the world parameter when specifying semantic values, and we will only mention the world of evaluation when it is relevant. The parameters of evaluation that we will write systematically are the assignment parameter and the context parameter.

bears an index  $i$  and refers to a particular time interval that must precede the utterance time.

(16) John loved Mary.

(17)  $\llbracket \text{love} \rrbracket^{g,c} = \lambda y. \lambda x. \lambda t. x \text{ loves } y \text{ at } t$

(18)  $\llbracket \text{PAST}_i [\text{John love Mary}] \rrbracket^{g,c}$   
 $= \llbracket \text{love} \rrbracket^{g,c} (\llbracket \text{Mary} \rrbracket^{g,c}) (\llbracket \text{John} \rrbracket^{g,c}) (\llbracket \text{PAST}_i \rrbracket^{g,c})$

Note that we have here adopted a view on which semantic evaluation is with respect to a *variable assignment* ( $g$ ), as well as a *context* ( $c$ ) that has among its features a temporal component  $t_c$ . The idea is that sentences get evaluated with respect to a variable assignment that has salient objects in its range and with respect to a context whose temporal component is the utterance time; moreover, we don't use a sentence unless it is clear that its semantic value is defined. (And again, to say that a sentence is true is to say that its semantic value is 1.) The past tense PAST in (18) carries an index  $i$ , just like a pronoun *she* in (19) below, and both receive their values via the assignment:

(19)  $she_i$  lives in Nantes.

Reflecting the fact that (19) is felicitous only if the individual referred to by  $she_i$  is female, the semantic value of  $she_i$  is given in (20):

(20)  $\llbracket she_i \rrbracket^{g,c}$  is defined only if  $g(i)$  is female, in which case  
 $\llbracket she_i \rrbracket^{g,c} = g(i)$

(20) says that the semantic value of  $she_i$  with respect to an assignment  $g$  (and a context  $c$ ) is defined only if the individual assigned to the index  $i$ , that is,  $g(i)$ , is female. If this is the case,  $g(i)$  is the semantic value of  $she_i$ . In a similar way, tenses can be seen as variables with built-in restrictions on their possible values.<sup>10</sup> The lexical entries of

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<sup>10</sup> Adherents of the view of pronouns here often assume a more articulated picture on which pronouns are put together out of a number of different syntactic ingredients: a variable (the  $i$  here) and features (like the gender feature) that constrain the value of the variable and determine the pronoun's pronunciation. (See Heim and Kratzer 1998.) It is thus natural to articulate the referential approach to tense in the same way, distinguishing the time variable itself from features that



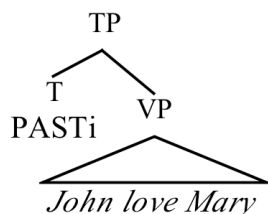
the past tense ( $PAST_i$ ) and present tense ( $PRES_i$ ) are given in (21) (Heim 1994):

- (21) a.  $\llbracket PAST_i \rrbracket^{g,c}$  is defined only if  $g(i) < t_c$ , in which case  
 $\llbracket PAST_i \rrbracket^{g,c} = g(i)$
- b.  $\llbracket PRES_i \rrbracket^{g,c}$  is defined only if  $g(i) = t_c$ , in which case  
 $\llbracket PRES_i \rrbracket^{g,c} = g(i)$

The past tense  $PAST_i$  in (21a) is a time variable. Its semantic value with respect to an assignment  $g$  and a context  $c$  is defined only if the value assigned to the index  $i$ ,  $g(i)$ , precedes the time component  $t_c$  of the context (which will generally correspond to the moment of utterance). If this is the case, its value is  $g(i)$ . The present tense  $PRES_i$  is defined only if the value assigned to the index  $i$ ,  $g(i)$ , is identical to  $t_c$ , and if its semantic value is defined,  $PRES_i$  gives the value  $g(i)$ .

The syntactic structure of a past tensed sentence *John loved Mary* will be as in (22) and its semantic value is given in (23):

(22)



- (23)  $\llbracket PAST_i [John\ love\ Mary] \rrbracket^{g,c}$  is defined only if  $g(i) < t_c$ .  
 Where defined,  $\llbracket PAST_i [John\ love\ Mary] \rrbracket^{g,c} = 1$  iff John loves  
 Mary at  $g(i)$ , 0 otherwise.

Now, reconsider Partee's example mentioned in (14), repeated here as (24):

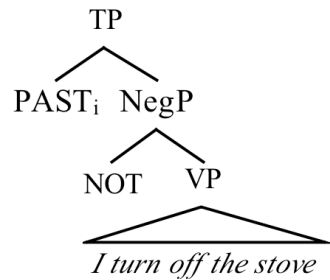
(24) I didn't turn off the stove.

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constrain the variable itself and that determine a past tense or present tense pronunciation. This is the position I will take in Chapter 5.

