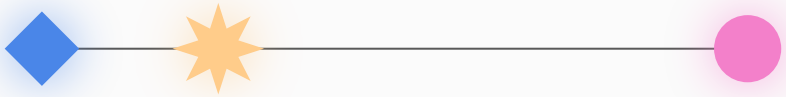
Grammatical resumptive pronouns facilitate processing before they are perceived



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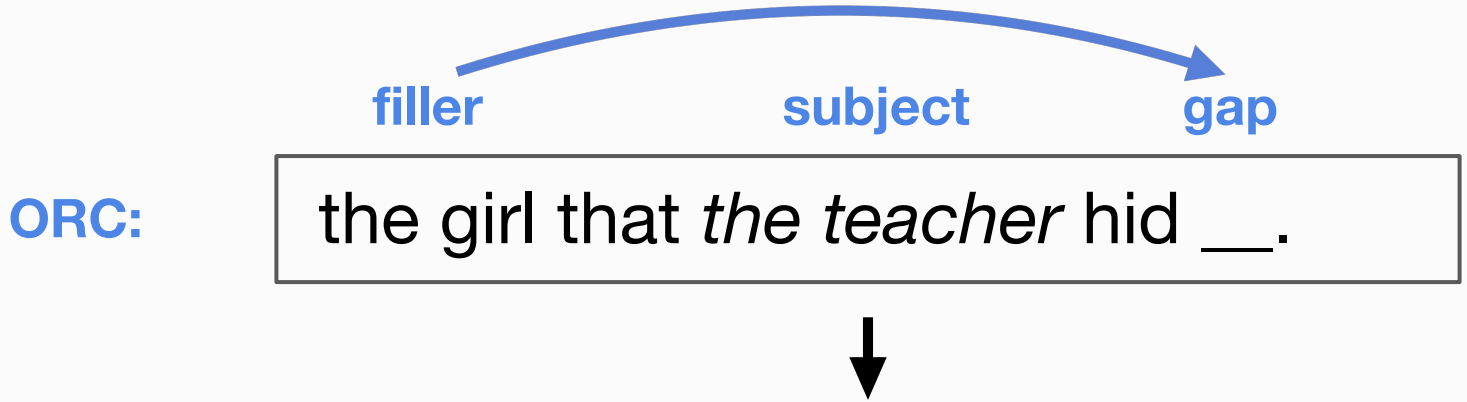
Maziar Toosarvandani[b], Matt Wagers[b]

[a] Tel Aviv University
[b] University of California, Santa Cruz

HSP 2026
MIT

Object filler-gap dependencies

Filler-gap dependency resolution is a **predictive** process.



Difficulty on the subject in ORCs is attributed to subject gap prediction (e.g., Staub 2010).

This study

Questions: What drives predictions?
Can we detect prediction prior to the integration site?

Data: Acceptability and reading times in Hebrew

Conclusions: Animacy-based prediction at the *subject* is mediated by the grammatical properties of the dependency *tail*.

Animacy matters

Processing effects	Syntactic constraints
Animacy **similarity**-based interference (Fadlon et al. 2019; Gidron 2024) **Animate headed** ORCs are more difficult (Mak et al. 2002; Chen 2014; Lowder & Gordon 2014; Wagers & Pendleton 2016; Chen & Hale 2021) **Inanimate subjects** in ORCs are more difficult (Lowder & Gordon 2012)	Some languages require the subject to be higher on the **animacy hierarchy** than the object, disallowing, e.g., *inanimate subject* + *animate object* (Silverstein 1976; Aissen 1997; Chung 1998; Deal & Royer 2025)

Animacy matters

Animac
interfer
2024)

Anima
difficult
Lowder &
2016; Ch

Inanim
more d

subject

object

g 1998;

Intuition: Animacy effects are conceptual.

RCs: the **doll** that the **teacher** hid ✔

the **girl** that the **car** hid ✗

Animacy matters

Intuition: Animacy effects are conceptual.

Prediction: Animacy effects across constructions.

RCs:	the **doll** that the **teacher** hid	✔
	the **girl** that the **car** hid	✗
WHQs:	which **doll** the **teacher** hid	**?**
	which **girl** the **car** hid	**?**

Resumptive pronouns

Hebrew ORCs license optional RPs, alongside gaps:

lo	raiti	et	ha-yalda	še-ha-mexonit	histira	__ \ ota.
NEG	I.saw	ACC	the-girl	that-the-car	hid	__ \ RP.

RPs are more frequent and acceptable with animate fillers.

(Fadlon et al. 2019; Cartner et al. 2021; McCloskey 2017)

Hebrew WHQs license gaps, while RPs are marginal and at most intrusive:

lo	raiti	et	mi	ha-mexonit	histira	__ \ ?ota.
NEG	I.saw	ACC	who	the-car	hid	__ \ ?RP.

Acceptability: Methods

Relative clauses

Tail: gap / RP

I didn't see…

Well aligned	the doll that the teacher hid	∅ / RP
Animacy match	the doll that the car hid	∅ / RP
	the girl that the teacher hid	∅ / RP
Poorly aligned	the girl that the car hid	∅ / RP

Same form:
ota (F)
oto (M)

…from the other children

Acceptability: Methods

Wh-questions

Tail: gap / RP

I didn't see…

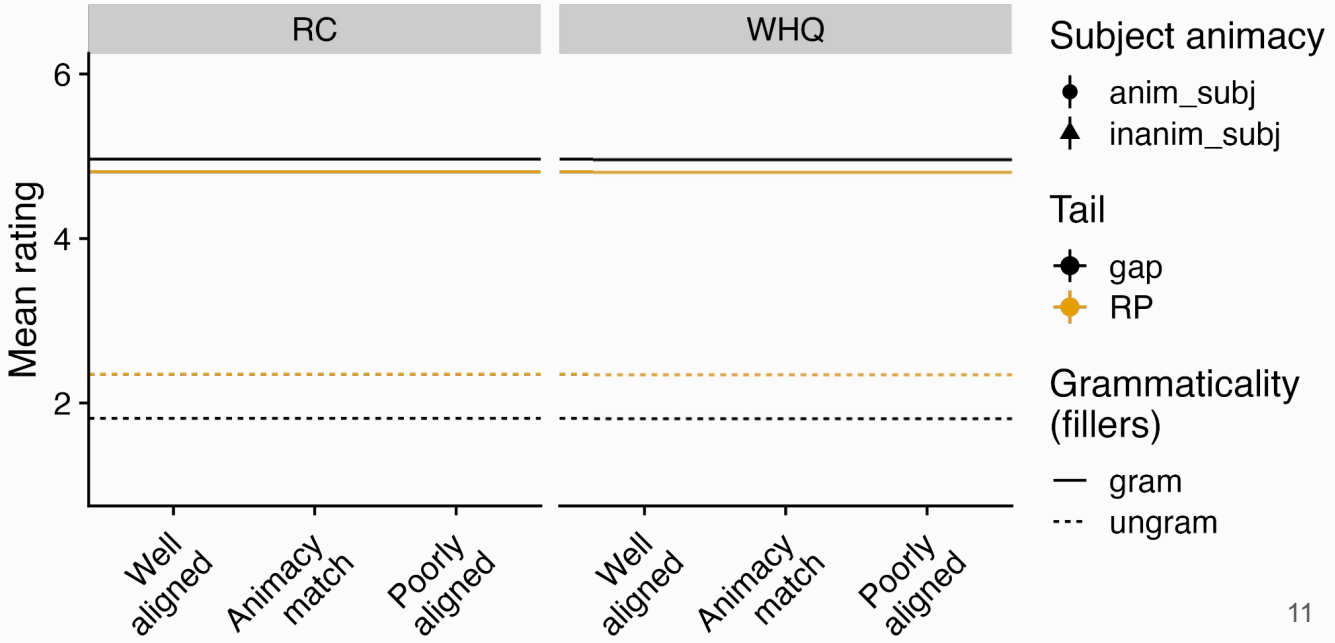
Well aligned	which doll	the teacher	hid	∅ / RP
Animacy match	which doll	the car	hid	∅ / RP
	which girl	the teacher	hid	∅ / RP
Poorly aligned	which girl	the car	hid	∅ / RP

