Gap prediction is not fully constrained by grammar

Hebrew Maze results

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Filler-gap dependency resolution

Filled-gap effect (FGE)
Increased difficulty when a potential gap position is filled (“the girl”).

(1) Which painting did the boy see **the girl** admiring __?

Active

No FGE inside islands
No increased difficulty on “the forest”, inside an island.

(2) Which painting did the story about **the forest** inspire __?

Grammatically constrained

Stowe (1986)

Cataphora resolution

Mismatch effect

Difficulty when a potential antecedent mismatches the cataphor.

(3) When she was at the party, **the boy** cruelly teased the girl.

Active

No mismatch effect violating Principle B

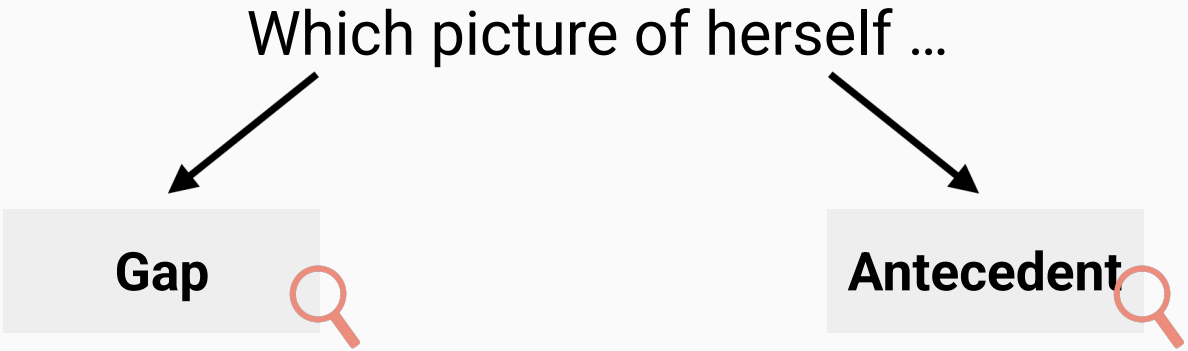
No difficulty on mismatching NP if binding violates Principle B.

(4) While driving her to school, **Christopher** told Hannah that…

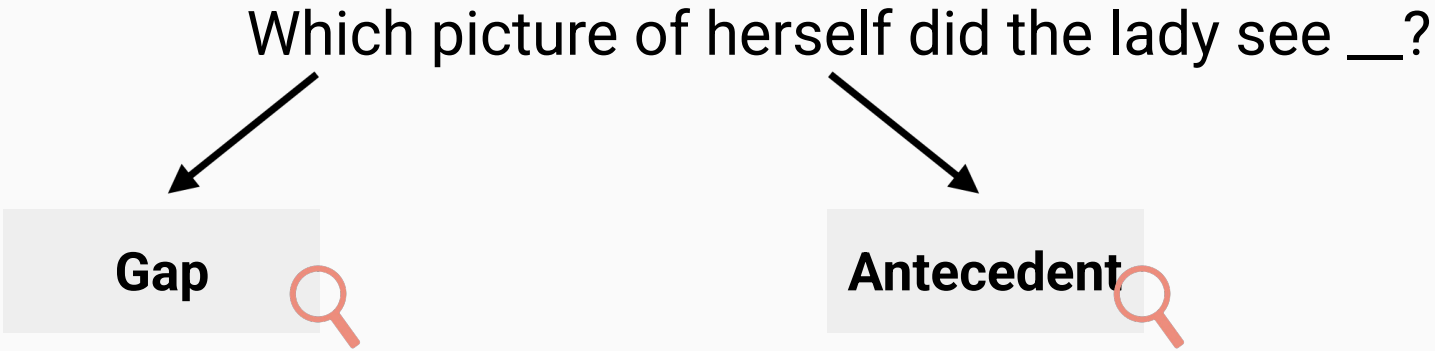
Grammatically constrained

Kazanina et al. (2007); Giskes & Kush (2021); Kush & Dillon (2021)

Reflexive-filler: Simultaneous searches



Reflexive-filler: Simultaneous searches



❗ The antecedent must be higher than the gap

Reflexive-filler

1) Which picture of herself did the boy see **the girl** admiring __?
2) Which picture of herself did the lady see **the girl** admiring __?

What are our predictions given the reflexive-filler?

Does the search for an antecedent affect the search for a gap?

Reflexive-filler: Predictions

Subject

1) Which picture of herself did the boy see **the girl** admiring __?
2) Which picture of herself did the lady see **the girl** admiring __?

Mismatch effect:

Subject slowdown in (1)
compared to (2)

Reflexive-filler: Predictions

Object

1) Which picture of herself did the boy see **the girl** admiring __?

2) Which picture of herself did the lady see **the girl** admiring __?

FGE only in (2) ?

Antecedent search is prioritized over the filler-gap dependency

Or: The parser forms a global prediction, wherein a gap must *follow* an antecedent

FGE in both (1) and (2) ?

