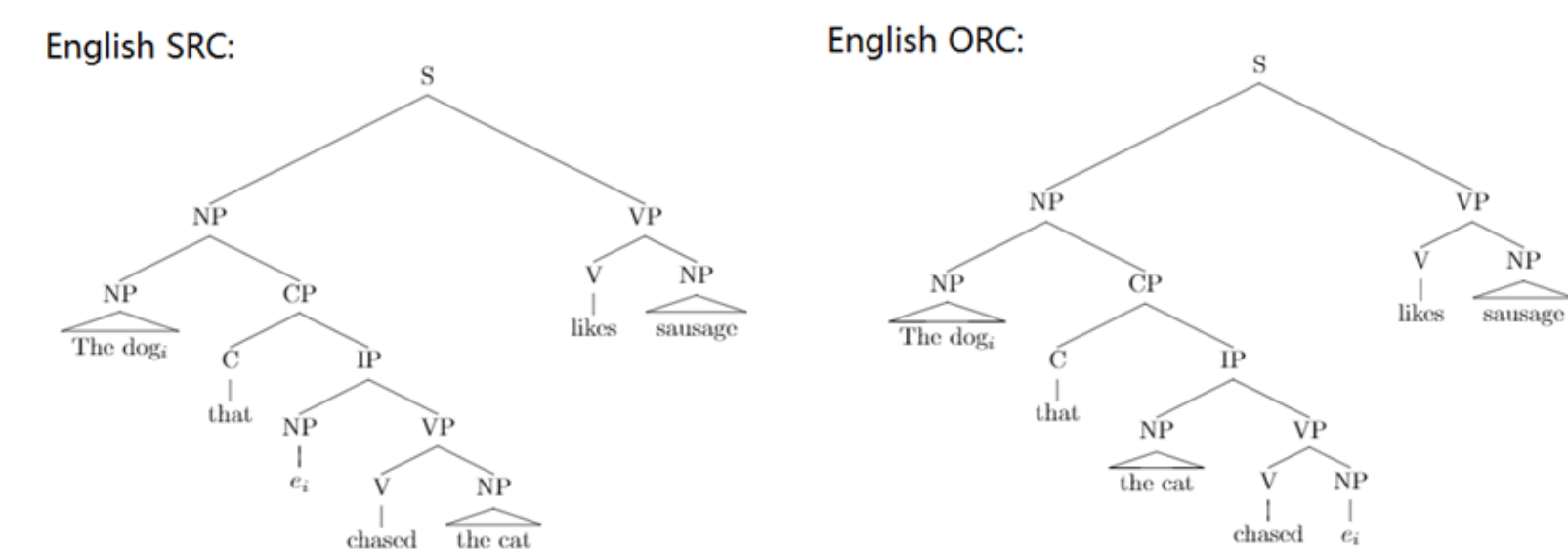


## Abstract

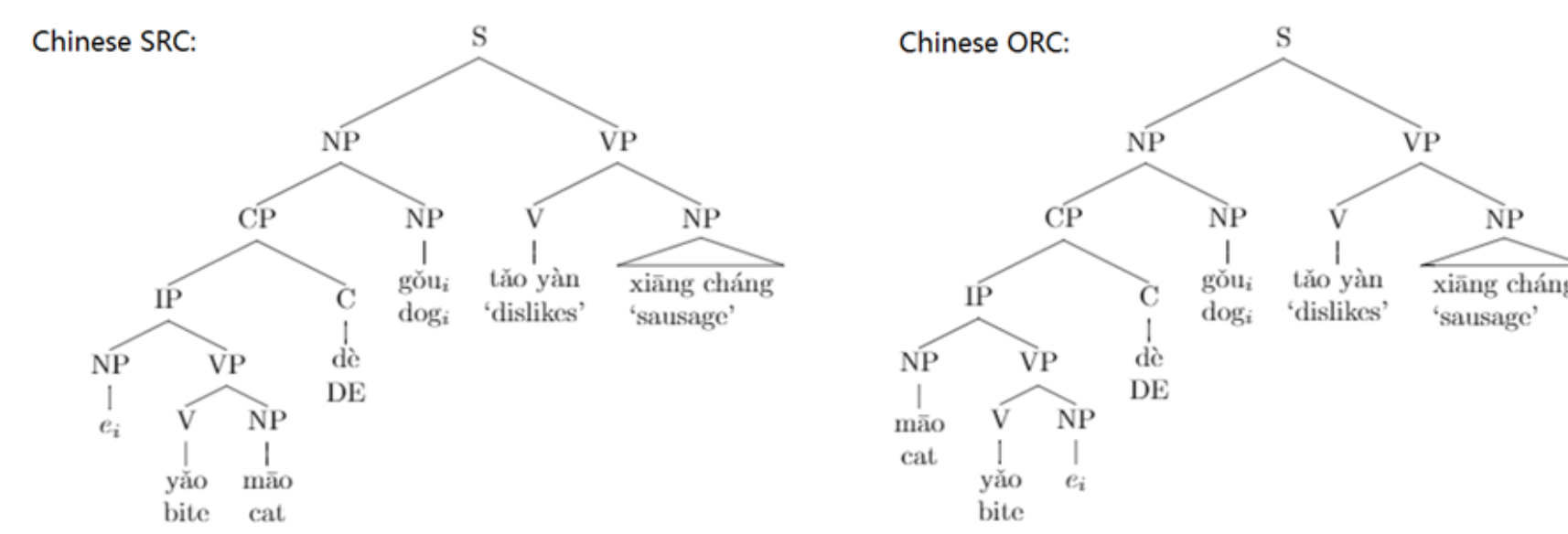
By reviewing popular theories of RC processing strategy in Chinese and numerous previous studies, this study argues for a testing-environment-dependent processing of Chinese relative clauses. A “local-summation model” is proposed to describe the asymmetry between subject- and object-extracted relative clauses in Chinese. Based on the above observations, this study also provide suggestions regarding methods and designs for future studies on Chinese relative clauses

## Introduction

Relative Clauses (RCs) have been a widely-studied topic in language processing in recent years. RCs are defined as subordinate clauses that modify a noun phrase, which is relativized. RCs of major interests can be divided into two categories: Subject-extracted RCs (SRCs) and Object-extracted RCs (ORCs). In languages with head-initial RCs, ORCs are more difficult to process than SRCs. Tree structures of English SRC and ORC are shown below.



Numerous hypotheses have been proposed to explain such pattern, and all predicts a relative advantage in SRC processing in languages with head-initial RCs. Nonetheless, such theories yield different predictions in Mandarin Chinese, where RCs are head-final. Tree structures of Chinese SRC and ORC are shown below.



Chinese can therefore be a testing ground for all the hypotheses regarding RC processing. Unfortunately, studies on RC processing in Chinese yield controversial results, with some supporting SRC advantage, and others supporting ORC advantage. Experimental paradigms are also widely different, and different hypotheses are used to explained the results.

## Analysis of Previous Studies

Multiple theories of RC processing have been proposed, and they yield different predictions about the processing asymmetry of RCs in Chinese, as well as the critical region that contribute to the asymmetry. **Table 1** list eight popular theories in literature, in addition to the prediction they yield when applied to Chinese RCs. “REL” stands for the relativizer word “de”, and “MCHN” stands for main clause head noun. These eight theories fall into 2 main categories as shown in **Table 1**: Expectation-Based theories and Movement-Based theories. The former attribute the RC processing asymmetry to the syntactic expectation readers have for possible developments of the sentences. The latter focus more on the processing cost due to syntactic movement in RC structures. Experimental paradigms also varies. Some created active reading environments (e.g. self-paced reading), and others created passive environments (e.g. EEG). **Table 2** and **Table 3** list the region-specific findings of existing studies using active and passive environments respectively.