(24) means that in a specific past time *interval*, the speaker didn't turn off the stove. Note first that if this intuition is correct, something must be added to the tense logic approach, since only time *points* but not time *intervals* are relevant to temporal interpretation on a tense logic approach, a point to which we return in the next section. Second, recall from our discussion in the previous section: without additional assumptions, an existential approach fails to capture the meaning of Partee's sentence. On a referential treatment of tense, (24) will have the syntactic structure as in (25); the lexical entries are given in (26) and the detailed calculation in (27) below. Crucially, on this formulation we have variables over time *intervals* and not merely moments, and similarly an expression like *turn off the stove* selects for an argument that is a time interval and not merely a moment.<sup>11</sup>

(25)



(26)

- a.  $\llbracket \text{PAST}_i \rrbracket^{g,c} = g(i)$  only if  $g(i) < t_c$ , undefined otherwise
- b.  $\llbracket \text{NOT}_i \rrbracket^{g,c} = \lambda P. \lambda t. P(t) = 0$
- c.  $\llbracket \text{VP I turn off the stove} \rrbracket^{g,c} = \lambda t. \text{the speaker in } c \text{ turns off the stove in } t$

(27)

- a.  $\llbracket \text{NegP NOT [I turn off the stove]} \rrbracket^{g,c} = \lambda t. \text{it's not the case that the speaker in } c \text{ turns off the stove in } t$

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<sup>11</sup> Intervals are sets of moments, and, when we write " $g(i) < t_c$ " here, this is a shorthand to say that every moment in the interval  $g(i)$  precedes  $t_c$ .

- b.  $\llbracket_{\text{TP}} \text{PAST}_i [\text{NOT} [\text{I turn off the stove}]] \rrbracket^{g,c} = 1$  if and only if  $g(i) < t_c$ .  
 Where defined,  $\llbracket_{\text{TP}} \rrbracket^{g,c} = 1$  iff it's not the case that the speaker in  $c$  turns off the stove in  $g(i)$ , 0 otherwise.

The last line in (27) says the following: the semantic value of the proposition *I didn't turn off the stove* with respect to an assignment  $g$  and a context  $c$  is defined only if the value of  $\text{PAST}_i$ ,  $g(i)$ , precedes  $t_c$ . When this condition is met, the semantic value is 1 if and only if it's not the case that the speaker turns off the stove *within* that interval  $g(i)$ . The definedness condition means that a speaker will only use the sentence when some past time interval is salient, and the rest means that in that case he will express something true if and only if it's not the case that the speaker turns off the stove *within* that interval. Thus the derivation in (27) correctly captures the meaning of Partee's example, on the assumption that past tense is a variable over time *intervals*, but not moments of time, as is originally assumed by the tense logic treatment. The semantics based on intervals will be developed in Section 2.1.4; where we explain in detail what motivates the interval semantics and how it accounts for data that are problematic for tense logic semantics.

#### 2.1.4 Interval semantics

On a tense logic approach, sentences are evaluated at moments of time. Bennett and Partee (1978) (henceforth B&P) argue that this position is not always tenable. Some sentences are rather evaluated at intervals of time. Time intervals are "convex" by definition, that is, any moment  $m$  between two moments  $m_1$  and  $m_2$  that are in an interval  $I$  ( $m_1 < m < m_2$ ) is also in  $I$ .

B&P argue against the treatment of present perfect in English on a tense logic approach (Montague 1973). They show that it would predict the same truth conditions for the simple past sentence in (28a) and the present perfect sentence in (28b): (28a) and (28b) are true if there is a past time point at which *John visits Rome* is true.

- (28) a. John has visited Rome.  
 b. John visited Rome.

However, the present perfect is different from the simple past: present perfect involves an implicit time interval (reference time) that starts in the past and extends to the moment of utterance, explaining why (29a) but not (29b) is acceptable.

- (29) a. John has walked today.  
 b. \*John has walked yesterday.

Another criticism of the tense logic assumption that the semantics of tense involves moments rather than intervals is based on Montague's treatment of the progressive (Montague 1973). B&P point out that on Montague's analysis, a progressive sentence like (30) is true at a moment  $m$  if and only if there exists an open interval  $I$ , such that  $m \in I$  and for all moments  $m'$  in  $I$ , *John leaves* is true at  $m'$ . Suppose that  $m$  is the utterance time. Since  $I$  is an open interval, its members  $m'$  can either precede or follow  $m$ . Therefore, *John leaves* is true at some moment in the past.

(30) John is leaving.

(31) John has left.

Given Montague's analysis of the present perfect, (31) is true if there is a moment  $m$  in the past at which *John leaves* is true. Thus, (30) is predicted to entail (31), which is obviously not correct.

B&P propose a temporal treatment of sentences based on intervals instead of moments of time. A progressive sentence such as (32) is true at a time  $m$  if and only if  $m$  is a moment, there is an interval  $I$  such that  $m \in I$ ,  $m$  is not the endpoint for  $I$ , and *John builds a house* is true throughout  $I$ .