…from the other children

Acceptability: Methods

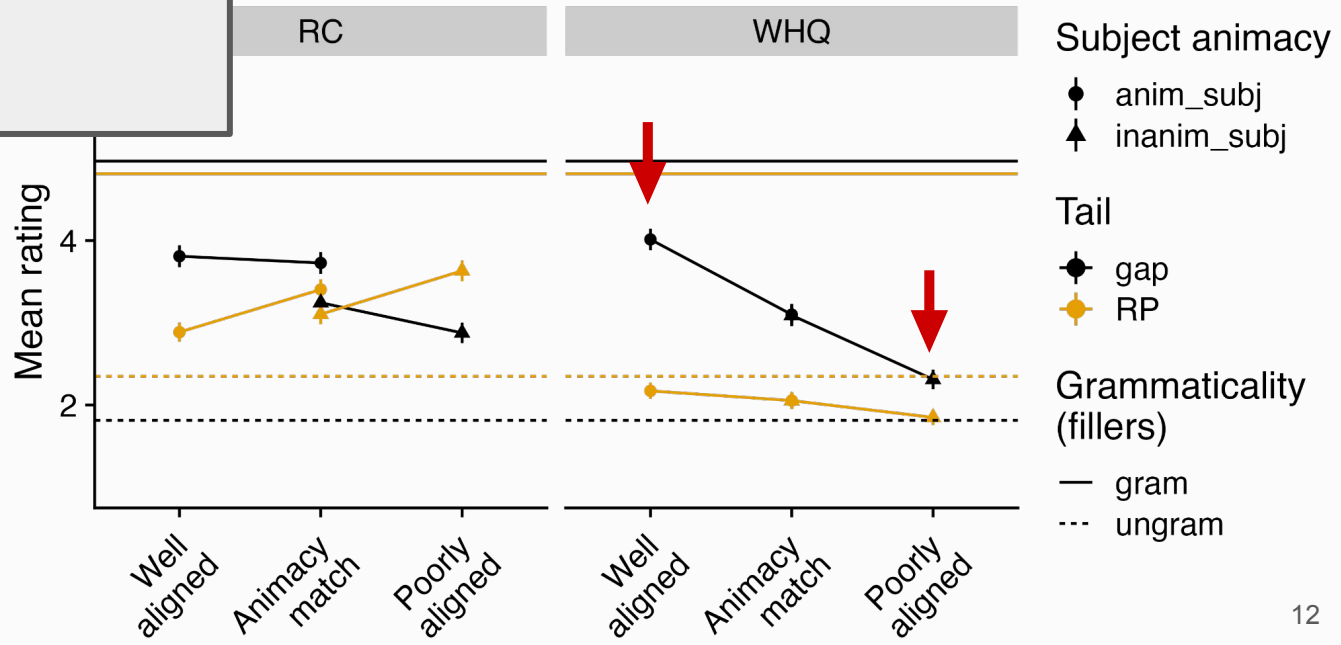
- 32 sets, 2×2×4: *Structure*, *Tail*, *Animacy alignment*
- 162 Hebrew speakers
- 6pt scale acceptability judgment
- brms in R (appendix)

Acceptability: Results & discussion



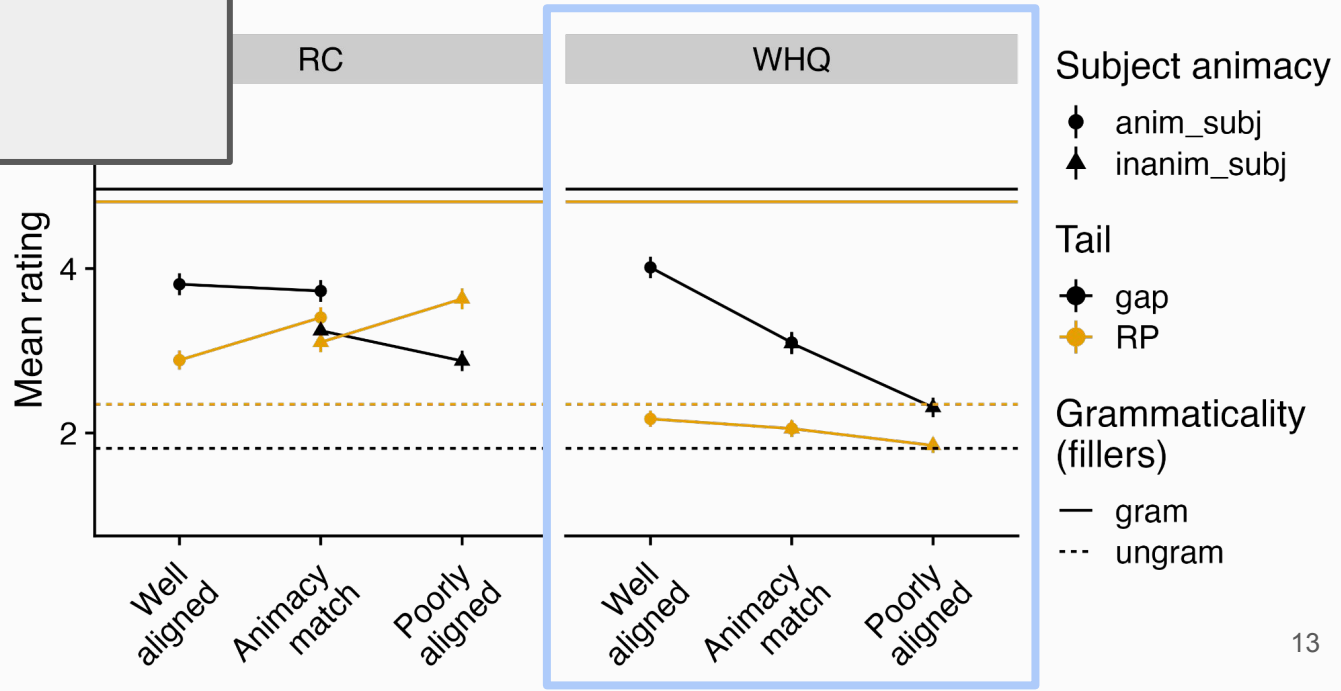
Acceptability: Results & discussion

Animacy misalignment lowers the acceptability of object dependencies.



