# Linguistic Cues Guide Prediction in the Processing of Mandarin Relative Clauses: An ERP Study

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## Abstract

Sentence processing has been increasingly considered as a strongly incremental and grammatically guided process in which the comprehender builds a syntactic structure and computes semantic meanings as the sentence unfolds. However, strong incrementality is challenged by linguistic phenomena such as head-final constructions where unambiguous markers of a structure only appear at the end of the structure in the bottom-up input. In these cases, the parser has no indication in the bottom-up input confirming that a particular structure is present and thus might initially commit to an incorrect structural analysis, only having to reanalyze when this information becomes available in the bottom-up input and experiencing a processing disruption known as a garden-path effect. Alternatively, it is possible that particularly in contexts which would appear to engender widespread garden-paths such as head-final constructions, the parser does not pursue incremental processing, instead delaying structural commitments until unambiguous evidence for a phrase (such as its head or other markers) becomes available. This dissertation thus investigates the processing of a head-final structure, Mandarin relative clauses, examining whether strongly incremental processing may indeed be possible within these structures, made possible by engaging in structural prediction using cues which appear early in the sentence and may allow the parser to generate an expectation that a relative clause is present prior to encountering unambiguous bottom-up information marking the relative clause. The previous literature examining whether local linguistic cues before the relative clause marker might facilitate predicting these structures has largely focused on testing one particular cue (classifier-noun mismatch) and has shown mixed findings regarding whether this cue enables the parser to predict relative clause structures in Mandarin, possibly due to the flexibility of classifier-noun relations in Mandarin.

This dissertation thus examines whether a new and potentially stronger cue, temporal mismatch, would be an effective cue for relative clause prediction. The present study uses a manipulation where Mandarin relative clauses are preceded by initial mismatch between temporal expressions (such as "tomorrow … used to"), such that the parser might posit a relative clause structure before encountering the Mandarin relative clause marker *de*, since the only way to resolve that temporal mismatch in Mandarin is by positing a relative clause downstream. This dissertation utilizes the event-related potentials technique in a large-scale study (N=74 participants) to track brain responses for detecting the mismatch cue and generating structural prediction with millisecond-level timing accuracy during the dynamics of moment-by-moment sentence processing. In doing so, this dissertation also addresses two other open questions: (1) whether processing of temporal mismatch itself depends on the type of temporal markers involved, by including two kinds of temporal markers, a temporal adverb (*cengjing* "used to") and an aspect marker (*-guo*), in Mandarin; and (2) the extent to which detecting temporal mismatch and engaging in prediction varies at the level of individuals, by independently assessing participants' linguistic and non-linguistic cognitive abilities and examining the extent to which they modulate brain responses during the processing of sentences with temporal mismatches and relative clauses.

Results show that temporal mismatch overall facilitates the prediction of relative clause structures, suggesting that the parser is indeed able to utilize predictive cues to facilitate predicting head-final structures. In addition, processing at the temporal mismatch itself differed based on the kind of temporal marker involved. While the aspect marker *–guo* yielded P600 across all participants without significant modulation by individual differences in linguistic or non-linguistic cognitive abilities, the processing of the temporal adverb *cengjing* was strongly

modulated by individuals' language abilities as assessed by a vocabulary measure. Overall, this dissertation presents strong evidence for syntactic prediction, demonstrating the parser's ability to utilize implicit linguistic cues to engage in structural prediction and achieve strong incrementality.

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# Chapter 1: Introduction

Recent literature on sentence processing has increasingly characterized processing as incremental and grammatically accurate (e.g., Altmann and Mirković, 2009; Kazanina, 2017; Kuperberg and Jaeger, 2016; Yoshida, Dickey, and Sturt, 2013). That is, the parser can build syntactic structures and compute meanings as each word is encountered in the sentence by making recourse to predictive mechanisms, rather than delaying these processes until unambiguous information about relevant structures is encountered.

However, there are a wide range of structures that would appear to challenge strong incrementality. One of these cases is head-final constructions, where information indicating the presence of these structures only appears towards the right edge (Yamashita, Hirose, and Packard, 2010). Thus, when processing head-final constructions, the parser has little to no information on the left edge to guide their expectations about probable structures for the upcoming materials. To make it even more challenging, many head-final constructions are structurally complex, making them even less expected for the parser which tends to assume relatively simple structures as the default starting point of structural building (Ferreira and Clifton, 1986; Frazier and Fodor, 1978). This thus raises critical questions about whether strongly incremental processing extends to languages with head-final constructions. Since there is no marker on the left edge, would head-final constructions always cause processing disruptions such as garden-path effects or cause the parser delay commitment to structural analysis until the unambiguous information is encountered, and would it be possible at all for speakers to incrementally parse these structures by making recourse to predictive mechanisms?

This dissertation examines one such challenging case, relative clauses in Mandarin Chinese (Lin, 2008; Xiang, 2017). Relative clauses in Mandarin are head-final; for example, (1)

includes a Mandarin relative clause where the relative clause marker *de* marks the clause and the object ("tree") is extracted as the head noun (example adapted from Hsu, Tsai, Yang, and Chen, 2014). Crucially, there is no indication of the relative clause until the relative clause marker. The parser thus might initially adopt an analysis of the words comprising the beginning of the relative clause *linju zhong* "neighbor plant …" as a simple main clause structure. However, upon encountering *de*, which indicates that the parser needs to reanalyze away from the main clause analysis in favor of a relative clause analysis, a processing disruption called a garden-path effect may occur.

| | | | | | | |
|---|---|---|---|---|---|---|
| (1) | *Linju* | *zhong* | ***de*** | *shu* | *jie-le* | *guozi* |
| | neighbor | plant | RC marker | tree | bore-ASP | fruits |

"The tree that a neighbor planted bore fruits."

Studies on head-final relative clauses have proposed that the parser might be able to *predict* the presence of a relative clause in advance of encountering *de* and thus alleviate the garden-path effect, utilizing linguistic cues that may appear early in the sentence and indicate that a relative clause is likely to appear. Studies have primarily focused on testing one cue, so-called classifier-noun mismatch, using sentences where an initial semantic mismatch between a classifier and a noun (e.g., between *ke* and *linju* "neighbor" in 2) can only be resolved if the sentence continues with a relative clause, which places *linju* "neighbor" within the relative clause and allows for the classifier to ultimately associate with the upcoming relative clause head noun *shu* "tree" (e.g., Hsu, 2006; Hsu, Tsai, Yang, Chen, 2014; Wu, Kaiser, & Andersen, 2009; for Japanese, see e.g., Yoshida, 2006).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (2) | *yi-ke* | *linju* | *zhong* | *de* | *shu* | *jie-le* | *guozi* |

one-classifier(tree) neighbor plant RC marker tree bore fruit

"A tree that a neighbor planted bore fruits." (adapted from Hsu et al., 2014)

However, studies have not consistently found this cue to reduce the garden-path at the relative clause marker *de*, suggesting that classifier-noun mismatch may not serve as a robust cue for predicting relative clauses in Mandarin. This may possibly be due to the fact that the relation between classifiers and nouns is rather flexible in Mandarin (Tsang and Chambers, 2011; Hsu et al., 2014), which may lead the parser to attempt to accommodate unusual classifier-noun combinations, rather than positing a complex structure such as a relative clause to resolve mismatches between classifiers and nouns.

This dissertation thus examines whether a new and potentially more robust cue would facilitate the parser to recruit predictive mechanisms in processing Mandarin relative clauses online. The particular cue tested in this study is temporal mismatch, such as in (3) where the initial time frame *mingtian* "tomorrow" and the following temporal marker *cengjing* "used to" do not match in temporal reference. Crucially, in Mandarin, temporal mismatches such as (3) can only be resolved by a relative clause downstream, making them a potentially unambiguous relative clause prediction cue to help the parser pre-assemble this structure before encountering the relative clause marker *de* downstream.

(3) *Mingtian Lisi cengjing jieyue tushu* ***de*** *tushuguan jiangyao banzou*

Tomorrow Lisi used to borrow book RC marker library will move

"Tomorrow, the library where Lisi used to borrow books will move away."

Furthermore, studies have shown that temporal mismatches in simple sentences (such as M*ingtian Lisi cengjing jieyue tushu* "Tomorrow Lisi used to borrow books") are consistently

detected by the parser in online processing (Collart and Chen, 2020; Qiu and Zhou, 2012; also see Zhang and Zhang, 2008). Thus, the parser might be able to utilize temporal mismatch as an informative cue to predict a relative clause structure and reduce the potential garden-path before encountering the relative clause marker in the bottom-up input.

Examining sentences where local temporal mismatches are ultimately resolved by relative clauses allows this dissertation to broadly address several crucial questions. First and foremost, the dissertation examines the role of predictive mechanisms in facilitating the incremental processing of a head-final construction where prediction is paramount to incrementality. This study uses electroencephalography to track the dynamics of brain responses with millisecond-level timing resolution in real-time while the brain processes the predictive cue and the relative clause structure. The dissertation thus advances the literature on the processing of head-final structures that has thus far yielded mixed results regarding whether prediction facilitates strong incrementality in processing these structures. More broadly, while the literature on prediction at other levels of representation (such as lexico-semantic prediction) is relatively rich, the prediction of syntactic structures is still a less well-understood aspect of predictive processing (Lau, Stroud, Plesch, Phillips, 2006; Kaan, Kirkham, and Wijnen, 2016; Yoshida et al., 2013). This dissertation thus provides new evidence regarding the role of prediction in sentence processing, showing that the parser can generate structural predictions based on indirect cues when the cue is sufficiently informative for making such predictions.

In addition, the dissertation contributes to our understanding of temporal information during sentence processing, examining the processing of two types of temporal marker (adverbs versus aspect markers) and the extent to which temporal processing depends on the type of temporal markers. In doing so, the current study connects two bodies of literature, that on

temporal processing and that on relative clause prediction, highlighting the importance of examining how distinct sources of linguistic information may interact in order to facilitate real-time language processing. Finally, this dissertation examines the extent to which processing temporal mismatches and predicting relative clauses might be subject to variability at the level of individual speakers, bringing new perspectives from the recent sentence processing and individual differences literatures to bear on questions regarding how head-final structures are processed (Borovsky, Elman, and Fernald, 2012; Johnson, Fiorentino, and Gabriele, 2016; Tanner and van Hell, 2014; Van Dyke, Johns, and Kukona, 2014). The dissertation will examine the impact of individual differences in linguistic and non-linguistic cognitive abilities on the processing of temporal mismatches and the prediction of relative clauses.

This dissertation is structured as follows. Chapter 2 surveys important background literature motivating the current study, focusing largely on the literature using the ERP methodology, the experimental method utilized by the main study reported in this dissertation. This includes discussion of the notion of incrementality in sentence processing, the role of prediction in sentence processing, and the examination of individual differences in language processing. It also introduces two event-related potentials (ERP) components; the first is N400, a negative-going brain waveform emerging around 300-500ms following the onset of a critical word, which has traditionally been viewed as an index of lexico-semantic processing and more recently, as an index of lexico-semantic prediction (for a review, see e.g., Lau, Phillips, Poeppel, 2008). The second is P600, a positive-going brain waveform emerging around 600-900ms following the onset of a critical word that has traditionally been viewed as an index of syntactic processing, including syntactic revision and repair when anomalies are detected; it has also recently been examined as an index of syntactic prediction (see e.g., Kaan et al., 2016). These

components are central to examination of the processing of temporal mismatch and relative clause prediction in the present study. Chapter 2 then reviews previous research on the processing of head-final relative clauses, including Mandarin relative clauses, focusing on the linguistic manipulations and findings from these studies. Chapter 2 also introduces temporal relations and studies on temporal processing in Mandarin. Then, In Chapter 3, I introduce the current study which includes three experiments: two offline norming experiments and one online ERP experiment. I present in detail the research questions, designs, and findings from each of these experiments. Finally, Chapter 4 discusses the major findings in light of the broader literature on sentence processing and outlines potentially fruitful directions for future research.

# Chapter 2: Literature Review

## Incrementality and Prediction in Sentence Processing

The broad literature on sentence processing has increasingly characterized processing as strongly incremental. That is, the parser actively attempts to construct sentence structure and meaning as each new word is encountered as much as possible, rather than waiting until the end of phrases or clauses to do so (Kamide, 2008). It has been argued that, in order to achieve strong incrementality, the parser engages in prediction about upcoming content (e.g., Altmann and Mirković, 2009; Jaeger and Snider, 2013; for reviews, see Kamide, 2008, Kuperberg and Jaeger, 2016, and Pickering and Gambi, 2018).

There is broad evidence demonstrating that the parser can generate prediction about lexical semantic aspects of upcoming words (Altmann and Kamide, 1999; Borovsky et al., 2012; DeLong, Urbach, and Kutas, 2005; Federmeier and Kutas, 1999; Grisoni, Miller, and Pulvermüller, 2017; Kamide, Altmann, and Haywood, 2003; Lau, Namyst, Fogel, and Delgado, 2016; Otten and Van Berkum, 2009; Szewczyk and Schriefers, 2013). For example, Borovsky et al. (2012) examined participants' eye movements in a visual-world scene consisting of pictures of four objects (such as a bone, a cat, a treasure, and a ship), while participants heard sentences such as *The pirate hides the treasure*. They found that participants launched anticipatory looks to the target object (*treasure*) before hearing the word in the auditory input, using information from the subject noun phrase (*The pirate*) and the selectional properties of the verb (*hides*).

On the other hand, there is an emerging body of literature showing that the parser can also make predictions about syntactic structures in sentence processing (e.g., Dillon, Nevins, Austin, and Phillips, 2012; Fiorentino, Bost, Abel, and Zuccarelli, 2012; Kazanina, 2017; Lau et al., 2006; Omaki, Lau, Davidson White, Dakan, Apple, and Phillips, 2015; Yoshida et al., 2013).

It might not be totally surprising for the studies on lexical semantic prediction to find that the parser can anticipate elements that do not serve as phrasal heads when the overall phrase structure has already been shaped, such as predicting argument noun phrases by drawing upon the argument structure of verbs already encountered in the bottom-up input. However, whether the parser is able to pre-build syntactic structure before encountering any element defining that structure in the bottom-up input is an intriguing question about the parser's predictive power and has only recently been examined in the sentence processing literature. For example, Kazanina (2017) examined this issue in Russian, where genitive case marking on the direct object (*podarkov* "gifts") can be licensed by a negated verb later in the sentence (*ne darit'* "not to give") such as in (4a); thus, genitive case marking on the direct object might help the parser to anticipate the negation downstream as compared to when the direct object is marked with accusative case which doesn't have to do with negation (*podarki* in 4b). In a series of self-paced reading experiments, Kazanina found that processing at the negation and the verb was indeed facilitated when the direct object was marked with genitive case compared to with accusative case, suggesting that the parser can actively predict verb properties by using case-marking information on the preceding object.

| | | | | | |
|---|---|---|---|---|---|
| (4a) *Roditeli* | *dogovorilis'* | *podar**kov*** | *molodoženam* | ***ne*** | *darit'*. |
| Parents-NOM | agreed | gifts-GEN | newlyweds-DAT | not | to-give |
| (4b) *Roditeli* | *dogovorilis'* | *podar**ki*** | *molodoženam* | ***ne*** | *darit'*. |
| Parents-NOM | agreed | gifts-ACC | newlyweds-DAT | not | to-give |

Both meaning: "The parents agreed not to give gifts to the newlyweds."

Structural prediction has also been examined using ERP (e.g. Lau et al., 2006; Kaan et al., 2016; see also Dillon et al., 2012, for an ERP study on predicting morphological markings on

the verb). Lau et al. (2006) examined the extent to which the parser would anticipate an empty syntactic category, such as an elided (omitted) noun, based on the preceding sentence context. They tested sentences such as (5) where the presence or absence of a possessive (*Mary's mother*) in the first clause would grammatically allow or prevent an elided noun in the second clause; for example, in (5a) it is possible to posit an elided noun after *Dana's* given the presence of the possessive (for example, a grammatical variant of 5a with ellipsis would be *Although Erica kissed Mary's mother, she did not kiss Dana's*.). In contrast, this operation is ungrammatical in (5b) and an overt noun is required after *Dana's* (e.g., a grammatical variant of 5a would be *Although the woman kissed Mary, she did not kiss Dana's brother*). Although both sentences end up having an ungrammatical category (the preposition *of* ) after *Dana's* in the stimuli tested by Lau et al. (2006), they argued that the parser might strongly predict an overt noun in the non-ellipsis condition (5b) and thus find *of* as a strong violation coming from a different word category, compared to the ellipsis condition (5a).

(5a) Ellipsis: **Although Erica kissed Mary's mother, she did not kiss Dana's* ***of*** *the bride.*
(5b) Non-ellipsis: **Although the woman kissed Mary, she did not kiss Dana's* ***of*** *the bride.*

Lau et al. found that the non-ellipsis condition (5b) indeed yielded a greater anterior negativity than the ellipsis condition (5a) around 200 ms after the category violation (*of*), an ERP component that had been argued to reflect integration of the current word category into the syntactic structure (Hahne and Friederici, 1999; Neville, Nicol, Barss, Forster, and Garrett, 1991). This suggests that the parser must have formed expectations regarding an elided versus an overt noun, and thus found it easier to detect the word category violation when there was a stronger expectation for an overt noun (non-ellipsis condition), compared to when the expectation for an overt noun was attenuated due to the anticipation of ellipsis (ellipsis

condition). Lau et al.'s study thus demonstrated that the parser indeed engages in syntactic prediction. (However, see also Kaan et al., 2016, who also showed this prediction effect in a similar design but observed the effect in a different ERP component (a positivity, called P600) rather than the anterior negativity, and see Steinhauer and Drury (2012) for a critical discussion of the anterior negativities in ERP studies examining word category violations; Kaan et al, 2016 is also discussed in a later section of this literature review discussing the P600 component).

Overall, research that directly examines syntactic prediction is less common compared to research examining lexical semantic prediction, in particular as regards studies investigating sentence processing at the brain-level using techniques such as ERP. As outlined in Chapter 1, this dissertation examines Mandarin relative clauses, a head-final structure that is prone to cause garden-path disruptions (Lin, 2008; Xiang, 2017); therefore, incrementally parsing Mandarin relative clauses appears to require the parser to make structural predictions and anticipate relative clauses before encountering the late-occurring marker. In this dissertation, we examine whether native Mandarin speakers indeed engage in prediction during the processing of sentences with relative clauses, using ERP to track the processing of these structures in real-time. As a reminder, an example of Mandarin relative clauses is provided in (6) below. Again, the relative clause is only marked towards the end by the relative clause marker *de*, potentially causing the parser to initially adopt a main-clause analysis ("The millionaire invited …") and later reanalyze the structure as a relative clause when *de* is encountered.

| | | | | | |
|---|---|---|---|---|---|
| (6) | *Fuhao* | *yaoqing* | *de* | *guanyuan* | *xinhuaibugui* |
| | Millionaire | invite | RC marker | official | have bad intentions |

"The official that the millionaire invited had bad intentions." (adapted from Wu et al., 2009)

Therefore, the parser has to implement some level of prediction in order to anticipate this complex structure ahead of the time in order to avoid the garden-path in processing Mandarin relative clauses. To my knowledge, the question of whether these structures could be processed in an incremental manner at all using prediction has only been examined by a few studies. This dissertation thus addresses this gap, examining whether Mandarin relative clauses can be predicted by the parser in online processing, and whether a specific linguistic cue, temporal mismatch, might facilitate the parser to engage in such prediction. In addition, this dissertation investigates whether predicting Mandarin relative clauses by utilizing temporal mismatch as a predictive cue is subject to individual differences among native speakers, informing our understanding of the abilities that may underlie the processing of complex sentences. This dissertation thus makes important contributions to the sentence processing literature by providing new evidence for the role of structural prediction in facilitating the incremental processing of head-final structures.

The following contents of the literature review are organized as follows. I start with reviewing important studies on examining garden-path sentences; the review focuses on studies using the ERP technique which is also the main technique utilized by the present study, rather than on the psycholinguistic studies on the processing of garden-path sentences. Interested readers can refer to this large body of psycholinguistic literature for more details (e.g., Christianson, Williams, Zacks, and Ferreira, 2006; Ferreira, Christianson, and Hollingworth, 2001; Sanz, Laka, and Tanenhaus, 2015; Swets, Desmet, Clifton, and Ferreira, 2008). I will also discuss two ERP components, N400 and P600, that have served as crucial measures in studies on predictive processing and are also outcome measures in the present study. I then discuss the literature on variability in sentence processing at the level of individual speakers, a relatively

new domain of investigation in the sentence processing literature. I review studies showing variability in predictive processing, reviewing the domains in which even adult native speakers vary in generating predictions and processing complex constructions, and the individual abilities that might subserve this variability. Then, I turn to the literature specifically on the incremental processing of head-final relative clauses in Japanese and Chinese, where previous studies have largely focused on testing one possible cue for predicting head-final relative clauses (classifier-noun mismatch) and discuss a few potential issues regarding the existing literature in this domain. Finally, I discuss the studies on processing temporal relations in Mandarin in simple sentences; the present study is the first to my knowledge to examine temporal information in relation to generating structural predictions about relative clauses.

**Processing Garden-path Sentences**

As discussed above, when the parser has to reanalyze sentence structures, as in the case of garden-path sentences, processing disruptions commonly result. In one of the first ERP studies on garden-path sentences, Osterhout and colleagues (1994) examined English garden-path sentences, specifically sentences that are temporarily ambiguous between transitive and intransitive structures (Experiment 2, Osterhout, Holcomb, and Swinney, 1994). Osterhout and colleagues used these sentences as a testing ground for claims made by two prominent sentence processing models at the time, the minimal attachment model (Frazier and Rayner, 1982) and lexically driven parsing models (Fodor, 1978; Ford, Bresnan, and Kaplan, 1982; Holmes, Stowe, and Cupples, 1989). The minimal attachment model argues that the parser would prefer building simpler structures with minimal attachment nodes in the syntactic structure, while the lexically driven parsing models argue that the parser can use lexical information, such as verb subcategorization biases, to build more complicated structures when called for. Osterhout et al.

tested sentences with embedded complementizer clauses such as (7), where the verb varied in their subcategorization criteria favoring towards complementizer clauses or direct objects. The minimal attachment model would predict that the parser would always start with a transitive structure and thus might experience garden-path across the board, while lexically driven models would predict that the parser would utilize the verb subcategorization information to construct a more complicated, intransitive structure if necessary, thus the level of garden-path might be more graded, with (7d) yielding greater garden-path than (7a) and (7c).

(7a) *The doctor <u>hoped</u> the patient **was** lying.* (Intransitive)

(7b) **The doctor <u>forced</u> the patient **was** lying.* (Transitive)

(7c) *The doctor <u>believed</u> the patient **was** lying.* (Intransitively biased)

(7d) *The doctor <u>charged</u> the patient **was** lying.* (Transitively biased)

Previous literature has suggested that an ERP component called P600 appears to reflect garden-path effects (Osterhout and Holcomb, 1992). Osterhout et al. thus examined whether differential P600 effects would be elicited at the auxiliary (*was*) indicating the presence of a complementizer clause, which would reflect varying degrees of garden-path. They found that (7d) indeed yielded increased P600 at the auxiliary *was*, compared to intransitive and intransitively-biased sentences (7a/c). Osterhout et al. interpreted the results as consistent with the claims from lexically driven parsing models. Given that transitivity biases influenced the size of the P600, Osterhout et al. suggested that these results are compatible with lexically-driven models positing that lexical information on the verb is utilized to resolve local ambiguities.

Since Osterhout et al. (1994), numerous ERP studies have examined garden-path sentences in various languages (Friederici, Mecklinger, Spencer, Steinhauer, and Donchin, 2001;

Gouvea, Phillips, Kazanina, and Poeppel, 2010; Hörberg, Koptjevskaja-Tamm, and Kallionen, 2013; Kaan and Swaab, 2003; Matzke, Mai, Nager, Russeler, and Munte, 2002; O'Rourke and Colflesh, 2015; Vos, Gunter, Schriefers, and Friederici, 2001). In one such study, Gouvea et al. (2010) examined garden-path sentences such as (8b), among a range of other sentence types argued to elicit P600. In (8b), after reading *The patient met the doctor and the nurse …* the parser is likely to assume *the nurse* is the object of *met* and have no reason to expect another clause. They would then experience a garden-path effect at *showed* which unambiguously indicates that *nurse* is in fact the subject of another clause.

(8a) Control:

*The patient met the doctor <u>while</u> the nurse with the white dress **showed** the chart during the meeting*.

(8b) Garden path:

*The patient met the doctor <u>and</u> the nurse with the white dress **showed** the chart during the meeting*.

Gouvea et al. found that, compared to the non-garden-path control (8a), the garden-path condition (8b) yielded increased P600 at *showed* which indicates the need to reanalyze. Gouvea et al. interpreted the greater P600 as reflecting the parser undoing the previous analysis and reanalyzing the already encountered words as a new structure.

In summary, existing studies have shown that P600 serves as an ERP index of garden-path effects during online processing. This holds crucial implications for the current study on Mandarin relative clauses, a head-final structure that would appear to widely cause garden-path effects or lead the parser to hold off incremental structure building and wait until the end of the

clause. Thus, the present study uses P600 as a probe to examine the predictive processing of Mandarin relative clauses. The logic is that, if not predicted, relative clauses would yield the P600 garden path effect; however, when the parser is able to predict the relative clause, the P600 effect should be smaller or absent.

In the next section, I review literature on crucial ERP components for studying prediction during online sentence processing.

**ERP Evidence for Prediction during Sentence Processing**

As discussed above, studies on garden-path sentences have typically tested for the ERP component P600 as an important index of structural reanalysis during online processing. This section discusses two important ERP components, N400 and P600, which have been utilized in the literature to examine predictive processing.

An ERP component that has been argued to reflect lexical semantic prediction is the N400. N400 is a negative-going waveform peaking around 300-500 ms post-onset of relevant events, with a central-posterior scalp distribution. N400 is typically considered as reflecting lexical access from long-term memory and has been observed for a wide range of linguistic phenomena (Kutas and Federmeier, 2011). Crucially, N400 is typically utilized as an index of lexical semantic prediction, based on finding that large amplitude of N400 is often yielded by words of low predictability (Federmeier and Kutas, 1999; Kutas and Hillyard, 1984; Lau et al., 2008, 2016; Otten and Van Berkum, 2009; Thornhill and Van Petten, 2012; Van Berkum, Brown, Zwitserlood, Kooijman, and Hagoort, 2005).

Federmeier and Kutas (1999) examined the processing of the final word in sentences such as (9), where the word is expected (*pines*), unexpected but from the same category as the expected word (*palms*), or unexpected and from an unrelated category (*roses*).

(9) *The air smelled like a Christmas wreath and the ground was littered with needles. The land in this part of the country was just covered with* <u>*pines/palms/roses*</u>.

Federmeier and Kutas found that, while the unexpected between-category word (*roses*) yielded a large N400, the within-category word (*palms*) yielded reduced N400 that is close to the baseline expected word (*pines*). The fact that *palms* did not yield a large N400 suggests that N400 does not merely reflect the semantic fit of the word in the context (as argued by the so-called integration view of N400; Brown and Hagoort, 1993; Van Berkum, Hagoort, and Brown, 1999). If N400 only reflected the degree of semantic fit, then *palms* would be as poor of a fit as *roses* in this context and would have yielded a large N400. Federmeier and Kutas thus argued that the reduced N400 at *palms* can be explained if one adopts a different view of the N400 (the so-called prediction view; Lau et al., 2008, 2013; Van Berkum et al., 2005). Under this view, the context leads to the prediction of specifically the most predictable word *pines*, and this would lead to some pre-activation of its semantic neighbors such as *palms* due to spreading activation. Thus, the reduced N400 at the semantic neighbor of the predicted word suggests that the parser has truly predicted the target word based on the context, thus pre-activating semantic associates as a result (see also Otten and Van Berkum, 2009, Thornhill and Van Petten, 2012).

Some of the most convincing evidence of lexical semantic predictions come from N400 studies showing that the parser can anticipate a noun beforehand, revealing effects of prediction even before the noun itself, such as at the preceding determiner. For example, Otten and Van Berkum (2009) examined Dutch determiners before the critical noun (10); in Dutch, definite

determiners (common gender determiner *de* / neuter gender determiner *het*) must agree with the lexical gender of the noun (*ketting* "necklace", common gender / *collier* "collar" neuter gender). Thus, if Dutch speakers actively predict the common-gender noun *ketting* based on the lead-in context, then the common gender determiner *de* would be more anticipated since it is consistent with the predicted noun, than the neuter gender determiner *het* which would indicate an unexpected noun is upcoming.

(10) Lead-in discourse:

*De actrice had een prachtige jurk aan, maar ze vond haar hals nog wat sober…*

"The actress wore a beautiful dress, but she thought her neck was a little plain…"

(10a) Prediction-consistent determiner:

*Ze pakte **de** verfijnde maar toch opvallende ketting die haar stylist had uitgezocht*.

"She picked up the$_{com}$ delicate yet striking necklace that had been selected by her stylist."

(10b) Prediction-inconsistent determiner:

*Ze pakte **het** verfijnde maar toch opvallende collier dat haar stylist had uitgezocht*.

"She picked up the$_{neut}$ delicate yet striking collar that had been selected by her stylist."

Otten and Van Berkum found that Dutch speakers overall showed a larger N400 at the determiner that is inconsistent with the predicted noun (10b) compared to the determiner that is consistent with the predicted noun (10a), showing that the parser can generate very specific predictions about upcoming words based on sufficient information provided in the discourse (see Kochari and Flecken, 2018, for a recent replication of Otten and Van Berkum, 2009). Overall,

the fact that N400 amplitude is modulated by sentential context further demonstrates that the parser engages in prediction about upcoming words based on contextual information.

Another key ERP component for studying predictive processing is P600. P600 is a positive-going waveform emerging around 600-900 ms post-onset of a critical stimulus, and has been generally associated with the detection, revision, and formation of syntactic structures and relations (Friederici, Pfeifer and Hahne, 1993; Gouvea et al. 2010; Hagoort, Brown, and Groothusen, 1993; Kaan, Harris, Gibson, and Holcomb, 2000; Phillips, Kazanina, and Abada, 2005; for a review, see Molinaro, Barber, and Carreiras, 2011). One study which attempted to test a number of different P600-eliciting structures within the same experiment is Gouvea et al. (2010). In addition to garden-path sentences, Gouvea et al. (2010) also examined sentences involving ungrammaticality, *wh*-dependency, and long-distance dependency. All their conditions yielded P600 effects, which is consistent with the view that P600 may reflect various kinds of syntactic processes that are involved in building and revising syntactic structures and relations, in both ungrammatical and grammatical (including garden-path) sentences.

On the other hand, the recent literature has suggested broader interpretations of P600, rather than taking it only as a marker of strictly syntactic operations (Bornkessel-Schlesewsky and Schlesewsky, 2008; Kim and Osterhout, 2005; Van Herten, Chwilla, and Kolk, 2006). There have been several studies showing that semantically anomalous sentences that are syntactically well-formed also elicited P600. For example, Van Hertern et al. found that sentences with thematic anomaly such as (11) independently yielded a P600 effect. Thus, P600 has also been argued to be a general indicator of anomaly repair and reanalysis, in addition to only reflecting such operations in the syntactic domain.

(11) *De ladder die op de schilder klom…*

the ladder that on the painter climbed…

"The ladder that climbed the painter…"

While much of the ERP literature has focused on lexical semantic prediction, only relatively few studies have examined the prediction of syntactic structures (Lau et al., 2006; Kaan, Kirkham, and Wijnen, 2016). Kaan et al. (2016) examined native and non-native speakers' prediction of elided nouns based on the preceding sentence context that either does or does not license noun ellipsis. Directly building on Lau et al. (2006)'s ellipsis paradigm, Kaan et al. tested contexts where an overt noun can be omitted (noun ellipsis) or is required to appear. For example, (12a) allows for ellipsis due to the possessive (*John's surgeon*) in the first clause, thus not requiring an overt noun after *Max's* in the second clause (e.g., *Although Peter met John's surgeon, he did not meet Max's*); however, (12b) does not allow noun ellipsis due to the lack of possessive in the first clause, and thus requires an explicit noun after *Max's*. The parser should thus strongly anticipate an overt noun in the non-ellipsis condition (12b) compared to the ellipsis condition (12a) where this continuation is not required.

(12a) Ellipsis: *Although Peter met John's surgeon, he did not meet Max's *of the operation.*

(12b) Non-ellipsis: *Although the surgeon met John, he did not meet Max's *of the operation.*

Kaan et al.'s native results showed that the non-ellipsis condition yielded a greater positivity at the possessive (*Max's*) compared to the ellipsis condition, although they did not replicate Lau et al. (2006)'s finding at the preposition (*of*). Kaan et al. interpreted the positivity as potentially a P600 in the non-ellipsis condition; since the P600 emerged even before the preposition, they argued that it potentially reflects the parser's different expectation when

encountering *Max's* about likely continuations, strongly expecting an overt noun to follow in the non-ellipsis condition but not in the ellipsis condition.