(32) John is building a house.

Under B&P's approach, only simple present sentences can be true in an interval of time, all other sentences can only be true at a moment of time.

To explain why (33) entails (34), while (30) does not entail (31), B&P propose that verb phrases like *John walk* but not verb phrases like *John leave* have the "subinterval property", as defined in (35) below:

(33) John is walking.

(34) John has walked.

(35)  $P$  has the subinterval property:  $P(t) \leftrightarrow (\forall t' \subseteq t) P(t')$ .

That  $P$  has the subinterval property means that if  $P$  is true for the duration of  $t$ , then  $P$  is true at any subinterval of  $t$ . We can then explain the entailment from (33) to (34): if (33) is true at the moment of utterance  $m$ , the progressive tells us that there exists an open interval  $I$  such that  $m \in I$ , and such that *John walks* is true at  $I$ . Given the subinterval property of the predicate, that *John walks* is true at  $I$  implies that *John walks* is true at an interval  $I'$  such that  $I' \subseteq I$  and that  $I'$  has the utterance time  $m$  as the final point. This is exactly the truth condition of the present perfect sentence in (34): that *John walks* is true at a time interval that starts at a past time point and extends to the moment of the utterance. That's how B&P predict the inference from (33) to (34).

In contrast, the verb phrase *leave* in (30) and (31) does not have the subinterval property, explaining why (30) does not entail (31).

Note that the interval semantics is motivated by the temporal interpretation of predicates of different aspectual classes: the “subinterval property” for instance, inspired a number of semantic analyses of aspectual classes. We turn to aspect in the next section. In particular, we review in Section 2.2.1 the well-adopted Vendlerian classification of predicates: *states*, *activities*, *accomplishments* and *achievements*. *States* and *activities* have the “subinterval property”, while *accomplishments* and *achievements* don't.

## 2.2 Aspect

Traditionally, the term “aspect” is used to describe two different kinds of phenomena, known as *situation aspect* and *viewpoint aspect* (Dahl 1981, Smith 1991, Olsen 1997 a.o.). *Situation aspect* refers to the inherent temporal contour of the type of eventuality described by the predicate. By contrast, *viewpoint aspect* has to do with a perspective on the event that a predicate is used to describe. Cross-linguistically, *viewpoint aspect* is often overtly expressed by grammatical

morphemes, while *situation aspect* is typically anchored in the lexical meaning and thus not overtly marked by grammatical morphemes.<sup>12</sup>

### 2.2.1 Lexical aspect: Vendler’s classification

*Lexical aspect*, also known as “situation aspect” or “Aktionsart”, is directly related to the types of situation described by a predicate. In the literature, the classification of predicates is largely based on parameters such as telicity, dynamicity, and durativity of the situation. Morphologically, situation aspect is unmarked. We present in this section Vendler’s four-way classification, some tests that permit us to distinguish them and the limits of these tests.

The idea of classifying predicates according to their meanings and temporal properties is due to philosophers such as Ryle (1949) and Vendler (1957). The classification adopted by most linguists is probably Vendler’s four verbal classes: *states*, *activities*, *accomplishments* and *achievements*. Table 1 below lists some examples of predicates according to Vendler’s classification:

<b>States</b>	<b>Activities</b>	<b>Accomplishments</b>	<b>Achievements</b>
<i>know</i>	<i>run</i>	<i>build a house</i>	<i>notice</i>
<i>believe</i>	<i>play tennis</i>	<i>draw a circle</i>	<i>die</i>
<i>love</i>	<i>sing</i>	<i>run 200 meters</i>	<i>win</i>
<i>be happy</i>	<i>push a cart</i>	<i>paint a picture</i>	<i>fall</i>

Table 1 Examples of Vendler verb classes

“States” are predicates describing non-dynamic eventualities that do not have a natural endpoint, such as *know*, *believe* or *be happy*. “Activities” are predicates describing dynamic eventualities and do not have a natural endpoint, such as *run*, *play tennis*. Accomplishment predicates refer to non-instantaneous dynamic events with an inherent

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<sup>12</sup> Note that there are also languages exhibiting specific morphology that modifies or specifies situation aspect: both in German and some Slavic languages, there seems to be verbal prefixes modifying the situation aspect.

Thanks to Brenda Laca and Lisa Matthewson for bringing to my attention the morphologically marked situation aspect.

culmination and therefore have a natural endpoint, such as *build a house*. Achievement predicates describe telic instantaneous events that culminate, such as *recognize* or *find*.

To understand the notion of the “natural endpoint” for an eventuality, we could imagine that someone *runs* or *believes in something* forever and that one can *stop running* but normally not *finish running*. In contrast, the event of “building a house” is generally conceived to have an end, thus one can *finish building a house*. If the moment at which one put the last brick signifies that the house building is completed, then that moment can be considered as the endpoint of the whole event described by *build a house*. This is what distinguishes predicates like *build a house* from predicates like *run*: the former but not the latter is used to describe an event with a natural endpoint.

