

Language statistics vs. interference in processing center-embedding illusions: insights from Mandarin Chinese

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Context:

English has a double centre-embedding illusion

**Double
centre-
embedding**

The patient [_{RC} the nurse [_{RC} the clinic hired] saw] coughed.
Grammatical (but relatively hard to process)

“Missing VP”

The patient [_{RC} the nurse [_{RC} the clinic hired]] coughed.
Ungrammatical (relatively easy to process)

Frazier 1985; Gibson & Thomas 1999; Frank & Ernst 2019

Also Gimenes et al. 2009 (French); Paneda & Lago 2020 (Spanish)

Context:

But German (also Dutch) does not

**Double
centre-
embedding**

Der Anwalt, [RC den der Zeuge, [RC den der Spion betrachtete], schnitt], überzeugte den Richter.
the lawyer who the witness who the spy watched avoided convinced the judge

Grammatical (relatively easy to process)

“Missing VP”

Der Anwalt, [RC den der Zeuge, [RC den der Spion betrachtete],], überzeugte den Richter.
the lawyer who the witness who the spy watched convinced the judge

Ungrammatical (relatively hard to process)

Vasishth et al. 2010 (also Frank et al. 2016; Frank & Ernst 2019).

But see Bader 2016; Haeussler & Bader 2015

Why are missing VP sentences illusory only in certain languages (English, not German)?

Parsing differences due to ...

1. Interference: Different syntactic representations
2. Language statistics: Differences in word order distributions, e.g. frequency of (single) centre-embedding

Huang & Phillips 2021: Mandarin poses a problem for language statistics account

Language statistics account predicts no illusion in Mandarin:

- Mandarin word order = (Single) centre-embedding is quite frequent. (head-final relative clauses + SVO structure)
- Grammatical double centre-embedding should be easier than ungrammatical “Missing NP” sentences.

But grammatical double centre-embedding is not more acceptable in Mandarin (“missing NP illusion”).

This study: Maybe acceptability ratings provide an incomplete picture of cross-linguistic variation?

Language statistics accounts:

- German/Dutch speakers can detect the ungrammaticality (incompleteness) of Missing VP sentences **online** (self-paced reading, eye-tracking).
- But English speakers do not.

Vasishth et al. 2010; Frank et al. 2016

“Rescuing” the language statistics account for Mandarin

A scenario:

Mandarin speakers are like German/Dutch speakers in real-time processing: they can detect the ungrammaticality (incompleteness) of Missing NP sentences **online**.

However, Mandarin speakers might just find it easier to repair Missing NP sentences **offline**.

→ Relatively high acceptability ratings.

Do Mandarin speakers detect the ungrammaticality of Missing NP sentences in real time?

Experiment 1 (self-paced reading)

NP1

Zongli daodi	jiejianle	na-ming	[_{RC}	ceng	xiezhuguo	zhe-ge	[_{RC}	gang	jiefa	tanwu-an
PM	actually	met	that-CL	previously	helped	this-CL	just	expose	corruption-case	
<i>ADV1</i>	<i>de</i>	<i>NP2</i>	<i>ADV2</i>	<i>de</i>	<i>NP3</i>	<i>or</i>	<i>or+1</i>	<i>or+2</i>		
bujiu	de]	lüshi	yi-liang-ci	de]	yi yuan	haishi	zhe-ming	xiaoxinjinshen	de	dashi?
recently	DE	lawyer	one-two-time	DE	legislator	or	this-CL	cautious	DE	ambassador

“Did the prime minister meet that legislator who ... or this cautious ambassador?”

