

Rapid semantic updating despite prediction errors: Evidence from Mandarin Chinese

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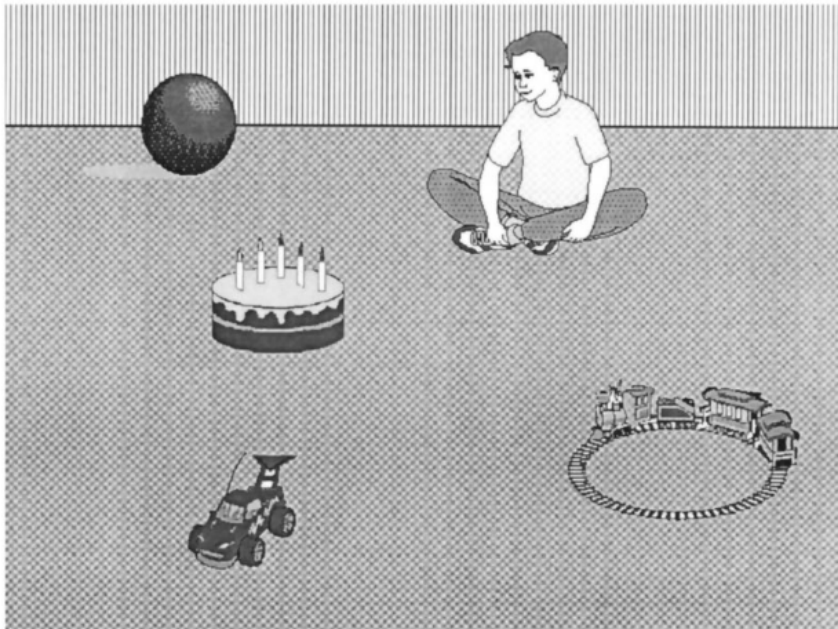
book

I went to the library to borrow a



Introduction

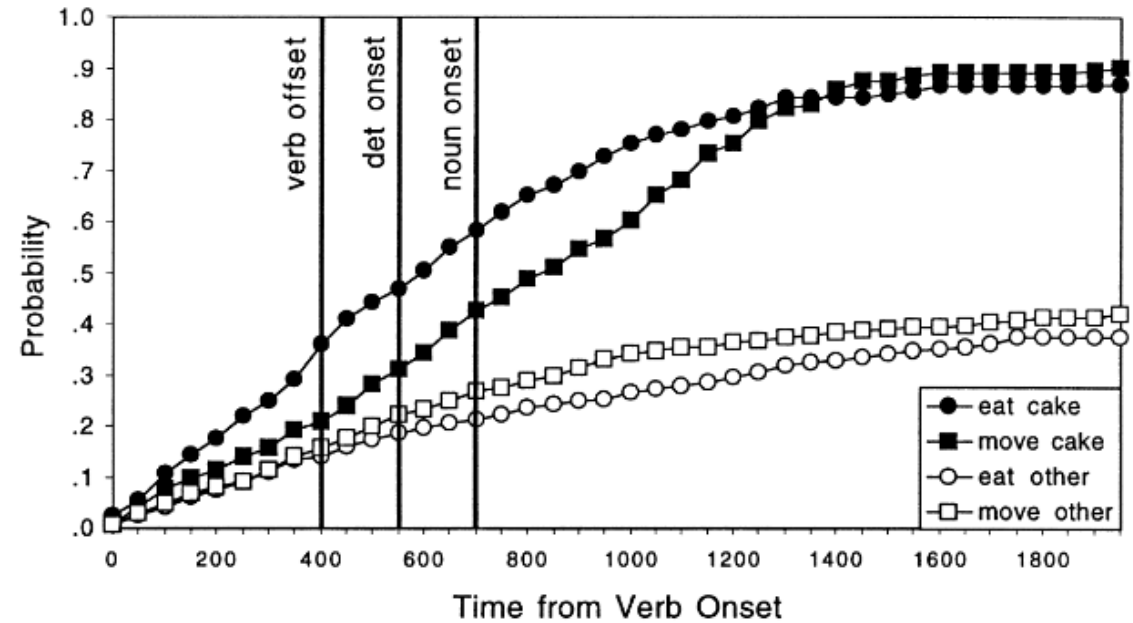
Predicting semantic information



*The boy will **move/eat** the cake.*

The boy will eat ...

Something edible



Introduction

Updating predictions based on incoming information

Studies found that comprehenders can use unexpected information to update their predictions very quickly (Fleur et al., 2020; Szewczyk et al., 2022; Szewczyk & Wodniecka, 2020; Chow & Chen, 2020).

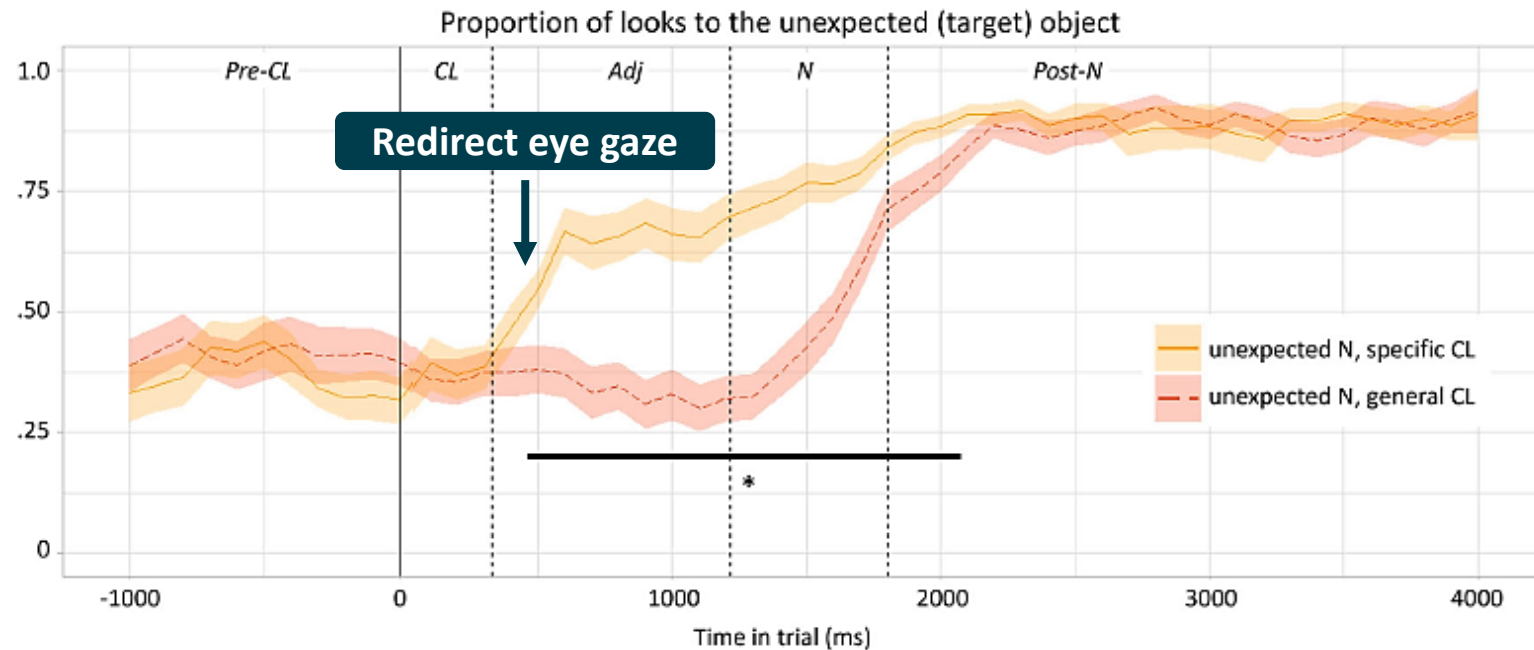
Chow & Chen (2020) examined listeners' sensitivity to cues that are inconsistent with their predictions by using nominal classifiers in Mandarin Chinese.