Gap search is prioritized over the reflexive-antecedent dependency

Experiments 1 & 2

Materials

Reflexive-filler

MATCH

eize sirton šel acmo ha-balaš cilem et ha-xašud moxek?
which video of himself the-detective.M filmed ACC **the-suspect.M** delete?

MISMATCH

eize sirton šel acmo ha-balašit cilema et ha-xašud moxek?
which video of himself the-detective.F filmed ACC **the-suspect.M** delete?

Experiments 1 & 2

Materials

Reflexive-filler

MATCH

eize sirton šel acmo ha-balaš cilem et ha-xašud moxek?
which video of himself the-detective.M filmed ACC **the-suspect.M** delete?

MISMATCH

eize sirton šel acmo ha-balašit cilema et ha-xašud moxek?
which video of himself the-detective.F filmed ACC **the-suspect.M** delete?

Baseline

MATCH

when the-detective.M filmed ACC **the-suspect.M** delete video of himself?

MISMATCH

when the-detective.F filmed ACC **the-suspect.M** delete video of himself?

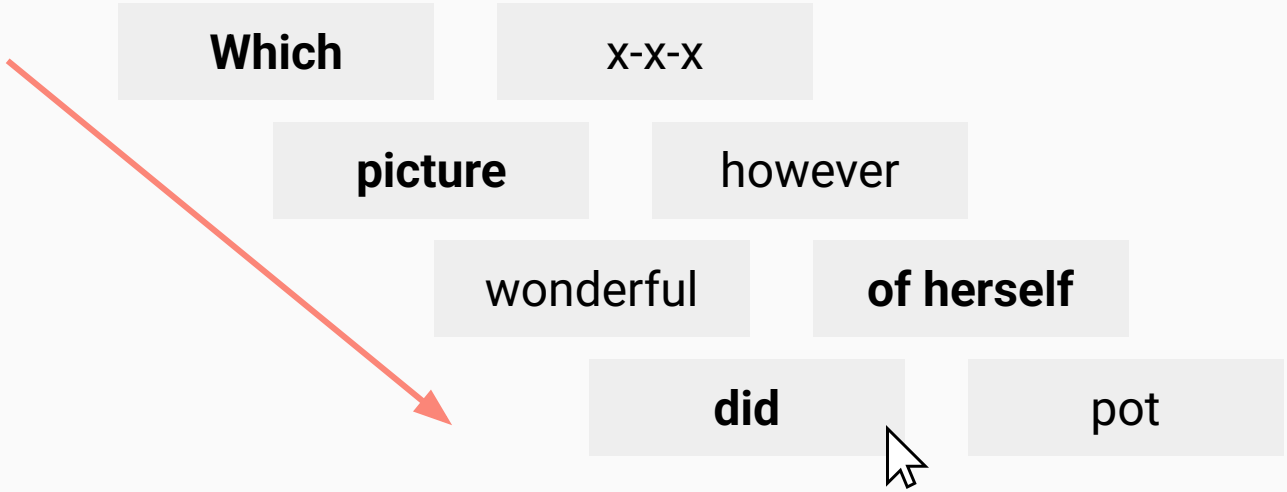
Experiments 1 & 2

24 items sets. Administered online using PCIbex.

Experiment 1: SPR	Experiment 2: Maze
• Self-paced reading task • **60** Hebrew speakers, **3** excluded due to <60% comprehension accuracy	• Grammatical Maze task • **60** Hebrew speakers, **12** excluded due to <60% comprehension & Maze accuracy

