Research on Temporal Interpretation Patterns in Discourse Through Corpus Methods

Dan Xing[a], Huanhong Li[†b]

[a]*Department of Chinese Language and Literature, Peking University*
[b]*School of Government, Nanjing University.*

Abstract

This paper investigates temporal scope in discourse, focusing on the challenges of temporal governance over events. It identifies the low agreement rate between human annotators and large language models on temporal governance as stemming from inherent uncertainty and ambiguity in temporal interpretation. We categorize eight subtypes within two major categories of temporal governance patterns—single-time–multiple-events and multiple-times–single-event sentences and statistically analyze their distribution across six corpora and five discourse modes. The results reveal that different corpora and discourse modes exhibit characteristic preferences for temporal governance patterns: literary texts displayed the greatest diversity, while sports texts showed minimal variation. Rightward Adjacent Governance emerged as the most frequent subtype overall, strongly correlated with narrative mode, whereas Rightward Continuous Governance was most common in descriptive mode. However, the habitual use of a given pattern does not prevent ambiguity from arising. Beyond these distributional tendencies, the study identifies universal mechanisms that constrain the scope of temporal governance: it ceases with abstract entities, negation, conditions, or states; it is sustained by sequential or simultaneous conjunctions; it is disrupted by contrast, causation, or purpose; and it is further constrained by syntactic placement and subject agency. Temporal parsing thus depends on the interplay of semantic, pragmatic, and syntactic factors, which jointly shape the boundaries of governance. Importantly, when these rule-based constraints were introduced into temporal parsing, large language models showed substantial improvement in inter-annotator agreement (IAA). Together, these results suggest that while different corpora and discourse modes prefer distinct governance patterns, constraint mechanisms ultimately define when governance continues, terminates, or is interrupted, thereby advancing both theoretical understanding and computational modeling of temporal interpretation.

Keywords: Temporal Governance Patterns; Discourse Modes; Temporal Interpretation; Corpus and LLM Methods; Temporal Boundary

1. Introduction

The interpretation of temporal information in natural language has long been a central concern in linguistics and computational linguistics. Substantial progress has been made in understanding temporal semantics through the study of tense, aspect, temporal reference, and other aspects

[†]Corresponding author: (Email: huanhongli@nju.edu.cn)

[1–10]. Recent discourse-level research has further advanced our understanding of how text genres shape the distribution of situation types, how grammatical tense structures temporal relations, and how prominence influences hierarchical discourse organization [11–13]. Nevertheless, it is still unclear whether temporal interpretation patterns differ systematically across genres, how such variation is mediated by discourse modes, and what constraints determine the boundaries of temporal governance. In particular, research on Chinese temporal interpretation has not yet integrated aspectual information with discourse modes, nor has it systematically examined the scope of temporal expressions in governing events and the constraints on that scope.

This paper examines the relationship between temporal expressions and events in sentences that contain either a single temporal expression with multiple events or multiple temporal expressions with a single event. Specifically, it investigates where the scope of temporal expressions ends and why. The focus lies on delineating the boundaries of temporal scope, that is, the range of influence exerted by temporal expressions as governing elements. The term *governance boundary (guan jie)* refers to the range within which a governing element can exert its semantic or syntactic control in discourse. It was first proposed by Liao [14] in his *Theory of Discourse Governance Boundaries*, which systematically formalized the scope of governing elements. Subsequent studies further refined the criteria for determining governance boundaries from formal, semantic, and other perspectives [15–17]. *Temporal governance* refers to the scope of influence of a temporal expression over the occurrence time of an event (e.g., its start time, duration, or end time). This relationship indicates that the temporal range denoted by a temporal expression encompasses the time span during which an event occurs. In this context, to say that *A governs B* means that the temporal scope of A covers the occurrence time of B.

Our data come from the UMR-Chinese corpus[18], which contains 399 annotated sentences, among which we examined 69 that include temporal expressions and event components. The inter-annotator agreement (IAA) rate on temporal governance tasks between two human annotators was 43.47%, showing discrepancies in 30 out of the 69 sentences. To further investigate these challenges, we evaluated the performance of large language models (LLMs) on the same tasks. For sentences where both human annotators reached consensus (39 sentences), ChatGPT-4o achieved 46% accuracy. This notable difference in performance highlights the limitations of current LLMs in handling temporal governance.

Corpus Source	0001	0002	0003	0004	0005	0006	0007	caili	zhongkao	dollar	SUM
Number of Sentences	51	60	31	59	40	35	82	12	19	10	399
Number of Temporal Sentences	4	17	12	9	12	1	7	2	4	1	69
Number of Disagreements	0	8	2	5	9	0	2	1	3	0	30
Number of Agreements	4	9	10	4	3	1	5	1	1	1	39

Table 1: Inter-annotator agreement rate on temporal governance task

This paper contributes to the study of temporal governance in discourse by addressing two key issues:

- To integrate temporal interpretation with discourse modes, we identify patterns of temporal governance across different genres. This includes examining trends in temporal governance patterns within six corpora and categorizing types of temporal governance across five discourse modes.

- Based on the identified temporal governance patterns, we develop genre-specific parsing guidelines. These guidelines are constructed by summarizing constraints from four di-

mensions: types of situation events, inter-sentential relationships, principles of temporal progression, and syntactic–semantic factors.

The structure of the paper is as follows. In Section 1 of this article, we introduce the background assumptions and general ideas that inform the analysis. Section 2 summarizes existing research on temporal interpretation. Section 3 details the source and scale of the corpus data and outlines our methodology. In this section, we assess the performance of human annotators and large language models in tasks related to the governance of temporal expressions. Additionally, we propose a pragmatic principle for temporal governance and categorize temporal interpretation patterns based on temporal-event relations. Section 4 provides a formal sketch of temporal governance patterns within the framework of Discourse Modes Theory, introducing trends in temporal governance across corpora and five discourse modes. It further examines factors influencing the governance of temporal expressions, including specific types of situation events, inter-sentential relationships, principles of temporal progression, and syntactic and semantic constraints. Section 6 concludes the study.

2. Related work

Research on temporal governance is closely tied to the interpretation of temporal information in events. Previous linguistic studies have primarily examined tense, aspect, lexical and adverbial information, as well as pragmatic principles [1]. Tense research typically analyzes event timing relative to a reference point, focusing on anterior, simultaneous, and posterior relations. Reichenbach's seminal framework [2] introduced the tripartite distinction of speech time (S), event time (E), and reference time (R), which has guided much subsequent work. Bruce [3] expanded this approach by modeling multiple temporal references through intervals and defining seven logical relations, later extended by Allen [19], Allen and Koomen [20] into thirteen basic relations. Pustejovsky et al. [21] further categorized temporal relations into event–time anchoring and event–event sequencing, distinguishing between local and global structures. The distinction between tense and aspect has also been emphasized [22, 23]. Tense is deictic, tied to speech time, while aspect is non-deictic, describing the internal temporal structure of events. Aspect is analyzed through lexical aspect, which concerns inherent features of verbs such as endpoints and duration, and viewpoint aspect, which frames events as complete or incomplete [4]. Smith [5] highlighted the role of situational boundedness: imperfective viewpoints render events unbounded, while neutral viewpoints allow both bounded and unbounded readings. He further argued that viewpoint aspect mediates reference–event time relations in tenseless languages such as Chinese. Chinese, accordingly, relies on aspectual markers—perfective (*le*, *guo*) and imperfective (*zai*, *zhe*)—to signal temporal relations. Semantic theories of temporal interpretation add further nuance. Abusch [7] proposed an integrated account of tense and modality, clarifying how temporal expressions operate under local evaluation constraints. At the discourse level, Smith [11], Palmer and Friedrich [12], and Becker and Egetenmeyer [13] examined how narrative, descriptive, and report modes influence temporal meaning, often drawing on Discourse Representation Theory. Experimental work also shows that temporal overlap and distance shape interpretations of state and event clauses [8].

Despite these advances, several gaps remain. First, research has yet to explore the scope of temporal expressions in governing events and the factors that constrain this governance, particularly in sentences with a single temporal expression governing multiple events or multiple temporal expressions governing a single event. Furthermore, while discourse modes have been

analyzed, questions persist about temporal interpretation patterns across various genres and how text types influence these patterns. Additionally, computational semantics has predominantly focused on English and other European languages, with insufficient attention to the complex temporal systems of non-Indo-European languages like Chinese, particularly in natural language processing. Addressing these gaps could enhance our understanding of temporal semantics and broaden both linguistic and computational applications.

3. Corpus Data and Methodology

3.1. Corpus data

We collected suitable data from six corpora: Wikinews, sports texts, interlanguage texts, popular science texts, transportation texts, and literature texts. Specifically, the Wikinews data were extracted from the UMR dataset [24]. sports texts and transportation texts were obtained from the SpaCE2022 dataset [25]. Interlanguage texts were sourced from the HSK corpus [26]. Popular science texts were collected from the Popular science articles of the Chinese Academy of Sciences website. Literature texts were retrieved from the BCC corpus [27] and the China writer website. The dataset comprises a total of 132 paragraphs, as summarized in Table 2. Within these texts, there are 251 temporal expressions (T), 799 events (E), and 478 temporal expression-event (T-E) pairs.