In sum, ERP studies on the prediction of syntactic structures are still relatively limited compared to the relatively rich set of ERP studies providing evidence for lexical semantic prediction. The current study will contribute to this small body of literature, examining structural prediction of Mandarin relative clauses using ERP. Given that prediction should facilitate pre-assembling the relative clause structure and thus lead to a reduction of the garden-path effect, the current study will test for structural prediction using garden-path effects as a probe, such that a relative clause that is predicted should lead to a reduced garden-path, reflected by reduction in the P600 amplitude.

**Individual Differences in Sentence Processing**

In recent years, the field of sentence processing has witnessed a surge of interest in examining variability beyond aggregated results, at the level of individual speakers (Borovsky et al., 2012; DeLong, Groppe, Urbach, and Kutas, 2012; Johnson et al., 2016; O'Rourke and Colflesh, 2015; Otten and Van Berkum, 2009; Tanner and Van Hell, 2014; Van Dyke et al., 2014; see Boudewyn, 2015 for a review). This trend brings novel and intriguing perspectives regarding the aspects of language processing that might be subject to individual differences and the kinds of abilities that may impact those aspects of language processing, shedding light on the relation between language processing and domain-general cognitive processing. The next section reviews detailed findings regarding native language variability and individual abilities relevant to the processing of syntax and to prediction.

A handful of recent ERP studies have demonstrated that individual brain responses robustly differ even when processing core aspects of morphosyntax, and that this variability

exists even among adult native speakers who have traditionally been studied as a homogenous group (Grey, Tanner and Van Hell, 2017; Tanner and Van Hell, 2014). In one such study, Tanner and Van Hell (2014) examined the processing of agreement violation, including subject-verb agreement violations (*The clerk at the clothing boutique was/*were severely underpaid and unhappy*) and verb tense violations (*The crime rate was increasing/*increase despite the growing police force*). They found that, when analyzed at the group level, these violations overall showed a biphasic Left Anterior Negativity (LAN)-P600 response that is typical of grammatical violations of this kind. However, analyses at the individual level showed that participants systematically varied in their response profiles. By quantifying the response dominance using a Response Dominance Index (RDI), Tanner and Van Hell further found that individual brain responses varied along a continuum between negativity- and positivity-dominant responses. Their findings stand in contrast with traditional ERP studies arguing that morphosyntactic violations should consistently yield LAN-P600, showing that individual differences are a systematic source of variability in morphosyntactic processing, even among a seemingly homogenous native speaker population such as college-educated young adults.

ERP studies have also found variability among native speakers in processing garden-path sentences (Friederici, Steinhauer, Mecklinger, and Meyer, 1998; O'Rourke, 2013; Vos and Friederici, 2003; Vos et al., 2001). Using stimuli similar to those in Gouvea et al. (2010), O'Rourke and Colflesh (2015) examined comprehension accuracy and brain responses to garden-path sentences, such as *The patient met the doctor while/and the nurse with the white dress showed the chart during the meeting*. While their garden-path condition yielded an overall P600 effect, the authors further analyzed individual participants' RDI following Tanner and Van Hell (2014)'s approach and found that about half of the participants showed a negativity-

dominant response and the rest of them showed a positivity-dominant response. Individual RDI values also correlated with comprehension accuracy for garden-path sentences, with P600-dominant participants showing higher comprehension accuracy. It is thus important for studies on garden-path processing to address potential individual differences by analyzing results beyond the group level and examining the relation between garden-path resolution and processing-related abilities of the individual.

The literature on individual differences has highlighted several key abilities that might modulate sentence processing, including both non-verbal cognitive abilities such as working memory and linguistic abilities such as receptive vocabulary. For example, one ability that has been argued to be crucial for successful garden-path resolution is working memory capacity, which refers to the capacity to briefly hold information in memory while continuing to process new information. Working memory has been found to play an important role in processing a variety of complex sentence structures, including garden-path sentences (Friederici et al., 1998; Johnson et al., 2016; O'Rourke, 2013; Otten and Van Berkum, 2009; Vos and Friederici, 2003; Vos et al., 2001). In an ERP study, Vos and Friederici (2003) examined brain responses to German sentences with subject-first and object-first word orders such as (13). Because these sentences are initially ambiguous between subject-first and object-first structures and the parser tends to prefer a subject-first analysis, the disambiguating auxiliary at the end of the sentence might cause garden-path in the object-first condition (at *haben* in 13b). The authors also measured participants' working memory span via a Reading Span task (Daneman and Carpenter, 1980) and formed a high-span group and a low-span group.

(13a) Subject-first:

*Er erfuhr, daß es die Schauspielerin war, die die Regisseurinnen abgelenkt* ***hat****.*

He found out, that it was the actress, who the producers distracted has.

“He found out that it was the actress who distracted the producers.”

(13b) Object-first:

*Er erfuhr, daß es die Schauspielerin war, die die Regisseurinnen abgelenkt* ***haben***.

He found out, that it was the actress, who the producers distracted have.

“He found out that it was the actress who the producers distracted.”

Vos and Friederici found a greater P600 at the final auxiliary for object-first sentences compared to subject-first sentences, reflecting syntactic reanalysis due to a garden-path in the object-first condition. However, this P600 effect was only present for the high-span participants, not for the low-span participants. The authors interpreted this pattern to reflect that high-span speakers might be more efficient parsers, adopting only one active analysis and possessing sufficient resources for reanalysis, while low-span speakers might not focus on one particular structural analysis nor possess enough resources for reanalysis, leading to null results for the garden-path.

However, other studies have not consistently found straightforward relations between working memory capacity and garden-path sentence processing. For example, O’Rourke and Colflesh (2014) found that the P600 effect yielded by garden-path sentences was modulated by the scores from an N-back Lure task (Kane, Conway, Miura and Colflesh, 2007) which measures the ability to resolve conflicting information, rather than scores from span tasks. The authors suggested that, while this doesn’t contradict previous accounts of garden-path resolution and working memory, their results show that successful reanalysis of garden-path sentences might

specifically call for domain-general conflict resolution abilities, more so than simply working memory capacity as measured by span tasks (O'Rourke and Colflesh, 2014; Novick, Hussey, Teubner-Rhodes, Harbison, and Bunting, 2014).

Furthermore, as regards predictive processing, studies in the ERP literature have not consistently found relations between working memory and prediction. In a study testing for lexico-semantic prediction by examining responses to gender-marked prenominal determiners in Dutch (discussed in the previous section), Otten and Van Berkum (2009) additionally tested working memory capacity of their participants. Somewhat surprisingly, there was no relation between working memory capacity and the N400 effect observed for the prediction-inconsistent vs. prediction-consistent determiner, suggesting that participants were able to anticipate highly specific information about the critical word regardless of their working memory.

In addition to non-linguistic cognitive abilities, linguistic skills such as receptive vocabulary have also been argued to be an important source of individual variability in sentence processing. No ERP study to my knowledge has reported a relationship between vocabulary and predictive processing, but there is some evidence in the psycholinguistic literature which suggests that greater vocabulary leads to more successful sentence processing and comprehension. This has been demonstrated for the prediction of verb arguments (Borovsky et al., 2012), as well as in studies examining the comprehendion of sentences with complex structures (Van Dyke et al., 2014). For instance, Van Dyke et al. examined individual differences in comprehending sentences involving long-distance dependencies in the presence of memory interference. Participants would see a memory list such as *table-sink-truck*, then read sentences such as *It was the boat / that the guy / who lived / by the sea / _ fixed / in two sunny days* while their reading times for each segment were recorded, and then recall the memory list and respond

to a comprehension question about the sentence they just read. Van Dyke et al. also comprehensively measured a battery of individual abilities, ranging from print mapping, reading skills, oral language use, memory, and intelligence. They found that participants' reading times in the region that should be affected by interference was best predicted by their receptive vocabulary score, rather than working memory. Van Dyke et al. thus suggested that high-quality lexical representation in long-term memory might contribute to successful comprehension, in this case, successful processing of the object position of *fixed*, which is filled with a noun phrase from earlier in the sentence, despite the presence of similar noun phrases presented as words in the recall task, and that vocabulary might outweigh working memory capacity in modulating sentence comprehension in this case. Thus, it is crucial to test not only cognitive abilities such as working memory but also linguistic abilities such as vocabulary to comprehensively account for potential sources of variability. The current study follows this methodology.

**Processing of Head-final Relative Clauses**

The test case for incrementality in this dissertation is Mandarin relative clauses, a head-final structure that is only unambiguously marked towards the end of the clause. This section thus lays out the background research on head-final structures and reviews in detail previous studies examining head-final relative clauses in Japanese and Chinese.

In the sentence processing literature, head-final structures in general have been studied as an intriguing testing ground for theories about sentence parsing. As discussed in the previous section, recent developments in this literature have increasingly recognized incrementality as an important feature of human sentence parsing. The parser is considered to be able to engage in some amount of prediction in order to achieve incrementality, actively projecting upcoming speech and even more abstract information such as phrase structure (Crocker, 1994; Lombardo

and Sturt, 2002; Sturt & Crocker, 1996). On the other hand, a different camp has put forth parsing theories that do not assume a fully incremental parser. This camp argues that parsing relies heavily on encountering bottom-up information that directly influences structure-building processes, such as head-driven processing models (e.g., Abney, 1989; Garnsey, Pearlmutter, Meyers, and Lotocky, 1997; Boland, Tanenhaus, and Garnsey, 1990; Trueswell, Tanenhaus, and Kello, 1993).

Head-final structures thus offer an attractive testing ground to empirically examine claims from these theories which would make opposing predictions about the extent to which head-final structures are processed incrementally. If parsing must rely on crucial bottom-up information stored in phrasal heads, as argued by head-driven processing models, then head-final structures should show major processing delay due to the late occurrence of the important phrasal head. However, if head-final structures can also be processed in a somewhat predictive manner, then the parser should be able to utilize existing information when available, to project upcoming structure before even encountering the phrasal head, which would provide convincing evidence that incrementality even extends to head-final constructions.

The potential role of prediction in facilitating the incremental processing of head-final structures was examined in psycholinguistic studies by Yoshida (2006) and Hsu (2006). Both studies include examination of whether head-final relative clauses (in Japanese and Mandarin, respectively) could be parsed in an incremental fashion by utilizing local linguistic cues to pre-assemble upcoming relative clause structures before encountering the relative clause head.

Japanese is a predominantly head-final language in which relative clauses have been widely known to cause garden-path effects (Inoue, 1991; Miyamoto, 2002, 2003; Yamashita, 1995). (14) is an example of a Japanese relative clause. Given that there is a dative marked

object, the parser most likely assumes the first three noun phrases as arguments in the same clause with a dative verb such as “gave”. However, when *tabeta* “ate” is encountered, the parser realizes that “ate” is not a dative verb as predicted. This might make the parser realize it is necessary to reanalyze away from this initial assumption about the structure and experience a garden-path (Inoue, 1991).

| | | | | | | |
|---|---|---|---|---|---|---|
| (14) | *Brown-ga* | *White-ni* | *ringo-o* | *tabeta* | *inu-o* | *ageta*. |
| | Brown-NOM | White-DAT | apple-ACC | ate | dog-ACC | gave |

“Brown gave White the dog which ate the apple.”

Yoshida (2006) took advantage of Japanese relative clause structure as a test case for examining whether incremental processing is possible for head-final structures, and whether the parser would be able to incrementally project Japanese relative clause structures using local linguistic cues before bottom-up information confirms such a structure is present (such as verb properties that would only be possible in relative clauses, or the head noun following the verb). Yoshida proposed that it is possible that the left edge of Japanese relative clauses can be indicated by classifiers. In languages like Japanese and Mandarin, classifiers are a type of words that are used to categorize nouns into semantic classes and typically appear between numerals and the head noun. While there has been argument about the exact nature of classifier-noun relations, it is widely recognized that the classifier and the noun must match in semantic class, and that a classifier cannot be associated with a noun that does not match the classifier’s selectional properties (Erbaugh, 2004; Matsumoto, 1993). For example, (15) shows that the classifier *satsu*, which selects for printed matter, should only combine with nouns belonging to

this specific category (such as “books”) but cannot combine with nouns outside the category (such as “students”, which would need a different classifier).

(15) *san-satsu-no* *hon* / **gakusee*

three-classifier(printed matter) book / *student

“three books” / “three students”

As for how classifiers might indicate the left edge of head-final relative clauses, Yoshida gave an example such as (16), where the classifier *satsu* must be unambiguously associated with the relative head NP *hon* “book”. Although there is an NP, *gakusee* “student” adjacent to the classifier, it cannot be associated with the classifier due to the incongruity between the semantic class selected by the classifier (printed matter) and *gakusee* “student”. Crucially, Yoshida pointed out that when the classifier mismatches with an adjacent nominative NP, a Japanese speaker might realize that it signals an upcoming noun phrase that matches with the classifier (*hon* “book”), which needs to be introduced via a relative clause. Thus, encountering an apparent classifier-noun mismatch might serve as a cue for the parser to predict an upcoming relative clause in Japanese.

(16) *3-satsu-no* *gakusee-ga* *yonda* *hon*

3-classifier(printed matter) student-Nom read book

“three books that the student read”

In a self-paced reading experiment, Yoshida examined whether the parser indeed uses the classifier-noun mismatch as a cue to pre-assemble head-final relative clause structures in Japanese. The experiment included two target conditions: a Classifier Match condition where the classifier matches with the immediately adjacent noun (17a, *san-nin-no tosioita sensee-ga* “three

aged teachers"), and a Classifier Mismatch condition where the classifier mismatches with the adjacent noun (17b, *san-satsu-no tosioita sensee-ga*). Upon encountering the noun *sensee-ga* "teachers", for the Classifier Match condition, Japanese native speakers might bias towards treating "three aged teachers" as the subject noun phrase of a complementizer phrase. Thus, when they realize that the sentence wraps up with a relative clause instead, as indicated by the bare embedded verb *okutta* "gave" followed by the head noun *hon-o* "book", the parser would be garden-pathed as the previously encountered sequence must be reanalyzed as a part of a relative clause. In contrast, in the Classifier Mismatch condition (17b), the parser may notice the apparent semantic mismatch between the numeral-classifier sequence *san-satsu-no* and *sensee-ga* "teachers", and thus abandon an analysis that tries to link the two elements as a noun phrase. As discussed above, the parser might instead realize that the classifier *satsu* must eventually be linked with a matching noun later in the sentence, such that a relative clause structure must be present to introduce the matching noun.

(17a) Classifier Match Condition

| | | | | | | |
|---|---|---|---|---|---|---|
| *Tannin-wa* | *san-**nin**-no* | | *tosioita* | *sensee-ga* | *atarasii* | *koochoo-ni* |
| Class-teacher-Top | three-cl(human)-Gen | | aged | teacher-Nom | new president-Dat | |
| *yorokonde* | ***okutta*** | *hon-o* | *aru-seeto-ni* | *kyoositu-de* | *yomase-masita.* | |
| gladly | **gave** | book-Acc | a-student-Dat | classroom-at | made-read. | |

"The teacher made a student read the book that three aged teachers gladly gave to the new president at the classroom."

(17b) Classifier Mismatch Condition

| | | | | | |
|---|---|---|---|---|---|
| *Tannin-wa* | *san-**satsu**-no* | *tosioita* | *sensee-ga* | *atarasii koochoo-ni* | |
| Class-teacher-Top | three-cl(book)-Gen | aged | teacher-Nom | new president-Dat | |
| *yorokonde* | ***okutta*** | *hon-o* | *aru-seeto-ni* | *kyoositu-de* | *yomase-masita* |
| gladly | **gave** | book-Acc | a-student-Dat | classroom-at | made-read. |

"The teacher made a student read three books that an aged teacher gladly gave to the new president at the classroom."

Thus, it is possible that the classifier-noun mismatch may facilitate the parser to predict the upcoming relative clause. If the parser indeed uses classifier-noun mismatch as a cue to project relative clause structures, the garden-path effect at the bare embedded verb *okutta* "gave" should be alleviated, leading to a shorter reading time around this region, compared to (17a) where no such cue is present.

Yoshida's results confirmed these hypotheses. At the embedded subject noun (*sensee-ga* "teacher") there was a slowdown in the Classifier Mismatch condition, indicating the parser detected the semantic incompatibility between the classifier and the noun. However, at the region marking the relative clause (the embedded bare verb *okutta*), the Classifier Mismatch condition was read faster than the Classifier Match condition. Yoshida's findings suggest that classifier-noun mismatch may be utilized to facilitate the construction of a relative clause in Japanese even before any unambiguous evidence for the relative clause is encountered in the bottom-up input. This finding is consistent with the predictions of sentence processing models arguing for strong incrementality, which is achieved in head-final structures with aid from a predictive mechanism allowing for the anticipation of upcoming structure based on local linguistic cues.

**Processing Mandarin Relative Clauses: Behavioral evidence**

Studies on relative clause prediction in Mandarin, however, have painted a more complex picture. Mandarin relative clauses are all marked with *de*, which comes between the modification and the head noun of the relative clause. Consider a Mandarin noun phrase such as (18) which includes a relative clause. It begins with a noun phrase with no case marking and a verb (*jushi zazhong* "boulder hit"), followed by the relative clause marker and the head noun modified by the relative clause (*jizhe* "journalist").

| | | | | |
|---|---|---|---|---|
| (18) | *jushi* | *zazhong* | ***de*** | *jizhe* |
| | boulder | hit | RC marker | journalist |

"the journalist that the boulder hit" (adapted from Wu et al., 2009)

It has been shown that Mandarin relative clauses (with the exception of subject-extracted relative clauses) are also prone to garden-paths (Lin, 2008; Xiang, 2017), as the unambiguous marker of the structure only appears at the end of the clause. When processing a relative clause like (18) in real time, the parser might start with the simplest analysis of the structure, thinking it might be a main clause about the boulder hitting something. However, once *de* is encountered, the parser would have to reanalyze the structure as a relative clause, yielding a garden-path around *de*. Therefore, the same question arises regarding Mandarin relative clauses: is it possible for the parser to incrementally process the structure, and if so, what information might facilitate the pre-assembly of the relative clause before encountering the relative clause marker *de*?

A series of studies by Wu and colleagues examined whether classifier-noun mismatch would serve as a cue for the parser to predict relative clauses in Mandarin (Wu et al., 2009, 2014, 2017). In a self-paced reading study, Wu et al. (2009) compared the processing at the relative clause marker *de* when the sentence includes no classifier (19a) or a classifier-noun sequence

(19b) before the relative clause marker *de*. Crucially, the classifier condition includes an apparent mismatch between the classifier *wei* and the immediately adjacent noun *jushi* "boulder". This might provide a cue for the parser that a matching noun that is consistent with the selection criteria of the classifier must appear later, which can only be achieved by positing a relative clause structure in Mandarin. Thus, if the parser can utilize this cue, a relative clause structure will have been posited before even encountering *de* in (19b); in contrast, the parser would not have any reason to predict a relative clause structure in (19a) since there is no classifier nor mismatch information to indicate the presence of the complex structure; this would lead to a garden-path effect at the relative clause. If a relative clause has been predicted in the Classifier condition (19b), this condition should show a faster reading time upon encountering the relative clause marker *de*, reflecting the reduced garden-path effect, compared to the No classifier condition (19a).

(19a) No classifier condition

| *Jushi* | *zazhong* ***de*** | *jizhe* | *jingtide* | *huangu* | *sizhou.* |
|---|---|---|---|---|---|
| boulder hit | RC marker | journalist | cautiously | look-about | surroundings |

"The journalist that the boulder hit looked about his surroundings cautiously."

(19b) Classifier condition

| *Na-wei* | *jushi* | *zazhong* | ***de*** | *jizhe* | *jingtide* | *huangu* | *sizhou.* |
|---|---|---|---|---|---|---|---|
| that-CL(human) | boulder | hit | DE | journalist | cautiously | look-about | surroundings |

"The journalist that the boulder hit looked about his surroundings cautiously."

Wu et al.'s results indeed showed this pattern. At the adverb (*jingtide* "cautiously"), which they treated as a spillover region for *de*, the Classifier condition (19b) showed a faster reading time compared to the same region in the No classifier condition (19a). These findings suggest facilitation from the classifier-noun mismatch for processing relative clauses. Wu et al. also found that the Classifier condition (19b) showed a slowdown at the embedded verb *zazhong* "hit", which they treated as a spillover region for the classifier, possibly reflecting an initial disruption caused by the classifier-noun mismatch.

However, the facilitation effect instantiated by classifier-noun mismatch has not been consistently found across studies. Hsu (2006) examined whether relative clause prediction is possible if the parser is provided with an initial classifier-noun mismatch in Mandarin Chinese (Hsu, 2006, Chapter 3). Hsu also adopted a design where two crucial conditions are included (see example 20 below): a Classifier Match condition (20a) where the classifier *wei* (person) matches with the adjacent noun phrase *yonggongde xuesheng* "diligent student", and a Classifier Mismatch condition (20b) where the classifier *pian* (article) mismatches with the adjacent noun phrase *yonggongde xuesheng* "diligent student". Both conditions include a relative clause that is unambiguously marked by *de*, the relative clause marker in Mandarin. Again, the classifier mismatch might serve as a cue for the parser to pre-construct the relative clause, because the only way to resolve the mismatch in Mandarin is to have a relative clause that eventually introduces a matching noun (*wenzhang* "article"). Hsu predicted that, if classifier-noun mismatch could facilitate the parser to predict the upcoming relative clause, then the relative clause marker *de* should show a shorter reading time compared to (20a) where no cue for the relative clause is present.

(20a) Classifier Match condition

*Laoshi caixiang* *na-si-wei* *yonggongde* *xuesheng* *zaoshang* *zai*

Teacher guess that-4-CL(person) diligent student morning at

*xuexiao-de* *tushuguanli* *shouji-de* *wenzhang* *yinggaidui* *jiaoxueyoubangzhu*

school-POSS library-in collect-RC marker article should to teaching helpful

'The teacher thinks that the articles that the four diligent students collected carefully in the school's library this morning should be helpful for teaching.'

(20b) Classifier Mismatch condition

*Laoshi caixiang* *na-si-pian* *yonggongde* *xuesheng* *zaoshang* *zai*

Teacher guess that-4-CL(article) diligent student morning at

*xuexiao-de* *tushuguanli* *shouji-de* *wenzhang* *yinggaidui* *jiaoxueyoubangzhu*

school-POSS library-in collect-RC marker article should to teaching helpful

'The teacher thinks that the articles that the four diligent students collected carefully in the school's library this morning should be helpful for teaching.'

However, Hsu's results showed a different pattern. At the noun itself (*xuesheng* "student"), reading times slowed down in classifier mismatch (20b) compared to classifier match (20a). At the relative clause, the classifier mismatch condition also showed a slowdown compared to the classifier match condition, suggesting that classifier-noun mismatch did not facilitate the parser to predict the relative clause. Given this apparently different finding from those reported for Japanese in Yoshida (2006), Hsu argued that it might be due to linguistic differences between Japanese and Mandarin in the case marking on nouns. In Yoshida's study on

Japanese, the classifiers are marked with genitive case (*-no*), making a relative clause the only possible structure to follow, whereas Mandarin does not case-mark classifiers nor nouns and allows for dropping the adjacent noun when the conversational context allows. This flexibility might have led to the parser not using classifier-noun relations robustly to predict relative clauses in Mandarin.

Hsu further pointed out a concern in her experiments, which is that the relative clauses were not presented with any context that makes the use of these structures felicitous. As argued by previous work (Crain and Steedman, 1985; Wu, Haskell, and Andersen, 2006), relative clauses are usually taken to imply that there is a set of objects that share some properties, such that some form of noun modification is necessary to narrow down the intended object(s) within the set. When no context is available to provide information about the set, it is possible that the lack of felicitous context prevents the parser from considering a relative clause as an option, thus weakening any effects from structural cues such as classifier-noun mismatch. To verify these hypotheses, Hsu conducted follow-up experiments where the target sentences were preceded by a lead-in sentence. The lead-in sentence introduced either two referents that are consistent with the head noun of the relative clause (e.g., two articles), which makes using relative clauses more felicitous, or only one referent that is consistent with the head noun of the relative clause (e.g., one article and one book). Results from the follow-up study showed that the facilitation from the cue of a mismatching classifier is found only in the 2-referent context, but not in the 1-referent context. Hsu thus argued that classifier-noun mismatch might be able to facilitate the parser to predict relative clauses in Mandarin, but only in contexts where the use of relative clauses themselves is pragmatically appropriate.

**Processing Mandarin Relative Clauses: Electrophysiological evidence**

To my knowledge, there has only been one study that examined Mandarin relative clause prediction via electroencephalography (EEG). Hsu and colleagues (2014) used EEG to examine whether predictive processing of Mandarin relative clauses is facilitated by classifier-noun mismatch (see also Chen, Xu, Tan, Zhang, and Zhong, 2013, for an ERP study involving Mandarin relative clauses preceded by classifier-noun mismatches in a different paradigm). Hsu et al. compared the processing of a relative clause when it is preceded by a classifier-noun mismatch as a predictive cue (21b), versus when no such cue is present (21a). As discussed above, the mismatch between the classifier *ke* (selecting for trees) and the noun *linju* "neighbor" in (21a) is argued to lead the parser to adopt a relative clause analysis from the beginning, compared to (21b) where the match between *wei* and *linju* might lead the parser to wrongly pursue a main clause analysis. Thus, they predicted that the mismatch in (21a) may initially appear anomalous by the parser, yielding a greater N400 at *lingju* "neighbor" reflecting that the noun is semantically incompatible with the classifier *ke*. However, if the classifier-noun mismatch facilitates pre-constructing the relative clause, the garden-path at *de* should be reduced in the Classifier-noun mismatch condition (21a); as discussed above, garden-paths commonly yield large P600 in ERP studies, thus (21a) should yield a smaller P600 at *de* compared to (21b), if the classifier-noun mismatch is indeed an effective cue for relative clauses.

(21a) Classifier-noun mismatch (labeled as "Match-long" condition in Hsu et al., 2014):

| *yi-**ke*** | *linju* | *zhong* | ***de*** | *shu* | *jie-le* | *guozi* |
|---|---|---|---|---|---|---|
| one-classifier(tree) | neighbor | plant | RC marker | tree | bore | fruit |

"A tree that a neighbor planted bore some fruits."

(21b) Classifier-noun match (labeled as "Match-short" condition in Hsu et al., 2014)

| *yi-**wei*** | *linju* | *zhong* | ***de*** | *shu* | *jie-le* | *guozi* |
|---|---|---|---|---|---|---|
| one-classifier(person) | neighbor | plant | RC marker | tree | bore | fruit |

"A tree that a neighbor planted bore some fruits."

However, Hsu et al. instead found larger negative-going waveforms, which are different from N400 or P600, at both positions in (21a) compared to (21b). They interpreted the unusual pattern as reflecting increased working memory load at the mismatch due to trying to process a semantic mismatch and a structural cue and expecting a matching noun to resolve the mismatch at the relative clause marker. The authors further suggested that the impact of classifier-noun mismatch on relative clause prediction might be rather limited, potentially because it is a very indirect cue for positing a complex structure such as a relative clause.

Overall, the literature on relative clause prediction on Mandarin has generated mixed findings regarding the extent to which relative clause prediction can be initiated by classifier-noun mismatch, suggesting that classifier-noun mismatch may not serve as a robust cue for Mandarin relative clause prediction. There are a few factors tied to the classifier-noun relation itself that might contribute to classifier-noun mismatch being a relatively weak cue. While a range of studies, including Hsu et al. (2013) have shown that mismatches between classifiers and nouns are detected during processing (Bi, Yu, Geng, and Alario, 2010; Chou, Lee, Hung, and Chen, 2012; Huettig, Chen, Bowerman, and Majid, 2010; Tsai, Hsu, Yang, and Chen, 2008; Zhang, Zhang, and Min, 2012; Zhou et al., 2010), it does not guarantee that these mismatches provide an unambiguous cue so that the parser should reanalyze away from combining the classifier and noun, in favor of a relative clause structure. Overall, the relation between classifier and noun in Mandarin is very flexible, with different classifiers varying in how constraining they are with respect to the nouns they select for. Some classifiers have been argued to function

similar to grammatical markers, selecting for nouns that do not seem to share any obvious semantic features, while other classifiers are very strict with regard to the semantic features that the nouns must possess. For example, while the classifier *ke* in (21a) only selects for plants, another common classifier *ge* select for a wide range of objects (person, building, car, abstract entities, etc.), functioning as a generic classifier for nouns that do not have a prototypical classifier.

In addition, even for classifiers that do select for nouns based on more obvious semantic features, the specific semantic features that each of them selects for are not clear-cut and native speakers might attempt to accommodate unusual classifier-noun combinations. For example, a study by Tsang and Chambers (2011) showed that even shape classifiers have a rather loose restriction on the nouns they can select for. For example, their participants were presented with a classifier (*tiu*, for long, lean objects) and pictures of three objects (a scarf, a flag, and a key), and were asked to rank the compatibility of the three objects with the classifier. They found that, although typically only one of the objects should be allowed for each classifier (the scarf in this case), participants chose another feature-matching object (the flag) equally frequently. Therefore, the parser may sometimes attempt to accommodate an unexpected classifier-noun combination, rather than abandon their linking and instead predict RC structure. Overall, these mixed findings suggest that classifier-noun mismatch may not be a robust enough cue for structural prediction in Mandarin. Therefore, the present study examines whether tense mismatch, a different cue and potentially a more unambiguous signal for the need to predict an RC to resolve the mismatch, would lead the parser to posit an RC structure.

**Temporal Relations in Mandarin**

In Mandarin, there are several temporal markers around the verb that typically refer to absolute time (Lu and Ma, 2003). These markers come in two broad types, namely pre-verbal temporal adverbs (such as *cengjing* and *jiangyao* in 22a-b), and post-verbal aspect markers (such as *-guo* and *-le* in 22c-d) which attach to the verb similar to a suffix. When used in sentences, temporal markers must match with the temporal reference of the time frame in the same clause (e.g. *shangzhou* "last week" – *cengjing* "used to").

(22a) *Shangzhou* *xiaozhang* *cengjing* *chuxi* *huiyi*

Last week chancellor used to attend conference

"Last week the chancellor attended a conference."

(22b) *Xiazhou* *xiaozhang* *jiangyao* *chuxi* *huiyi*

Next week chancellor will/would attend conference

"Next week the chancellor will attend a conference."

(22c) *Shangzhou* *xiaozhang* *chuxi-guo* *huiyi*

Last week chancellor attend-ASP-exp conference

"Last week the chancellor attended a conference."

(22d) *Shangzhou* *xiaozhang* *chuxi-le* *huiyi*

Last week chancellor attend-ASP-perf conference

"Last week the chancellor attended a conference."

There are a few important points to note about Mandarin temporal markers. First, while the past temporal adverb *cengjing* only refers to absolute past, the future temporal adverb *jiangyao* is more flexible in that it can refer to relative future and can double as a modal verb

indexing intentions. For example, (23a) shows an example of *jiangyao* referring to relative future, and (23b) *jiangyao* serving as a modal. In contrast, *cengjing* cannot refer to relative past.

(23a) *Ta* *jiangyao* *chufa* *shi* *turan* *zhaobudao* *jipiao* *le*
He will/would depart time suddenly can't find flight ticket ASP
"He suddenly can't find his flight tickets when he was about to head out."

(23b) *Biye-hou* *ta* *jiangyao* *chuangye*
Graduation-after he will/would start a business
"After graduation, he plans to start his own business."

Second, the two aspect markers, *-guo* and *-le*, have subtle differences although they can both refer to completed events. *-guo* typically refers to completed events; scholars have considered it to be an experiential aspect marker that emphasizes that the agent has experienced the verb event and the event has ended (J.-W. Lin, 2003). In contrast, *-le* can refer to both completed and uncompleted events, and is argued to be a perfective marker that indicates bounded events, including events that have begun but not yet ended, events that have begun and ended, and events that have not begun but are very likely to happen. For example, *-le* can also be used in scenarios as in (24a), while this sentence with *-guo* is unacceptable (24b).

(24a) *Mingtian* *yao* *xia-yu* *le*
Tomorrow will rain ASP
"It will rain tomorrow." (Implication: The likelihood of rain tomorrow is very high)

(24b) **Mingtian* *yao* *xia-yu* *guo*
Tomorrow will rain ASP
"It will rain tomorrow." (Implication: The likelihood of rain tomorrow is very high)

The distinction between temporal adverbs and aspect markers has long been discussed in the theoretical literature on Chinese languages (Lü, 1990; Ma and Wang, 2004). Temporal adverbs such as *cengjing* "used to" are argued to represent temporal information via lexical semantics, as they are less grammaticalized and can refer to absolute time beyond the verbal domain. For example, *cengjing* can function as an adjective (*cengjing de laoshi* "a former teacher"). In contrast, aspect markers such as *-guo* are considered to embody temporal information via morphosyntax, as they are highly grammaticalized and strongly bound to the verb as a suffix (Shi and Li, 2001).