	Theory	Proposed By	Assymetry Prediction	Critical Region Prediction
Movement-Based Theories	Structural Distance Theory	Lin & Bever, 2006	SRC advantage	REL, MCHN
	Linear Distance Integration Theory	Packard, Ye, & Zhou, 2010	ORC advantage	REL, MCHN
	Dependency Locality Theory	Hsiao & Gibson, 2003	ORC advantage	Relative clause
	Argument Crossing Hypothesis	Zhou, 2010	ORC advantage	MCHN
Expectation-Based Theories	Accessibility Hierarchy Theory	Keenan & Comrie, 1977	SRC advantage	/
	Expectation-Based Processing Theory	Hale, 2001	SRC advantage	Relative clause
	Perspective Shift Theory	MacWhinney & Pleh, 1988	SRC advantage	MCHN
	Canonical Word Order Theory	Bever, 1970	ORC advantage	Relative clause

Table 1. Summary of Theories and Predictions

	RC-V	RC-N	REL	MCHN
B.Chen et al.	SRC advantage	ORC advantage	/	/
Gibson and Wu	SRC advantage	ORC advantage	ORC advantage	ORC advantage
Jager et al.	SRC advantage	SRC advantage	SRC advantage	SRC advantage
Sung et al.	SRC advantage	ORC advantage	ORC advantage	ORC advantage
Vasishth	SRC advantage	ORC advantage	SRC advantage	SRC advantage
Hsiao and Gibson	/	ORC advantage	/	/
Lin and Garnsey	/	/	ORC advantage	ORC advantage

Table 2. Experimental Results in Active Reading Environments

	RC-V	RC-N	REL	MCHN
Liu, Tao, Zhou and Yang	/	/	SRC advantage	n.d.
Wang and Bing	ORC advantage	ORC advantage	/	SRC advantage
Zhang and Jiang	/	SRC advantage	SRC advantage	n.d.

Table 3. Experimental Results in Passive Reading Environments

Major problems associated with previous studies are listed as follows:

- Active and passive reading environments (self-paced and controlled speed) might have different influences on parsing strategies, (see **Table 2**, **Table 3**, **Chart 1**, **Chart 2**) but the difference is yet to be proved.
- Matrix subject position RCs can lead to sentence ambiguity. (see **Example 1**)
- Most studies suggesting Expectation-Based theories do not take other constructions sharing similar sentence initial portion as RCs in Chinese. (see **Example 2**)
- Some critical region data have not been determined using passive reading environment paradigms.

**Example 1.** Matrix-object position RC can lead to ambiguity  
jǐng tān kàn dào le nǚ zǐ wǎn nòng de shāng rén  
Police officer see ASP woman flirt REL businessman  
Interpretation 1: “The police officer saw the businessman who the woman flirted with.”  
Interpretation 2: “The police officer saw that it was the woman who flirted with the businessman.”

**Example 2.** Constructions sharing similar sentence initial portion as RCs in Chinese.

**DE-Construction**

dài bǔ fàn rén de shù liàng shàng shēng le  
arrest criminal DE number increase ASP  
“The number of criminals being arrested increased.”

**Imperative with zero-pronoun**

dài bǔ fàn rén qù bǎ  
PRO arrest criminal QU BA  
“Let’s go and arrest the criminals”