Introduction

Updating predictions based on incoming information

Chow & Chen (2020) found that Mandarin Chinese listeners were able to rapidly redirect their eye gaze towards a previously unexpected object upon hearing a prediction-inconsistent classifier.



Anna at Starbucks bought one CL_piece / CL_general very nice-tasting cake.

Unexpected N

Introduction

How about consecutive cues?



Processing the first prediction-inconsistent cue can already overload the system

- To detect and resolve conflicts between prediction and bottom-up input (e.g., coffee and CL_piece)
- To update existing predictions or make new ones



The cost of prediction error seems very small or very short-lived

- Eye-tracking: redirect eye gaze without an extensive search for alternatives (Chow & Chen, 2020)
- ERP: reduced N400 at the noun which is preceded by an informative cue (Szewczyk et al., 2022; Szewczyk & Wodniecka, 2020; cf. Husband & Bovolenta, 2020)

The present study

Goal

- 1) Replicate the predictive effect of specific classifiers.
- 2) Investigate how prediction errors affect subsequent semantic processing.

We used *prediction-mismatching classifiers* to **signal a prediction error** (Chow & Chen, 2020).

- Nominal classifiers are obligatory in Mandarin Chinese when the noun is modified by a demonstrative or numeral.

Specific, matching

- 一本书 (one CL_{ben} book)
- 一束花 (one CL_{shu} flower)
- 一台相机 (one CL_{tai} camera)

Specific, mismatching

- *块书 (one *CL_{kuai} book)
- *张花 (one *CL_{zhang} flower)
- *份相机 (one *CL_{fen} camera)

General

- 一些书 (some books)
- 一些花 (some flowers)
- 一个相机 (one CL_{ge} camera)

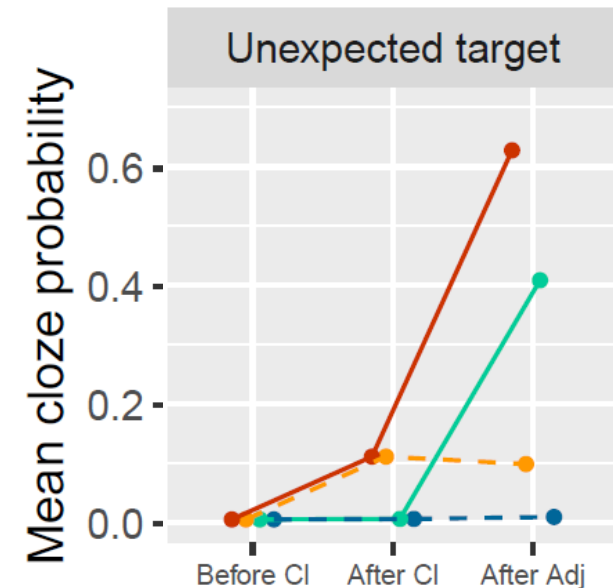
The present study

Goal

- 1) Replicate the predictive effect of specific classifiers.
- 2) Investigate how prediction errors affect subsequent semantic processing.

We then used *informative adjectives* to **trigger potential updating of noun predictions**.

- We measured *cloze probabilities* of the target noun to ensure that an informative adjective can always make the noun more likely to follow even after a prediction-mismatching classifier (cf. Husband & Bovolenta, 2020).

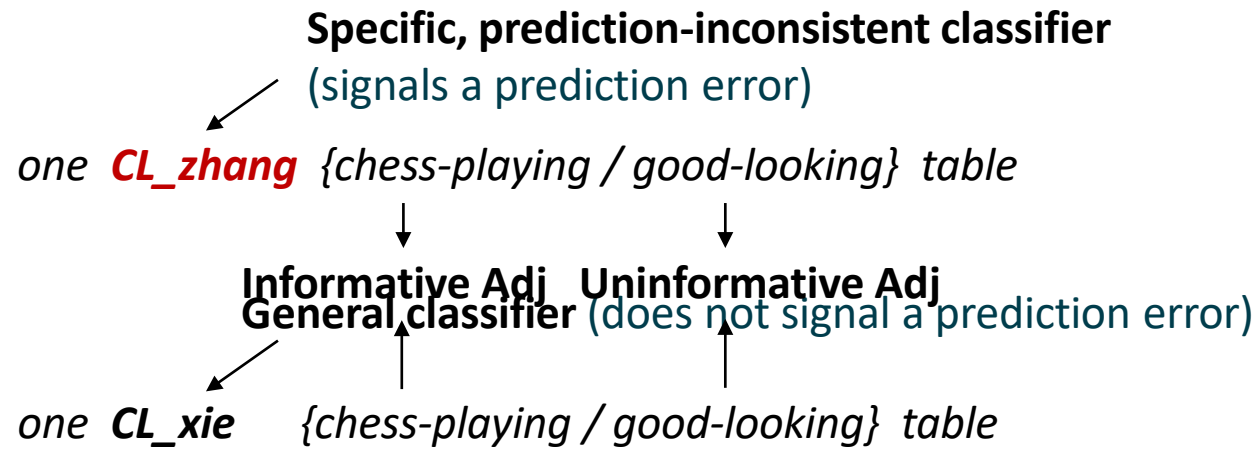


Method

A 2×2 design: Classifier (specific vs. general) × Adjective (informative vs. uninformative)

(originally in Chinese)

The old house's courtyard is full of greenery, and in its centre, there is ...