**Processing Temporal Relations in Mandarin**

There have been a few processing studies showing that temporal mismatches are robustly detected in online comprehension (Collart and Chan, 2020; Qiu and Zhou, 2012; see also Zhang and Zhang, 2008, for a study on mismatches in the aspect domain), and only one ERP study to our knowledge that explicitly examines the processing temporal mismatches involving different types of markers (Qiu and Zhou, 2012).

Qiu and Zhou (2012) examined temporal processing by testing temporal mismatches involving both temporal adverbs and aspect markers as compared to temporal match sentences. Building upon the theoretical distinction between temporal adverbs and aspect markers, Qiu and Zhou (2012) hypothesized that the processing of temporal markers might reflect their distinct representation of temporal information as argued in the theoretical literature. Specifically, they predicted that temporal mismatch involving temporal adverbs should yield N400, reflecting the lexical semantic nature of this mismatch, possibly followed by a P600 which is commonly observed after N400. In contrast, temporal mismatch involving aspect markers should yield greater P600, reflecting it being a morphosyntactic mismatch.

Qiu and Zhou conducted two sentence acceptability judgment experiments in which participants read sentences presented segment-by-segment and judged whether each sentence was acceptable by pressing “yes” or “no” after each sentence. In their Experiment 1, Qiu and Zhou (2012) included three temporal markers, including two temporal adverbs (*cengjing*, “used to” and *jiangyao* “will”, 25-26) and one aspect marker (*-guo*, 27). They compared ERPs at the temporal marker in the temporal mismatch sentences versus the respective match sentences (25a vs. 25b, 26a vs. 26b, 27a vs. 27b). They observed a significant P600 effect in response to temporal mismatches involving the future adverb *jiangyao*, the past adverb *cengjing*, and the aspect marker *-guo*.

| | | | | | | |
|---|---|---|---|---|---|---|
| (25a) | *Xiageyue* | *lianheguo* | ***jiangyao*** | *paichu* | *tebie* | *diaochazu* |
| | Next month | UN | **will** | dispatch | special | investigation team |
| | “Next month the United Nations will dispatch a special investigation team.” | | | | | |
| (25b) | **Shanggeyue* | *lianheguo* | ***jiangyao*** | *paichu* | *tebie* | *diaochazu* |
| | Last month | UN | **will** | dispatch | special | investigation team |
| | “Last month the United Nations will dispatch a special investigation team.” | | | | | |
| (26a) | *Shanggeyue* | *lianheguo* | ***cengjing*** | *paichu* | *tebie* | *diaochazu* |
| | Last month | UN | **used to** | dispatch | special | investigation team |
| | “Last month the United Nations dispatched a special investigation team.” | | | | | |
| (26b) | **Xiageyue* | *lianheguo* | ***cengjing*** | *paichu* | *tebie* | *diaochazu* |
| | Last month | UN | **used to** | dispatch | special | investigation team |
| | “Next month the United Nations dispatched a special investigation team.” | | | | | |
| (27a) | *Shanggeyue* | *lianheguo* | *paichu-**guo*** | *tebie* | *diaochazu* | |
| | Last month | UN | dispatch-ASP | special | investigation team | |

"Last month the United Nations dispatched a special investigation team."

| | | | | | |
|---|---|---|---|---|---|
| (27b) | **Xiageyue* | *lianheguo* | *paichu-**guo*** | *tebie* | *diaochazu* |
| | Next month | UN | dispatch-ASP | special | investigation team |

"Next month the United Nations dispatched a special investigation team."

However, contrary to their predictions, only the mismatching future adverb elicited a reliable N400 effect, while the mismatching past adverb *cengjing* did not. Qiu and Zhou attributed this unexpected finding to the fact that their sentence stimuli mixed together a highly grammaticalized aspect marker and temporal adverbs. This might have made participants pay more attention to the adverbs' grammatical properties than to their lexical semantics, reducing potential N400 effects for *cengjing*. Moreover, the future adverb in Experiment 1 came in two variants (*jiangyao/jianghui*) to make sentences more natural, while the past adverb came in only one form (*cengjing*); they thus argued that these variations might have also confounded ERP responses to the past adverb.

Thus, Qiu and Zhou conducted a second experiment where they reduced the variation in stimuli to examine whether the past adverb would yield an N400 effect as predicted. Their Experiment 2 conditions only included one future adverb (*jiangyao*, 25a-b) and one past adverb (*cengjing*, 26a-b), and excluded the aspect marker *-guo*. This time, there was indeed greater N400 and P600 for temporal mismatches involving both adverbs compared to temporal match conditions. Taken together, Qiu and Zhou interpreted the distinct brain components elicited for temporal adverbs and the aspect marker *-guo* as confirming the theoretical distinction between these marker types, arguing that temporal mismatch is treated as a semantic anomaly when it involves temporal adverbs, as reflected by the N400 effect. On the other hand, temporal

mismatch is treated as a morphosyntactic violation when it involves aspect markers, as reflected by the P600 effect observed at *-guo*.

Taken together, the findings from Qiu and Zhou (2012) provide evidence that temporal mismatches in Mandarin are robustly detected by the parser during online processing, with mismatches involving the aspect marker yielding greater P600 and mismatches involving the temporal adverb yielding greater N400-P600. However, it is unclear to what degree Qiu and Zhou (2012)'s findings reflect the processing of temporal relations in more natural conditions as their target sentences containing temporal mismatches were always anomalous, such that detecting the temporal mismatch directly indicates whether the sentence was overall well-formed or not. Further examination is necessary to address this question.

Qiu and Zhou (2012)'s findings of distinct ERP components for the two types of temporal markers suggest that the processing of temporal mismatches in Mandarin might be impacted by the type of temporal markers involved. As they argued, the observation that adverb mismatches yielded greater N400-P600 while the aspect mismatch yielded greater P600 is consistent with the theoretical distinction that temporal adverbs encode temporal information via lexical-semantics, while aspects encode temporal information via morphosyntax. However, this argument raises several open questions. First, ERP responses to the two types of markers may not be as robustly distinct as the authors have argued. When tested in the *same* experiment (Experiment 1), the adverb mismatch involving *cengjing* "used to" did not elicit an N400 effect but only a P600, which is the response that was also elicited for the aspect mismatch; Qiu and Zhou's predicted N400-P600 effect at *cengjing* only appeared in their Experiment 2 that did not include aspect markers. This suggests that processing of temporal mismatches involving the

adverb *cengjing* may be variable and possibly influenced, for example, by aspects of the broader experimental context such as what other temporal markers are present.

In contrast, ERP responses to temporal mismatches involving the aspect marker *-guo* seem to reliably yield P600 effects, as also suggested by a recent study on processing aspect markers by Collart and Chan (2020). In their ERP study, Collart and Chan specifically examined the processing of two aspect markers, *-guo* and *-le*. They examined ERP responses to mismatches involving the two aspect markers as compared to their match counterparts (28a vs. 28b, 29a vs. 29b). Collart and Chan found an increased frontal negativity for mismatches involving *-le* and a greater P600 for mismatches involving *-guo* and argued that the different ERP responses reflect distinct mechanisms of time reference for the two aspect markers.

| | | | | |
|---|---|---|---|---|
| (28a) | *Yufu* | *zuotian* | *diao-le* | *guiyu* |
| | Fisherman | yesterday | fish-ASP | salmon |
| | "Yesterday, the fisherman fished salmons." | | | |
| (28b) | **Yufu* | *mingtian* | *diao-le* | *guiyu* |
| | Fisherman | yesterday | fish-ASP | salmon |
| | "Yesterday, the fisherman fished salmons." | | | |
| (29a) | *Yufu* | *zuotian* | *diao-guo* | *guiyu* |
| | Fisherman | yesterday | fish-ASP | salmon |
| | "Yesterday, the fisherman fished salmons." | | | |
| (29b) | **Yufu* | *mingtian* | *diao-guo* | *guiyu* |
| | Fisherman | yesterday | fish-ASP | salmon |
| | "Yesterday, the fisherman fished salmons." | | | |

Taken together, the literature on processing temporal relations in Mandarin has established that temporal mismatches are robustly detected by the parser in online processing, and that processing at the temporal mismatch might be impacted by the specific temporal marker involved. While temporal mismatches involving some markers such as *-guo* reliably elicited P600, temporal mismatches involving the temporal adverb *cengjing* elicited more variable ERP responses across experiments.

The overall finding of the parser's sensitivity to temporal mismatch holds important implications for the current study examining relative clause processing. Recall that the major goal of the current study is to examine the extent to which predictive processing of Mandarin relative clause structures may be facilitated by local linguistic cues. Building on the previous literature that has focused on testing one cue (classifier-noun mismatch), the current study examines temporal mismatches as a potentially robust cue for predicting relative clauses in Mandarin.

Temporal mismatch is a promising relative clause prediction cue to examine because it may provide a relatively unambiguous cue indicating the presence of a relative clause. When encountering a temporal mismatch such as *Xiageyue Lisi cengjing* "Next month Lisi used to", the parser might detect the incongruency between the future time reference and the past temporal adverb; unlike classifier-noun combinations, there appears to be little possibility of accommodating these incongruous time referents. Thus, it is possible that the parser will take temporal mismatch as a reliable cue to posit a relative clause structure. In addition, the only way to resolve this temporal mismatch in Mandarin is to posit a relative clause structure such as (30), where the relative clause introduces a matching tense (*jiangyao* "will") later in the sentence and globally resolves the initial mismatch between temporal expressions.

(30) *Xiageyue Lisi cengjing jieyue tushu de tushuguan jiangyao banzou*

Next month Lisi used to borrow book RC marker library will move

"Next month, the library where Lisi borrowed books will move away."

Note that our manipulation is similar to what has been tested in studies focusing on classifier-noun mismatches, where an apparent mismatch earlier in the sentence can be resolved globally by having the sentence continue with a relative clause. On the other hand, the current study differs from those studies in that we test whether a new and potentially strong cue, temporal mismatch, would facilitate predicting the relative clause.

By virtue of having temporal mismatches globally resolved by relative clauses, the current study is also able to address a major limitation in the studies on processing temporal relations themselves (Collart and Chan, 2020; Qiu and Zhou, 2012). That is, these studies have generally relied on a violation paradigm comparing simple, ill-formed temporal mismatch sentences with temporal match sentences, and thus may not reflect how temporal processing usually proceeds in more natural conditions. This limitation will be addressed in the present study which uses globally well-formed sentences like (30), where local temporal mismatches are ultimately resolved by posting the relative clause. Thus, another important question that the dissertation will address is how temporal mismatches are processed in overall well-formed sentences, and whether different types of markers are processed similarly or differently under these conditions.

## Chapter 3: Current Study

The current study examines the extent to which the parser can utilize local linguistic information to pre-assemble syntactic structures incrementally. The first research question is whether temporal mismatches would facilitate the prediction of upcoming relative clause structures in Mandarin. Building on previous studies on predicting head-final relative clauses, the current study utilizes constructions like (31) where a relative clause is preceded by either temporal match (30a, "last month … used to") or temporal mismatch (31b, "next month … used to"). Crucially, we predict that temporal mismatch (31b) would guide the parser to predict the relative clause, and thus reduce the garden-path effect at the relative clause marker *de*, compared to when a temporal match precedes the relative clause. In ERP, this would be reflected by reduced P600 amplitudes at *de* in the mismatch sentences where relative clause prediction is licensed by the mismatch cue, compared to the match sentences which do not have any cue for the relative clause.

(31a) *Tingshuo, shanggeyue Lisi cengjing jieyue tushu de tushuguan*
Seemingly last month Lisi used to borrow book RC marker library
*yijing banzou-le*
already move-perfective
"Seemingly, last month the library where Lisi borrowed books moved away."

(31b) *Tingshuo, xiageyue Lisi cengjing jieyue tushu de tushuguan*
Seemingly next month Lisi used to borrow book RC marker library
*jiangyao banzou*
will move
"Seemingly, next month the library where Lisi borrowed books will move away."

By examining temporal mismatch, the current study is able to address the open question regarding whether the parser is able to utilize local, indirect cues to predict a head-final structure such as a Mandarin relative clause before encountering any unambiguous marker of the structure. As discussed in the previous chapters, existing studies on Mandarin have manipulated the match/mismatch between classifiers and nouns as a potential predictive cue; however, studies have not consistently found classifier-noun mismatches to engender the prediction of relative clauses. As discussed in the literature review, a potential reason might be that relations between classifiers and nouns are flexible. Thus, an unusual classifier-noun combination may not reliably indicate that the parser needs to predict a complex structure such as a relative clause. We thus hypothesize that temporal mismatches might be a stronger violation and thus might serve as a reliable cue. Although the current study does not directly compare classifier-noun mismatches and temporal mismatches, we attempt to address this hypothesis by testing whether temporal mismatches, a new cue that has never been tested before to my knowledge, guide the prediction of relative clauses in Mandarin.

The second research question of the current study concerns how temporal mismatch itself is processed, including temporal mismatches involving two kinds of temporal markers. As discussed in the literature, Qiu and Zhou (2012) found that temporal mismatches involving temporal adverbs (such as *cengjing*) and aspect markers (such as *-guo*) yielded distinct ERP responses when these markers were tested in separately studies, and thus argued that temporal relations involving the two markers are processed differently. The current study examines this claim, including both the temporal adverb *cengjing* and the aspect marker *-guo* in the same experiment, allowing for direct comparisons between the two markers. By using sentences where relative clauses resolve local temporal mismatches, the current study is also able to examine the

processing of temporal mismatches in globally well-formed sentences and thus may better reflect the processing in globally well-formed sentences, potentially better capturing the processing of temporal relations during natural language comprehension. It is possible that we could observe increased N400-P600 for mismatches involving the temporal adverb and increased P600 for mismatches involving the aspect marker, which would be consistent with Qiu and Zhou (2012)'s characterization of processing for the two temporal markers. However, recall that the N400 effect for the adverb *cengjing* was only present in one of Qiu and Zhou's two experiments, suggesting that whether the N400 emerges for *cengjing* might be somewhat variable. It is also worth noting that it would not be fully straightforward to conclude from these distinct ERP patterns (N400-P600 versus P600 only), should they emerge, that adverb mismatch is necessarily processed as a semantic mismatch and aspect mismatch as a morphosyntactic mismatch. Recall that the literature has argued for broader interpretations for both N400 and P600 that do not always neatly align them with semantic and morphosyntactic processing, respectively (Bornkessel-Schlesewsky and Schlesewsky, 2008; Kim and Osterhout, 2005); in particular, P600 has been argued to be yielded in some contexts involving apparent semantic mismatches, as well as in contexts traditionally associated with P600 such as those involving syntactic revision or repair. Thus, an alternative outcome for the current study would be that P600 is yielded at mismatches involving both the temporal adverb and the aspect marker.

In addition, the current study also investigates to what extent the processing of temporal mismatches and the use of temporal mismatch to predict syntactic structures varies among individuals, and whether such variation is related to individual verbal and non-verbal cognitive abilities. We will examine this by including a battery of individual difference measures assessing vocabulary, and verbal and non-verbal working memory capacity for each individual.

We conducted three experiments: two offline experiments (Experiment 1 and 2) and one online, EEG experiment (Experiment 3). The first offline experiment was a naturalness rating experiment which examined whether our target sentences are considered natural by native speakers, and whether the perceived naturalness differs between temporal match and mismatch sentences. The second offline experiment was an offline fragment completion experiment which examined whether relative clauses are indeed the preferred continuation following temporal mismatches; in this task, we asked native speakers to complete fragments involving temporal mismatch and match to arrive at grammatical sentences. For the online experiment, we conducted an EEG study to examine whether temporal mismatches guide the prediction of relative clauses in real time, to examine the processing of temporal mismatches involving temporal adverbs and aspect markers, as well as to examine whether the ability to use temporal mismatch cues to engage in predictive processing is subject to individual differences in verbal and non-verbal cognitive abilities.

## Experiment 1: Naturalness Rating Experiment

The aim of the naturalness rating experiment is to examine whether temporal mismatch sentences and temporal match sentences are considered equally natural by native speakers. If they are deemed equally natural, we can then utilize these constructions to examine the effect of temporal match/mismatch on predicting relative clause online. This verifies that any apparent effect of prediction that may be found for the temporal mismatch sentences is not instead due to them being less natural than the match sentences.

### *Participants*

Sixty-four native speakers of Mandarin (21 males, mean age = 19.9, age range = 18 - 23) completed the naturalness rating experiment. They were recruited from the undergraduate

student population at Shanghai International Studies University and surrounding communities. Participants completed the experiment on the web via Qualtrics; they agreed to an online information statement at the beginning of the experiment, following human subject procedures approved by the University of Kansas Office of Research (STUDY00143249). Participants were rewarded a 35 Chinese Yuan Amazon China gift card upon completion of the study.

***Materials and Design***

Forty-eight (48) sets of target sentences were constructed. Each set includes 4 sentences, crossing the factors Match (Mismatch versus Match) and Marker (Temporal Adverb versus Aspect Marker). The targets were divided into four Latin-square lists with 12 targets per condition per list, such that a participant read sentences belonging to all four conditions but read exactly one sentence from the same set. Target sentences start with a lead-in (*tingshuo* "seemingly) and a time frame referring to either past or future (such as "last month" or "next month"). In the two Mismatch conditions (A and C), the time frame always refers to future in order to establish the local mismatch with the first temporal marker. This is followed by a name (*Lisi*) and a subordinate verb phrase (*jie shu* "to borrow books"), marked by either the temporal adverb (*cengjing* "used to", in A) or the aspect marker (*-guo*, in C). There is then a relative clause marker (*de*) across all four conditions, followed by the head noun of the relative clause (*tushuguan* "library"). The sentences then wrap up grammatically with the verb phrase in the main clause, whose temporal reference always matches with the time frame at the beginning by including either future temporal adverb (*jiangyao* or *jianghui*) or past temporal adverb (*yijing* "already"). Examples of target stimuli are provided in Table 1.

Table 1 Example sentences for target conditions in Experiment 1.

| | **Match** | **Marker** | **Sentence** | | | | |
|---|---|---|---|---|---|---|---|
| A | Mismatch | Temporal Adverb | *Tingshuo,* | *xiageyue* | *Lisi* | ***cengjing*** | *jieyue tushu* |
| | | | Seemingly | next month | Lisi | used to | borrow books |
| | | | *de* | *tushuguan* | *jiangyao* | *banzou* | |
| | | | RC marker | library | will | move | |
| | | | "Accordingly, next month the library where Lisi borrowed books will move away." | | | | |
| B | Match | Temporal Adverb | *Tingshuo,* | *shanggeyue* | *Lisi* | ***cengjing*** | *jieyue tushu* |
| | | | Seemingly, | last month | Lisi | used to | borrow book |
| | | | *de* | *tushuguan* | *yijing* | *banzou-le* | |
| | | | RC marker | library | already | move-perfective | |
| | | | "Seemingly, last month the library where Lisi borrowed books moved away." | | | | |
| C | Mismatch | Aspect Marker | *Tingshuo,* | *xiageyue* | *Lisi* | *jieyue-**guo*** | *tushu* |
| | | | Seemingly, | next month | Lisi | borrow-ASP | book |
| | | | *de* | *tushuguan* | *jiangyao* | *banzou* | |
| | | | RC marker | library | will | move | |
| | | | "Seemingly, next month the library where Lisi borrowed books will move away." | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| D | Match | Aspect Marker | *Tingshuo* Seemingly, | *Shanggeyue* last month | *Lisi* Lisi | *jieyue-**guo*** borrow-ASP | *tushu* book |
| | | | *de* RC marker | *tushuguan* library | *yijing* already | *banzou-le* move-perfective | |
| | | | "Seemingly, last month the library where Lisi borrowed books moved away." | | | | |

Each list also includes 48 well-formed filler sentences. 32 fillers are coordinate structures involving *bingqie* "and" or *danshi* "but" alternatively. They begin with a time frame referring to either future (n=16) or past (n=16), followed by a subject and a main verb phrase that always matches with the sentence-initial time frame. Among the past fillers, 8 mark the verb tense by the temporal adverb *cengjing* and 8 by the aspect marker *-guo*, in order to balance the distribution of the two markers. The remaining 16 include coordinate structures involving *yinwei* "because" and do not involve any temporal expressions or relative clause structures.

Additionally, each list includes 24 ill-formed fillers which are semantically incongruent sentences so that participants would encounter stimuli that allow them to use the full rating scale, as the target sentences were not designed to be anomalous.

These fillers have sentence frames that mimic the distribution of target conditions and well-formed fillers (12 target-like sentences and 16 filler-like sentences). See Table 2 for example filler stimuli.

Table 2 Examples of filler sentences.

| **Type** | **Sentence** | | | | |
|---|---|---|---|---|---|
| Future | *Tingshuo,* | *mingnian* | *Zhangsan* | *jiangyao* | *chuxi huiyi* |
| | Seemingly | next year | Zhangsan | will | attend meeting |
| | *bingqie* | *youkeneng* | *he tongshi* | *jucan* | |
| | and | possibly | with colleague | have meal | |
| | "Seemingly, next year Zhangsan will attend the meeting and possibly grab a meal with colleagues." | | | | |
| Past | *Tingshuo* | *shangzhou* | *zhe-pian di* | *cengjing* | *bei zhuanrang* |
| | Seemingly | last week | the lot | used to | was sold |
| | *danshi* | *maijia* | *bingmeiyou* | *donggong* | |
| | but | the buyer | had not | build | |
| | "Seemingly, Last week the lot was sold but the buyer hadn't built anything." | | | | |
| Coor-dinate | *Sushe-li* | *Xiaomei* | *buqingyuan-de* | *dasao-le* | *weishengjian* |
| | Dorm-in | Xiaomei | reluctantly | clean | bathroom |
| | *yinwei* | *shiyou-men* | *bu yuanyi* | *ganhuo* | |
| | because | roommates | do not want | *do chores* | |
| | "At the dorm, Xiaomei reluctantly cleaned the bathroom because her roommates did not want to do (house) chores." | | | | |
| Incon-gruent | *Tingshuo* | *xiageyue* | *Li dabo* | *cengjing* | *fangmu binggan* |
| | Seemingly | next month | Uncle Li | used to | herd cookies |
| | *de* | *caoyuan* | *jiangyao* | *yinglai yuji* | |
| | RC marker | grassland | will | enter monsoon | |

| | |
|---|---|
| | “Seemingly, next month the grassland where Uncle Li used to herd cookies will enter monsoon season.” |

***Task and Procedure***

Participants were instructed to rate the naturalness of each sentence on a 5-point Likert scale (1 = very unnatural, 5 = very natural). Each participant was randomly assigned to a list in which the 120 sentences were presented in fully randomized order. At the beginning of the experiment, participants completed a language background questionnaire and completed a practice session to get familiarized with the rating task. In the main experiment, sentences were presented on separate screens with a 5-point clickable scale for participants to rate naturalness. The experiment took about 30 minutes to complete.

***Results***

Data from N = 60 participants were carried forward for analyses; data from 4 additional participants were excluded because their mean rating for the ill-formed fillers was higher than 2.5. On average, all target sentences were rated as 3.59, while the well-formed fillers were rated 3.99 and ill-formed fillers 1.41. This suggests that target sentences were overall acceptable among native speakers.

The ratings were statistically analyzed via a series of cumulative link mixed-effect models using the *clmm* package in R and the *probit* link function. Model fitting was conducted in a top-down fashion. The initial model included Match, Marker, and Match x Marker as fixed factors, and Participant and Item as random intercepts. The initial model was then optimized by removing one fixed factor at a time, starting with the interaction term. Each fixed factor was tested for removal by comparing the initial model fit with a smaller model via log likelihood

ratio test. That is, if removing a factor significantly impaired model fit then it would be excluded, and if removing it did not impair the fit it would be retained. This procedure arrived at the final model which included only the intercept and the main effect of Marker ($\beta$ = 0.16, SE = 0.06, $z$ = 2.56, $p$ = 0.01); sentences with the Aspect Marker *-guo* (C and D) were rated higher than sentences with the Temporal Adverb *-cengjing* (A and B). Neither Match nor Match x Marker was included in the final model, showing that the ratings were similar between Match (A and C) and Mismatch sentences (B and D), and that the effect of Marker remained constant regardless of Match/Mismatch status. See Table 3 for descriptive statistics of the ratings.

To summarize, Experiment 1 showed that temporal mismatch and match sentences are considered equally natural; this crucially allows us to test temporal mismatch as a cue for relative clause prediction in the experiments below, as it establishes that temporal mismatch and naturalness are not confounded. Moreover, ratings for the target sentences across conditions establish that our items are overall considered acceptable by native speakers.

Table 3 Means and standard deviations of ratings for the target conditions in Experiment 1

| **Condition** | **Match** | **Marker** | **Mean rating (SD)** |
|---|---|---|---|
| A | Mismatch | Temporal adverb (*cengjing*) | 3.52 (1.51) |
| B | Match | | 3.54 (1.41) |
| C | Mismatch | Aspect marker (*-guo*) | 3.63 (1.44) |
| D | Match | | 3.68 (1.39) |

**Experiment 2: Offline Sentence Completion Experiment**

The purpose of the offline sentence completion experiment is to establish whether native Mandarin speakers indeed prefer relative clause continuations to sentences beginning with temporal mismatches. If participants indeed produce more relative clauses following fragments

that include temporal mismatch, this would provide crucial support for our hypothesis that temporal mismatch may provide a cue for predicting relative clauses online; we test this hypothesis directly in online Experiment 3 below.

***Participants***

Fifty-eight native speakers of Mandarin (16 males, mean age = 19.1, age range = 18 - 30) took part in the offline sentence completion experiment. They were recruited from the undergraduate student population at Fudan University and surrounding communities; none of the participants have taken part in Experiment 1.

Participants completed the experiment on the internet via Qualtrics. At the beginning of the experiment, participants provided their consent following an online information statement at the beginning of the experiment, following human subject procedures approved by the University of Kansas Office of Research (STUDY00143249). They were rewarded a 70 Chinese Yuan Amazon China gift card upon completion of the study.

***Materials and Design***

The fragment stimuli were created from the sentence stimuli in the rating experiment (Experiment 1); only the targets and well-formed fillers were included. Similar to the design of the rating experiment, 48 sets of target fragments were generated; each set includeed 4 fragments crossing the factors Match (Mismatch versus Match) and Marker (Temporal Adverb versus Aspect Marker). Targets were divided into 4 Latin-square lists with 12 targets per condition per list. Fragments were generated by cutting the rating targets right before the relative clause marker *de*. Thus, we expect the fragments to elicit continuations involving relative clause in the Mismatch conditions (A and C) in order to resolve the local temporal mismatch, but less so in the

Match conditions (B and D) because there is no mismatch to resolve. See Table 4 for examples of target fragments.

Table 4 Example of target fragments in Experiment 2.

| | **Match** | **Marker** | **Example** | | | | | |
|---|---|---|---|---|---|---|---|---|
| A | Mismatch | Temporal Adverb | *Tingshuo,* Seemingly, | *Xiageyue* Next month | *Lisi* Lisi | *cengjing* used to | *jie shu* borrow book | ... |
| B | Match | Temporal Adverb | *Tingshuo,* Seemingly, | *Shanggeyue* Last month | *Lisi* Lisi | *cengjing* used to | *jie shu* borrow book | ... |
| C | Mismatch | Aspect Marker | *Tingshuo,* Seemingly, | *Xiageyue* Next month | *Lisi* Lisi | *jie-guo* borrow-ASP | *shu* book | ... |
| D | Match | Aspect Marker | *Tingshuo,* Seemingly, | *Shanggeyue* Last month | *Lisi* Lisi | *jie-guo* borrow-ASP | *shu* book | ... |

Each list also includes 48 filler fragments that were held identical across the 4 lists. Similar to the fillers in the rating experiment, 32 filler fragments are coordinate structures involving *bingqie* “and” or *danshi* “but” alternatively, and begin with a time frame referring to either future (n=16) or past (n=16); the time expression always matched with the temporal marker on the main verb. The remaining 16 include coordinate structures involving *yinwei* “because” and do not involve any temporal expressions or relative clause structures. To generate filler fragments, each kind of fillers was cut off at one of the three positions: 6 were cut following the first verb phrase, 6 were cut following the conjunction word, and 4 were complete sentences. The aim of using different cut-off points is to mask the purpose of the experiment and to vary the level of complexity among all the items. See Table 5 for examples of filler fragments.

Table 5 Examples of filler fragments in Experiment 2.

| Type | Example sentence | | | | |
|---|---|---|---|---|---|
| Future | *Tingshuo,* | *mingnian* | *Zhangsan* | *jiangyao* | ... |
| | Seemingly | next year | Zhangsan | will | … |
| | "Seemingly, next year Zhangsan will …" | | | | |
| Past | *Tingshuo,* | *shangzhou* | *zhe-pian di* | *cengjing* | *bei zhuanrang* |
| | Seemingy | last week | the lot | used to | was sold |
| | *danshi* | ... | | | |
| | but | … | | | |
| | "Seemingly, Last week the lot was sold but ..." | | | | |
| Coor- | *Sushe-li,* | *Xiaomei* | *buqingyuan-de* | ... | |
| dinate | Dorm-in | Xiaomei | reluctantly | … | |
| | "At the dorm, Xiaomei reluctantly ..." | | | | |

***Task and Procedure***

Participants were randomly assigned to one of the 4 lists, which included a total of 96 items presented in a random order. At the beginning of the experiment, participants completed a language background questionnaire and completed a training session instructing them about the task. Participants were instructed to complete the fragments by typing continuations in the text box following each fragment; they were told that their continuations should ultimately constitute complete and well-formed sentences. They were also told that if a sentence appears to be already complete and well-formed without adding anything, they could type a period. Participants then practiced on 6 fragments involving a variety of sentence constructions that do not involve any

temporal expressions. Afterwards, participants started the main experiment, which took about an hour to complete.

***Coding Methods***

Completions were coded as either "relative clause" (1) or "other" (0). To account for variations in the responses, two coding methods (conservative coding and lenient coding) were adopted. Under the conservative coding, a completion was coded as "relative clause" only if it included an adjunct relative clause *and* a matching temporal marker after the relative clause similar to the target sentences in Experiment 3, and all other completions were coded as "other". Under the lenient coding, a completion was coded as "relative clause" as long as it included an adjunct relative clause, and all other completions were coded as "other".

Examples of coding under the two methods are included in Table 6, where continuation (a) is an example of a non-relative clause and thus coded as 0 under both coding methods, and (c) is an example of a relative clause and thus coded as 1 under both coding methods. Note that continuation (b) is an example that is coded as 0 under the conservative coding but as 1 under the lenient coding; this is because (b) only includes a relative clause but not a matching temporal marker towards the end of the sentence, thus meeting the criteria for a relative clause under the lenient coding but not under the conservative coding. Results from the two coding methods are reported separately below.

Table 6 Examples of coding for fragment completions in Experiment 2.

| **Fragment** | **Continuation** | **Conservative coding** | **Lenient coding** |
|---|---|---|---|
| *Tingshuo, xiageyue Lisi*<br>Seemingly next month Lisi | a) *danshi meiyou jiedao* | 0 | 0 |

| | | | |
|---|---|---|---|
| *cengjing jie-shu …*<br>used to borrow-book | but didn't borrow-resultative<br>"*Seemingly, next month Lisi borrowed books but didn't actually get them." | | |
| | b) *de difang meiyou-le*<br>RC marker place disappear<br>"Seemingly, next month the place where Lisi borrowed books (will) disappear." | 0 | 1 |
| | c) *de difang <u>jiangyao</u> banzou*<br>RC marker place will move<br>"Seemingly, next month the place where Lisi borrowed books will move away." | 1 | 1 |

***Results***

The experiment yielded 2493 codable completions; all N=58 participants' responses were included in the analysis.

Using the conservative coding, 87.29% of the completions for the Mismatch conditions (A and C) were relative clauses, while only 29.2% completions for the Match conditions (B and D) were relative clauses. This pattern holds when the percentages were broken down by Marker,

with 89.90% for Mismatch-Temporal Adverb and 84.65% for Mismatch-Aspect Marker, and 29.35% for Match-Temporal Adverb and 29.05% for Match-Aspect Marker. These observations were statistically tested via a generalized linear regression model with a Poisson link function, which included Match and Marker as main effects and the interaction term Match x Marker. The model showed a significant main effect of Match ($\beta = 1.12$, SE = 0.08, $p < 0.01$), while no significant effects was found for Marker nor Match x Marker. This indicates that Mismatch conditions yielded more relative clause completions than the Match conditions, which held across the Marker types.

Using the lenient coding, 88.66 % of the completions for the Mismatch conditions (A and C) were relative clauses, while only 29.6% completions for the Match conditions (B and D) were relative clauses. This pattern holds when the percentages were broken down by Marker, with 91.51% for Mismatch-Temporal Adverb and 85.78% for Mismatch-Aspect Marker, and 29.82% for Match-Temporal Adverb and 29.37% for Match-Aspect Marker. These observations were statistically tested via a generalized linear regression model with a Poisson link function, which included Match and Marker as main effects and the interaction term Match x Marker. The model showed a significant main effect of Match ($\beta = 1.12$, SE = 0.08, $p < 0.01$), while no significant effects was found for Marker nor Match x Marker. This indicates that Mismatch conditions yielded more relative clause completions than the Match conditions, which held across the Marker types.

