Structural predictions by agreement mismatches

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https://goo.gl/zV3Kmk

Background of the study (Negative Polarity Items in Japanese)

• How are Japanese NPIs different from English NPIs?

license

(1) [Chiitaa   sika   okotte   -nai]

2. In the same clause

Cheetah   only (NPI)   angry   -NEG

1. Negation **only**

"Cheetah is the only animal which is angry."

Single clause subject entity
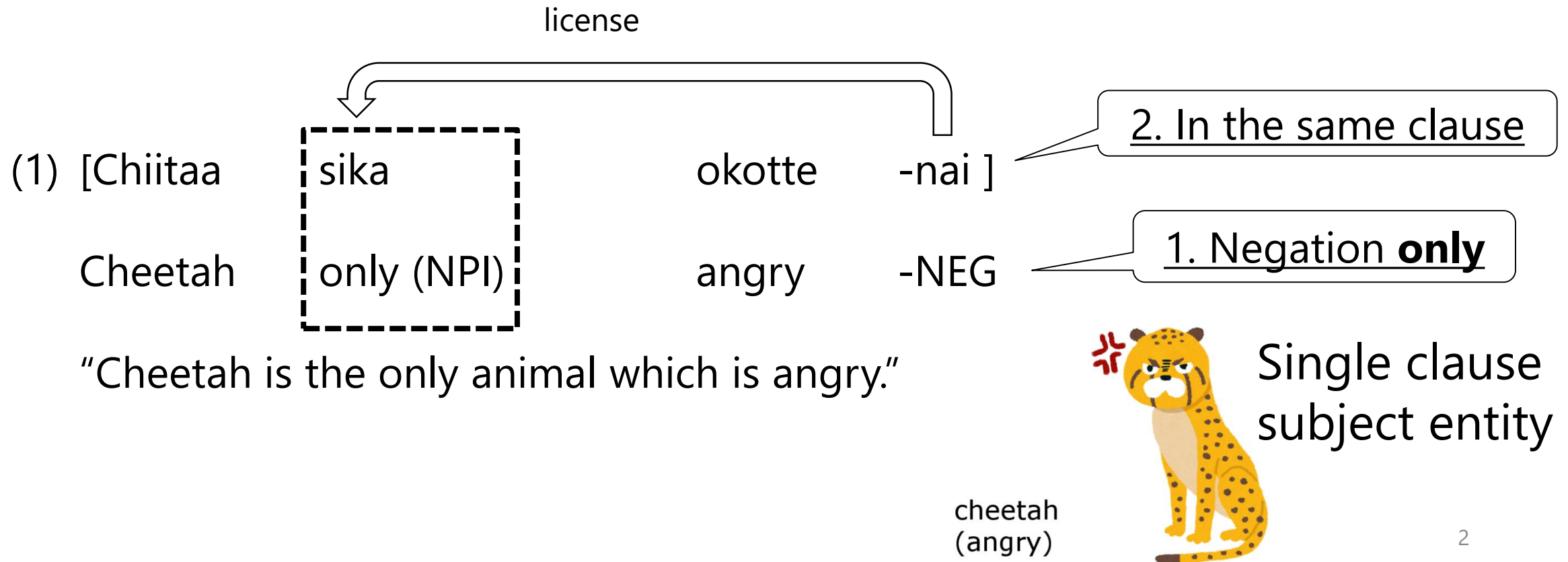
cheetah (angry)

Expectation of NEG lead by NPI

expectation (Yoshida, Bise, Kato)
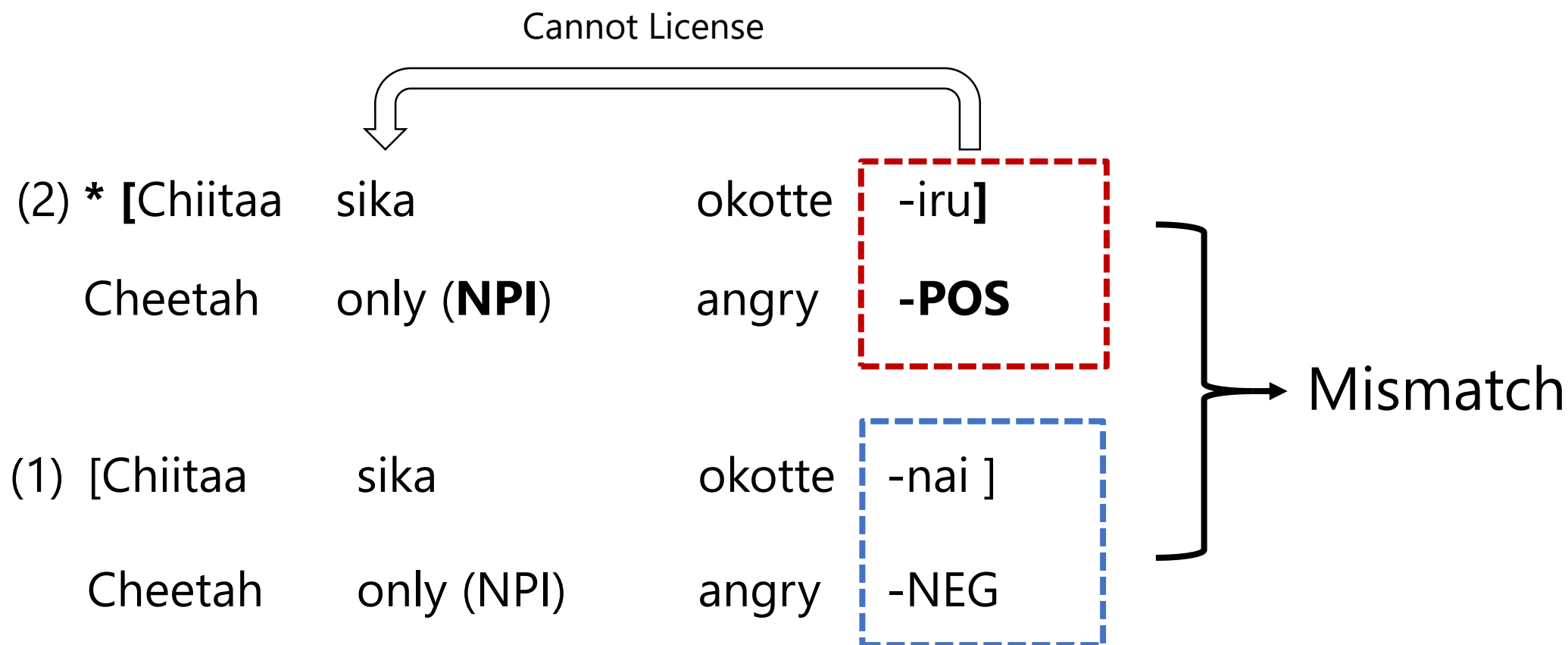
(1) [Chiitaa   sika   okotte   -nai]

