

Interactions Between Aspects and Temporal Relations: A Case Study of the Perfective *le**

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This paper discusses how perfective *le* influences temporal relations. I argue that, in Mandarin, an aspect indirectly influences temporal relations via rhetorical relations in two ways: first, based on its semantics, an aspect specifies a default rhetorical relation, which in turn determines a temporal relation, when there is no cue or other information in the discourse indicating otherwise, and second, an aspect sets up a temporal constraint, which the temporal relations specified by rhetorical relations must obey. Perfective *le* has been argued to present a situation as a whole. Based on its semantics, I argue that perfective *le* specifies a default rhetorical relation *Narration*, which indicates temporal progression, and sets up a temporal constraint: the internal process of a situation presented by perfective *le* cannot be accessed unless it is necessary. In addition, this paper proposes a new temporal relation for *Narration* and one for *Elaboration*. When a state that goes with perfective *le* is connected to the following sentence by *Narration*, it does not have to be the case that the whole state temporally precedes the situation described by the following sentence. Instead, it suffices that the starting point of the state temporally precedes the latter situation. *Elaboration* does not necessarily specify temporal inclusion, contra Asher & Lascarides (2003:160). When an achievement presented by perfective *le* is elaborated on, the situations providing more details temporally precede the achievement.

Key words: temporal relation, perfective *le*, semantics-pragmatics interface, Mandarin Chinese

1. Introduction

The sentences in a discourse describe situations, and situations may be temporally related to each other. A situation can temporally precede, follow, or overlap another one

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in the same discourse. In English, tenses play a role in determining temporal relations. For example,

- (1) a. John is absent today.
- b. He was severely injured in a car accident.

In the example above, clearly, (1b) occurs before (= in the past of) (1a) because (1b) is past tense and (1a) is present tense. But tense does not help when the sentences are the same tense. Asher & Lascarides (2003) argue that the sentences in a coherent discourse are connected by appropriate rhetorical relations, and that rhetorical relations determine temporal relations, among other things. See the examples below.

- (2) a. John fell down.
 - b. Mary helped him up.
- (3) a. John fell down.
 - b. Mary pushed him.

In the two examples above, (2a) occurs before (= in the past of) (2b), and (3b) occurs before (3a). That is, in (2), the contextual order of the situations matches the temporal order, while in (3) the contextual order is the reverse of the temporal order. According to Segmented Discourse Representation Theory (henceforth, SDRT) proposed by Asher & Lascarides (2003), (2b) is connected to (2a) by *Narration*¹ and (3b) is attached to (3a) by *Explanation*. *Narration* specifies that the contextual order matches the temporal order, i.e. advancement of narrative time. *Explanation* specifies that the cause occurs before the effect. The temporal relations specified by these two rhetorical relations match native speaker's intuition of the temporal relations between the sentences in (2) and (3).

Mandarin is not morphologically marked for tense, as noted by many authors, e.g. Li & Thompson (1981:13), J. Lin (2003, 2006), Wu (2007b, 2009a); but Mandarin has a rich aspectual system. This paper discusses how perfective *le* influences temporal relations. I would like to address three questions. First, does perfective *le* directly determine temporal relations or indirectly affect temporal relations via rhetorical relations, as proposed by SDRT? Second, does the aspectual semantics of perfective *le* influence temporal relations? If the answer is positive, in what way? And third, what implication does this paper have for the influence of aspects on temporal relations in general?

the anonymous reviewers of *Language and Linguistics* for their enlightening and productive comments as well. All remaining errors are, undoubtedly, mine.

¹ In this paper, rhetorical relations are italicized, with the first letter capitalized.

This paper is organized as follows. In §2, I select, among the abundant research on perfective *le*, a few studies and summarize them. Based on the semantics of perfective *le*, I propose a hypothesis of the role of perfective *le* in temporal relations. I also briefly compare Smith's (2003) theory of discourse structure with SDRT in this section. In §3, I test the hypothesis and attempt to answer the three research questions raised above. In §4, I propose an SDRT account. In §5, I conclude this paper.

2. Literature review

2.1 Semantics of perfective *le* and temporal relations

Perfective *le* has been a very popular issue in Chinese linguistics. There is a tremendous amount of studies on perfective *le*, such as J. Lin (2000, 2003, 2006), W. Lin (1979), Kang (1999), Li & Thompson (1981), Mangione & Li (1993), Rohsenow (1978), Shi (1990),² Smith (1997), Wu (2005), just to name a few. Among these, I will briefly mention the work of Li & Thompson (1981), J. Lin (2003), Smith (1997, 2003) and Wu (2005).

Li & Thompson (1981:213-215) have explicitly pointed out that perfective *le* is not a past tense marker. Perfective *le* has been observed to have three readings: a completive reading, a terminative reading, and an inchoative reading. It has also been observed that the different readings of perfective *le* are related to the situation types that perfective *le* presents. Let us look at the following examples:

- (4) a. zhangsan xie le yi feng xin
 Zhangsan write Pfv³ one CL letter
 'Zhangsan wrote a letter.'
- b. zhangsan kan le zhe bu dianying san ci
 Zhangsan see Pfv this CL movie three time
 keshi mei yi ci kanwan
 but no one time see-finish
 'Zhangsan saw this movie three times, but did not finish it even once.'

² It is generally agreed that there are two variants of *le*, perfective (verbal) *le* and sentential *le*, though some works, such as Rohsenow (1978), Shi (1990), et al., attempt to propose a unified semantics for these two variants of *le*. In this paper, I focus only on perfective *le*.

³ The abbreviations used in this paper include CL for classifier, DE for modifier-modifiee marker, Disp for disposal marker, Pass for passive marker, Pfv for perfective marker, Poss for possessive marker, Prc for participle, Rel for relative marker, and ZA for zero anaphora.

- c. zher de hua dou hong le⁴
 here DE flower all red Pfv
 ‘The flowers here all became red.’

Smith (1997:264-266) points out the following points: first, perfective *le* presents a closed event when it goes with activities, semelfactives, and achievements; second, when an accomplishment goes with perfective *le*, the event can be either terminated or completed;⁵ and third, stative verbs have an inchoative reading when they go with perfective *le*. In (4a-b), *xie yi feng xin* ‘to write a letter’ is a typical accomplishment because it is compatible with the progressive *zai* and a completive phrase such as *wu fenzhong nei* ‘in five minutes’. This event can have either a completive reading, as in (4a), or a terminative reading, as in (4b), when it goes with perfective *le*, just as Smith describes. In (4c), *hong* ‘red’ is a stative situation. When it goes with perfective *le*, it has an inchoative reading, exactly as Smith states.

J. Lin (2000, 2003, 2006) proposes that a telic event presented by perfective *le* receives a completive (past-tense) reading while an atelic situation perfective *le* presents an on-going (present-tense) reading.

Wu (2005) makes a finer distinction in terms of situation types, compared to J. Lin (2000, 2003, 2006). He agrees with J. Lin in that telic events presented by perfective *le* get a completive reading, though he argues that this is a defeasible reading because contextual information can override it, as in (4b). But, he points out that atelic situations do not behave in parallel in terms of perfective *le*. Activities do not go with perfective *le* alone. States are not all compatible with perfective *le*. Stage-level states are compatible with perfective *le* and receive an inchoative reading, whereas individual-level states are not compatible with perfective *le*.⁶ Therefore, Wu proposes that perfective *le* identifies

⁴ One might ask why this *le* is treated as perfective *le*, not the sentential *le*. Smith (1997: 292-294) assumes that perfective *le* goes with states to express an inchoative reading. Please refer to Wu (2005) where it is argued that the *le* after a state verb is, indeed, perfective *le*.

⁵ A reviewer asked about the difference between ‘terminated’ and ‘completed’, and s/he also asked why (4a) is completive and (4b) is terminative. The distinction between ‘terminated’ and ‘completed’ discussed in Smith (1997:264-265), where she cites Chu (1976) and Rohsenow (1978) for this distinction, is based on the concept that an event is considered completed if its starting point, its natural final endpoint, and its process, if it has one, are all presented, and if an event starts but does not reach its natural final endpoint, then it is considered terminated, but not completed. Based on this concept, because by uttering (4a) the speaker presents the starting point of the event, its process and its natural final endpoint, (4a) is considered completed. In (4b), the *see this movie* event starts but does not reach its natural final endpoint, i.e. the subject does not finish seeing this movie, it is considered terminated, not completed.

⁶ Chang (2003) has a similar observation, though he does not commit himself to the question whether the *le* compatible with stage-level states is perfective *le* or the sentential *le*.

the significant point (SigP) of a situation, which is the final endpoint of a dynamic event and the starting point of a stage-level state, and locates the interval, before a referent time t' , the interval from the starting point of a situation to its SigP.

