



The Eyes Are the Windows to the Thoughts

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CBS - RCLCN Lecture Series (7 Dec. 2022)



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Opening Minds • Shaping the Future
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COLLECTING
HUMAN DATA

Identifying signals that reflect language users' processing of language comprehension and production can help us understand the cognitive process (e.g., by SPR, EEG, eye-tracking, fMRI, etc.)



Why observe eye-movements?

We fixate on things we are mentally paying attention to

- > Information on cognitive processes involved in language processing
- > Online, moment-to-moment, measures provide researchers information on the temporal order of such processes
- > In linguistic studies: the prediction and the integration of semantic information during structure-building; e.g., word sense disambiguation, dependency processing



Why observe eye-movements?

What natural reading in Chinese languages is like?

- > Patterns of eye movement during text reading can be influenced by the readability of texts, and by the task of reading
 - Words that are more predicated from previous contexts are more likely to be skipped, or less fixation time
 - Language specific reading patterns and effects also exist

- > Need more data





Eye-movements on a text

我六岁那年，有一次，在一本书里看见一幅很棒的图画，

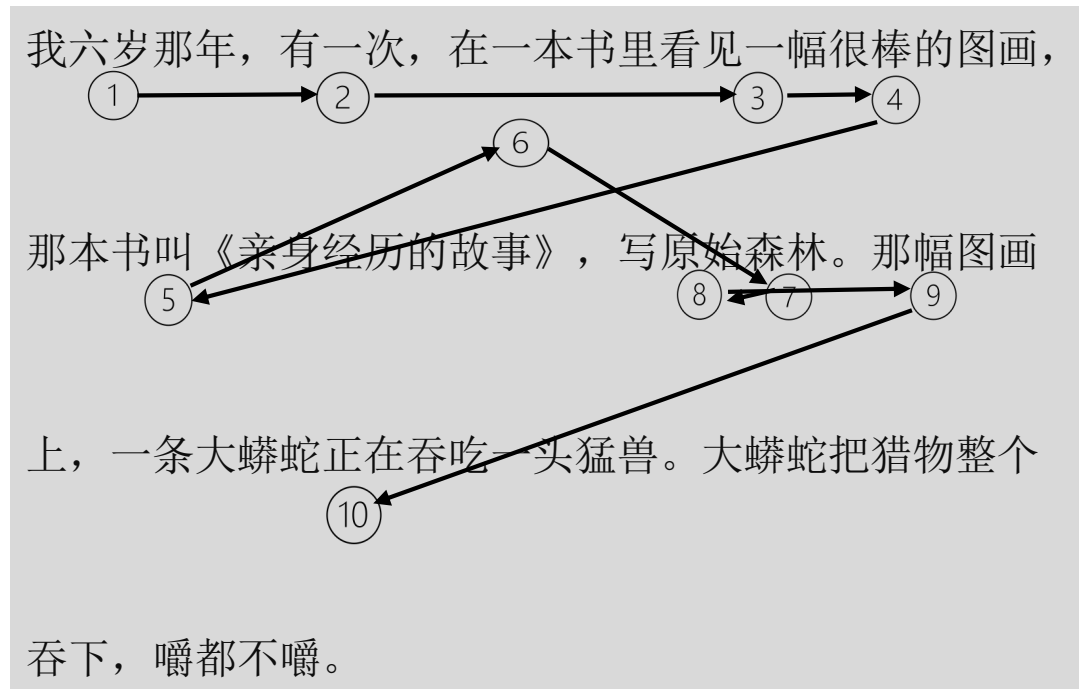
那本书叫《亲身经历的故事》，写原始森林。那幅图画

上，一条大蟒蛇正在吞吃一头猛兽。大蟒蛇把猎物整个

吞下，嚼都不嚼。



Eye-movements on a text



Mandarin vs. Cantonese

Similar, but still different

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吞下，嚼都不嚼。

70 characters

9 sentences

六歲嗰年，我喺一本書入面見過幅好得人驚嘅圖畫。

嗰本書叫做《真實故事》，係關於原始森林嘅。幅圖畫

入邊有條蟒蛇張開咗血盆大口，吞緊一隻野獸落肚。

62 characters

6 sentences





The corpus 1.0

	Mandarin	Cantonese
number of tokens	4357	5074
number of types	1016	1036
average number of tokens per sentence (sd)	12.17 (7.66)	15.10 (8.68)
range of number of tokens per sentence	1-42	1-46
average token length (sd)	1.41 (0.63)	1.34 (0.61)
range of token length	1-8	1-6
number of participants	15	14



