The negotiation of meanings derived at different representation levels determines when and how the pragmatic meaning is activated and used during sentence comprehension (Politzer-Ahles et al., 2013). In this sentence, *Even a rich person cannot afford such an expensive house,* a less likely event *a rich person cannot afford an expensive house* is constrained by the *even* construction, denoting the unexpectedness of what is described in the construction, and implying that any event which is more likely to happen than the embedded event must occur. If the event does not rank at the lowest end of the scale, embedding such event in the construction can result in infelicitousness (Fauconnier, 1975; Yuan, 2006). However, it remains unclear whether such construction-based pragmatic constraint can exert an immediate impact on local linguistic representation building and at what stage the detection of anomaly of such pragmatic constraint affects the relevant processes (Filik et al., 2009; Jiang et al., 2013a; Jiang and Zhou, 2014).

Extensive evidence from ERPs (event-related brain potentials) has suggested that readers can immediately detect when an upcoming word is pragmatically incongruent with the prior sentential/discourse/communicative context (such as the prediction generated from the discourse representation, reader's world knowledge, or even the speaker identity), as indicated by an increased N400 response on the word that indexes an increased effort of integrating the word into the pragmatic context (e.g., Van Berkum et al., 1999, 2003, 2008; Hagoort et al., 2004; Jiang et al., 2013a,b; Nieuwland, 2013; Li et al., 2014). Some studies showed a relatively late starting (∼400 ms) but prolonged negativity effect on the words (e.g., sentence-initial scalar quantifiers *some kids were riding bicycles*) preceded by a context mismatching the pragmatic meaning of the quantifier (e.g., a picture showing all kids were riding bicycles). This negative response indexes a process of canceling or inhibiting initially built pragmatic representation, implicitly indicating that pragmatic information is instantly used for online sentence processing (Politzer-Ahles et al., 2013). In contrast, research using the eye-tracking technique has observed plenty inconsistent findings (e.g., Rayner et al., 2004; see also Warren, 2011 for a review). It is evident that ERP research typically adopts rapid serial visual presentation (RSVP) paradigm in which one word at a certain time is presented in the screen and participants are required to fixate the target and avoid making eye movements. Therefore, the word-by-word presentation prevents natural eye movement behavior

condition compared with the congruent and the underspecified conditions, which did not differ between the two. Based on these findings, Jiang et al. (2013a) claimed that Chinese readers can rapidly integrate the critical word or phrase (i.e., the VP) into the pragmatic context, subsequently allowing the observation of the inverse correlation of N400 response with the perceived event likelihood.

These observations are crucial to understanding how readers use the pragmatic constraint information (e.g., event likelihood) to build up sentence representations in Chinese reading (see also Li et al., 2014). From a methodological perspective, the time course of pragmatic processing may be discounted when word-by-word RSVP paradigm is used to study reading. As mentioned earlier, in RSVP, the oculomotor activities are usually restricted, and the preprocessing of the critical VP in the parafovea zone is prevented. Moreover, readers is not allowed to look back and reread earlier parts of the text from which the processing difficulty is re-encountered at a later stage (e.g., on the commenting phrase). This paradigm usually uses a fixed presentation rate

TABLE 1 | An example of a set of sentences used in the experiment.

	Sentences							
Condition	**Lian**	**Scalar adjective**	**Adjective phrase (AP)**	**Objective noun**	**Subject noun**	**Model verb (MV)**	**Main VP**	**Commenting clause (CC)**
Affirmative sentences								
Congruent	连	Ŋ	**危险的**	大桥	成超	**都能**	**ĩ**	**ɿ**
	Even such a **dangerous** bridge Chengchao **can come across, he is so brave**							
Underspecified	连		**这样的**	大桥	成超	**都能**	**走过去**	**ɿ**
	Even **such a** bridge Chengchao **can come across, he is so brave**							
Incongruent	连	Ŋ	**ŋ**	大桥	成超		**ĩ**	**真是勇敢**
	Even such a **secure** bridge Chengchao **can come across, he is so brave**							
Negative sentences								
Congruent	连	Ŋ	**安全的**	大桥	成超	**ь**	**走过去**	**真是胆小**
	Even such a **secure** bridge Chengchao **cannot come across, he is so timid**.							
Underspecified	连		**这样的**	大桥	成超	**都不能**	**ĩ**	**真是胆小**
	Even **such a** bridge Chengchao **cannot come across, he is so timid**							
Incongruent	连	Ŋ	**ʅ**	大桥	成超	**都不能**	**走过去**	**真是胆小**
	Even such a **dangerous** bridge Chengchao **cannot come across, he is so timid**							

Regions of interest were bolded.

relocates the object noun to an earlier position in the sentence. The *Lian: : :dou: : :* construction in di□erent experimental sets constrained a di□erent event.