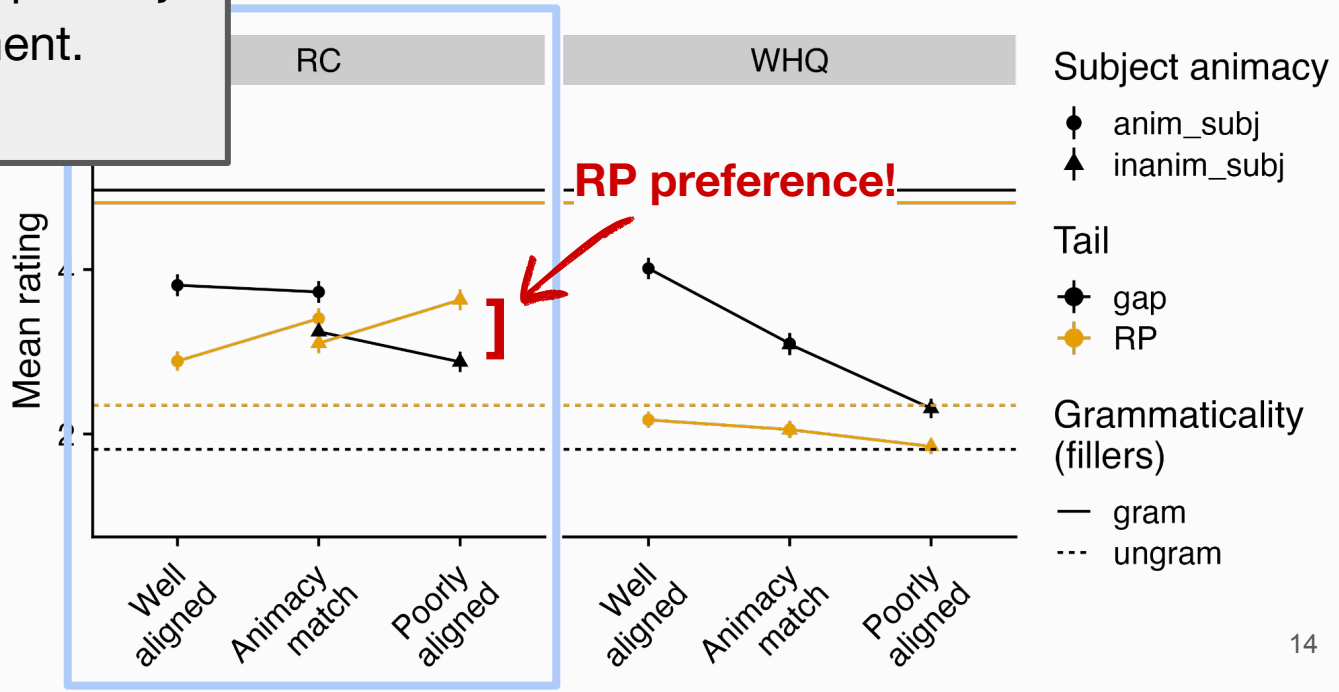
Acceptability: Results & discussion

In **WHQs**, **RPs** are rated poorly and track misalignment effects.



Acceptability: Results & discussion

In **RCs**, **RPs** are optional and ameliorate the unacceptability of animacy misalignment.



Acceptability: Results & discussion

Animacy Hebrew Misalignment effects are structure-specific.

RPs RPs only ameliorate dependency unacceptability in RCs.

Poorly aligned

RC: I didn't see the girl that the car hid __ / RP ❌ ✅

WHQ: I didn't see which girl the car hid __ / RP ❌ ❌

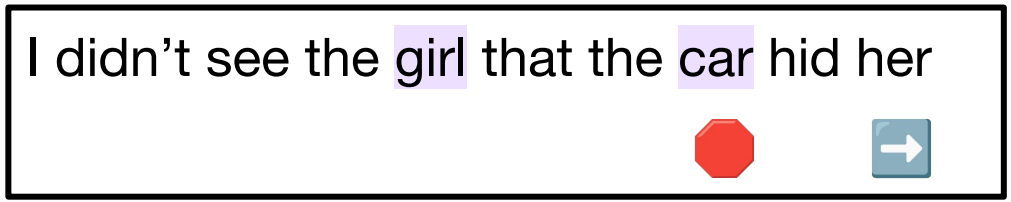
Predictive processing

Animacy Hebrew Misalignment effects are structure-specific.

RPs RPs only ameliorate dependency unacceptability in RCs.

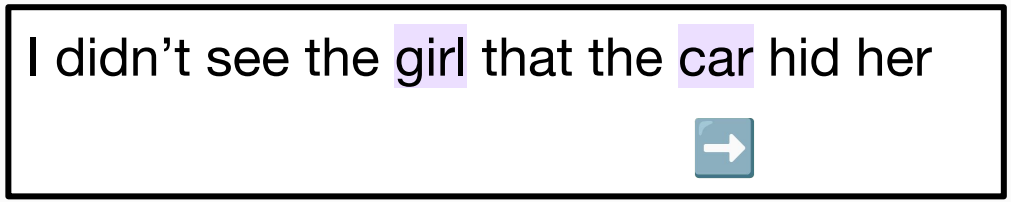
Prediction Are RPs predicted; do they overcome animacy difficulty?

(A) Online difficulty is insensitive to RPs



(B) RPs are predicted, and overcome difficulty

(Keshev & Meltzer-Asscher 2017)