The corpus 1.0

Different purposes, different strategies

Two reading tasks:

- > Normal reading (NR)
- > Task specific reading (TSR)



IP Time: 00000348 ms / Trial Time: 00000348 ms

「綿羊見到乜就食乜㗎喇。」「就算有刺嘅花都食？」

「係呀，就算有刺嘅花都食。」「係噉啲花要刺嚟做乜

呀？」我一時唔知點答佢。當時我正係嘗試緊將一粒棘住

我個引擎嘅螺絲扭返出嚟。我好擔心，

Normal Reading



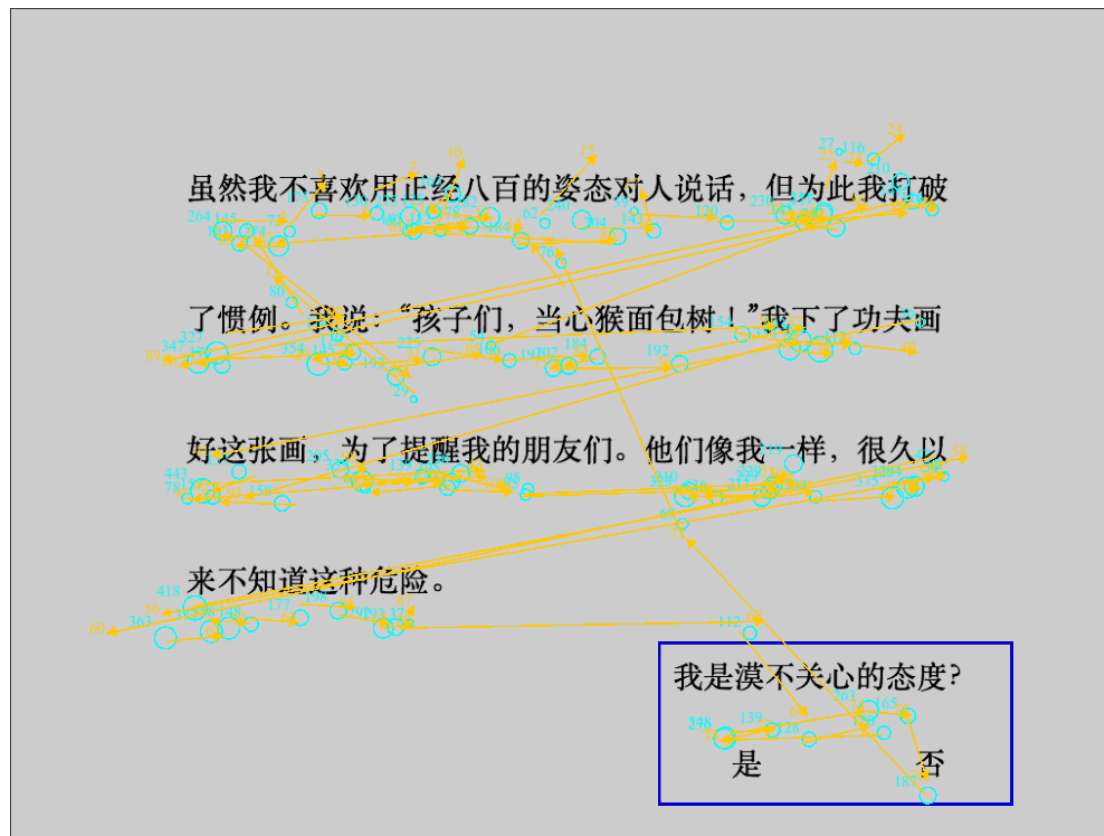
IP Time: 00000478 ms / Trial Time: 00000478 ms