Although Vendler talks about “verb” classes, the properties associated with different classes, as we have just seen, concern the whole VP rather than the verb in isolation. In particular, some verbs, which are “activity verbs” on their own, yield accomplishments when they combine with an object whose condition over time serves to measure out the development of the event (*eat an apple* or *mow the lawn*) or a prepositional phrase, describing the *telos* (goal) of the event. Take *walk* and *walk to school* for instance. The verb *walk* is classified as an activity when it stands alone, because the action of *walking* does not necessarily involve culmination, while *walk to the store* is considered as an accomplishment VP, since the action of walking to the store leads to a natural endpoint, the arrival point (the store). The presence / absence of a phrase modifying the verb can thus change the category of the VP. (See Verkuyl 1993 and Rosen 1999 for discussion.)

To distinguish Vendlerian verb classes, we can use several tests such as the progressive test, the *for*-adverbial test and the implication test. These tests are indicative rather than criterial.

#### Progressive test

While activities and accomplishments are compatible with the progressive, most states and achievements are not:

- (36) a. \*John is knowing Mary.                      → state

- b. Mary is dancing. → activity
- c. Max is building a house. → accomplishment
- d.\*Paul is recognizing his brother. → achievement

The progressive test divides the four classes into two groups: *activities* and *accomplishments* on the one hand, *states* and *achievements* on the other hand. Note that some states in their progressive form are acceptable but convey a special meaning (See Rothstein (2004)). Take (37) below for instance. It means that Peter is acting purposely as if he were stupid or he is just engaging in stupid behavior.

(37) Peter is being stupid.

There are also achievements compatible with the progressive, where the use of the progressive serves to indicate a preparatory stage of the instantaneous event described by the predicate. (38) below means that John's reaching the top is imminent.

(38) John is reaching the top.

#### Entailment test

The entailment test is related to the progressive test. The idea is as follows: although both activities and accomplishments are compatible with progressive aspect, they do not have the same kinds of entailments. Compare (39) with (40):

- (39) a. John is swimming.
- b. John has swum.
- (40) a. John is building a house.
- b. John has built a house.

If John is swimming, then John must have swum. Since (39a) entails (39b), we can conclude that *swim* is an activity. On the contrary, *John is building a house* in (40a) does not entail that he has built a house in (40b). Thus we can conclude that the VP *build a house* is an accomplishment.

The inference patterns above are also referred to as the "Imperfective Paradox" (Dowty 1979). It is a criterion often used crosslinguistically to determine whether a predicate is *telic* – that is,



whether it describes a process having a natural endpoint.<sup>13</sup> The progressive form of a *telic* predicate, such as *build a house* in (40a) entails at most the partial realization of the event described by *build a house*, and these subparts of the event cannot be described as a complete event of building a house. Since the perfect form of the same *telic* predicate ((40b)) conveys the realization of the entire event of John building a house, (40a) does not entail (40b). In contrast, the imperfective form of an *atelic* predicate like *swim* in (39a) entails the realization of subparts of a whole bigger event characterized as swimming, and the realized subparts are themselves “smaller” events of swimming. This is why (39a) entails the sentence with perfective aspect in (39b), which conveys the realization of swimming events (see also Bohnemeyer & Swift 2004).

The entailment test correlates with the “subinterval property” discussed in Section 2.1.4 (Bennett & Partee 1978). Activities, which pass the entailment test, give rise to properties of times that have the subinterval property, while accomplishments, which fail the entailment test, do not (see our earlier discussion of interval semantics).

Note that whether activities have the subinterval property is a debated issue in the literature. Since for an activity to realize (to be defined as activity), there should be a minimal duration of the process (see Dowty 1986, Rothstein 2004 and Reis Silva & Matthewson 2007 for discussion).

#### For-adverbial test

Another test that is standardly used in the literature is the *for*-adverbial test: verb classes are sensitive to the type of adverbials that modify them. States (41a) and activities (41b) are compatible with *for*-adverbials but not *in*-adverbials, while accomplishments (42a) and

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<sup>13</sup> A predicate is *telic* if it describes an eventuality that is, according to Rothstein (2004:7), a movement “towards an endpoint where the properties of the endpoint are determined by the description of the event”. An *atelic* predicate describes an eventuality that, “once started...can go on indefinitely, since the nature of the eventuality itself does not determine its endpoint”. See also Depraetere (1995) for discussion.

achievements (42b) can combine with *in*-adverbials but not *for*-adverbials.

- (41) a. Mary was sick for/\*in three days.  
       b. Mary walked for/\*in an hour.
- (42) a. John wrote a letter in/\*for ten minutes.  
       b. John reached the top in/\*for five minutes.

