

What Tagalog can teach us

The influence of word order in reflexive processing

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Comprehenders use a cue-based retrieval mechanism to form linguistic dependencies in real-time

Upon encountering a reflexive like *herself*, comprehenders launch a retrieval operation to look for an element in working memory that best matches the cues instantiated by the reflexive

Much of what we know about language processing suffers from a **lack of linguistic diversity**

- ◉ Mostly from W.E.I.R.D language users
(Henrich, Heine, & Norenzayan, 2010)
- ◉ 85% of the data come from 10 languages
(Anand, Chung, & Wagers, 2011)



Skeptic Steve asks:
General theory of language
processing? Or sampling bias?

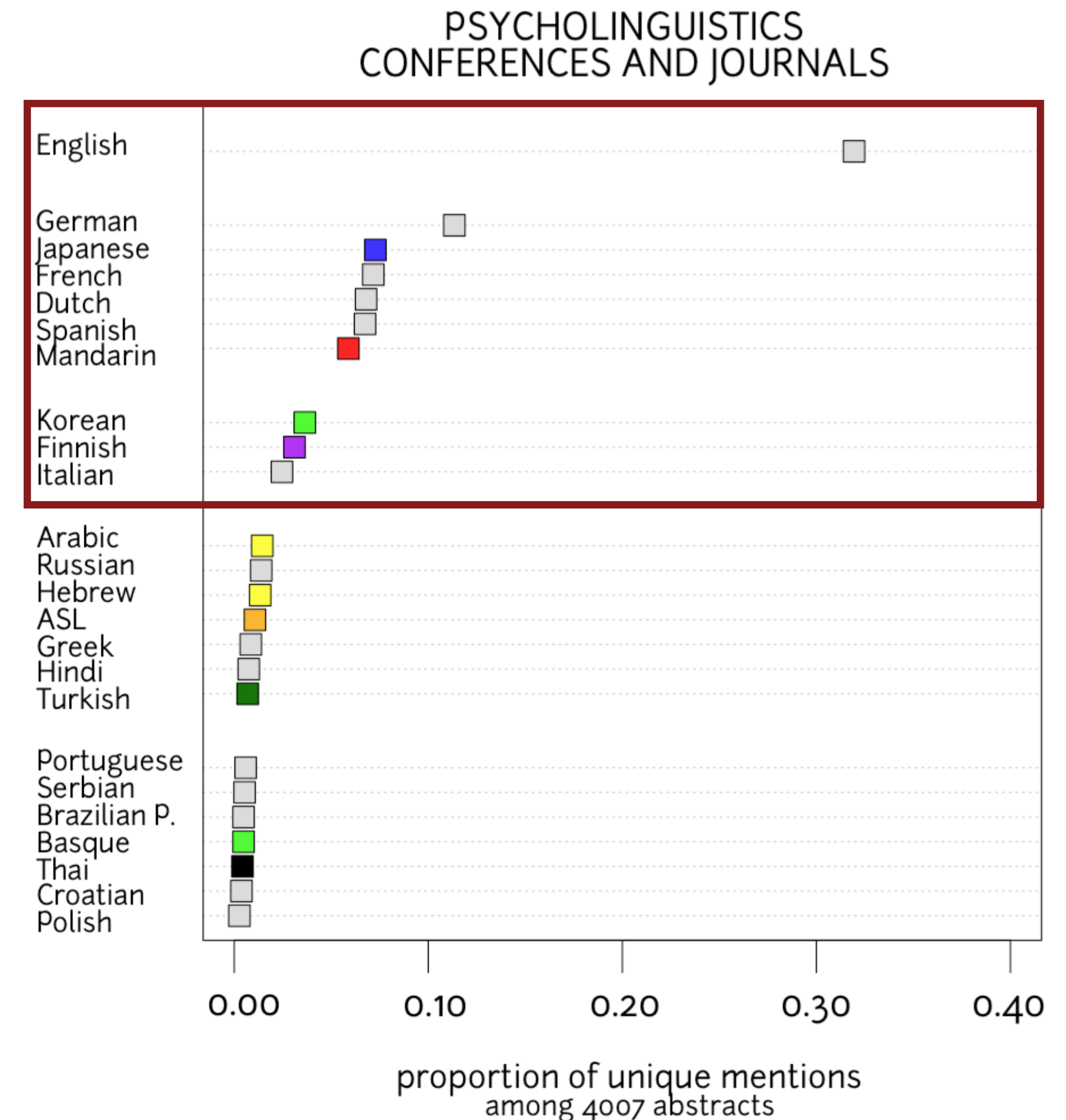


Figure from Anand, Chung, & Wagers (2011)

Comprehenders use a cue-based retrieval mechanism to form linguistic dependencies in real-time

Upon encountering a reflexive like *herself*, comprehenders launch a retrieval operation to look for an element in working memory that best matches the cues instantiated by the reflexive

How do different word order properties of a language affect or change what we know about how linguistic dependencies are processed?

After controlling for a potential confound in the literature, Tagalog comprehenders exhibited interference effects that are consistent with a cue-based retrieval mechanism. There are some wrinkles, however.