The main VP consisted of an action verb and a verb complement. The embedded event was mP cons=p [(complement.)-316(T)1(he)-316(embedded)-3154Vcomplemebyembeddv316aryTJ0 0 0Li

TABLE 2 | Eye movement measures for regions of interest, including adjective phrase (AP), dou + modal verb (MV), the main VP and commenting clause (CC) areas.

Measure	Congruent	Underspecified	Incongruent
Pre-critical region 1 – Adjective phrase (AP)			
FFD (ms)	224.79/	233.83/	222.78/
GD (ms)	288.151/	337.183/	279.146/
TFD (ms)	558.339/	635.388/	643.423/
REG-IN (probability)	0:57.0:50/	0:70.0:46/	0:63.0:48/
Pre-critical region 2 – Dou + modal verb (MV)			
FFD (ms)	252.88/	244.82/	249.88/
GD (ms)	324.168/	319.167/	325.172/
TFD (ms)	491.285/	513.316/	553.334/
REG-IN (probability)	0:32.0:47/	0:32.0:47/	0:38.0:49/
Critical region – Main VP			
REG-OUT (probability)	0:25.0:43/	0:24.0:43/	0:29.0:45/
FFD (ms)	255.95/	256.96/	256.94/
GD (ms)	354.193/	354.196/	349.191/
TFD (ms)	512.317/	524.343/	548.348/
Post-critical region – Commenting clause (CC)			
REG-OUT (probability)	0:78.0:42/	0:81.0:39/	0:84.0:37/
FFD (ms)	284.123/	285.127/	291.126/
GD (ms)	436.235/	436.250/	440.230/
TFD (ms)	547.307/	559.327/	608.323/

FFD, first fixation duration (ms); GD, gaze duration (ms); TFD, total fixation duration (ms); REG-OUT (probability). Probability of regressions-in, i.e., the proportion of regressive saccades on a region from a region with higher index; REG-OUT (probability), Probability of regressions-out, i.e., the proportion of regressing out of a region, limited to the first pass reading of that region.

increased cost for the incongruent sentences during the first-pass reading.

However, for the total fixation duration, readers spent longer time fixating on the AP region when reading the underspecified and incongruent sentences, as compared to reading the congruent sentences (Underspecified vs. Congruent, $b = 0.13$, $SE = 0.04$, $t = 3.19$; Incongruent vs. Congruent, $b = 0.12$, $SE = 0.03$, $t = 3.70$). Furthermore, with more linguistic information accumulated for the underspecified and incongruent conditions, the readers were more likely to make regressions back to the pre-critical region (Underspecified vs. Congruent, $b = 0.82$, $SE = 0.20$, $z = 4.21$; Incongruent vs. Congruent, $b = 0.28$, $SE = 0.11$, $z = 2.55$).

Pre-critical Region 2 – Model Verb (MV)

The measures on MV may reflect parafoveal congruency effect on the critical VP prior to the fixation. Readers spent shorter first fixations on the MV region in the underspecified sentences than in the congruent ones (FFD: $b = -0.03$, $SE = 0.01$, $t = -2.14$). This reduced FFD on the MV in the underspecified condition might be due to the increased FFD in the same condition on the earlier AP region. The readers may initiate the inference of missing scalar adjectives based on their knowledge or pragmatic constraints of the *lian:::dou:::* construction to deal with the uncertainty of event likelihood in the underspecified sentences. With the initial missing scalar adjectives filled, it may cost less to process the upcoming MV during the first pass reading.