    Cheetah   only (NPI)   angry   -NEG

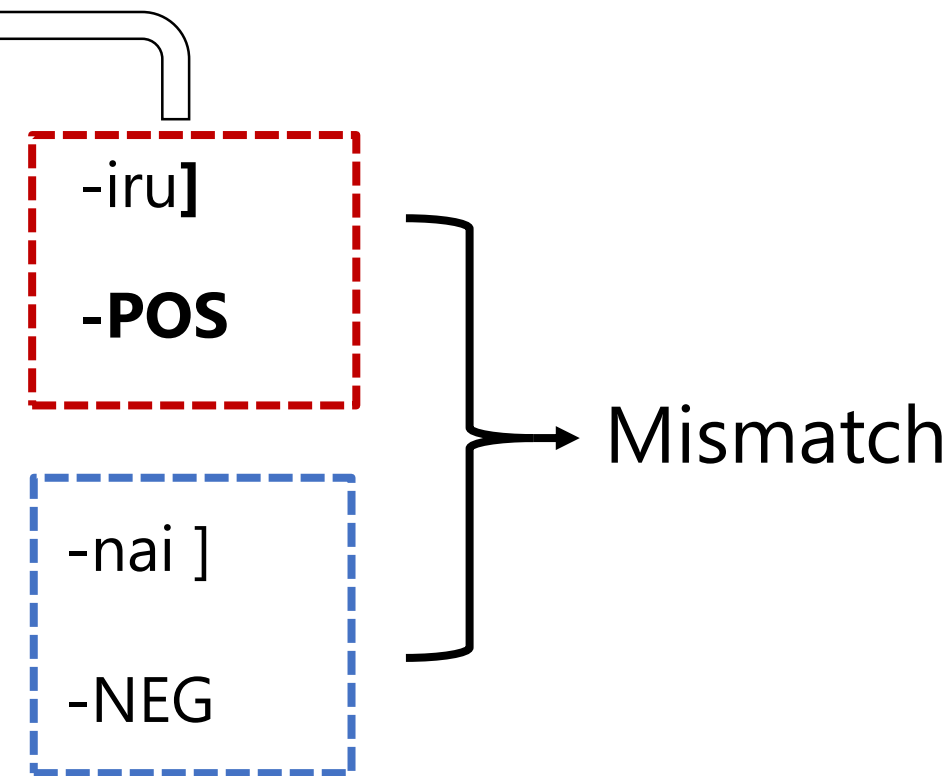   "Cheetah is the only animal which is angry."

cheetah
(angry)

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Mismatch between NPI and NEG

Cannot License

(2) * [Chiitaa   sika   okotte   -iru]

      Cheetah   only (**NPI**)   angry   **-POS**

(1) [Chiitaa   sika   okotte   -nai]

      Cheetah   only (NPI)   angry   -NEG

Mismatch

"Cheetah is the only animal which is angry."

Mismatch between NPI and NEG

-iru**]**

-POS

-nai]

-NEG

} Mismatch

s angry."

1. makes reader/listeners wait until another input which determines the structure.

2. makes them re-construct or even predict the upcoming structure to resolve the mismatch.