Experiments 1 & 2

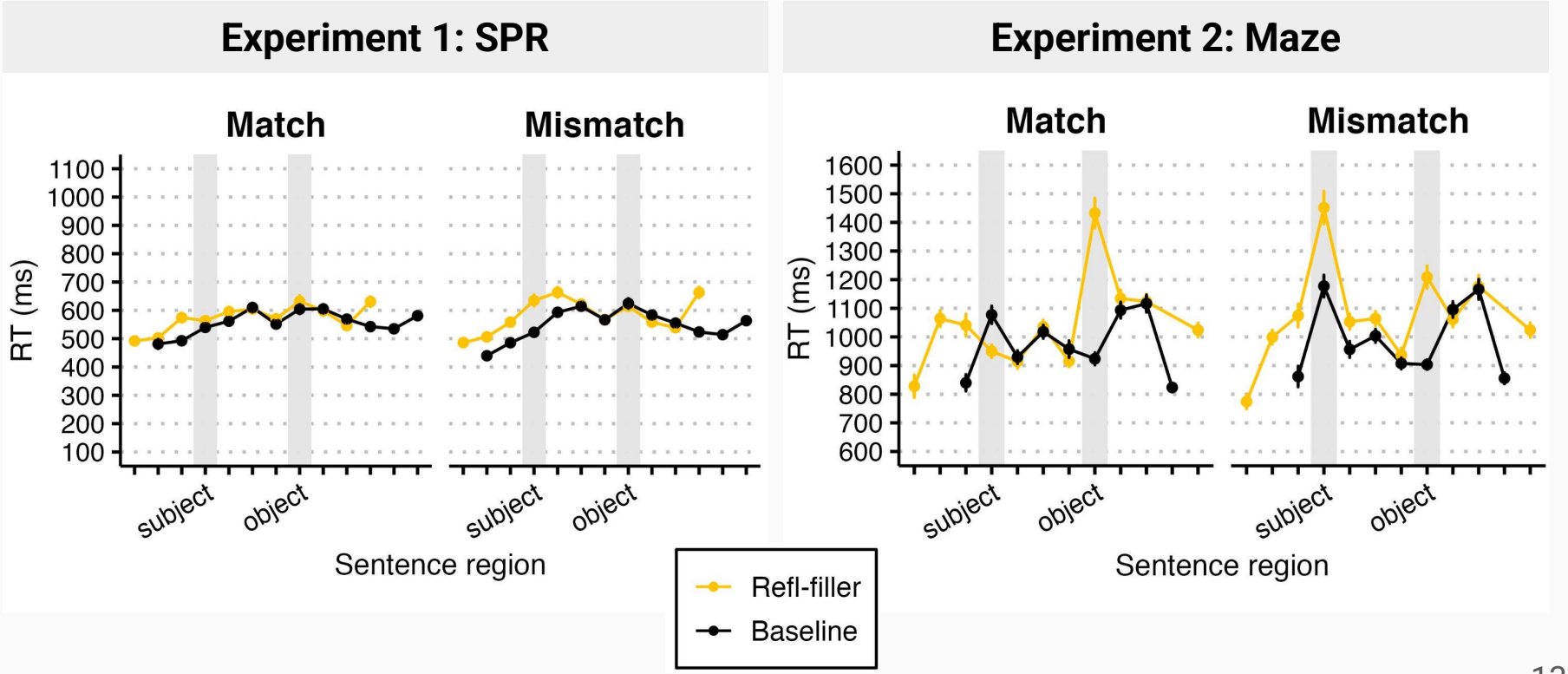
The Maze task:



Boyce et al. (2020); Forster et al. (2009)
Multilingual A-Maze foil generation: Duff (2024)