Expected



Distractor



Target

Competitor

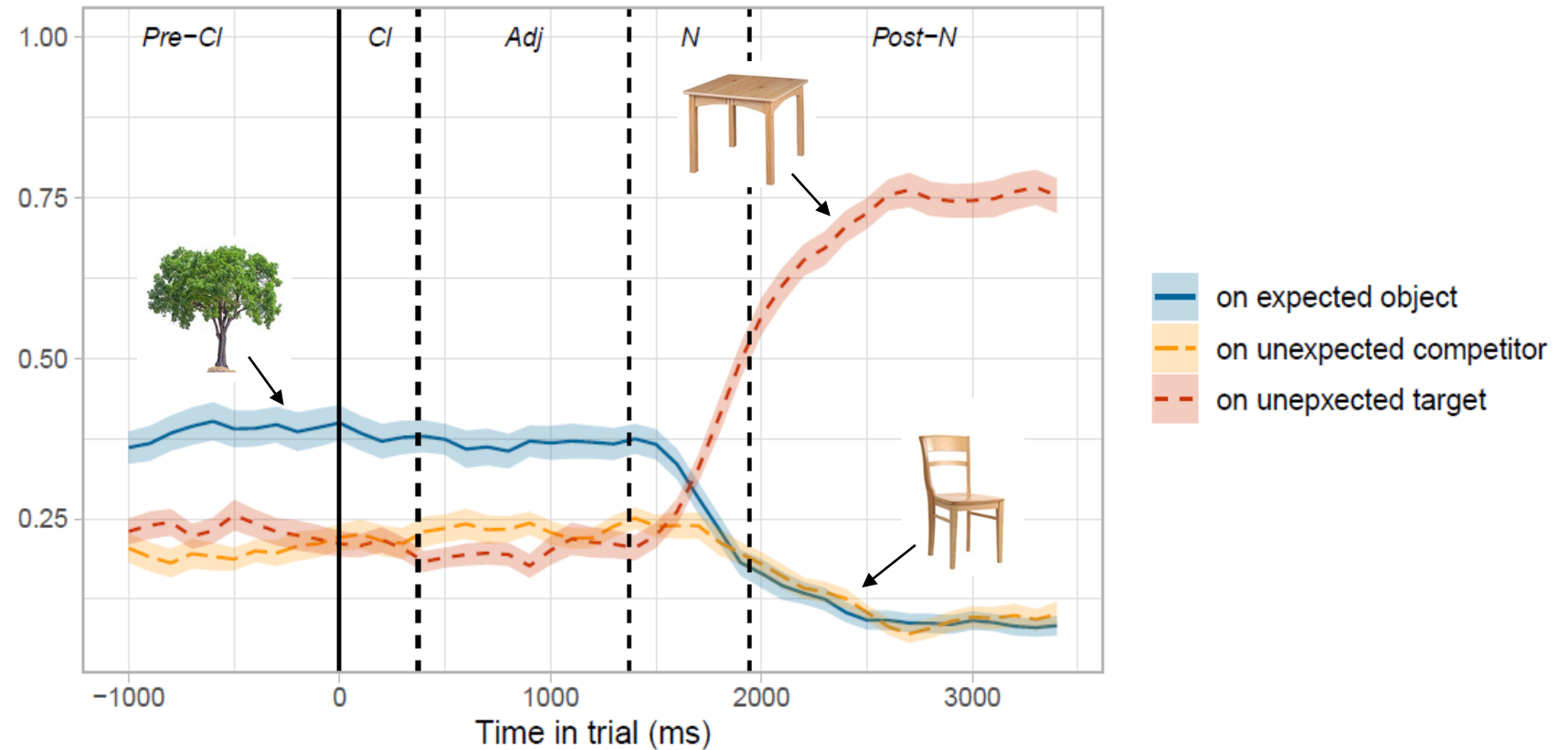
50 participants; 40 experimental + 110 filler items

Results

Following a general classifier (*CL_xie*) and an uninformative adjective (*good-looking*)

Listeners were more likely to look at the expected object before the mention of the target noun.

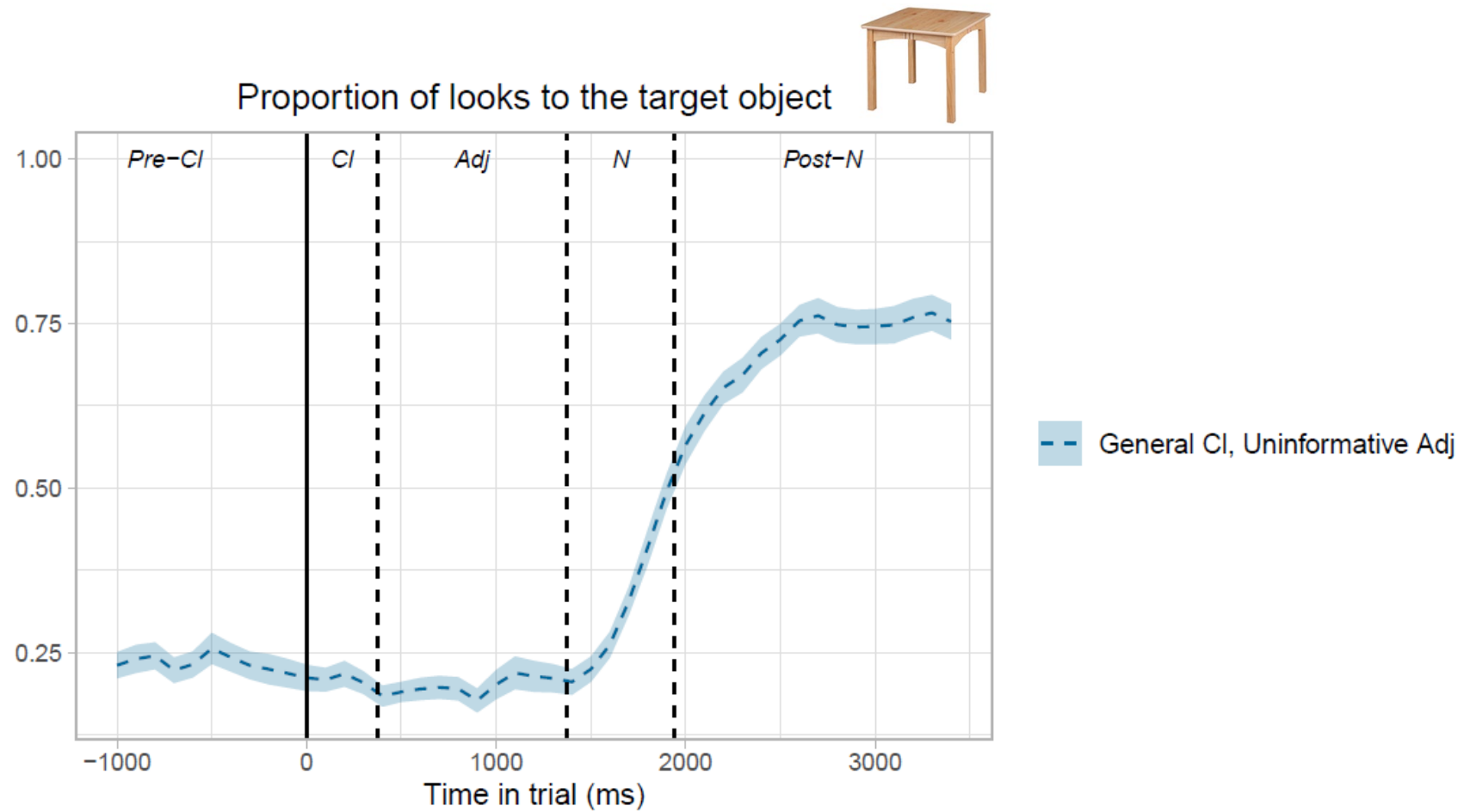
Fixations to objects in General CI, Uninformative Adj condition



Results

Following a general classifier (*CL_xie*)

Proportion of looks to the unexpected target object was low until the mention of the noun (*blue*).