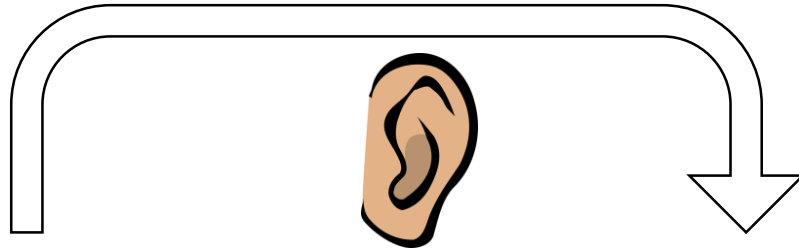# Bi-clausal structures can resolve the mismatch between NPI and NEG

evidence for
relative clause

(3) [$_{MC}$ Chiitaa sika   [$_{NP}$ [$_{RC}$ okotte -iru] inoshishi]-o mi-nai]

Cheetah only (NPI)   angry   POS   boar-ACC look-NEG

Cheetah is the only animal which looks at the boar which is angry."

boar
(angry)

Relative clause
head entity

expectation

(1) [Chiitaa   sika   okotte   -nai]

Cheetah   only (NPI)   angry   -NEG

"Cheetah is the only animal which is angry."

Single clause
subject entity

4700ms

(1) [Chiitaa   sika   okotte   -iru]
    Cheetah   only (NPI) angry   -POS
    *

Mismatch condition

4700ms

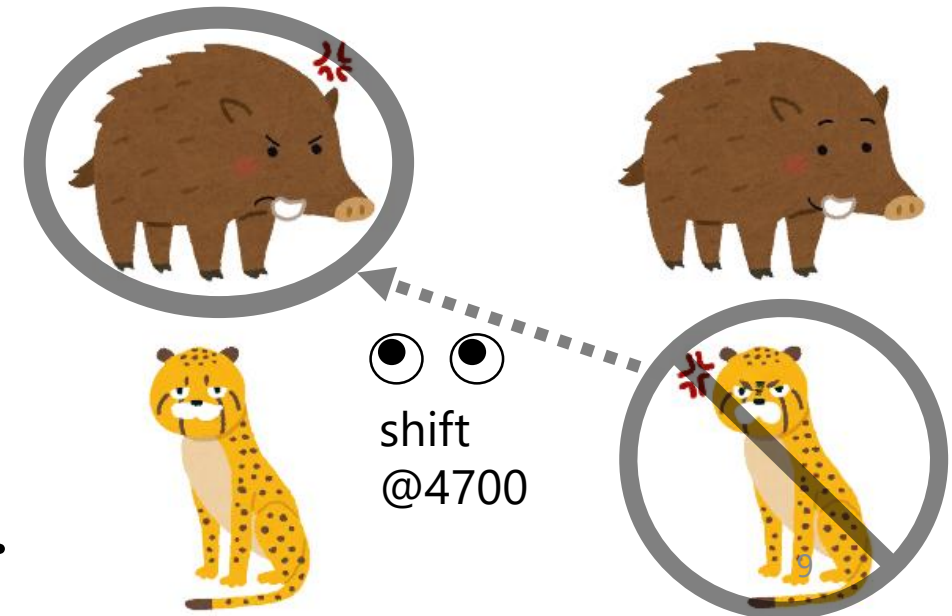evidence for
relative clause

(3) [_{MC} Chiitaa   sika   [_{NP} [_{RC} okotte   -iru]   inoshishi]-o   mi-nai]

Cheetah   only (NPI)   angry   POS   boar-ACC   look-NEG

Cheetah is the only animal which look at the boar which is angry."

1. There are two animals which are angry.
2. The animal which is angry is not the cheetah.

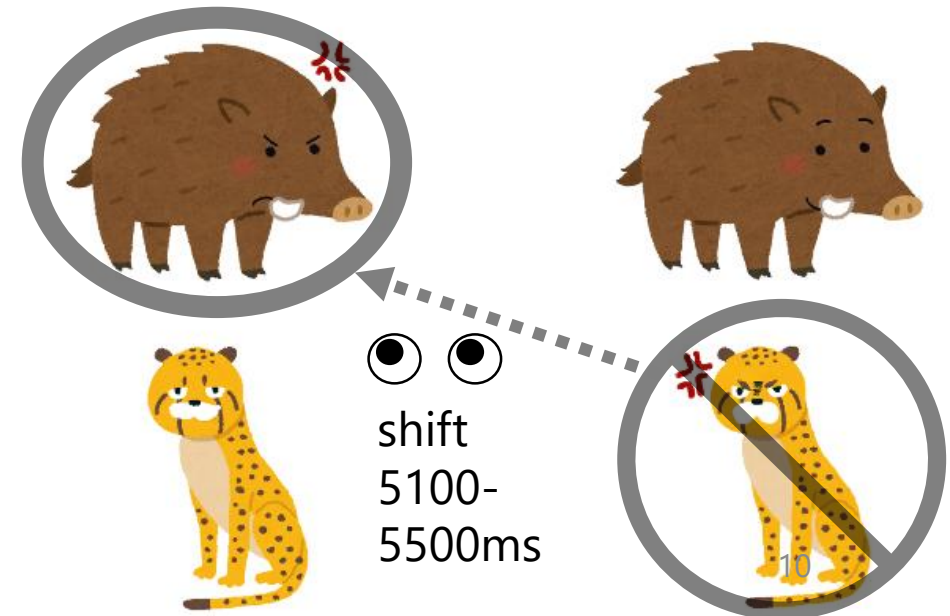   -> **The angry boar is the best candidate.**

shift
@4700

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No-Mismatch condition

evidence for
relative clause

(3) [_{MC} Chiitaa **dake** [_{NP} [_{RC} okotte -iru] inoshishi]-o mi-nai]