Experiments 1 & 2

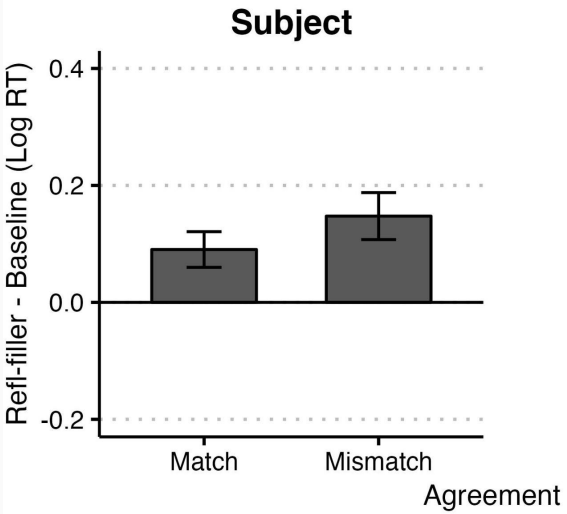
Results



Experiments 1 & 2

Results

Experiment 1: SPR



Subject RTs: Mismatch effect

Structure × Agreement

Est	SE	l-95%	u-95%
0.03	**0.01**	**0.00**	**0.05**

Object RTs: No FGE…

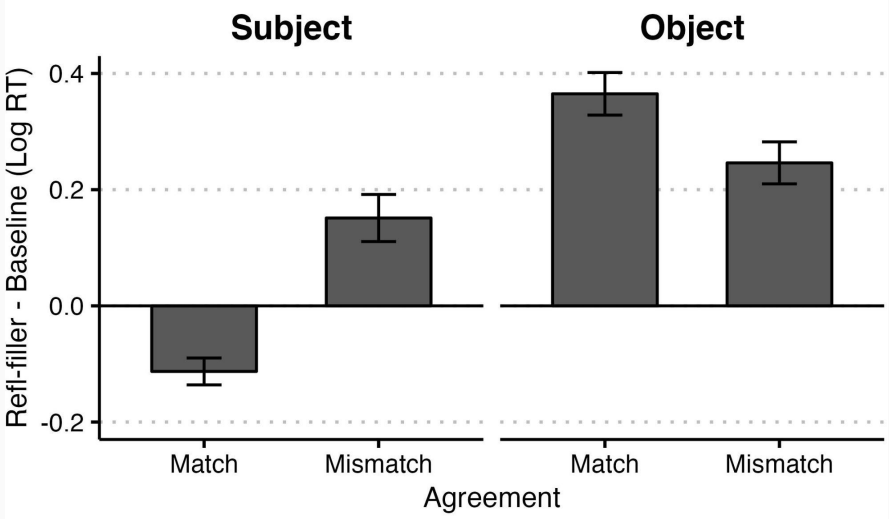
Structure

Est	SE	l-95%	u-95%
0.00	**0.01**	**-0.03**	**0.03**

Experiments 1 & 2

Results

Experiment 2: Maze



Subject RTs: Mismatch effect

Structure × Agreement

Est	SE	l-95%	u-95%
0.07	**0.01**	**0.04**	**0.10**

Object RTs: Modulated FGE

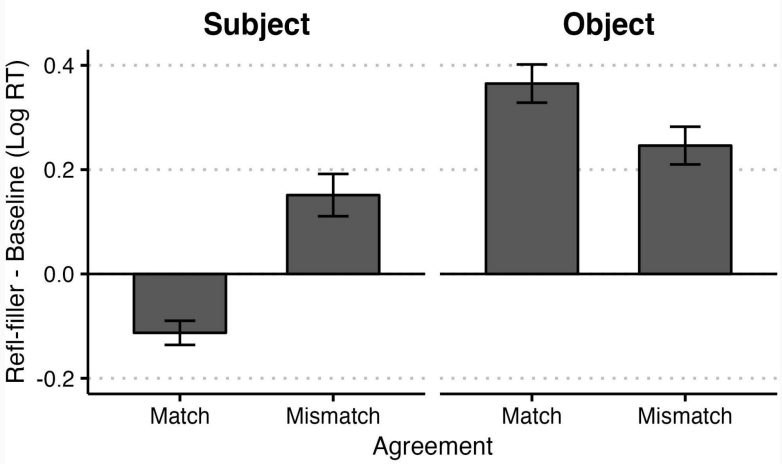
Structure × Agreement

Est	SE	l-95%	u-95%
0.03	**0.01**	**0.01**	**0.06**

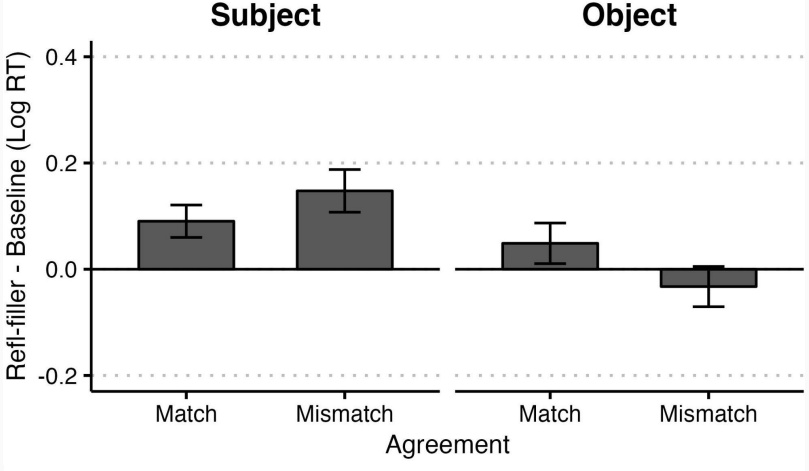
Experiments 1 & 2

Results

Experiment 2: Maze



Experiment 1: SPR



Comprehension question accuracy:

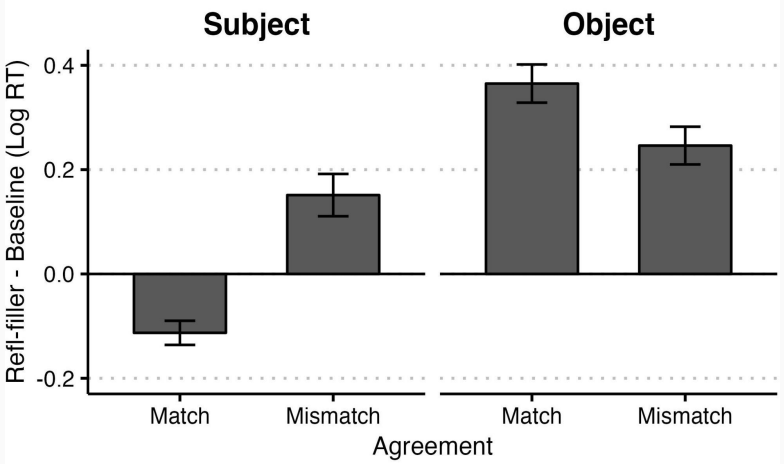
Avg. 88%

Avg. 66%

Experiments 1 & 2

Results

Experiment 2: Maze



Smaller FGE after a Mismatch

→ Gap prediction is sensitive to the requirements of the filler

However, the FGE **persists** after a Mismatch

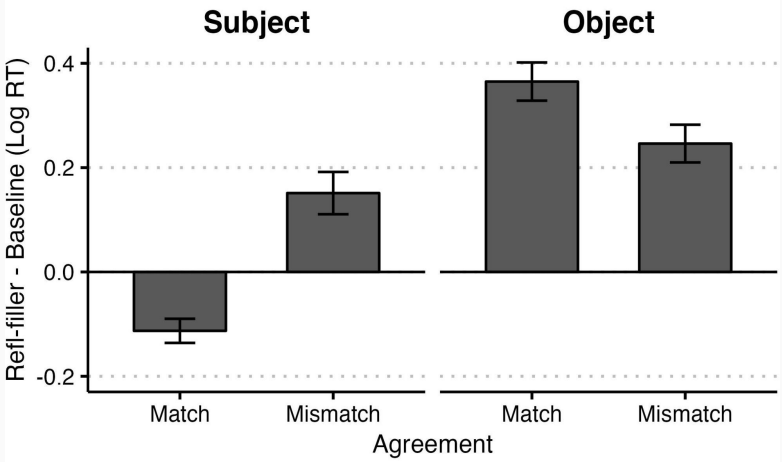
→ Gap search is (somewhat) prioritized over the reflexive-antecedent dependency

Which video of himself did the detective.F film **the suspect.M** delete?

Experiments 1 & 2

Results

Experiment 2: Maze



Noisy-channel hypothesis

Gap prediction after a mismatch is the result of rationalization over noisy reading: Readers assume the subject mismatch must have been an error (e.g., the reflexive was intended to be feminine), and only thus predict an object gap.

Levy (2008)

Which video of himself did the detective.F film **the suspect.M** delete?

Experiment 3

Materials

Reflexive-filler

MATCH

eize sirton šel acmo ha-balaš cilem et ha-xašud moxek?
which video of himself the-detective.M filmed ACC **the-suspect.M** delete?

MISMATCH

eize sirton šel acmo ha-balašit cilema et ha-xašud moxek?
which video of himself the-detective.F filmed ACC **the-suspect.M** delete?

2-MISMATCH

eize sirton šel acmo ha-balašiot cilmu et ha-xašud moxek?
which video of himself the-detective.F.PL filmed ACC **the-suspect.M** delete?

Baseline

when the-detective.M filmed ACC **the-suspect.M** delete video of himself?
when the-detective.F filmed ACC **the-suspect.M** delete video of himself?
when the-detective.F.PL filmed ACC **the-suspect.M** delete video of himself?

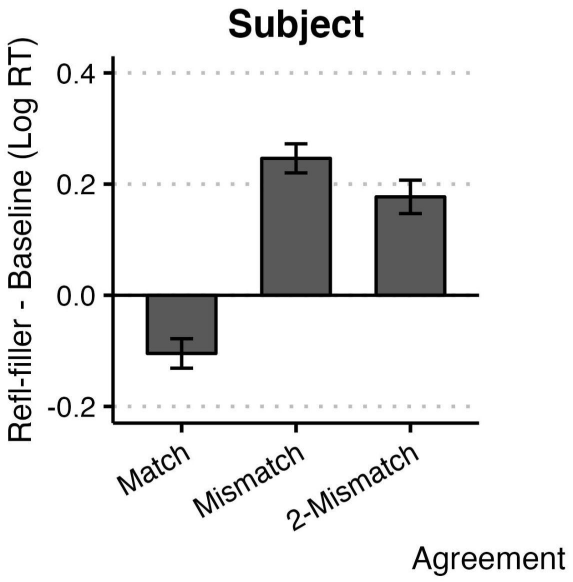
Experiments 3

- 36 items sets
- Grammatical Maze task
- Administered online using PCIbex
- 90 Hebrew speakers, 11 excluded due to <60% comprehension & Maze accuracy