Today

Background: Cue-based retrieval

Background: Reflexive processing

Experiment: Self-paced reading in Tagalog

Discussion

Future directions

Background:

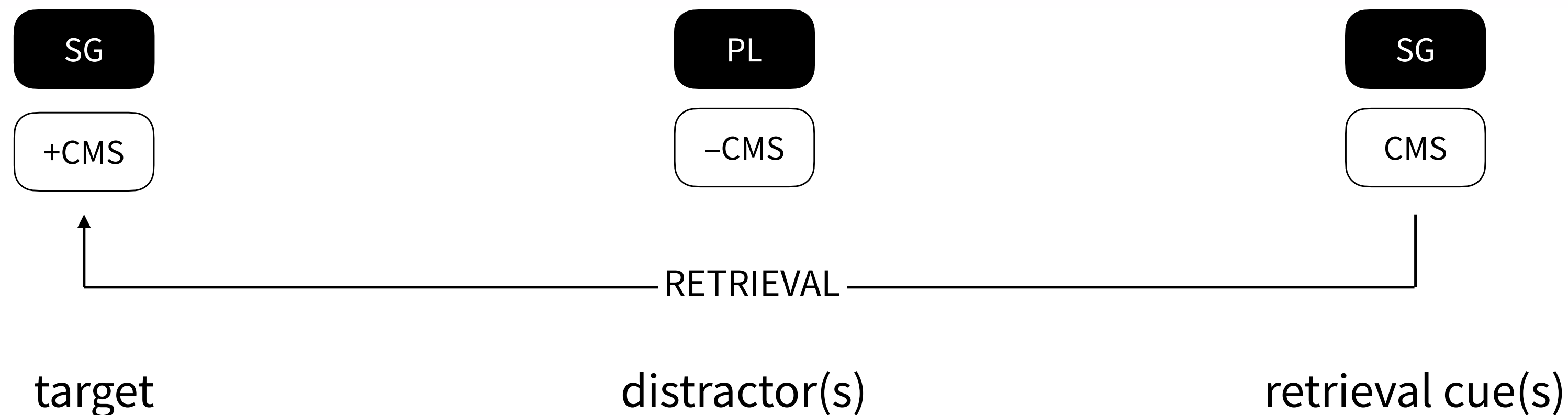
Cue-based retrieval

Cue-based retrieval

Comprehenders use a cue-based retrieval mechanism to form linguistic dependencies in real-time

(1) Adapted from Dillon et al. (2013)

The bodybuilder [who the personal trainers worked with] was competitive for ...



Similarity-based interference

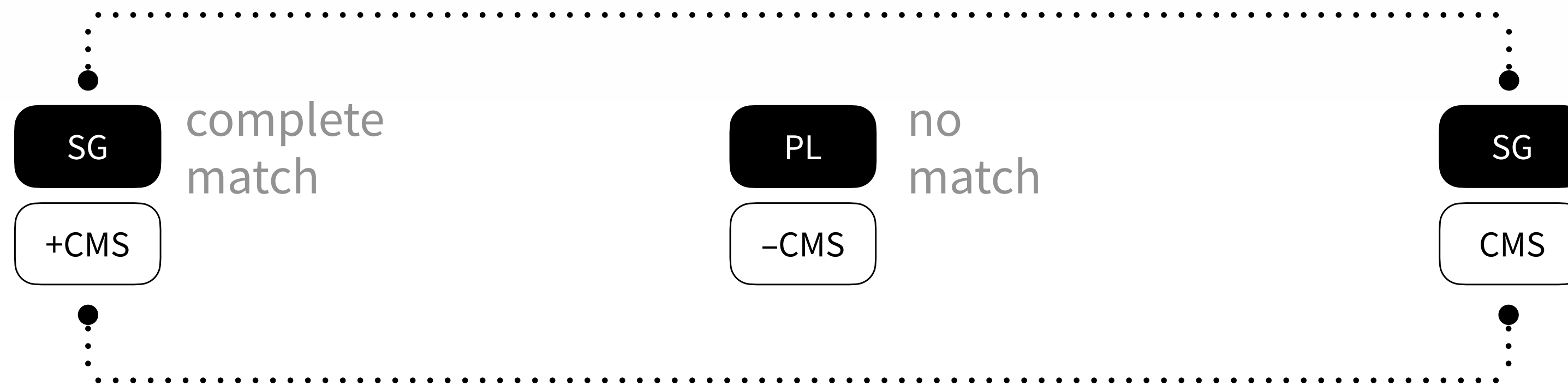
When the distractor(s) match(es) in features with the target, similarity-based interference is observed

- Inhibitory interference – there's a **slowdown** at the retrieval site
- Facilitatory interference – there's a **speedup** at the retrieval site