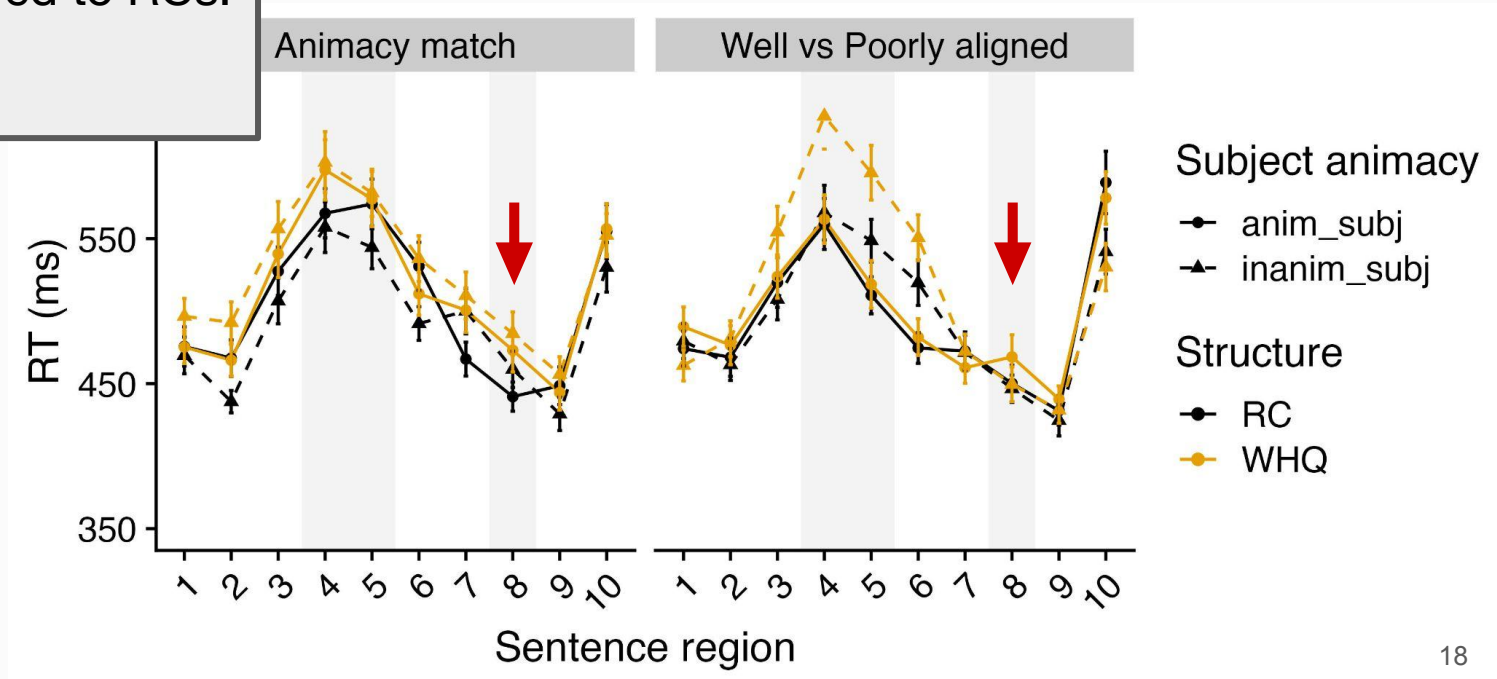
SPR: methods

- 40 sets, 2×4: *Structure*, *Animacy alignment*
- 80 Hebrew speakers
- Moving window self-paced reading

	Relative clauses	*Wh-questions*
Well aligned	the doll that the teacher hid RP	which doll the teacher hid RP
Animacy match	the doll that the car hid RP	which doll the car hid RP
	the girl that the teacher hid RP	which girl the teacher hid RP
Poorly aligned	the girl that the car hid RP	which girl the car hid RP

SPR: results & discussion

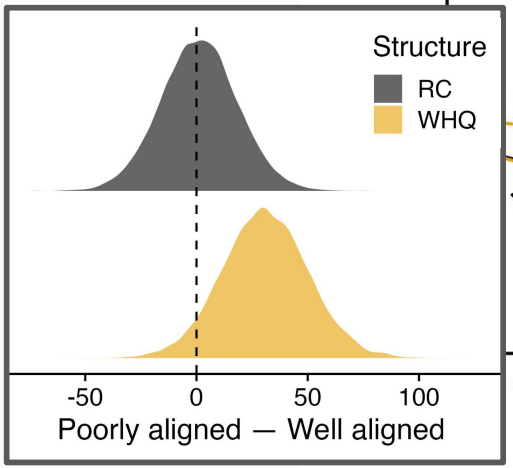
RP region: Slowdown in WHQs compared to RCs.

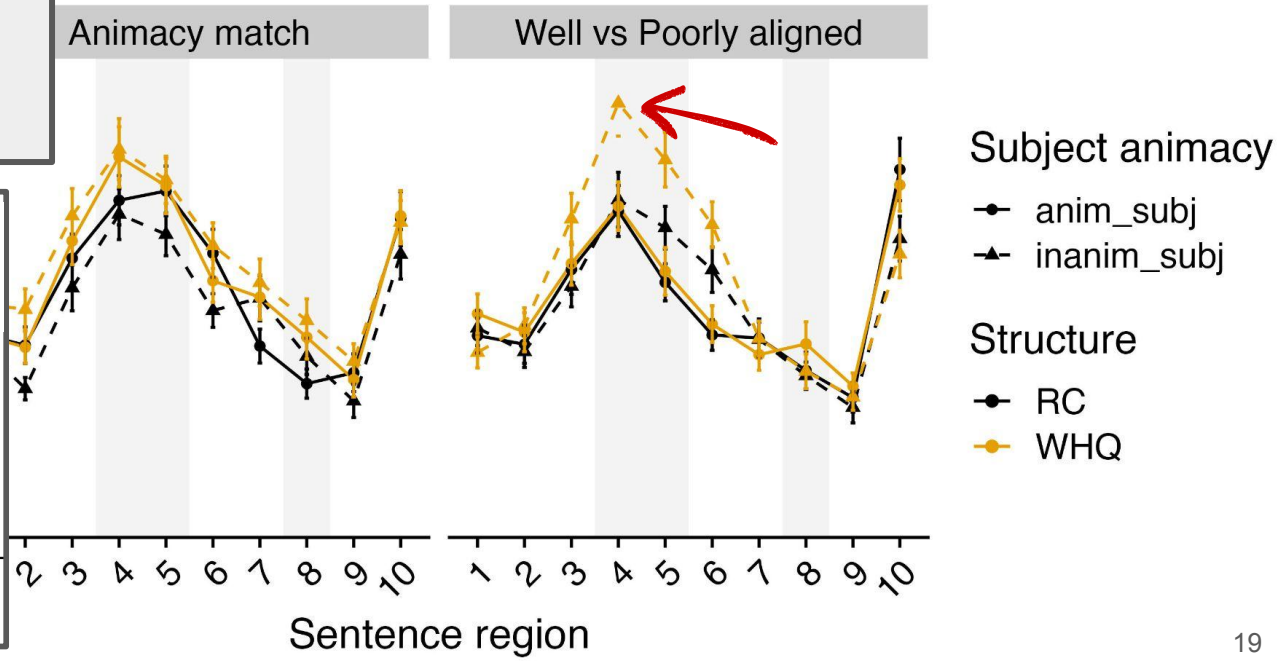


SPR: results & discussion

Subject region: Animacy misalignment slowdown only in **WHQs**.

(cf. Cartner et al. 2023)





SPR: results & discussion

Animacy Animacy misalignment slowdown is structure-specific.

RPs & **Prediction** In **RCs**, licensed RPs are predictable and overcome processing difficulty; in **WHQs,** RPs are not predicted.

Poorly aligned

RC: I didn't see the girl that the car hid her ➡️

WHQ: I didn't see which girl the car hid her 🛑

Implications

Animacy Animacy effects are not just conceptual; they are shaped by the available dependency licensing mechanisms.

RPs Hebrew RPs are grammatical in RCs and intrusive in WHQs.
RC RPs are predicted and affect dependency processing.

Prediction Predicted structure affects the processing of upstream material.
Prediction does not amount to ease of integration.