Table 2: Source and Scale of Corpus data

Corpus Type	**Original Number of Paragraphs**	**Filtered Number of Paragraphs**	**Filtered Number of Temporal Expressions(T)**	**Filtered Number of entities(E)**	**Filtered T-E Pairs**
Transportation Text	2862	19	27	113	54
Popular Science	58	18	46	116	70
Interlanguage Text(HSK)	32	23	41	123	87
Literature	622	31	44	191	120
Wikinews(UMR)	428	31	74	189	125
Sports Actions Text	2193	10	19	67	22
Count	6195	132	251	799	478

3.2. Methods

The study initially categorizes temporal parsing outcomes into three types based on temporal-event relations, then defines *temporal governance* based on these parsing results. Building on temporal governance, it proposes eight temporal parsing patterns. Finally, by examining the proportions of temporal parsing patterns and discourse modes across six corpora, it finds a positive correlation between the two. The workflow is shown in Figure 1.

In terms of corpus query, we first queried the corpus for all the tokens of temporal expressions and selected single-time multiple-events and multiple-time single-events paragraphs. Then, we annotated the temporal governance of events manually based on the relationships between temporal expressions and events. The temporal relationships between temporal expressions and events primarily encompass six scenarios: (1) temporal expressions containing only the event's start time; (2) temporal expressions containing only the event's end time; (3) temporal expressions containing only the event's duration; (4) temporal expressions containing both the event's start time and duration; (5) temporal expressions containing both the event's duration and end time; (6) temporal expressions containing the event's start time, duration, and end time. The specific illustration is shown in Table 3.

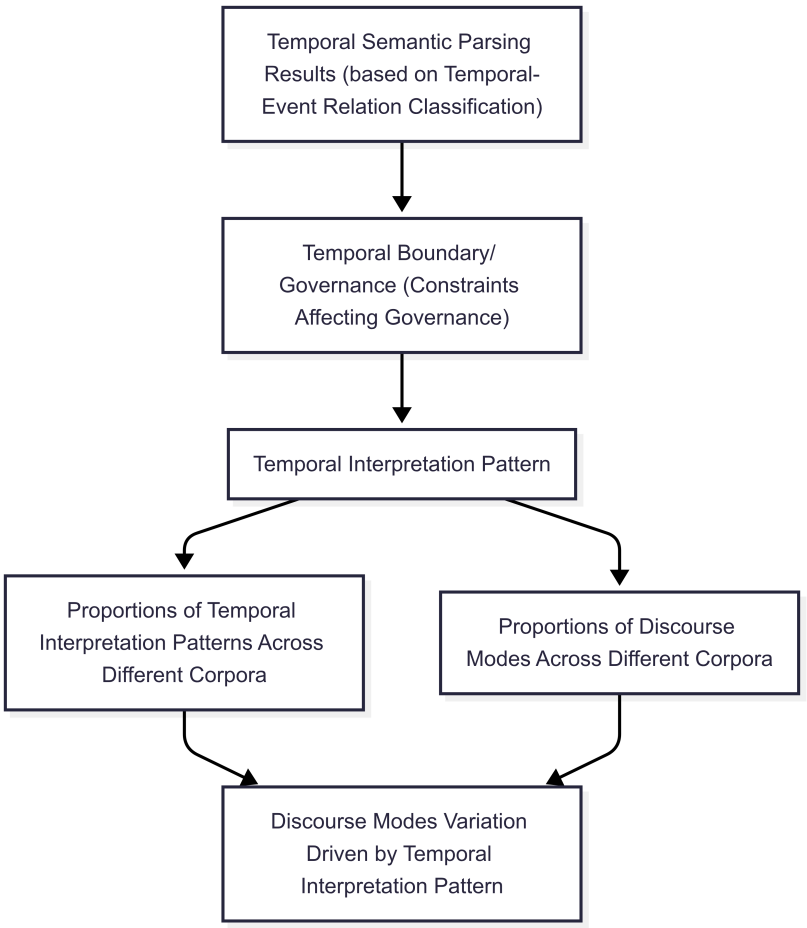
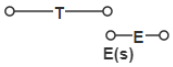
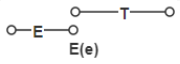
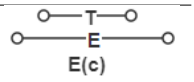
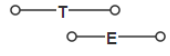
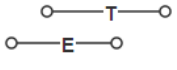
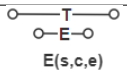


Figure 1: The workflow diagram of temporal governance patterns

The results of temporal governance of events can be primarily classified into three categories based on the temporal containment relationships between time expressions and events: (1) the temporal information of the event is fully determined and can be classified into one of the six temporal relationships mentioned above; (2) the temporal information of the event is unknown and cannot be strictly classified into any of the six temporal relationships; (3) the temporal information parsing is ambiguous, where the temporal expression might govern either event A or event B. Event classification has been systematically studied [28–30]. In this paper, events are defined as minimal argument structures centered on predicates, specifically event units formed by N+V, V+N, or N1+V+N2 structures.

The example of temporal governance is given in Example (1), the temporal expression (*2007 nian 7 yue, July 2007*) specifies the start time of Event 1 (*the parent company, American Media Company, stopped the publication of World News Weekly*). In contrast, Event 2, (*zhoubao de wangluo ban reng jixu shengcun, the weekly's online version continued to exist*) describes the ongoing existence of the online version without indicating a specific time point or duration.

Table 3: The classification and cognitive schema of event governance by temporal expressions.

The Classification of Event Governance by Temporal Expressions.	Cognitive Schema
The temporal expression only includes the event's start time point	
The temporal expression only includes the event's end time point	
The temporal expression only includes the event's duration period	
The temporal expression includes both the event's start time point and duration period	
The temporal expression includes both the event's duration period and end time point	
The temporal expression includes the event's start time point, duration period, and end time point	

Consequently, the temporal parsing of Event 2 cannot be strictly classified into any of the six temporal expression scenarios mentioned above. Overall, the primary temporal expression (*2007 nian 7 yue, July 2007*) in this sentence contains only the start time of Event 1, thus falling under the category of *the temporal information of the event is fully determined*.

(1) *2007 nian 7 yue mugongsi meiguo meiti gongsi tingzhi le shijie xinwen*
2007 year 7 month, parent-company American Media Company stop ASP World News
zhoubao de faxing, buguo zhoubao de wangluo ban reng jixu shengcun.
Weekly AUX publication though weekly AUX online version still continue exist.
In July 2007, the parent company American Media Company stopped the publication of "World News Weekly," though the weekly's online version continued to exist.

Temporal governance ambiguity arises from inherent ambiguities within the text itself. For instance, in Example (2), the temporal expression (*yiri, the following afternoon*) could govern Event 1 (*dacheng siren feiji, boarding a private jet*), Event 2 (*di fozhou, arriving in Florida*), or Event 3 (*bei paidao shenqing qiaocui yanjing fuzhong, being photographed looking haggard with swollen eyes*). This temporal expression could potentially govern Event 1, Event 3, or simultaneously encompass both Event 1 and Event 3, thereby creating ambiguity in the temporal semantic parsing of these events.

(2) *yiri xiawu dacheng siren feiji di fozhou de yalianna bei meiti paidao*
following afternoon board private jet arrive Florida AUX s/he PASS media photographed
shenqing qiaocui yanjing fuzhong.
looking haggard eyes puffy.
Ariana was photographed by the media looking haggard and with puffy eyes after arriving in Florida the following afternoon on a private jet.

Additionally, through preliminary testing, we observed that both humans and machines struggle with temporal governance tasks, further highlighting the research value of this issue. We examined 69 sentences with temporal expressions and event components from a corpus of 399 annotated sentences in the Universal Meaning Representation for Chinese (UMR-Chinese). UMR annotation involves labeling the semantic roles of events in a sentence under the guidance of UMR annotation guidelines, including the temporal roles of events, which ensures consistency in annotation. We selected textual passages containing temporal components to observe the scope of temporal governance by double-blind annotators. The inter-annotator agreement rate on temporal governance tasks between two human annotators was 43.47%, showing discrepancies in 30 out of the 69 sentences. One example of inconsistencies is illustrated in Example (3). In this sentence, there is a temporal expression: *in recent years* (T), and two events: *the emergence of population decline in China* (E1) and *making it extremely difficult to get married in China* (E2). One annotator considers that T governs E1, while another annotator believes that T governs E2.