The *for*-adverbial test is also known as the test of “telicity”. States and activities, which are compatible with a *for*-adverbial, describe a kind of situation that lacks an inherent endpoint (see also footnote 10). They are thus *atelic*. In contrast, accomplishments and achievements, which are incompatible with a *for*-adverbial, are *telic*. They describe a process having a natural endpoint, the culmination of the described process. As we noted, a number of verbs like *eat* can be used to describe either an activity of eating or a process that culminates such as *eat a cake*. What is crucial here is when a VP containing the verb *eat* is compatible with a *for*-adverbial, as the case in (43a), we focus on the “activity” of *eating*, even if the object *his cake* is present. Conversely, (43b) is acceptable because *eat* can be used to talk about an eating process as a whole. (43b) could mean something like *Max ate his meal in ten minutes*.

- (43) a. Max ate his cake for ten minutes.  
       b. Max ate in ten minutes.

Table 2 synthesizes the correlation between verb classes and the test mentioned above:

	Progressive	Entailment	<i>for</i> -adverbial
States	*	-	√
Activities	√	√	√
Accomplishments	√	*	*
Achievement	* / ?	-	*

Table 2 Tests for Vendlerian verb classes

In the literature, there are also arguments for distinguishing a fifth verb class, *semelfactives*, from the four Vendlerian classes we just discussed. Smith (1991) and Verkuyl (1993) use this term to refer to dynamic events that occur very quickly and with no result state. Typical examples are *knock at the door*, *cough*, and *blink*. A semelfactive describes a (near-)instantaneous event, such as an event of someone knocking at the door *once*. Since the event is extremely brief, one might expect a sentence with a semelfactive predicate not be compatible with a durative adverbial, predicting a sentence like in (44) to be ungrammatical. (44) is however perfectly fine, but it means that a sequence of the knocking events and not a single knocking by John has lasted for two minutes. The *for*-adverbial modifies not a single instantaneous event but a sequence of events, itself having duration. Smith (1991) points out that most of the time the event described by a semelfactive predicate occurs in “repetitive sequences”. A sequence of multiple events behaves very much like an event described by an activity predicate, that is, they are dynamic events with duration and with no culmination, explaining why semelfactives are compatible with *for*-adverbials ((44)) and the progressive form ((45)), just like activities.

(44) John knocked at the door for two minutes.

(45) Someone is knocking at the door.

What distinguishes semelfactives from activities is their duration: semelfactives describe punctual events that can occur only once and have a very brief duration, such as *blink (once)* and *knock at the door*

(*once*), while activities describe events having a larger minimal duration, such as *walk*. The minimal duration of an action characterized by *walk* is the time that it takes to complete one step.<sup>14</sup> Semelfactives are different from achievements because they describe events with no resulting states, while achievements report culminating events.

We will not go further here into details about the semantic properties of semelfactives, although we will refer to this class again in Chapter 3 when we discuss the framework that Smith and Erbaugh (2005) adopt in their analysis of time in Mandarin. All the tests we have discussed so far are English-specific. For discussion about the cross-linguistic variation of Aktionsart, see Bar-el (2005).

### 2.2.2 Grammatical Aspect

Grammatical aspect, also called “viewpoint aspect”, is concerned with perspectives on an event. With perfective aspect, we consider an event as a whole, and thus perfective aspect provides an external perspective on the event; with imperfective aspect, we focus on an inner stage of an event, and thus imperfective aspect provides an internal perspective on the event. (Comrie 1976) Languages vary as to whether or not they morphologically mark viewpoint aspect: French and Mandarin overtly mark imperfective and perfective viewpoint aspect, while Finnish and Icelandic do not (Smith 1991).

Aspect has been conceived in terms of the notion of *reference time* introduced by Reichenbach (1947) and discussed by Klein (1994) (who uses the name “topic time”). Reference time conveys a temporal perspective from which “the speaker invites his audience to consider the event” (Taylor 1977:203). Take the past perfect in English for instance:

(46) John had left.

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<sup>14</sup> The contrast between semelfactives and activities in terms of event duration is not absolute in the sense that events like *knocking at the door* or *blinking* also take time, though very little time relative to events like *walk* (take a step).

According to Reichenbach, in using (46), we situate an *event time* – the time of John’s leaving – with respect to two other times, the *speech time* and a *reference time*. The use of past perfect in (46) indicates both that the event time precedes the reference time and that the reference time precedes the speech time. Klein attributes this to two different ingredients, past tense and perfect aspect: past tense orders the reference time before the speech time and perfect aspect locates the event time before the reference time. Generally speaking, Klein proposes that tense relates reference time to utterance time and aspect relates event time to reference time. Klein sees the reference time as a particular time span about which a sentence makes an assertion. Table 3 below recapitulates the three time spans in the tense-aspect theory of Reichenbach and Klein.

Utterance time (UT) / Speech time	Time of speech
Eventuality time (ET)	Time of the situation
Reference time (RT) / Topic time (TT)	Time about which something is asserted

*Table 3 Three time spans in Reichenbach (1947) & Klein (1994)*

A reference time can also be explicit. Consider (47):

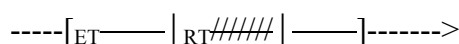
(47) At 2 pm, Susan was sleeping.