However, later measures showed longer TFD and more REG-IN in the incongruent relative to the congruent sentences (TFD: $b = 0.10$, $SE = 0.02$, $t = 4.31$; REG-IN: $b = 0.30$, $SE = 0.10$, $z = 2.87$). These results suggest that the processing difficulty for the incongruent condition did not appear as an early parafoveal processing mechanism prior to the fixation. The incongruent condition did not affect the initial processing of MV, but the later measures, probably involving re-checking linguistic information of event likelihood at earlier regions after the incongruency, has been detected in the later likelih-279(likelih-2797,)]TJ/F238-2275 Tf 14nt lik

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TABLE 3 | Fixed effect estimates for the eye movement measures across pre-critical regions including adjective phrase (AP) and modal verbs (MV).

Effect	FFD			GD			TFD			REG-IN		
	b	*SE*	*t*	*b*	*SE*	*t*	*b*	*SE*	*t*	*b*	*SE*	*z*
Pre-critical region 1 – Adjective phrase (AP)												
Congruent vs. Underspecified	0:03	0:02	1:39	0:12	0:04	**3:34**	0:13	0:04	**3:19**	0:82	0:20	**4:21**
Congruent vs. Incongruent	−0:01	0:01	−0:68	−0:03	0:02	−1:49	0:12	0:03	**3:70**	0:28	0:11	**2:55**
Pre-critical region 2 – Dou C modal verb (MV)												
Congruent vs. Underspecified	−0:03	0:01	**−2:14**	−0:02	0:02	−0:79	0:03	0:02	1:17	0:01	0:10	0:08
Congruent vs. Incongruent	−0:01	0:01	−0:83	0:00	0:02	0:06	0:10	0:02	**4:31**	0:30	0:10	**2:87**

Significant terms are marked in bold. b, regression coefficient.

TABLE 4 | Fixed effect estimates for the eye movement measures across critical and post-critical regions including main VP and commenting clause (CC).

Effect	REG-OUT			FFD			GD			TFD		
	b	*SE*	*z*	*b*	*SE*	*t*	*b*	*SE*	*t*	*b*	*SE*	*t*
Critical region – Main VP												
Congruent vs. Underspecified	0.07	0.14	0.50	0.00	0.02	0.05	0.00	0.02	0.08	0.01	0.03	0.24
Congruent vs. Incongruent	0.32	0.16	**2.01**	0.01	0.02	0.34	−0.01	0.02	−0.35	0.06	0.03	**2.07**
Post-critical region-commenting clause (CC)												
Congruent vs. Underspecified	0.37	0.16	**2.38**	0.00	0.02	0.15	−0.01	0.02	−0.52	0.01	0.03	0.41
Congruent vs. Incongruent	0.68	0.20	**3.32**	0.02	0.02	1.01	0.00	0.02	0.16	0.10	0.03	**3.22**

Significant terms are marked in bold. b, regression coefficient.

Unlike the previous ERP study (Jiang et al., 2013a) in which the segmented words were presented sequentially and separately, the current study allowed readers to make saccadic movements back and forth spontaneously. Moreover, the sentence comprehension was minimally demanded with a task to probe readers by answering questions about the sentence (cf. Jiang et al., 2013a), creating an opportunity to examine an implicit use of pragmatic information during sentence reading. We will discuss how these methodological factors contribute to the eye movement activities later.

In addition to the eye-movement measures on critical regions ("VP") where the nature of condition (incongruent or unspecified) was determined, we calculated such measures on regions prior to or following the VP. Depending on experimental conditions, these regions were hypothesized to attract more or less saccadic looks given the necessity to specify eventual representations (such as on "AP"), given the possible parafoveal views on the critical region that permits an early detection of pragmatic constraints (such as on "MV"), or given the possible wrap-up process for the whole discourse (such as on "CC"). On the pre-critical regions (particularly the MV region), there was no evidence indicating that the incongruent information can be processed parafoveally. Consistent with previous studies (Ni et al., 1998; Rayner et al., 2004; Filik, 2008; Filik et al., 2009), there was no significant effect of pragmatic congruence on the first-pass reading time of the critical region, where the incongruity of a sentence became apparent. However, readers did spend longer total reading time, and made more regressive saccades out of the VP region to the pre-critical regions in the incongruent condition, as compared to the congruent condition. Similar observations were also made in the post-critical region. These results suggest that there was no immediate processing cost associated with the reading of pragmatically incongruent information relative to the reading of congruent information. When the event likelihood is unspecified, the effort of rereading and regressive looks were requested to a far lesser extent than a sentence with an incongruent event, as the differences between these conditions were only obvious on the late measures of sentence-final region (see later for section "Discussion"). The differences in the first-pass reading on AP does not seem to be driven by lexical features (e.g., word frequency); the early reading time seems to increase when the linguistic information specifying the event likelihood is absent in the underspecified condition.