Table 4: Inter-annotator agreement rate on temporal governance task

Corpus Source	0001	0002	0003	0004	0005	0006	0007	caili	zhongkao	dollar	SUM
Number of Sentences	51	60	31	59	40	35	82	12	19	10	399
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Number of Disagreements	0	8	2	5	9	0	2	1	3	0	30
Number of Agreements	4	9	10	4	3	1	5	1	1	1	39

(3) *jinnianlai, zhongguo youyu chuxian renkou weisuo xianxiang, qie nan nü*
in-rencent-years, China due-to appear population imbalance phenomenon, and male female
bili bu junyun, daozhi zai zhongguo jiehun jiwei kunnan.
ratio not balanced, lead-to in China marriage extremely difficult.
Recently, due to population decline and gender imbalance, marriage has become extremely difficult in China.

To further investigate these challenges, we evaluated the performance of large language models (LLMs) on the same tasks. Using few-shot prompting, we tested models like ChatGPT-4o and Claude 3.5 through their APIs. The prompt instructed the models to present each corpus sentence, identifying the temporal expressions, events, and events governed by the temporal expression, as shown in Table4. For sentences where both human annotators reached consensus (39 sentences), Claude 3.5 achieved a 66% accuracy rate in correctly identifying the events governed by the temporal expression, while ChatGPT-4o achieved 46% accuracy. This notable difference in performance highlights the limitations of current LLMs in handling temporal boundaries, as they display inconsistency in this domain.

4. Results

The results fall into three parts. First, we classify temporal governance patterns in single-time–multiple-event and multiple-time–single-event constructions. Second, we examine their distribution across six corpora and five discourse modes, highlighting genre-based variation. Third, we identify constraints on governance boundaries from event types, discourse relations, progression principles, and syntactic–semantic factors.

4.1. Classification of temporal governance patterns

We analyze the patterns of how temporal expressions govern events by collecting sentences rich in temporal expressions and categorizing them into two types: *single-time-multiple-events* and *multiple-time-single-event*.

4.1.1. Single-time Multiple-events sentences

A single-time-multiple-events sentence contains one temporal expression and two or more events. In a single-time-two-events sentence, there is one temporal expression (T), and two events (E1 and E2). Since the sequence of E1 and E2 remains fixed, there are three main possible combinations of T, E1, and E2. The possible temporal governance scenarios are illustrated in Figure 2:

a. T occurs before E1 (i.e., T, E1, E2)

b. T occurs between E1 and E2 (i.e., E1, T, E2)

c. T occurs after E2 (i.e., E1, E2, T)

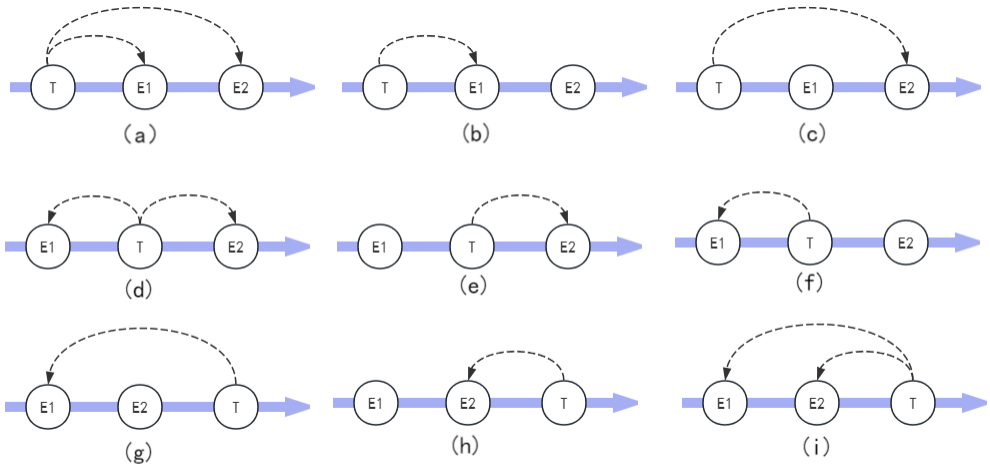

Figure 2: All of the possible temporal governance patterns of a single-time-multiple-events Sentence

The three scenarios mentioned above can be mainly categorized into long-distance governance and adjacent governance.

Long distance governance primarily consists of *continuous long-distance governance* and *non-continuous long-distance governance*. Based on the direction of governance, long-distance governance is further categorized into rightward and leftward governance. Consequently, four types of long-distance governance emerge: rightward long-distance governance, which includes *continuous rightward long-distance governance* and *non-continuous rightward long-distance governance*; and leftward long-distance governance, encompassing *continuous leftward long-distance governance* and *discontinuous leftward long-distance governance*.

Continuous rightward long-distance governance refers to temporal expressions that continuously govern all events positioned to their right. The term *long-distance* indicates that the temporal

expression governs both adjacent and relatively distant events. In this paper, the scenarios depicted in subfigure (a) of Figure 2 and Figure 3 where temporal expression governs all subsequent events are classified as *continuous rightward long-distance governance*. For instance, in Example (4), the temporal expression T, (*dangwan 22dian33fen, 22:33 that evening*), governs both E1, *yanchanghui linjinweisheng, the concert was nearing its end*), and E2, (*tiyuchang quyu fasheng baozha, an explosion occurred in the stadium area*), aligning with type (a). When events are extended, the concept of *continuous rightward long-distance governance* in single-time, multiple-event sentences is illustrated in the subsequent figure 3.

(4) *dangwan* *22dian33fen* *gelande* *de* *"weixian* *nvren"* *xunhui* *yanchanghui* *linjin*
that-night 22:33 s/he POSS "Dangerous Woman" tour concert nearing
weisheng, *tiyuchang* *quyu* *fasheng* *baozha.*
end, stadium area occurred explosion.
At 10:33 PM that night, as Grande's "Dangerous Woman" tour was nearing its end, an explosion occurred in the stadium area.

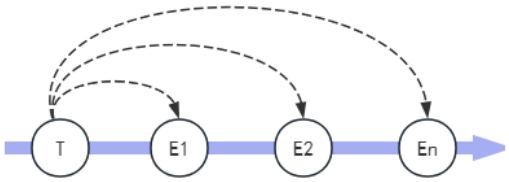

Figure 3: Continuous rightward long-distance governance in single-time-multiple-events sentences

Non-continuous rightward long-distance governance refers to a situation where a temporal expression exerts non-continuous governance over a distant event that occurs later. For instance, in example (5), the temporal governance over event 2 (E2) corresponds to sub-graph (c) in Figure (2).

(5) *1851* *nian,* *weile* *renmen* *buzai* *shiyong* *tongzhi* *fenbi,* *lianbangguohui*
1851 year, in-order-to people no-longer use copper cent-coins, the-Federal-Congress
shouquan *faxing* *yinzhi* *3* *meifen* *yingbi.*
authorized the-issuance-of silver 3 cent coins.
In 1851, to discourage people from using copper cent-coins, the U.S. Congress authorized the issuance of a silver 3-cent coin.

Leftward long-distance governance is relatively rare in common corpora. *Non-continuous leftward long-distance governance*, such as in sub-graph (g) of Figure (2), involves a temporal expression exerting non-continuous governance over distant events to its left. *Continuous leftward long-distance governance* describes a case where the temporal expression continuously governs all events to its left, which is often found in Chinese poetic texts. For instance, in Xi Murong's poetry, the temporal expression (*zaiyige yaoyuan de chunri xiawu, on a distant spring afternoon*) governs the events (*zhongman xincha haiyou xiangsishu, was filled with fresh tea plants and dense acacia trees*, *haoxiang dayinguo ni, seem to remember I promised you*), as shown in example (6), depicted in sub-graph (i) of Figure (2).

(6) *ni shuo na poshang zhongman le xincha haiyou ximi de xiangsi shu wo*
You said that hillside fill-with ASP fresh-tea-plants and-also dense AUX acacia trees I
haoxiang daying guo ni zai yi ge yaoyuan de chunri xiawu.
seem-to promise ASP you on a CL distant spring-day afternoon.
You said the hillside was filled with fresh tea plants and dense acacia trees. I seem to remember I promised you on a distant spring afternoon.

Adjacent governance includes rightward adjacent governance, leftward adjacent governance, and bidirectional adjacent governance. *Rightward adjacent governance* refers to situations where a temporal expression governs adjacent events occurring after it (to its right), as illustrated in sub-graphs (b) and (e) of Figure (2). For instance, in example (7), T governs event 2 (E2), corresponding to sub-graph (e).

(7) *gai tai you liutianjun chuangban, yu 1982 nian huo jianada*
This station by PRON founded, in 1982 year received Canadian
shixun weiyuanhui CRTC fafang diquxing shoufei
Radio-television-and-Telecommunications Commission (CRTC) issued regional pay
dianshi paizhao.
TV license.
This station was founded by Liu Tianjun and received a regional pay-TV license from the Canadian Radio-television and Telecommunications Commission (CRTC) in 1982.

When multiple single-time, single-event sentences are combined, they result in multi-time, multi-event sentences in form. For example, when temporal expression T1 governs E1 and T2 governs E2, this phenomenon is also referred to as *rightward adjacent governance* in this paper. For instance, in example (8), the temporal expressions govern the subsequent events in sequence separately, as shown in the figure 4 below.