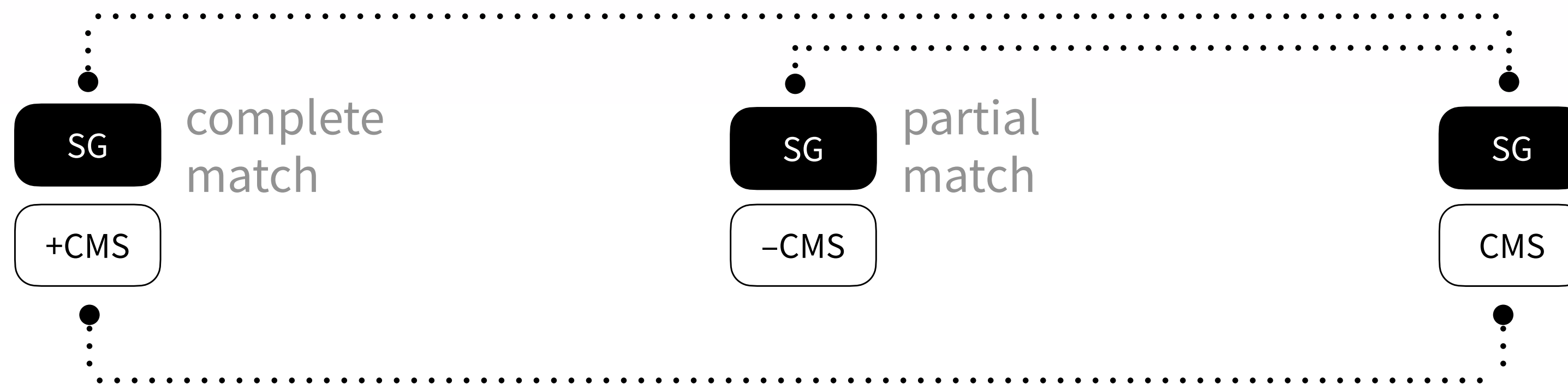
Inhibitory interference

Partial match in (3) causes a slowdown

(2) The **bodybuilder** [who the **personal trainers** worked with] **was** competitive for ...



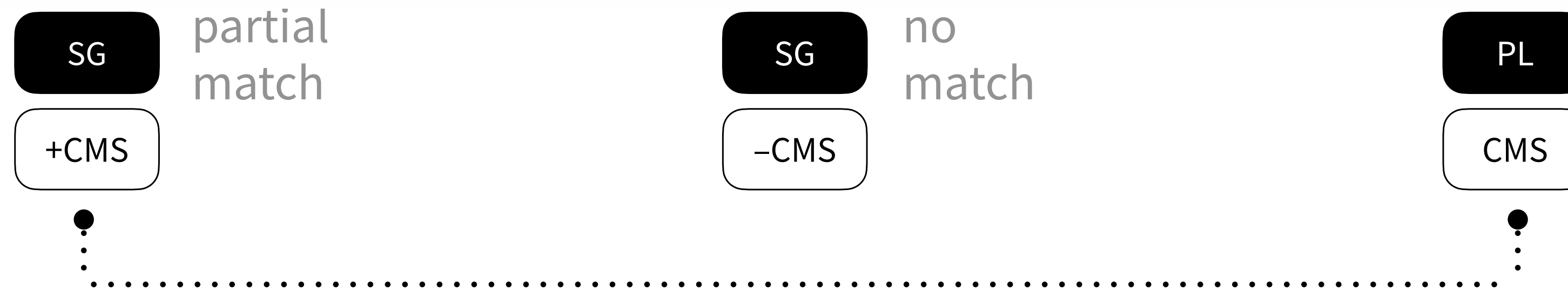
(3) The **bodybuilder** [who the **personal trainer** worked with] **was** competitive for ...



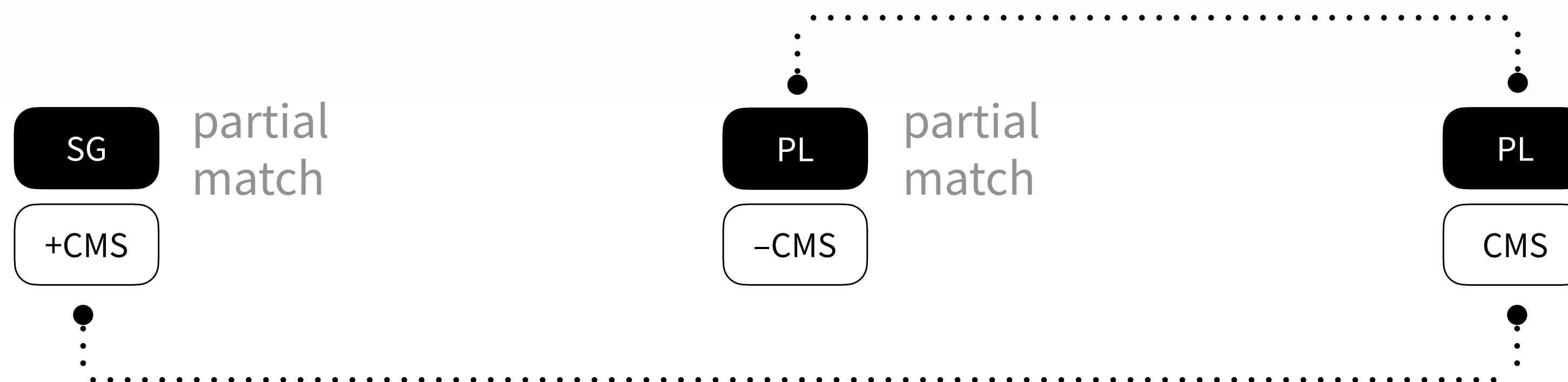
Facilitatory interference

Partial matches in (5) cause a speedup

(4) *The **bodybuilder** [who the **personal trainer** worked with] **were** competitive for ...



(5) *The **bodybuilder** [who the **personal trainers** worked with] **were** competitive for ...