Overall, the critical findings in relation to the comparison between pragmatically incongruent and congruent sentences clearly indicate that interruption of the integration of event likelihood into the pragmatic constraints of the *lian: : :dou: : :* construction does not intervene with the eye movement measures immediately as the information about the event likelihood becomes salient. Our results are comparable with some of the previous research investigating the effects of pragmatic implausibility (e.g., Ni et al., 1998; Braze et al., 2002; Rayner et al., 2004; see Warren, 2011 for a review) on eye movements in reading. For example, Rayner et al. (2004) found that when a word was completely anomalous in a context or against one's real-world knowledge, increased gaze duration can be observed on the anomalous word without delay. However, when a word was implausible but still possible to appear in the sentence, the so called "pragmatic anomaly," the effect did not emerge until a considerably later time – *go-past* time. Our results also

extended the findings of Filik et al. (2009), that the effect of incongruence in sentences with the *even* construction was not evident until a post critical region, to a language other than English. Presumably, these measures suggest that the increased difficulty is initiated by some sort of second-pass processing in search of more information to resolve the incongruence between the current event and pragmatic constraints. When processing *lian: : :dou,* to check whether the event indeed fits the lowest end of the pragmatic scale, readers need to contrast a particular event against a set of alternatives on the event likelihood scale, and decide whether this event can be an unexpected candidate or sits at the bottom of the scale. This difficulty was increased given the mismatch of the linguistic input and the prediction of the *lian: : :dou* constraint. Therefore, readers spent more time to recover from this mismatch and probably recheck any further information to resolve such mismatch (Jiang et al., 2013a), resulting in more regression-in on the pre-critical region and regression-outs on the critical/post-critical regions. Increased regressive saccades were reported for sentences with long distance dependencies which demand higher working memory load (e.g., in *who does Mary think that John calls?* Nicenboim et al., 2015). Here the AP, the key linguistic information that defines the event likelihood, is possibly reactivated on regions following AP and may demand higher working memory load as reflected by more regressive looks to reconfigure the event likelihood in the incongruent condition. The increased reading time on the sentence-final commenting phrase suggested a continued difficulty that arose earlier from the critical VP. This sentence wrap-up effect was consistent with the observation of an increased sustained negativity on that phrase in Jiang et al. (2013a). The pragmatically implausible word increased the rereading time (i.e., total reading time minus gaze duration) and probability of regression-out when it was located at the sentence-final position (Camblin et al., 2007a). It should be noted that the underspecified condition did not show any effect on VP but showed more regression out of the sentence-final position, possibly due to an effort to wrap up the sentence by rechecking previous AP (as reflected by increased regression-ins on AP) against the possibility of specifying the meaning of the event (Zhou et al., 2010; Jiang and Zhou, 2012; Jiang et al., 2013a).

Implications to Models of Pragmatic Processing

Our findings appear to contradict the ERP results (Jiang et al., 2013a) which argue for a "one-step" model of pragmatic processing (Hagoort and Van Berkum, 2007). The eye-tracking data cannot be accommodated easily by the "one-step" but may fit into a "two-step" language processing model. According to the latter model, in the first step, the local, context-independent meaning of a local structure is computed; only when this step is completed, the meaning is computed against the wider sentential, discourse and communicative context or against an individual's pragmatic knowledge (Grice, 1975; Fodor, 1983; Sperber and Wilson, 1995; Cutler and Clifton, 1999; Lattner and Friederici, 2003). This model is in contrast with the "one-step" model which assumes that different levels of meanings are activated simultaneously in the context, resulting in a unified N400 on words in ERPs that mismatched a diverse set of contextual information (Hagoort and Van Berkum, 2007), including the N400 effect on VP in the incongruent condition in Jiang et al. (2013a). Given that N400 typically indexes the immediate impact of pragmatic constraint during online linguistic processing (Kutas and Federmeier, 2011), it was concluded that the pragmatic information is rapidly used in online sentence reading.