(8) *xin shidai sui yu 2012nian6yue chongxin shenqing chuangban Talentvision,*
New Era subsequently in June-2012 again applied establish Talentvision,
bing yu 2013nian2yue zaici huo pi, zai yu tongnian 5yue23ri yi chengshi
and in February-2013 again receive approval, PART on same-year May-23 as city
2 gaoqing tai de mingyi qibo.
2 HD channel AUX under-the-name began-broadcasting.
New Era subsequently applied again in June 2012 to establish Talentvision, and in February 2013 received approval once more, then began broadcasting on May 23 of the same year under the name City 2 HD channel.

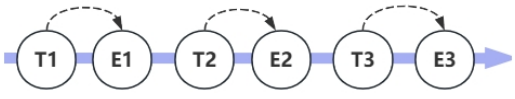

Figure 4: Rightward adjacent governance

Leftward adjacent governance refers to a situation where the temporal expression in the text governs some of the events that appear to its left. For example, sub-graph (f) (h) in Figure (2)

illustrates a case of *leftward adjacent governance*. This phenomenon typically occurs in sentences with inverted temporal adverbial clauses, introduced by prepositions such as *(yu, at)* or *(zai, in)*, as seen in example sentence (9).

(9) *shijie xinwen zhoubao chuangkan yu 1979nian. zai 1980niandai, shijie xinwen*
World News Weekly publish in 1979. In the-1980s, World News
zhoubao faxingliang dadao 120wan fen. buguo zhi 2007nian, gai kan
Weekly circulation reach 1.2-million CL. However by 2007, this publications
faxingliang yijing die zhi 8wan3qian fen.
circulation had-already dropped to 83000 CL.
World News Weekly was first published in 1979. In the 1980s, the circulation of *World News Weekly* reached as high as 1.2 million CL. However, by 2007, its circulation had already dropped to 83,000 CL.

Bidirectional adjacent governance refers to cases where the temporal expression governs adjacent events both before and after it, as shown in sub-graph (d) of Figure (2). In example (10), the temporal expression (T) governs its leftward event *duoda (more than)*, and rightward events *likai (leave)*,*juji, gather*, and *goumai, buy*, with the specific temporal semantic interpretation figure 5 provided below.

(10) *xianchang guanzhong duoda 21000 ren, shifashi dapi renshi*
on-site audience more-than 21000 people, at-time-of-incident large-number-of people
zhengzai likai tiyuchang, juji zai datang goumai jinianpin.
PROG leave stadium, gather in lobby buy souvenirs.
The audience on-site numbered as many as 21,000 people, and at the time of the incident, a large number of people were leaving the stadium, gathering in the lobby to purchase souvenirs.

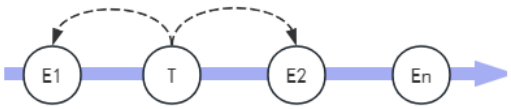

Figure 5: Bidirectional adjacent governance

4.1.2. Multiple-times Single-event sentences

Multiple-times, single-event refers to a situation where multiple temporal expressions appear in a sentence and jointly govern the same event, as shown in Figure 6. Subtype (a) occurs frequently in our corpus, whereas patterns (b) and (c) have not been observed in our current data. Therefore, this study concentrates exclusively on pattern (a). In such sentences, multiple temporal expressions may have an inclusion relationship, where temporal expressions from different time granularities jointly govern the same event, creating a hierarchical temporal positioning. The broader temporal expression establishes the overall time frame for the event, while the narrower temporal expression further specifies the exact timing. These temporal expressions center around a core event, offering multiple temporal expressions or reference points, although the event occurs

only once. The *multiple-times, single-event* scenario is more likely to appear in complex sentences or sentence groups.

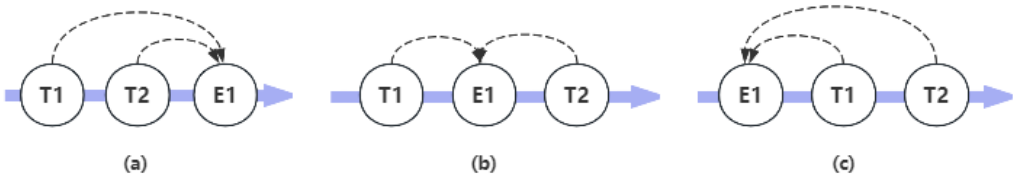

Figure 6: Temporal governance of Multiple-Time Single-Event sentences

(11) *a 2017 nian 5 yue 22 ri, meiguo geshou yaliannagelande zai yingguo*
a 2017 year 5 month 22 day, American singer S/he at United-Kingdom
manchesite jingjichang juxing yanchanghui; b yanchanghui linjin weisheng,
Manchester Arena hold concert; b concert nearing end,
dangdi shijian 22:33 fen fasheng baozha zhishi 23 ren siwang 119 ren
local time 22:33 minutes occur explosion, cause 23 people dead 119 people
shang. c dangwan 22 dian 33 fen gelande de "weixian nvren" xunhui
injured. c that-night 22 hour 33 minutes, s/he POSS "Dangerous Woman" tour
yanchanghui linjin weisheng, tiyuchang quyu fasheng baozha. d xianchang
concert nearing end, stadium area occur explosion. d on-site
guanzhong duoda 21000 ren, shifashi dapi renshi zhengzai
audience more-than 21000 people, at-time-of-incident large-number-of people PROG
likai tiyuchang, juji zai datang goumai jinianpin. e damanchesite jingcha
leave stadium, gather in lobby buy souvenirs. e Manchester police
xuanbu shijian wei kongbu xiji, rending qi wei zisha gongji.
announce incident as terrorist attack, determine it as suicide attack.

a On May 22, 2017, American singer Ariana Grande held a concert at the Manchester Arena in the United Kingdom; b as the concert was nearing its end, an explosion occurred at 10:33 p.m. local time, resulting in 23 deaths and 119 injuries. c That night at 10:33 p.m., during Grande's "Dangerous Woman" tour concert nearing its end, an explosion occurred in the stadium area. d The audience on-site numbered as many as 21,000 people, and at the time of the incident, a large number of people were leaving the stadium, gathering in the lobby to purchase souvenirs. e The Greater Manchester Police declared the incident a terrorist attack, identifying it as a suicide bombing.

For example (11), where sentences (a-e) demonstrate a semantic progression and causal relationships: sentence (a) provides background information and context; sentences (b) and (c) describe the occurrence and development of events; sentence (d) details the specific circumstances and setting; and sentence (e) characterizes the event and presents its outcome. The temporal expressions T1 (*2017 nian 5 yue 22 ri, May 22,2017*) and T2 (*dangdi shijian 22:33 fen, 10:33 p.m. local time*) both govern the Event (*fasheng baozhaoccur explosion*) and Event(*zhishi 23 ren siwang 119 ren shang, cause 23 people dead 119 people injured*). T1 belongs to continuous

long-distance rightward governance, while T2 belongs to rightward adjacent governance. The temporal governance of events is presented in the following Table 5.

Table 5: Temporal Information Parsing of Multi Events

Temporal Expression	Governing Sentence(s)	Governing Event(s)	Type of Temporal Governance
May 22,2017 (Sentence a)	Sentences a-d	Sentence a:(juxing yanchanghui, holding concert) Sentence b: (yanchanghui linjin weisheng, concert nearing end) Sentence b:(fasheng baozha, explosion occurs) Sentence b:(zhishi 23 ren si wang 119 ren shang, 23 killed 119 injured) Sentence c:(linjin weisheng, nearing end) Sentence c:(fasheng baozha, explosion occurs) Sentence d:(zhengzai likai tiyuchang, leaving the stadium) Sentence d:(goumai jinianpin, buying souvenirs)	Start time of event in Sentence a; Start, duration, and end time points of all events in Sentences b and c; Start time point of all events in Sentence d
22:33 (Sentence b)	Sentence b	Sentence b:(yanchanghui linjin weisheng, concert nearing end) Sentence b:(fasheng baozha, explosion occurs) Sentence b:(zhishi 23 ren si wang 119 ren shang, 23 killed 119 injured)	Start time point, duration, and end time point of all events in Sentence b
22:33 that evening (Sentence c)	Sentences c-d	Sentence c: (linjin weisheng, nearing end) Sentence c: (fasheng baozha, explosion occurs) Sentence d:(zhengzai likai tiyuchang, leaving the stadium) Sentence d: (goumai jinianpin, buying souvenirs)	Start, duration, and end time points of all events in Sentence c; Start time point of all events in Sentence d
At the time of the incident (Sentence d)	Sentence d	Sentence d: (zhengzai likai tiyuchang, leaving the stadium) Sentence d:(goumai jinianpin, buying souvenirs)	Start time point of all events in Sentence d
No time expression (Sentence e)	Sentence e	Sentence e:(xuanbu shijian wei kongbu qiji, declaring incident a terrorist attack) Sentence e:(rending wei zisha gongji, identifying it as a suicide attack)	Cannot be categorized; temporal information of events is indeterminate

4.2. Temporal governance patterns across different corpora

4.2.1. Trends of temporal governance patterns

This section examines how temporal expressions govern events across six corpora. We analyzed a total of 132 paragraphs containing 237 sentences across diverse corpus. The corpus included 31 paragraphs with 57 sentences from 15 Wikipedia news articles, 31 paragraphs from literary sources encompassing prose, novels, and science fiction, 18 paragraphs containing 41 sentences from 6 popular science texts, 19 paragraphs with 30 sentences from transportation-related texts, 10 paragraphs comprising 18 sentences from sports texts, and 23 paragraphs with 39 sentences from the HSK dynamic composition corpus serving as intermediate language corpora.