Experiments 3

Results

Experiment 3: Maze



Subject RTs: Mismatch effect

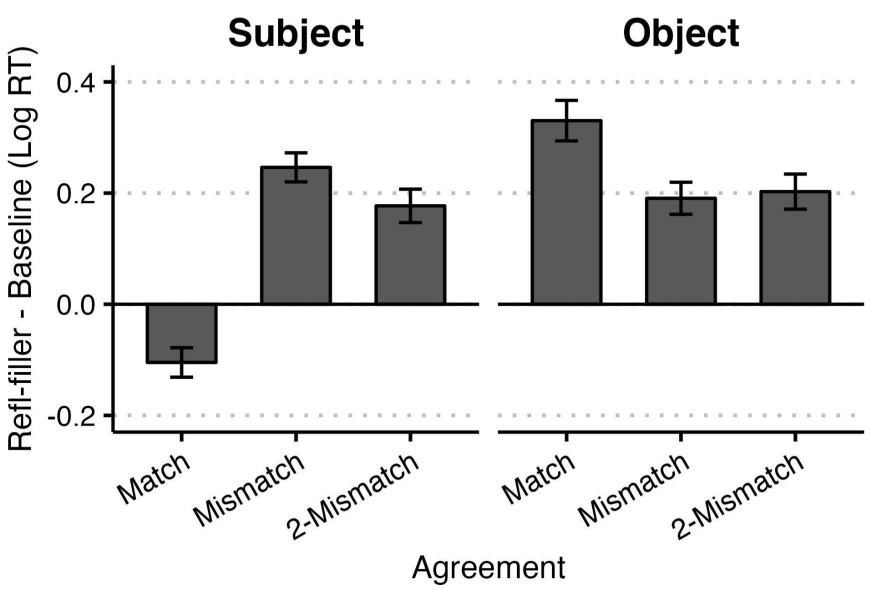
Match/Mismatch × Agreement

Est	SE	l-95%	u-95%
-0.05	**0.01**	**-0.06**	**-0.04**

Experiments 3

Results

Experiment 3: Maze



Object RTs: Modulated FGE

Match/Mismatch × Agreement

Est	SE	l-95%	u-95%
0.02	**0.01**	**0.01**	**0.04**

Object RTs: Mismatch ≈ 2-Mismatch

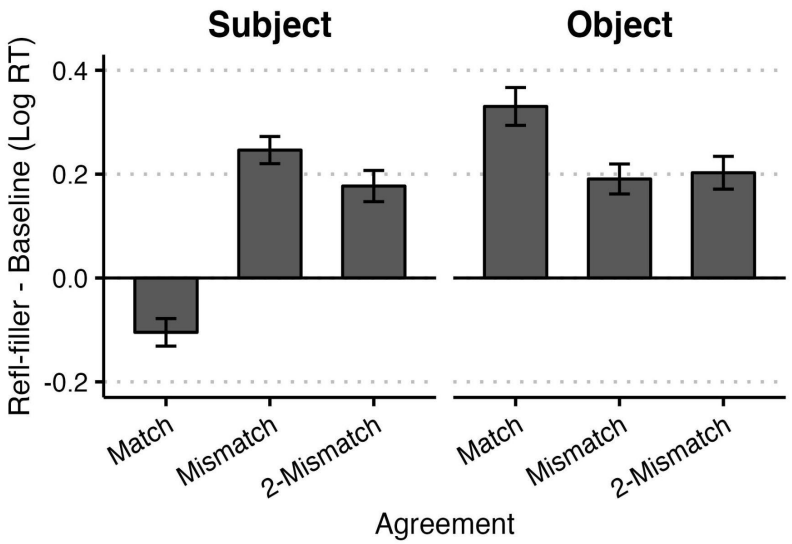
Mismatch/2-Mismatch × Agreement

Est	SE	l-95%	u-95%
-0.00	**0.01**	**-0.02**	**0.02**

BF < 1/100: Extreme evidence against a Mismatch/2-Mismatch difference.

Experiments 3

Experiment 3: Maze



The FGE persists in 2-Mismatch, where misinterpretation is less likely.

→ No evidence that it is the result of rational misinterpretation.

Discussion

Predictions

FGE only after match	**FGE either way**
Antecedent search is prioritized over the filler-gap dependency.	Gap search is prioritized over the reflexive-antecedent dependency.

Results

FGE is *smaller* after a mismatch

Gap search is prioritized, but predictions are somewhat sensitive to the reflexive.

Discussion

Why did we only find a FGE *modulation*, while islands are evidenced to *fully* block gap prediction?

Stowe (1986); Traxler & Pickering (1996); Pickering et al. (1994); Keshev & Meltzer-Asscher (2017); Phillips (2006)

Subject island: Which painting did the story about **the forest** inspire?

- One search (gap); the gap itself is ungrammatical within an island.

Reflexive-filler: Which picture of herself did the boy see **the girl** admiring?

- Two searches (gap & antecedent); the gap itself is licensed in the FG position.

Conclusions

Subject Mismatch effect → A fronted reflexive triggers an active search for its antecedent.

cf. Kazanina et al. (2007); Giskes & Kush (2021); Kush & Dillon (2021)

Smaller FGE after Mismatch → Gap prediction is sensitive to the requirements of the reflexive-filler. However, it is privileged, overriding the search for an antecedent.

FGE in Maze task, but not SPR → The Maze forces highly incremental processing, while SPR is passive, and may produce inattentive participants.