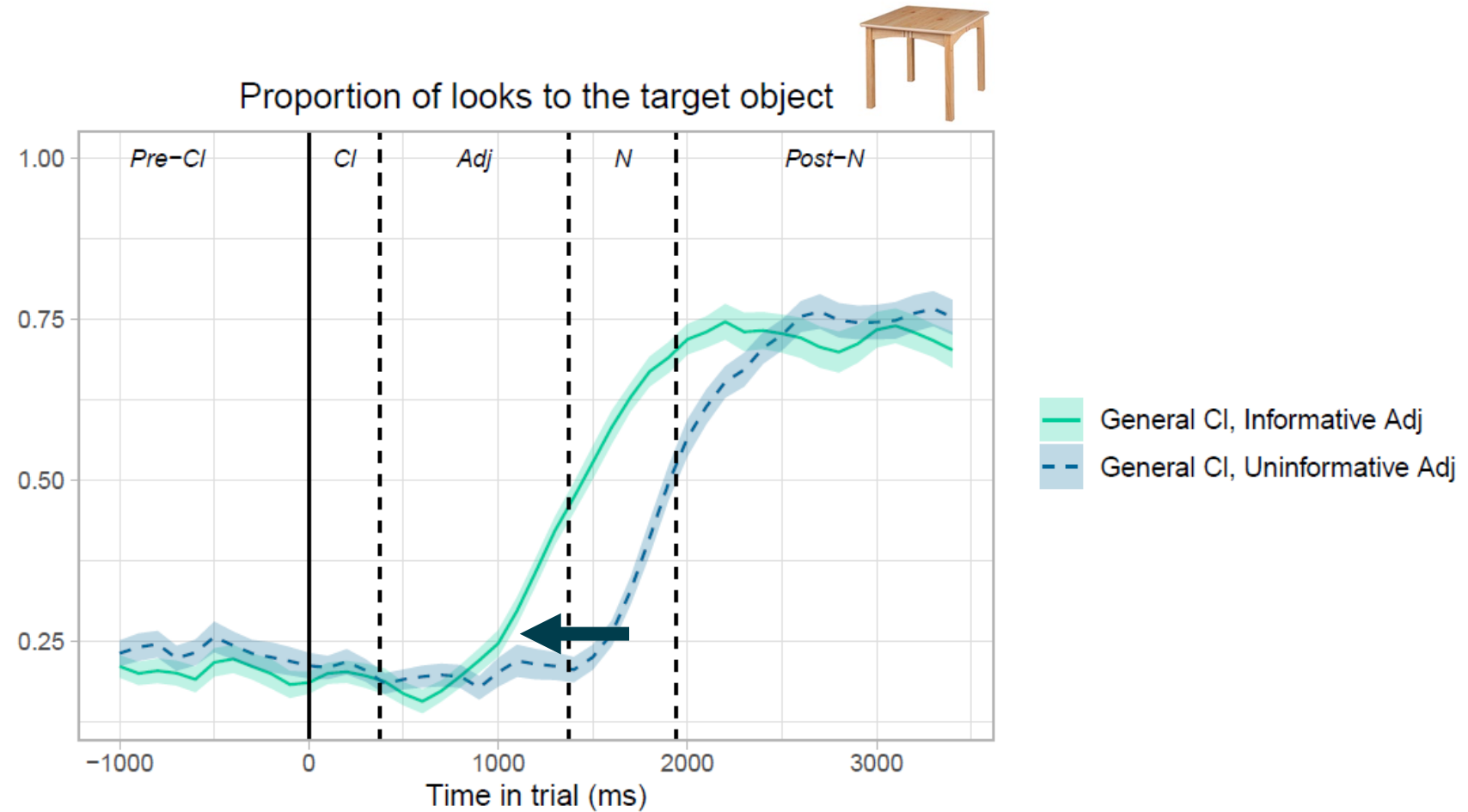


Results

Following a general classifier (*CL_xie*)

Proportion of looks to the unexpected target object was low until the mention of the noun (**blue**).

After hearing an informative adjective (*chess-playing*), compared to an uninformative one (*good-looking*), listeners increased their looks to the target object (**green** vs. **blue**).