The distribution of temporal expression types varies in different corpora. Temporal expressions can also be divided into relative temporal expressions and absolute temporal expressions, depending on whether they require a temporal reference point [15]. Relative temporal expressions indicate the time relative to another point in the sentence. Examples include *the day after tomorrow*, *before the Spring Festival*, *many years later*, and *after class*. Absolute temporal expressions,

on the other hand, represent fixed time points without needing a reference. Examples include *2024*, *July 5th*, and *the Anti-Japanese War period*. As shown in Table 6, in transportation corpus, absolute temporal expressions appear more frequently than relative temporal expressions. In contrast, relative temporal expressions are more prevalent in literary, popular science, sports action, and HSK dynamic composition corpora.

Table 6: The distribution of temporal expressions across six corpora

Corpus	Temporal Expression(T)	Rightward Adjacent Governance	Proportion	Leftward adjacent governance	Proportion	Non-continuous rightward long-distance governance	Proportion	Continuous rightward long-distance governance	Proportion	Bidirectional adjacent governance	Proportion	SUM	SUM
Transportation Text	Absolute T	12	**42.86%**	2	7.14%	3	10.71%	6	21.43%	0	0.00%	23	28
	Relative T	4	**14.29%**	0	0.00%	0	0.00%	1	3.57%	0	0.00%	5	
Wikinews(UMR)	Absolute T	20	**27.03%**	1	1.35%	0	0.00%	12	16.22%	0	0.00%	33	74
	Relative T	23	**31.08%**	0	0.00%	3	4.05%	13	17.57%	0	0.00%	40	
	Temporal phase	1	1.35%	0	0.00%	0	0.00%	0	0.00%	0	0.00%	1	
Sports Action Text	Temporal phase	1	5.26%	2	**10.53%**	0	0.00%	0	0.00%	0	0.00%	3	19
	Relative T	15	**78.95%**	0	0.00%	0	0.00%	1	5.26%	0	0.00%	16	
Interlanguage Text(HSK)	Absolute T	5	**12.82%**	0	0.00%	0	0.00%	0	0.00%	0	0.00%	5	39
	Relative T	11	28.21%	0	0.00%	4	10.26%	19	**48.72%**	0	**0.00%**	34	
Popular Science	Absolute T	17	**38.64%**	0	0.00%	0	0.00%	3	6.82%	0	0.00%	20	44
	Relative T	14	**31.82%**	0	0.00%	1	2.27%	9	20.45%	0	0.00%	24	
literature	Absolute T	2	22.22%	0	0.00%	1	1.59%	0	0.00%	0	0.00%	3	63
	Relative T	27	42.86%	3	4.76%	6	0.00%	23	36.51%	1	1.59%	60	

Temporal governance patterns also differs across corpus. The literary corpus exhibits the richest variety of temporal governance, with five temporal patterns present across all corpora. Generally, rightward adjacent governance predominates; however, in interlanguage text (HSK), continuous rightward long-distance governance slightly surpasses it. *Non-continuous rightward long-distance governance* is not found in Sports action text. *Bidirectional adjacent governance* is observed only in the literary corpus, with a very low proportion, as shown in Figure 7.

The literary corpus includes four genres—prose, novels, science fiction, and poetry comprising a total of 51 sentences. Among the genres, poetry, in particular, exhibits the greatest variety of temporal governance. Long-distance rightward continuous governance is most prevalent in science fiction texts, while rightward adjacent governance is most common in prose, poetry, and novels. As shown in figure 8.

4.2.2. Distribution of Temporal governance patterns in five discourse modes

We hypothesize that the average distribution of situational entities and temporal interpretation patterns across different corpora can reflect the expected distribution of their primary discourse modes. Smith [31] proposed five discourse modes: narrative, description, report, information, and argument. Each mode is closely associated with situation event types, temporal interpretation patterns, and their principle of progression. Then, we analyze the distribution of discourse modes across six corpora, focusing on situational event types, temporal interpretation, and principles of temporal reference. Our goal is to investigate whether the patterns of temporal governance in Chinese align with the temporal interpretation characteristics of the five discourse modes.

Smith [31] proposed a framework in which situation types are categorized into events (including bounded events and activity events), states, general statives (generic or generalizing sentences), and abstract entities (e.g., facts and propositions). Building on this framework, Friedrich and Palmer [32], Friedrich et al. [33] introduced two additional categories: speech acts (e.g., questions and imperative clauses) and derived SE types, where the SE type of a clause may shift due to the inclusion of linguistic markers that indicate uncertainty about the described situation. We examined the distribution of situational event (SE) types across six corpora. As illustrated in Figure 9, events and states consistently account for high proportions across all corpus, while derived SE types also appear at notable percentages in transportation texts, Wikinews, and popular

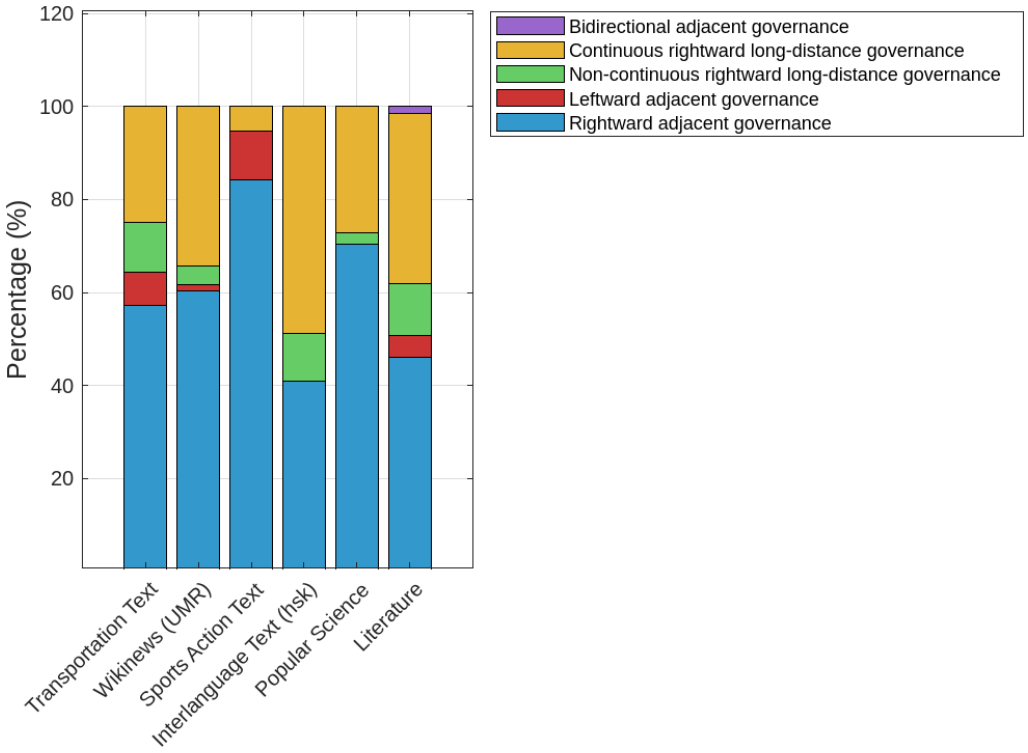

Figure 7: Distribution of temporal governance across different corpora

science articles. Literary texts, popular science and wikinews display the most diverse range of SE types, whereas sports texts exhibit the least variety.

Tense interpretation patterns vary and are primarily categorized into three modes: Continuity, Anaphora, and Deixis. Each discourse mode aligns with distinct interpretation patterns. As Smith [11] explains, *In the Narrative mode, tense conveys Continuity; in the Descriptive mode, tense is Anaphoric. In the Report and all other modes, tense is Deictic; this is the default interpretation.* In the Narrative mode, interpretation relies heavily on Continuity, which establishes various reference times and advances through perfective event sentences or bounded events. In the Descriptive mode, all sentences within a paragraph share a unified reference time. The Report mode, along with the Argument and Information modes, is anchored in the reporter's temporal perspective, using Speech Time as the reference point and characterized by deixis. Paragraphs in the Report mode often include both deictic time adverbials and deictic tenses to clarify temporal relationships and situational time positioning. According to Figure 10, we can investigate how temporal interpretation patterns correspond to discourse modes. In sports texts, only the continuity temporal interpretation and narrative modes are present.