六歲嗰年，我喺一本書入面見過幅好得人驚嘅圖畫。嗰本書叫做《真實故事》，係關於原始森林嘅。幅圖畫入邊有條蟒蛇張開咗血盆大口，吞緊一隻野獸落肚。

Task Specific Reading



Eye-movements on a text





Features

comprehension

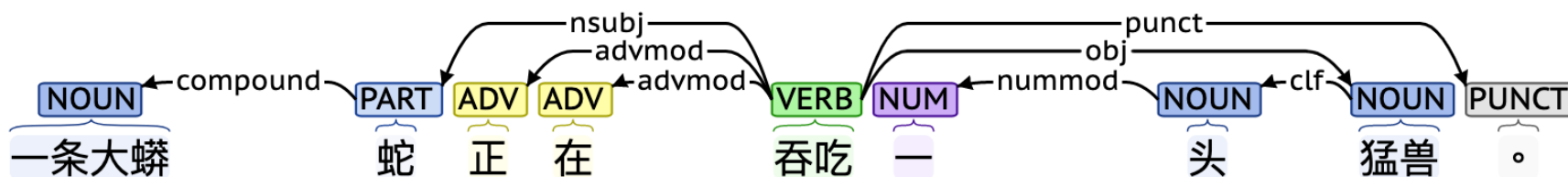
- Word's omission rates
- Sentences skipping rates
- POS re-read rates

- First fixation duration
- Second fixation duration
- Regression path duration
- Total dwell time

Features

Text complexity

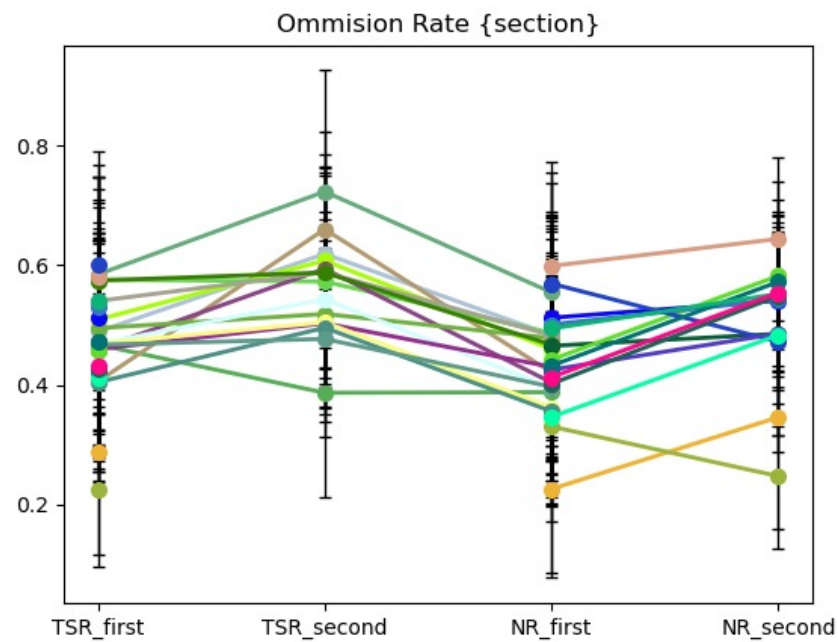
- Orthographic neighborhood number
- Linear dependency distance to the head
- Linear dependency distance to the root
- Depth of dependency distance to the root