Thank you!

mandycartner@mail.tau.ac.il

Award #2019804 to Ivy Sichel,
Matt Wagers & Maziar Toosarvandani

Materials

structure	alignment	dependency↓ (RP / *gap*)
Wh-question	✓ *aligned*	lo ra'iti eize buba ha-mora hestira ota / ⌀ me-ha-yeladim ha-axerim NEG I.saw which doll the-teacher hid it / ⌀ from-the-children the-other
	animacy match	lo ra'iti eize buba ha-mexonit hestira ota / ⌀ me-ha-yeladim ha-axerim NEG I.saw which doll the-car hid it / ⌀ from-the-children the-other lo ra'iti eize yalda ha-mora hestira ota / ⌀ me-ha-yeladim ha-axerim NEG I.saw which girl the-teacher hid her / ⌀ from-the-children the-other
	× misaligned	lo ra'iti eize yalda ha-mexonit hestira ota / ⌀ me-ha-yeladim ha-axerim NEG I.saw which girl the-car hid her / ⌀ from-the-children the-other
Relative clause	✓ aligned	lo ra'iti et ha-buba še-ha-mora hestira ota / ⌀ me-ha-yeladim ha-axerim NEG I.saw ACC the-doll that-the-teacher hid it / ⌀ from-the-children the-other
	animacy match	lo ra'iti et ha-buba še-ha-mexonit hestira ota / ⌀ me-ha-yeladim ha-axerim NEG I.saw ACC the-doll that-the-car hid it / ⌀ from-the-children the-other lo ra'iti et ha-yalda še-ha-mora hestira ota / ⌀ me-ha-yeladim ha-axerim NEG I.saw ACC the-girl that-the-teacher hid her / ⌀ from-the-children the-other
	× misaligned	lo ra'iti et ha-yalda še-ha-mexonit hestira ota / ⌀ me-ha-yeladim ha-axerim NEG I.saw ACC the-girl that-the-car hid her / ⌀ from-the-children the-other

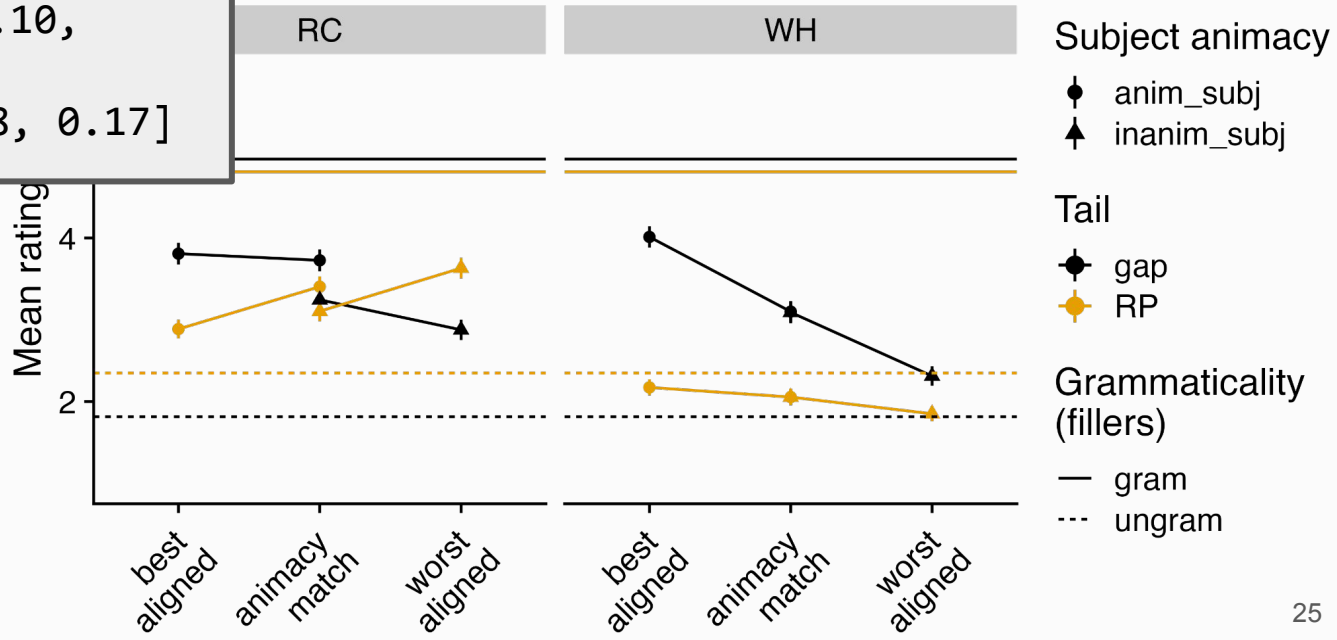
Materials

The neighbor/sprinkler	wet	the girl/car
The passenger/glass	scratched	the driver/mirror
The advisor/idea	served	the CEO/corporation
The protestor/protest	stopped	the politician/war
The child/paintbrush	dirtied	the student/chair
The manager/reform	replaced	the worker/machine
The boy/microphone	recorded	the man/noise
The coach/sun	dried	the athlete/towel

Acceptability: brms

Misalignment costs are larger in **WHQs** compared to **RCs**

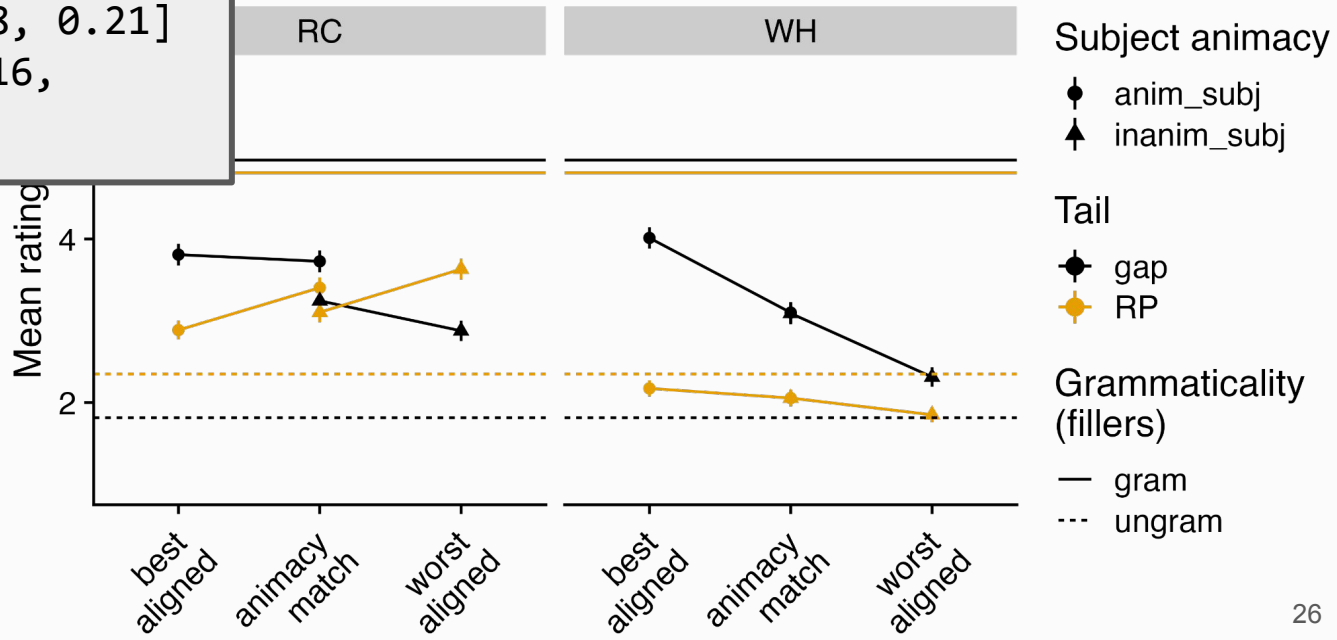
```
stru:subj -0.05 [-0.10,
-0.00]
stru:obj  0.13 [0.08, 0.17]
```