The distribution of discourse modes and governance patterns across different corpora reveals several notable patterns: Narrative maintains a high proportion across all genres, particularly reaching 100% in Sports Action Text, demonstrating the highly narrative nature of this corpus; Report accounts for nearly 25% in both Transportation Text and Popular Science, indicating the significance of report mode in these two corpora; Wikinews is dominated by Narrative and

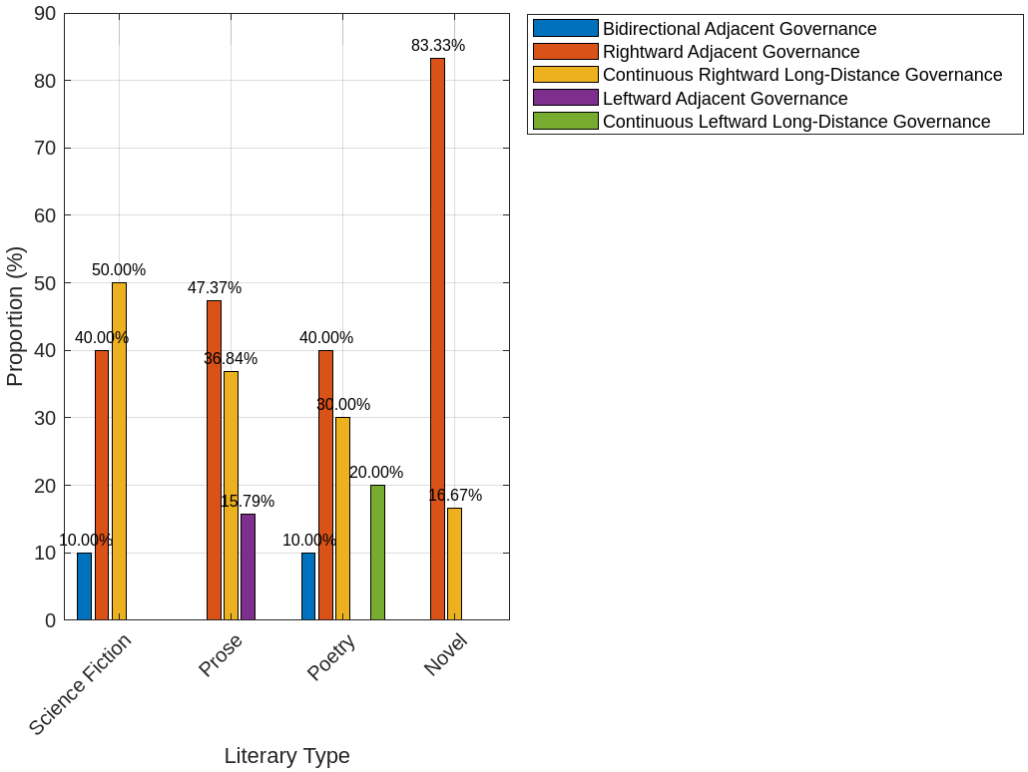

Figure 8: Distribution of temporal governance in the literary genre

Description, showing that news corpus primarily focus on storytelling and scene description; Popular Science exhibits a balanced distribution of Report, Narrative, and Description, reflecting the diversity of science popularization texts; Literature is predominantly Narrative with Description as secondary, highlighting that literary works mainly focus on storytelling and vivid depiction, as shown in figure 11. This further demonstrates that Rightward Adjacent Governance is positively correlated with narrative mode, while Rightward Continuous Governance is positively correlated with description mode.

4.3. Constraints of temporal boundary on events

4.3.1. Situation events type

Dowty [34] argues that in narrative discourse, temporal relationships between events and states in consecutive sentences are typically indicated by temporal adverbs. In the absence of explicit temporal markers, sentences with accomplishment or achievement predicates but no definite time adverbs follow a sequential order. However, when the second sentence contains a stative or activity predicate, the state or process generally overlaps with the preceding sentence, maintaining a static narrative time.

Temporal expressions may have limited scope when applied to abstract entities (e.g., facts, propositions), derived SE (Situation Entity) types, or states. For instance, in example (12), the temporal expression's scope ends before the *meiyou xiaojiao, no horns* event (derived SE type

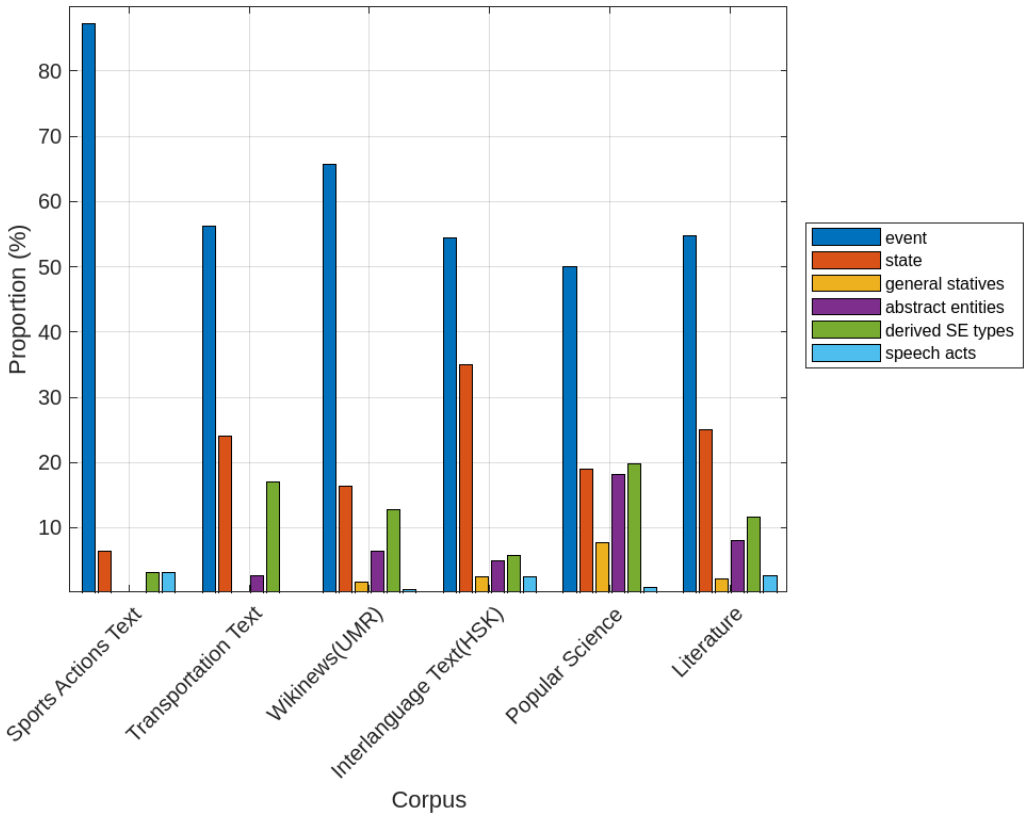

Figure 9: Distribution of situational event types across various corpora

- negation); in (13), before the *qixing, cycling* event (derived SE type - condition); and in (14), before *biaoshi fennu, expressing anger* (abstract entity - proposition), with subsequent events falling outside the temporal expression's scope.

(12) *liu ge yue hou, xiao wu li chuan chu liaoliang de tiku, liuning bang*
six CL months later, small room in-PART came PART loud PART crying, s/he help
hailun zhaogu xinsheng de yinger. dingchong duan zhe yi pen re shui,
s/he take-care-of newborn PART baby. s/he hold ASP a basin-CL hot water,
tantebuan de kanqu. haihao, yinger etou shang meiyou xiao jiao.
anxiously PART look-over. fortunately, baby forehead on no small horn.
Six months later, loud cries echoed from the small room. Liuning held the newborn baby as Helen cared for it. Dingchong, carrying a basin of warm water, looked over anxiously. Fortunately, there was no small horn on the baby's forehead.