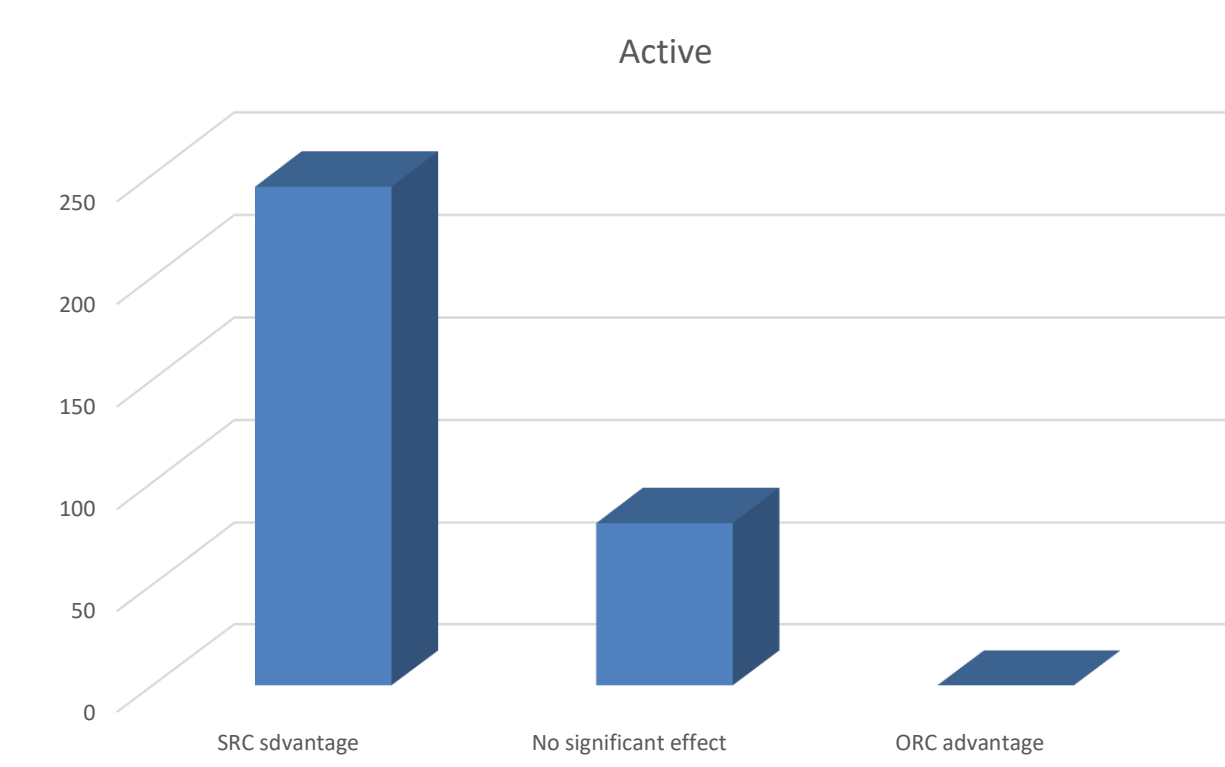


Chart 1. RC-V position in Active Reading Environments (Weighted with participant numbers)