Acceptability: brms

Misalignment costs are larger w/ **gaps** compared to **RPs**

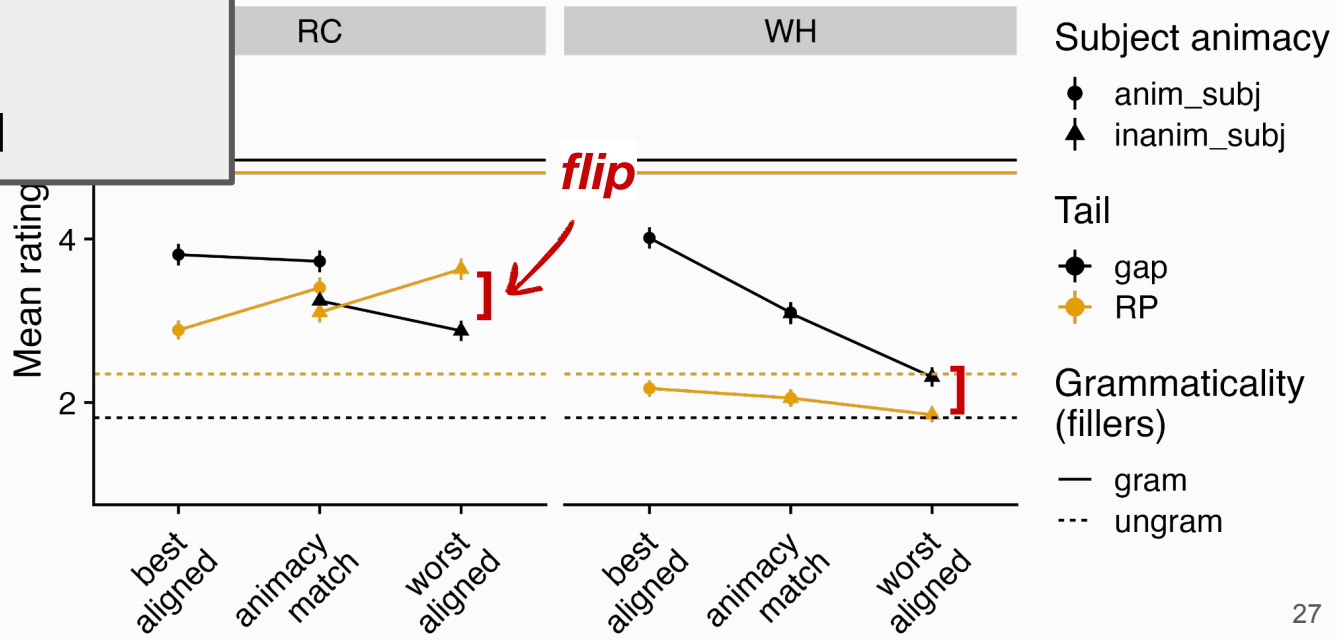
```
tail:subj 0.14 [0.08, 0.21]
tail:obj -0.11 [-0.16,
-0.07]
```



Acceptability: brms

The **preference for gaps** is larger in **WHQs** compared to **RCs**

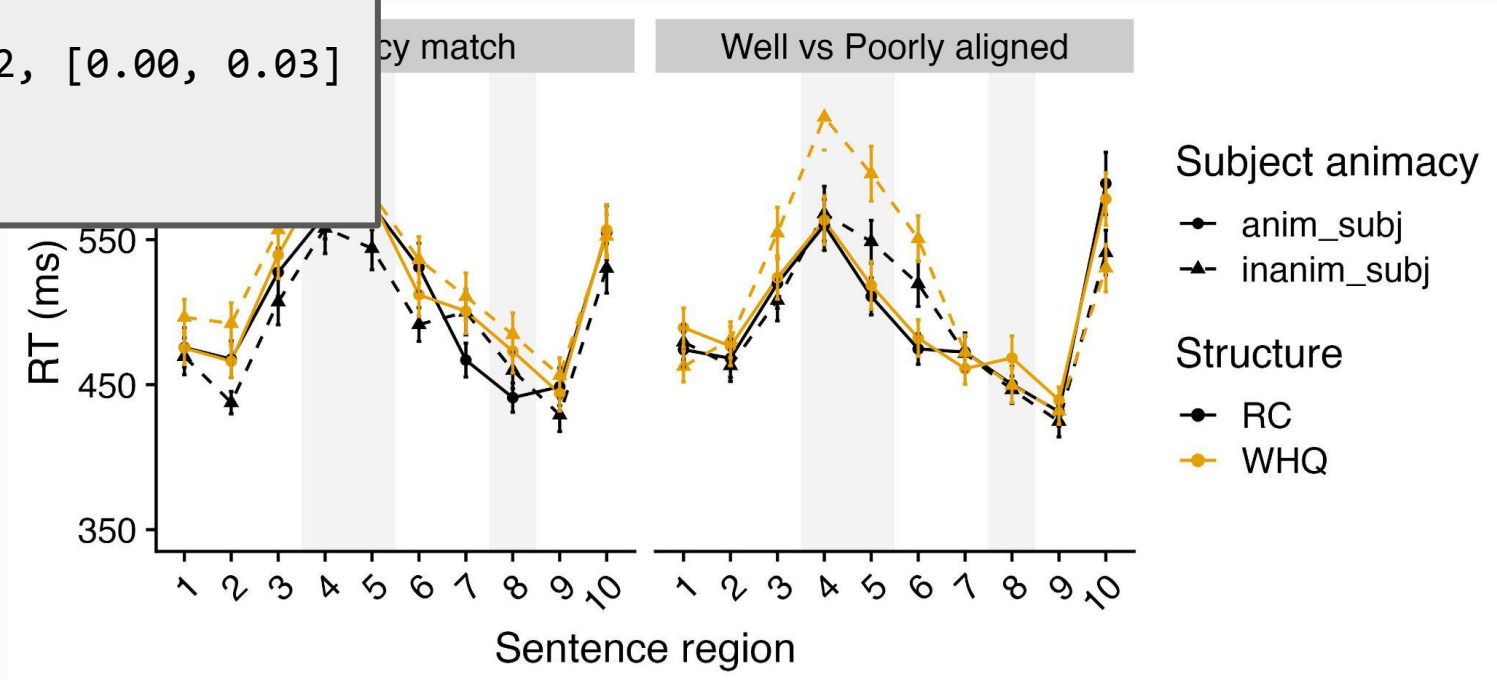
stru:tail
-0.18 [-0.23, -0.12]



SPR: brms

Subject: slower in WHQs than RCs

subj:stru 0.02, [0.00, 0.03]