Thus, fragments are more likely to be completed with relative clauses when they include temporal mismatch than when they include temporal match, which did not differ based on the type of temporal marker involved in the match/mismatch relationship.

To summarize, the two offline experiments reported above demonstrated that relative clauses preceded by temporal mismatch are considered globally acceptable, and that relative clauses are the preferred continuation following temporal mismatches. These findings confirm crucial assumptions underlying the study, suggesting that the parser may use temporal mismatch to predict relative clauses during online processing.

Table 7 Count and percentage of relative clause continuations for Experiment 2, under the conservative and the lenient coding schema.

| **Condition** | **Match** | **Marker** | **Count (%) of RC completion, conservative coding** | **Count (%) of RC completion, lenient coding** |
|---|---|---|---|---|
| A | Mismatch | Temporal adverb (*cengjing*) | 561 (89.90%) | 571 (91.51%) |
| B | Match | | 184 (29.35%) | 187 (29.82%) |
| C | Mismatch | Aspect marker (*-guo*) | 524 (84.65%) | 531 (85.78%) |
| D | Match | | 181 (29.05%) | 183 (29.37%) |

## Experiment 3: EEG Experiment and Individual Differences Measurements

Experiment 3 directly tests the hypothesis that the parser recruits temporal mismatches as a cue to predict relative clauses online, using EEG to track the dynamics of processing at the brain level. Experiment 3 also addresses two additional questions, whether processing of temporal mismatches differs based on the type of temporal markers, and the extent to which processing temporal mismatches and predicting relative clauses is subject to individual differences.

### *Participants*

Seventy-seven right-handed native speakers of Mandarin (30 males, mean age = 25.2, age range = 18 - 38) with no diagnosed reading or speech difficulties were recruited from the Mandarin-speaking population at Hong Kong Polytechnic University and surrounding communities. None of the EEG participants took part in Experiment 1 or Experiment 2. The EEG experiment was conducted at the Speech and Language Sciences Lab at Hong Kong Polytechnic University. All participants provided written consent before the study, following human subject procedures approved by the University of Kansas Office of Research (STUDY00143371). Each participant received a reward of 100 Hong Kong dollars (approximately 12 US dollars) per hour upon completion of the study.

***Materials and Design***

160 sets of target sentences were constructed. Each set includes 4 sentences, crossing the factors Match and Marker. Target sentences start with a lead-in ("Seemingly") and a time frame referring to either past or future (such as "last month" or "next month"). In the two Mismatch conditions (A and C, in Table 8 below), the time frame always refers to future in order to establish the temporary mismatch with the first temporal marker. This is followed by a name (*Lisi*) and a subordinate verb phrase (*jie shu* "to borrow books"), marked by either the temporal adverb (*cengjing* "used to", in A) or the aspect marker (*-guo*, in C). There is then a relative clause marker (*de*) across all four conditions, followed by the head noun of the relative clause (*tushuguan* "library"). The sentences then wrap up grammatically with the verb phrase in the main clause, whose tense always matches with the time reference at the beginning by including either future temporal adverb (*jiangyao* or *jianghui*) or past temporal adverb (*yijing* "already"). Examples of target sentences are provided in Table 8.

Targets were divided into four Latin-square lists (40 targets per condition per list), such that a participant read sentences belonging to all target conditions but only read one sentence from the a given set.

Table 8 Examples of target sentences for Experiment 3.

| | **Match** | **Marker** | **Sentence** | | | | |
|---|---|---|---|---|---|---|---|
| A | Mismatch | Temporal Adverb | *Tingshuo,*<br>Seemingly | *xiageyue*<br>next month | *Lisi*<br>Lisi | ***cengjing***<br>used to | *jieyue tushu*<br>borrow books |
| | | | *de*<br>RC marker | *tushuguan*<br>library | *jiangyao*<br>will | *banzou*<br>move | |
| | | | "Seemingly, next month the library where Lisi borrowed books will move away." | | | | |
| B | Match | Temporal Adverb | *Tingshuo,*<br>Seemingly, | *shanggeyue*<br>last month | *Lisi*<br>Lisi | ***cengjing***<br>used to | *jieyue tushu*<br>borrow book |
| | | | *de*<br>RC marker | *tushuguan*<br>library | *yijing*<br>already | *banzou-le*<br>move-perfective | |
| | | | "Seemingly, last month the library where Lisi borrowed books moved away." | | | | |
| C | Mismatch | Aspect Marker | *Tingshuo,*<br>Seemingly, | *xiageyue*<br>next month | *Lisi*<br>Lisi | *jieyue-**guo***<br>borrow-ASP | *tushu*<br>book |
| | | | *de*<br>RC marker | *tushuguan*<br>library | *jiangyao*<br>will | *banzou*<br>move | |

| | | | |
|---|---|---|---|
| | | | "Seemingly, next month the library where Lisi borrowed books will move away." |
| D | Match | Aspect Marker | *Tingshuo* *Shanggeyue* *Lisi* *jieyue-**guo*** *tushu*<br>Seemingly, last month Lisi borrow-ASP book<br>*de* *tushuguan* *yijing* *banzou-le*<br>RC marker library already move-perfective<br>"Seemingly, last month the library where Lisi borrowed books moved away." |

Each list additionally includes 120 filler sentences. Eighty begin with a time frame referring to either past (n=40) or future (n=40), followed by a subject and a main verb phrase that always matches with the sentence-initial time frame. The remaining 40 fillers include coordinate structures and do not include any temporal expressions or relative clause structures. Examples of fillers are provided in Table 9.

Table 9 Examples of filler sentences for Experiment 3.

| **Filler Type** | **Sentence** |
|---|---|
| Future | *Tingshuo,* *mingnian* *Zhangsan* *jiangyao* *qianwang* *Shanghai*<br>Seemingly, next year Zhangsan will travel Shanghai<br>*canjia* *zhongyao* *huiyi*<br>attend important meeting<br>"Seemingly, next year Zhangsan will travel to Shanghai to attend an important meeting." |

| | | | | | | |
|---|---|---|---|---|---|---|
| Past | *Jushuo,* | *shangzhou* | *Xiaoli* | *cengjing* | *goumai* | *huangjin* |
| | Seemingly, | Last week | Xiaoli | used to | purchase | gold |
| | *yongyu* | *geren* | *touzi* | | | |
| | to use for | personal | investment | | | |
| | "Last week, Xiaoli purchased gold for personal investment." | | | | | |
| Declarative | *Daxue-li,* | *Xiaomei* | *chule* | *xuexi* | *jiushi* | *dagong* |
| | University-in | Xiaomei | except | study | or | |
| | *zhuan* | *shenghuofei* | | | | |
| | earn | living cost | | | | |
| | "At the university, Xiaomei was either studying hard or working to earn her living." | | | | | |

Stimuli sentences were controlled with regard to a number of properties. All target sentences consist of 9 segments (as indicated in Table 8), while fillers consist of 8, 9, or 10 segments with 40 fillers of each length; the distribution of sentence lengths was balanced across filler types. Targets always start with a lead-in segment that is either *tingshuo* or *jushuo* (both meaning "seemingly"), while fillers of Future and Past type start with *tingshuo*, *jushuo,* or *(someone) shuo* "according to (someone)" as the lead-in segment. For targets and Future/Past fillers, the time frame after the lead-in alternated among eight pairs of noun phrases indicating future and past time, including *shanggeyue / xiageyue* "last month / next month", *shangzhou / xiazhou* "last week/next week", *zuotian / mingtian* "yesterday / tomorrow", *qunian / mingnian* "last year / next year", *qiantian / houtian* "the day before yesterday / the day after tomorrow", *qiannian / hounian* "the year before last year / the year after next year", *shangge jidu / xiage jidu*

"last quarter / next quarter", and *shang xueqi / xia xueqi* "last semester / next semester". For the subjects of the relative clauses (for targets) and subjects of the sentences (for fillers), 280 distinct noun phrases were used to avoid repeats across sentences. Across the 160 target sets, 136 disyllabic verbs were used for the verb in the relative clauses, among which 24 verbs were repeated once (i.e. appeared twice) and 112 verbs appeared once, and 80 location nouns were used as head nouns of the relative clauses with each noun repeated once. In order to ensure that the sentences were natural, the 24 repeated verbs appeared with the same location nouns for both of their appearances, but these instances were balanced across conditions so that participants would not associate the repeat with any target condition properties. For fillers, a mix of monosyllabic, disyllabic, and trisyllabic verbs were used without any overlap with verbs in the target sentences. The object noun phrases in the relative clauses were kept unique without any repeats across the target sets. See Appendix I for a complete experimental list.

A total of 280 sentences (160 targets and 120 fillers) were presented segment-by-segment in the Rapid Serial Visual Presentation paradigm using the experiment control software Presentation (Neurobehavioral Systems, Inc.). Sentence presentation started with a fixation cross (+) presented for 600ms in the middle of the screen followed by a 450ms pause, then each segment was presented for 450ms with a 300ms inter-stimulus interval. Between each sentence, a pause was presented; the duration of each pause was randomly selected between 500ms and 1000ms with 50ms increments. A break was offered every 28 sentences.

***Task***

In the main EEG experiment, participants were asked to read sentences for comprehension and answer comprehension questions by pressing the right arrow key for *shi* "yes" or the left arrow key for *fou* "no" with the index finger and the ring finger of their right

hand. Comprehension questions were presented following one fourth (70) of the stimuli and were evenly distributed across conditions and balanced for yes/no as correct answers. The comprehension questions did not target any tense-related information or require any explicit analysis of the relative clause structure.

### *Measures of Individual Differences*

In addition to the main EEG task, we also assessed participants on a battery of individual difference tasks measuring their verbal and non-verbal cognitive abilities.

**Vocabulary**. Linguistic skills such as receptive vocabulary size have been argued to account for individual variability in structural prediction, as has been demonstrated for the prediction of verb arguments (Borovsky et al., 2012), as well as for individual variability in comprehending other sentences with complex structures (Van Dyke et al., 2014). The present study measures vocabulary size via a Chinese vocabulary test based on character identification (Chan & Chang, 2018). Participants were presented with a mix of 60 real characters and 30 nonce characters and asked to identify only the characters that they recognized as real. Following Chan and Chang (2018), the Vocabulary Size score was computed as $h - 2*f$, where $h$ is the hit rate of correctly identified real characters, and $f$ is the false alarm rate of incorrectly accepted nonce characters.

**Working memory capacity**. We assessed individual working memory capacity via two tasks: a Count Span task which measures non-verbal working memory, and a Reading Span task which measures verbal working memory (Conway, Kane, Bunting, Hambrick, Wilhelm, and Engle, 2005). In the Count Span task, participants were asked to count out loud the number of appearances of a specific shape when they viewed an array of shapes on the computer screen. The experimenter recorded the numbers that the participant had counted on each screen, after

which a screen with a new array of shapes appeared. After between 2 and 6 screens, the participant would be prompted to recall the numbers they counted on the previous set of screens in their order of occurrence by entering the digits on the keyboard. Following Conway et al. (2005), we calculated an accuracy score for this task by comparing their total number of correctly recalled digits versus the total numbers of counted digits.

In the Reading Span Task, following Conway et al. (2005), participants read a sentence out loud, made a semantic judgment about the sentence, then said a letter presented on the screen which they were asked to remember. After 2 to 6 sentences, participants were prompted to recall the letters that they had said following each sentence in the previous set. All the sentences and instructions in both tasks were presented in Mandarin.

Scores for both tasks were computed as the accuracy of numbers or letters recalled using partial scoring, such that the correct numbers/letters recalled in the correct positions are counted towards the overall scores, regardless of whether the full sequence of numbers/letters were recalled in the correct order.

***Procedure***

Participants provided their written consent upon arrival, and then completed a language background questionnaire, the Edinburgh Handedness Inventory (Oldfield, 1971), and the Chinese vocabulary test while an experimenter was preparing the EEG cap; this took about an hour. Then, the participant was led to a sound-proof room where they completed the main EEG task while wearing the cap, which took about 1 hour. Afterwards, the cap was taken off of the participant and Reading Span and Count Span were administered; both tasks were presented using the Paradigm software (Tagliaferri, 2005). An entire session took about 3 hours to complete.

### *EEG Recording Apparatus*

EEG was continuously recorded in Curry 7 (Compumedics Neuroscan, Inc.), using elastic QuikCap electrode caps (Compumedics Neuroscan, Inc.) containing 64 Ag/AgCl scalp electrodes arranged in an International 10-20 layout. Four electrodes were placed on the outer canthi and above and below the right eye to monitor blinks and horizontal eye movements, and an electrode was placed on each mastoid. Impedances for all scalp electrodes were kept below 5 kΩ during the recording. Data were sampled at a rate of 1 kHz and referenced online to a reference electrode placed between CZ and CPZ. Recordings were filtered online with a 400 Hz lowpass filter and amplified with a 128-channel Neuroscan Synamps amplifier (Compumedics Neuroscan, Inc.).

### *Data Processing*

Offline data processing was carried out in EEGLAB (Delorme & Makeig, 2004) and MATLAB (The MathWorks, Inc.). Continuous EEG data were re-referenced offline to the mean of the left and right mastoids. Bad channels were interpolated; no more than 3 bad channels were found per participant. The continuous data were then segmented into -300 ms to 1000 ms epochs relative to the onset of segment 2, 4, 6, and 8 in each sentence, and demeaned using the mean of the whole epoch (as recommended by Groppe, Makeig, and Kutas, 2009). The data were then decomposed into independent components via Independent Component Analysis (Makeig, Bell, Jung, and Sejnowski, 1996). For each participant, one to four independent components that are typical of eye movements or blinks were identified by visual inspection and removed from the data. Epochs were then visually inspected for remaining artifacts which were rejected from the data, resulting in the exclusion of three participants' data due to excessive artifacts (i.e. more than 50% of target events were rejected due to artifacts); for remaining participants, an average

of 12.07% of target events were rejected. Epochs were then low-pass filtered at 30 Hz, baseline-corrected to the 300ms pre-stimulus interval, and averaged for each condition for each participant. The remaining data from N=74 participants were carried forward for statistical analyses.

***Data Analysis***

ERP analyses were time-locked relative to the onset of the temporal marker (segment 4) and the relative clause marker *de* (segment 6). EEG data were analyzed based on mean amplitudes for the following time windows at each critical segment: 400-600 ms for N400 and 600-800 ms for P600. These mean amplitudes were analyzed for six regions of interest: Left Anterior (F1, F3, F5, FC1, FC3, FC5, C1, C3, and C5), Left Posterior (CP1, CP3, CP5, P1, P3, P5, PO3, PO5, and PO7), Right Anterior (F2, F4, F6, FC2, FC4, FC6, C2, C4, and C6), Right Posterior (CP2, CP4, CP6, P2, P4, P6, PO4, PO6, and PO8), Midline Anterior (FPZ, FZ, FCZ, and CZ), and Midline Posterior (CPZ, PZ, POZ, and OZ). Analyses were conducted via linear mixed-effects models using the *lme4* package in the R programming environment (R Core Team, 2017). One model was constructed for each time window at each critical region. The dependent variable in the models is the mean ERP amplitude at a given electrode for a given condition. Model fitting began by building an initial big model including all fixed factors and possible interactions related to predictors of interest: Match (Match / Mismatch) with Match as the baseline, Marker Type (Temporal Adverb / Aspect Marker) with Adverb as the baseline, Anteriority (Anterior / Posterior) with Anterior as the baseline, and Hemisphere (Left / Right / Midline) with Left as the baseline. Participants were included as the random intercept. The initial model was then optimized to reach a best model by backward-fitting via log-likelihood ratio tests: if removing a factor from the initial model did not reduce model fit, then that factor is

removed and a simpler model without that factor is built; if, however, removing a factor led to worse fit, then the factor was retained in the model.

***Behavioral Results***

For the comprehension questions in the main EEG task, the mean accuracy for all trials was 95.66% (SD = 7.07). Percent accuracy for each target condition was above 90% for each target condition (See Table 10). Two-way ANOVA on mean accuracy did not reveal any significant main effect nor interactions of Match and Marker Type (Match: $F(1, 288) = 0.18$, $p = 0.67$; Marker Type: $F(1, 288) = 0.07$, $p = 0.80$, Match × Marker Type: $F(1, 288) = 1.24$, $p = 0.27$). Thus, mean accuracy for comprehension questions were similar across target conditions.

Table 10 Mean accuracy for comprehension questions across target conditions.

| | **Target condition** | **Mean accuracy (SD)** |
|---|---|---|
| A | Mismatch, Adverb (*cengjing*) | 95.89% (6.84) |
| B | Match, Adverb (*cengjing*) | 96.44% (6.95) |
| C | Mismatch, Aspect (*-guo*) | 96.58% (6.06) |
| D | Match, Aspect (*-guo*) | 95.34% (7.47) |

***EEG Results***

Results (N=74) at the temporal mismatch and at the relative clause marker *de* are reported separately below. For each time window at each critical segment, the best model for that time window is reported. Because our crucial comparison is between Match and Mismatch, below we focus on reporting significant main effects or interactions involving Match in the best models.

**Results at the temporal marker**. At 400-600ms post-onset of the temporal marker, the best model includes these fixed effects: Marker, Anteriority, Hemisphere, Marker x Hemisphere, and Anteriority x Hemisphere (Table 11). No main effects or interactions involving Match was

present, indicating that mean ERPs at 400-600ms after the onset of the temporal marker did not differ between Match and Mismatch conditions.

Table 11 Linear mixed-effect model for mean ERPs at 400-600ms following the temporal marker.

Best model: erp = 1 + Marker + Anteriority + Hemisphere + Marker x Hemisphere + Anteriority x Hemisphere + (1 | Subject)

| **Fixed effects** | **Estimate** | **Std. Error** | **df** | ***t* value** | ***p*** |
|---|---|---|---|---|---|
| *(Intercept)* | -0.76135 | 0.13401 | 195.33940 | -5.681 | 4.80e-08*** |
| *markerAspect* | -0.15005 | 0.10305 | 1694.00000 | -1.456 | 0.14556 |
| *antpos* | 0.67040 | 0.10305 | 1694.00000 | 6.506 | 1.02e-10*** |
| *hemmid* | 0.04572 | 0.12621 | 1694.00000 | 0.362 | 0.71722 |
| *hemright* | -0.05052 | 0.12621 | 1694.00000 | -0.400 | 0.68902 |
| *markerAspect x hemmid* | -0.41837 | 0.14573 | 1694.00000 | -2.871 | 0.00415** |
| *markerAspect x hemright* | -0.36522 | 0.14573 | 1694.00000 | -2.506 | 0.01230* |
| *Antpos x hemmid* | -0.42085 | 0.14573 | 1694.00000 | -2.888 | 0.00393** |
| *Antpos x hemright* | -0.20655 | 0.14573 | 1694.00000 | -1.417 | 0.15657 |

* $p < .05$, ** $p < 0.01$, *** $p < 0.001$

At 600-800ms post-onset of the temporal marker, the best model includes these fixed effects: Match, Marker, Anteriority, Hemisphere, and an interaction of Match x Marker (Table 12). Given the significant interaction of Match x Marker, the data was split by Marker to examine the effect of Match separately for each marker type. The separate analysis showed that there is a significant effect of Match for the aspect marker *-guo* (estimate = 0.2730, standard error = 0.0934, $p < 0.05$), reflecting a greater positivity for Mismatch; no effect involving Match

was significant for the temporal adverb *cengjing*. Waveforms for mean ERP amplitudes at the temporal marker are shown in Figure 1 (*cengjing*) and Figure 2 (*-guo*).

**Summary of ERP results at temporal marker**. To summarize, at the temporal marker there was a P600 effect for Mismatch for the aspect marker *-guo*, while no effect (N400 or P600) of Mismatch was found for the temporal adverb *cengjing*.

Table 12 Linear mixed-effect model for mean ERPs at 600-800ms following the temporal marker.

Best model: erp = 1 + Match + Marker + Anteriority + Hemisphere + Match x Marker + (1 | Subject)

| **Fixed effects** | **Estimate** | **Std. Error** | **df** | ***t* value** | ***p*** |
|---|---|---|---|---|---|
| *(Intercept)* | 0.79645 | 0.14747 | 158.08793 | 5.401 | 2.4e-07**** |
| *matchMismatch* | -0.03911 | 0.09690 | 1696.00000 | -0.404 | 0.68655 |
| *markerAspect* | -0.10207 | 0.09690 | 1696.00000 | -1.053 | 0.29230 |
| *antpos* | -0.82175 | 0.06852 | 1696.00000 | -11.993 | < 2e-16*** |
| *hemmid* | 0.25964 | 0.08392 | 1696.00000 | 3.094 | 0.00201** |
| *hemright* | -0.19584 | 0.08392 | 1696.00000 | -2.334 | 0.01973* |
| *matchMismatch x markerAspect* | 0.31214 | 0.13704 | 1696.00000 | 2.278 | 0.02286* |

* $p < .05$, ** $p < 0.01$, *** $p < 0.001$

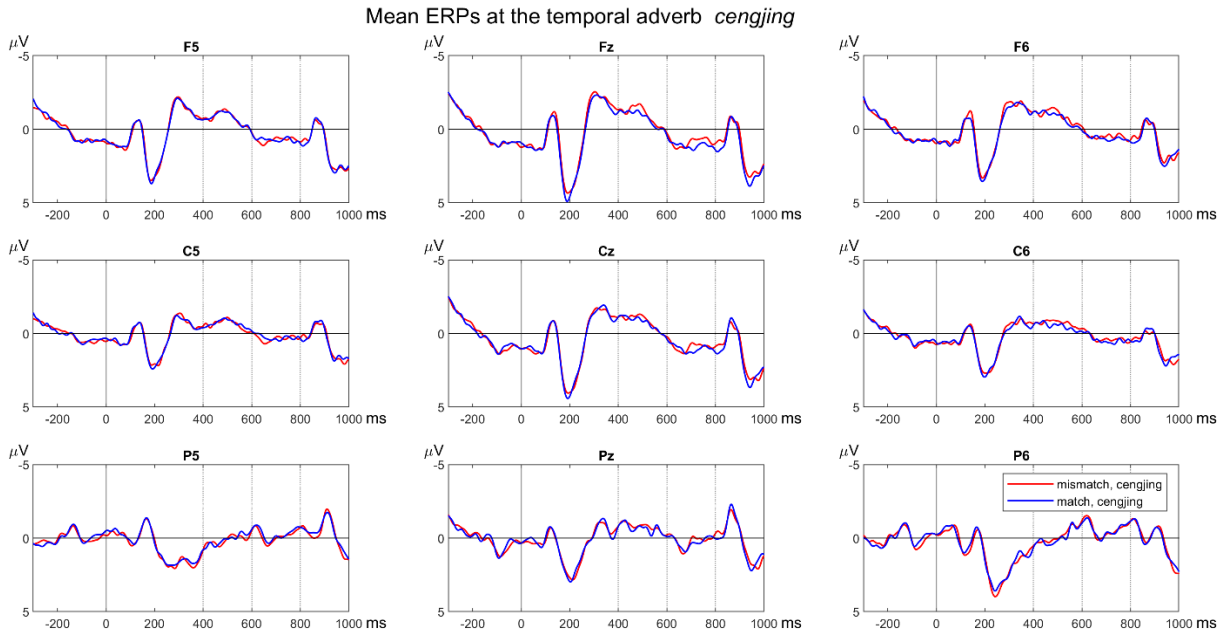


Figure 1: ERPs at representative electrodes for the temporal adverb *cengjing*, plotted for -300ms to 1000ms time-locked to the onset of *cengjing*.

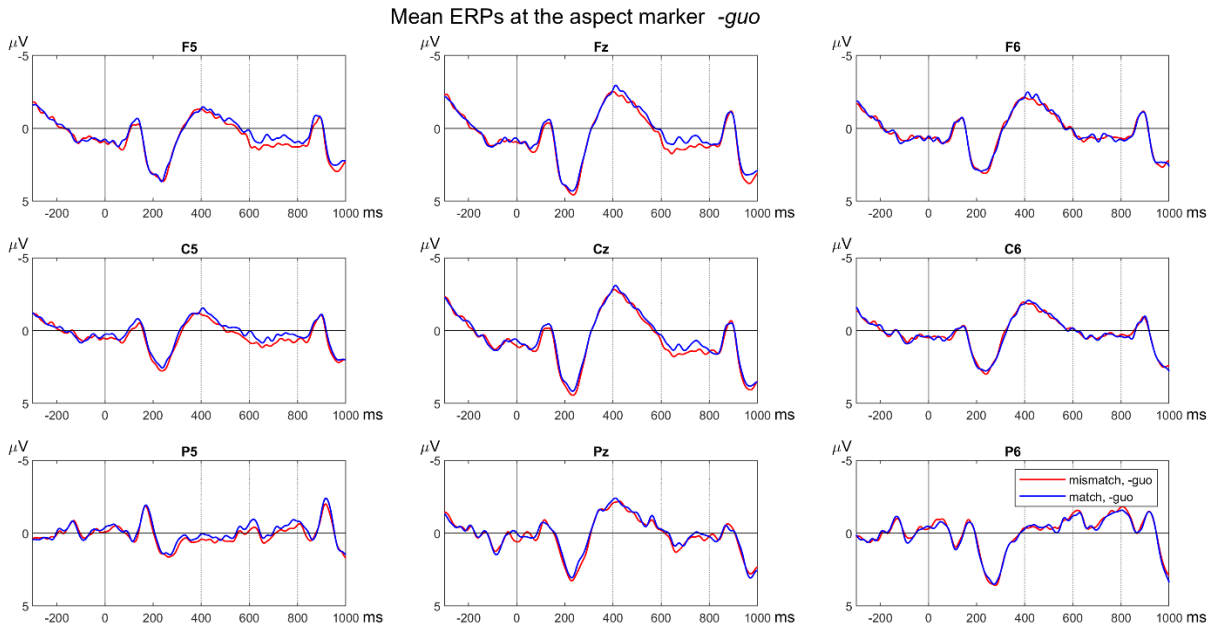


Figure 2: ERPs at representative electrodes for the aspect marker *-guo*, plotted for -300 to 1000ms time-locked to the onset of *-guo*.

**Results at the relative clause**. At 400-600ms post-onset of the relative clause marker *de*, the best model includes these fixed effects: Match, Marker, Anteriority, Hemisphere, Marker x

Hemisphere, and Anteriority x Hemisphere (Table 13). The significant main effect of Match shows that mean ERPs for Mismatch conditions are less positive than Match conditions. This reflects that temporal mismatch overall reduced the garden-path at the relative clause as compared to temporal match, which does not provide a cue facilitating prediction of the relative clause. This effect held across the board for both markers, as indicated by a lack of interaction of Match x Marker.

Table 13 Linear mixed-effect model for mean ERPs at 400-600ms following the relative clause marker.

Best model: erp = 1+ Match + Marker + Anteriority + Hemisphere + Marker x Hemisphere + Anteriority x Hemisphere + (1 | Subject)

| **Fixed effects** | **Estimate** | **Std. Error** | **df** | ***t* value** | ***p*** |
|---|---|---|---|---|---|
| *(Intercept)* | -2.06684 | 0.15983 | 158.09478 | -12.931 | < 2e-16 *** |
| *matchMismatch* | -0.17904 | 0.06064 | 1693.00000 | -2.953 | 0.003194 ** |
| *markerAspect* | 0.46609 | 0.10502 | 1693.00000 | 4.438 | 9.67e-06 *** |
| *antpos* | 1.23625 | 0.10502 | 1693.00000 | 11.771 | < 2e-16 *** |
| *hemmid* | 0.49935 | 0.12863 | 1693.00000 | 3.882 | 0.000108 *** |
| *hemright* | 0.90119 | 0.12863 | 1693.00000 | 7.006 | 3.52e-12 *** |
| *markerAspect x hemmid* | -0.38421 | 0.14853 | 1693.00000 | -2.587 | 0.009770 ** |
| *markerAspect x hemright* | -0.48184 | 0.14853 | 1693.00000 | -3.244 | 0.001201 ** |
| *Antpos x hemmid* | -0.48157 | 0.14853 | 1693.00000 | -3.242 | 0.001209 ** |
| *Antpos x hemright* | -0.49602 | 0.14853 | 1693.00000 | -3.340 | 0.000857 *** |

At 600-800ms post-onset of *de*, the best model includes these fixed effects: Match, Marker, Anteriority, Hemisphere, and Anteriority x Hemisphere. There is a significant main effect of Match, showing that mean ERPs for Mismatch conditions are less positive than Match conditions. This effect held across the board for both markers, as indicated by a lack of interaction of Match x Marker. Thus, for both 400-600ms and 600-800ms time windows, Mismatch showed an overall reduced positivity compared to Match, indicating that temporal mismatches reduced the garden-path effect at the relative clause across the board and thus served as an effective cue for predicting relative clauses. Waveforms for mean ERP amplitudes at the relative clause marker are shown in Figure 3 (*cengjing*) and Figure 4 (*-guo*).

Table 14 Linear mixed-effect model for mean ERPs at 600-800ms following the relative clause marker.

Best model: erp = 1 + Match + Marker + Anteriority + Hemisphere + Anteriority x Hemisphere + (1 | subject)

| **Fixed effects** | **Estimate** | **Std. Error** | **df** | ***t* value** | ***p*** |
|---|---|---|---|---|---|
| *(Intercept)* | -0.96692 | 0.15716 | 157.52826 | -6.152 | 6.05e-09 *** |
| *matchMismatch* | -0.28900 | 0.06747 | 1695.00000 | -4.283 | 1.95e-05 *** |
| *markerAspect* | 0.31780 | 0.06747 | 1695.00000 | 4.710 | 2.68e-06 *** |
| *antpos* | 0.13158 | 0.11687 | 1695.00000 | 1.126 | 0.26035 |
| *hemmid* | 0.57547 | 0.11687 | 1695.00000 | 4.924 | 9.30e-07 *** |
| *hemright* | 0.69979 | 0.11687 | 1695.00000 | 5.988 | 2.59e-09 *** |
| *Antpos x hemmid* | -0.21704 | 0.16527 | 1695.00000 | -1.313 | 0.18928 |
| *Antpos x hemright* | -0.46179 | 0.16527 | 1695.00000 | -2.794 | 0.00526 ** |

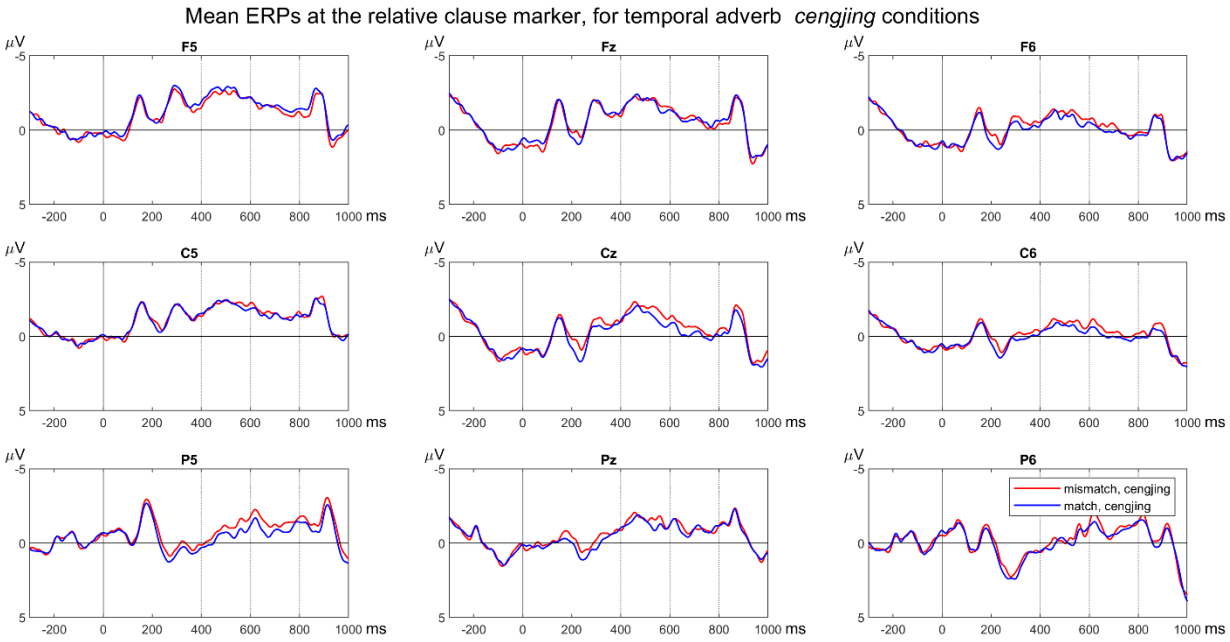


Figure 3: ERPs at representative electrodes at the relative clause marker following the temporal adverb *cengjing*, plotted for -300ms to 1000ms time-locked to the onset of the relative clause marker.