Regardless of how the semantics of perfective *le* is formalized in previous works, it is agreed that perfective *le* presents (part of) a situation as a whole. Based on this semantics of perfective *le*, I hypothesize the role of perfective *le* in temporal relations as follows:

- (5) Hypothesis for the role of perfective *le* in temporal relations
 - a. A situation presented by perfective *le* can advance the narrative time when no cue or other information in the context specifies otherwise.
 - b. The time for the internal process of a situation presented by perfective *le* cannot be accessed unless doing so is required.

Both (5a) and (5b) follow naturally from the semantics of perfective *le*. Because perfective *le* presents a situation as a whole, the situation which *le* presents is either completed or terminated. A sentence that contextually follows a sentence describing a completed or terminated event naturally occurs after (= in the future of) the sentence describing completion or termination. Because perfective *le* presents a situation as a whole, the internal process of the whole should not be easily accessed.

2.2 Smith's (2003) modes of discourse

Smith (2003) discusses the local structure of texts. She suggests that a passage of text that shares certain features belongs to a particular Discourse Mode. She proposes five modes: Narrative, Description, Report, Information, and Argument. She suggests that these Discourse Modes are characterized in terms of the situations they introduce into the discourse, temporality and progression.

The Narrative mode primarily introduces specific Events and States into the discourse. It is temporally dynamic and is located in time. It causes advancement in narrative time. The Report mode primarily introduces Events, States, and General Statives into the discourse. It is also temporally dynamic and is located in time. It initiates advancement anchored to Speech Time. The Description mode primarily introduces Events, States and on-going Events into the discourse. It is temporally static and is located in time. It evokes spatial advancement through the scene or object. The Information mode primarily introduces General Statives into the discourse. It is atemporal. It initiates metaphorical motion through the text domain. The Argument mode primarily introduces Facts, Propositions, and General Statives into the discourse. It is also atemporal. It causes metaphorical motion through the text domain.

The functions of Smith's Discourse Modes seem to resemble those of the rhetorical relations used in SDRT since both Discourse Modes and rhetorical relations in SDRT are related to temporal relations. However, Discourse Modes and rhetorical relations in SDRT are actually very different. The most significant difference is that a Discourse Mode realizes a passage of text, while a rhetorical relation connects two sentences together.

Though Smith (2003:22) suggests that two sentences suffice to set up linguistic features that can decide a Discourse Mode, the possibility for a Discourse Mode to characterize more than two sentences marks the difference between Discourse Modes and SDRT. Besides, Smith's theory of Discourse Modes cannot represent the hierarchical structure of discourse because it is not clear how passages of different modes are related to each other. It has long been established that discourse has a hierarchical structure, e.g. Asher & Lascarides (2003), Mann & Thompson (1987), et al. It is very important to represent the hierarchical structure of discourse because a great number of linguistic phenomena depend on it. For example, to identify an appropriate antecedent to a zero anaphor in Mandarin depends on the hierarchical structure. See the example below.

- (6) a. a-de kandao rongrong diedao le
 A-de see Rongrong fall Prc
 'A-de saw Rongrong fall down.'
- b. Ø gankuai zoushangqian ba ta fuqilai
 ZA hurried walk forward Disp she help up
 'He (= A-de) hurried forward and helped her (= Rongrong) up.'
- (7) a. a-de kandao rongrong diedao le
 A-de see Rongrong fall Prc
 'A-de saw Rongrong fall down.'
- b. Ø ku de hen shangxin
 ZA cry DE very sad
 'She (= Rongrong) cried very sadly.'
- c. Ø gankuai zoushangqian ba ta fuqilai
 ZA hurriedly walk forward Disp she help up
 'He (= A-de) hurried forward and helped her (= Rongrong) up.'

(6b) is attached to the matrix clause (6a), *A-de saw something* and therefore the zero anaphor in (6a) is resolved to the only possible candidate to the antecedent to the ZA in the matrix clause, i.e. *A-de*. (7b), on the other hand, is attached to the embedded clause of (7a), i.e. *Rongrong fall down*, and therefore the antecedent to the zero anaphor

in (7b) is the only possible candidate *Rongrong*.⁷

The above examples clearly show the importance of the hierarchical structure of discourse. Since it is not clear how Discourse Modes are related to each other to form a hierarchical structure, while SDRT can represent the hierarchical structure of discourse, I choose SDRT as the framework to analyze the issues discussed in this paper.⁸

3. Testing the hypothesis

3.1 Advancement of narrative time

Wu (2006, 2009b) observes that a situation presented by the experiential *guo* cannot advance the narrative time unless its event time is explicitly specified. Wu (2007a) observes that a situation presented by the durative *zhe* can advance the narrative time only when another situation that has come to an end is embedded under the previous situation. Contrary to the fact that the experiential *guo* and the durative *zhe* are restricted in terms of advancement of narrative time, (5) hypothesizes that a situation perfective *le* presents can advance the narrative time, when no cue or other information in the context says otherwise. The following examples support this hypothesis.

- (8) a. zhangsan zuotian wanshang chi le fan
Zhangsan yesterday night eat Prv meal
'Last night, Zhangsan ate a meal.'
- b. kan le dianshi
watch Pfv TV
'(he) watched TV,'
- c. xi le zao
wash Pfv bath
'(he) took a bath,'
- d. ranhou qu shuijiao
then go sleep
'(and) then went to bed.'

⁷ For a detailed SDRT analysis of this example and of locating an appropriate antecedent to zero anaphora in Mandarin, interested readers are referred to Wu & Tseng (2008).

⁸ A reviewer suggested that studies on temporal reference in Mandarin be reviewed but this paper deals with temporal relations between sentences in discourse, not temporal reference of sentences so such a review will not be made here. Interested readers are referred to studies that discuss the temporal reference (i.e. tense) of Mandarin sentences, e.g. J. Lin (2003, 2006), Smith & Erbaugh (2005).

The sentences in (8) describe a series of events that occur consecutively. Among (8a-c), there are no cue phrases such as *ranhou* ‘and then’, *jiexialai* ‘next’ etc., that indicates advancement of narrative time. Unlike the *fall down* event and the *help up* event in (2), which have a natural sequence between them, as suggested in Asher & Lascarides (2003:199-204), the events described by (8a-c) do not have any natural sequence among them. How can we determine the temporal relations among these three sentences? Perfective *le* plays a significant role here. Perfective *le* in (8a) and (8b) indicates the completion of these two events because there is no information in the context that specifies otherwise. Since (8a) is completed, (8b) can occur after it. Since (8b) is also completed, (8c) can occur after it as well. If the three occurrences of perfective *le* in (8a-c) are removed, the discourse becomes very unnatural. This fact further supports that the default function of perfective *le* is to specify advancement of narrative time.⁹

⁹ I thank an anonymous reviewer, who suggested using an example of this kind to strengthen the argumentation of this point. The example used to demonstrate advancement of narrative time in an earlier draft is as follows:

- (i) a. li wenxiu bu neng zai ting supu zheban kujiao
Li Wenxiu no can more hear Supu so cry
‘Wenxiu Li could not hear Supu crying like this any more.’
- b. yushi huidao le ji lao ren jia zhong
so return Pfv Ji old man home inside
‘So, (she) returned to Old Man Ji’s home.’
- c. cong beiru dixia ba na zhang lang pi na le chulai
from bed sheet under Disp that CL wolf skin take Pfv out
‘(She) took out the wolf skin from under the bed sheet.’
- d. kan le hen jiu hen jiu
look Pfv very long very long
‘(She) looked at it for a very, very long time.’

The same reviewer suggested that in the above example the temporal relations are denoted by other elements, such as *dao* in *huidao* ‘to return to’ in (ib), *chulai* ‘out’ in (ic), not perfective *le*. He/she also suggested that an explanation is called for why the examples in (i) are acceptable and have the same rhetorical relations, when perfective *le* is omitted. The function of *dao* and *chulai* in the example above is to make an event telic and it is true that perfective *le* is not required here. For the second suggestion, Wu (2007c) has argued that telic events and perfective *le* have similar influence on temporal relations, that is, a telic event can advance the narrative time when no cue or other information in the context specifies otherwise, and the time for the internal process of a telic event cannot be accessed unless doing so is required. Since *huidao* ‘to return to’ and *na chulai* ‘to take out’ are both telic, according to Wu (2007c), they can advance the narrative time. Since telic events and perfective *le* influence temporal relations in similar ways, it is natural that, in a discourse with no cue about temporal relations but with telic events as (i), the same temporal relations surface between the sentences, with or without perfective *le*. Please note that telic events do not only indicate advancement of

(8) supports the hypothesis that perfective *le* can advance the narrative time when there is no cue or other information in the discourse indicating otherwise. The situations involved in (8) are completed events. Let us look at an example with a terminated event:

- (9) a. xiaoming zuoye xie le yiban
 Xiaoming assignment write Pfv half
 ‘Xiaoming wrote half of the assignment.’
 b. paochuqu wan
 run out play
 ‘(he) ran out to play.’
 c. jieguo bei mama ma
 result Pass mom scold
 ‘As a result, (he) was scolded by his mother.’