Background:

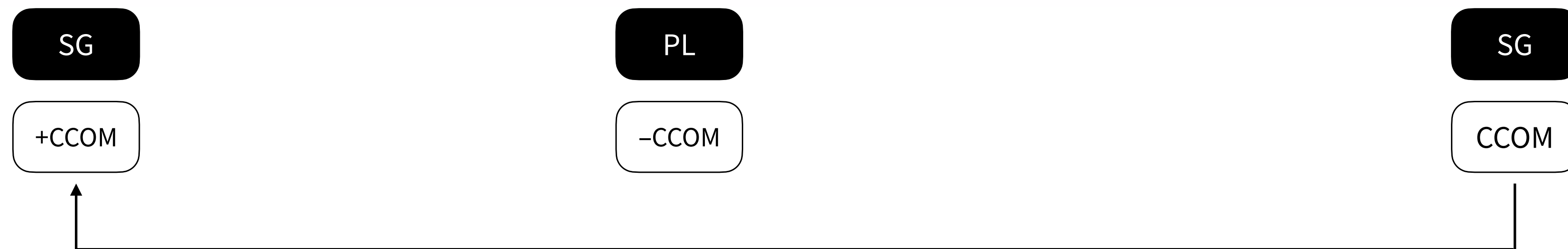
Reflexive processing

A cue-based account

Upon encountering the reflexive, a comprehender launches a cue-based retrieval operation that looks for a feature-matching antecedent in working memory (Lewis, Vasishth, & Van Dyke, 2006; *inter alia*)

(6) Adapted from Dillon et al. (2013)

The bodybuilder [who the personal trainers worked with] injured himself...



Syntactically guided retrieval (SGR)

Some maintain that the retrieval operation at the reflexive is syntactically guided (Sturt, 2003; Xiang et al., 2009; Dillon et al., 2013; *inter alia*)

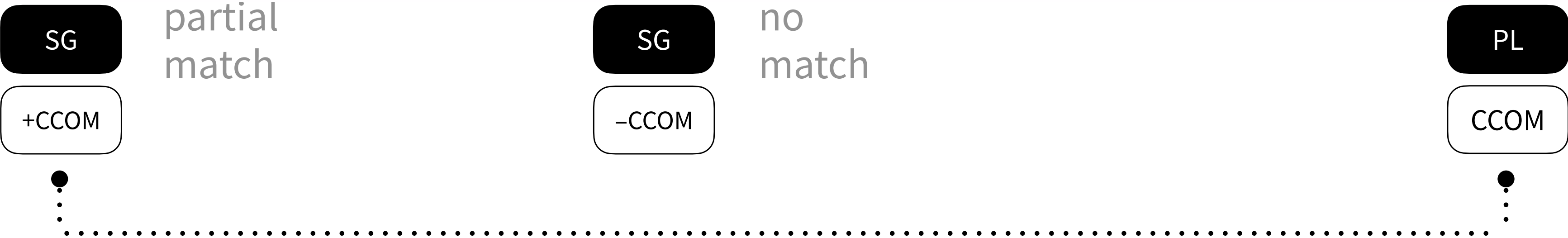
Comprehenders deploy Principle A to constrain the domain that she must search to find an antecedent

- Categorical filter
- Higher weighting of structural cues

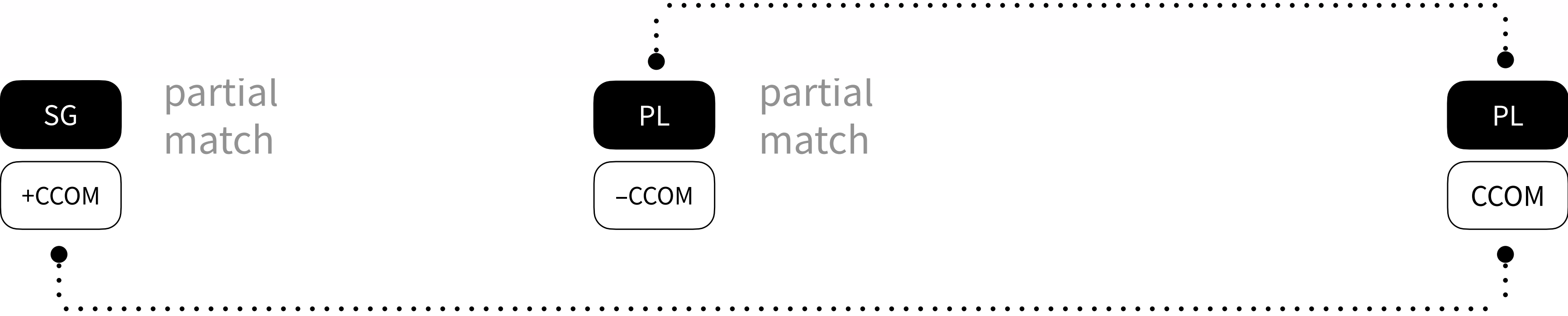
SGR

No evidence for facilitatory interference (Dillon et al., 2013; *inter alia*)
Weak interference (*cf.* Jaeger et al., 2020)

(7) *The **bodybuilder** [who the **personal trainer** worked with] injured **themselves**...



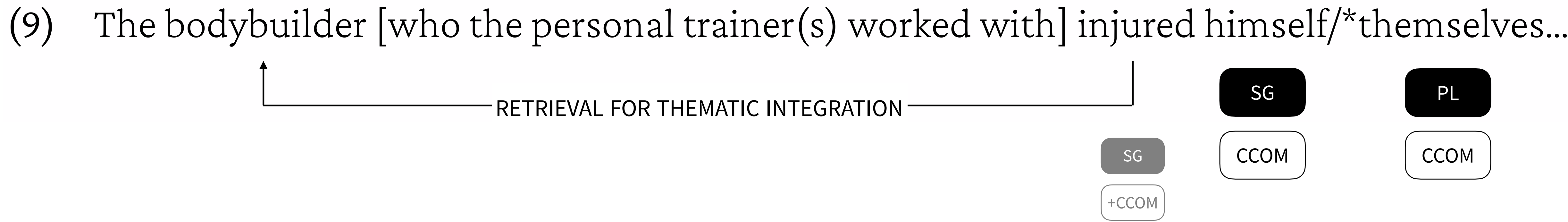
(8) *The **bodybuilder** [who the **personal trainers** worked with] injured **themselves**...