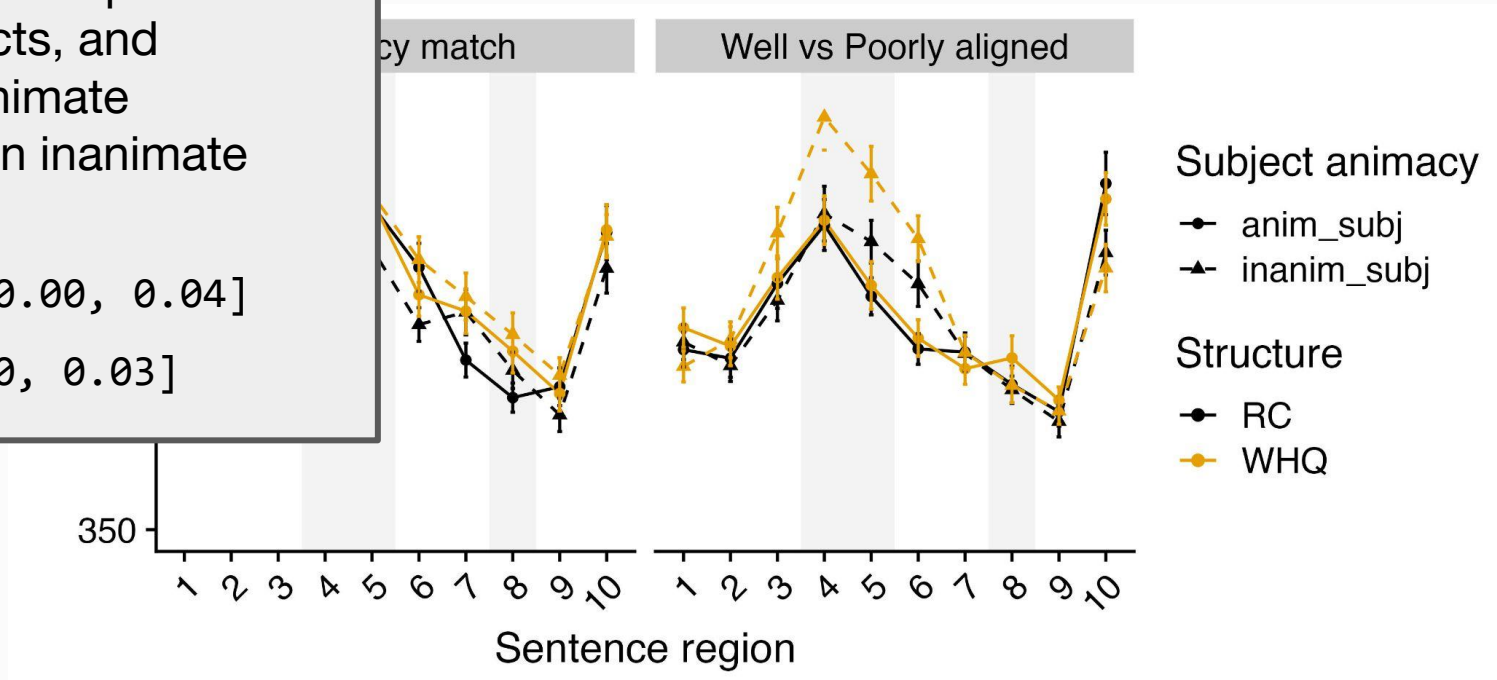


SPR: brms

Subject spill-over: Slower with inanimate compared to animate subjects, and following an animate compared to an inanimate object

subj 0.022, [0.00, 0.04]

obj 0.02,[0.00, 0.03]

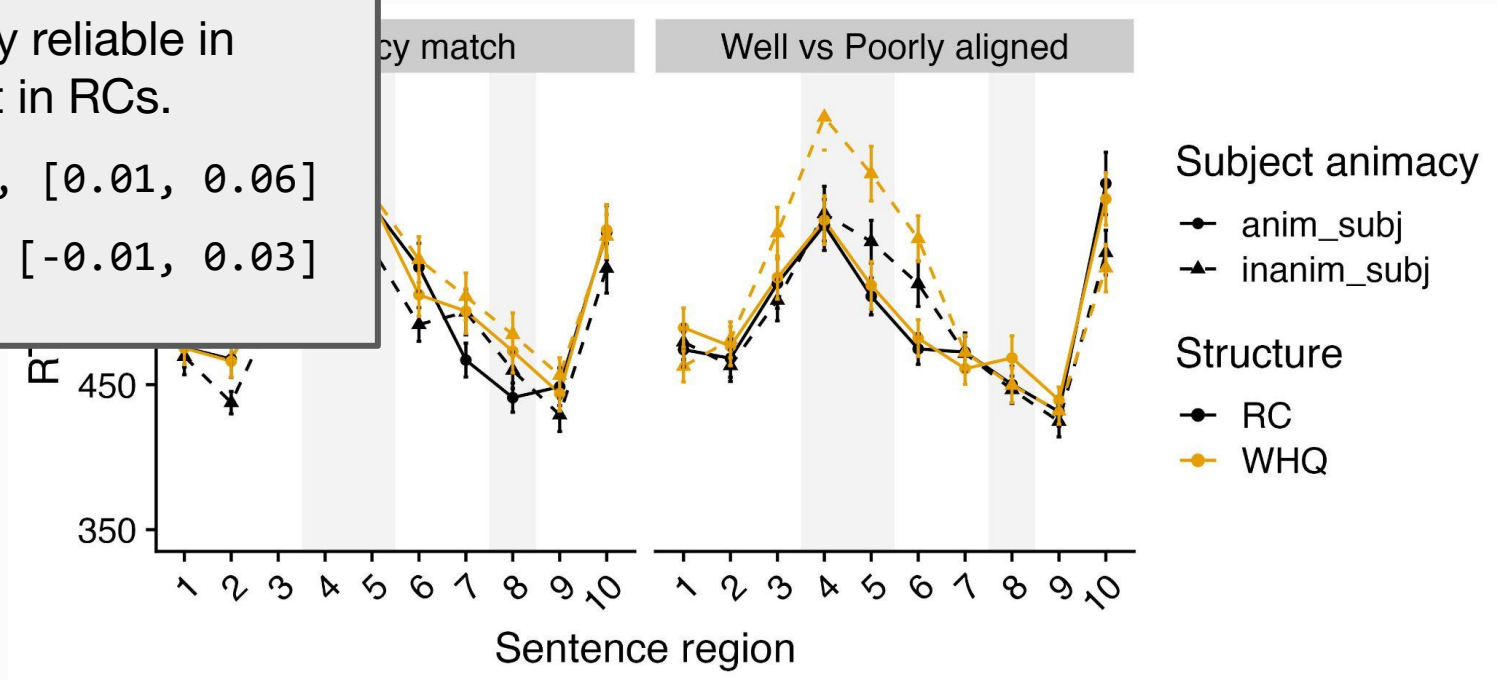


SPR: brms

Subject spill-over: The slowdown on inanimate subjects is only reliable in WHQs and not in RCs.