In (9), the *write the assignment* event is terminated, but not completed,¹⁰ and there is no cue to indicate a temporal relation. Neither is there a natural sequence between (9a) and (9b). Therefore, the default function of perfective *le* kicks in and specifies that (9b) occurs after (= in the future of) (9a), i.e. the narrative time is advanced. Next, let us look at an example of stage-level states presented by perfective *le*:

- (10) a. shu ye lü le
 tree leaf green Pfv
 ‘The tree leaves became green.’

narrative time. A telic can serve as a temporal background, can be elaborated on, can be explained, etc. All those rhetorical relations indicate different temporal relations. For a complete picture of how temporal relations between sentences with no aspect marker in Mandarin are determined, please refer to Wu (2007c).

¹⁰ A reviewer suggested that it is a mistake to think that (9a) is about the predicate *write the assignment*, while in fact it requires the interpretation of *write half of the assignment*. As far as I am concerned, *yiban* ‘half’ in (9a) is an event modification, i.e. *yiban* ‘half’ modifies the *write the assignment* event. Based on the discussion about ‘completed’ and ‘terminated’ in footnote (5), the event *zuoye xie yi ban* ‘to write half of the assignment’ is considered terminated, because *yiban* ‘half’ describes that the *write the assignment* event starts but does not reach its natural final endpoint, i.e. the subject started writing the assignment but did not finish it. Under the same view, the example presented by the reviewer, *Xiaoming wrote parts of the assignment*, can also be considered terminated, but not completed, because the *write the assignment* event starts but does not reach its natural final endpoint.

- b. hua hong le
flower red Pfv
'The flowers became red.'
- c. ren de xinqing ye genzhe hao qilai
people Poss mood also follow good start
'Following the change, people's mood became good as well.'

In the example above, the predicates in (10a) and (10b) are both stage-level states. The intuition is that the tree leaves became green first, and then the flowers became red. That is, (10b) occurs after (10a). There is no cue phrase between (10a) and (10b) to indicate their temporal relation. Neither is there a natural sequence between them because tree leaves do not have to become green before the flowers become red, or vice versa. Then, what determines the temporal relation between (10a) and (10b)?

Again, it is perfective *le* that plays a role here. Since there is no cue phrase or other information between (10a) and (10b) specifying otherwise, perfective *le* indicates the advancement of the narrative time.

In (10), the intuition is very clear that the tree leaves had become green before the flowers became red. Once these two states start, they continue to hold since the discourse does not specify their termination. Naturally, these two states hold during the same interval. This is why one gets a feeling that (10a) and (10b) temporally overlap with each other. But, the temporal overlapping between (10a) and (10b) is an inference.¹¹ Perfective *le* behaves the same in (8) and (10), i.e. it specifies temporal precedence.¹² The difference is that in (8) an event is completed before another starts, whereas in (10) a state starts before another state starts,¹³ but the previous state continues to hold when

¹¹ Dowty (1986) has a similar discussion about activities in English. He suggests that a perfective activity in English can temporally overlap with other events in the same discourse, due to the subinterval property. Dowty's point is very similar to the discussion regarding stage-level states here.

¹² Temporal precedence and advancement of narrative time are two sides of a coin. The advancement of narrative time means a series of situations occurs one after another. In other words, in this series of situations, one temporally precedes another. But, please note that this relation is one-way. That is, while advancement of narrative time implies temporal precedence, temporal precedence is not necessarily associated with advancement of narrative time. The temporal relation specified by *Explanation* is a good example.

¹³ An anonymous reviewer observed that perfective *le* in (10) cannot be omitted and hence suggested that the occurrence of perfective *le* is not determined by discourse only. However, this paper does not discuss whether the occurrence (or the forbiddance) of perfective *le* is determined by discourse. Instead, this paper deals with how perfective *le* influences temporal relations. The issue about the occurrence or the forbiddance of perfective *le* is left for future studies.

the latter event starts and holds. This discrepancy lies in the different interactions between perfective *le* and the kinds of situation types expressed in these examples.

To sum up, perfective *le* specifies a default temporal relation, based on its semantics. It has been argued that perfective *le* presents a situation as a whole. Since a situation is presented as a whole, it is natural that another situation can temporally follow it. This is why perfective *le* defeasibly indicates advancement of narrative time. When there is no cue or information specifying otherwise in the context, a situation presented by perfective *le* temporally precedes a situation which follows the preceding one in the context.

3.2 Provision of more details

As reviewed in §2, perfective *le* presents a situation as a whole. Since a situation is presented as a whole by perfective *le*, its internal process should not be accessed. However, in a context where more details are provided on an eventuality presented by perfective *le*, the internal process of the eventuality has to be accessed. See the example below.

- (11) a. hushi yuanzhang zai kaimushi de zhici zhong
 Hu shi dean at opening ceremony DE speech inside
 tandao le bushao ling ren shen si de hua
 talk Pfv many make people deep think Rel words
 ‘In his speech at the opening ceremony, Dean Shi Hu talked about a lot of things that made people think profoundly.’
- b. ta tandao kexue shi yi zhong fangfa
 he talk science be one kind method
 minzhu shi yi zhong shenghuo fangshi
 democracy be one kind life style
 ‘He said that science of a way (of explaining the unknown) and democracy was a lifestyle.’

In the above example, (11b) is part of what Dean Shi Hu talked about at the opening ceremony. That is, (11b) provides more details on (11a). Naturally, (11b) temporally overlaps with (11a) since (11b) is, actually, part of the event described by (11a).

One interesting question immediately arises at this point. Achievements do not have an internal process, as discussed by Vendler (1957), Smith (1997), Wu (2005), et al. Does this mean that no details can be provided on achievements? Actually, this is not true. Consider the following example:

- (12) a. ta zhongyu dida le zhi ci tierensanxiang de zhongdian
 he finally arrive Pfv this time triathlon DE destination
 ‘Finally, he arrived at the destination of this triathlon.’
 b. ta zai shui li bei shuimu dingyao
 he at water inside Pass jellyfish bite
 ‘He was stung by jellyfish in the water.’
 c. lupao shi bei gou zhui
 running time Pass dog chase
 ‘He was chased by a dog while he was running.’
 d. ta dou yao ya chengguolai le
 he all clench tooth make it through to the end Prc
 ‘He clenched his teeth and made it through to the end.’

In (12a), *dida* ‘to arrive’ is a typical achievement because it is compatible with a completive phrase such as *wu fenzhong nei* ‘in five minutes’ but is not compatible with the progressive *zai*. Though (12a) is an achievement, (12b-d) still provide more details on it. Nevertheless, (12b-d) do not provide details on the *arrival at the destination* event because this event denotes only a point, as suggested in Smith (1997) and Wu (2005), and no detail can be provided on such a point. Instead, (12b-d) provide details on the preparatory process of the achievement described by (12a).

Though an achievement is usually suggested to denote an instantaneous event, few events in the real world are truly instantaneous. Typical achievements include ‘to die’, ‘to arrive’, ‘to win (a game)’, etc. Before one dies, he/she usually suffers from some disease or injury. Before one can arrive at some place, he/she has to be on the way first. To win a game involves preparation and practice. That is, though the preparatory process of an achievement is not coded in the semantics of the achievement, the achievement certainly has a preparatory process. It is this preparatory process on which more details are provided, as in (12).

The two types of provision of more details discussed above indicate different temporal relations. When more details are provided on the internal process of an event, temporal inclusion is evoked, as in (11), which is a typical example. (11b) is temporally included in (11a). On the other hand, when more details are provided on the preparatory process of an event, temporal precedence is evoked. (12) illustrates this point. (12b-d) provide details on the preparatory process of (12a), and therefore (12b-d) temporally precedes (12a).

Except for provision of more details, sentences of the other functions cannot access the internal or preparatory process of an event perfective *le* presents. Look at the following example:

- (13) a. guo le qi dian
 pass Pfv seven o'clock
 'When (the time) passes seven o'clock (= after seven o'clock),'
 b. lese bian bu neng xichu qinshi
 trash then no can carry out bedroom
 'then trash cannot be carried out of the bedrooms.'

In this example, (13b) does not provide any detail on (13a). Instead, (13a) provides a temporal frame for (13b) to hold. Since (13b) does not provide any detail on (13a), (13b) cannot be temporally included either in (13a) or in the preparatory process of (13a). Because (13a) provides a temporal frame, (13b) has to take whatever time (13a) has to provide. The time an event presented by perfective *le* has to offer is the time after the event is completed or terminated. Hence, (13b) has to temporally overlap the time after seven o'clock is passed. This example supports the hypothesis (5b) that the internal process of a situation presented by perfective *le* cannot be accessed unless it is required to do so.