The current data that tracked readers' eye-movement do not fully agree with the conclusion above. In the *lian: : :dou* construction, the reader has to form the representation of the event based on the local structure "determiner phrase + object noun + subject noun + VP," of which the likelihood is reversed by *lian: : :dou* in the global context. The "one-step" model would predict that pragmatic constraints of *lian: : :dou* is used in an immediate manner; this prediction was rejected by the lack of early modulation of congruency manipulation. In contrast, the specification of local event likelihood was manifested as an increased first-pass fixation duration in the underspecified condition, suggesting that the buildup of a local semantic meaning *can* be early. The *lian: : :dou* constraints are taken into account only when local representation is partially built and may be reanalyzed through initiating regressive saccades to the preceding sentential constituents whenever necessary.

The two-stage processing is consistent with recently proposed eye movement control models. For example, the E-Z Reader 10 (Reichle et al., 2009; see Reichle, 2011 for a review) specifies when the higher-level, post-lexical information affects eye movements during language comprehension. The model assumes that integration of a word into its syntactic and semantic context comes after the process of word identification, which is therefore post-lexical. Staub and colleagues (Staub, 2011; Abbott and Staub, 2015) provided evidence supporting this assumption as they observed that the integration difficulty of an implausible word (e.g., *the professor repaired the writer with a trusty old wrench*) does not appear on the early measures on the critical word (e.g., the skipping rate of *writer*) but appears downstream of that word. Even though the plausibility effect can, in some cases, be manifested in the first-pass fixation measures on a target word (Staub et al., 2007; Matsuki et al., 2011), the plausibility and other lexical effects (e.g., word frequency) are typically additive, suggesting the pragmatic information may not impact local processing in the early time course during sentence reading (Abbott and Staub, 2015). These model-guided experimental findings suggest that computation of plausibility or higher-level pragmatic meaning affects post-lexical integration, instead of lexical identification itself, during sentence comprehension.

How can we reconcile the contradictory findings between Jiang et al. (2013a) and the current study? In Jiang et al.'s study, each word (or phrase) was presented serially for 400 ms followed by an inter-stimulus interval (ISI) of 400 ms. Previous studies have shown that the presentation rate may affect the manifestation of different cognitive processes: the contextual effect is more likely to emerge without delay in a prolonged presentation rate (Camblin et al., 2007b). Similarly, the comparatively slower RSVP rates of word presentation in Jiang et al. (2013a) may provide readers with sufficient time to integrate

the critical VP with the pragmatic information conveyed by *lian: : :dou*, allowing the e□ect of congruence-related N400 to appear on the VP.

In the current eye-tracking paradigm, sentences were presented as an entirety in one line, and the readers were allowed to preview information and initiate regressive saccades to reanalyze uncertain or incongruent linguistic input. In an ERP study when readers were allowed to read at their own pace, longer reading time was predicted by larger amplitudes of ERP on words mismatching pragmatic constraint (e.g., less plausible sentence: *at the breakfast the boy would plant toast and jam*, Ditman et al., 2007), indicating that the immediacy of pragmatic congruency is a□ected by presentation speed. Moreover, in a task that does not emphasize the verification of acceptability of the sentence (cf. Jiang et al., 2013a), it is likely that the reader may adopt a good-enough strategy (Ferreira et al., 2002; Ferreira and Patson, 2007) as the demand of recovering from the pragmatic incongruence during normal sentence reading is low; consequently the incongruence e□ect appears late.

In summary, by using the eye tracking technique, the present study reveals a relatively delayed time course of processing pragmatic constraints during on-line reading of Chinese sentences with *lian: : :dou: : :*construction. When reading incongruent sentences, as compared with congruent ones, the reader spends longer total fixations, made more regressive saccades out of the critical regions where pragmatic infelicitousness is initially detected. This finding is comparable to the observation of *even* construction in English (Filik et al., 2009) which showed a delayed processing cost and an e□ort of reanalysis for highly likely events used after *even*. The current study provides new evidence showing that the processing of pragmatic constraints of the Chinese *lian: : :dou: : :* construction may not interrupt the early stage of lexical processing during natural sentence reading, and o□ers a methodological perspective that promotes ecological studies of language processing.

DATA AVAILABILITY STATEMENT

Original data covered by this study can be obtained from the corresponding authors upon request.

ETHICS STATEMENT

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