Cheetah only (Non-NPI) angry POS boar-ACC look-NEG

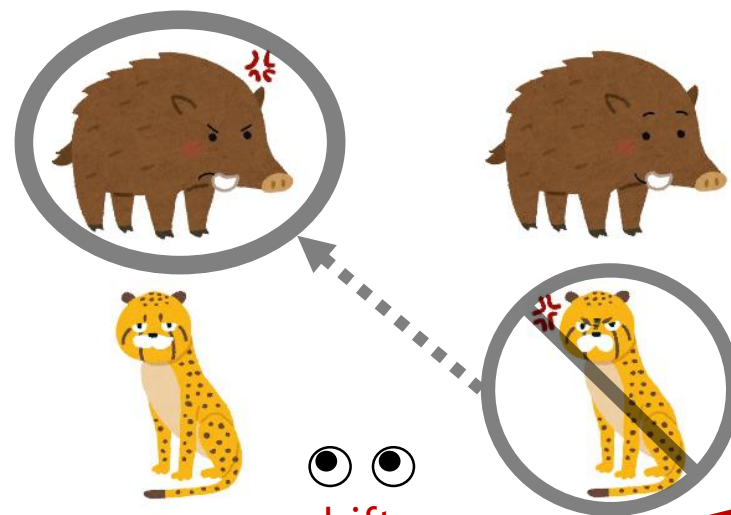Cheetah is the only animal which look at the boar which is angry."
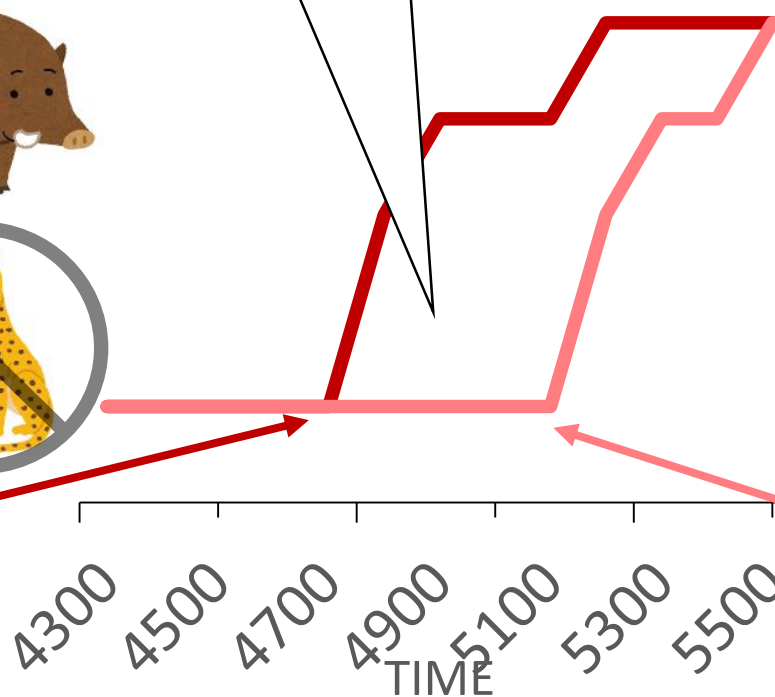
Relative clause
head entity

shift
5100-
5500ms

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Predictions

Mismatch condition (NPI & Positive)

The prediction effect for the RC analysis

No-Mismatch condition (NPI & Positive)
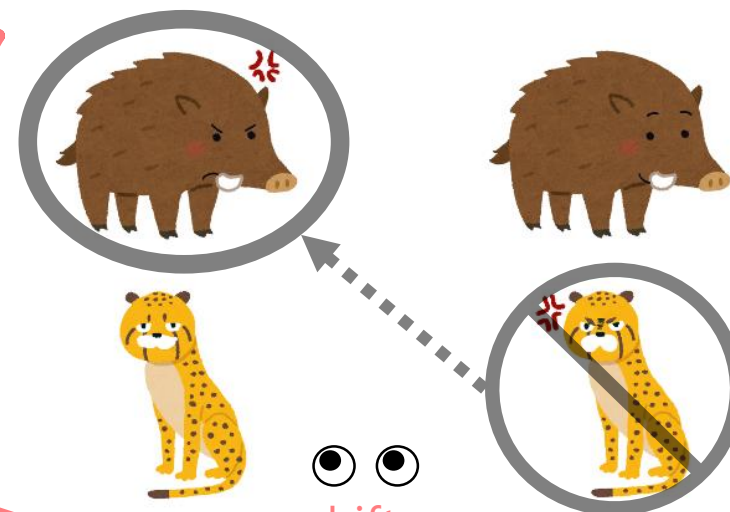
shift @4700

shift after

TIME
4300 4500 4700 4900 5100 5300 5500

(3) [_MC_ Chiitaa **sika**   [_NP_ [_RC_ okotte -iru]
    Cheetah   only (NPI)   angry   POS

(3) [_MC_ Chiitaa **dake**   [_NP_ [_RC_ okotte -iru] inoshishi
    Cheetah   only (NPI)   angry   POS   boar

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Experiment

- 33 participants
- 24 items (Relative clause)
- 48 fillers (Non-relative clause)
- 2x2 conditions (Latin square design)
  - Each participant sees each item only in one condition)

NPI & Positive

(4) a. [Chiitaa   sika   [okotte   iru]   inoshishi-o   mite-nak-atta]

Cheetah   only (**NPI**)   angry   **POS**   boar-ACC   look-NEG-PST

Cheetah is the only animal which looked at the boar which is angry."

mismatch!