One interesting question to ask is why (11) and (12) involve provision of details. Because neither (11) nor (12) has any cue phrase to indicate a temporal relation, it is important to decide whether (11) and (12) involve provision of details or advancement of narrative time. The hint lies in the lexical information. (11b) clearly is part of the speech described by (11a). (12b-d) are parts of the process of the triathlon described by (12a). In SDRT, this kind of part-whole relationship between situations is referred to as a subtype relation (Asher & Lascarides 2003:282-283). As long as there is a subtype relation between two situations, it can be inferred that provision of details is involved. On the other hand, for the examples of advancement of narrative time such as (8), (9) and (10), because the situations in these examples do not have a subtype relation, these examples do not involve provision of more details. Because (8), (9), and (10) do not have any cue phrase or other information to indicate otherwise, the default function of perfective *le* kicks in and indicates that these examples involve advancement of narrative time.

To sum up, the internal process of a situation presented by perfective *le* is not accessible unless it is absolutely necessary to do so. When a sentence (or a few sentences) provide more details about an event, accessing the internal process of the event is required. Only under this circumstance can the internal process of an event presented by perfective *le* be accessed. This kind of example evokes temporal inclusion. When an achievement is involved with provision of more details, the details are not provided on the achievement, due to its semantics. Instead, more details are provided on the preparatory

process of an achievement. Examples of this kind evoke temporal precedence.¹⁴

3.3 Other functions

A sentence with perfective *le* can have other functions, as long as the functions do not indicate temporal relations that violate the hypothesis (5). (13) above is an example. (13a) provides a temporal frame for (13b). Since the time a telic event presented by perfective *le* can provide is the time after the event is completed, (13b) temporally overlaps the time after (13a) is completed. This temporal relation does not violate the hypothesis (5) and therefore is legitimate.

A sentence with perfective *le* can explain another sentence or be explained by another sentence. Asher & Lascarides (2003:160) propose that the sentence serving as the cause temporally precedes the sentence functioning as the result when one sentence explains the other. See the examples below:

¹⁴ An anonymous reviewer asked whether the process part of the accomplishment will be accessed. In terms of provision of more details, i.e. *Elaboration*, the internal process of an accomplishment is accessed. Conceptually, *Elaboration* accesses the same part regardless of whether it is an accomplishment or an achievement because it accesses the process that leads to the natural final endpoint of an event. Different temporal relations are evoked by an accomplishment and an achievement because the accessed process of an accomplishment is part of the semantics of the accomplishment, whereas the accessed progress of an achievement is not part of the semantics of the achievement. The same reviewer also asked about what is accessed when a resultative verb compound (RVC) is elaborated on. I think the answer depends on whether an RVC in Mandarin is considered an accomplishment or an achievement. See the example below:

- (i) a. gongcheng dui zhongyu zhasui le na kuai da shitou
engineer team finally blow-pieces Pfv that CL big stone
'The engineer team finally blew that big stone to pieces.'
- b. tamen shi guo ge zhong zhayao keshi dou mei yong
they try Exp every kind explosive but all no use
'They tried all kinds of explosives but none of them was useful.'
- c. zuotian tamen yong le zui xin de zhayao zhongyu chenggong le
yesterday they use Pfv most new DE explosive finally succeed Proc
'Yesterday, they used the most updated explosive and finally succeeded.'

For some native speakers, an RVC such as *zhasui* 'to blow (something) into pieces' is an accomplishment. These native speakers find (ib-c) temporally overlapping (ia). However, for other native speakers, an RVC is an achievement. They find (ib-c) temporally preceding (ia) because (ib-c) elaborate on the preparatory process of (ia).

- (14) a. xiaoming quexi le haoji tian
 Xiaoming absent Pfv several day
 ‘Xiaoming is absent for several days.’
 b. yinwei ta bing de hen zhong
 because he ill DE very serious
 ‘because he was seriously ill.’

(14b) explains (14a), as explicitly indicated by the cue phrase *yinwei* ‘because’.¹⁵ Since (14b) is the cause and (14a) is the result, (14b) occurs before (14a). This temporal relation does not violate the hypothesis (5). There is a cue phrase specifying the function of (14b) and hence this example does not have to be a case of advancement of narrative time. And, the internal process of (14a) is not accessed. Since the hypothesis (5) is obeyed, the temporal relation between (14a) and (14b) is legitimate.

- (15) a. zhangsan chang le san tian san ye de ge
 Zhangsan sing Pfv three day three night DE song
 ‘Zhangsan sang for three days and three nights.’
 b. ta jintian houloung ya de shuo bu chu hua lai
 he today throat hoarse to the extent that speak no out words come
 ‘Today, his throat is so hoarse that he can’t speak a word.’

In (15), (15a) explains (15b) because singing for three days and three nights will make one’s throat hoarse. Since (15a) is the cause and (15b) is the result, (15a) occurs before (15b). Again, this temporal relation does not violate the hypothesis (5). The cause-effect relationship between the two events described by (15a) and (15b) specifies the relationship between these two sentences and therefore no advancement of narrative time is involved. (15b) does not require accessing the internal process of (15a), and therefore the temporal constraint (5b) is obeyed.

In sum, a sentence with perfective *le* can have any kind of relation, other than advancement of narrative time and provision of more details, with a sentence that follows, as long as the relation between the sentences specifies a temporal relation that obeys the two conditions in the hypothesis (5).

¹⁵ An anonymous reviewer asked whether logical inference between the two clauses in (14) can lead to *Explanation*, and whether the cue phrase is necessary. It is true that logical inference can specify a rhetorical relation and the cue phrase is not required here. A cue phrase directly determines a temporal relation. For example, if *yinwei* ‘because’ in (14b) is replaced with *ranhou* ‘and then’, the temporal relation between (14a) and (14b) changes accordingly. The same reviewer asked whether the cause-result relation is the only possible one that leads to *Explanation*. According to Asher & Lascarides (2003:204-207), the answer is positive.

3.4 Discussion and summary

This paper addresses three research questions, as stated in §1. First, does perfective *le* directly determine temporal relations or indirectly affect temporal relations via rhetorical relations, as proposed by SDRT? Second, does the aspectual semantics of perfective *le* influence temporal relations? If the answer is positive, in what way? Third, what implication does this paper have for the influence of aspects on temporal relations in general?

Now, we can answer these three questions. The answer to the first question is: no, perfective *le* does not directly determine temporal relations. As we can see from the discussion above, a sentence presented by perfective *le* has different temporal relations with a sentence that follows. For example, a sentence presented by *le* can temporally precede the following sentence, as in (8), (9), (10), (13), and (15). A sentence presented by *le* can temporally include the following sentence, as in (11). Or, a sentence *le* presents can temporally follow the sentence after it, as in (14). If perfective *le* directly determined temporal relations, it would be difficult to explain how a sentence perfective *le* can have so many different temporal relations with a sentence that follows. Besides, some of the temporal relations are contradictory to each other. In (14), the sentence with *le* temporally follows the sentence after it, whereas in (15) the sentence with *le* temporally precedes the following sentence. If perfective *le* did directly determine temporal relations, it would be very difficult to explain how the aspect marker could specify contradictory temporal relations.

If perfective *le* does not directly determine temporal relations, then what does? The examples discussed above show that the ‘functions’ of the sentence with *le* determines temporal relations, as shown in the discussion of (11)–(15) above.

In fact, this is a result consistent with what SDRT proposes. SDRT mainly argues for two points. First, sentences in a coherent discourse are connected to each other by appropriate rhetorical relations. Second, rhetorical relations determine temporal relations, among other things. The function of a sentence as discussed above is exactly the rhetorical relation that connects the sentence to another sentence adjacent to it. In (11), the rhetorical relation that connects (11b) to (11a) is *Elaboration*, i.e. (11b) elaborates on (11a). In (13), (13b) is connected to (13a) by *Background_T*, a temporal background.¹⁶ The sentences in (14) and (15) are connected by *Explanation*.

¹⁶ Asher & Lascarides (2003) propose only *Background*. However, as argued in Wu (2006, 2007c, 2009b), two kinds of *Background* need to be distinguished. One is *Background_T*, a temporal background, which equals to the *Background* proposed in Asher & Lascarides (2003). The other is *Background_I*, an informational background. These two kinds of *Background* indicate different temporal relations. Interested readers are referred to Wu (2006, 2007c:121-124, 2009b).

If perfective *le* does not directly determine temporal relations and instead rhetorical relations determine temporal relations, what role does perfective *le* play in the determination of temporal relations?

The hypothesis (5) provides the answer. (5a) states that a situation presented by perfective *le* can advance the narrative time, when no cue or other information in the context says otherwise. (5b) states that the time for the internal process of a situation presented cannot be accessed unless doing so is required.

When a sentence advances the narrative time, it is connected to the following sentence by *Narration*. (5a) means that perfective *le* specifies that a sentence it presents is, by default, connected to the following sentence by *Narration*. This is a default inference because it does not require any extra information and because it can be overridden if there is information in the discourse that says otherwise. In (8), (9), and (10), there is neither cue phrase nor other information, such as a subtype relation, that indicates what rhetorical relation connects the sentences. The default function of perfective *le* applies here. This is why (8a) and (8b) are connected by *Narration* and so are (9a) and (9b) on the one hand and (10a) and (10b) on the other.