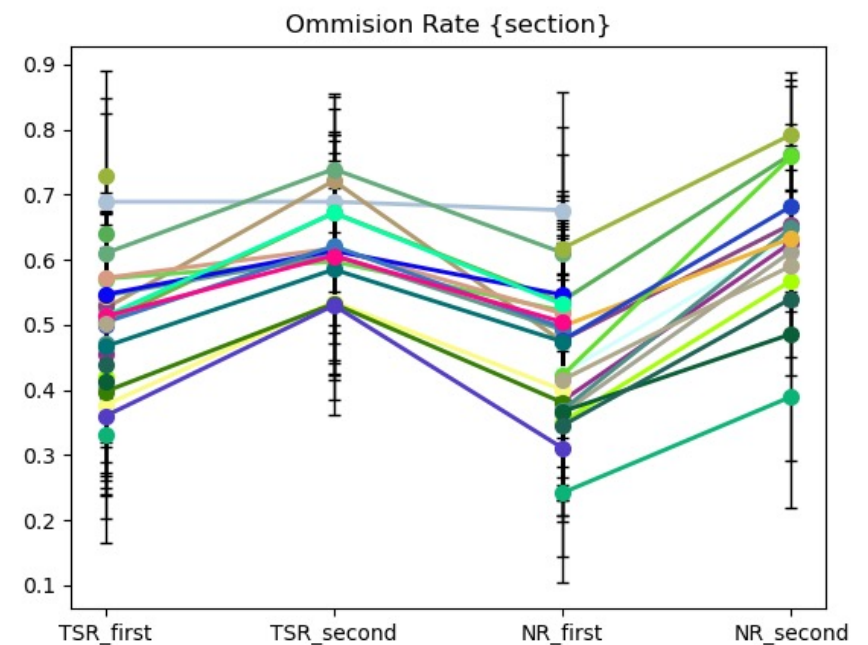
Word omission rates

Mandarin



	TSR_first	TSR_second	NR_first	NR_second
mean_omission_rate(sentence)	0.474616	0.558652	0.438624	0.503965
std_omission_rate(sentence)	0.190852	0.181062	0.195506	0.17887

Cantonese

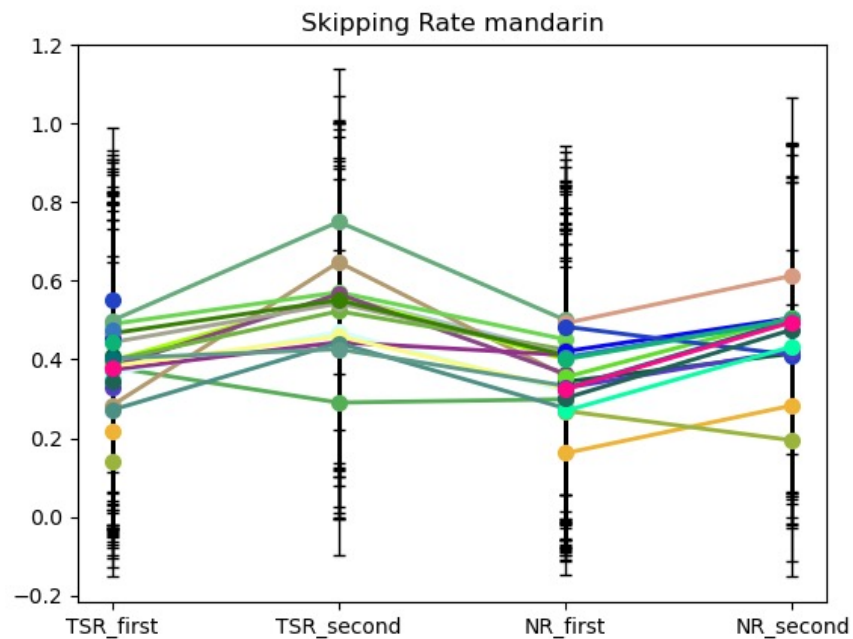


	TSR_first	TSR_second	NR_first	NR_second
mean_omission_rate(sentence)	0.501638	0.62274	0.458294	0.625343
std_omission_rate(sentence)	0.175993	0.15603	0.181169	0.163779