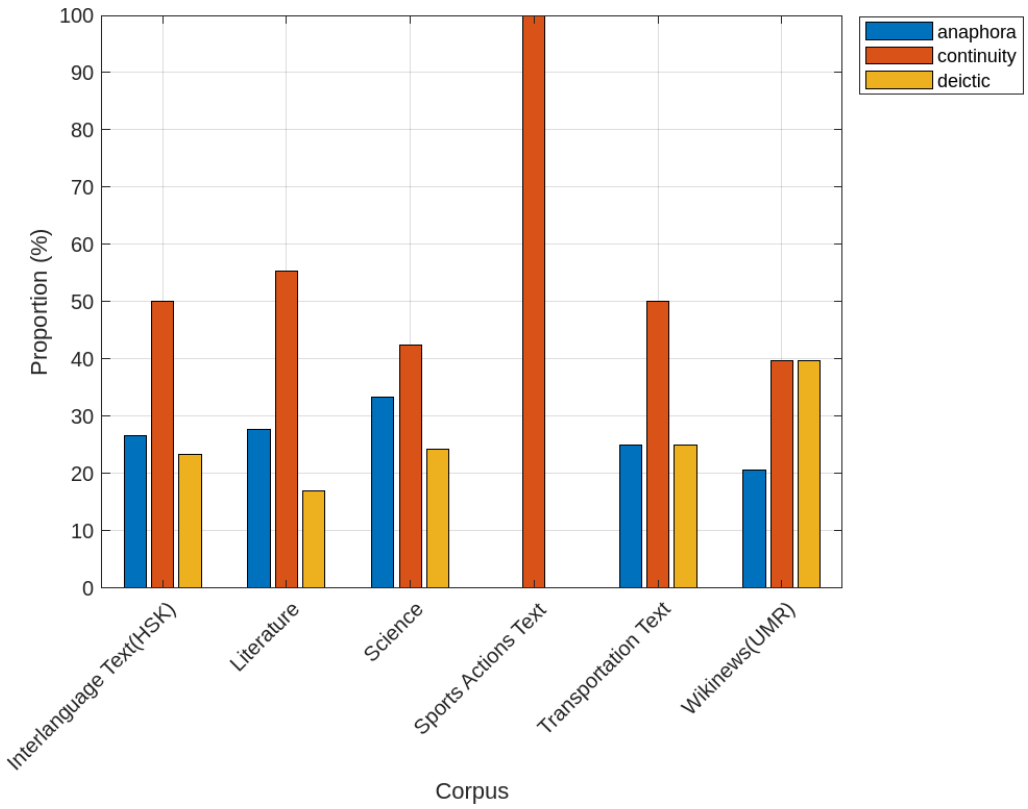

Figure 10: Distribution of temporal interpretation across various corpora

(13) *wo erzi zai beijing de shihou, wo meitian zaoshang bi xianzai zaoqi yi ge*
my son in Beijing PART time, I everyday morning than now wakeup one CL
xiaoshi, gen ta yiqi qi che 5 gongli dao xuexiao. erqie, dang ni he yi
hour, with him together ride bike 5 kilometers to school. and, when you with a
ge 17 sui de nanhai yiqi qixing, sudu ye xiangdang keguan.
CL 17 years PART boy together cycling, speed also quite impressive.
When my son was in Beijing, I woke up an hour earlier every morning than I do now to cycle 5 kilometers to school with him. Moreover, when you ride with a 17-year-old boy, the speed is quite impressive.

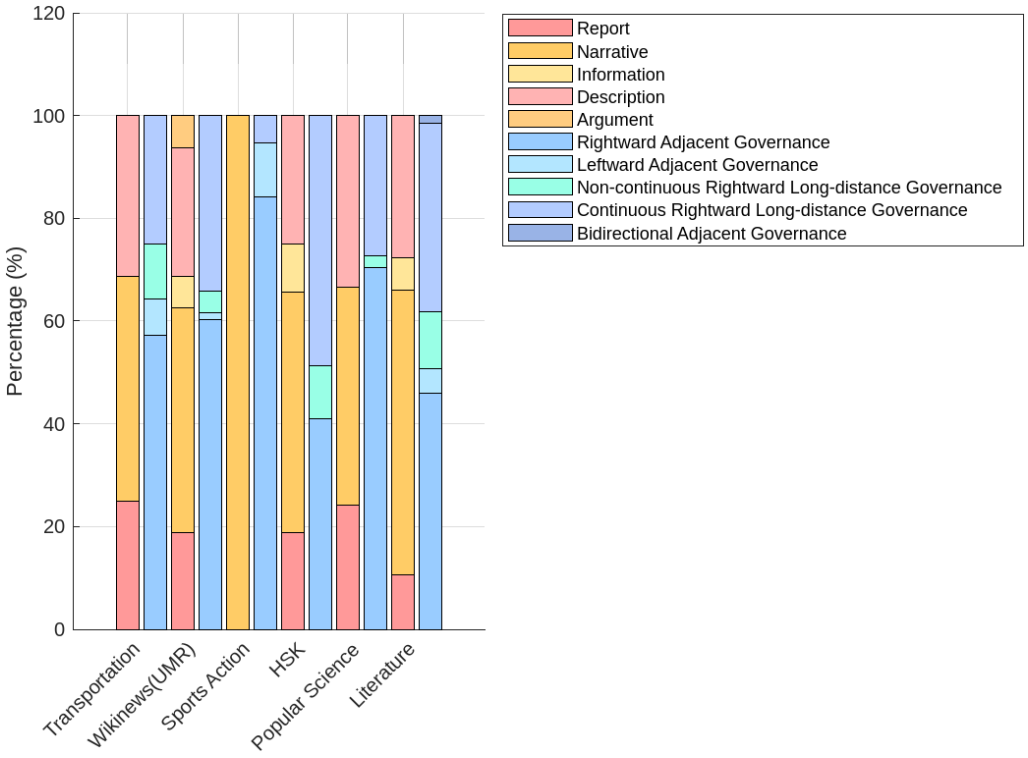

Figure 11: Proportion of discourse modes and governance types across various corpora

(14) *juemi xinxi zai anfa shu xiaoshi nei zai xinwen meiti zhong xielou*
top-secret information within incident few hours PART in news media PART leaked
biaoshi fennu, zhe fangai le diaocha gongzuo, diaocharenyuan xuyao bimian
express anger, this hinder ASP investigative work, investigators need avoid
yinqi xijizhe gongfan de jingjue.
provoking attackers accomplices-POSS PART alertness.
Top-secret information was leaked to the news media within hours of the incident, sparking anger as it hindered the investigation. Investigators need to avoid provoking the attackers and alerting their accomplices.

4.3.2. Relationships within sentences

When the events in clauses within a sentence are closely related, especially with conjunctions like *first..., then..., and, also, or at the same time*, and without other intervening factors, the events are usually governed by the temporal expression. However, events in clauses expressing contrast, causation, purpose, or explanation are generally not governed by temporal expressions, even when they appear within the temporal expression's scope.

(15) *manchesite cheng zuqiu julebu dui zong jiaolian peipu·guadiaola zai tingwen*
Manchester City Football Club team head coach s/he in/at hearing
baozha an shijian hou xiangdang zhenjing, yinwei tade qi er zhenghao
bombing incident event after quite shocked, because his wife child(ren) exactly
ye canyu le yalianna dangwan de yanchanghui...
also participated-in ASP s/he that-night PART concert...
Manchester City Football Club's head coach Pep Guardiola was quite shocked upon hearing about the bombing incident, as his wife and children had also attended Ariana Grande's concert that evening.

In narrative discourse, when sentences containing causal relationships, when the resulting event appears first but occurs later, and the causal event appears later but occurs earlier, the temporal expression preceding the resulting event does not govern the causal event. For instance, in examples (15), the temporal expression governs the resulting event but does not extend its temporal scope to the causal event. Similarly, in example (16), when a clause expressing contrast is present, it is not governed by the temporal expression. Likewise, in example (17), a clause expressing purpose is also not governed by the temporal expression (*zhidao 2012nian, until 2012*)

(16) *shenqing ceng yu 2009nian huopi, dan gai tai yizhi weineng*
application once in 2009 approved, but this station continuously unable
qibo.
begin-broadcasting.
The application was approved in 2009, but this station has continuously been unable to begin broadcasting.

(17) *zhe qijian, tuling zai mimabianzhi he mimapojie de shuxue jichu*
this period, Turing in cryptography and cryptanalysis AUX mathematical foundations
fangmian zuochu le juda gongxian, zhexie gongzuo feichang zhongyao he
aspect make ASP significant contributions, these work extremely important and
jichu, shijishang zhidao 2012nian yingguo zhengfu cai yunxu jiang tamen
foundational, in-fact until 2012 British government ADV allow let them
gongkai fabiao, yi qingzhu tuling danchen 100 zhounian.
public release, to celebrate Turing birth 100th anniversary.
During this period, Turing made significant contributions to the mathematical foundations of cryptography and cryptanalysis. These works were extremely important and foundational, and in fact, it was not until 2012 that the British government allowed them to be publicly released to celebrate the 100th anniversary of Turing's birth.

4.3.3. Principles of temporal progression

The temporal progression of events influences the governance of temporal expressions. As Smith [31] stated, the principles of temporal progression are fundamentally pragmatic, grounded in inferences about how situations are interconnected and how they relate to time. When the tense interpretation is anaphoric and the discourse mode is descriptive, continuous governance typically dominates. In contrast, when the tense interpretation is limited to continuity and the discourse

mode is narrative, adjacent governance tends to prevail as the narrative progresses and establishes a series of distinct Reference Times. If all events share the same Reference Time, long-distance continuous governance generally applies, as illustrated in Example (1). Furthermore, when a new Reference Time emerges within the discourse and is included within the Reference Time of the preceding event, continuous governance remains applicable, as demonstrated in Examples (11).