In the other examples discussed in the previous sub-sections, there is always information that overrides the default function of perfective *le*. In (11) and (12), the (b) sentences provide more details on the (a) sentences. In (13a), the time *seven o'clock* indicates the possibility of a temporal frame. In (14) and (15), there is a cause-effect relationship between the sentences. All of the information in these examples overrides the default function of perfective *le*. Provision of more details indicates *Elaboration*. A temporal frame indicates *background_T*. A cause-effect relationship specifies *Explanation*. The temporal relations in (8)-(12) are not determined by the default function of perfective *le*. Instead, the temporal relations in these examples are determined by the rhetorical relations decided by the lexical information discussed above.

(5b) is a constraint. Only *Elaboration* requires accessing the internal process of a situation. Thus, (5b) means that, unless a sentence with perfective *le* is connected to another sentence by *Elaboration*, the internal process of the situation described by the former sentence cannot be accessed.

As for the third question, this paper and Wu (2006, 2007a, 2009b) all show that an aspect marker indirectly influences temporal relations via rhetorical relations in two ways: (1) based on its semantics, an aspect marker specifies a default rhetorical relation, which in turns determines a temporal relation; and (2) an aspect marker sets up a temporal constraint, which the temporal relations specified by rhetorical relations must obey.

4. An SDRT account

In §3, I have argued that perfective *le* does not directly determine temporal relations and that perfective *le* indirectly influences temporal relations via rhetorical relations in two ways: it specifies a default rhetorical relation and it sets a temporal constraint on when the internal process of a situation it presents is accessible. These two points support the idea of SDRT that temporal relations are determined by rhetorical relations that connect sentences in a discourse.

I have also observed new temporal relations that are not discussed in related works such as Asher & Lascarides (2003). Asher & Lascarides (2003:163) propose that *Narration* indicates that an eventuality temporally precedes another eventuality. However, as discussed above, when a state that goes with perfective *le* is connected to the following sentence by *Narration*, it does not have to be the case that the whole state temporally precedes the situation described by the following situations. Instead, it suffices that the starting point of the state temporally precedes the following situation. Asher & Lascarides (2003:160) propose that *Elaboration* involves temporal inclusion. As pointed out above, when an achievement presented by perfective *le* is involved with *Elaboration*, the details are provided on the preparatory process that leads to the achievement. That is, in terms of achievements perfective *le* presents, *Elaboration* means temporal precedence.¹⁷

In order to model the phenomena observed in this paper, SDRT is utilized. SDRT works as follows. First, all of the sentences in a discourse are translated into glue logic formulæ. Next, each sentence is attached to its most appropriate attachment site by a rhetorical relation and then all of the underspecified information, such as anaphora resolution, is resolved. Then, a Segmented Discourse Representation Structure (SDRS, hereafter) is formed. Finally, the rhetorical relations are interpreted in the Satisfaction Schema for Veridical Rhetorical Relations and temporal relations are derived according to meaning postulates for rhetorical relations.

Based on the new temporal relations discovered from the above discussion, new meaning postulates for temporal relations are proposed in (16a) and (16b). (16c-d) are meaning postulates revised from Asher & Lascarides (2003), which are also required.

¹⁷ Please refer to Wu (2007c) for a similar result with respect to sentences without any aspect marker.

- (16) a. *Narration* for Stage-level States
 $\Phi_{Narration(\alpha, \beta)} \Rightarrow (\text{stage-level}(e_\alpha) \rightarrow (\text{SigP}(e) \prec t \wedge \text{overlap}(\text{prestate}(e_\beta), \text{ADV}(t))))$
- b. *Elaboration* for Achievements
 $\Phi_{Elaboration(\alpha, \beta)} \Rightarrow (\text{achievement}(e_\alpha) \rightarrow (\text{occasion}(e_\delta, e_\alpha) \wedge \text{part_of}(e_\beta, e_\delta)))$
- c. *Narration* for Events
 $\Phi_{Narration(\alpha, \beta)} \Rightarrow (\text{event}(e_\alpha) \rightarrow \text{overlap}(\text{prestate}(e_\beta), \text{ADV}(\text{poststate}(e_\alpha))))^{18, 19}$
- d. *Elaboration* for Other Events
 $\Phi_{Elaboration(\alpha, \beta)} \Rightarrow (\text{part_of}(e_\beta, e_\alpha))$
- e. *Explanation*
 $\Phi_{Explanation(\beta, \alpha)} \Rightarrow \neg(e_\beta \prec e_\alpha)^{20}$
- f. *Background_T*
 $\Phi_{Background_T(\beta, \alpha)} \Rightarrow (le(\dots)(\alpha) \rightarrow (e_\alpha \prec t \wedge \text{overlap}(t, e_\beta)))$

The formalism expressed in (16) requires an explanation. (16a) is the meaning postulate for *Narration* involving stage-level states. It basically says that if β is connected to α by *Narration* and the eventuality described by the clause labeled as α is a stage-level state, then the time of the prestate of the eventuality described by the clause labeled as β overlap the time, modified by an adverbial, after the SigP of the eventuality described by the clause labeled as α .

(16b) is the meaning postulate for *Elaboration* involving achievements. It basically says that it is the preparatory process that is accessed when an achievement perfective *le* presents is elaborated on. This preparatory process is formalized as the *occasion* relationship. *occasion*(α, β) basically means that “there is a plan or a ‘natural event-sequence’ such that events of the sort described by α lead to events of the sort described by β ” (Asher & Lascarides 2003:200). The preparatory process and the achievement to

¹⁸ (16a) and (16c) are revised versions stated in Asher & Lascarides (2003:163). The revision is motivated because Asher & Lascarides (ibid.) fail to note that an event and a stage-level state behave a little differently with respect to *Narration*.

¹⁹ An anonymous reviewer asked about the definition of state here because for events that do not cause a change of state it is not clear what *poststate* refers to. The term *poststate* used in SDRT has a broad meaning, roughly equal to both the target state and the resultant state proposed in Parsons (1990). When a situation that causes a change of state is involved, the *poststate* refers to its target state. When a situation does not cause a change of state, the *poststate* refers to its resultant state.

²⁰ *Explanation* specifies other temporal relations, though, under the circumstances in our discussion, this rhetorical relation specifies the temporal relation designated by (16e). For more detail, interested readers are referred to Wu (2007c:116-121).

which the process leads fit this definition. When a clause labeled as β elaborates on a clause labeled as α and the eventuality described by the clause marked as α is an achievement, then the elaborating clause marked as β is a temporal part of an event marked as δ , which ‘occasions’ the event marked as α .

(16c) is the meaning postulate for *Narration* involving events. It says that if α is connected to β by *Narration* and α is an event, then the poststate of α temporally overlaps the pre-state of β modified by a temporal adverbial. The reason why it is not the case that the post-state of α temporally overlaps with the prestate of β is that β does not necessarily follow immediately α . For example, *John left one hour after he finished his meal*. In this example, the *leave* event does not immediately follow the *finish his meal* event. Instead, the *leave* event occurs one hour after the *finish his meal* event.

(16d) takes care of *Elaboration* for events other than achievements. It says that if β elaborates on α , then β is a temporal part of α , that is, temporal inclusion. (16e) deals with *Explanation*. It says that if β explains α , then β cannot occur before α . (16f) says that, if the temporal background of β is α and α is presented by perfective *le*, β temporally overlaps with the time after α .

Based on the functions of perfective *le*, a new axiom is required for perfective *le* to infer a default rhetorical relation and a temporal constraint on *Elaboration* is also required. The default function and the temporal constraint can be formalized as below.

- (17) a. Axiom for perfective *le*
 $(?(\alpha, \beta, \lambda) \wedge le(\dots)(\alpha)) > Narration(\alpha, \beta, \lambda)$
 b. Temporal Constraint on *Elaboration*
 $(part_of(e_\beta, e_\alpha) \wedge le(\dots)(\alpha) \wedge ?(\alpha, \beta, \lambda)) \rightarrow Elaboration(\alpha, \beta, \lambda)$

(17a) formalizes the default function of perfective *le*. It says that if α is connected to β to form a discourse λ by an underspecified rhetorical relation and α contains perfective *le*, then by default the underspecified rhetorical relation is *Narration*. In this axiom, the question mark ‘?’ represents underspecified information and the greater-than sign $>$ represents a defeasible inference. (17b) formalizes the constraint set by perfective *le*. It says that if event β is a temporal part of event α , α contains perfective *le*, and α is connected to β by some underspecified rhetorical relation, then this underspecified rhetorical relation must be *Elaboration*. This is a monotonic inference because it is a constraint and has to be obeyed.

With the meaning postulates in (16) and the default function and the temporal constraint of perfective *le* in (17), I can start to demonstrate how SDRT derives temporal relations. (8) is repeated below as (18) and the relevant sentences in this discourse are translated into glue logic formulæ as in (19).

- (18) a. zhangsan zuotian wanshang chi le fan
 Zhangsan yesterday night eat Prv meal
 ‘Last night, Zhangsan ate a meal.’
 b. kan le dianshi
 watch Pfv TV
 ‘(he) watched TV,’
 c. xi le zao
 wash Pfv bath
 ‘(he) took a bath,’
 d. ranhou qu shuijiao
 then go sleep
 ‘(and) then went to bed.’