(47) conveys that the event of Susan sleeping is ongoing at a past time point, “2 pm”. The event time is Susan’s sleeping time and the reference time is “2 pm”. The past tense carried by the auxiliary *was* orders the reference time and the speech time: “2 pm” should precede the speech time. Progressive aspect relates the reference time to the event time: “2 pm” is temporally included within the time of Susan sleeping.

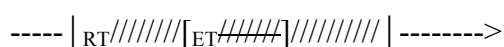
Adopting this perspective, we can see imperfective and perfective viewpoint aspects as differing in terms of interaction with the reference time. Basically, with imperfective aspect, the time of the event described by the predicate includes the reference time and the intersection of the two time intervals does not contain the endpoint of

the event, as shown in the schema in (48); by contrast, perfective aspect requires the event time to be included within the reference time, as shown in (49).

(48) Imperfective:



(49) Perfective:



### 2.3 Event semantics and stative /eventive contrast

This section reviews event semantics, a framework largely used in recent literature on tense and aspect. The analysis that we adopt to account for the temporal interpretations of bare predicates in Mandarin, the *argument structure analysis* developed by Katz (1995, 2003), is based on an event semantics. The basic idea is that stative predicates differ from eventive predicates in their argument structure: stative predicates lack the “event argument” that eventive predicates have.

#### 2.3.1 Event semantics

The proposal of an extra event argument for eventive predicates is due to Davidson (1967). He argues that in a sentence like *John did it slowly, deliberately...*, the anaphoric pronoun *it* refers not to an individual but to an “action”; and what the adverbials *slowly* and *deliberately* modify is that action. Thus, it is natural to presume entities of this type when we use a sentence to talk about an “action” (Davidson 1967:37-40). What can be seen from the inference is that an eventive verb like *kiss* is a predicate taking three arguments: a patient, an agent and an event, as shown in (50):

(50)  $[[\text{kiss}]^{\text{g,c}} = \lambda x.\lambda y.\lambda e. \text{KISS}(e, y, x)]^{15}$

The VP in the sentence *John kissed Mary* denotes a set of events of John kissing Mary. Assuming that the lexical entries for *John* and

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<sup>15</sup> “KISS (e, y, x)” here is shorthand for “e is an event of y kissing x”

*Mary* are as indicated in (51), the semantic value for the VP will be like in (52):

$$(51) \begin{aligned} \llbracket \text{John} \rrbracket^{g,c} &= J \\ \llbracket \text{Mary} \rrbracket^{g,c} &= M \end{aligned}$$

$$(52) \llbracket \text{VP John kiss Mary} \rrbracket^{g,c} = \lambda e. \text{KISS}(e, J, M)$$

### 2.3.2 Stative/eventive contrast

Davidson's idea concerning the event argument of eventive verbs inspired many scholars such as Galton (1984), Sandström (1993) and Katz (1995, 2003) in their treatment of stative *vs.* eventive predicates. In particular, Katz claims that stative predicates are properties of times, and they do not have the event argument that eventive predicates have. The lexical entry of a stative verb like *love* is given in (53). This reflects Davidson's view that "action sentences" should be distinguished from sentences referring to a "fact", such as "*the cat has mange*", by their logical structure.

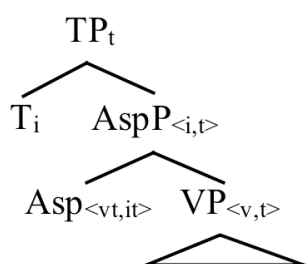
$$(53) \begin{aligned} \llbracket \text{love} \rrbracket^{g,c} &= \lambda x. \lambda y. \lambda t. \text{LOVE}(t, y, x) \\ \llbracket \text{VP John love Mary} \rrbracket^{g,c} &= \lambda t. \text{LOVE}(t, J, M) \end{aligned}$$

According to Katz, an eventive verb is a predicate of events; an aspect operator is needed to map such a predicate to a predicate of times of the sort that stative predicates contribute. Tense will then apply to time predicates to give a truth value to the sentence. Syntactically, sentences describing a particular event differ from sentences describing a state. This is because (following Klein (1994) and Kratzer (1998)) they include a syntactic projection between tense and the VP whose head is occupied by the aspect operator PERFECTIVE or PROGRESSIVE – an operator that converts properties of events to properties of times.

Recall Reichenbach and Klein's theory of tense and aspect that we discussed in the previous section: tense relates the reference time to the utterance time and aspect relates the reference time to the event time. A specific compositional implementation of Klein's theory was proposed by Kratzer (1998). She proposes that aspect takes the property of events denoted by the VP (of type  $\langle v, t \rangle$ , where  $v$  is the

type of events<sup>16</sup>) and returns at AspP a property of times (of type  $\langle i, t \rangle$ , where  $i$  is the type of time intervals). The T node is sister to AspP, and introduces a variable over time intervals, which corresponds to the reference time. This is how aspect establishes the relation between event time and reference time.