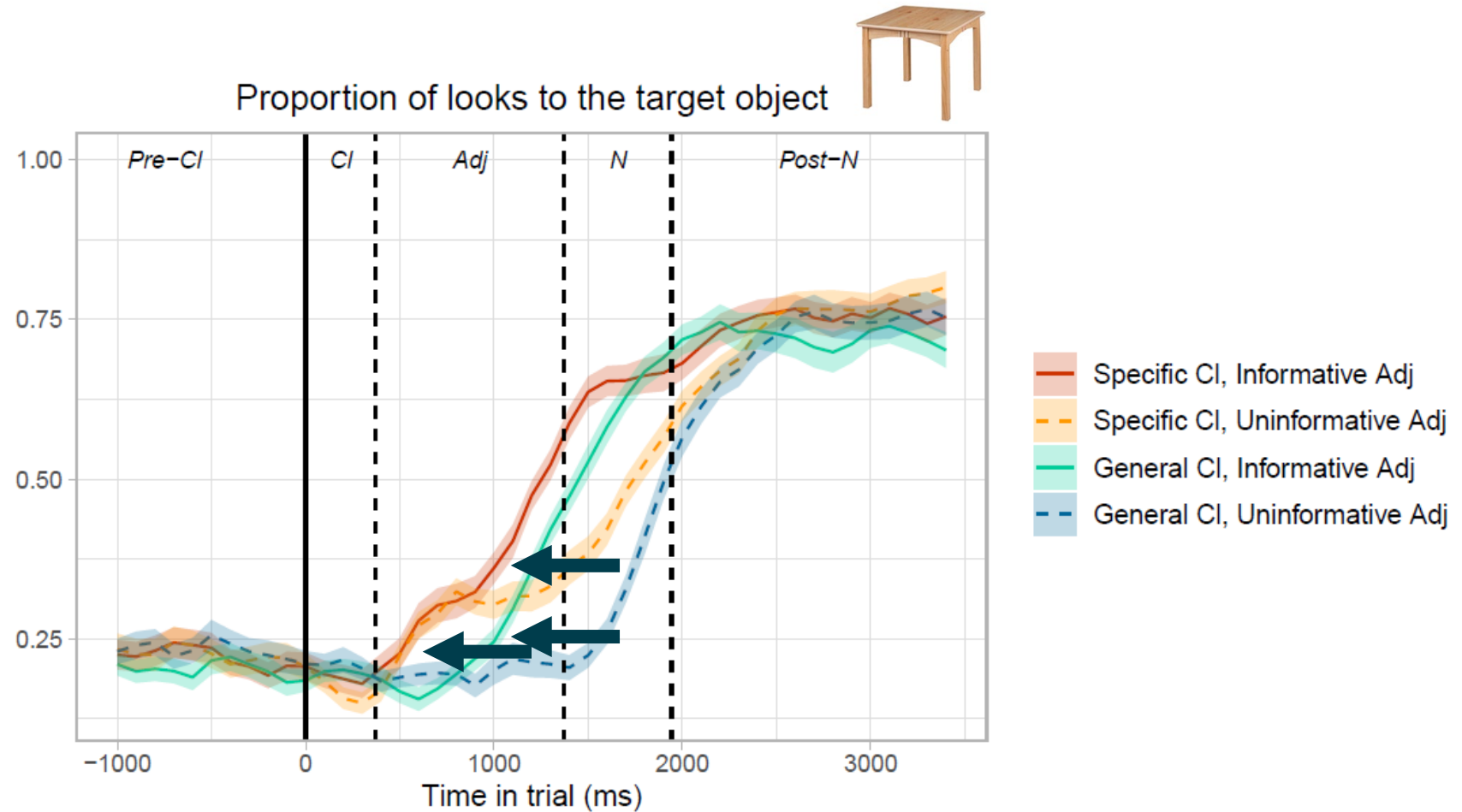


Results

Following a specific classifier (*CL_zhang*)

Listeners started to be more likely to look to the target object when they heard a specific, relative to a general, classifier (red, yellow vs. green, blue).

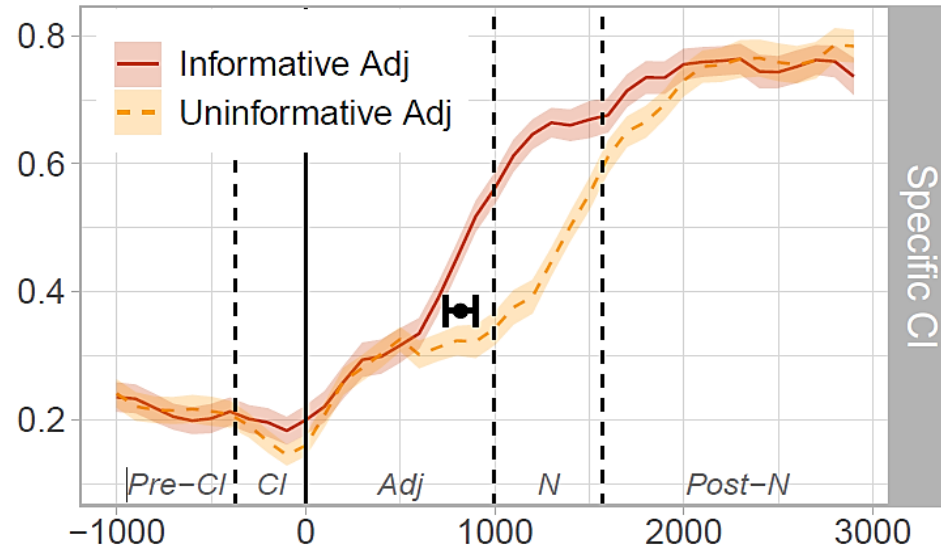
Later, they increased their looks to the target object upon hearing an informative adjective, compared to an uninformative one (red vs. yellow).



Results

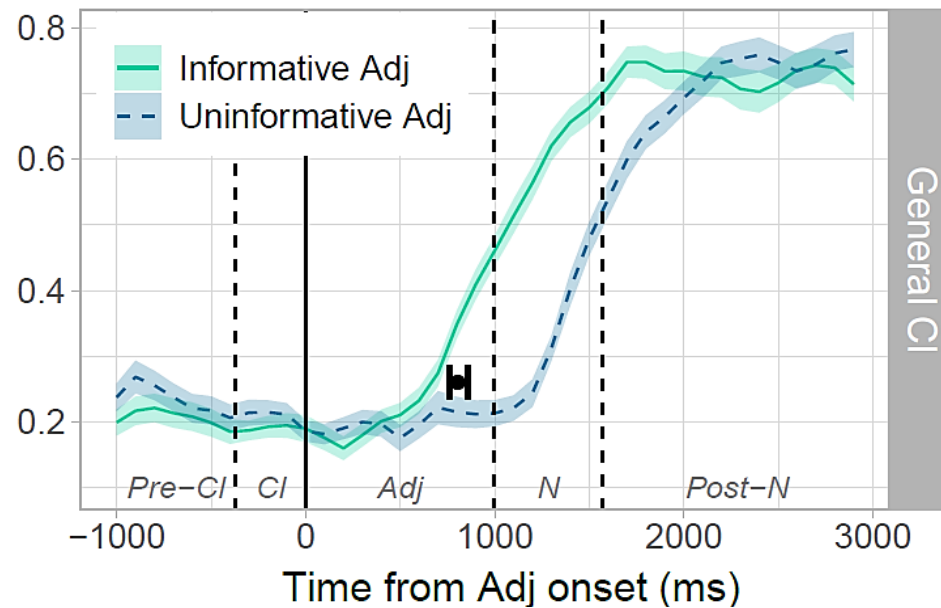
Bootstrapping analysis

to identify the time point at which participants' looks to the unexpected target object diverged.



Following a specific classifier

819 ms, 95% CI = [740, 900]



Following a general classifier

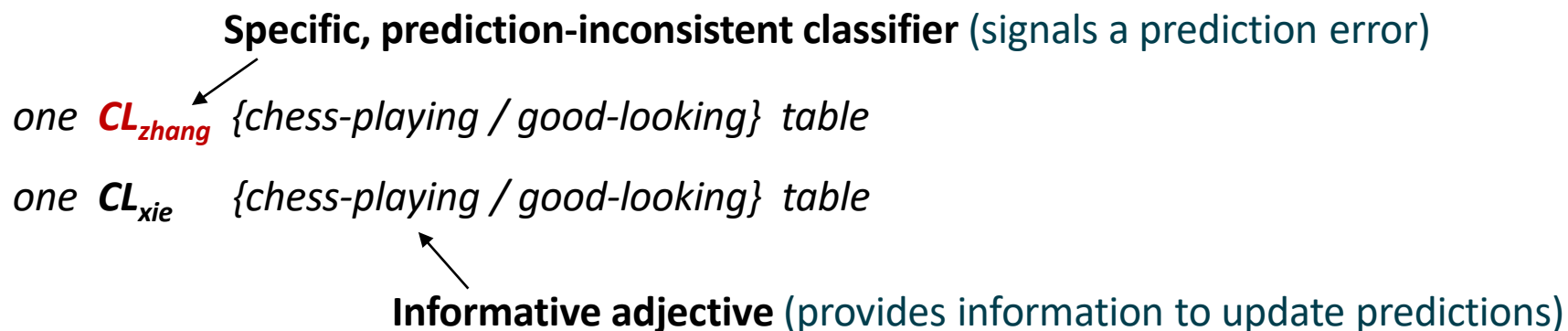
804 ms, 95% CI = [760, 860]

No difference in divergence point

Conclusion

In the present study, we investigated whether an early sign of prediction error can hinder subsequent semantic processing.