An alternative to SGR: Recent activation

A potential confound: Reflexives occurred immediately after the verb (King, Andrews, & Wagers, 2012; Kush & Phillips, 2014)

The immediate post-verbal position of the reflexive can give the reflexive easy access to the antecedent via recent activation



An alternative to SGR: Recent activation

King, Andrews, & Wagers (2012) found the following:

- No evidence for interference when the reflexive was immediately post-verbal
- Evidence for interference when there is more distance between the verb and the reflexive

(10) The bricklayer who employed Gregory/Helen **shipped himself/herself** sacks of mortar...

(11) The bricklayer who employed Gregory/Helen **shipped** sacks of mortar to **himself/herself**...

Experiment: Self-paced reading in Tagalog

The basics of Tagalog reflexives

Tagalog reflexives can be formed in one of three ways:

- bare *sarili* ‘self’
- *sarili* + genitive pronoun
(e.g., *sarili ko* ‘myself’; c.f. *bayan ko* ‘my country’)
- dative pronoun + LNK + *sarili*
(e.g., *aking sarili* ‘myself’; c.f. *aking bayan* ‘my country’)

They need to be locally bound (Richards, 2013; *inter alia*)

VSO to the rescue

Tagalog word order allows us to control for recent activation

(12) Verb.PV – NP1 – [_{RC} Verb.PV NP2 ...] – Reflexive ...



THEMATIC INTEGRATION

This configuration allows us to see a “clearer picture” of the retrieval operation in reflexive processing

Research questions

1

To what extent do Tagalog comprehenders attend to the number feature of the target?

2

To what extent do they attend to the number feature of the distractor?

Design

2 (GRAMMATICALITY: **Gram**, **Ungram**) × 2 (MATCH: Match, Mismatch)

Verb.PV	Target[SG/PL]	Lnk	Verb.PV	Distractor[SG/PL]	Adverb	Reflexive[PL]
Pinupuri	ng mga dalaga	na	hinaharana	ng mga tambay	gabi-gabi	ang kanilang mga sarili
	ng dalaga			ng tambay		

praise	maiden(s)	LNK	serenade	loiterer(s)	every night	themselves
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The maiden(s) who the loiterer(s) serenade(s) every night praise themselves ...

24 items via Latin square (+56 fillers)

Pinupuri

ng mga dalaga

na

hinaharana

ng mga tambay

gabi-gabi

ang kanilang mga sarili

sa salamin

gabi-gabi

kasi

...

Sino ang pinupuri?

ang mga tambay

ang mga dalaga

Procedure

Phrase-by-phrase self-paced reading using Ibex (Drummond, 2016)

Comprehension question after each item

- Grammatical conditions probed the interpretation of the reflexive:
Sino ang pinupuri? (Who is being praised?)
- Ungrammatical conditions: Agent of RC, Temporal, Location
Sino ang taga-harana? (Who is the one serenading?)

Participants

80 participants recruited via Prolific

- 18–62 years old ($M_{\text{age}} = 31$)
- 64 were self-reported L1 TGL. The rest were sequential bilinguals

Total exclusions ($N = 10$)

- less than 75% accuracy in non-critical comprehension questions
- Unnatural free responses during debriefing: “What hobbies and interests did you pick up due to the pandemic?”

Predictions

Simple (e.g., Lewis & Vasishth, 2005): Match slower than Mismatch
SGR (strong; e.g., Dillon et al., 2013): No interference