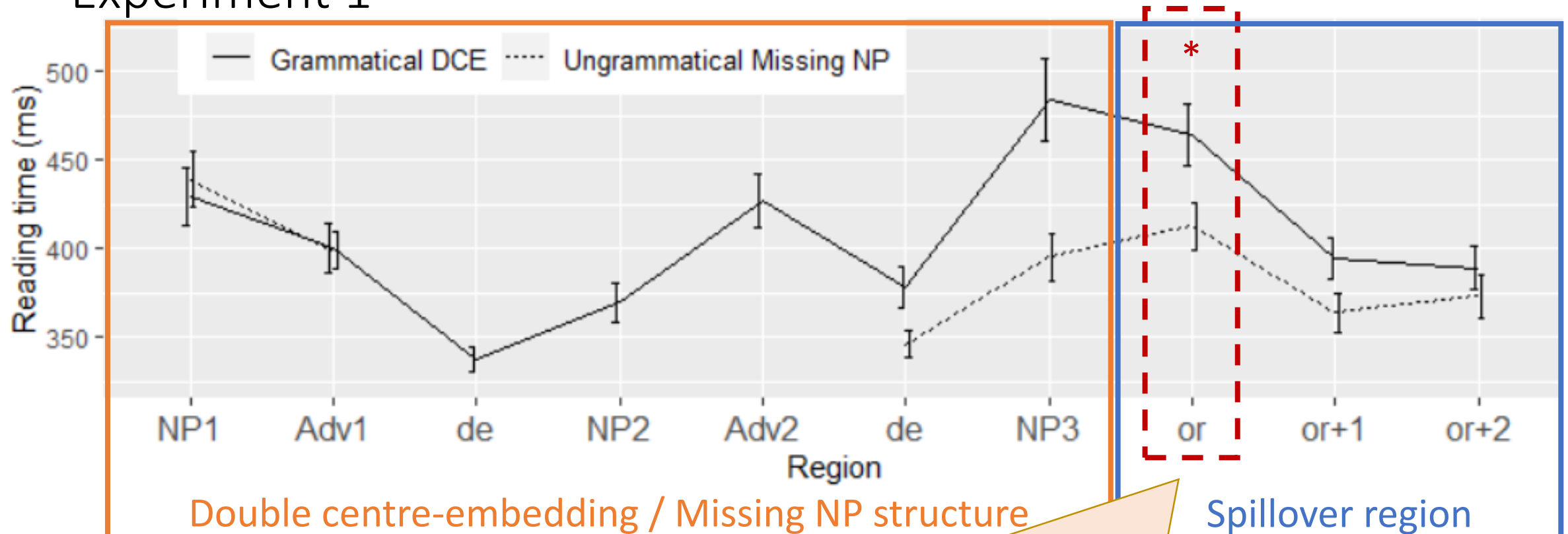
Double centre-embedding (Missing NP) structure