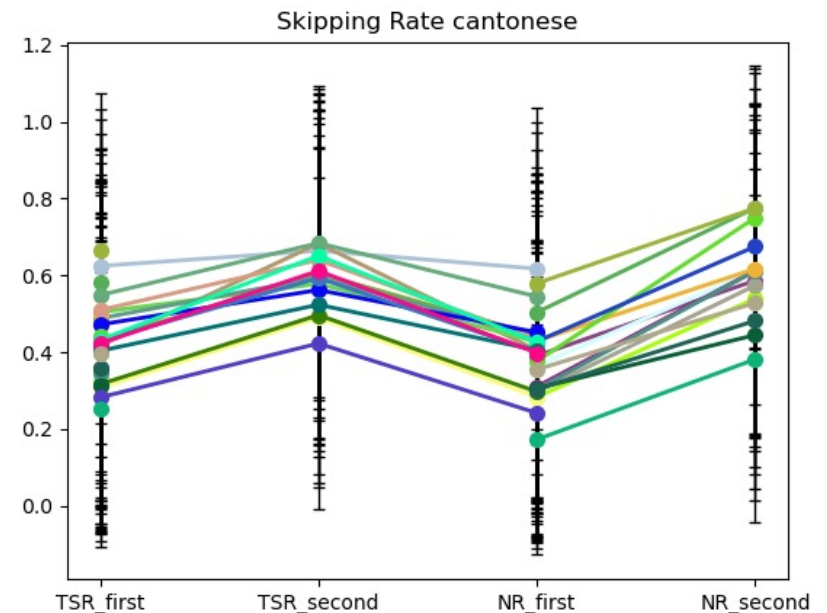
Sentence skipping rates

Mandarin



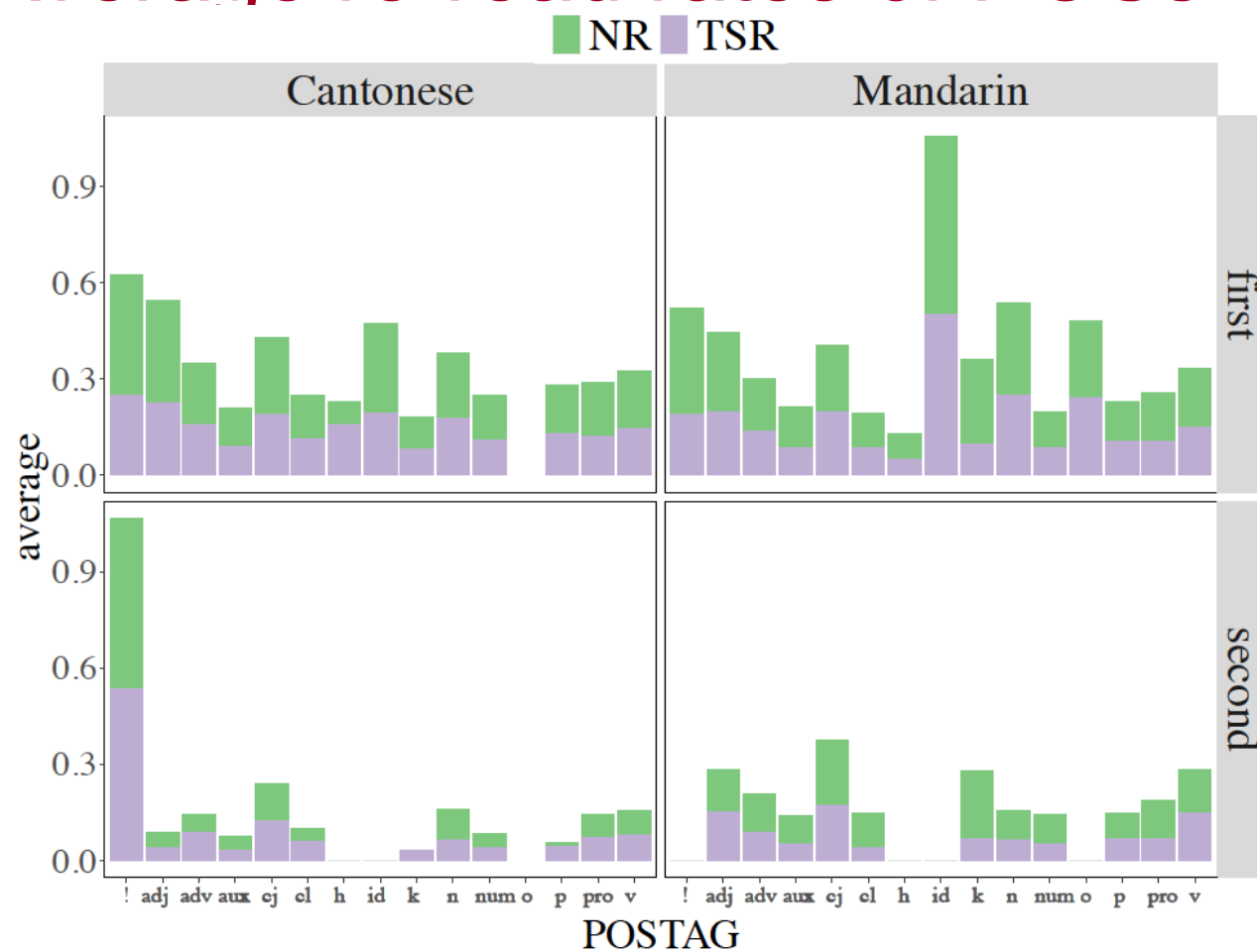
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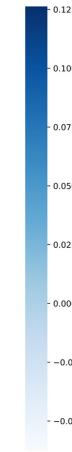
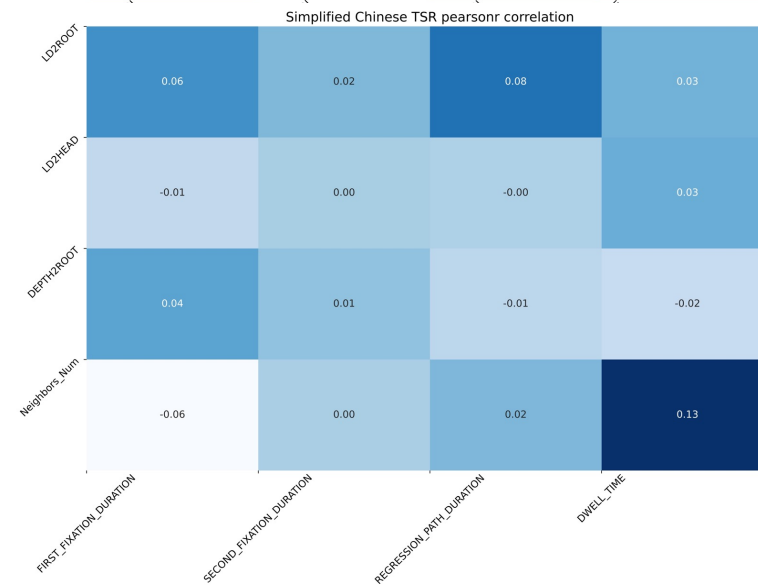
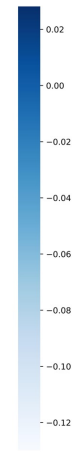
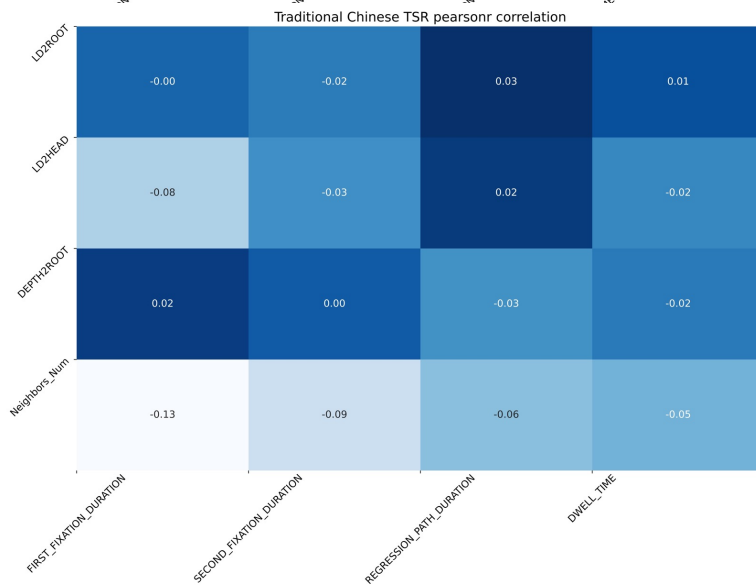
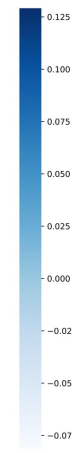
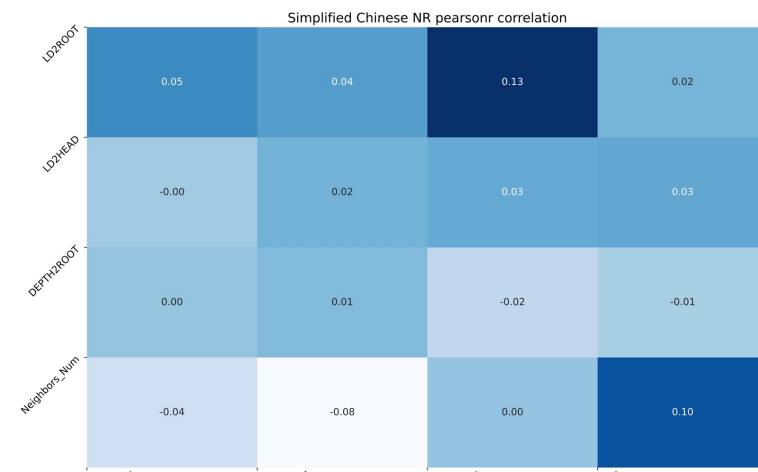
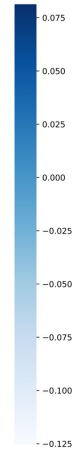
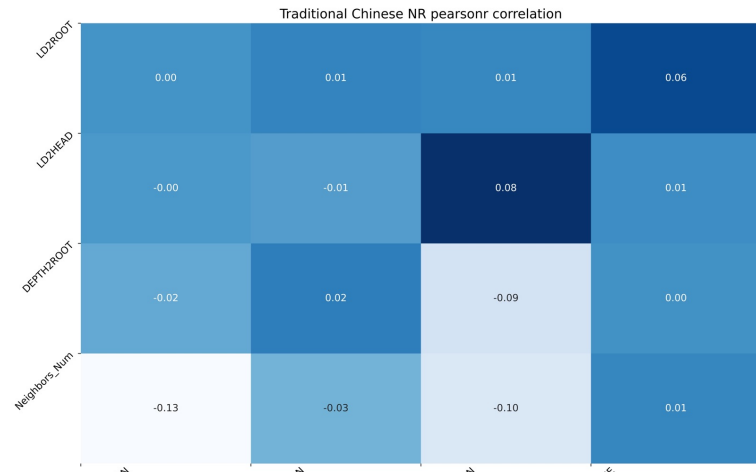
Average re-read rates of POSs





Features

	Mandarin	Cantonese
average orthographic neighbor number per word (sd)	372.14	144.02
average linear dependency distance of a word to its head	2.92	3.43
average linear dependency distance of a word to its sentence root	8.79	15.91
average depth of dependency distance of a word to its sentence root	2.23	2.40





Future application

A cognitively proper computational model can make similar decisions as humans do

- > To compare patterns of machines and of human beings
- > Language models' prediction of human processing patterns and signals
 - Can language models accurately model human behaviors in language processing?



Future application

A cognitively proper computational model can make similar decisions as humans do

- > What features can influence (what level of) readability?
- > Individual differences?
- > Do language models also rely on features of readability as humans do?
- > Multilingual comparison



Thank you!



Big thanks to the following members:

Dr. Emmanuele Chersoni

Dr. Bo Peng

Deran Kong

Wenxi Fei

Leon Lee

Junlin Li

Le Qiu