Non-NPI & Positive

b. [Chiitaa   dake   [okotte   iru]   inoshishi-o   mite-nak-atta]

Cheetah   only (**Non-NPI**)   angry   **POS**   boar-ACC   look-NEG-PST

Cheetah is the only animal which didn't look at the boar which is angry."

NPI & Negative

c. [Chiitaa   sika   [okotte   nai]   inoshishi-o   mite-nak-atta]

Cheetah   only (**NPI**)   angry   **NEG**   boar-ACC   look-NEG-PST

Cheetah is the only animal which looked at the boar which is not angry."

Non-NPI & Negative
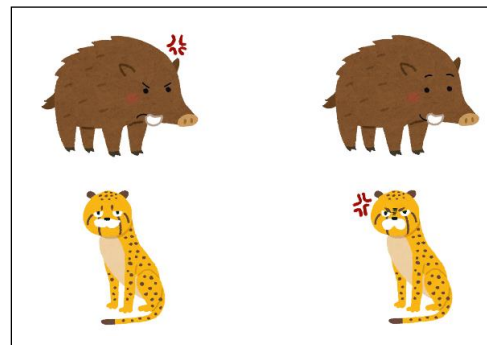
d. [Chiitaa   dake   [okotte   nai]   inoshishi-o   mite-nak-atta]

Cheetah   only (**Non-NP**)   angry   **NEG**   boar-ACC   look-NEG-PST

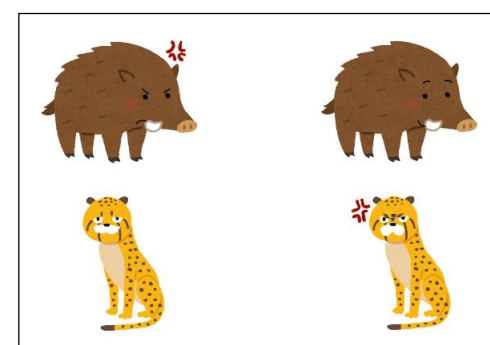Cheetah is the only animal which didn't look at the boar which is not angry."
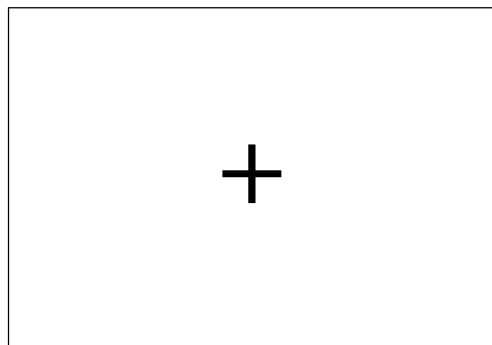
Fixation:
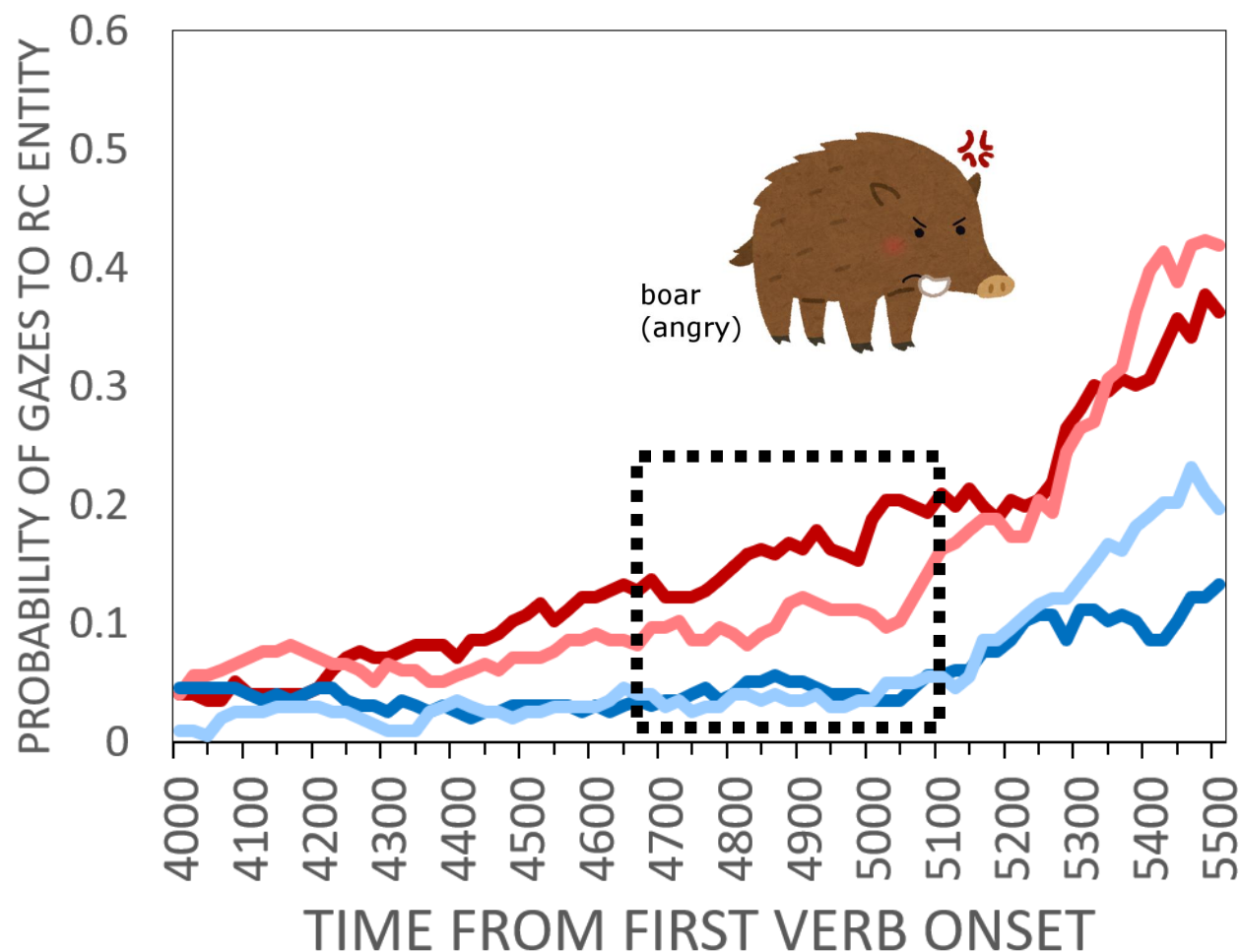1000ms
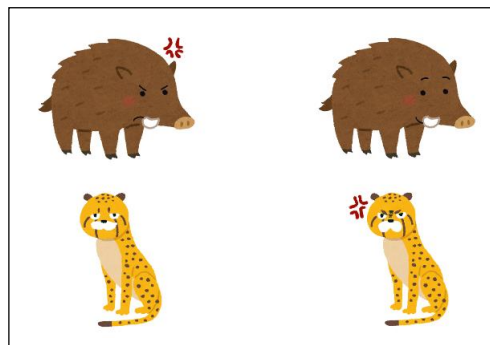
Visual display:
2000ms