See Appendix for example sentences

Spillover region

Mandarin speakers don't detect the ungrammaticality of Missing NP sentences

Experiment 1



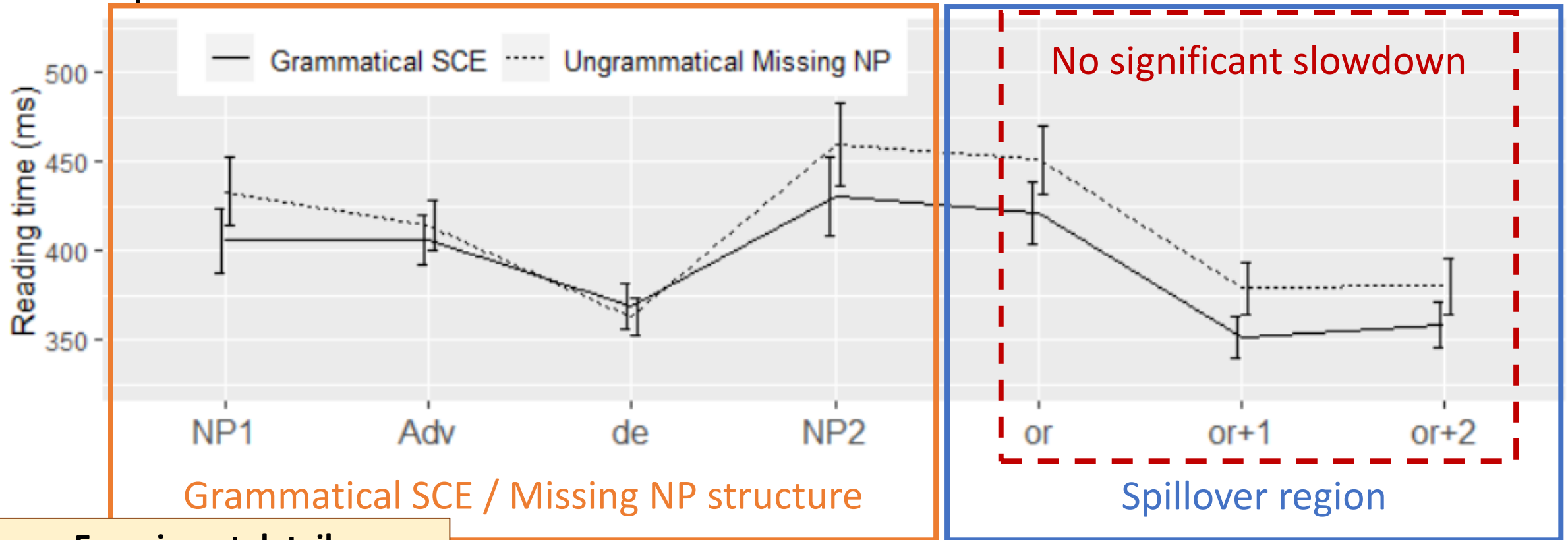
Experiment details

- 40 native speakers Mandarin speakers on Prolific
- 20 DCE/Missing NP sentences

No slowdown for Missing NP sentences.
In fact, slowdown seen for grammatical DCE sentences around NP3 → appearance of NP3 is unexpected?

In fact, Missing NP sentences are read on par with grammatical single centre-embedding (SCE)

Experiment 2



Experiment details

- 32 native speakers Mandarin speakers on Prolific
- 20 SCE/Missing NP sentences

Mandarin has a centre-embedding illusion, like English, unlike German

The illusion is observed in **online measures**.

- **Further evidence against a language statistics approach**, adding to offline evidence provided by Huang & Phillips.

Next steps / In-progress: How are missing NP sentences interpreted thematically **in real time**?

- Which verb gets paired with what NPs?
- How are these relations different from/similar to those observed in offline processing?
- Evaluate Huang & Phillips' interference + repair account.

Appendix: Experiment 1 materials

(1) a. Grammatical DCE sentence

Zongli daodi jiejianle na-ming [_{RC} ceng xiezhuguo zhe-ge [_{RC} gang jiefa tanwu-an
PM actually met that-CL previously helped this-CL just expose corruption-case
ADV1 de NP2 ADV2 de NP3 or or+1 or+2
bujiu de] lüshi yi-liang-ci de] yiyuan haishi zhe-ming xiaoxinjinshen de dashi?
recently DE lawyer one-two-time DE legislator or this-CL cautious DE ambassador
“Did the prime minister actually meet that legislator who previously helped a couple of times this
lawyer who just exposed the corruption case recently, or this cautious ambassador?”

b. Ungrammatical Missing NP (MNP) sentence

Zongli daodi jiejianle na-ming [_{RC} ceng xiezhuguo zhe-ge [_{RC} gang jiefa tanwu-an
PM actually met that-CL previously helped this-CL just expose corruption-case
ADV1 de NP3 or or+1 or+2
bujiu ____ de] yiyuan haishi zhe-ming xiaoxinjinshen de dashi?
recently ____ DE legislator or this-CL cautious DE ambassador
“*Did the prime minister actually meet that legislator who previously helped this ____ just exposed
the corruption case recently, or this cautious ambassador?”

Appendix: Experiment 2 materials

(2) a. Grammatical SCE sentence

Zongli daodi jiejianle na-ming [RC gang yu jizhe yiqi jiefa tanwu-an
PM actually met that-CL just with reporter together expose corruption-case
ADV1 *de* *NP2* *or* *or+1* *or+2*
bujiu *de*] yiyuan haishi zhe-ming xiaoxinjinshen *de* dashi?
recently DE legislator or this-CL careful DE ambassador
“Did the prime minister meet that legislator who just, together with the reporter, exposed the corruption case recently, or this cautious ambassador?”

b. Ungrammatical Missing NP (MNP) sentence

Zongli daodi jiejianle na-ming [RC ceng xiezhuguo zhe-ge [RC gang jiefa tanwu-an
PM actually met that-CL previously helped this-CL just expose corruption-case
ADV1 *de* *NP3* *or* *or+1* *or+2*
bujiu ____ *de*] yiyuan haishi zhe-ming xiaoxinjinshen *de* dashi?
recently ____ DE legislator or this-CL cautious DE ambassador
“*Did the prime minister actually meet that legislator who previously helped this ____ just exposed the corruption case recently, or this cautious ambassador?”