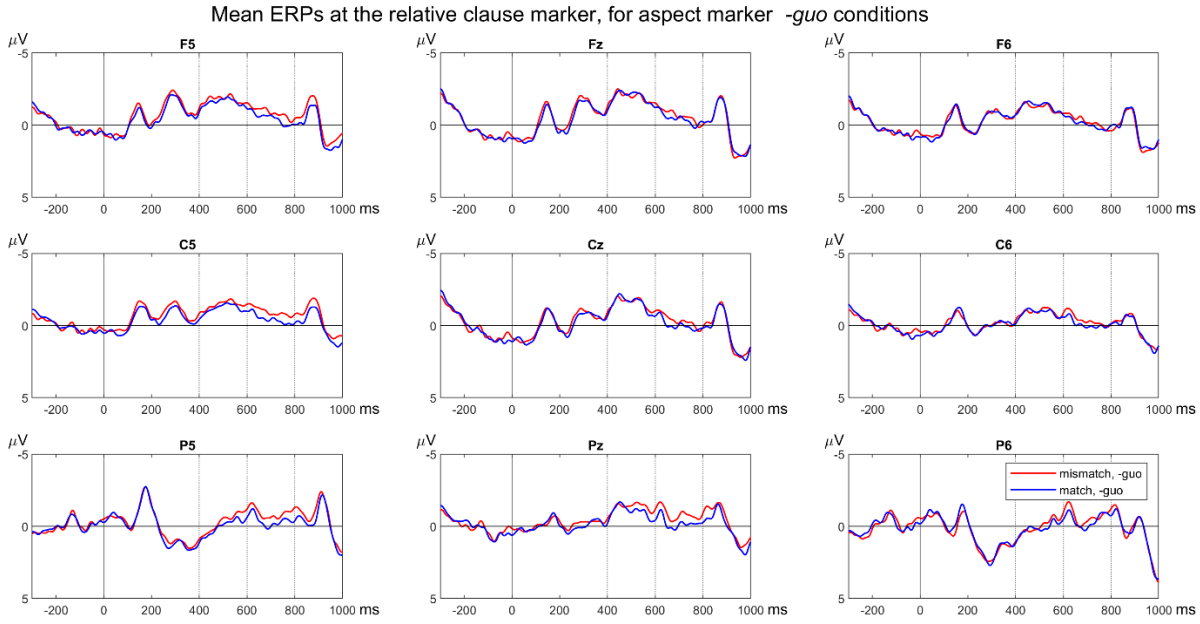


Figure 4: ERPs at representative electrodes at the relative clause marker following the aspect marker *-guo*, plotted for -300ms to 1000ms time-locked to the onset of the relative clause marker.

**Summary of ERP results at the relative clause**. At the relative clause marker *de*, Mismatch conditions showed overall reduced P600 compared to Match conditions across markers. The finding of reduced P600 indicates that temporal mismatch conditions yielded a reduced garden-path at the relative clause, showing that temporal mismatches overall provide an effective cue to guide the parser to predict the relative clause structure.

### *Individual Difference Results*

In addition to the main ERP analyses above, we conducted analyses examining individual differences in brain responses during the processing of temporal mismatch and relative clauses. As mentioned in the procedures section, we measured individual differences via a battery of independent measures, assessing verbal working memory capacity via the Reading Span task, non-verbal working memory capacity via the Count Span task, and vocabulary size via the Chinese vocabulary test. Thus, the individual difference variables include Reading Span score, Count Span score, and Vocabulary score. The analyses reported below examine the extent to which these variables modulate the size of ERP effects (mean differences between the Match and Mismatch conditions, calculated separately for the 400-600ms and 600-800ms time windows) at the temporal marker (*cengjing* or *-guo*) and at the relative clause marker *de*.

For ERPs at the temporal marker, a mean effect size for the 400-600ms time window was calculated as the mean effect size for Match minus the mean effect size for Mismatch, such that greater values reflect bigger negativities. For the 600-800ms time window, the mean effect size was calculated as the mean effect size for Mismatch minus the mean effect size for Match, such that greater values reflect bigger positivities. Given that the main analyses at 600-800ms post-onset of the temporal marker showed a significant interaction of Match x Marker, effect sizes for

this time window were calculated separately for the temporal adverb *cengjing* and the aspect marker *-guo*.

For ERPs at the relative clause marker, mean effect sizes for the 400-600ms time window and for the 600-800ms time window were calculated as the mean effect size for Mismatch minus the mean effect size for Match, such that greater values reflect bigger positivities. These mean effect sizes collapsed across both the temporal adverb *cengjing* and the aspect marker *-guo*, since there is only a main effect of Match but no interaction between Match and Marker in the main analyses.

The above calculations generated 5 mean effect sizes for each participant. For each mean effect sizes, a multiple regression model was constructed with the mean effect size as the dependent variable. Independent variables include all the individual difference scores: Reading Span score, Count Span score, and Vocabulary score. See Table 15 for descriptive statistics and Table 16 for pairwise correlations for these individual difference scores.

Table 15 Descriptive statistics of individual difference scores.

| **Individual difference measure** | **Mean** | **Minimum** | **Maximum** |
|---|---|---|---|
| Reading Span score (%) | 82.85 | 54.45 | 93.47 |
| Count Span score (%) | 75.39 | 42.44 | 98.67 |
| Vocabulary score (out of 60) | 43.62 | 16 | 54 |

Table 16 Pairwise correlation between individual difference scores.

| | **Reading Span score** | **Count Span score** | **Vocabulary score** |
|---|---|---|---|
| Reading Span score | 1 | 0.44* | (not significant) |
| Count Span score | 0.44* | 1 | 0.24* |

| | | | |
|---|---|---|---|
| Vocabulary score | (not significant) | 0.24* | 1 |

* $p < .05$, ** $p < 0.01$, *** $p < 0.001$

**Individual differences in processing at the temporal marker**. At the temporal marker, 400-600ms post-onset, there is no significant effect of any of the individual difference scores. At 600-800ms post-onset of *cengjing*, there is a significant effect of Vocabulary score ($\beta = -0.08$, SE = 0.04, $t = -2.04$, $p < 0.05$), such that participants with higher vocabulary scores showed less positive mean effect sizes for the mismatches involving the adverb *cengjing*; see Figure 5 for a visualization of this effect. At 600-800ms post-onset of *-guo*, no significant effect emerged for any of the individual difference scores.

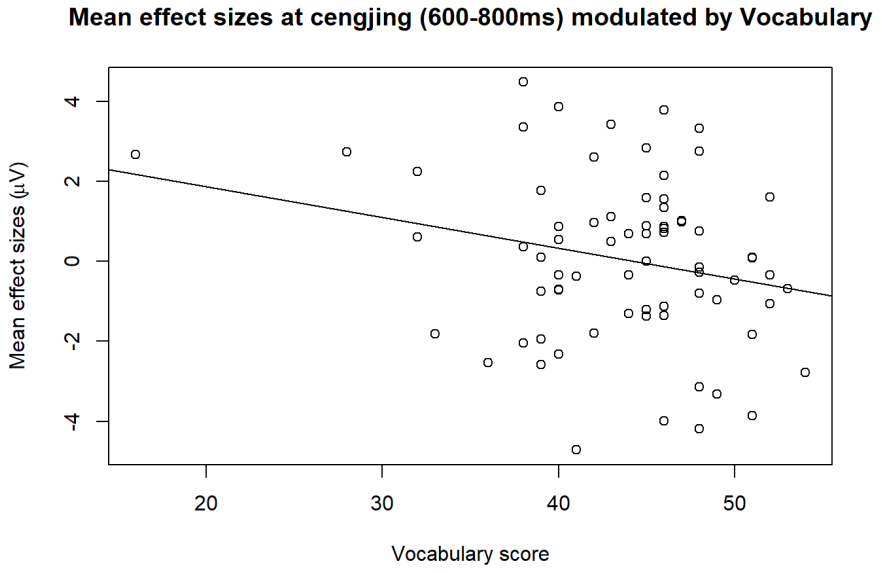


Figure 5: Mean effect sizes at the temporal adverb *cengjing* in the 600-800ms time window, plotted against vocabulary scores. The solid line represents the regression line between the two variables.

**Individual differences in processing at the relative clause marker.** At the relative clause marker *de*, for both 400-600ms and 600-800ms post-onset, no significant effect emerged

for any of the individual difference scores. See Table 17 for a summary of the multiple regression models for the individual difference results.

Table 17 Summary of individual differences for mean effect sizes at each time window analyzed via multiple regression models.

| **Segment and time window** | **Individual difference score** | ***β*** | **SE** | ***t*** | ***p*** |
|---|---|---|---|---|---|
| Temporal marker, 400-600ms | Reading span | -0.02 | 0.02 | -0.98 | 0.33 |
| | Count span | -0.01 | 0.01 | -0.43 | 0.66 |
| | Vocabulary | 0.04 | 0.03 | 1.33 | 0.18 |
| Temporal marker *cengjing*, 600-800ms | Reading span | 0.04 | 0.03 | 1.38 | 0.17 |
| | Count span | -0.004 | 0.02 | -0.18 | 0.86 |
| | Vocabulary | -0.08 | 0.04 | -2.04 | <0.05* |
| Temporal marker -*guo*, 600-800ms | Reading span | 0.002 | 0.03 | 0.07 | 0.94 |
| | Count span | -0.01 | 0.02 | -0.61 | 0.542 |
| | Vocabulary | -0.03 | 0.04 | -0.78 | 0.44 |
| RC marker, 400-600ms | Reading span | 0.02 | 0.02 | 1.11 | 0.27 |
| | Count span | -0.01 | 0.01 | -1.19 | 0.24 |
| | Vocabulary | -0.04 | 0.02 | -1.87 | 0.06 |
| RC marker, 600-800ms | Reading span | 0.03 | 0.02 | 1.63 | 0.11 |
| | Count span | -0.02 | 0.01 | -1.25 | 0.22 |
| | Vocabulary | -0.02 | 0.02 | -0.75 | 0.45 |

* $p < .05$, ** $p < 0.01$, *** $p < 0.001$

**Summary of individual differences results**. In summary, the major finding from the individual difference analyses is that individual brain responses at 600-800ms post-onset of the

temporal marker *cengjing* is modulated by vocabulary scores, such that participants with higher vocabulary scores showed less positive mean effect sizes in this time window. This suggests that the null results for this time window in the main analyses might have masked the individual variability in how native speakers process temporal mismatches involving temporal adverbs, which might be linked to individual speakers' vocabulary abilities. In contrast, working memory did not significantly modulate the processing of temporal mismatch or the prediction of the upcoming relative clause. I will return to these findings in the discussion.

# Chapter 4: Overall Discussion

In this study, I have examined whether the parser engages in prediction, guided by temporal mismatch as a linguistic cue, in order to facilitate the incremental processing of Mandarin relative clauses. The present findings demonstrate that temporal mismatches guide the prediction of relative clauses in online processing. Below I summarize the results and discuss their implications and directions for future studies.

## Summary of Results

Two norming studies, Experiment 1 and 2, were conducted to verify the design of the critical sentence stimuli to be used in the EEG study. Experiment 1 tested whether temporal mismatch and temporal match sentences involving relative clauses were perceived as equally acceptable by native speakers via a naturalness rating task. Results showed that native speakers indeed consider temporal mismatch and temporal match sentences as equally natural. This was important to demonstrate in order to examine temporal mismatch as a potential relative clause prediction cue in natural sentences.

Experiment 2 tested whether temporal mismatch effectively prompts relative clause continuations offline in a sentence fragment completion task. Results showed that fragments involving temporal mismatches yielded significantly more relative clause continuations compared to the fragments involving temporal matches. These results established that native speakers indeed prefer to resolve temporal mismatches by relative clauses downstream in the sentence, further suggesting that temporal mismatch may be able to serve as a relative clause predictive cue during processing.

Experiment 3 is the main EEG study examining whether temporal mismatch would facilitate the predictive processing of relative clauses online, by comparing ERPs at the relative

clause marker *de* when there is a temporal mismatch earlier in the sentence versus when there is no such cue (temporal match). Overall, we found that temporal mismatch indeed serves as an effective cue for relative clauses, reducing the garden-path at the relative clause marker *de* as reflected by a reduced P600 compared to temporal match; these effects held across both temporal markers. As concerns processing at the temporal marker itself, while aspect mismatch yielded a P600 compared to aspect match, adverb mismatch did not yield any significant ERP results at the group level; individual difference results revealed that this might be due to the fact that individual speakers vary in their brain responses at the adverb mismatch, as modulated by their scores in the vocabulary test. In sum, the present study demonstrates that temporal mismatch overall facilitates the parser to predict the relative clause structure, suggesting that the parser can use strongly predictive cues to pre-assemble syntactic structures, even for head-final structures such as Mandarin relative clauses, which are only marked at the right edge. Below, I further discuss each of these findings and their implications as well as directions for future research.

**Predictive Mechanisms in Relative Clause Processing**

A crucial finding from this dissertation study is that the parser can utilize local linguistic information such as temporal mismatch to pre-assemble the syntactic structure of upcoming materials. When processing head-final structures such as Mandarin relative clauses, the parser is able to recruit predictive mechanisms online using subtle linguistic cues and grammatical knowledge (Omaki et al., 2015; Kamide, 2008; Kuperberg and Jaeger, 2016; Yoshida, 2006; Yoshida et al., 2013).

This dissertation thus provides new evidence demonstrating prediction as a powerful mechanism in human language comprehension. The present findings show that the parser is capable of using local linguistic information (temporal mismatch) to pre-assemble upcoming

syntactic structure and reduce potential processing disruption, thus achieving incremental and grammatically accurate parsing. This dissertation advances our understanding of the role of prediction in sentence processing in several ways. First, the target for prediction in this study is an abstract syntactic element, while many existing ERP prediction studies have examined prediction at the lexical-semantic level (e.g., Federmeier and Kutas, 1999; Otten and Van Berkum, 2009). The current study thus provides strong evidence that the parser can predict not only specific words but also more complex material such as syntactic structures. Second, the present study examines whether a predictive cue that is very subtle and indirect could be utilized by the parser to facilitate structural prediction. Temporal mismatch relations overall do not have any direct relation to complex sentence structures such as relative clauses; therefore, in order to utilize them as predictive cues, the parser must recruit highly abstract knowledge about globally resolving apparent local mismatches in a particular language to successfully generate syntactic predictions. More broadly, the present study suggests that apparent violations can be utilized to generate structure predictions, one of only a few studies to my knowledge that have demonstrated this phenomenon for processing any type of syntactic construction (e.g., Fiorentino et al., 2012; Grodner, Gibson, and Tunstall, 2002; Yoshida, 2006).

Moreover, this dissertation holds important implications particularly for parsing head-final structures. Head-final and mixed-headed constructions have been of increasing interest for the sentence processing literature for examining parsing mechanisms, as they provide empirical test cases for claims made by alternative approaches to sentence processing (Lin, 2008; Yamashita et al., 2010). For example, head-final structures allow for examination of sentence processing models arguing that the parser relies on phrasal heads for projecting syntactic structures (such as head-driven models), which would predict that head-final structures cannot be

processed incrementally due to the delayed occurrence of phrasal heads holding crucial information about the structure. On the contrary, finding that the parser is able to use incoming information to pre-assemble head-final structures without delaying incremental processing until bottom-up input such as a phrasal head is encountered is consistent with models that argue for a more active parsing mechanism (such as fully incremental parsing approach). The results of the current study are clearly in line with the latter approach, showing that the parser can utilize subtle linguistic information to project syntactic structures and reduce parsing disruptions such as garden-path effects, even before encountering the phrasal head. The current study joins a growing body of literature arguing for strongly incremental processing (Dillon et al., 2012; Kazanina, 2017; Yoshida et al., 2013).

**Linguistic Cues for Predictive Processing**

The current study examines for the first time to my knowledge, whether temporal mismatch in particular serves as an effective relative clause prediction cue, whereas the previous literature has largely focused on testing classifier-noun mismatches and has yielded mixed findings. While the current study did not directly compare these two kinds of mismatch cues, we suggest that it is possible that temporal mismatch might be a more robust cue than classifier-noun mismatch because of the more constraining, less variable relation between temporal expressions as compared to that between classifiers and nouns. Thus, detecting an apparent mismatch between temporal elements may strongly indicate that the two temporal elements are part of different phrases, leading to the positing of a relative clause structure. In contrast, the parser may try to accommodate unexpected combinations of classifier and nouns, rather than reanalyzing the syntactic structure to place the classifier and noun in different clauses.

In addition, specific classifiers might vary in how constraining they are with respect to the nouns they combine with. Hsu et al. (2014) have suggested that a relative clause prediction effect might be more likely to arise in studies that use predominantly animate classifiers (such as *wei*, selecting for persons, included in Wu et al. 2008) than in studies that use a wide range of classifiers including both animate and inanimate classifiers such as in Hsu et al. (2014). While it remains unclear to what extent animacy directly impacts how constraining and potentially how reliable of a predictive cue it is for a specific classifier, different Mandarin classifiers do vary in this regard. Some classifiers strictly select for nouns belonging to a category, such as *wei* only selecting persons and *ke* only selecting trees, while other classifiers allow for nouns from multiple, unrelated categories, such as *tiao*, which can take a range of nouns including *weijin* (scarf), *lu* (road), and *fagui* (law).

Taken together, one way to unite the findings of the current study demonstrating evidence for prediction using temporal mismatch and the previous ERP literature showing a lack of robust prediction using classifier-noun mismatch, would be to hypothesize that the less variable a cue is, the more reliable of a predictive cue it might be. The question of what make a cue less variable is beyond the scope of this dissertation, but I present some possibilities here. First, it might have to do with the saliency of the notion encoded in the cue itself, with more salient items being less variable and potentially stronger cues for prediction. Intuitively, temporal relations are straightforward, requiring that temporal elements must agree in temporal reference such as past, future, or present. In contrast, classifier-noun relations in Chinese languages are much less obvious in what aspect of meaning or features they must agree on, with some classifiers being highly grammaticalized and abstract in their preferred category of head nouns, while other classifiers are less grammaticalized and more specific about the particular semantic feature the

head nouns they combine with should carry. Thus, an apparent violation of a more salient concept such as temporal mismatch might more reliably prompt the parser to reanalyze away from the combination, by positing an alternative structure such as relative clause in the current study.

Second, particularly for mismatch cues that involve more than one element, the effectiveness of a cue for facilitating prediction might also depend on how strict the mapping is between the elements, such that violation (mismatch) of a highly constraining relation might more robustly engender the prediction of an alternative structure. While the mapping between temporal elements is highly constraining, with each time reference only mapping with a very small number of temporal markers, classifier-noun relations overall embody a many-to-many mapping between classifiers and nouns; studies have shown that even native speakers vary in pairing classifiers with their prototypical noun classes (e.g. Tsang and Chambers, 2011). Thus, an apparent violation of a more constraining relation might be less likely to be accommodated and more likely to be resolved by the parser positing an alternative structure. The current study does not intend to tease apart the two closely related possibilities, and future studies are called for in order to examine the extent to which some violation types are more likely to be tolerated, and in turn serve as less effective predictive cues, than others.

**Processing Temporal Relations in Mandarin**

By testing sentences that include apparent temporal mismatches which are ultimately resolved by positing relative clauses, this dissertation also addresses the representation and the processing of temporal relations themselves. In Chinese theoretical linguistics, there has been an ongoing debate about the nature of temporal information as represented by the various kinds of temporal markers involved (Collart and Chan, 2020; J. Lin, 2003; Lu and Ma, 2003; Ma and

Wang, 2004; see also Zhang and Zhang, 2008). As discussed in Chapter 2, an important dimension along which temporal markers differ in Mandarin is the level of grammaticalization. Specifically, one major type of temporal markers, aspect markers such as *-guo, -le*, and *-zhe*, are highly grammaticalized into a functional category as a result of diachronic change; the other major type, temporal adverbs, are less grammaticalized and more variable in their lexical category (Lu and Ma, 2003; Qiu and Zhou, 2012).

The ERP literature has thus examined the processing of these temporal markers to attempt to verify the claims made in the theoretical literature, testing whether ERPs yielded by various (types of) temporal markers reflect their degree of grammaticalization. These studies have yielded interesting insights into processing of temporal relations for tenseless languages such as Chinese (Collart and Chen, 2020; Qiu and Zhou, 2012). However, these studies have typically reled on violation paradigms to compare temporal markers involved in match and mismatch relations in globally ill-formed sentences, which does not necessarily reflect how temporal relations are normally processed. The present study addresses this question by connecting the literature on temporal processing and relative clause processing, enabling us to examine temporal mismatch in globally well-formed sentences. This contrasts with Qiu and Zhou (2012) where half of the critical sentences were ill-formed, such that encountering a temporal mismatch indicated that the entire sentence would be anomalous. Thus, the current findings more likely reflect the processing of different types of temporal markers in more natural comprehensions.

As for *how* processing temporal adverbs versus aspects might differ, this dissertation puts forth a proposal different from Qiu and Zhou (2012). Qiu and Zhou (2012) overall found adverb mismatch yielded increased biphasic N400-P600 and aspect mismatch yielded increased P600,

thus arguing that distinct ERP components (N400 versus P600) reflect different representation of temporal information for these two types of markers. However, it remains unclear whether the key difference between adverbial versus aspect processing indeed lies in the presence or absence of N400. Recall that the N400 effect was actually not observed in Qiu and Zhou's Experiment I that included both adverbs and aspect markers, where only an increased P600 was observed for adverb mismatch. Adverb mismatch only elicited N400 in their Experiment II where only adverbs, but not aspect markers, were included in the target sentences. Like Experiment 1 in Qiu and Zhou (2012), the current study did not observe any effect in the N400 time window for the adverb mismatch, despite testing adverb mismatch and aspect markers together. Instead, the current study only observed an effect in the P600 window that varied across individuals, while the aspect mismatch yielded an overall P600 effect at the group level as also observed by Qiu and Zhou (2012). Thus, the current study suggests that the key difference in temporal processing for adverbs versus aspects might lie in the extent to which they are subject to individual variations in brain responses in the P600 time window, rather than the presence or absence of N400. We turn to what may underlie this variation in the next section.

**Variability in Native Language Processing**

In addition to reporting group-level results, the present study also examined variability at the level of individual participants in processing the complex sentences tested in the current study. Recall that brain responses at the adverb mismatch (600-800 ms post-onset) varied between individual speakers, as modulated by individual participants' vocabulary scores, such that participants with higher vocabulary scores showed a less positive mean effect size. This finding demonstrates that there is robust variation in processing profiles even within populations that have typically been treated as homogenous such as college-educated young adults (for

similar findings in the domain of morphosyntax, see Tanner & van Hell, 2014; for a review, see Kidd, Donnelly, and Christiansen, 2018).

In particular, the present study suggests that linguistic abilities such as receptive vocabulary might be a crucial source of native variability in sentence processing. This is consistent with a handful of studies on individual differences in predictive processing and in the processing of complex sentence constructions which showed that vocabulary captured variability in native sentence processing (Borovsky et al, 2012; van Dyke et al. 2014). The role of vocabulary has been made particularly clear in studies that tested multiple sources of individual differences (e.g. Van Dyke et al., 2014), which showed that vocabulary better accounts for individual differences in sentence processing that commonly assessed non-linguistic cognitive abilities such as working memory.

For the current study, it is possible that those with greater language abilities, as reflected by vocabulary, find it less costly to reanalyze away from the adverb mismatch, which can arguably be construed as a lexical-semantically encoded mismatch, and thus yield smaller positivities upon encountering this type of mismatch. Another possibility is that participants in general detect and reanalyze away from the adverb mismatch with a similar level of effort, but those with weaker language abilities treat the mismatch more as an apparent syntactic violation, thus trending towards a positivity, while those with greater language abilities treat the mismatch as more of a lexico-semantic incompatibility, trending toward less positive (more negative) responses.

On the other hand, brain responses at the aspect (*-guo*) mismatch and at the relative clause marker *de* were not robustly modulated by any individual differences, suggesting that individual participants processed these elements in a less variable fashion. These findings

suggest that the processing of temporal mismatches involving the aspect marker *–guo*, and the ability to generate relative clause predictions overall (using *cengjing* or *–guo*) are not highly vulnerable to individual differences in receptive vocabulary and working memory capacity. The lack of modulation of our prediction effect by vocabulary appears to contrast with the findings reported by Borovsky et al. (2012) who report a significant relationship between prediction and vocabulary, but this might be due to the fact that Borovsky et al. (2012) were testing for the prediction of particular arguments, while the current examines the prediction of relative clause structures.

Finally, the fact that working memory capacity did not show any effect suggest that the ability to detect temporal mismatch and predict relative clauses was not modulated by working memory capacity in the current study. This is in line with previous findings from ERP studies on prediction, where working memory capacity hasn't always been found to modulate prediction effects. For example, in Otten and Van Berkum (2009)'s study on the prediction of upcoming words in discourse, they did not find working memory capacity to modulate individuals' ability to predict as measured by sensitivity to prediction-compatible versus prediction-incompatible determiner gender. Overall, individuals were able to engage in relative clause prediction to similar degrees regardless of their level of working memory capacity in the current study, potentially because when provided with a robust predictive cue within the sentence, such prediction might not be highly resource-intensive as regards working memory capacity (see Otten and Van Berkum, 2009 for a similar proposal). Moreover, although the current study tested a large sample of participants (N=74), it is possible that future research that samples more broadly from the population may yield wider variability in working memory which might be found to modulate ERP effects of prediction.

**Future Research**

There are a number of directions that future research could pursue in order to address open questions raised by the current study. First, future studies could compare temporal mismatch and classifier-noun mismatch in the same study, testing whether they are equally effective in serving as potential cues for relative clauses. Based on evidence from the current study which suggest that temporal mismatch serves as an effective cue for relative clause prediction, and previous studies that did not find evidence for classifier-noun mismatch as an effective cue, the present study has suggested that temporal mismatch may serve as a more effective Mandarin relative clause predictive cue than classifier-noun mismatch. A future study could include both cues within the same study, which would allow for directly comparing temporal versus classifier-noun mismatch as potential cues for relative clauses, and for examining whether the presence of one potential cue would influence the effectiveness of the other cue. For example, when participants have encountered sentences where relative clauses can be predicted by apparent temporal mismatches. For example, when participants have encountered sentences where relative clauses can be predicted by apparent temporal mismatches, a relatively strong cue, it is possible that this would lead to greater utilization of other mismatch cues such as classifier-noun mismatches.

Another direction for future studies is to investigate how detailed the predicted relative clause structure is. The current study presents an initial step in studying Mandarin relative clause prediction by showing that predicting this structure can be facilitated by a novel linguistic cue, but I have left open the question of what exactly is predicted for the relative clauses. While the current study suggests that a relative clause is indeed predicted following temporal mismatch, this study was not designed to directly inform our understanding of how detailed the predicted

structure is. Indeed, to my knowledge, no study has investigated this question yet regarding Mandarin relative clause prediction. In order to consider how such research could be developed in the future, a line of psycholinguistic research on Japanese relative clauses by Yoshida (2006) may be instructive. For example, one experiment in Yoshida (2006) found that prediction about relative clauses (as cued by classifier-noun mismatch) is sufficient to induce the so-called island effect associated with Japanese relative clauses. The idea is that when a relative clause can be predicted from a classifier-noun mismatch (e.g., *3-satsu-no … sensee*-ga in 32b), the parser would in turn recognize that this potential relative clause prevents moving noun phrases across relative clause boundaries (island effect), and thus would not interpret the fronted noun phrase *Dono-sensee-ni* "which-student-Dat" as an argument inside the relative clause, as compared to (32a) where no cues for the relative clause are available.

(32a) *Dono-sensee-ni tannin-wa* [*3-**nin-no** tosioita sensee-ga atarasii*
Which-student-Dat class-teacher-Top 3-Cl(person)-Gen aged teacher-Nom new
*koochoo-ni yorokonde okutta*] *hon-o kyoositu-de yomasemasita-ka?*
President-Dat gladly gave book-Acc class-room-at read-made-honorific-Q
"Which student did the class teacher made read three books at the classroom that the old teacher gladly gave to the new president?"

(32b) *Dono-sensee-ni tannin-wa 3-**satsu-no** [tosioita sensee-ga atarasii*
Which-student-Dat class-teacher-Top 3-Cl(book)-Gen aged teacher-Nom new
*koochoo-ni yorokonde okutta*] *hon-o kyoositu-de yomasemasita-ka?*
President-Dat gladly gave book-Acc class-room-at read-made-honorific-Q
"Which student did the class teacher made read three books at the classroom that the old teacher gladly gave to the new president?"

While this is taken as evidence that the parser can compute detailed relative clause structures using mismatch cues (Yoshida, 2006), this possibility will need to be tested in Mandarin where relative clauses might also incur island constraints (Hsu, 2008). Future studies could use similar paradigms to probe how detailed the predicted Mandarin relative clause structure is.

With regard to individual differences, as mentioned earlier, future studies could consider looking into whether predicting relative clause structures might relate to various kinds of linguistic abilities and non-linguistic cognitive abilities, as assessed by other measures. For example, future studies could adopt more syntax-relevant measures that target the ability to formulate syntactic structures in general and examine how individual differences in those measures interact with predicting relative clauses specifically. Future research could also look into relevant measures of non-linguistic cognitive abilities in addition to working memory capacity. For example, the ability to update context during processing is crucial for utilizing contextual cues such as mismatch information in order to update expectations about structure building; for the sentence types tested in the current study, it is possible that individual differences in context-updating ability may affect individuals' ability to shift from a main clause analysis to a relative clause analysis upon encountering the temporal mismatch cue. This could be assessed via measures of domain-general context maintenance ability, such as the Continuous Performance Test (Rosvold, Mirsky, Sarason, Bransome, and Beck, 1956; Cohen, Barch, Carter, and Servan-Schreiber, 1999).

Finally, another intriguing question for future research is whether engaging in relative clause prediction using linguistic cues depends on the predictive validity of the cue. In the current study, all cases of temporal mismatch are followed by relative clauses, making temporal

mismatch a reliable cue for prediction. It has been argued in other domains such as lexico-semantic prediction that the utilization of predictive cues may depend in part on their predictive validity in a particular context (e.g., Lau et al. 2013). That is, the parser is more likely to utilize a predictive cue when it is relatively reliable, meaning that the predicted outcome has a high likelihood of indeed occurring. Manipulating the predictive validity of temporal mismatch as a relative clause prediction cue would involve testing contexts in which most temporal mismatches are followed by relative clauses, as compared to contexts in which relatively few most temporal mismatches are indeed followed by relative clauses, which should reduce the predictive validity of the cue. I am currently conducting a behavioral study examining whether manipulating the predictive validity of temporal mismatch modulates the prediction effect observed at the relative clause marker. In one block of the experiment, the predictive validity is high such that temporal mismatch is always followed by a relative clause, whereas in the other block the predictive validity is low, with temporal mismatch rarely followed by a relative clause (resulting in anomalous sentence). If relative clause prediction is indeed sensitive to the predictive validity of the temporal mismatch cue, then the prediction effect should be greater in the high predictive validity block and smaller in the low predictive validity block. This result would provide converging evidence in support of the claim that the effect observed at the relative clause marker in the current study indeed reflects the engagement of an active prediction mechanism supporting the pre-assembly of relative clause structure.

**Conclusions**

This dissertation investigated the extent to which strong incrementality can be achieved by engaging in predictive processing when parsing a head-final structure in which the disambiguating element appears at the right edge. Using head-final Mandarin relative clauses as

a testing ground, the current study examined whether the parser would be able to utilize a predictive cue, temporal mismatch, to pre-assemble relative clauses online, as local temporal mismatch can only be globally resolved by positing relative clauses in Mandarin. In a series of offline and online (ERP) experiments, the current study established that temporal mismatch serves as an effective prediction cue for Mandarin relative clauses, as evidence by reduced processing disruption at the relative clause when it is preceded by a temporal mismatch cue. In addition, findings from the current study show that temporal mismatch itself is robustly detected online by the parser, although brain responses yielded by temporal mismatch differed based on the type of temporal markers involved, with ERP effects observed for aspectual mismatch but not for adverbial mismatch in the group results. As revealed by an individual difference analysis, native speakers vary in their brain responses to the adverbial mismatch as modulated their performance on an independent vocabulary test, such that individuals with higher vocabulary scores yielded less positive responses for adverbial mismatch, potentially reflecting that they either find it less costly to reanalyze away from this mismatch or treat it as less of a morphosyntactic mismatch and more of a lexical-semantic mismatch.

The present study joins an emerging body of literature in demonstrating the critical role of predictive mechanisms as a core feature of human sentence processing, with the parser engaging in the prediction of highly abstract aspects of not-yet-encountered parts of an utterance. Consistent with recent studies showing variability in sentence processing among adult native speakers, this dissertation also suggests that the processing of temporal relations in Mandarin varies even among a participant pool consisting of college-age young adults, and that vocabulary plays an important role in explaining native variability in sentence processing. Broadly, this dissertation holds implications for processing head-final constructions across human languages

and speaks to the importance of studying a wide range of linguistic phenomena to verify and refine theories and models on sentence processing.

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# Appendix

## Appendix I: EEG experiment stimuli sentences

Below is a table of stimuli sentences for the EEG experiment. Sets 1 – 160 are target sets and sets 161 – 280 are fillers.