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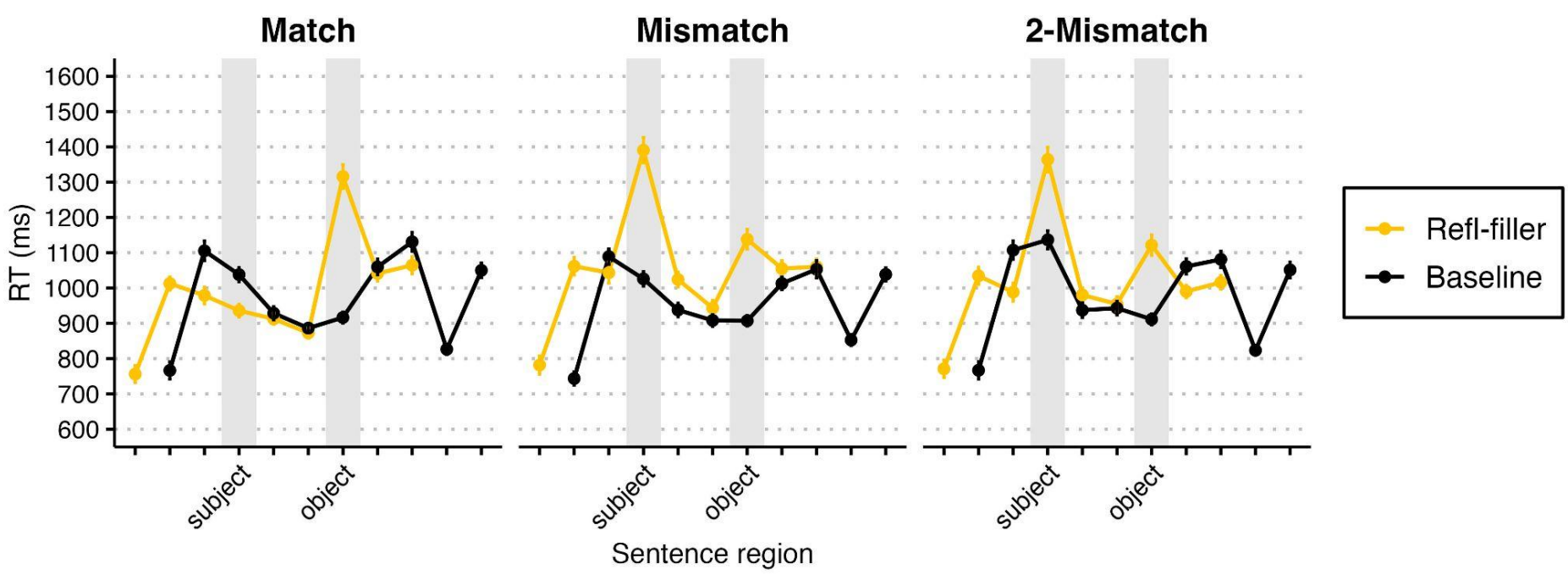
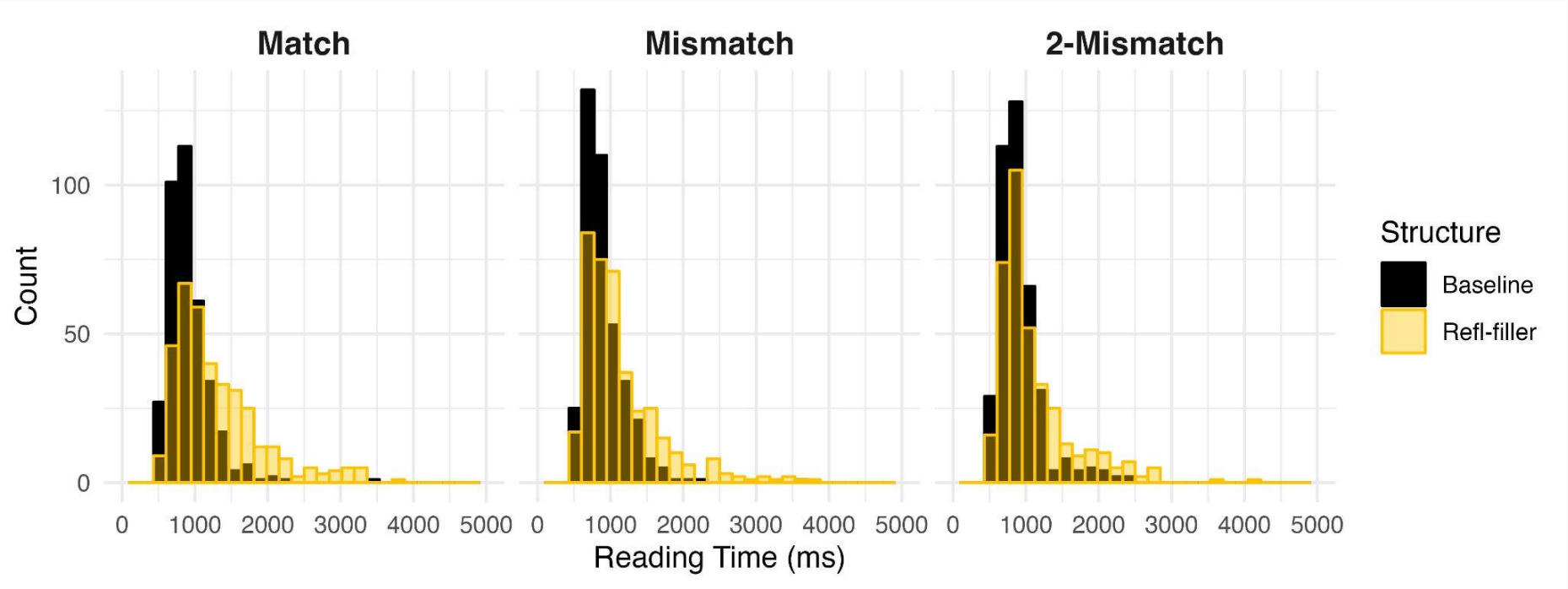
Exp 3: Word-by-word RTs



Exp 3: RT distribution at Object (FG) position



Noisy-channel: Reflexive misinterpretation

MISMATCH

eize	sirton	šel	acmo	ha-balašit	cilema	et	ha-xašud	moxek?
which	video	of	himself	the-detective.F	filmed	ACC	**the-suspect.M**	delete?