(54)



(See also Kratzer 1998)

Specifically, imperfective aspect requires that the reference time be included in the event time. The semantics of the imperfective operator IMP is given in (55), based on Kratzer (1998:17)<sup>17</sup>. IMP takes a property of events and gives a property of times, true of a time  $t$  (the reference time) that is included in the running time of the eventuality (its event time) described by the VP.

(55) Imperfective aspect:

$$\llbracket \text{IMP} \rrbracket = \lambda P_{\langle v, t \rangle} . \lambda t . \exists e [ t \subseteq \tau(e) \ \& \ P(e) = 1 ]$$

( $\tau$  is a “temporal trace” function from an event to its run time.  
See Krifka (1989a:97)).

Conversely, perfective aspect requires that the reference time include the event time. Thus the operator PERF combines with a property of

<sup>16</sup> The type “ $v$ ” used here corresponds to the “ $l$ ” type in Kratzer (1998). The only reason to use “ $v$ ” instead of “ $l$ ” is to be consistent with the terminology used in other parts of the dissertation.

<sup>17</sup> Kratzer’s lexical entries for aspectual operators and for verbs select for a world argument  $w$  as well, that we omit here.



eventualities and returns a property of times, true of a time  $t$  (the reference time) that includes the event time, as shown in (56):

(56) Perfective aspect:

$$\llbracket \text{PERF} \rrbracket = \lambda P_{\langle v, t \rangle} . \lambda t . \exists e (\tau(e) \subseteq t \ \& \ P(e) = 1)$$

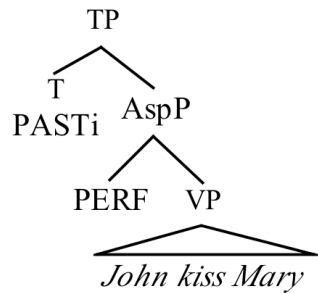
In his proposal concerning differences between sentences describing states and those describing events, Katz (2003) adopts Kratzer's semantic account of aspect in the sense of Klein. To illustrate, given the lexical entries of the past tense and the perfective aspect in (57), a sentence describing an event like *John kissed Mary* will have a structure as in (58) and the detailed derivation in (59).

(57)  $\llbracket \text{PAST}_i \rrbracket^{g,c}$  is defined only if  $g(i) < t_c$ ; where defined,

$$\llbracket \text{PAST}_i \rrbracket^{g,c} = g(i)$$

$$\llbracket \text{PERF} \rrbracket^{g,c} = \lambda P . \lambda t . \exists e [P(e) = 1 \ \& \ \tau(e) \subseteq t]$$

(58)



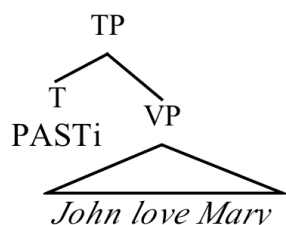
(59)  $\llbracket \text{VPJohn kiss Mary} \rrbracket^{g,c} = \lambda e . \text{KISS}(e, J, M)$

$$\llbracket \text{AspP} \rrbracket^{g,c} = \lambda t . \exists e [\text{KISS}(e, J, M) \ \& \ \tau(e) \subseteq t]$$

$\llbracket \text{TP} \rrbracket^{g,c}$  is defined only if  $g(i) < t_c$ ; where defined,  $\llbracket \text{TP} \rrbracket^{g,c} = 1$  iff there is an event of  $J$  kissing  $M$ , such that its running time is included in  $g(i)$ .

By contrast, a sentence with a stative VP like *John loved Mary* will have a structure as in (60), where the stative VP can combine directly with the past tense.

(60)



The derivation for *John loved Mary* is given in (61):

- (61)  $\llbracket \text{VPJohn love Mary} \rrbracket^{\text{g},c} = \lambda t. \text{LOVE}(t, J, M)$   
 $\llbracket \text{TP} \rrbracket^{\text{g},c}$  is defined only if  $g(i) < t_c$ , where defined,  $\llbracket \text{TP} \rrbracket^{\text{g},c} = 1$  iff  
*J* loves *M* for the duration of  $g(i)$ .

If we compare the semantic value of the stative VP in (61) with that of the AspP of the eventive sentence in (59), we find the same logical type: they are both properties of times.

The advantage of the argument structure analysis of the difference between stative and eventive predicates is that it correctly captures phenomena such as the incompatibility of the progressive aspect with stative verbs, and the “Stative Adverb Gap” extensively discussed in Katz (2003).

On the argument structure analysis, the progressive, being an operator that maps event predicates to time predicates, should not be compatible with stative VPs, themselves predicates of times. This is exactly what we find in English:<sup>18</sup>

- (62) \*Mary is knowing the answer.