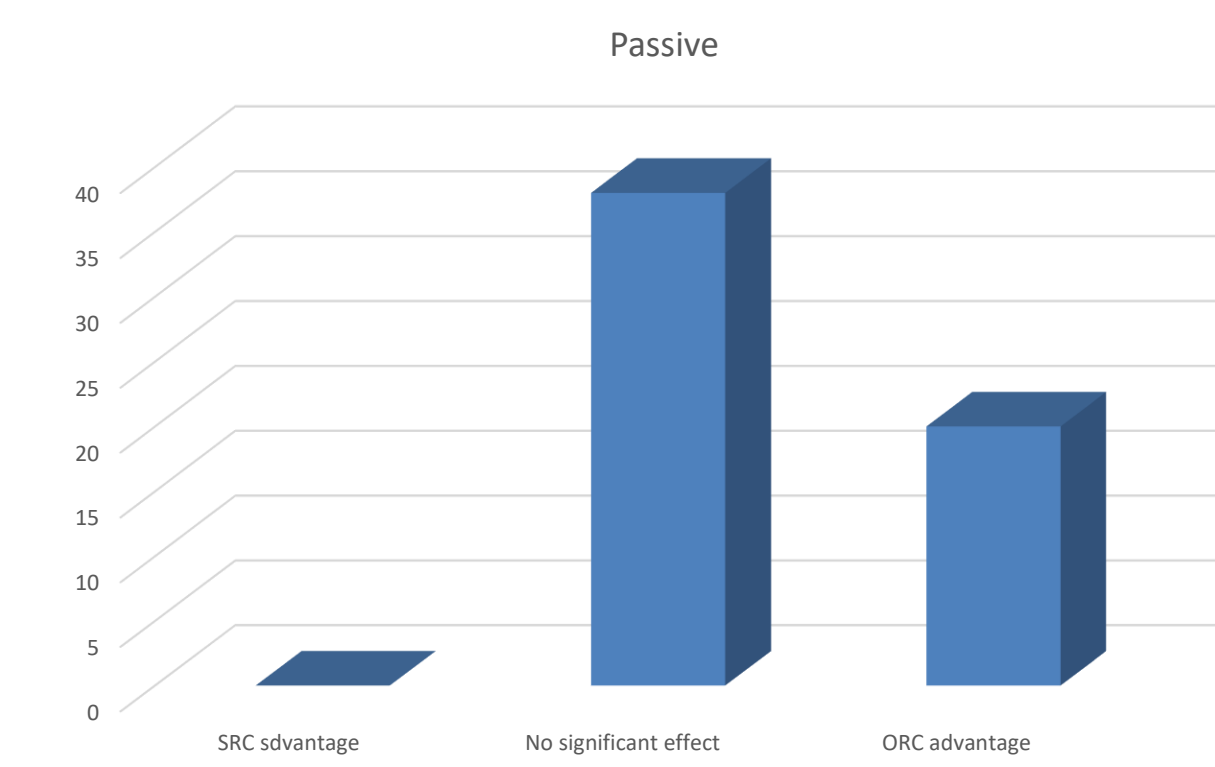


Chart 2. RC-V position in Passive Reading Environments (Weighted with participant numbers)

## Discussion

Great controversy still exists in explaining the mechanism of Chinese RC processing. As shown in **Table 2** and **3**, there exist region-specific differences in findings across different studies. The only thing we can be sure about is that the asymmetry between SRC and ORC processing exists, but whether a SRC advantage or an ORC advantage underlies the asymmetry is still widely disputed. Based on the analysis of different studies, we can see that difficulty asymmetry in Chinese RC processing is not determined by a single factor. Even though most scholars tried to explain the ORC or SRC advantage using one single theory that, as they claim, works cross-linguistically, it is very likely that more than one factor decides the RC processing difficulty. This is supported by the observations that SRC and ORC advantages at different regions can co-exist in the same condition. Therefore, multiple linguistics factors that are location dependent need to be “summed” to yield the overall asymmetry in RC processing. In other words, we need to adopt a “local-summation model” in explaining Chinese RC processing.

In addition, there exist a possible correlation between experiment environment and the parsing strategy, as shown in **Chart 1** and **Chart 2**. Therefore, future studies should try to study the influence experiment paradigms have on parsing strategies readers use. Also, matrix-subject position RCs should be the focus for future studies to avoid potential ambiguity. Matrix-subject position RCs may share sentence initial portions with other constructions like DE-construction and Pro-dropped sentences. Thus, such structures should also be tested to study the validity of Expectation-Based Theories.

## Suggested Future Study

To solve the problems associated with previous studies as mentioned in previous sections, the following study is proposed.

The proposed study will use EEG device time-locked to eye-tracking device to create an active reading environment while using ERP technique, which is commonly associated with passive reading environments. This study will test if participants would show SRC advantage as in similar environments created by self-paced reading paradigms. Also, in addition to reading time, ERP data can provide more understanding of expectancy and surprisal effects in active reading environments. In addition to the two RC conditions, pro-drop imperative and SVO sentences will also be tested. By comparing SRC with pro-drop sentences, we can verify reader’s default expectation, if there is any, for constructions with sentence-initial verbs like RC-V in RCs. SVO condition will also be used as a comparison with ORCs, as these two constructions also share the same sentence-initial portions. This design can help us further verify the argument in most studies suggesting Expectation-Based theories for Chinese RC processing. The four conditions are listed in **Table 4**.

Conditions	Example Sentences
Subject relative clause	小明说：追猫的大黑狗确实胖胖的。 Xiaoming shuo: zhui mao de daheigou qeshi pangpangde. Xiaoming say: chase cat REL big black dog indeed fat Xiaoming said: “The big black dog that chases the cat is fat indeed”
Imperative (pro-drop)	小明说，追猫去吧。 Xiaoming shuo, zhui mao qu ba. Xiaoming say, chase cat go BA Xiaoming said: “Let’s go chase the cat.”
Object relative clause	小明说，猫追的大黑狗确实胖胖的。 Xiaoming shuo, mao zhui de daheigou qeshi pangpangde. Xiaoming say cat chase REL big black dog indeed fat Xiaoming said: “The big black dog that the little white cat chases is fat indeed.”
SVO	小明说，猫追了大黑狗。 Xiaoming shuo, mao zhui le daheigou. Xiaoming say, cat chase ASP big black dog Xiaoming said: “the cat chased the big black dog.”

Table 4. Conditions in the proposed future study

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