Condition

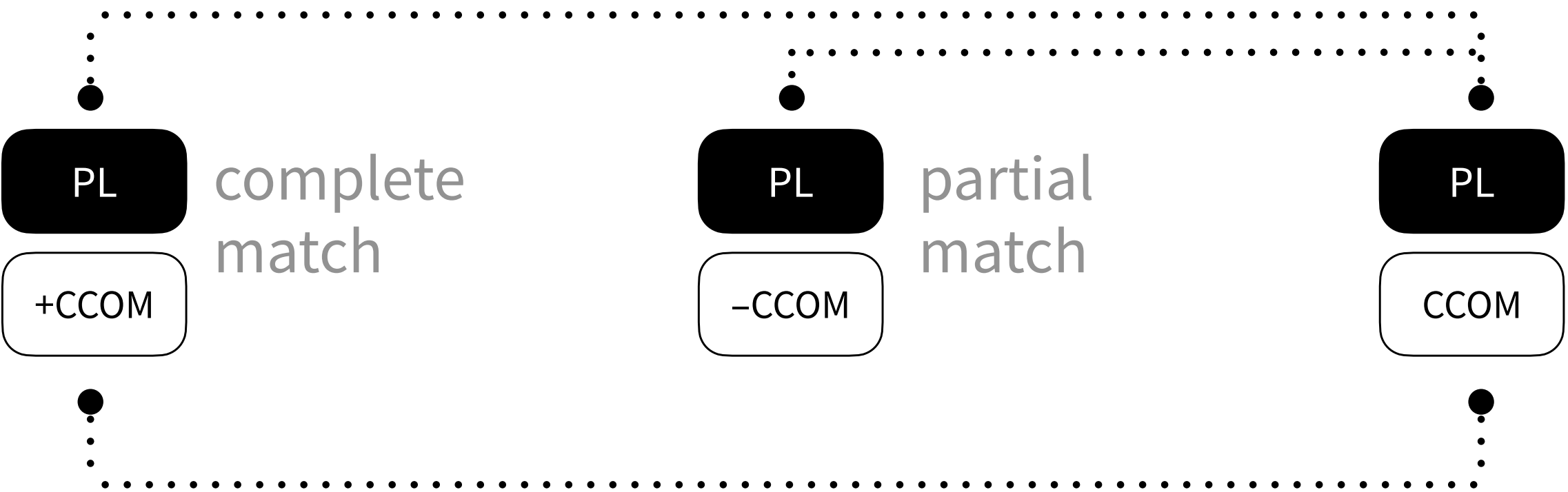
Gram

Match

Target

Distractor

Reflexive



Gram

Mismatch



Predictions

Simple (e.g., Lewis & Vasishth, 2005): Match faster than Mismatch
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Condition

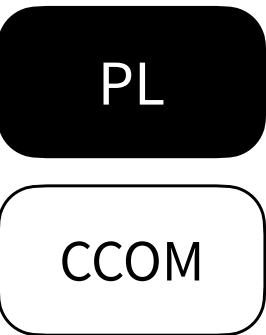
Ungram

Match

Target

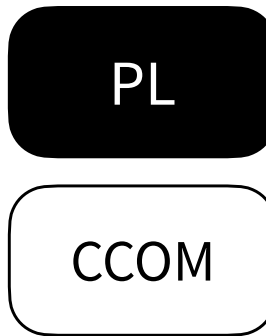
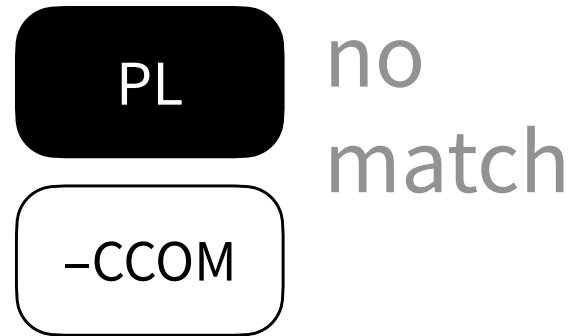
Distractor

Reflexive



Ungram

Mismatch



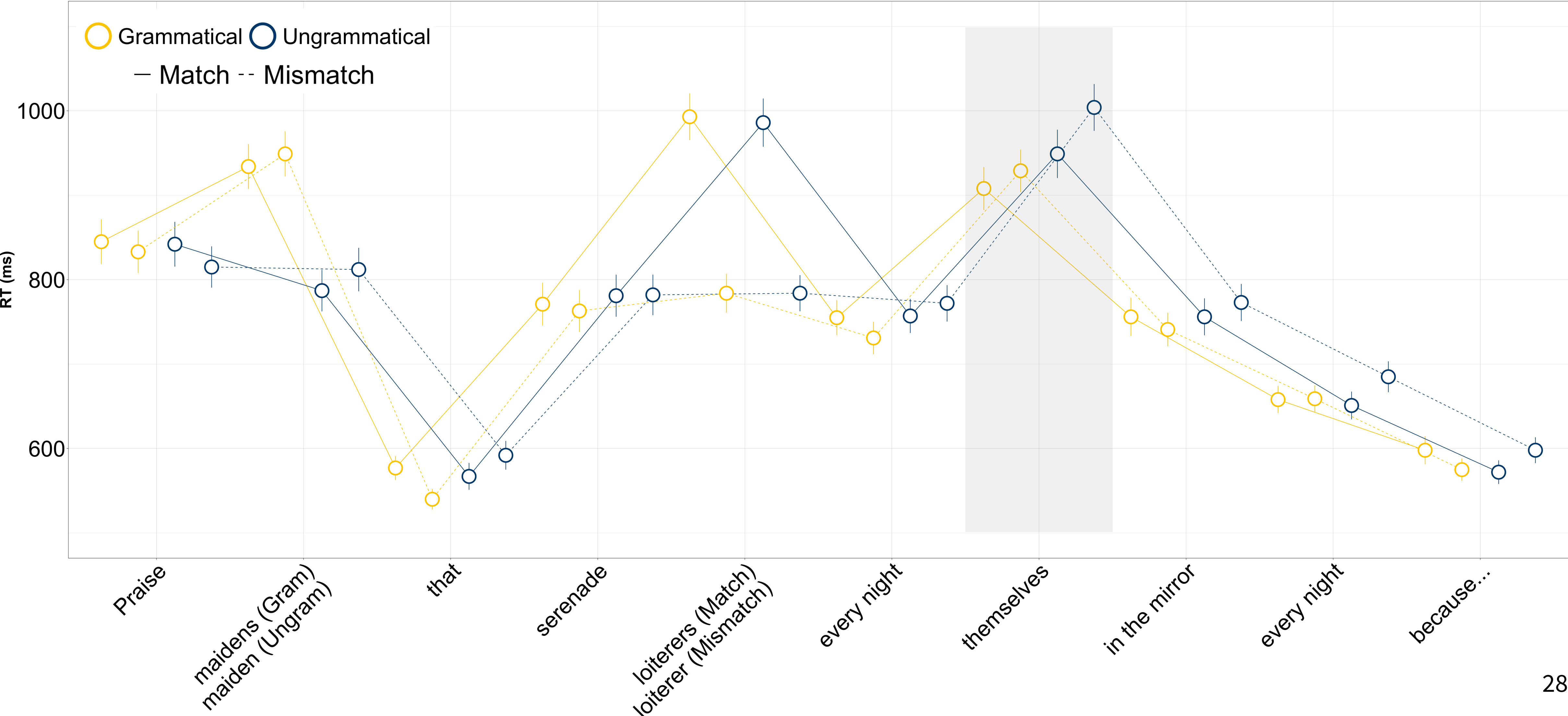
Results: Interpretation of reflexive

		%	No evidence for the number- feature of the distractor affecting participants' accuracy <i>(M = .03, 95% CrI [-.43, .47], Pr(β > 0) = .57)</i>
Match	Target (PL)	71	
	Distractor (PL)	29	
Mismatch	Target (PL)	74	
	Distractor (SG)	26	