Spoken
sentence

Mouse
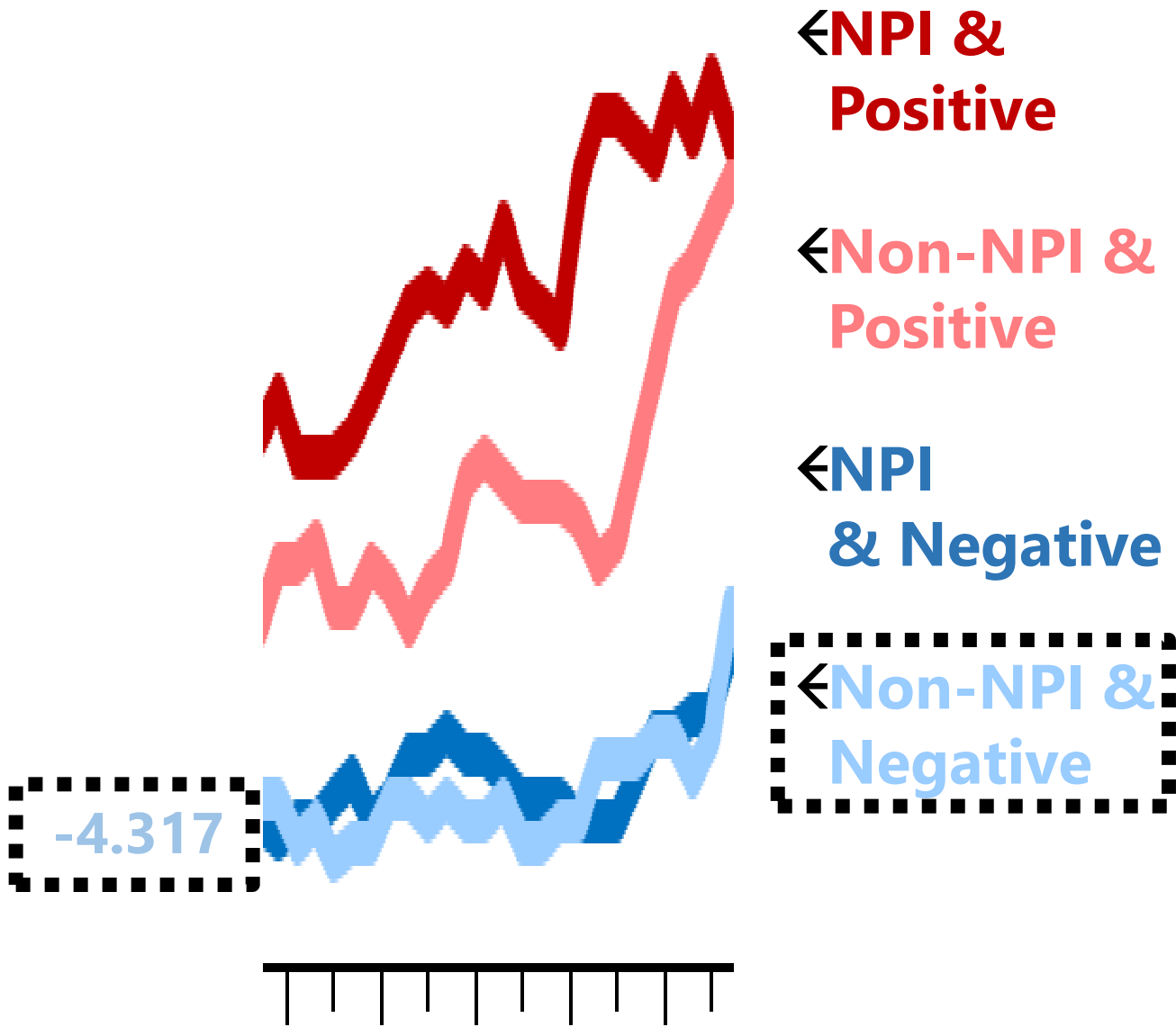click

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Gaze to RC head (4700ms—5100ms)

Backward selection
logit ~ npi * aff + (1 | subj) + (1 | item)
model summary:

Factor	β	Std.	t	p
(Intercept)	-4.317	0.22	-19.26	
NPI	0.206	0.12	1.66	0.094 .
POL	0.831	0.12	6.70	< .001 ***
NPI:POL	0.264	0.12	2.13	0.032 *

Gaze to RC head(4700ms—5100ms) Intercept(Non-NPI & Negative)

has NPI?	is Positive?	Factor	β	p
1	1	(Intercept)	-4.317	
0	1	NPI	0.206	0.094 .
1	0	POL	0.831	<.001 ***
0	0	NPI:POL	0.264	0.032 *

NPI & Positive

Non-NPI & Positive

NPI & Negative

Non-NPI & Negative

-4.317

mismatch!

Gaze to RC head (4700ms—5100ms)
Main effect of NPI

← **NPI & Positive**

← **Non-NPI & Positive**

← **NPI & Negative**

← **Non-NPI & Negative**

p = 0.09 .

-4.1

+0.2 ↑

-4.3

has NPI?	is Positive?	Factor	β	p
1	**1**	(Intercept)	**-4.317**	
0	**1**	**NPI**	**0.206**	0.094 .
1	**0**	**POL**	**0.831**	<.001 ***
0	**0**	**NPI:POL**	**0.264**	0.032 *

mismatch!

Gaze to RC head (4700ms—5100ms)
Main effect of Polarity (Positive)

has NPI?	is Positive?	Factor	β	p
1	1	(Intercept)	-4.317	
0	1	NPI	0.206	0.094 .
1	0	POL	0.831	<.001 ***
0	0	NPI:POL	0.264	0.032 *

mismatch!

Gaze to RC head (4700ms—5100ms) Interaction of NPI and Positive

has NPI?	is Positive?	Factor	β	p
1	1	(Intercept)	-4.317	
0	1	NPI	0.206	0.094 .
1	0	POL	0.831	<.001 ***
0	0	NPI:POL	0.264	0.032 *

The prediction effect for the RC analysis by mismatch

mismatch!

Predictions

The prediction effect for the RC analysis

Mismatch condition (NPI & Positive)

No-Mismatch condition (NPI & Positive)