(18) *jin nian 2yue yilai, feizhou aibola chuxiere yiqing yuyanyulie, muqian*
this year February since, Africa Ebola hemorrhagic-fever epidemic has-been-worsening, now
shenzhi yi kuosan zhi ouzhou he meiguo. ju WTO tongji,
even already spread to Europe and the-United-States. According-to WTO statistics,
jiezhi 10yue 31ri, feizhou meiguo he xibanya deng ba guo (qizhong,
as-of October 31, Africa the-United-States and Spain etc. 8 countries (among-which,
niriliya yu saineijiaer yijing xuanbu jieshu yiqing) leiji chuxian aibola
Nigeria and Senegal already declare end epidemic) cumulatively report Ebola
quezhen yisi he keneng ganran bingli wei 13567 li, 4951 ren siwang.
confirmed suspected and probable infection cases be 13,567 cases, 4,951 people deaths.
Since February this year, the Ebola hemorrhagic fever epidemic in Africa has been worsening, and it has now even spread to Europe and the United States. According to WTO statistics, as of October 31, eight countries — including Africa, the United States, and Spain (with Nigeria and Senegal having already declared an end to the epidemic) — have cumulatively reported 13,567 confirmed, suspected, and probable Ebola cases, with 4,951 deaths.

When multiple temporal expressions appear in sentences, their relationship also affects how events are temporally parsed. When an inclusion or co-reference relationship exists, the events governed by the included temporal expression are generally also governed by the encompassing temporal expression. For instance, in example (18), T1 (*jin nian 2yue yilai, since February this year*) includes T2 (*muqian, currently*) and T3 (*jiezhi 10yue 31ri, until October 31st*). Therefore, T1 governs the event (*chuxian aibola quezhen yisi he keneng ganran bingli wei 13567 li, 4951 ren siwang, 13,567 cases appeared, 4,951 people died*) until the end of the sentences.

4.3.4. Syntactic and semantic constraints

The syntactic distribution of temporal expressions influences the temporal governance of events. When a temporal expression is embedded within an object clause, the temporal parsing patterns of the event typically follows rightward adjacent governance. For example, in example (19), the temporal expression (*lianggeyue hou, two months later*) is part of the object clause of the predicate (*haoqi, curious*) and governs only the immediately following event (*shui xian shuo chu na ge jueding, who said that decision*).

(19) *wo youdian haoqi lianggeyue hou shi shui xian shuo chu na ge jueding, taolun*
I a-bit curious two-months later is who first say PART that CL decision, discuss
zheyang de wenti sihu meiyou yiyi.
such AUX question seems no meaning.
I'm a bit curious about who first made that decision two months later, but discussing such a question seems meaningless.

Furthermore, in clausal events, the agency of subjects also affects temporal expression governance patterns. For example, in example (20), the subject (*yueguang, moonlight*) in the environmental description lacks agency and thus is not governed by the temporal expression (*shanglou hou, after going upstairs*), resulting in discontinuous governance.

(20) *shanglou hou kai deng guan deng, xinchao pengpai, zai yese*
going-upstairs after turned-on the-light turned-off the-light emotions surged, under the-night
yanhu xia wo kai sheng lianxi zenme shuo genghao, yueguang zhao jin
cover PART I began vocal practice how-to express better, moonlight shines into
fangjian, na pian qingrou de yin hui li cang zhe jijiang jiexiao de
the-room, that CL gentle PART silvery glow in contains ASP upcoming be-revealed PART
daan, shijian jingjing liutang, yuese ling wo fakuang.
answer, time quietly flows, moonlight drives me mad.
After going upstairs, I turned the light on and off, emotions surging within me. Under the cover of the night, I began to ponder how to express myself better. Moonlight poured into the room, and within that gentle silvery glow lay the answer waiting to be unveiled. Time flowed quietly, while the moonlight drove me to madness.

4.3.5. Rule-Friven VS Rule-Free

We examine the constraints of the governance of temporal expressions in narrative discourse. Temporal expressions have limited scope when applied to abstract entities, derived situation entity (SE) types, or states. In sentences, events linked by conjunctions such as *first..., then... or and* are generally governed by the same temporal expression, while clauses indicating contrast, causation, purpose, or explanation are usually excluded from its scope. The progression of temporal governance depends on the relationship between successive temporal expressions: new expressions without inclusive relationships typically initiate independent governance. Temporal interpretation also influences governance patterns, with anaphoric tense and descriptive discourse modes favoring continuous governance. Syntactically, temporal expressions embedded within object clauses typically adhere to rightward adjacent governance. Semantically, the agency of subjects further shapes the governance patterns of temporal expressions.

Based on the above research, we compared the IAA between rule-driven and rule-free approaches, finding that rule-guided LLMs consistently achieved higher agreement rates on this taskas shown in table7. Using few-shot prompting, we tested models like ChatGPT-4o, ChatGPT-4.5, DeepseekV1 and DeepseekV3 through their APIs. The prompt instructed the models to present each corpus sentence, identifying the temporal expressions, events, and events governed by the temporal expression.

Table 7: Performance of Rule-Driven and Rule-Free LLMs in Temporal Governance

LLMs	**GPT4o**	**GPT4.5**	**DeepseekV3**	**DeepseekV1**
Few-shots	46%	55%	47%	60%
Rule-guidedAgent	69%	-	68%	70%

5. Conclusion

We initiated our study of temporal expression governance after noting significant inconsistencies among annotators using the UMR Chinese framework. Statistical analysis of IAA and large language model performance revealed underlying issues of uncertainty in judging temporal boundaries, which motivated a systematic investigation. Our research addresses three core questions: the scope of temporal expressions in sentences with either multiple events and one time reference or multiple temporal expressions and a single event; the distribution of governance patterns across genres and discourse modes; and the constraints that determine when temporal expressions constrain events. To this end, we classified temporal semantic parsing into three types: (1) events with fully certain temporal information that fit one of six defined relationships; (2) events with uncertain temporal information that cannot be clearly classified; and (3) ambiguous cases where a temporal expression may govern either event A or event B.

This study proposed eight subtypes of the temporal governance pattern in sentences with single-time, multiple-events structures and multiple-times, single-event structures. Subsequently, using discourse mode theory as a framework, we analyzed 132 paragraphs from six corpora to examine trends in temporal governance and explore the relationships among governance patterns, tense interpretation, and discourse modes. The results show that absolute temporal expressions occur more often in transportation texts, while relative expressions dominate in literary and popular science texts. Literary texts exhibit the greatest diversity of governance patterns, covering five subtypes, whereas sports texts lack non-continuous long-distance governance and bidirectional adjacent governance appears only rarely in literary texts; rightward adjacent governance is generally predominant, but in interlanguage (HSK) texts, continuous rightward long-distance governance slightly exceeds it. Narrative mode is dominant across all corpora, reaching 100% in sports texts, while report mode accounts for about one quarter of transportation and popular science texts; Wikinews combines narrative and description, popular science is more balanced across modes, and literary texts emphasize narrative supplemented by description. These findings further demonstrate that rightward adjacent governance is positively correlated with narrative mode, whereas rightward continuous governance is positively correlated with description mode.

Furthermore, we identified key constraints on temporal governance. Temporal scope terminates with abstract entities, derived speech acts (e.g., negation, condition), or states, but extends across clausal events linked by sequential or simultaneous conjunctions. By contrast, contrastive, causal, purposive, or explanatory relations typically block governance, and in reverse causality only the result event is governed. Temporal interpretation further conditions scope: accomplishment and achievement predicates default to sequential order, while states and activities overlap with the prior narrative time. Co-occurring temporal expressions interact through inclusion or co-reference, with the broader expression extending governance. Syntactic distribution and subject agency also modulate patterns. Incorporating these rule-based constraints into parsing significantly enhanced model performance and inter-annotator agreement.

This study opens several avenues for further research. First, the temporal governance patterns identified here should be tested on larger and more varied datasets, including cross-linguistic comparisons, to establish their general validity. Second, the rules and constraints can be developed into systematic annotation guidelines and computational models, providing a firmer basis for temporal parsing. Third, future work should examine how multiple temporal expressions interact across longer stretches of discourse, not just at the sentence level. Finally, combining these rule-based insights with large language models could yield hybrid approaches that are both theoretically rigorous and practically effective for temporal interpretation.

Author Contributions

The first author was primarily responsible for data organization, research execution, result analysis, and manuscript drafting, while the corresponding author supervised the revisions and contributed to the refinement and finalization of the manuscript.

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Author Biography

Dan Xing is a Ph.D. candidate in Chinese Language and Literature at Peking University. Her research interests include corpus linguistics, modern Chinese syntax and semantics, and computational linguistics.

Dr. Li Huanhong is a Research Fellow at the School of Government, Nanjing University, and a part-time Research Fellow at the Center for Crisis Management Research, Tsinghua University. His research focuses on methodology of concept construction and measurement in social sciences, as well as risk research.