N.B. Grammatical conditions only

Consistent with Principle A:
The number of the distractor had little impact on how comprehenders **ultimately** interpreted the reflexive

Results: Overview of RTs at each region



Results: Critical region

Clear evidence for GRAMMATICALITY effect

($M = .05$, 95% CrI [.01, .10], $\Pr(\beta > 0) = .99$)

Clear evidence for MATCH effect

($M = .05$, 95% CrI [.0, .09], $\Pr(\beta > 0) = .98$)

Some evidence for an interaction

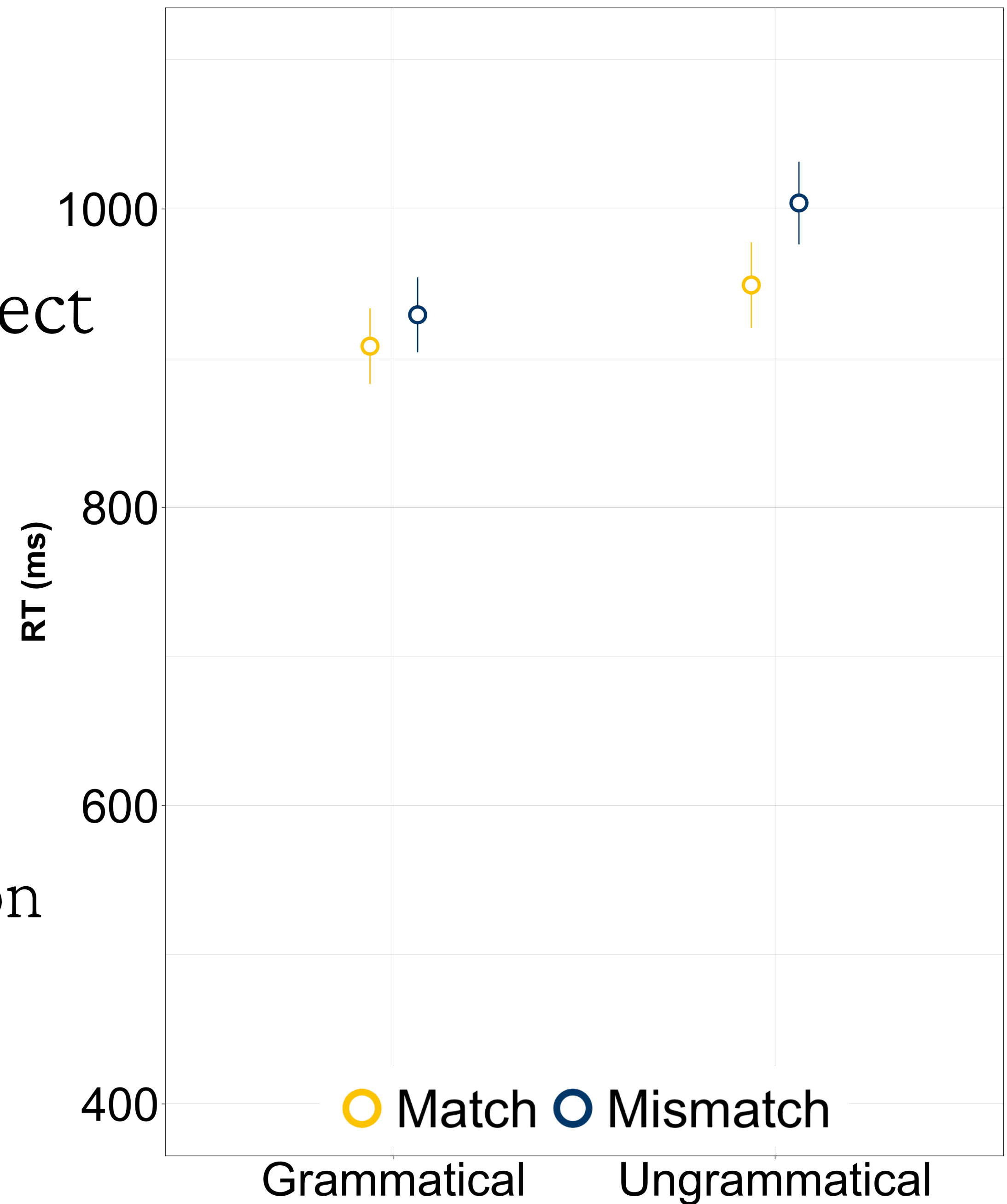
($M = .04$, 95% CrI [-.05, .13], $\Pr(\beta > 0) = .82$)

- Ungram: Clear evidence for facilitation

($M = .07$, 95% CrI [0, .14], $\Pr(\beta > 0) = .97$)

- Gram: Some evidence for facilitation

($M = .03$, 95% CrI [-.04, .09], $\Pr(\beta > 0) = .80$)