- (19) π_1 : Zhangsan(x) \wedge meal(y) \wedge eat(x, y, e_1) \wedge *le*(e_1)²¹
 π_2 : TV(z) \wedge watch(u, z, e_2) \wedge $u = ?/u = x \wedge$ *le*(e_2)
 π_3 : take_a_bath(v, e_3) \wedge $v = ?/v = u \wedge$ *le*(e_3)
 π_4 : go_to_bed(w, e_4) \wedge $w = ?/w = v \wedge$ *le*(e_4)

(18a-d) translated into glue logic formulæ and are labeled as π_1 - π_4 respectively. When π_2 comes into the discourse, it has to be attached to π_1 because the relationship between π_1 and π_2 would be missing if π_2 were attached to the top of discourse. Which rhetorical relation attaches π_2 to π_1 ? There is neither cue phrase nor information in the discourse. Since π_1 contains perfective *le*, the default function of perfective *le* (17a) applies. (17a) indicates that π_1 is connected to π_2 by *Narration*. Since π_2 is attached to π_1 , the zero anaphor in π_2 , u , is resolved to x in π_1 , that is, $u = \text{Zhangsan}$.²²

When π_3 comes into the discourse, it has to be attached to π_2 . If π_3 were attached to π_1 , the relationship between π_2 and π_3 would be missing. Again, there is no cue phrase or information here and hence (17a) applies. π_3 is attached to π_2 by *Narration*. Since π_3 is attached to π_2 , the zero anaphor v in π_3 , is resolved to u in π_2 , which is coreferential with Zhangsan.

²¹ To simplify the formalism and to facilitate the understanding of the main points argued in this paper, irrelevant sentences and information are omitted from the glue logic formulæ and the SDRS. Some phrases, such as possessives, definite NPs, nominal compounds, proper names, adjectives, verbal compounds, aspect markers, etc., are not fully represented.

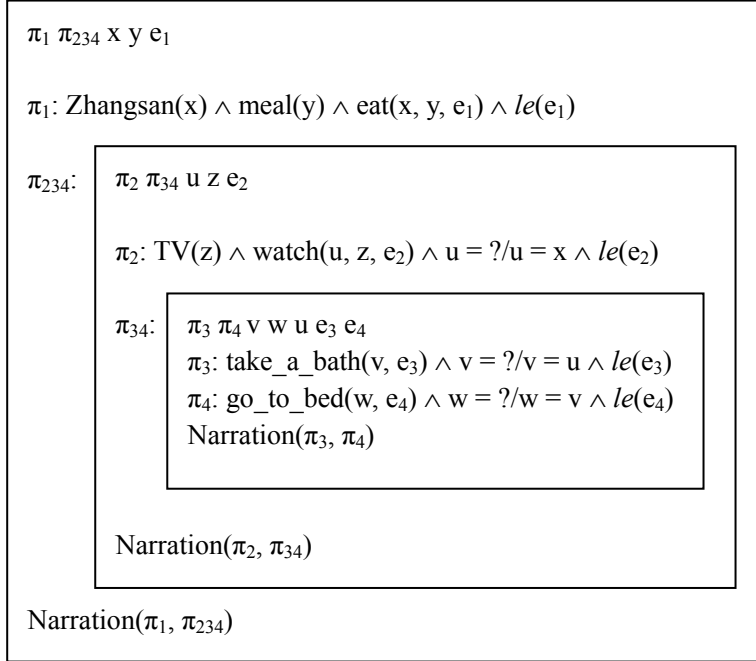
²² I will not go into the details of how zero anaphora is resolved because that is not the theme of this paper. Interested readers are referred to Wu & Tseng (2008) for an SDRT account of zero anaphor resolution in Mandarin.

When π_4 comes into the discourse, it is attached to π_3 for the same reason discussed above. The cue phrase *ranhou* ‘and then’ specifies that π_4 is connected to π_3 by *Narration*. Since *Narration* does not specify a temporal relation violating the hypothesis (5), it is legitimate. The zero anaphor w in π_4 is resolved to the only possible antecedent candidate v in π_3 , which is coreferential with Zhangsan in a series of attachment and anaphora resolution as discussed above.

One point that needs to note is that π_3 and π_4 are connected to form a small chunk, and it is this small chunk, instead of π_3 alone, that is attached to π_2 . Then, π_2 , π_3 , and π_4 form a small chunk, and this small chunk, rather than π_2 alone, is connected to π_1 . This way, all of the four sentences can be related to each other.

Based on the discussion above, an SDRS for (18a-d) is formed as in (20).

(20)



Given the SDRS above, the rhetorical relations can be interpreted in the Satisfaction Schema for the Veridical Rhetorical Relations, as below.

(21) Satisfaction Schema for *Narration*

- a. $(w, f) \llbracket \text{Narration}(\pi_1, \pi_{234}) \rrbracket_M (w', g)$
 $\text{iff } (w, f) \llbracket K_{\pi_1} \wedge K_{\pi_{234}} \wedge \Phi_{\text{Narration}(\pi_1, \pi_{234})} \rrbracket_M (w', g)$
- b. $(w, f) \llbracket \text{Narration}(\pi_2, \pi_{34}) \rrbracket_M (w', g)$
 $\text{iff } (w, f) \llbracket K_{\pi_2} \wedge K_{\pi_{34}} \wedge \Phi_{\text{Narration}(\pi_2, \pi_{34})} \rrbracket_M (w', g)$
- c. $(w, f) \llbracket \text{Narration}(\pi_3, \pi_4) \rrbracket_M (w', g)$
 $\text{iff } (w, f) \llbracket K_{\pi_3} \wedge K_{\pi_4} \wedge \Phi_{\text{Narration}(\pi_3, \pi_4)} \rrbracket_M (w', g)$

The Satisfaction Schema (21a) says that π_1 is attached to π_{234} by *Narration* if and only if the following three all hold: first, the situation described by π_1 , represented as K_{π_1} , second, the situation described by π_{234} , represented as $K_{\pi_{234}}$, and, finally, the meaning postulate for *Narration*, represented by $\Phi_{\text{Narration}(\pi_1, \pi_{234})}$.

Since π_1 is an event, (16c) applies. (16c) indicates that π_1 occurs before π_{234} . Because π_2 is also an event, (16c) indicates that π_2 occurs before π_{34} . Since π_3 is also an event, π_3 occurs before π_4 as well. Because π_3 occurs before π_4 and π_2 occurs before π_{34} , it can be inferred that π_2 occurs before π_3 , which in turn occurs before π_4 . Since π_1 occurs before π_{234} , based on the previous inference, it can be concluded that π_1 occurs before π_2 , which occurs before π_3 , which occurs before π_4 . That is, (18a-d) occur one after another. This result matches native speaker's intuition about the temporal relations in (18).

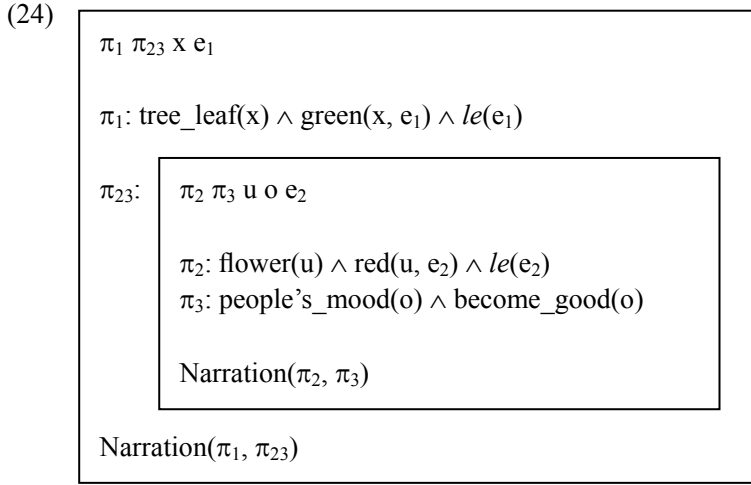
The example of *Narration* involving states is repeated below. The sentences are translated into glue logic formulæ, as in (23).

- (22) a. shu ye lü le
 tree leaf green Pfv
 'The tree leaves became green.'
 - b. hua hong le
 flower red Pfv
 'The flowers became red.'
 - c. ren de xinqing ye genzhe hao qilai
 people Poss mood also follow good start
 'Following the change, people's mood became good as well.'
- (23) π_1 : $\text{tree_leaf}(x) \wedge \text{green}(x, e_1) \wedge \text{le}(e_1)$
 π_2 : $\text{flower}(u) \wedge \text{red}(u, e_2) \wedge \text{le}(e_2)$
 π_3 : $\text{people's_mood}(o) \wedge \text{become_good}(o)$

When π_2 comes into the discourse, it has only one available attachment, i.e. π_1 . So, π_2 is attached to π_1 . Because there is no cue phrase or information in the discourse, the

default function of perfective *le* (17a) applies. That is, *Narration* attaches π_2 to π_1 . When π_3 comes into the discourse, it has two available attachment sites: π_1 and π_2 . π_3 has to be attached to π_1 because the relationship between π_2 and π_3 would be missing if π_3 were attached to π_1 . Therefore, π_3 is attached to π_2 . Which rhetorical relation connects them? Again, the default function of perfective *le* (17a) applies because there is no cue phrase or information in the context.