Specifically, we utilised the grammatical properties of noun phrases in Mandarin Chinese and examined the impact of prediction-inconsistent classifiers on listeners' ability to update their noun predictions using informative adjectives.



Conclusion

- Upon hearing a specific classifier that is incompatible with the expected noun, listeners quickly redirected their gaze from the expected object towards the two unexpected objects.

=> The predictive effect of classifiers

- When the sentence continued with an informative adjective, listeners directed their eye gaze towards the target object, no matter whether they had previously encountered a specific or general classifier.

=> The predictive effect of adjectives

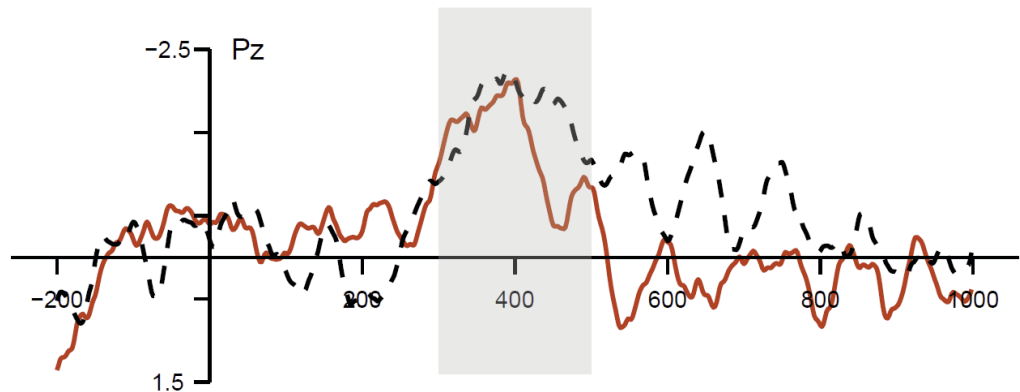
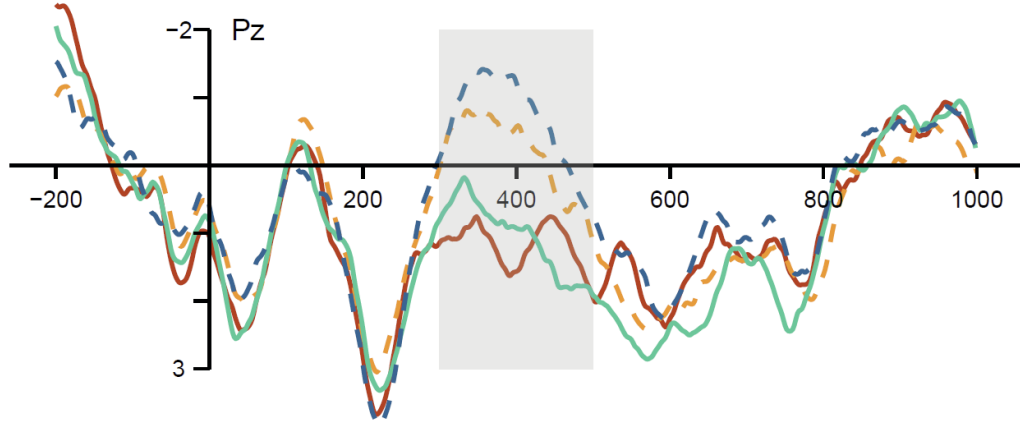
- The timing of this prediction updating were similar in the specific and general classifier conditions.

=> No evidence for disruptive effects of prediction errors

=> Rapid adaptation to new information

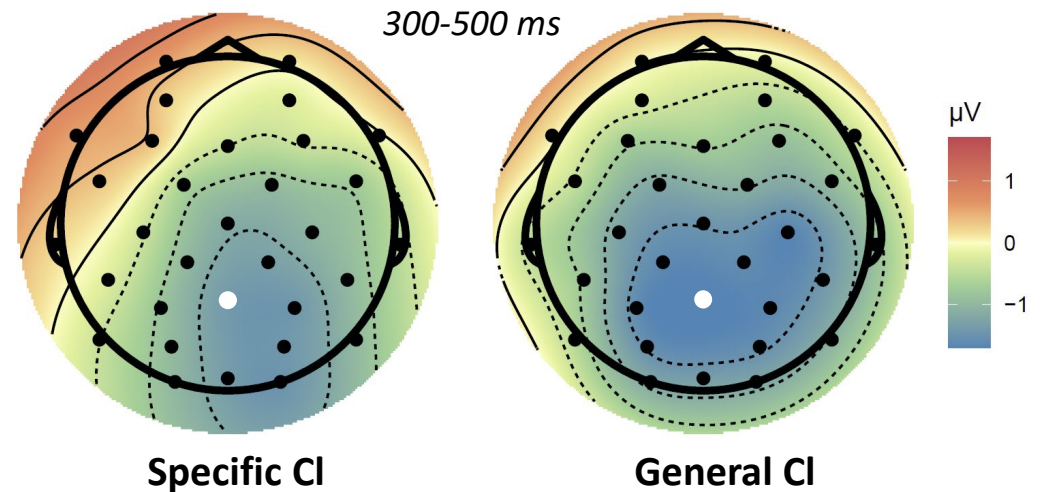
! candidate objects were already present on the screen

The ERP study



The night was too dark, so in order to read the words in the book clearly, Jack brought over ...

- Specific CI, Informative Mod: one CL_{zhi} burning candle ...
- - Specific CI, Uninformative Mod: one CL_{zhi} spare candle ...
- General CI, Informative Mod: one CL_{ge} burning candle ...
- - General CI, Uninformative Mod: one CL_{ge} spare candle ...



- Specific CI
 - - General CI
- Difference wave:**
Uninformative – Informative

Thank you!