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<sup>18</sup> As we have mentioned in Section 2.2.1, in some contexts, progressive aspect can appear in sentence with a stative predicate, such as *John is being stupid*, but the sentence has a particular meaning. It could mean that temporally John is acting purposely as if he were stupid. In the current discussion, we do not take into account these specific cases. The reader can consult Johannsdottir (2011), who proposes a coercion when the progressive combines with states.

The second advantage of the argument structure analysis is to explain the “Stative Adverb Gap”. Katz (2003) points out that a number of adverbs cannot appear in sentences with a stative predicate, but almost none are restricted from modifying sentences with an eventive predicate. The asymmetry can be illustrated by the contrast between (63a) and (63b). Adverbs such as *quickly* are compatible with eventive verbs like *kiss*, but incompatible with stative verbs like *love*.

- (63) a. \*John loved Mary quickly.  
b. John kissed Mary quickly.

(Katz 2003:456)

However, almost no adverbs function the other way around: that is, would be compatible with stative verbs but incompatible with eventive verbs. For instance, no adverb fits the particular schema in (64):

- (64) a. John loved Mary ADVERB.  
b. \*John kissed Mary ADVERB.

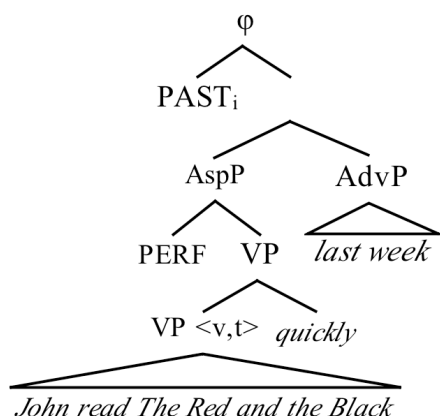
(Katz 2003:456)

One could explain the contrast observed in (63) by verb-adverb selectional restrictions. For instance, some adverbials select for dynamic properties of an eventuality, explaining the behavior of *quickly* in (63). The problem is, according to Katz, that this selectional restriction on adverbial modification cannot capture the asymmetry between (63) and (64) -that is- why there are no adverbs that select for properties that a stative predicate but not an eventive predicate would have.

The argument structure approach can carry over to account for the asymmetry discussed above in a simple way. The behavior of different kinds of modifying adverbials lies in the different syntactic positions they occupy. Sentential adverbs, such as *probably* and *immediately*, are TP adjuncts. Temporal adverbs, such as *in 1919* and *last year*, adjoin either to a stative VP or an AspP, adding restrictions on times. Event adverbials, such as *quickly* and *slowly*, modify eventive VPs. Consider (65), a sentence containing at the same time an event adverbial *quickly* and a temporal adverbial *last week*. Its syntactic structure is illustrated in (66), and the truth conditions of (65) are given in (67).

(65) John read *The Red and the Black* quickly last week.

(66)



(67)  $[[\phi]]^{g,c}$  is defined only if  $g(i) < t_c$ , where defined,  $[[\phi]]^{g,c} = 1$  iff  $\exists e$   
 $[\text{READ}(e, J, RB) \ \& \ \text{quick}(e) \ \& \ \tau(e) \subseteq g(i) \ \& \ g(i) \subseteq \text{last week}(c)]$

(67) says that the semantic value of the structure  $\phi$  is defined only if the value assigned to  $\text{PAST}_i$ ,  $g(i)$ , precedes the utterance time.  $\phi$  is true if and only if there is an event of John reading *The Red and the Black*, such that the event is quick and whose running time is included in a contextually determined time  $g(i)$ , which should be in the week before the week of the utterance time.

At this stage, we can easily explain the Stative Adverb Gap. Adverbs like *quickly* are properties of events, and thus cannot apply to stative VPs, explaining the contrast between (63a) and (63b). The lexical entry of *quickly* is given in (68).

(68)  $[[\text{quickly}]]^{g,c} = \lambda e. e$  is quick

Temporal adverbials like *last week* are properties of times, and therefore compatible with both a stative VP and an AspP having an eventive VP as a component. This is why no adverbs can only appear with a stative VP but not an eventive VP, as the schema in (64) indicates. This restriction on adverbial modification follows from the argument structure approach.

We will show in Chapter 3 how Mandarin data provide evidence for Katz's argument structure analysis. We claim that aspect must be overtly realized in root clauses in Mandarin, unlike in languages like English. It plays the role of mapping properties of events to properties of times, in Mandarin just like in English.

## 2.4 Semantic Assumptions and notation

We follow Heim & Kratzer (1998) in our assumptions about the rules of semantic composition. The notation used in this thesis is summarized in Table 4 and Table 5:

Individuals:	type e
Times:	type i
Events:	type v
worlds:	type s
Truth values:	type t

*Table 4 Notation for types*

Individual variables:	x, y, z...
Time variables:	t
Event variables:	e
World variables:	w
Function variables:	P, Q... (capital letters)

*Table 5 Notation for metalanguage*