Condition labels: a – Mismatch, Temporal Adverb; b – Match, Temporal Adverb; c – Mismatch, Aspect Marker; d – Match, Aspect Marker; e – Filler, Future; f – Filler, Past; g – Filler, Declarative.

| Set | Condition | Sentence | Comprehension question | Answer key |
|---|---|---|---|---|
| 1 | a | 听说，/下周/陈市长/曾经/整顿市容/的/城区/将要/恢复供水。 | 这句话提到了一位市长吗？ | 是 |
| 1 | b | 听说，/上周/陈市长/曾经/整顿市容/的/城区/已经/恢复了供水。 | 这句话提到了一位市长吗？ | 是 |
| 1 | c | 听说，/下周/陈市长/整顿过/市容/的/城区/将要/恢复供水。 | 这句话提到了一位市长吗？ | 是 |
| 1 | d | 听说，/上周/陈市长/整顿过/市容/的/城区/已经/恢复了供水。 | 这句话提到了一位市长吗？ | 是 |
| 2 | a | 听说，/后天/小芙/曾经/品尝小吃/的/饭店/将要/对外转租。 | | |
| 2 | b | 听说，/前天/小芙/曾经/品尝小吃/的/饭店/已经/对外转租了。 | | |
| 2 | c | 听说，/后天/小芙/品尝过/小吃/的/饭店/将要/对外转租。 | | |
| 2 | d | 听说，/前天/小芙/品尝过/小吃/的/饭店/已经/对外转租了。 | | |
| 3 | a | 听说，/下个月/马阿姨/曾经/提交议案/的/部门/将要/提前下班。 | 这句话是关于一个部门吗？ | 是 |
| 3 | b | 听说，/上个月/马阿姨/曾经/提交议案/的/部门/已经/提前下班了。 | 这句话是关于一个部门吗？ | 是 |
| 3 | c | 听说，/下个月/马阿姨/提交过/议案/的/部门/将要/提前下班。 | 这句话是关于一个部门吗？ | 是 |
| 3 | d | 听说，/上个月/马阿姨/提交过/议案/的/部门/已经/提前下班了。 | 这句话是关于一个部门吗？ | 是 |
| 4 | a | 据说，/后天/郭市长/曾经/颁布法令/的/会堂/将要/装投影仪。 | | |
| 4 | b | 据说，/前天/郭市长/曾经/颁布法令/的/会堂/已经/装了投影仪。 | | |
| 4 | c | 据说，/后天/郭市长/颁布过/法令/的/会堂/将要/装投影仪。 | | |
| 4 | d | 据说，/前天/郭市长/颁布过/法令/的/会堂/已经/装了投影仪。 | | |

| | | | | |
|---|---|---|---|---|
| 5 | a | 据说，/下周/小钱/曾经/庆祝生日/的/酒吧/将要/搬走。 | | |
| 5 | b | 据说，/上周/小钱/曾经/庆祝生日/的/酒吧/已经/搬走了。 | | |
| 5 | c | 据说，/下周/小钱/庆祝过/生日/的/酒吧/将要/搬走。 | | |
| 5 | d | 据说，/上周/小钱/庆祝过/生日/的/酒吧/已经/搬走了。 | | |
| 6 | a | 听说，/下个季度/刘老板/曾经/存放商品/的/仓库/将要/改造翻新。 | | |
| 6 | b | 听说，/上个季度/刘老板/曾经/存放商品/的/仓库/已经/改造翻新了。 | | |
| 6 | c | 听说，/下个季度/刘老板/存放过/商品/的/仓库/将要/改造翻新。 | | |
| 6 | d | 听说，/上个季度/刘老板/存放过/商品/的/仓库/已经/改造翻新了。 | | |
| 7 | a | 据说，/后年/小田/曾经/观看预赛/的/球场/将要/被翻新。 | 这句话提到了一个教育机构吗？ | 否 |
| 7 | b | 据说，/前年/小田/曾经/观看预赛/的/球场/已经/被翻新了。 | 这句话提到了一个教育机构吗？ | 否 |
| 7 | c | 据说，/后年/小田/观看过/预赛/的/球场/将要/被翻新。 | 这句话提到了一个教育机构吗？ | 否 |
| 7 | d | 据说，/前年/小田/观看过/预赛/的/球场/已经/被翻新了。 | 这句话提到了一个教育机构吗？ | 否 |
| 8 | a | 听说，/明年/陈主任/曾经/安置住户/的/旅馆/将要/提高房价。 | 这句话是关于一个停车场吗？ | 否 |
| 8 | b | 听说，/去年/陈主任/曾经/安置住户/的/旅馆/已经/提高了房价。 | 这句话是关于一个停车场吗？ | 否 |
| 8 | c | 听说，/明年/陈主任/安置过/住户/的/旅馆/将要/提高房价。 | 这句话是关于一个停车场吗？ | 否 |
| 8 | d | 听说，/去年/陈主任/安置过/住户/的/旅馆/已经/提高了房价。 | 这句话是关于一个停车场吗？ | 否 |
| 9 | a | 据说，/明天/何伯伯/曾经/播种玉米/的/田地/将要/卖给别人。 | | |
| 9 | b | 据说，/昨天/何伯伯/曾经/播种玉米/的/田地/已经/卖给别人了。 | | |
| 9 | c | 据说，/明天/何伯伯/播种过/玉米/的/田地/将要/卖给别人。 | | |
| 9 | d | 据说，/昨天/何伯伯/播种过/玉米/的/田地/已经/卖给别人了。 | | |
| 10 | a | 据说，/明年/老顾/曾经/考核员工/的/基地/将要/扩大规模。 | | |
| 10 | b | 据说，/去年/老顾/曾经/考核员工/的/基地/已经/扩大了规模。 | | |
| 10 | c | 据说，/明年/老顾/考核过/员工/的/基地/将要/扩大规模。 | | |
| 10 | d | 据说，/去年/老顾/考核过/员工/的/基地/已经/扩大了规模。 | | |

| | | | | |
|---|---|---|---|---|
| 11 | a | 听说，/下个月/张导演/曾经/录制短片/的/景区/将要/进行绿化。 | 这句话是关于一个旅游团吗？ | 否 |
| 11 | b | 听说，/上个月/张导演/曾经/录制短片/的/景区/已经/进行了绿化。 | 这句话是关于一个旅游团吗？ | 否 |
| 11 | c | 听说，/下个月/张导演/录制过/短片/的/景区/将要/进行绿化。 | 这句话是关于一个旅游团吗？ | 否 |
| 11 | d | 听说，/上个月/张导演/录制过/短片/的/景区/已经/进行了绿化。 | 这句话是关于一个旅游团吗？ | 否 |
| 12 | a | 据说，/明天/小杰/曾经/刊登启事/的/报纸/将要/停刊。 | | |
| 12 | b | 据说，/昨天/小杰/曾经/刊登启事/的/报纸/已经/停刊了。 | | |
| 12 | c | 据说，/明天/小杰/刊登过/启事/的/报纸/将要/停刊。 | | |
| 12 | d | 据说，/昨天/小杰/刊登过/启事/的/报纸/已经/停刊了。 | | |
| 13 | a | 听说，/下学期/小杨/曾经/借阅古籍/的/图书馆/将要/引进新书。 | 这句话提到了小杨吗？ | 是 |
| 13 | b | 听说，/上学期/小杨/曾经/借阅古籍/的/图书馆/已经/引进了新书。 | 这句话提到了小杨吗？ | 是 |
| 13 | c | 听说，/下学期/小杨/借阅过/古籍/的/图书馆/将要/引进新书。 | 这句话提到了小杨吗？ | 是 |
| 13 | d | 听说，/上学期/小杨/借阅过/古籍/的/图书馆/已经/引进了新书。 | 这句话提到了小杨吗？ | 是 |
| 14 | a | 据说，/下周/老梁/曾经/指挥交通/的/路口/将要/装路灯。 | 这句话是关于一个港口吗？ | 否 |
| 14 | b | 据说，/上周/老梁/曾经/指挥交通/的/路口/已经/装了路灯。 | 这句话是关于一个港口吗？ | 否 |
| 14 | c | 据说，/下周/老梁/指挥过/交通/的/路口/将要/装路灯。 | 这句话是关于一个港口吗？ | 否 |
| 14 | d | 据说，/上周/老梁/指挥过/交通/的/路口/已经/装了路灯。 | 这句话是关于一个港口吗？ | 否 |
| 15 | a | 据说，/后年/老陆/曾经/领取利息/的/银行/将要/招聘保安。 | | |
| 15 | b | 据说，/前年/老陆/曾经/领取利息/的/银行/已经/招聘了保安。 | | |
| 15 | c | 据说，/后年/老陆/领取过/利息/的/银行/将要/招聘保安。 | | |
| 15 | d | 据说，/前年/老陆/领取过/利息/的/银行/已经/招聘了保安。 | | |
| 16 | a | 听说，/后年/小谭/曾经/存储数据/的/电脑/将要/更新系统。 | | |
| 16 | b | 听说，/前年/小谭/曾经/存储数据/的/电脑/已经/更新了系统。 | | |
| 16 | c | 听说，/后年/小谭/存储过/数据/的/电脑/将要/更新系统。 | | |
| 16 | d | 听说，/前年/小谭/存储过/数据/的/电脑/已经/更新了系统。 | | |

| | | | | |
|---|---|---|---|---|
| 17 | a | 据说，/明天/沈阿姨/曾经/订购机票/的/网站/将要/改版。 | | |
| 17 | b | 据说，/昨天/沈阿姨/曾经/订购机票/的/网站/已经/改版了。 | | |
| 17 | c | 据说，/明天/沈阿姨/订购过/机票/的/网站/将要/改版。 | | |
| 17 | d | 据说，/昨天/沈阿姨/订购过/机票/的/网站/已经/改版了。 | | |
| 18 | a | 听说，/明天/小卢/曾经/排练歌剧/的/音乐厅/将要/扩大规模。 | 这句话提到了演唱会吗？ | 否 |
| 18 | b | 听说，/昨天/小卢/曾经/排练歌剧/的/音乐厅/已经/扩大了规模。 | 这句话提到了演唱会吗？ | 否 |
| 18 | c | 听说，/明天/小卢/排练过/歌剧/的/音乐厅/将要/扩大规模。 | 这句话提到了演唱会吗？ | 否 |
| 18 | d | 听说，/昨天/小卢/排练过/歌剧/的/音乐厅/已经/扩大了规模。 | 这句话提到了演唱会吗？ | 否 |
| 19 | a | 听说，/明天/丁大伯/曾经/托运行李/的/机场/将要/整修设备。 | | |
| 19 | b | 听说，/昨天/丁大伯/曾经/托运行李/的/机场/已经/整修了设备。 | | |
| 19 | c | 听说，/明天/丁大伯/托运过/行李/的/机场/将要/整修设备。 | | |
| 19 | d | 听说，/昨天/丁大伯/托运过/行李/的/机场/已经/整修了设备。 | | |
| 20 | a | 听说，/下个季度/摄影师/曾经/放映纪录片/的/电影院/将要/收取会费。 | | |
| 20 | b | 听说，/上个季度/摄影师/曾经/放映纪录片/的/电影院/已经/收取了会费。 | | |
| 20 | c | 听说，/下个季度/摄影师/放映过/纪录片/的/电影院/将要/收取会费。 | | |
| 20 | d | 听说，/上个季度/摄影师/放映过/纪录片/的/电影院/已经/收取了会费。 | | |
| 21 | a | 据说，/下周/桂爷爷/曾经/展出藏品/的/博物馆/将要/进行装潢。 | 这句话是关于一条胡同吗？ | 否 |
| 21 | b | 据说，/上周/桂爷爷/曾经/展出藏品/的/博物馆/已经/进行了装潢。 | 这句话是关于一条胡同吗？ | 否 |
| 21 | c | 据说，/下周/桂爷爷/展出过/藏品/的/博物馆/将要/进行装潢。 | 这句话是关于一条胡同吗？ | 否 |
| 21 | d | 据说，/上周/桂爷爷/展出过/藏品/的/博物馆/已经/进行了装潢。 | 这句话是关于一条胡同吗？ | 否 |
| 22 | a | 据说，/后年/朱市长/曾经/接见总统/的/会堂/将要/洗刷外墙。 | | |
| 22 | b | 据说，/前年/朱市长/曾经/接见总统/的/会堂/已经/洗刷了外墙。 | | |
| 22 | c | 据说，/后年/朱市长/接见过/总统/的/会堂/将要/洗刷外墙。 | | |
| 22 | d | 据说，/前年/朱市长/接见过/总统/的/会堂/已经/洗刷了外墙。 | | |

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| 23 | a | 听说，/下个季度/小楠/曾经/签订合同/的/展会/将要/扩大规模。 | | |
| 23 | b | 听说，/上个季度/小楠/曾经/签订合同/的/展会/已经/扩大了规模。 | | |
| 23 | c | 听说，/下个季度/小楠/签订过/合同/的/展会/将要/扩大规模。 | | |
| 23 | d | 听说，/上个季度/小楠/签订过/合同/的/展会/已经/扩大了规模。 | | |
| 24 | a | 据说，/明年/老席/曾经/召集乡亲/的/场地/将要/铺设地板。 | | |
| 24 | b | 据说，/去年/老席/曾经/召集乡亲/的/场地/已经/铺设了地板。 | | |
| 24 | c | 据说，/明年/老席/召集过/乡亲/的/场地/将要/铺设地板。 | | |
| 24 | d | 据说，/去年/老席/召集过/乡亲/的/场地/已经/铺设了地板。 | | |
| 25 | a | 听说，/明天/小戴/曾经/拍卖作品/的/画廊/将要/邀请知名画家。 | 这句话提到了小戴吗？ | 是 |
| 25 | b | 听说，/昨天/小戴/曾经/拍卖作品/的/画廊/已经/邀请了知名画家。 | 这句话提到了小戴吗？ | 是 |
| 25 | c | 听说，/明天/小戴/拍卖过/作品/的/画廊/将要/邀请知名画家。 | 这句话提到了小戴吗？ | 是 |
| 25 | d | 听说，/昨天/小戴/拍卖过/作品/的/画廊/已经/邀请了知名画家。 | 这句话提到了小戴吗？ | 是 |
| 26 | a | 听说，/下周/贾奶奶/曾经/观赏樱花/的/公园/将要/造假山。 | 这句话中，公园要拆掉什么东西吗？ | 否 |
| 26 | b | 听说，/上周/贾奶奶/曾经/观赏樱花/的/公园/已经/造了假山。 | 这句话中，公园要拆掉什么东西吗？ | 否 |
| 26 | c | 听说，/下周/贾奶奶/观赏过/樱花/的/公园/将要/造假山。 | 这句话中，公园要拆掉什么东西吗？ | 否 |
| 26 | d | 听说，/上周/贾奶奶/观赏过/樱花/的/公园/已经/造了假山。 | 这句话中，公园要拆掉什么东西吗？ | 否 |
| 27 | a | 听说，/下学期/小陆/曾经/补习英语/的/辅导班/将要/扩大规模。 | | |
| 27 | b | 听说，/上学期/小陆/曾经/补习英语/的/辅导班/已经/扩大了规模。 | | |
| 27 | c | 听说，/下学期/小陆/补习过/英语/的/辅导班/将要/扩大规模。 | | |
| 27 | d | 听说，/上学期/小陆/补习过/英语/的/辅导班/已经/扩大了规模。 | | |
| 28 | a | 据说，/下个季度/小锐/曾经/测试网速/的/校园/将要/更换运营商。 | | |
| 28 | b | 据说，/上个季度/小锐/曾经/测试网速/的/校园/已经/更换了运营商。 | | |
| 28 | c | 据说，/下个季度/小锐/测试过/网速/的/校园/将要/更换运营商。 | | |
| 28 | d | 据说，/上个季度/小锐/测试过/网速/的/校园/已经/更换了运营商。 | | |

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| 29 | a | 据说，/后天/老金/曾经/接待贵客/的/酒店/将要/推出新菜。 | | |
| 29 | b | 据说，/前天/老金/曾经/接待贵客/的/酒店/已经/推出了新菜。 | | |
| 29 | c | 据说，/后天/老金/接待过/贵客/的/酒店/将要/推出新菜。 | | |
| 29 | d | 据说，/前天/老金/接待过/贵客/的/酒店/已经/推出了新菜。 | | |
| 30 | a | 听说，/下周/老祁/曾经/收割庄稼/的/山坡/将要/退耕还林。 | | |
| 30 | b | 听说，/上周/老祁/曾经/收割庄稼/的/山坡/已经/退耕还林了。 | | |
| 30 | c | 听说，/下周/老祁/收割过/庄稼/的/山坡/将要/退耕还林。 | | |
| 30 | d | 听说，/上周/老祁/收割过/庄稼/的/山坡/已经/退耕还林了。 | | |
| 31 | a | 听说，/明天/区政府/曾经/拆除建筑/的/街道/将要/重新绿化。 | 这句话提到了区政府吗？ | 是 |
| 31 | b | 听说，/昨天/区政府/曾经/拆除建筑/的/街道/已经/重新绿化了。 | 这句话提到了区政府吗？ | 是 |
| 31 | c | 听说，/明天/区政府/拆除过/建筑/的/街道/将要/重新绿化。 | 这句话提到了区政府吗？ | 是 |
| 31 | d | 听说，/昨天/区政府/拆除过/建筑/的/街道/已经/重新绿化了。 | 这句话提到了区政府吗？ | 是 |
| 32 | a | 据说，/后天/小莎/曾经/点评美食/的/博客/将要/关闭。 | | |
| 32 | b | 据说，/前天/小莎/曾经/点评美食/的/博客/已经/关闭了。 | | |
| 32 | c | 据说，/后天/小莎/点评过/美食/的/博客/将要/关闭。 | | |
| 32 | d | 据说，/前天/小莎/点评过/美食/的/博客/已经/关闭了。 | | |
| 33 | a | 听说，/明天/小莉/曾经/订做时装/的/商店/将要/停止营业。 | | |
| 33 | b | 听说，/昨天/小莉/曾经/订做时装/的/商店/已经/停止营业了。 | | |
| 33 | c | 听说，/明天/小莉/订做过/时装/的/商店/将要/停止营业。 | | |
| 33 | d | 听说，/昨天/小莉/订做过/时装/的/商店/已经/停止营业了。 | | |
| 34 | a | 据说，/明年/孙老板/曾经/批发服装/的/市场/将会/扩大规模。 | | |
| 34 | b | 据说，/去年/孙老板/曾经/批发服装/的/市场/已经/扩大了规模。 | | |
| 34 | c | 据说，/明年/孙老板/批发过/服装/的/市场/将会/扩大规模。 | | |
| 34 | d | 据说，/去年/孙老板/批发过/服装/的/市场/已经/扩大了规模。 | | |

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| 35 | a | 听说，/明年/小云/曾经/送别友人/的/车站/将要/加开列车。 | | |
| 35 | b | 听说，/去年/小云/曾经/送别友人/的/车站/已经/加开了列车。 | | |
| 35 | c | 听说，/明年/小云/送别过/友人/的/车站/将要/加开列车。 | | |
| 35 | d | 听说，/去年/小云/送别过/友人/的/车站/已经/加开了列车。 | | |
| 36 | a | 据说，/下周/毕叔叔/曾经/看望病人/的/医院/将要/加开病房。 | 这句话中，病房会增加吗？ | 是 |
| 36 | b | 据说，/上周/毕叔叔/曾经/看望病人/的/医院/已经/加开了病房。 | 这句话中，病房增加了吗？ | 是 |
| 36 | c | 据说，/下周/毕叔叔/看望过/病人/的/医院/将要/加开病房。 | 这句话中，病房会增加吗？ | 是 |
| 36 | d | 据说，/上周/毕叔叔/看望过/病人/的/医院/已经/加开了病房。 | 这句话中，病房增加了吗？ | 是 |
| 37 | a | 据说，/下个季度/老闻/曾经/饲养禽类/的/农场/将要/加入农会。 | | |
| 37 | b | 据说，/上个季度/老闻/曾经/饲养禽类/的/农场/已经/加入了农会。 | | |
| 37 | c | 据说，/下个季度/老闻/饲养过/禽类/的/农场/将要/加入农会。 | | |
| 37 | d | 据说，/上个季度/老闻/饲养过/禽类/的/农场/已经/加入了农会。 | | |
| 38 | a | 据说，/下周/小楚/曾经/照顾老人/的/社区/将要/设立医疗站。 | | |
| 38 | b | 据说，/上周/小楚/曾经/照顾老人/的/社区/已经/设立了医疗站。 | | |
| 38 | c | 据说，/下周/小楚/照顾过/老人/的/社区/将要/设立医疗站。 | | |
| 38 | d | 据说，/上周/小楚/照顾过/老人/的/社区/已经/设立了医疗站。 | | |
| 39 | a | 据说，/后年/小荣/曾经/搭建仪器/的/实验室/将要/整改。 | | |
| 39 | b | 据说，/前年/小荣/曾经/搭建仪器/的/实验室/已经/整改了。 | | |
| 39 | c | 据说，/后年/小荣/搭建过/仪器/的/实验室/将要/整改。 | | |
| 39 | d | 据说，/前年/小荣/搭建过/仪器/的/实验室/已经/整改了。 | | |
| 40 | a | 据说，/后天/小宇/曾经/投递包裹/的/小区/将要/通暖气。 | 这句话提到了保安吗？ | 否 |
| 40 | b | 据说，/前天/小宇/曾经/投递包裹/的/小区/已经/通了暖气。 | 这句话提到了保安吗？ | 否 |
| 40 | c | 据说，/后天/小宇/投递过/包裹/的/小区/将要/通暖气。 | 这句话提到了保安吗？ | 否 |
| 40 | d | 据说，/前天/小宇/投递过/包裹/的/小区/已经/通了暖气。 | 这句话提到了保安吗？ | 否 |

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| 41 | a | 听说，/明年/魏伯伯/曾经/收割麦子/的/山坡/将要/退耕还林。 | | |
| 41 | b | 听说，/去年/魏伯伯/曾经/收割麦子/的/山坡/已经/退耕还林了。 | | |
| 41 | c | 听说，/明年/魏伯伯/收割过/麦子/的/山坡/将要/退耕还林。 | | |
| 41 | d | 听说，/去年/魏伯伯/收割过/麦子/的/山坡/已经/退耕还林了。 | | |
| 42 | a | 听说，/下个月/老马/曾经/招待客户/的/会议室/将要/重新装修。 | 这句话中，有人要拆掉一个房间吗？ | 否 |
| 42 | b | 听说，/上个月/老马/曾经/招待客户/的/会议室/已经/重新装修了。 | 这句话中，有人拆掉了一个房间吗？ | 否 |
| 42 | c | 听说，/下个月/老马/招待过/客户/的/会议室/将要/重新装修。 | 这句话中，有人要拆掉一个房间吗？ | 否 |
| 42 | d | 听说，/上个月/老马/招待过/客户/的/会议室/已经/重新装修了。 | 这句话中，有人拆掉了一个房间吗？ | 否 |
| 43 | a | 据说，/下周/老费/曾经/捕捞鱼虾/的/湖边/将要/建保护区。 | | |
| 43 | b | 据说，/上周/老费/曾经/捕捞鱼虾/的/湖边/已经/建了保护区。 | | |
| 43 | c | 据说，/下周/老费/捕捞过/鱼虾/的/湖边/将要/建保护区。 | | |
| 43 | d | 据说，/上周/老费/捕捞过/鱼虾/的/湖边/已经/建了保护区。 | | |
| 44 | a | 听说，/下个季度/小翰/曾经/分析行情/的/报告/将要/在内刊刊登。 | | |
| 44 | b | 听说，/上个季度/小翰/曾经/分析行情/的/报告/已经/在内刊刊登了。 | | |
| 44 | c | 听说，/下个季度/小翰/分析过/行情/的/报告/将要/在内刊刊登。 | | |
| 44 | d | 听说，/上个季度/小翰/分析过/行情/的/报告/已经/在内刊刊登了。 | | |
| 45 | a | 据说，/下学期/孟主任/曾经/表彰教工/的/礼堂/将要/升级设备。 | | |
| 45 | b | 据说，/上学期/孟主任/曾经/表彰教工/的/礼堂/已经/升级了设备。 | | |
| 45 | c | 据说，/下学期/孟主任/表彰过/教工/的/礼堂/将要/升级设备。 | | |
| 45 | d | 据说，/上学期/孟主任/表彰过/教工/的/礼堂/已经/升级了设备。 | | |
| 46 | a | 据说，/下个月/小贝/曾经/观测黑洞/的/天文台/将要/对市民开放。 | | |
| 46 | b | 据说，/上个月/小贝/曾经/观测黑洞/的/天文台/已经/对市民开放了。 | | |
| 46 | c | 据说，/下个月/小贝/观测过/黑洞/的/天文台/将要/对市民开放。 | | |
| 46 | d | 据说，/上个月/小贝/观测过/黑洞/的/天文台/已经/对市民开放了。 | | |

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| 47 | a | 听说，/明天/市政府/曾经/规划道路/的/城区/将要/修建少年宫。 | | |
| 47 | b | 听说，/昨天/市政府/曾经/规划道路/的/城区/已经/修建了少年宫。 | | |
| 47 | c | 听说，/明天/市政府/规划过/道路/的/城区/将要/建少年宫。 | | |
| 47 | d | 听说，/昨天/市政府/规划过/道路/的/城区/已经/修建了少年宫。 | | |
| 48 | a | 听说，/明天/小伟/曾经/招募志愿者/的/学校/将要/放寒假。 | | |
| 48 | b | 听说，/昨天/小伟/曾经/招募志愿者/的/学校/已经/放了寒假。 | | |
| 48 | c | 听说，/明天/小伟/招募过/志愿者/的/学校/将要/放寒假。 | | |
| 48 | d | 听说，/昨天/小伟/招募过/志愿者/的/学校/已经/放了寒假。 | | |
| 49 | a | 听说，/后天/小红/曾经/遗失手机/的/饭店/将要/被监控。 | | |
| 49 | b | 听说，/前天/小红/曾经/遗失手机/的/饭店/已经/被监控了。 | | |
| 49 | c | 听说，/后天/小红/遗失过/手机/的/饭店/将要/被监控。 | | |
| 49 | d | 听说，/前天/小红/遗失过/手机/的/饭店/已经/被监控了。 | | |
| 50 | a | 据说，/明天/杜师傅/曾经/粉刷墙面/的/房间/将要/交付给业主。 | | |
| 50 | b | 据说，/昨天/杜师傅/曾经/粉刷墙面/的/房间/已经/交付给了业主。 | | |
| 50 | c | 据说，/明天/杜师傅/粉刷过/墙面/的/房间/将要/交付给业主。 | | |
| 50 | d | 据说，/昨天/杜师傅/粉刷过/墙面/的/房间/已经/交付给了业主。 | | |
| 51 | a | 听说，/下个季度/小玲/曾经/主持节目/的/频道/将要/推出新栏目。 | | |
| 51 | b | 听说，/上个季度/小玲/曾经/主持节目/的/频道/已经/推出了新栏目。 | | |
| 51 | c | 听说，/下个季度/小玲/主持过/节目/的/频道/将要/推出新栏目。 | | |
| 51 | d | 听说，/上个季度/小玲/主持过/节目/的/频道/已经/推出了新栏目。 | | |
| 52 | a | 听说，/下个月/小尤/曾经/维修暖气/的/大楼/将要/转租。 | 这句话是关于一个超市吗？ | 否 |
| 52 | b | 听说，/上个月/小尤/曾经/维修暖气/的/大楼/已经/转租了。 | 这句话是关于一个超市吗？ | 否 |
| 52 | c | 听说，/下个月/小尤/维修过/暖气/的/大楼/将要/转租。 | 这句话是关于一个超市吗？ | 否 |
| 52 | d | 听说，/上个月/小尤/维修过/暖气/的/大楼/已经/转租了。 | 这句话是关于一个超市吗？ | 否 |

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| 53 | a | 据说，/下个月/惠叔叔/曾经/购买茶叶/的/超市/将要/推出礼盒。 | | |
| 53 | b | 据说，/上个月/惠叔叔/曾经/购买茶叶/的/超市/已经/推出了礼盒。 | | |
| 53 | c | 据说，/下个月/惠叔叔/购买过/茶叶/的/超市/将要/推出礼盒。 | | |
| 53 | d | 据说，/上个月/惠叔叔/购买过/茶叶/的/超市/已经/推出了礼盒。 | | |
| 54 | a | 听说，/下学期/小智/曾经/偶遇校长/的/餐厅/将要/推出优惠。 | | |
| 54 | b | 听说，/上学期/小智/曾经/偶遇校长/的/餐厅/已经/推出了优惠。 | | |
| 54 | c | 听说，/下学期/小智/偶遇过/校长/的/餐厅/将要/推出优惠。 | | |
| 54 | d | 听说，/上学期/小智/偶遇过/校长/的/餐厅/已经/推出了优惠。 | | |
| 55 | a | 听说，/下个季度/小娅/曾经/设计家装/的/工作室/将要/搬走。 | 这句话提到了一个收费站吗？ | 否 |
| 55 | b | 听说，/上个季度/小娅/曾经/设计家装/的/工作室/已经/搬走了。 | 这句话提到了一个收费站吗？ | 否 |
| 55 | c | 听说，/下个季度/小娅/设计过/家装/的/工作室/将要/搬走。 | 这句话提到了一个收费站吗？ | 否 |
| 55 | d | 听说，/上个季度/小娅/设计过/家装/的/工作室/已经/搬走了。 | 这句话提到了一个收费站吗？ | 否 |
| 56 | a | 据说，/后年/韩导演/曾经/录制影像/的/景区/将要/修建索道。 | 这句话中，有人拆掉索道吗？ | 否 |
| 56 | b | 据说，/前年/韩导演/曾经/录制影像/的/景区/已经/修建了索道。 | 这句话中，有人拆掉索道吗？ | 否 |
| 56 | c | 据说，/后年/韩导演/录制过/影像/的/景区/将要/修建索道。 | 这句话中，有人拆掉索道吗？ | 否 |
| 56 | d | 据说，/前年/韩导演/录制过/影像/的/景区/已经/修建了索道。 | 这句话中，有人拆掉索道吗？ | 否 |
| 57 | a | 听说，/明天/小鹏/曾经/布置道具/的/剧院/将要/上演新作。 | | |
| 57 | b | 听说，/昨天/小鹏/曾经/布置道具/的/剧院/已经/上演了新作。 | | |
| 57 | c | 听说，/明天/小鹏/布置过/道具/的/剧院/将要/上演新作。 | | |
| 57 | d | 听说，/昨天/小鹏/布置过/道具/的/剧院/已经/上演了新作。 | | |
| 58 | a | 据说，/明天/董爷爷/曾经/培育种子/的/花圃/将要/被拆掉。 | | |
| 58 | b | 据说，/昨天/董爷爷/曾经/培育种子/的/花圃/已经/被拆掉了。 | | |
| 58 | c | 据说，/明天/董爷爷/培育过/种子/的/花圃/将要/被拆掉。 | | |
| 58 | d | 据说，/昨天/董爷爷/培育过/种子/的/花圃/已经/被拆掉了。 | | |

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| 59 | a | 据说，/下个月/联合国/曾经/派出调查组/的/地区/将要/宣布独立。 | | |
| 59 | b | 据说，/上个月/联合国/曾经/派出调查组/的/地区/已经/宣布独立了。 | | |
| 59 | c | 据说，/下个月/联合国/派出过/调查组/的/地区/将要/宣布独立。 | | |
| 59 | d | 据说，/上个月/联合国/派出过/调查组/的/地区/已经/宣布独立了。 | | |
| 60 | a | 据说，/下学期/教职工/曾经/举办运动会/的/操场/将要/铺设跑道。 | | |
| 60 | b | 据说，/上学期/教职工/曾经/举办运动会/的/操场/已经/铺设了跑道。 | | |
| 60 | c | 据说，/下学期/教职工/举办过/运动会/的/操场/将要/铺设跑道。 | | |
| 60 | d | 据说，/上学期/教职工/举办过/运动会/的/操场/将要/铺设了跑道。 | | |
| 61 | a | 听说，/后年/老沈/曾经/修理汽车/的/工厂/将要/进行重组。 | | |
| 61 | b | 听说，/前年/老沈/曾经/修理汽车/的/工厂/已经/进行了重组。 | | |
| 61 | c | 听说，/后年/老沈/修理过/汽车/的/工厂/将要/进行重组。 | | |
| 61 | d | 听说，/前年/老沈/修理过/汽车/的/工厂/已经/进行了重组。 | | |
| 62 | a | 据说，/下学期/薛部长/曾经/试点教改/的/幼儿园/将要/提高学费。 | | |
| 62 | b | 据说，/上学期/薛部长/曾经/试点教改/的/幼儿园/已经/提高了学费。 | | |
| 62 | c | 据说，/下学期/薛部长/试点过/教改/的/幼儿园/将要/提高学费。 | | |
| 62 | d | 据说，/上学期/薛部长/试点过/教改/的/幼儿园/已经/提高了学费。 | | |
| 63 | a | 听说，/后年/小闫/曾经/练习长跑/的/体育馆/将要/对市民开放。 | | |
| 63 | b | 听说，/前年/小闫/曾经/练习长跑/的/体育馆/已经/对市民开放了。 | | |
| 63 | c | 听说，/后年/小闫/练习过/长跑/的/体育馆/将要/对市民开放。 | | |
| 63 | d | 听说，/前年/小闫/练习过/长跑/的/体育馆/已经/对市民开放了。 | | |
| 64 | a | 据说，/明天/小强/曾经/管理物业/的/大楼/将要/洗刷外墙。 | | |
| 64 | b | 据说，/昨天/小强/曾经/管理物业/的/大楼/已经/洗刷了外墙。 | | |
| 64 | c | 据说，/明天/小强/管理过/物业/的/大楼/将要/洗刷外墙。 | | |
| 64 | d | 据说，/昨天/小强/管理过/物业/的/大楼/已经/洗刷了外墙。 | | |