1 feature
frequent form

↓

acma
herself

2-MISMATCH

eize	sirton	šel	acmo	ha-balašiot	cilmu	et	ha-xašud	moxek?
which	video	of	himself	the-detective.F.PL	filmed	ACC	**the-suspect.M**	delete?

2 features
infrequent form

↓

acman
themselves.F

Example materials: Feature counterbalancing

Reflexive-filler: Masculine

MATCH	eize sirton šel acmo ha-balaš cilem et ha-xašud moxek? which video of himself the-detective.M filmed.M ACC **the-suspect.M** delete?
MISMATCH	eize sirton šel acmo ha-balašit cilema et ha-xašud moxek? which video of himself the-detective.F filmed.M ACC **the-suspect.M** delete?
2-MISMATCH	eize sirton šel acmo ha-balašiot cilmu et ha-xašud moxek? which video of himself the-detective.F.PL filmed.PL ACC **the-suspect.M** delete?

Reflexive-filler: Feminine

MATCH	eize tmuna šel acma ha-moxeret ra'ata et ha-lakoxa boxeret? which picture of herself the-seller.F saw.F ACC **the-costumer.F** choose?
MISMATCH	eize tmuna šel acma ha-moxer ra'a et ha-lakoxa boxeret? which picture of herself the-seller.M saw.M ACC **the-costumer.F** choose?
2-MISMATCH	eize tmuna šel acma ha-moxrim ra'u et ha-lakoxa boxeret? which picture of herself the-seller.M.PL saw.PL ACC **the-costumer.F** choose?

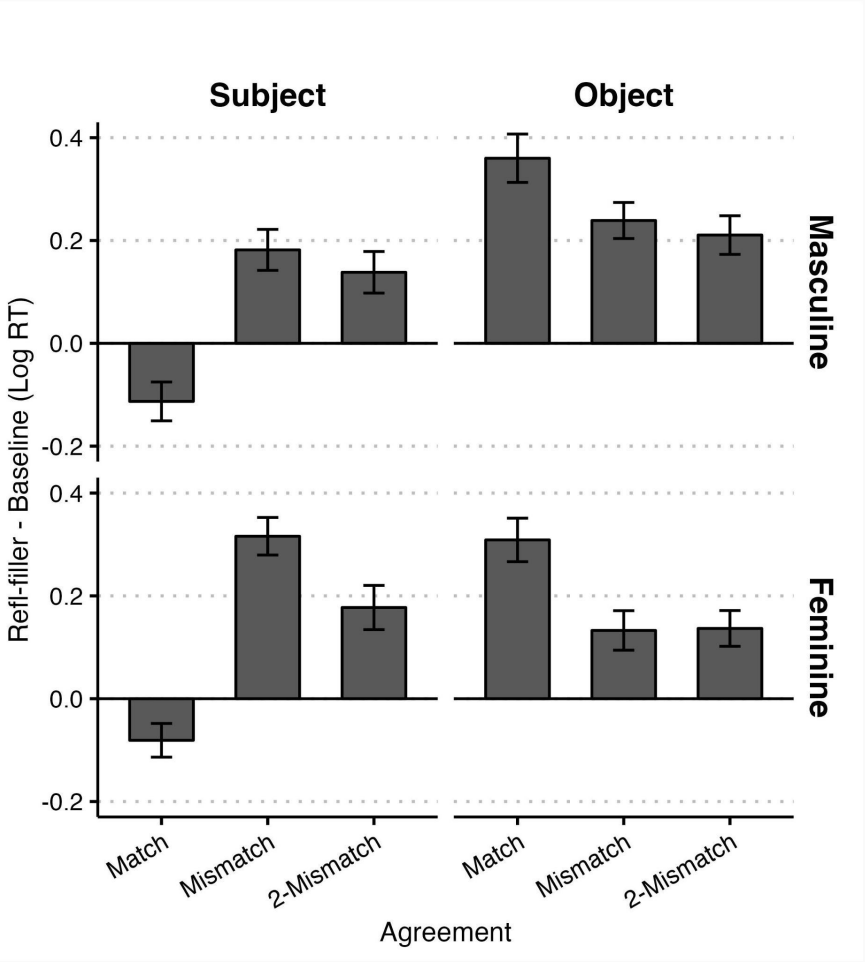
Noisy-channel: Across sets

Misinterpretation is less likely in the Masculine sets:

Input	**Intention**
himself	→ herself
himself	→ themselves.F

Than in the Feminine sets:

herself	→ himself
herself	→ themselves.M



English follow up: Inanimate subjects

MATCH	What information about himself did the filmmaker capture the politician sharing in secret?
NUMBER	What information about himself did the filmmakers capture the politician sharing in secret?
ANIMACY	What information about himself did the documentary capture the politician sharing in secret?