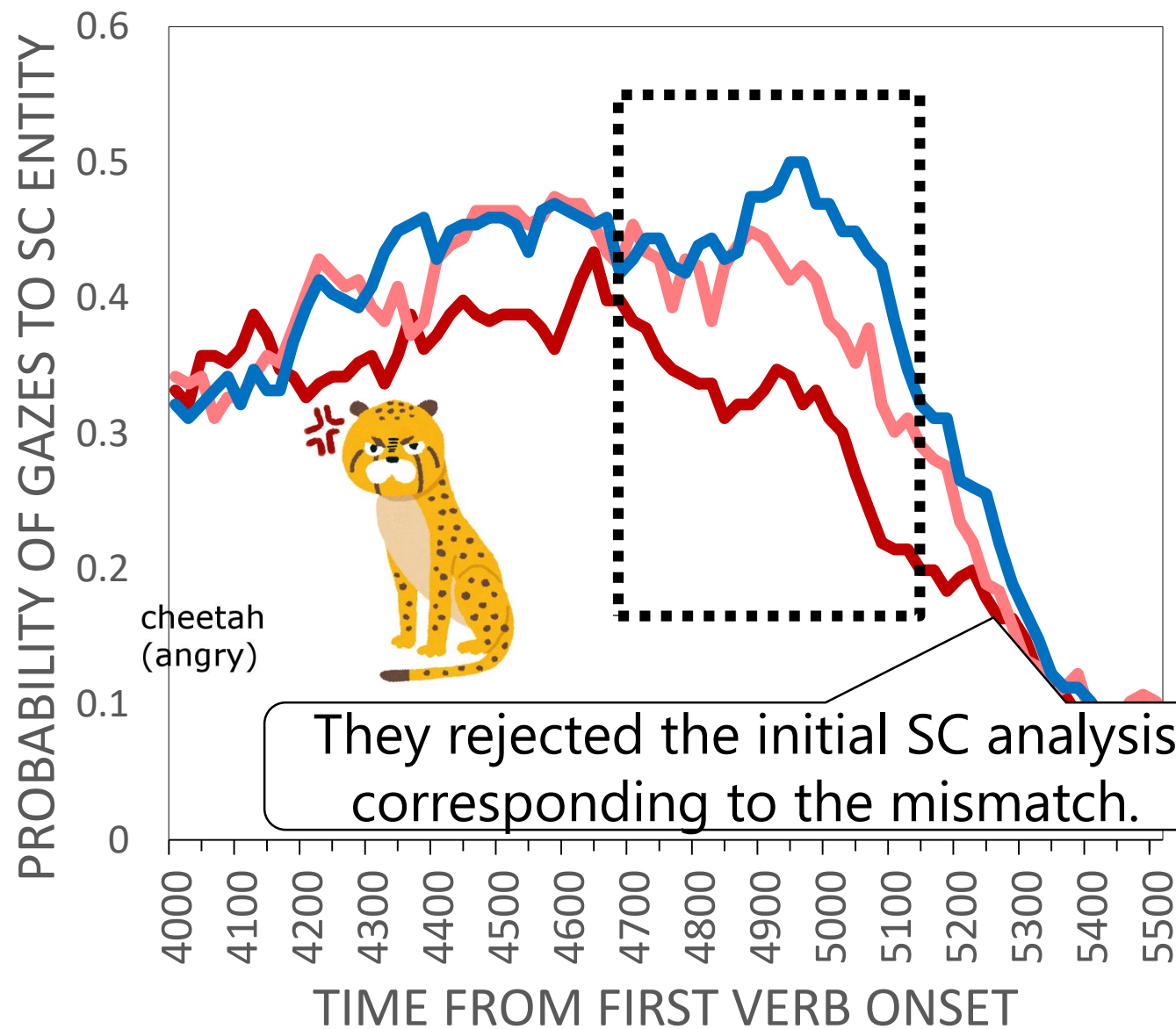shift @4700

shift after

TIME
4300 4500 4700 4900 5100 5300 5500
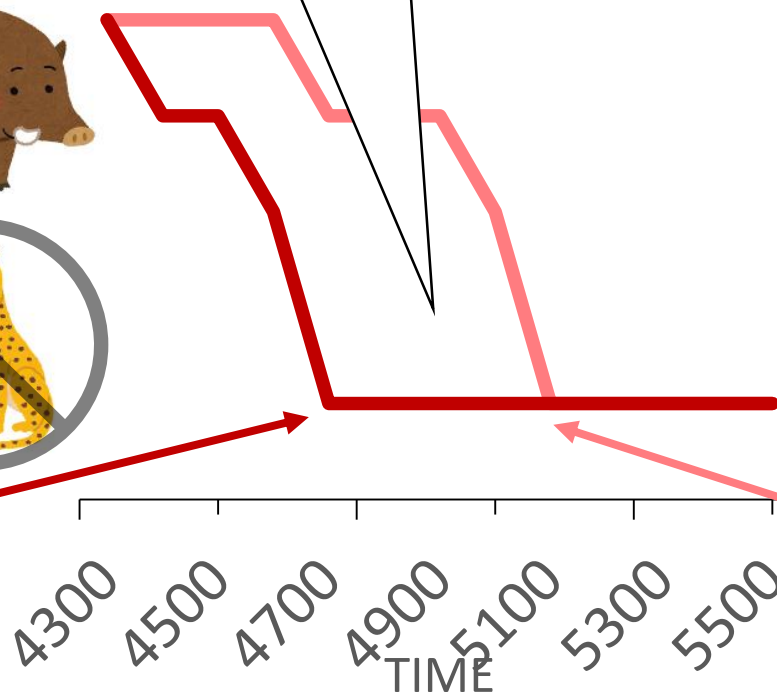
(3) [MC Chiitaa **sika**   [NP [RC okotte -iru]

    Cheetah   only (NPI)   angry   POS

(3) [MC Chiitaa **dake**   [NP [RC okotte -iru] inoshishi

    Cheetah   only (NPI)   angry   POS   boar

gaze to single clause subject entity

Conclusion

- Agreement mismatches lead structural predictions.

  - The parsers make a prediction that goes beyond what is confirmed by the linguistic evidence
  - … if it is contextually supported by the presence of visual objects hinting that there might be other entities involved in the situation.

What can we do next?

- Some effects should be reduced in (4a) compared to other conditions.
  - The processing load of NEG at the matrix level
  - The garden path effect corresponding to the second noun phrase
- We conduct the analysis of pupil-dilation which indicates the processing cost.