WHQ subj 0.04, [0.01, 0.06]

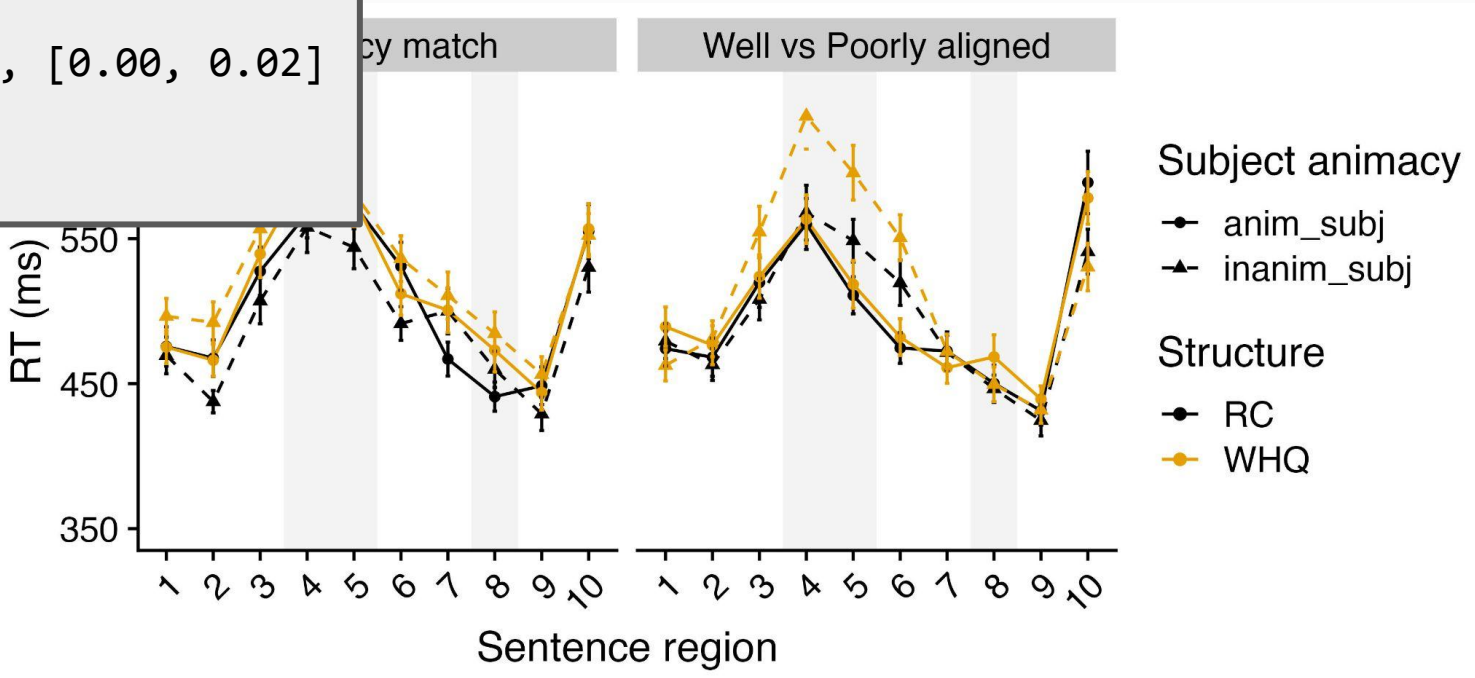
RC subj 0.01, [-0.01, 0.03]



SPR: brms

RPs: slower in WHQs than RCs

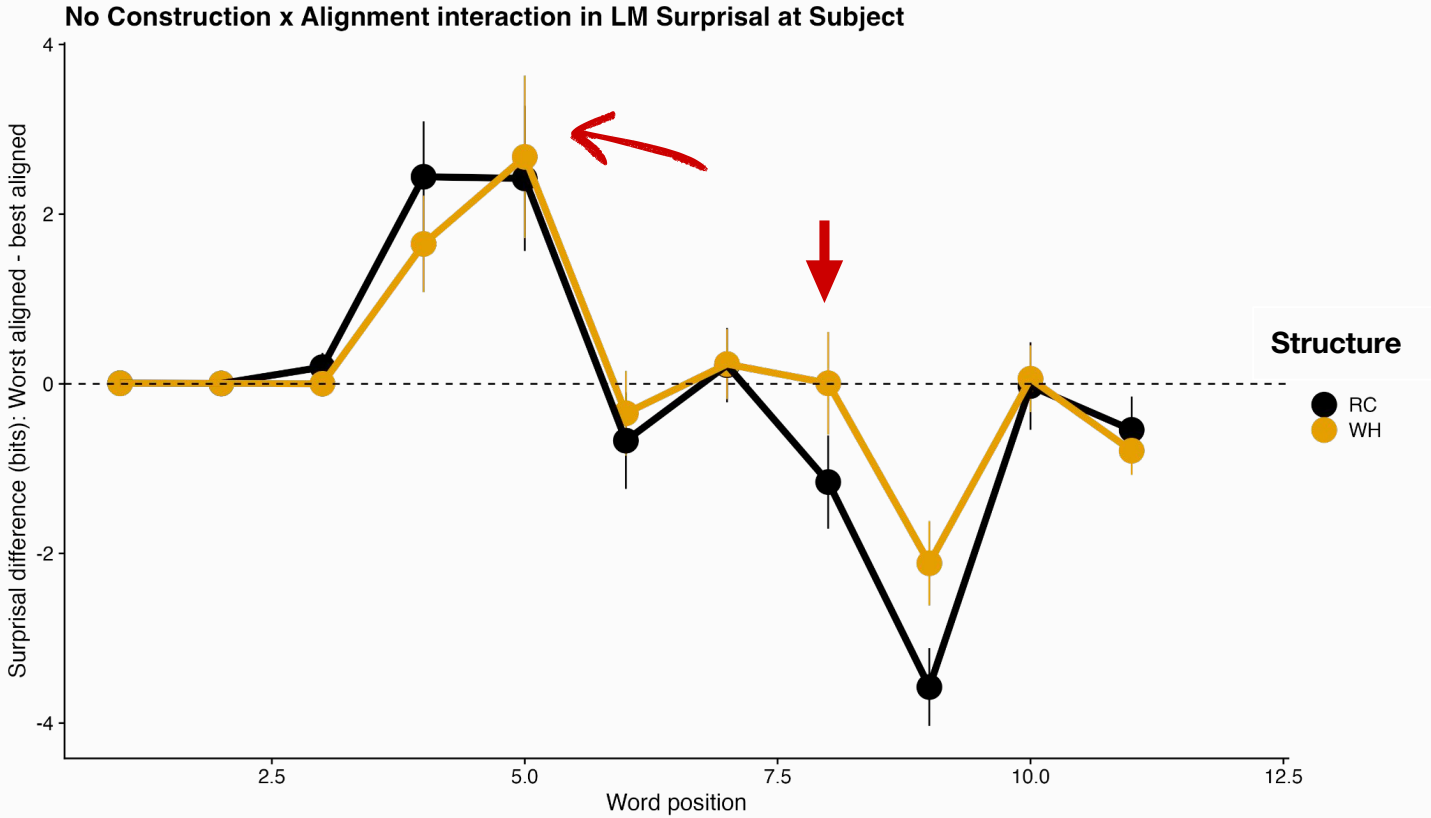
subj:stru 0.01, [0.00, 0.02]



Surprisal

Item-wise surprisals from `dicta-il/dicta lm2.0` (Schmidman, Schmidman, Cohen, Koppel, 2024)

Difference between best and worst aligned.



Surprisal Normalization Analysis

Following Van Schijndel & Linzen (2021)

Huang et al. (2024)

Timkey et al. (2025)

Filler data model:

```
lmer(RT ~  surprisal + surprisal_n1 +
           frequency*length +
           frequency_n1*length_n1 +

(1 + surprisal + surprisal_n1 + frequency +
length + frequency_n1 + length_n1 ||
Participant) +
(1 | item))
```