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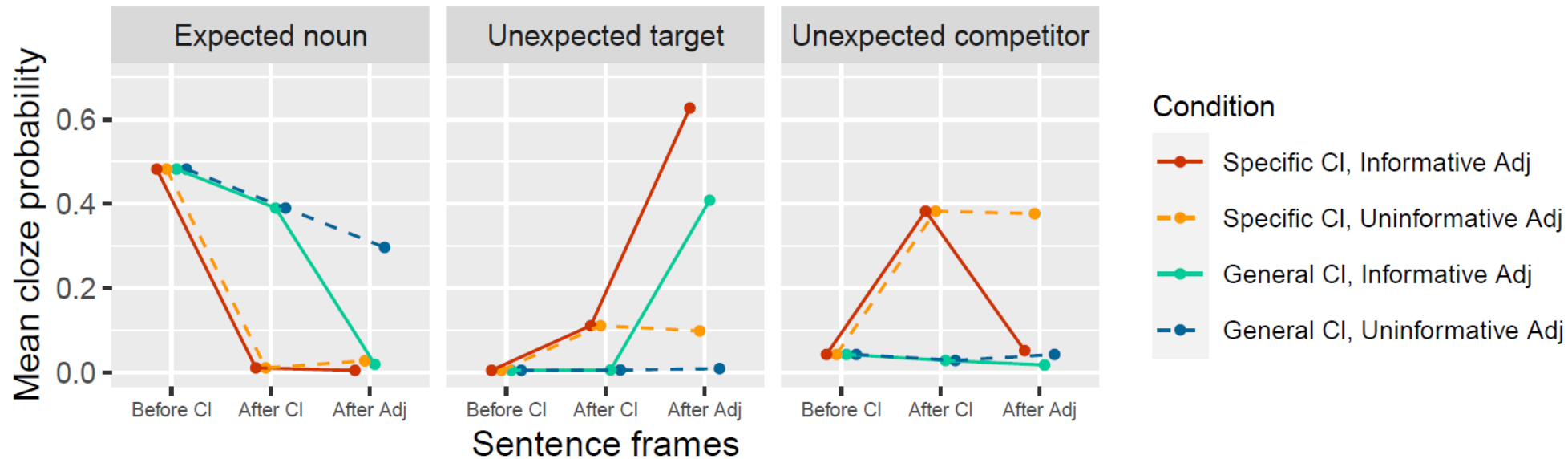
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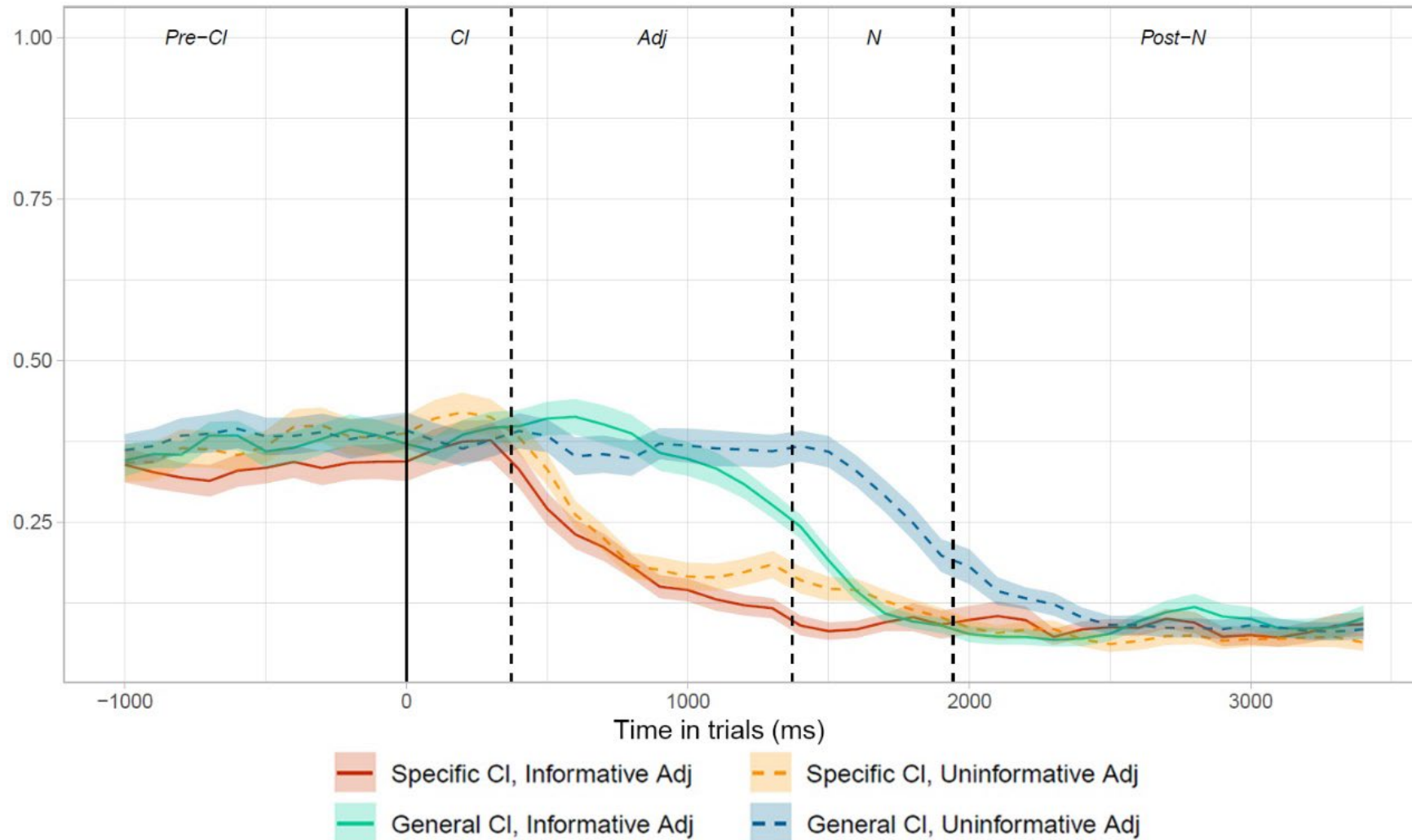
Cloze probability tasks

We did three rounds of offline cloze tasks.