Based on the discussion above, the SDRS for (22) is formed as below.



Then, the rhetorical relations in (24) are interpreted in the Satisfaction Schema for Veridical Rhetorical Relations.

(25) Satisfaction Schema for *Narration*

- a. $(w, f) \llbracket \text{Narration}(\pi_1, \pi_{23}) \rrbracket_M (w', g)$
iff $(w, f) \llbracket K_{\pi_1} \wedge K_{\pi_{23}} \wedge \Phi_{\text{Narration}(\pi_1, \pi_{23})} \rrbracket_M (w', g)$
- b. $(w, f) \llbracket \text{Narration}(\pi_2, \pi_3) \rrbracket_M (w', g)$
iff $(w, f) \llbracket K_{\pi_2} \wedge K_{\pi_3} \wedge \Phi_{\text{Narration}(\pi_2, \pi_3)} \rrbracket_M (w', g)$

The Satisfaction Schema in (25) looks exactly the same as the ones in (21). However, a different meaning postulate for *Narration* is applied here because π_1 describes a stage-level state. Since a stage-level state is involved with *Narration*, (16a) applies. (16a) says that, when a stage-level state is involved with *Narration*, the SigP of the state occurs before a time t and this time t temporally overlaps the prestate of the situation described by the second sentence. Because the SigP of a stage-level state is its starting point, as argued in Wu (2005), (16a) specifies that the state starts before the situation described

by the second sentence. In our example here, π_1 starts before π_{23} .

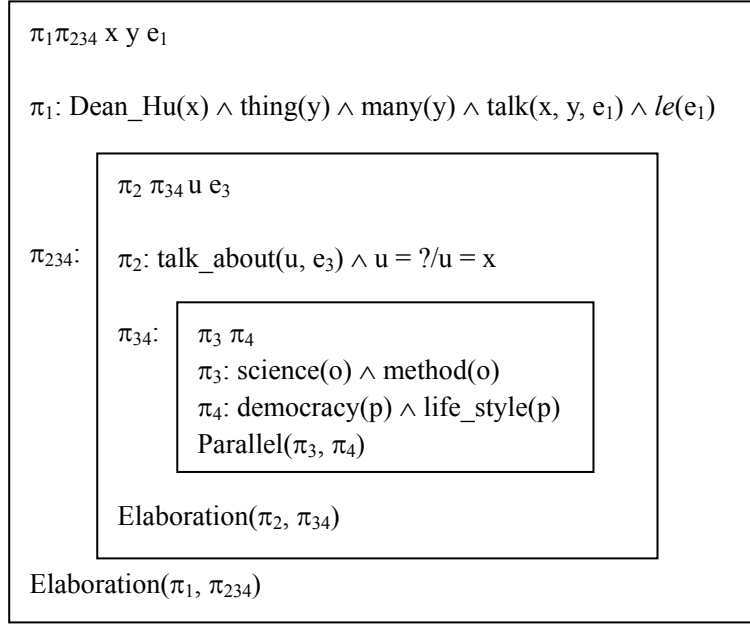
π_2 is attached to π_3 by *Narration* as well and π_2 is also a stage-level state. That is, (16a) also applies here. π_2 starts before π_3 . Since π_1 starts before π_{23} and π_2 starts before π_3 , π_1 also starts before π_2 and π_3 . π_1 and π_2 seem to temporally overlap each other because states tend to continue if they are not explicitly specified or implicitly inferred to end.

The typical example of *Elaboration* is repeated below as (26) and the sentences are translated into glue logic formulæ in (27).

- (26) a. hushi yuanzhang zai kaimushi de zhici zhong
 Hu shi dean at opening ceremony DE speech inside
 tandao le bushao ling ren shen si de hua
 talk Pfv many make people deep think Rel words
 ‘In his speech at the opening ceremony, Dean Shi Hu talked about a lot
 of things that made people think profoundly.’
 b. ta tandao kexue shi yi zhong fangfa
 he talk science be one kind method
 minzhu shi yi zhong shenghuo fangshi
 democracy be one kind life style
 ‘He said that science of a way (of explaining the unknown) and
 democracy was a lifestyle.’
- (27) π_1 : Dean_Hu(x) \wedge thing(y) \wedge many(y) \wedge talk(x, y, e₁) \wedge le(e₁)
 π_2 : talk_about(u, e₃) \wedge u = ?/u = x
 π_3 : science(o) \wedge method(o)
 π_4 : democracy(p) \wedge life_style(p)

(26a) is translated into π_1 in (27). In SDRT, the contents of what one utters are treated as an elaboration on the uttering event. This is why the contents of Dean Hu’s speech are translated into π_3 and π_4 in (27). There is information that specifies *Elaboration*. Obviously, π_2 is part of the speech described by π_1 . This information overrides the default function of perfective *le* and says that π_2 is connected to π_1 by *Elaboration*. The SDRS for (26) is as follows.

(28)



The rhetorical relation is interpreted in the Satisfaction Schema.

(29) Satisfaction Schema for *Elaboration*

$$(w, f) \llbracket \text{Elaboration}(\pi_1, \pi_{234}) \rrbracket_M (w', g) \\ \text{iff } (w, f) \llbracket K_{\pi_1} \wedge K_{\pi_{234}} \wedge \Phi_{\text{Elaboration}(\pi_1, \pi_{234})} \rrbracket_M (w', g)$$

Here, the meaning postulate (16d) applies because π_1 does not describe an achievement. (16d) says that *Elaboration* specifies temporal inclusion. Therefore, the situation described by π_{234} is temporally included in π_1 , which matches native speaker's intuition about the temporal relation of this example.

The example of *Elaboration* involving achievements is repeated below as (30). Relevant sentences are translated into glue logic formulæ as in (31).

- (30) a. ta zhongyu dida le zhe ci tierensanxiang de zhongdian
 he finally arrive Pfv this time triathlon DE destination
 ‘Finally, he arrived at the destination of this triathlon.’
 b. ta zai shui li bei shuimu dingyao
 he at water inside Pass jellyfish bite
 ‘He was stung in the water.’

- c. lupao shi bei gou zhui
 running time Pass dog chase
 ‘He was chased by a dog while he was running.’
- d. ta dou yao ya chengguolai le
 he all clench tooth make it through to the end Prc
 ‘He clenched his teeth and made it through to the end.’

- (31) π_1 : destination_of_triathlon(y) \wedge arrive(x, y, e₁) \wedge le(e₁) \wedge x = ?²³
 π_2 : jellyfish(v) \wedge bite(u, v, e₂) \wedge water(z) \wedge in(e₂, z) \wedge u = ?/u = x
 π_3 : dog(o) \wedge chase(o, p, e₃) \wedge p = ?/p = u

π_2 and π_3 are connected by *Narration* because they both describe telic events and telic events by default are connected to the sentence following it by *Narration*, as argued in Wu (2007c). π_2 and π_3 are attached to π_1 by *Elaboration* because the former two provide more details on the latter. The SDRS for (30) is formed as follows.

- (32)
- | |
|---|
| $\pi_1 \pi_{23} x y e_1$

π_1 : destination_of_triathlon(y) \wedge arrive(x, y, e ₁) \wedge le(e ₁) \wedge x = ?

<div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> $\pi_2 \pi_3 v u z e_2 o p e_3$

 π_{23}:
 π_2: jellyfish(v) \wedge bite(u, v, e₂) \wedge water(z) \wedge in(e₂, z) \wedge u = ?/u = x
 π_3: dog(o) \wedge chase(o, p, e₃) \wedge p = ?/p = u

 Narration(π_2, π_3) </div> $\text{Elaboration}(\pi_1, \pi_{23})$ |
|---|

The rhetorical relations in (32) are interpreted in the Satisfaction Schema.

²³ Please note that though this underspecified anaphor cannot be resolved in this context, it can when it is put back to the original passage. Only part of the original passage is extracted to serve as an example in this paper.

(33) Satisfaction Schema for *Elaboration* and *Narration*

- a. $(w, f) \llbracket \text{Elaboration}(\pi_1, \pi_{23}) \rrbracket_M (w', g)$
 $\text{iff } (w, f) \llbracket K_{\pi_1} \wedge K_{\pi_{23}} \wedge \Phi_{\text{Elaboration}(\pi_1, \pi_{23})} \rrbracket_M (w', g)$
- b. $(w, f) \llbracket \text{Narration}(\pi_2, \pi_3) \rrbracket_M (w', g)$
 $\text{iff } (w, f) \llbracket K_{\pi_2} \wedge K_{\pi_3} \wedge \Phi_{\text{Narration}(\pi_2, \pi_3)} \rrbracket_M (w', g)$

Since π_1 is an achievement, the meaning postulate (16b) applies here. (16b) specifies that π_{23} occurs before π_1 . Because π_2 is an event, the meaning postulate (16c) applies here. It indicates that π_2 occurs before π_3 . These temporal relations match native speaker's intuition about the temporal relations of this example.