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| 65 | a | 据说，/下周/老姜/曾经/检查视力/的/诊所/将要/开药房。 | | |
| 65 | b | 据说，/上周/老姜/曾经/检查视力/的/诊所/已经/开了药房。 | | |
| 65 | c | 据说，/下周/老姜/检查过/视力/的/诊所/将要/开药房。 | | |
| 65 | d | 据说，/上周/老姜/检查过/视力/的/诊所/已经/开了药房。 | | |
| 66 | a | 听说，/下个季度/小沈/曾经/制作游戏/的/工作室/将要/卖给别人。 | | |
| 66 | b | 听说，/上个季度/小沈/曾经/制作游戏/的/工作室/已经/转卖给了别人。 | | |
| 66 | c | 听说，/下个季度/小沈/制作过/游戏/的/工作室/将要/卖给别人。 | | |
| 66 | d | 听说，/上个季度/小沈/制作过/游戏/的/工作室/已经/转卖给了别人。 | | |
| 67 | a | 据说，/明年/老林/曾经/培训考生/的/学校/将要/开设新课程。 | 这句话中，学校要开新课吗？ | 是 |
| 67 | b | 据说，/去年/老林/曾经/培训考生/的/学校/已经/开设了新课程。 | 这句话中，学校开了新课吗？ | 是 |
| 67 | c | 据说，/明年/老林/培训过/考生/的/学校/将要/开设新课程。 | 这句话中，学校要开新课吗？ | 是 |
| 67 | d | 据说，/去年/老林/培训过/考生/的/学校/已经/开设了新课程。 | 这句话中，学校开了新课吗？ | 是 |
| 68 | a | 据说，/下个月/程爷爷/曾经/种植月季/的/花园/将要/重新施肥。 | | |
| 68 | b | 据说，/上个月/程爷爷/曾经/种植月季/的/花园/已经/重新施了肥。 | | |
| 68 | c | 据说，/下个月/程爷爷/种植过/月季/的/花园/将要/重新施肥。 | | |
| 68 | d | 据说，/上个月/程爷爷/种植过/月季/的/花园/已经/重新施了肥。 | | |
| 69 | a | 听说，/后年/小霞/曾经/播报新闻/的/电视台/将要/淘汰旧栏目。 | | |
| 69 | b | 听说，/前年/小霞/曾经/播报新闻/的/电视台/已经/淘汰了旧栏目。 | | |
| 69 | c | 听说，/后年/小霞/播报过/新闻/的/电视台/将要/淘汰旧栏目。 | | |
| 69 | d | 听说，/前年/小霞/播报过/新闻/的/电视台/已经/淘汰了旧栏目。 | | |
| 70 | a | 听说，/后天/小牧/曾经/销售生鲜/的/集市/将要/收摊位费。 | 这句话是关于一个集市吗？ | 是 |
| 70 | b | 听说，/前天/小牧/曾经/销售生鲜/的/集市/已经/收摊位费了。 | 这句话是关于一个集市吗？ | 是 |
| 70 | c | 听说，/后天/小牧/销售过/生鲜/的/集市/将要/收摊位费。 | 这句话是关于一个集市吗？ | 是 |
| 70 | d | 听说，/前天/小牧/销售过/生鲜/的/集市/已经/收摊位费了。 | 这句话是关于一个集市吗？ | 是 |

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| 71 | a | 据说，/下个季度/老陶/曾经/办理手续/的/部门/将要/延长工时。 | | |
| 71 | b | 据说，/上个季度/老陶/曾经/办理手续/的/部门/已经/延长了工时。 | | |
| 71 | c | 据说，/下个季度/老陶/办理过/手续/的/部门/将要/延长工时。 | | |
| 71 | d | 据说，/上个季度/老陶/办理过/手续/的/部门/已经/延长了工时。 | | |
| 72 | a | 听说，/明天/小海/曾经/披露消息/的/报告/将要/被上级审查。 | 这句话中，报告会被审查吗？ | 是 |
| 72 | b | 听说，/昨天/小海/曾经/披露消息/的/报告/已经/被上级审查了。 | 这句话中，报告被审查了吗？ | 是 |
| 72 | c | 听说，/明天/小海/披露过/消息/的/报告/将要/被上级审查。 | 这句话中，报告会被审查吗？ | 是 |
| 72 | d | 听说，/昨天/小海/披露过/消息/的/报告/已经/被上级审查了。 | 这句话中，报告被审查了吗？ | 是 |
| 73 | a | 听说，/下周/科学家/曾经/观测日食/的/天文台/将要/升级设备。 | | |
| 73 | b | 听说，/上周/科学家/曾经/观测日食/的/天文台/已经/升级了设备。 | | |
| 73 | c | 听说，/下周/科学家/观测过/日食/的/天文台/将要/升级设备。 | | |
| 73 | d | 听说，/上周/科学家/观测过/日食/的/天文台/已经/升级了设备。 | | |
| 74 | a | 听说，/下学期/小硕/曾经/合成样品/的/实验室/将要/招聘管理员。 | | |
| 74 | b | 听说，/上学期/小硕/曾经/合成样品/的/实验室/已经/招聘了管理员。 | | |
| 74 | c | 听说，/下学期/小硕/合成过/样品/的/实验室/将要/招聘管理员。 | | |
| 74 | d | 听说，/上学期/小硕/合成过/样品/的/实验室/已经/招聘了管理员。 | | |
| 75 | a | 听说，/下个季度/省政府/曾经/修建公路/的/山区/将要/开发旅游。 | | |
| 75 | b | 听说，/上个季度/省政府/曾经/修建公路/的/山区/已经/开发了旅游。 | | |
| 75 | c | 听说，/下个季度/省政府/修建过/公路/的/山区/将要/开发旅游。 | | |
| 75 | d | 听说，/上个季度/省政府/修建过/公路/的/山区/已经/开发了旅游。 | | |
| 76 | a | 据说，/明年/老黄/曾经/砍伐木材/的/树林/将要/封山育林。 | | |
| 76 | b | 据说，/去年/老黄/曾经/砍伐木材/的/树林/已经/封山育林了。 | | |
| 76 | c | 据说，/明年/老黄/砍伐过/木材/的/树林/将要/封山育林。 | | |
| 76 | d | 据说，/去年/老黄/砍伐过/木材/的/树林/已经/封山育林了。 | | |

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| 77 | a | 听说，/后天/李阿姨/曾经/兑换美元/的/银行/将要/暂停交易。 | | |
| 77 | b | 听说，/前天/李阿姨/曾经/兑换美元/的/银行/已经/暂停了交易。 | | |
| 77 | c | 听说，/后天/李阿姨/兑换过/美元/的/银行/将要/暂停交易。 | | |
| 77 | d | 听说，/前天/李阿姨/兑换过/美元/的/银行/已经/暂停了交易。 | | |
| 78 | a | 听说，/后年/老孙/曾经/排查超载/的/路口/将要/装上红绿灯。 | | |
| 78 | b | 听说，/前年/老孙/曾经/排查超载/的/路口/已经/装上了红绿灯。 | | |
| 78 | c | 听说，/后年/老孙/排查过/超载/的/路口/将要/装上红绿灯。 | | |
| 78 | d | 听说，/前年/老孙/排查过/超载/的/路口/已经/装上了红绿灯。 | | |
| 79 | a | 据说，/后天/老邱/曾经/签署协议/的/会议室/将要/被转租。 | 这句话中，会议室要出租吗？ | 是 |
| 79 | b | 据说，/前天/老邱/曾经/签署协议/的/会议室/已经/被转租了。 | 这句话中，会议室出租了吗？ | 是 |
| 79 | c | 据说，/后天/老邱/签署过/协议/的/会议室/将要/被转租。 | 这句话中，会议室要出租吗？ | 是 |
| 79 | d | 据说，/前天/老邱/签署过/协议/的/会议室/已经/被转租了。 | 这句话中，会议室出租了吗？ | 是 |
| 80 | a | 听说，/后天/关阿姨/曾经/批发文具/的/市场/将要/搬到开发区。 | 这句话和一个市场有关吗？ | 是 |
| 80 | b | 听说，/前天/关阿姨/曾经/批发文具/的/市场/已经/搬到了开发区。 | 这句话和一个市场有关吗？ | 是 |
| 80 | c | 听说，/后天/关阿姨/批发过/文具/的/市场/将会/搬到开发区。 | 这句话和一个市场有关吗？ | 是 |
| 80 | d | 听说，/前天/关阿姨/批发过/文具/的/市场/已经/搬到了开发区。 | 这句话和一个市场有关吗？ | 是 |
| 81 | a | 据说，/后天/小然/曾经/预定套房/的/旅馆/将要/换东家。 | 这句话是关于一个比赛场馆吗？ | 否 |
| 81 | b | 据说，/前天/小然/曾经/预定套房/的/旅馆/已经/换了东家。 | 这句话是关于一个比赛场馆吗？ | 否 |
| 81 | c | 据说，/后天/小然/预定过/套房/的/旅馆/将要/换东家。 | 这句话是关于一个比赛场馆吗？ | 否 |
| 81 | d | 据说，/前天/小然/预定过/套房/的/旅馆/已经/换了东家。 | 这句话是关于一个比赛场馆吗？ | 否 |
| 82 | a | 据说，/后年/李将军/曾经/驻守边境/的/国家/将要/开放贸易。 | | |
| 82 | b | 据说，/前年/李将军/曾经/驻守边境/的/国家/已经/开放了贸易。 | | |
| 82 | c | 据说，/后年/李将军/驻守过/边境/的/国家/将要/开放贸易。 | | |
| 82 | d | 据说，/前年/李将军/驻守过/边境/的/国家/已经/开放了贸易。 | | |

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| 83 | a | 据说，/下个季度/小俊/曾经/种植玫瑰/的/花园/将要/盖温室。 | | |
| 83 | b | 据说，/上个季度/小俊/曾经/种植玫瑰/的/花园/已经/盖了温室。 | | |
| 83 | c | 据说，/下个季度/小俊/种植过/玫瑰/的/花园/将要/盖温室。 | | |
| 83 | d | 据说，/上个季度/小俊/种植过/玫瑰/的/花园/已经/盖了温室。 | | |
| 84 | a | 听说，/下周/老曹/曾经/治理风沙/的/草原/将要/进入旱季。 | | |
| 84 | b | 听说，/上周/老曹/曾经/治理风沙/的/草原/已经/进入了旱季。 | | |
| 84 | c | 听说，/下周/老曹/治理过/风沙/的/草原/将要/进入旱季。 | | |
| 84 | d | 听说，/上周/老曹/治理过/风沙/的/草原/已经/进入了旱季。 | | |
| 85 | a | 听说，/下学期/小戈/曾经/演练队形/的/球场/将要/铺草皮。 | | |
| 85 | b | 听说，/上学期/小戈/曾经/演练队形/的/球场/已经/铺了草皮。 | | |
| 85 | c | 听说，/下学期/小戈/演练过/队形/的/球场/将要/铺草皮。 | | |
| 85 | d | 听说，/上学期/小戈/演练过/队形/的/球场/已经/铺了草皮。 | | |
| 86 | a | 听说，/下周/老高/曾经/驾驶公交/的/路段/将要/加开车次。 | | |
| 86 | b | 听说，/上周/老高/曾经/驾驶公交/的/路段/已经/加开了车次。 | | |
| 86 | c | 听说，/下周/老高/驾驶过/公交/的/路段/将要/加开车次。 | | |
| 86 | d | 听说，/上周/老高/驾驶过/公交/的/路段/已经/加开了车次。 | | |
| 87 | a | 据说，/下学期/小玮/曾经/采集信息/的/系统/将要/升级。 | | |
| 87 | b | 据说，/上学期/小玮/曾经/采集信息/的/系统/已经/升级了。 | | |
| 87 | c | 据说，/下学期/小玮/采集过/信息/的/系统/将要/升级。 | | |
| 87 | d | 据说，/上学期/小玮/采集过/信息/的/系统/已经/升级了。 | | |
| 88 | a | 据说，/后年/老俞/曾经/欣赏京剧/的/音乐厅/将要/对老人免费。 | | |
| 88 | b | 据说，/前年/老俞/曾经/欣赏京剧/的/音乐厅/已经/对老人免费了。 | | |
| 88 | c | 据说，/后年/老俞/欣赏过/京剧/的/音乐厅/将要/对老人免费。 | | |
| 88 | d | 据说，/前年/老俞/欣赏过/京剧/的/音乐厅/已经/对老人免费了。 | | |

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| 89 | a | 听说，/下周/方老板/曾经/运输货物/的/轮船/将要/出海远航。 | 这句话和列车有关吗？ | 否 |
| 89 | b | 听说，/上周/方老板/曾经/运输货物/的/轮船/已经/出海远航了。 | 这句话和列车有关吗？ | 否 |
| 89 | c | 听说，/下周/方老板/运输过/货物/的/轮船/将要/出海远航。 | 这句话和列车有关吗？ | 否 |
| 89 | d | 听说，/上周/方老板/运输过/货物/的/轮船/已经/出海远航了。 | 这句话和列车有关吗？ | 否 |
| 90 | a | 听说，/下周/环保局/曾经/检测空气/的/城市/将要/限制排放。 | 这句话是关于食品安全吗？ | 否 |
| 90 | b | 听说，/上周/环保局/曾经/检测空气/的/城市/已经/限制了排放。 | 这句话是关于食品安全吗？ | 否 |
| 90 | c | 听说，/下周/环保局/检测过/空气/的/城市/将要/限制排放。 | 这句话是关于食品安全吗？ | 否 |
| 90 | d | 听说，/上周/环保局/检测过/空气/的/城市/已经/限制了排放。 | 这句话是关于食品安全吗？ | 否 |
| 91 | a | 听说，/后年/小孙/曾经/测量水位/的/湖边/将要/建保护区。 | | |
| 91 | b | 听说，/前年/小孙/曾经/测量水位/的/湖边/已经/建了保护区。 | | |
| 91 | c | 听说，/后年/小孙/测量过/水位/的/湖边/将要/建保护区。 | | |
| 91 | d | 听说，/前年/小孙/测量过/水位/的/湖边/已经/建了保护区。 | | |
| 92 | a | 听说，/后天/小曹/曾经/配送快件/的/居民区/将要/装门禁。 | | |
| 92 | b | 听说，/前天/小曹/曾经/配送快件/的/居民区/已经/装了门禁。 | | |
| 92 | c | 听说，/后天/小曹/配送过/快件/的/居民区/将要/装门禁。 | | |
| 92 | d | 听说，/前天/小曹/配送过/快件/的/居民区/已经/装了门禁。 | | |
| 93 | a | 据说，/后年/老苏/曾经/运送建材/的/车站/将要/更改时刻表。 | | |
| 93 | b | 据说，/前年/老苏/曾经/运送建材/的/车站/已经/更改了时刻表。 | | |
| 93 | c | 据说，/后年/老苏/运送过/建材/的/车站/将要/更改时刻表。 | | |
| 93 | d | 据说，/前年/老苏/运送过/建材/的/车站/已经/更改了时刻表。 | | |
| 94 | a | 据说，/下个月/小秦/曾经/表演话剧/的/剧院/将要/升级音响。 | | |
| 94 | b | 据说，/上个月/小秦/曾经/表演话剧/的/剧院/已经/升级了音响。 | | |
| 94 | c | 据说，/下个月/小秦/表演过/话剧/的/剧院/将要/升级音响。 | | |
| 94 | d | 据说，/上个月/小秦/表演过/话剧/的/剧院/已经/升级了音响。 | | |

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| 95 | a | 听说，/下学期/胡老师/曾经/批阅试卷/的/教学楼/将要/重新装修。 | 这句话是关于一条河吗？ | 否 |
| 95 | b | 听说，/上学期/胡老师/曾经/批阅试卷/的/教学楼/已经/重新装修了。 | 这句话是关于一条河吗？ | 否 |
| 95 | c | 听说，/下学期/胡老师/批阅过/试卷/的/教学楼/将要/重新装修。 | 这句话是关于一条河吗？ | 否 |
| 95 | d | 听说，/上学期/胡老师/批阅过/试卷/的/教学楼/已经/重新装修了。 | 这句话是关于一条河吗？ | 否 |
| 96 | a | 听说，/明年/晓丹/曾经/朗诵诗歌/的/舞台/将要/更新音响。 | | |
| 96 | b | 听说，/去年/晓丹/曾经/朗诵诗歌/的/舞台/已经/更新了音响。 | | |
| 96 | c | 听说，/明年/晓丹/朗诵过/诗歌/的/舞台/将要/更新音响。 | | |
| 96 | d | 听说，/去年/晓丹/朗诵过/诗歌/的/舞台/已经/更新了音响。 | | |
| 97 | a | 据说，/下个月/小纪/曾经/组装电器/的/工厂/将要/设立工会。 | | |
| 97 | b | 据说，/上个月/小纪/曾经/组装电器/的/工厂/已经/设立了工会。 | | |
| 97 | c | 据说，/下个月/小纪/组装过/电器/的/工厂/将要/设立工会。 | | |
| 97 | d | 据说，/上个月/小纪/组装过/电器/的/工厂/已经/设立了工会。 | | |
| 98 | a | 据说，/下周/余阿姨/曾经/购买牛奶/的/超市/将要/召回产品。 | | |
| 98 | b | 据说，/上周/余阿姨/曾经/购买牛奶/的/超市/已经/召回了产品。 | | |
| 98 | c | 据说，/下周/余阿姨/购买过/牛奶/的/超市/将要/召回产品。 | | |
| 98 | d | 据说，/上周/余阿姨/购买过/牛奶/的/超市/已经/召回了产品。 | | |
| 99 | a | 据说，/明年/小敏/曾经/取得胜利/的/比赛/将要/颁发奖杯。 | | |
| 99 | b | 据说，/去年/小敏/曾经/取得胜利/的/比赛/已经/颁发了奖杯。 | | |
| 99 | c | 据说，/明年/小敏/取得过/胜利/的/比赛/将要/颁发奖杯。 | | |
| 99 | d | 据说，/去年/小敏/取得过/胜利/的/比赛/已经/颁发了奖杯。 | | |
| 100 | a | 听说，/下个季度/小冰/曾经/练习射击/的/体育馆/将要/提高价格。 | | |
| 100 | b | 听说，/上个季度/小冰/曾经/练习射击/的/体育馆/已经/提高了价格。 | | |
| 100 | c | 听说，/下个季度/小冰/练习过/射击/的/体育馆/将要/提高价格。 | | |
| 100 | d | 听说，/上个季度/小冰/练习过/射击/的/体育馆/已经/提高了价格。 | | |

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| 101 | a | 据说，/下学期/老卢/曾经/担任书记/的/大学/将要/涨学费。 | | |
| 101 | b | 据说，/上学期/老卢/曾经/担任书记/的/大学/已经/涨了学费。 | | |
| 101 | c | 据说，/下学期/老卢/担任过/书记/的/大学/将要/涨学费。 | | |
| 101 | d | 据说，/上学期/老卢/担任过/书记/的/大学/已经/涨了学费。 | | |
| 102 | a | 据说，/下个月/小倩/曾经/编写课本/的/教学楼/将要/被拆掉。 | 这句话中，教学楼要拆了吗？ | 是 |
| 102 | b | 据说，/上个月/小倩/曾经/编写课本/的/教学楼/已经/被拆掉了。 | 这句话中，教学楼被拆了吗？ | 是 |
| 102 | c | 据说，/下个月/小倩/编写过/课本/的/教学楼/将要/被拆掉。 | 这句话中，教学楼要拆了吗？ | 是 |
| 102 | d | 据说，/上个月/小倩/编写过/课本/的/教学楼/已经/被拆掉了。 | 这句话中，教学楼被拆了吗？ | 是 |
| 103 | a | 据说，/下周/小万/曾经/搭乘航班/的/机场/将要/增加航线。 | | |
| 103 | b | 据说，/上周/小万/曾经/搭乘航班/的/机场/已经/增加了航线。 | | |
| 103 | c | 据说，/下周/小万/搭乘过/航班/的/机场/将要/增加航线。 | | |
| 103 | d | 据说，/上周/小万/搭乘过/航班/的/机场/已经/增加了航线。 | | |
| 104 | a | 据说，/下个月/李伯伯/曾经/饲养奶牛/的/农场/将要/引进新品种。 | 这句话提到了一个农场吗？ | 是 |
| 104 | b | 据说，/上个月/李伯伯/曾经/饲养奶牛/的/农场/已经/引进了新品种。 | 这句话提到了一个农场吗？ | 是 |
| 104 | c | 据说，/下个月/李伯伯/饲养过/奶牛/的/农场/将要/引进新品种。 | 这句话提到了一个农场吗？ | 是 |
| 104 | d | 据说，/上个月/李伯伯/饲养过/奶牛/的/农场/已经/引进了新品种。 | 这句话提到了一个农场吗？ | 是 |
| 105 | a | 听说，/明天/建筑局/曾经/修建铁路/的/山区/将要/脱贫致富。 | | |
| 105 | b | 听说，/昨天/建筑局/曾经/修建铁路/的/山区/已经/脱贫致富了。 | | |
| 105 | c | 听说，/明天/建筑局/修建过/铁路/的/山区/将要/脱贫致富。 | | |
| 105 | d | 听说，/昨天/建筑局/修建过/铁路/的/山区/已经/脱贫致富了。 | | |
| 106 | a | 据说，/后天/小唐/曾经/拍摄电影/的/古镇/将要/集体搬迁。 | | |
| 106 | b | 据说，/前天/小唐/曾经/拍摄电影/的/古镇/已经/集体搬迁了。 | | |
| 106 | c | 据说，/后天/小唐/拍摄过/电影/的/古镇/将要/集体搬迁。 | | |
| 106 | d | 据说，/前天/小唐/拍摄过/电影/的/古镇/已经/集体搬迁了。 | | |

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| 107 | a | 听说，/下个月/小明/曾经/接受治疗/的/医院/将要/拆了。 | | |
| 107 | b | 听说，/上个月/小明/曾经/接受治疗/的/医院/已经/拆了。 | | |
| 107 | c | 听说，/下个月/小明/接受过/治疗/的/医院/就要/拆了。 | | |
| 107 | d | 听说，/上个月/小明/接受过/治疗/的/医院/已经/拆了。 | | |
| 108 | a | 听说，/下个月/小冯/曾经/备份文件/的/硬盘/将要/被清空。 | | |
| 108 | b | 听说，/上个月/小冯/曾经/备份文件/的/硬盘/已经/被清空了。 | | |
| 108 | c | 听说，/下个月/小冯/备份过/文件/的/硬盘/将要/被清空。 | | |
| 108 | d | 听说，/上个月/小冯/备份过/文件/的/硬盘/已经/被清空了。 | | |
| 109 | a | 据说，/下个月/老邢/曾经/清扫垃圾/的/居民区/将要/禁止吸烟。 | 这句话和禁烟有关吗？ | 是 |
| 109 | b | 据说，/上个月/老邢/曾经/清扫垃圾/的/居民区/已经/禁止了吸烟。 | 这句话和禁烟有关吗？ | 是 |
| 109 | c | 据说，/下个月/老邢/清扫过/垃圾/的/居民区/将要/禁止吸烟。 | 这句话和禁烟有关吗？ | 是 |
| 109 | d | 据说，/上个月/老邢/清扫过/垃圾/的/居民区/已经/禁止了吸烟。 | 这句话和禁烟有关吗？ | 是 |
| 110 | a | 听说，/明年/考古队/曾经/展出文物/的/博物馆/将要/招聘馆长。 | 这句话中，有人要招聘吗？ | 是 |
| 110 | b | 听说，/去年/考古队/曾经/展出文物/的/博物馆/已经/招聘了馆长。 | 这句话中，有人要招聘吗？ | 是 |
| 110 | c | 听说，/明年/考古队/展出过/文物/的/博物馆/将要/招聘馆长。 | 这句话中，有人要招聘吗？ | 是 |
| 110 | d | 听说，/去年/考古队/展出过/文物/的/博物馆/已经/招聘了馆长。 | 这句话中，有人要招聘吗？ | 是 |
| 111 | a | 听说，/下周/李导演/曾经/放映新片/的/电影院/将要/提高票价。 | | |
| 111 | b | 听说，/上周/李导演/曾经/放映新片/的/电影院/已经/提高了票价。 | | |
| 111 | c | 听说，/下周/李导演/放映过/新片/的/电影院/将要/提高票价。 | | |
| 111 | d | 听说，/上周/李导演/放映过/新片/的/电影院/已经/提高了票价。 | | |
| 112 | a | 据说，/后天/小许/曾经/参观展览/的/科技馆/将要/推出年票。 | | |
| 112 | b | 据说，/前天/小许/曾经/参观展览/的/科技馆/已经/推出了年票。 | | |
| 112 | c | 据说，/后天/小许/参观过/展览/的/科技馆/将要/推出年票。 | | |
| 112 | d | 据说，/前天/小许/参观过/展览/的/科技馆/已经/推出了年票。 | | |

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| 113 | a | 听说，/下个月/李大伯/曾经/放牧牛羊/的/草原/将要/迎来雨季。 | 这句话是关于一片树林吗？ | 否 |
| 113 | b | 听说，/上个月/李大伯/曾经/放牧牛羊/的/草原/已经/迎来了雨季。 | 这句话是关于一片树林吗？ | 否 |
| 113 | c | 听说，/下个月/李大伯/放牧过/牛羊/的/草原/将要/迎来雨季。 | 这句话是关于一片树林吗？ | 否 |
| 113 | d | 听说，/上个月/李大伯/放牧过/牛羊/的/草原/已经/迎来了雨季。 | 这句话是关于一片树林吗？ | 否 |
| 114 | a | 听说，/下学期/小雪/曾经/申请留学/的/系统/将要/全面升级。 | 这句话和申请留学有关吗？ | 是 |
| 114 | b | 听说，/上学期/小雪/曾经/申请留学/的/系统/已经/全面升级了。 | 这句话和申请留学有关吗？ | 是 |
| 114 | c | 听说，/下学期/小雪/申请过/留学/的/系统/将要/全面升级。 | 这句话和申请留学有关吗？ | 是 |
| 114 | d | 听说，/上学期/小雪/申请过/留学/的/系统/已经/全面升级了。 | 这句话和申请留学有关吗？ | 是 |
| 115 | a | 听说，/下个季度/游阿姨/曾经/采购原料/的/商店/将要/设立质检会。 | | |
| 115 | b | 听说，/上个季度/游阿姨/曾经/采购原料/的/商店/已经/设立了质检会。 | | |
| 115 | c | 听说，/下个季度/游阿姨/采购过/原料/的/商店/将要/设立质检会。 | | |
| 115 | d | 听说，/上个季度/游阿姨/采购过/原料/的/商店/已经/设立了质检会。 | | |
| 116 | a | 听说，/明天/高中生/曾经/补习物理/的/辅导班/将要/开设新课。 | | |
| 116 | b | 听说，/昨天/高中生/曾经/补习物理/的/辅导班/已经/开设了新课。 | | |
| 116 | c | 听说，/明天/高中生/补习过/物理/的/辅导班/将要/开设新课。 | | |
| 116 | d | 听说，/昨天/高中生/补习过/物理/的/辅导班/已经/开设了新课。 | | |
| 117 | a | 听说，/下个季度/孙大伯/曾经/销售特产/的/集市/将要/扩大规模。 | | |
| 117 | b | 听说，/上个季度/孙大伯/曾经/销售特产/的/集市/已经/扩大了规模。 | | |
| 117 | c | 听说，/下个季度/孙大伯/销售过/特产/的/集市/将要/扩大规模。 | | |
| 117 | d | 听说，/上个季度/孙大伯/销售过/特产/的/集市/已经/扩大了规模。 | | |
| 118 | a | 听说，/明年/老范/曾经/训练宠物/的/基地/将要/收留流浪狗。 | | |
| 118 | b | 听说，/去年/老范/曾经/训练宠物/的/基地/已经/收留了流浪狗。 | | |
| 118 | c | 听说，/明年/老范/训练过/宠物/的/基地/将要/收留流浪狗。 | | |
| 118 | d | 据说，/去年/老范/训练过/宠物/的/基地/已经/收留了流浪狗。 | | |

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| 119 | a | 据说，/下个月/小露/曾经/培育幼苗/的/花圃/将要/卖给别人。 | | |
| 119 | b | 据说，/上个月/小露/曾经/培育幼苗/的/花圃/已经/卖给别人了。 | | |
| 119 | c | 据说，/下个月/小露/培育过/幼苗/的/花圃/将要/卖给别人。 | | |
| 119 | d | 据说，/上个月/小露/培育过/幼苗/的/花圃/已经/卖给别人了。 | | |
| 120 | a | 听说，/后年/小邓/曾经/接种疫苗/的/诊所/将要/降低医疗费。 | | |
| 120 | b | 听说，/前年/小邓/曾经/接种疫苗/的/诊所/已经/降低了医疗费。 | | |
| 120 | c | 听说，/后年/小邓/接种过/疫苗/的/诊所/将要/降低医疗费。 | | |
| 120 | d | 听说，/前年/小邓/接种过/疫苗/的/诊所/已经/降低了医疗费。 | | |
| 121 | a | 据说，/后年/小琳/曾经/调查民意/的/街道/将要/拆迁改造。 | | |
| 121 | b | 据说，/前年/小琳/曾经/调查民意/的/街道/已经/拆迁改造了。 | | |
| 121 | c | 据说，/后年/小琳/调查过/民意/的/街道/将要/拆迁改造。 | | |
| 121 | d | 据说，/前年/小琳/调查过/民意/的/街道/已经/拆迁改造了。 | | |
| 122 | a | 据说，/下学期/小沛/曾经/安装空调/的/餐厅/将要/被卖掉。 | | |
| 122 | b | 据说，/上学期/小沛/曾经/安装空调/的/餐厅/已经/被卖掉了。 | | |
| 122 | c | 据说，/下学期/小沛/安装过/空调/的/餐厅/将要/被卖掉。 | | |
| 122 | d | 据说，/上学期/小沛/安装过/空调/的/餐厅/已经/被卖掉了。 | | |
| 123 | a | 据说，/下个月/小北/曾经/张贴传单/的/社区/将要/安装门禁。 | | |
| 123 | b | 据说，/上个月/小北/曾经/张贴传单/的/社区/已经/装了门禁。 | | |
| 123 | c | 据说，/下个月/小北/张贴过/传单/的/社区/将要/安装门禁。 | | |
| 123 | d | 据说，/上个月/小北/张贴过/传单/的/社区/已经/装了门禁。 | | |
| 124 | a | 据说，/明年/老任/曾经/驾驶货车/的/路段/将要/装测速仪。 | | |
| 124 | b | 据说，/去年/老任/曾经/驾驶货车/的/路段/已经/装了测速仪。 | | |
| 124 | c | 据说，/明年/老任/驾驶过/货车/的/路段/将要/装测速仪。 | | |
| 124 | d | 据说，/去年/老任/驾驶过/货车/的/路段/已经/装了测速仪。 | | |