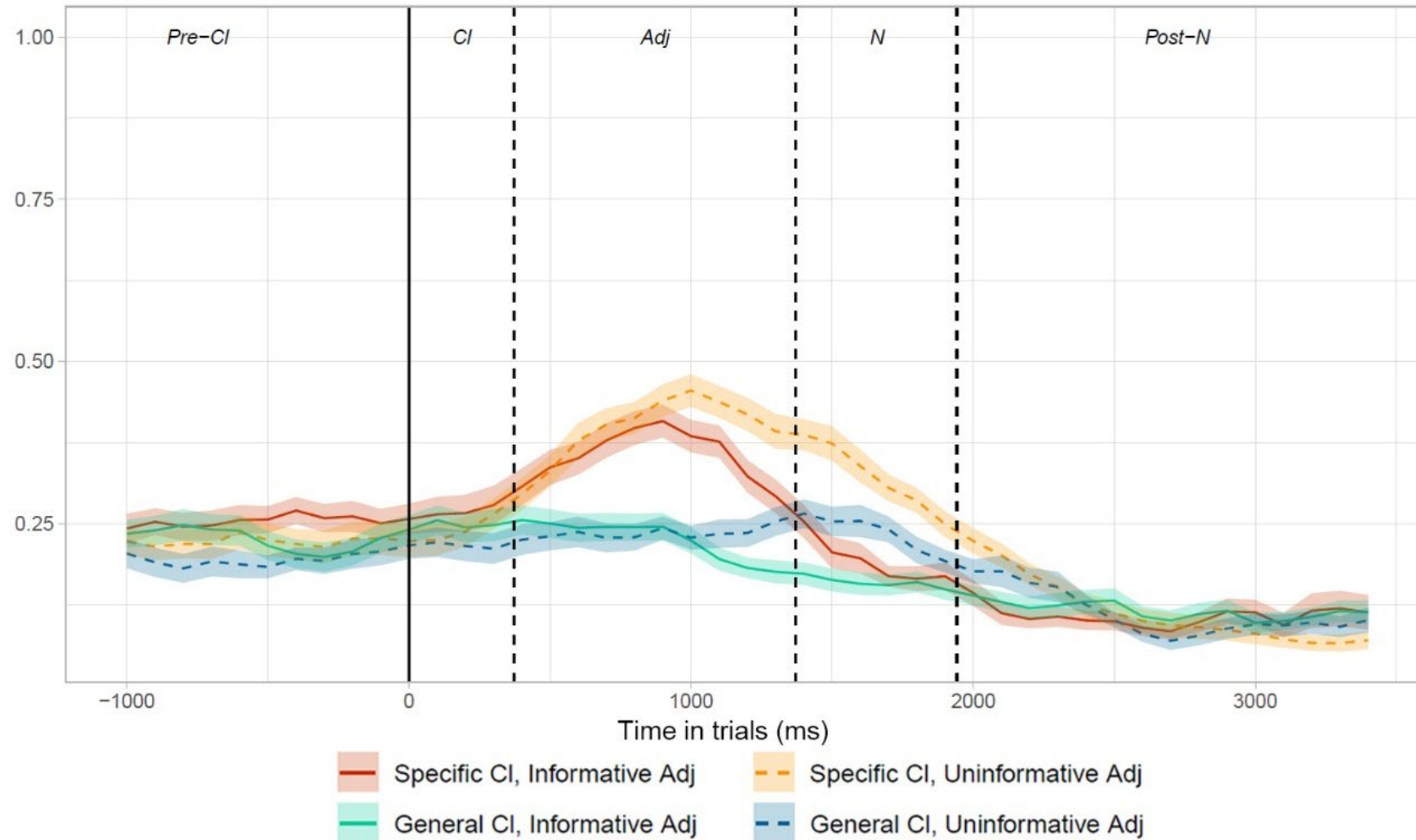
- Before the classifier:
..... *and in its centre, there is one* _____.
- After the classifier but before the adjective:
..... *and in its centre, there is one CL_zhang* _____.
- After the adjective but before the noun:
..... *and in its centre, there is one CL_zhang chess-playing* _____.



Looks to the expected object



Looks to the unexpected competitor



Disrupted semantic processing after prediction failure?

Husband & Bovolenta's (2020) results indicate that people couldn't take advantage of informative adjectives after they encountered a prediction error.

(originally in Italian)

*For my birthday I had not organised
a party, but my friends made me*

(expected: surprise_F)

Congruent article

*I don't like films that end badly,
I prefer those with*

(expected: ending_M)

Incongruent article (signals a prediction error)

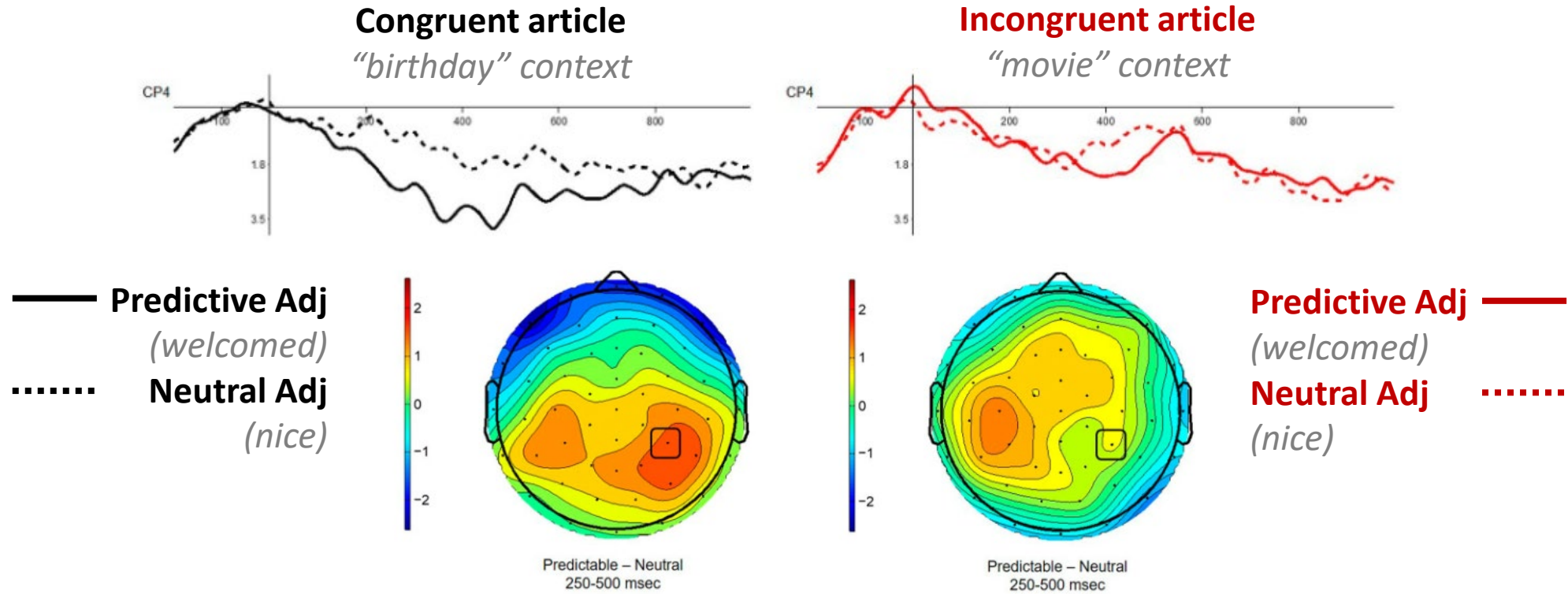
a_F {welcomed_F / nice_F} surprise_F

Predictive Adj

Neutral Adj

Disrupted semantic processing after prediction failure?

Husband & Bovolenta's (2020) results indicate that people couldn't take advantage of informative adjectives after they encountered a prediction error.



Disrupted semantic processing after prediction failure?

However, Husband & Bovolenta (2020) defined predictive/neutral adjective by co-occurrence frequencies

- i.e., the **conditional probability of the noun given the adjective** in the corpus.
- It is possible that the predictive adjectives were not truly predictive of the noun in the sentence context they used in the experiment.
- In fact, as the target noun was **implausible** following an incongruent article in most items, even the predictive adjective could not make the noun more likely in these sentence contexts.

	Adjective	Noun
<i>Many claim that the secretary stole money, but he rejected ...</i>	frugal/sad	meal ?