The example of temporal background is repeated below and the sentences are translated into glue logic formulæ as in (35).

- (34) a. guo le qi dian
pass Pfv seven o'clock
'When (the time) passes seven o'clock (= after seven o'clock),'²⁴
- b. lese bian bu neng xichu qinshi
trash then no can carry out bedroom
'then trash cannot be carried out of the bedrooms.'
- (35) $\pi_1: \text{seven_o'clock}(x) \wedge \text{pass}(x, e_1) \wedge le(e_1)$
 $\pi_2: \text{trash}(y) \wedge \text{bed_room}(z) \wedge \neg \text{take_out}(u, y, \text{from}(z)) \wedge u = ?$

²⁴ An anonymous reviewer suggested using two events forming a Foreground-Background pair as an example. However, in SDRT, it is explicitly specified that "*Background* imposes temporal constraints on its arguments" (Asher & Lascarides 2003:165). That is, in SDRT, the rhetorical relation *Background* actually refers to a temporal background. The same reviewer also suggested that *Background* and *Narration* may involve differences in the accessibility of pronominal reference. Indeed, Asher & Lascarides (2003:166) provide two examples to demonstrate a difference.

- (i) a. A burglar broke into Mary's apartment.
b. Mary was asleep.
c. He stole the silver.
- (ii) a. A burglar broke into Mary's.
b. A police woman visited her the next day.
c. ??He stole the silver.

In (i), (ib) is connected to (ia) by *Background*, while (iib) is attached to (iia) by *Narration*. In (i), the pronoun *he* can refer to the burglar mentioned in (ia), while in (ii) it cannot. However, since this paper deals with temporal relations, not pronominal (anaphora) resolution, this issue is left for future studies.

Since there are only two sentences, they are connected together. The rhetorical relation that connects π_2 to π_1 is *Background_T* because of the temporal phrase *seven o'clock* in (34). The SDRS for (34) is as below.

$$(36) \quad \begin{array}{l} \pi_1 \pi_2 x e_1 y z \\ \\ \pi_1: \text{seven_o'clock}(x) \wedge \text{pass}(x, e_1) \wedge le(e_1) \\ \pi_2: \text{trash}(y) \wedge \text{bed_room}(z) \wedge \neg \text{take_out}(u, y, \text{from}(z)) \wedge u = ? \\ \\ \text{Background}_T(\pi_1, \pi_2) \end{array}$$

The rhetorical relation is interpreted in the Satisfaction Schema.

$$(37) \quad \begin{array}{l} \text{Satisfaction Schema for } \text{Background}_T \\ (w, f) \llbracket \text{Background}_T(\pi_1, \pi_2) \rrbracket_M(w', g) \\ \text{iff } (w, f) \llbracket K_{\pi_2} \wedge K_{\pi_3} \wedge \Phi_{\text{Background}_T(\pi_1, \pi_2)} \rrbracket_M(w', g) \end{array}$$

The meaning postulate (16f) applies here because π_1 is presented by perfective *le*. (18f) specifies that under this circumstance π_1 occurs before π_2 . That is, the time after seven o'clock overlaps with the time when the trash cannot be taken out of the bedrooms.

The last example is the one of *Explanation*, repeated below as (38). The sentences are translated into glue logic formulæ as in (39).

- (38) a. xiaoming quexi le haoji tian
Xiaoming absent Pfv several day
'Xiaoming is absent for several days.'
b. yinwei ta bing de hen zhong
because he ill DE very serious
'because he was seriously ill.'

$$(39) \quad \begin{array}{l} \pi_1: \text{Xiaoming}(x) \wedge \text{absent}(x, e_1) \wedge \text{many_days}(e_1) \wedge le(e_1) \\ \pi_2: \text{ill}(y, s) \wedge \text{seriously}(s) \wedge y = ?/y = \text{Xiaoming} \end{array}$$

π_2 is attached to π_1 by *Explanation*, as explicitly specified by the cue phrase *yinwei* 'because' and the cue phrase overrides the default function of perfective *le*. The SDRS for (40) is formed.

$$(40) \quad \boxed{\begin{array}{l} \pi_1 \pi_2 x e_1 y s \\ \pi_1: \text{xiaoming}(x) \wedge \text{absent}(x, e_1) \wedge \text{many_days}(e_1) \wedge le(e_1) \\ \pi_2: \text{ill}(y, s) \wedge \text{seriously}(s) \wedge y = ?/y = \text{Xiaoming} \\ \text{Explanation}(\pi_1, \pi_2) \end{array}}$$

Again, the rhetorical relation in (40) is interpreted in the Satisfaction Schema for Veridical rhetorical relations, as in (41).

$$(41) \quad \text{Satisfaction Schema for } \textit{Explanation} \\ (w, f) \llbracket \text{Explanation}(\pi_1, \pi_2) \rrbracket_M (w', g) \\ \text{iff } (w, f) \llbracket K_{\pi_1} \wedge K_{\pi_2} \wedge \Phi_{\text{Explanation}(\pi_1, \pi_2)} \rrbracket_M (w', g)$$

The meaning postulate (16e) applies here. It specifies that π_2 cannot occur before π_1 in this case. This temporal relation matches native speaker's intuition about the temporal relation of this example.

To sum up, in this section, I propose a new axiom for perfective *le*, and two new meaning postulates for *Narration* and *Elaboration* respectively. I also formalize the default function and the temporal constraint of perfective *le*. I demonstrate how SDRT can accurately derive the temporal relations, with the new meaning postulates, the new axiom, the default function and the temporal constraint of perfective *le*.

5. Conclusion

In this paper, I argue that perfective *le* does not directly influence temporal relations and that perfective *le* indirectly influences temporal relations via rhetorical relations in two ways: it specifies a default rhetorical relation and constrains which rhetorical relation can connect a sentence presented by perfective *le* when the internal process of the situation described by the sentence can be accessed.

Because perfective *le* is argued to present a situation as a whole, another situation can easily occur after it. Therefore, when there is no cue phrase or information in the context specifying otherwise, a sentence perfective *le* presents is connected to the following sentence by *Narration*. Since perfective *le* presents a situation as a whole, the internal process of a situation presented by perfective *le* cannot be accessed unless it is required to do so. That is, the internal process of a situation presented by perfective *le* cannot be accessed unless the situation is elaborated on.

In terms of aspectual influence on temporal relations in general, this paper, together with Wu (2006, 2007a, 2009b), proves that an aspect marker indirectly influences temporal relations via rhetorical relations in two ways: first, based on its semantics, an aspect marker specifies a default rhetorical relation, which in turn decides a temporal relation, and second, an aspect marker sets up a temporal constraint, which the temporal relations specified by rhetorical relations must obey.

In this paper, I observe two new temporal relations. First, when a stage-level state is presented by perfective *le* and is connected to the following sentence by *Narration*, it does not have to be the case that the whole event temporally precedes the situation described by the following sentence. Instead, it suffices that the state starts before the situation described by the following sentence. Second, when an achievement presented by perfective *le* is elaborated on, the sentences providing more details temporally precedes the achievement.

Given the results above, I propose a new axiom for perfective *le*, which takes care of the default function of the aspect marker, and two meaning postulates for rhetorical relations, which deal with the new temporal relations discovered. I also formalize the temporal constraint on accessing the internal process of a situation presented by perfective *le*. I demonstrate how SDRT can satisfactorily derive the correct temporal relations, with the new axiom, new meaning postulates and the temporal constraint. I show that, as long as the default function and the temporal constraint of perfective *le* are not violated, any rhetorical relation can connect a sentence presented by perfective *le* to another sentence in the same discourse.

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時貌與時序關係的互動： 以完成貌「了」為例

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本篇論文探討完成貌「了」如何影響時序關係。本人論證，漢語中，時貌標記透過修辭關係以下面兩種方式間接影響時序關係：一、當文章脈絡中沒有其他時序關係之訊息時，時貌標記依其語意決定一修辭關係，修辭關係再決定時序關係；二、時貌標記標示一時序限制，供修辭關係所標示之時序關係遵守。因為完成貌「了」把一個事件視為一個整體，本人提出：當文章脈絡中沒有任何相關訊息時，完成貌「了」標示修辭關係「敘述」，而「敘述」則表示時序關係與事件被描述之順序相符合。此外，完成貌「了」亦限制了其所呈現之事件，其內部過程非有必要不能讀取。此外，本篇論文也替「敘述」及「闡述」兩個修辭關係分別提出了新的時序關係。

關鍵詞：時序關係，完成貌「了」，語意語用界面，漢語