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| 125 | a | 听说，/下个季度/夏总裁/曾经/发布新品/的/展会/将要/邀请大公司。 | | |
| 125 | b | 听说，/上个季度/夏总裁/曾经/发布新品/的/展会/已经/邀请了大公司。 | | |
| 125 | c | 听说，/下个季度/夏总裁/发布过/新品/的/展会/将要/邀请大公司。 | | |
| 125 | d | 听说，/上个季度/夏总裁/发布过/新品/的/展会/已经/邀请了大公司。 | | |
| 126 | a | 据说，/下个季度/老蔡/曾经/拍卖瓷器/的/画廊/将要/破产。 | | |
| 126 | b | 据说，/上个季度/老蔡/曾经/拍卖瓷器/的/画廊/已经/破产了。 | | |
| 126 | c | 据说，/下个季度/老蔡/拍卖过/瓷器/的/画廊/将要/破产。 | | |
| 126 | d | 据说，/上个季度/老蔡/拍卖过/瓷器/的/画廊/已经/破产了。 | | |
| 127 | a | 听说，/下学期/中文系/曾经/举行晚会/的/礼堂/将要/对外开放。 | | |
| 127 | b | 听说，/上学期/中文系/曾经/举行晚会/的/礼堂/已经/对外开放了。 | | |
| 127 | c | 听说，/下学期/中文系/举行过/晚会/的/礼堂/将要/对外开放。 | | |
| 127 | d | 听说，/上学期/中文系/举行过/晚会/的/礼堂/已经/对外开放了。 | | |
| 128 | a | 据说，/后天/侦查组/曾经/执行任务/的/国家/将要/中止内战。 | 这句话中，内战会停止吗？ | 是 |
| 128 | b | 据说，/前天/侦查组/曾经/执行任务/的/国家/已经/中止了内战。 | 这句话中，内战停止了吗？ | 是 |
| 128 | c | 据说，/后天/侦查组/执行过/任务/的/国家/将要/中止内战。 | 这句话中，内战会停止吗？ | 是 |
| 128 | d | 据说，/前天/侦查组/执行过/任务/的/国家/已经/中止了内战。 | 这句话中，内战停止了吗？ | 是 |
| 129 | a | 听说，/后天/老陈/曾经/保留档案/的/办公室/将要/装防盗门。 | | |
| 129 | b | 听说，/前天/老陈/曾经/保留档案/的/办公室/已经/装了防盗门。 | | |
| 129 | c | 听说，/后天/老陈/保留过/档案/的/办公室/将要/装防盗门。 | | |
| 129 | d | 听说，/前天/老陈/保留过/档案/的/办公室/已经/装了防盗门。 | | |
| 130 | a | 听说，/下学期/小丁/曾经/剪辑视频/的/电脑/将要/重装软件。 | 这句话提到了一个电子设备吗？ | 是 |
| 130 | b | 听说，/上学期/小丁/曾经/剪辑视频/的/电脑/已经/重装了软件。 | 这句话提到了一个电子设备吗？ | 是 |
| 130 | c | 听说，/下学期/小丁/剪辑过/视频/的/电脑/将要/重装软件。 | 这句话提到了一个电子设备吗？ | 是 |
| 130 | d | 听说，/上学期/小丁/剪辑过/视频/的/电脑/已经/重装了软件。 | 这句话提到了一个电子设备吗？ | 是 |

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| 131 | a | 据说，/下个季度/慈善家/曾经/提供援助/的/地区/将要/恢复供电。 | | |
| 131 | b | 据说，/上个季度/慈善家/曾经/提供援助/的/地区/已经/恢复了供电。 | | |
| 131 | c | 据说，/下个季度/慈善家/提供过/援助/的/地区/将要/恢复供电。 | | |
| 131 | d | 据说，/上个季度/慈善家/提供过/援助/的/地区/已经/恢复了供电。 | | |
| 132 | a | 听说，/后天/小安/曾经/分享游记/的/博客/将要/改版。 | | |
| 132 | b | 听说，/前天/小安/曾经/分享游记/的/博客/已经/改版了。 | | |
| 132 | c | 听说，/后天/小安/分享过/游记/的/博客/将要/改版。 | | |
| 132 | d | 听说，/前天/小安/分享过/游记/的/博客/已经/改版了。 | | |
| 133 | a | 听说，/下学期/周教授/曾经/批改论文/的/房间/将要/进行装修。 | 这句话是关于一个房间吗？ | 是 |
| 133 | b | 听说，/上学期/周教授/曾经/批改论文/的/房间/已经/装修好了。 | 这句话是关于一个房间吗？ | 是 |
| 133 | c | 听说，/下学期/周教授/批改过/论文/的/房间/将要/进行装修。 | 这句话是关于一个房间吗？ | 是 |
| 133 | d | 听说，/上学期/周教授/批改过/论文/的/房间/已经/装修好了。 | 这句话是关于一个房间吗？ | 是 |
| 134 | a | 听说，/明年/孙师傅/曾经/修复寺庙/的/古镇/将要/迎来游客。 | | |
| 134 | b | 听说，/去年/孙师傅/曾经/修复寺庙/的/古镇/已经/迎来了游客。 | | |
| 134 | c | 听说，/明年/孙师傅/修复过/寺庙/的/古镇/将要/迎来游客。 | | |
| 134 | d | 听说，/去年/孙师傅/修复过/寺庙/的/古镇/已经/迎来了游客。 | | |
| 135 | a | 听说，/后天/王爷爷/曾经/观赏花卉/的/公园/将要/建造人工湖。 | | |
| 135 | b | 听说，/前天/王爷爷/曾经/观赏花卉/的/公园/已经/建造了人工湖。 | | |
| 135 | c | 听说，/后天/王爷爷/观赏过/花卉/的/公园/将要/建造人工湖。 | | |
| 135 | d | 听说，/前天/王爷爷/观赏过/花卉/的/公园/已经/建造了人工湖。 | | |
| 136 | a | 听说，/明年/小王/曾经/推销产品/的/小区/将要/加强安保。 | | |
| 136 | b | 听说，/去年/小王/曾经/推销产品/的/小区/已经/加强了安保。 | | |
| 136 | c | 听说，/明年/小王/推销过/产品/的/小区/将要/加强安保。 | | |
| 136 | d | 听说，/去年/小王/推销过/产品/的/小区/已经/加强了安保。 | | |

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| 137 | a | 据说，/下个季度/小勇/曾经/投放广告/的/频道/将要/改版。 | | |
| 137 | b | 据说，/上个季度/小勇/曾经/投放广告/的/频道/已经/改版了。 | | |
| 137 | c | 据说，/下个季度/小勇/投放过/广告/的/频道/将要/改版。 | | |
| 137 | d | 据说，/上个季度/小勇/投放过/广告/的/频道/已经/改版了。 | | |
| 138 | a | 听说，/下个季度/小陈/曾经/发表文章/的/报纸/将要/停刊。 | | |
| 138 | b | 听说，/上个季度/小陈/曾经/发表文章/的/报纸/已经/停刊了。 | | |
| 138 | c | 听说，/下个季度/小陈/发表过/文章/的/报纸/将要/停刊。 | | |
| 138 | d | 听说，/上个季度/小陈/发表过/文章/的/报纸/已经/停刊了。 | | |
| 139 | a | 据说，/后天/贾老师/曾经/召开家长会/的/幼儿园/将要/办竞赛。 | | |
| 139 | b | 据说，/前天/贾老师/曾经/召开家长会/的/幼儿园/已经/办了竞赛。 | | |
| 139 | c | 据说，/后天/贾老师/召开过/家长会/的/幼儿园/将要/办竞赛。 | | |
| 139 | d | 据说，/前天/贾老师/召开过/家长会/的/幼儿园/已经/办了竞赛。 | | |
| 140 | a | 据说，/明年/温阿姨/曾经/采摘水果/的/树林/将要/种新品种。 | | |
| 140 | b | 据说，/去年/温阿姨/曾经/采摘水果/的/树林/已经/种了新品种。 | | |
| 140 | c | 据说，/明年/温阿姨/采摘过/水果/的/树林/将要/种新品种。 | | |
| 140 | d | 据说，/去年/温阿姨/采摘过/水果/的/树林/已经/种了新品种。 | | |
| 141 | a | 据说，/明年/唐伯伯/曾经/栽培水稻/的/田地/将要/退耕还林。 | | |
| 141 | b | 据说，/去年/唐伯伯/曾经/栽培水稻/的/田地/已经/退耕还林了。 | | |
| 141 | c | 据说，/明年/唐伯伯/栽培过/水稻/的/田地/将要/退耕还林。 | | |
| 141 | d | 据说，/去年/唐伯伯/栽培过/水稻/的/田地/已经/退耕还林了。 | | |
| 142 | a | 据说，/明天/贺主管/曾经/庆祝升职/的/酒吧/将要/暂时关门。 | | |
| 142 | b | 据说，/昨天/贺主管/曾经/庆祝升职/的/酒吧/已经/暂时关门了。 | | |
| 142 | c | 据说，/明天/贺主管/庆祝过/升职/的/酒吧/将要/暂时关门。 | | |
| 142 | d | 据说，/昨天/贺主管/庆祝过/升职/的/酒吧/已经/暂时关门了。 | | |

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| 143 | a | 听说，/明天/专家们/曾经/统计人口/的/城市/将要/开放户口。 | | |
| 143 | b | 听说，/昨天/专家们/曾经/统计人口/的/城市/已经/开放了户口。 | | |
| 143 | c | 听说，/明天/专家们/统计过/人口/的/城市/将要/开放户口。 | | |
| 143 | d | 听说，/昨天/专家们/统计过/人口/的/城市/已经/开放了户口。 | | |
| 144 | a | 据说，/明年/老彭/曾经/清点物资/的/仓库/将要/被推平。 | | |
| 144 | b | 据说，/去年/老彭/曾经/清点物资/的/仓库/已经/被推平了。 | | |
| 144 | c | 据说，/明年/老彭/清点过/物资/的/仓库/将要/被推平。 | | |
| 144 | d | 据说，/去年/老彭/清点过/物资/的/仓库/已经/被推平了。 | | |
| 145 | a | 据说，/后天/小龙/曾经/采访嘉宾/的/电视台/将要/直播大选。 | | |
| 145 | b | 据说，/前天/小龙/曾经/采访嘉宾/的/电视台/已经/直播了大选。 | | |
| 145 | c | 据说，/后天/小龙/采访过/嘉宾/的/电视台/将要/直播大选。 | | |
| 145 | d | 据说，/前天/小龙/采访过/嘉宾/的/电视台/已经/直播了大选。 | | |
| 146 | a | 据说，/下周/小哲/曾经/备份照片/的/硬盘/将要/被召回。 | | |
| 146 | b | 据说，/上周/小哲/曾经/备份照片/的/硬盘/已经/被召回了。 | | |
| 146 | c | 据说，/下周/小哲/备份过/照片/的/硬盘/将要/被召回。 | | |
| 146 | d | 据说，/上周/小哲/备份过/照片/的/硬盘/已经/被召回了。 | | |
| 147 | a | 据说，/下学期/小婷/曾经/监督抽奖/的/活动/将要/停办。 | 这句话提到了小婷吗？ | 是 |
| 147 | b | 据说，/上学期/小婷/曾经/监督抽奖/的/活动/已经/停办了。 | 这句话提到了小婷吗？ | 是 |
| 147 | c | 据说，/下学期/小婷/监督过/抽奖/的/活动/将要/停办。 | 这句话提到了小婷吗？ | 是 |
| 147 | d | 据说，/上学期/小婷/监督过/抽奖/的/活动/已经/停办了。 | 这句话提到了小婷吗？ | 是 |
| 148 | a | 据说，/明年/小勤/曾经/结识旅伴/的/活动/将要/扩大规模。 | 这句话是关于一个宴席吗？ | 否 |
| 148 | b | 据说，/去年/小勤/曾经/结识旅伴/的/活动/已经/扩大了规模。 | 这句话是关于一个宴席吗？ | 否 |
| 148 | c | 据说，/明年/小勤/结识过/旅伴/的/活动/将要/扩大规模。 | 这句话是关于一个宴席吗？ | 否 |
| 148 | d | 据说，/去年/小勤/结识过/旅伴/的/活动/已经/扩大了规模。 | 这句话是关于一个宴席吗？ | 否 |

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| 149 | a | 据说，/下个月/小商/曾经/查询资料/的/图书馆/将要/取消会费。 | | |
| 149 | b | 据说，/上个月/小商/曾经/查询资料/的/图书馆/已经/取消了会费。 | | |
| 149 | c | 据说，/下个月/小商/查询过/资料/的/图书馆/将要/取消会费。 | | |
| 149 | d | 据说，/上个月/小商/查询过/资料/的/图书馆/已经/取消了会费。 | | |
| 150 | a | 听说，/下学期/老廖/曾经/招收实习生/的/校园/将要/开求职讲座。 | | |
| 150 | b | 听说，/上学期/老廖/曾经/招收实习生/的/校园/已经/开了求职讲座。 | | |
| 150 | c | 听说，/下学期/老廖/招收过/实习生/的/校园/将要/开求职讲座。 | | |
| 150 | d | 听说，/上学期/老廖/招收过/实习生/的/校园/已经/开了求职讲座。 | | |
| 151 | a | 据说，/后年/小罗/曾经/运输海鲜/的/轮船/将要/停用。 | 这句话是关于一趟地铁吗？ | 否 |
| 151 | b | 据说，/前年/小罗/曾经/运输海鲜/的/轮船/已经/停用了。 | 这句话是关于一趟地铁吗？ | 否 |
| 151 | c | 据说，/后年/小罗/运输过/海鲜/的/轮船/将要/停用。 | 这句话是关于一趟地铁吗？ | 否 |
| 151 | d | 据说，/前年/小罗/运输过/海鲜/的/轮船/已经/停用了。 | 这句话是关于一趟地铁吗？ | 否 |
| 152 | a | 听说，/明年/小华/曾经/接待外宾/的/酒店/将要/招聘服务员。 | | |
| 152 | b | 听说，/去年/小华/曾经/接待外宾/的/酒店/已经/招聘了服务员。 | | |
| 152 | c | 听说，/明年/小华/接待过/外宾/的/酒店/将要/招聘服务员。 | | |
| 152 | d | 听说，/去年/小华/接待过/外宾/的/酒店/已经/招聘了服务员。 | | |
| 153 | a | 据说，/后年/小阳/曾经/聆听讲座/的/科技馆/将要/被拆迁。 | 这句话中，有个地方要停电吗？ | 否 |
| 153 | b | 据说，/前年/小阳/曾经/聆听讲座/的/科技馆/已经/被拆迁了。 | 这句话中，有个地方要停电吗？ | 否 |
| 153 | c | 据说，/后年/小阳/聆听过/讲座/的/科技馆/将要/被拆迁。 | 这句话中，有个地方要停电吗？ | 否 |
| 153 | d | 据说，/前年/小阳/聆听过/讲座/的/科技馆/已经/被拆迁了。 | 这句话中，有个地方要停电吗？ | 否 |
| 154 | a | 据说，/下个月/小庄/曾经/组织聚会/的/场地/将要/铺设新地板。 | | |
| 154 | b | 据说，/上个月/小庄/曾经/组织聚会/的/场地/已经/铺设了新地板。 | | |
| 154 | c | 据说，/下个月/小庄/组织过/聚会/的/场地/将要/铺设新地板。 | | |
| 154 | d | 据说，/上个月/小庄/组织过/聚会/的/场地/已经/铺设了新地板。 | | |

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| 155 | a | 听说，/下学期/老韩/曾经/担任教授/的/大学/将要/盖新校区。 | | |
| 155 | b | 听说，/上学期/老韩/曾经/担任教授/的/大学/已经/盖了新校区。 | | |
| 155 | c | 听说，/下学期/老韩/担任过/教授/的/大学/将要/盖新校区。 | | |
| 155 | d | 听说，/上学期/老韩/担任过/教授/的/大学/已经/盖了新校区。 | | |
| 156 | a | 听说，/明天/老肖/曾经/演唱戏曲/的/舞台/将要/升级设备。 | | |
| 156 | b | 听说，/昨天/老肖/曾经/演唱戏曲/的/舞台/已经/升级了设备。 | | |
| 156 | c | 听说，/明天/老肖/演唱过/戏曲/的/舞台/将要/升级设备。 | | |
| 156 | d | 听说，/昨天/老肖/演唱过/戏曲/的/舞台/已经/升级了设备。 | | |
| 157 | a | 据说，/下周/小申/曾经/下载电子书/的/网站/将要/被关闭。 | | |
| 157 | b | 据说，/上周/小申/曾经/下载电子书/的/网站/已经/被关闭了。 | | |
| 157 | c | 据说，/下周/小申/下载过/电子书/的/网站/将要/被关闭。 | | |
| 157 | d | 据说，/上周/小申/下载过/电子书/的/网站/已经/被关闭了。 | | |
| 158 | a | 据说，/后年/小施/曾经/处理文书/的/办公室/将要/搬到隔壁。 | | |
| 158 | b | 据说，/前年/小施/曾经/处理文书/的/办公室/已经/搬到了隔壁。 | | |
| 158 | c | 据说，/后年/小施/处理过/文书/的/办公室/将要/搬到隔壁。 | | |
| 158 | d | 据说，/前年/小施/处理过/文书/的/办公室/已经/搬到了隔壁。 | | |
| 159 | a | 听说，/后年/五年级/曾经/举办军训/的/操场/将要/改成草地。 | | |
| 159 | b | 听说，/前年/五年级/曾经/举办军训/的/操场/已经/改成了草地。 | | |
| 159 | c | 据说，/后年/五年级/举办过/军训/的/操场/将要/改成草地。 | | |
| 159 | d | 据说，/前年/五年级/举办过/军训/的/操场/已经/改成了草地。 | | |
| 160 | a | 听说，/下学期/小叶/曾经/取得季军/的/比赛/将要/提高标准。 | | |
| 160 | b | 听说，/上学期/小叶/曾经/取得季军/的/比赛/已经/提高了标准。 | | |
| 160 | c | 听说，/下学期/小叶/取得过/季军/的/比赛/将要/提高标准。 | | |
| 160 | d | 听说，/上学期/小叶/取得过/季军/的/比赛/已经/提高了标准。 | | |

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| 161 | e | 据说，/下个季度/财政部/将要/改变政策/并且/还要/审查账目。 | | |
| 162 | e | 听说，/下个月/罗教授/将要/出国深造/但是/他和家人/还没有/拿到护照。 | | |
| 163 | e | 据说，/明年/体校/将要/扩大招生/并且/要求/教师们/必须/好好教课。 | 这句话提到体校招生了吗？ | 是 |
| 164 | e | 听说，/下周/老康/将要/开始健身/但是/还没有/拿到会员卡。 | | |
| 165 | e | 据说，/后天/张三/将要/前往上海/并且/有可能/和同事/一起聚餐。 | | |
| 166 | e | 听说，/下学期/学校书店/将要/打折促销/但是/只有/在早上/才会/开门。 | | |
| 167 | e | 据说，/后年/刘奶奶/将要/卖掉房子/并且/有可能/搬回老家。 | | |
| 168 | e | 听说，/明年/铁路/将要/建成完工/但是/工人们/还没有/拿到工资。 | | |
| 169 | e | 据说，/后天/王省长/将要/视察灾区/并且/要求/马上/给灾民/分发必需品。 | 这句话是关于救灾的吗？ | 是 |
| 170 | e | 听说，/下周/足球队/将要/出国集训/但是/还没有/决定去哪儿。 | | |
| 171 | e | 据说，/下个季度/这家公司/将要/发行股票/并且/在海外/向投资者/发出邀请。 | | |
| 172 | e | 听说，/下学期/他和朋友/将要/承办活动/但是/他们/还没有/在学校/找到地点。 | | |
| 173 | e | 据说，/下个月/五金店/将要/解聘雇员/并且/计划/甩卖库存。 | | |
| 174 | e | 听说，/下个月/那位歌手/将要/出席生日会/但是/经纪人/不愿意/让粉丝到场。 | 这句话是关于某位领导的吗？ | 否 |
| 175 | e | 据说，/后天/环卫工人/将要/清理积水/并且/有可能/立刻/给居民/恢复供水。 | | |
| 176 | e | 听说，/下个季度/教育部/将要/推行改革/但是/很可能/遭到反对。 | | |
| 177 | e | 传言说，/下个季度/工会/将要/策划罢工/并且/希望/给雇员/争取年假。 | | |
| 178 | e | 同事说，/明天/王主任/将要/被调走/但是/股东们/很可能/一致/希望他留任。 | 这句话中，股东们希望王主任走吗？ | 否 |
| 179 | e | 同学说，/下学期/助教/将要/讲解题目/并且/让同学们/复习备考。 | | |
| 180 | e | 主任说，/下个季度/徐先生/将要/被提拔/但是/福利待遇/有可能/和以前一样。 | 这句话中，有人会被降职吗？ | 否 |

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| 181 | e | 据说，/后年/外交部/将要/改变策略/并且/计划/和邻国/商讨/组建贸易区。 | | |
| 182 | e | 听说，/明天/包大伯/将要/拆掉旧房子/但是/新房子/还没有盖。 | | |
| 183 | e | 据说，/下周/手机信号/将要/扩大覆盖面/并且/新用户/还可以/领流量包。 | | |
| 184 | e | 听说，/下学期/排球队/将要/开始集训/但是/总教练/偏偏/在这时/住院了。 | | |
| 185 | e | 据说，/明天/那位明星/将要/前往洛杉矶/并且/有可能/出演新电影。 | | |
| 186 | e | 听说，/明天/厨具店/将要/清仓甩卖/但是/名牌厨具/仍然/不会降价。 | | |
| 187 | e | 据说，/下周/画家/将要/卖掉作品/并且/打算/把利润/全都/捐给母校。 | | |
| 188 | e | 听说，/明年/海底隧道/将要/建成通车/但是/很多司机/不想走隧道。 | 这句话中，隧道要建好了吗？ | 是 |
| 189 | e | 据说，/下周/总裁/将要/视察分公司/并且/有可能/和职工/会谈。 | 这句话中，总裁要到分公司吗？ | 是 |
| 190 | e | 听说，/后年/城建局/将要/拆掉棚户区/但是/还没有/确定/如何补偿/居民。 | | |
| 191 | e | 据说，/明年/手游公司/将要/发行新作/并且/回馈/老玩家。 | | |
| 192 | e | 听说，/后天/人事部/将要/承办年会/但是/部长/还没有/决定地点。 | 这句话提到了消防演习吗？ | 否 |
| 193 | e | 据说，/后年/篮球队/将要/解聘教练/并且/在全国/寻找/新的人选/来做教练。 | | |
| 194 | e | 听说，/明天/总书记/将要/出席晚会/但是/并不打算/做讲话。 | | |
| 195 | e | 交警说，/后天/市政工人/将要/清理路障/并且/提醒/过往车辆/注意避让。 | | |
| 196 | e | 评论说，/后年/委员会/将要/推行新政/但是/所有人/都不确定/这些政策/能否成功。 | 这句话中，人们对新政都很有信心吗？ | 否 |
| 197 | e | 台长说，/下个月/创意部/将要/策划新栏目/并且/邀请/知名人士。 | | |
| 198 | e | 馆员说，/明年/镇馆之宝/将要/被运走/但是/不久后/就会/还给博物馆。 | | |
| 199 | e | 处长说，/下个月/易教授/将要/讲授课程/并且/有可能/在课后/给学生/解答问题。 | 这句话提到了一位教授吗？ | 是 |
| 200 | e | 经理说，/下学期/小巩/将要/得到奖励/但是/其他人/不服气。 | | |

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| 201 | f | 邻居说，/上个月/王奶奶/曾经/想买证券/并且/悄悄地/让儿子/汇了钱。 | 这句话中，王奶奶要买什么东西吗？ | 是 |
| 202 | f | 护士说，/上周/这位患者/曾经/前来就诊/但是/值班医生/诊断后/并没有/给他开药。 | 这句话中，有人给病人开药了吗？ | 否 |
| 203 | f | 老师说，/前年/小吴/曾经/去往山区/并且/和志愿者/义务支教。 | | |
| 204 | f | 小陈说，/前天/系主任/曾经/想印讲义/但是/打印机/后来/出了故障。 | | |
| 205 | f | 听说，/昨天/校长/曾经/致电教育局/并且/急切地/请求局长/马上/拨款。 | | |
| 206 | f | 据说，/去年/这片土地/曾经/被转让/但是/买家/没有动工。 | | |
| 207 | f | 听说，/上学期/校医院/曾经/提高药价/并且/不顾反对/让学生/缴纳医疗费。 | | |
| 208 | f | 据说，/上个季度/旅游业/曾经/陷入寒冬/但是/热门景点/仍然/迎来了/很多游客。 | 这句话是关于一艘游轮吗？ | 否 |
| 209 | f | 听说，/去年/篮球协会/评选过/劳模/并且/让球迷/提名运动员。 | 这句话是关于拳击协会吗？ | 是 |
| 210 | f | 据说，/上学期/学生会/选举过/主席/但是/选举结果/并没有/对外公布。 | | |
| 211 | f | 听说，/前天/这家报社/推出过/专栏/并且/广泛地/向读者/征求/意见。 | | |
| 212 | f | 据说，/上个月/刘阿姨/联系过/工人/但是/她的家电/还没人修。 | | |
| 213 | f | 听说，/上个季度/路况/出现过/好转/并且/让市民/极大地/节省了时间。 | | |
| 214 | f | 据说，/去年/电影票房/经历过/低迷/但是/电影公司/仍然/拍了/很多大片。 | 这句话是关于就业率的吗？ | 否 |
| 215 | f | 听说，/前年/就业率/有过/提高/并且/人均收入/高达五千元。 | 这句话提到了收入吗？ | 是 |
| 216 | f | 据说，/上周/很多市民/接到过/诈骗电话/但是/很多人/并没有/上当受骗。 | | |
| 217 | f | 经理说，/昨天/顾客/曾经/投诉柜员/并且/要求/让行长/介入/解决问题。 | | |
| 218 | f | 教授说，/上学期/本科生/曾经/研习古文/但是/并没有/坚持下去。 | | |
| 219 | f | 听说，/前天/那位网红/曾经/直播唱歌/并且/不停地/让网友/给她送花。 | | |
| 220 | f | 据说，/去年/这位法官/曾经/打算退休/但是/领导们/并没有/签字/批准退休。 | | |
| 221 | f | 听说，/上周/室友/曾经/想买词典/并且/在书店/找了很久。 | | |

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| 222 | f | 据说，/前天/赵大妈/曾经/前来咨询/但是/并没有/让孙子/报名奥数班。 | | |
| 223 | f | 听说，/前年/考察队/曾经/去往北极/并且/和科学家/在冰层里/小心地/取了样本。 | | |
| 224 | f | 据说，/前天/研究生/曾经/打印了作业/但是/后来发现/格式不对。 | 这句话中有人抄袭作业吗？ | 否 |
| 225 | f | 听说，/上周/农委会/选举过/干事/并且/命令/工作人员/提高效率。 | | |
| 226 | f | 据说，/上学期/平均考分/出现过/下降/但是/幸好/家长们/并没有/投诉教师。 | | |
| 227 | f | 听说，/前年/招生办/提高过/分数线/并且/还提议/减少招生。 | | |
| 228 | f | 据说，/上个季度/对外贸易/陷入过/衰退/但是/进口总额/反而/有所上升。 | | |
| 229 | f | 听说，/上学期/三年级/评选过/大队长/并且/教导处/还要给/当选者/颁发奖状。 | | |
| 230 | f | 据说，/前年/市议会/提名过/候选人/但是/多数派/没有同意。 | | |
| 231 | f | 店员说，/上个月/奶茶店/推出过/新口味/并且/对老顾客/还有/各种优惠。 | | |
| 232 | f | 证人说，/昨天/袁阿姨/联系过/律师/但是/她和家人/并没有/和律师/签合同。 | | |
| 233 | f | 中介说，/上个季度/房价/曾经/被低估/并且/间接地/影响了股市。 | 这句话中股市受影响了吗？ | 是 |
| 234 | f | 传言说，/昨天/工程师/曾经/打算辞职/但是/上司/劝说他/留了下来。 | | |
| 235 | f | 听说，/昨天/董事长/曾经/致电总部/并且/关切地/向经理/和秘书/询问情况。 | | |
| 236 | f | 据说，/上个月/警察局/曾经/接到报案/但是/无法/找到当事人。 | | |
| 237 | f | 听说，/上个季度/淘宝用户/投诉过/那位卖家/但是/客服/没有/及时答复。 | | |
| 238 | f | 据说，/上个月/老干部/研习过/书法/并且/买了/很多/高级毛笔/和宣纸。 | | |
| 239 | f | 听说，/上周/那位博主/直播过/开箱/并且/炫耀了/他的相机。 | 这句话中有人炫耀电子设备吗？ | 是 |
| 240 | f | 据说，/去年/菜价/出现过/波动/但是/菜农们/并没有/因此亏损。 | 这句话中菜价一直很稳定吗？ | 否 |
| 241 | g | 审讯室里，/嫌疑人/主动地/交代了/事实/因为/他的同谋/刚刚/被警察/逮捕了。 | | |

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| 242 | g | 在入口，/门卫/粗暴地/拦住了/销售员/因为/居民们/不想被打扰。 | 这句话提到了快递员吗？ | 否 |
| 243 | g | 公司里，/小周/仔细地/翻阅了/账单/因为/老板/希望他/上交报告。 | 这句话提到了帐单吗？ | 是 |
| 244 | g | 酒席上，/老朱/真诚地/感谢了/邻居们/因为/他们家/自从搬来/一直/受到帮助。 | | |
| 245 | g | 天桥上，/卖艺人/认真地/拉着/二胡/因为/路人们/被他吸引了。 | | |
| 246 | g | 比赛时，/教练/冷静地/观察着/局势/因为/对手们/似乎/别有用心。 | | |
| 247 | g | 电脑前，/王经理/不停地/刷新着/股票/因为/新闻说/股价/最近/起伏得厉害。 | | |
| 248 | g | 说实话，/小傅/真心地/喜欢/新工作/因为/同事们/都愿意帮她。 | 这句话中有人讨厌自己的工作吗？ | 否 |
| 249 | g | 电影中，/小丽/出色地/演绎了/女主角/因为/导演/要求她/发挥演技。 | | |
| 250 | g | 宿舍里，/小景/不情愿地/打扫了/卫生间/因为/室友们/没有一个/愿意/主动干活。 | | |
| 251 | g | 开会前，/秘书/飞快地/赶到了/会场/因为/大老板/让他汇报工作。 | 这句话中有人到了会场吗？ | 是 |
| 252 | g | 过年前，/阿姨/精心地/挑选了/礼品/因为/亲戚们/都盼着/收到礼物。 | | |
| 253 | g | 同事说，/小徐/勇敢地/递交了/辞职信/因为/她和朋友/打算/合资/创办工作室。 | | |
| 254 | g | 轮渡上，/售票员/不时地/数着/乘客/因为/很多人/还没买票。 | | |
| 255 | g | 故事里，/乌龟/出人意料地/赢得了/赛跑/因为/兔子/在途中/睡懒觉了。 | | |
| 256 | g | 下班后，/小柯/开心地/关上了/电脑/因为/他和同事/刚刚/好不容易/做完了项目。 | | |
| 257 | g | 传说中，/唐僧/成功地/取到了/佛经/因为/徒弟们/一路保护他。 | | |
| 258 | g | 记者说，/刘爷爷/愤怒地/批评了/施工队/因为/施工噪音/常常/打扰他休息。 | 这句话中有人被表扬了吗？ | 否 |
| 259 | g | 轿车里，/警察/紧张地/盯着/小偷/因为/群众们/盼着/尽快/把他抓住。 | | |
| 260 | g | 法庭外，/记者们/焦急地/等待着/当事人/因为/读者们/在关注进展。 | | |
| 261 | g | 警察局里，/受害人/无奈地/交代了/经过/因为/她和家人/都想/挽回损失。 | 这句话中有人受到损失了吗？ | 是 |

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| 262 | g | 影院外，/保安/不得不/拦住了/粉丝们/因为/大明星/不希望/被粉丝们/围观。 | 这句话中明星想看到粉丝吗？ | 否 |
| 263 | g | 律所里，/律师/快速地/翻阅了/卷宗/因为/他和同事/马上要出庭。 | | |
| 264 | g | 散会后，/会计/热情地/感谢了/翻译/因为/他和老板/需要/和外商交流。 | | |
| 265 | g | 公演时，/小亮/动情地/拉着/小提琴/因为/据说/这首曲子/非常/受欢迎。 | 这句话提到了一种乐器吗？ | 是 |
| 266 | g | 天黑后，/实验员/细心地/校对了/实验报告/因为/他和导师/要公布结果。 | | |
| 267 | g | 双十一前，/熊阿姨/频繁地/刷新着/淘宝/因为/很多卖家/都要/搞促销。 | | |
| 268 | g | 说实话，/小茜/非常地/喜欢/追网剧/因为/剧情/扣人心弦/而且/可以发弹幕。 | | |
| 269 | g | 纪录片里，/小凯/真实地/演绎了/皇帝/因为/他和编剧/参考了史料。 | | |
| 270 | g | 下班后，/小文/赶忙/打扫了/客厅/因为/朋友们/马上要/来聚餐。 | | |
| 271 | g | 下车后，/摄影师/匆匆地/赶到了/外景地/因为/电视剧/马上要/在这里/开拍。 | | |
| 272 | g | 春节前，/严阿姨/反复地/挑选了/食材/因为/她要/做年夜饭。 | | |
| 273 | g | 回乡前，/工人们/匿名/递交了/检举信/因为/包工头/一直/拖欠工资。 | | |
| 274 | g | 活动时，/助理/大致地/数着/听众/因为/主办方/希望/到场人数/越多越好。 | | |
| 275 | g | 辩论赛上，/校队/艰难地/赢了/总决赛/因为/对手们/实力很强。 | 这句话中校队胜利了吗？ | 是 |
| 276 | g | 到家后，/司机/用力地/关上了/车门/因为/他心情很差/需要/发泄一下。 | | |
| 277 | g | 这个赛季，/棒球队/最终/失去了/决赛权/因为/所有队员/都没有/发挥出/正常水平。 | | |
| 278 | g | 社论中，/作者/严厉地/批评了/贪腐之风/因为/人民利益/受到了损害。 | | |
| 279 | g | 上课时，/好学生/专注地/盯着/幻灯片/因为/这节课/其实/有点难。 | | |
| 280 | g | 下雪时，/张家夫妇/耐心地/等待着/出租车/因为/他们/不想/在雪地上/开车。 | 这句话中有人在等朋友吗？ | 否 |