Results: Critical region

Clear evidence for GRAMMATICALITY effect

($M = .05$, 95% CrI [-.01, .10], $\text{Pr}(\beta > 0) = .89$)

Sentences with feature-matching distractors were read faster, especially in the ungrammatical conditions

- Ungram: Clear evidence for facilitation

($M = .07$, 95% CrI [0, .14], $\text{Pr}(\beta > 0) = .97$)

- Gram: Some evidence for facilitation

($M = .03$, 95% CrI [-.04, .09], $\text{Pr}(\beta > 0) = .80$)



Results: Crit+1

Evidence for GRAMMATICALITY effect

($M = .03$, 95% CrI [-.02, .08], $\text{Pr}(\beta > 0) = .88$)

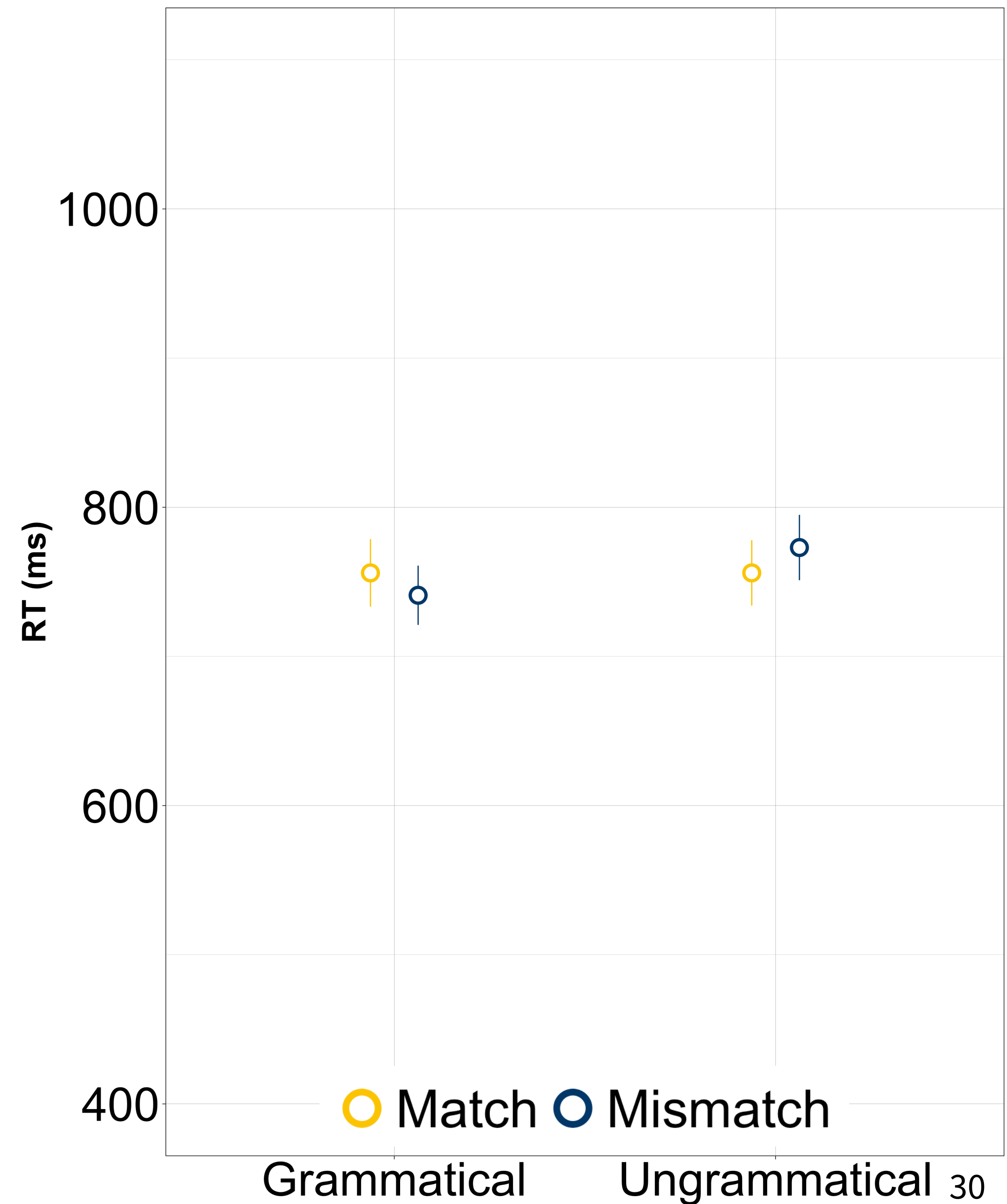
Evidence for MATCH effect

($M = .02$, 95% CrI [-.02, .17], $\text{Pr}(\beta > 0) = .85$)

Some evidence for interaction

($M = .04$, 95% CrI [-.06, .15], $\text{Pr}(\beta > 0) = .81$)

- Ungram: Evidence for facilitation
($M = .05$, 95% CrI [-.02, .11], $\text{Pr}(\beta > 0) = .91$)
- Gram: No evidence for facilitation
($M = .00$, 95% CrI [-.07, .07], $\text{Pr}(\beta > 0) = .52$)



Results: Crit+2

Weak evidence for GRAMMATICALITY effect

($M = .01$, 95% CrI $[-.03, .06]$, $\Pr(\beta > 0) = .69$)

Clear evidence for MATCH effect

($M = .04$, 95% CrI $[-.01, .08]$, $\Pr(\beta > 0) = .95$)

Evidence for interaction

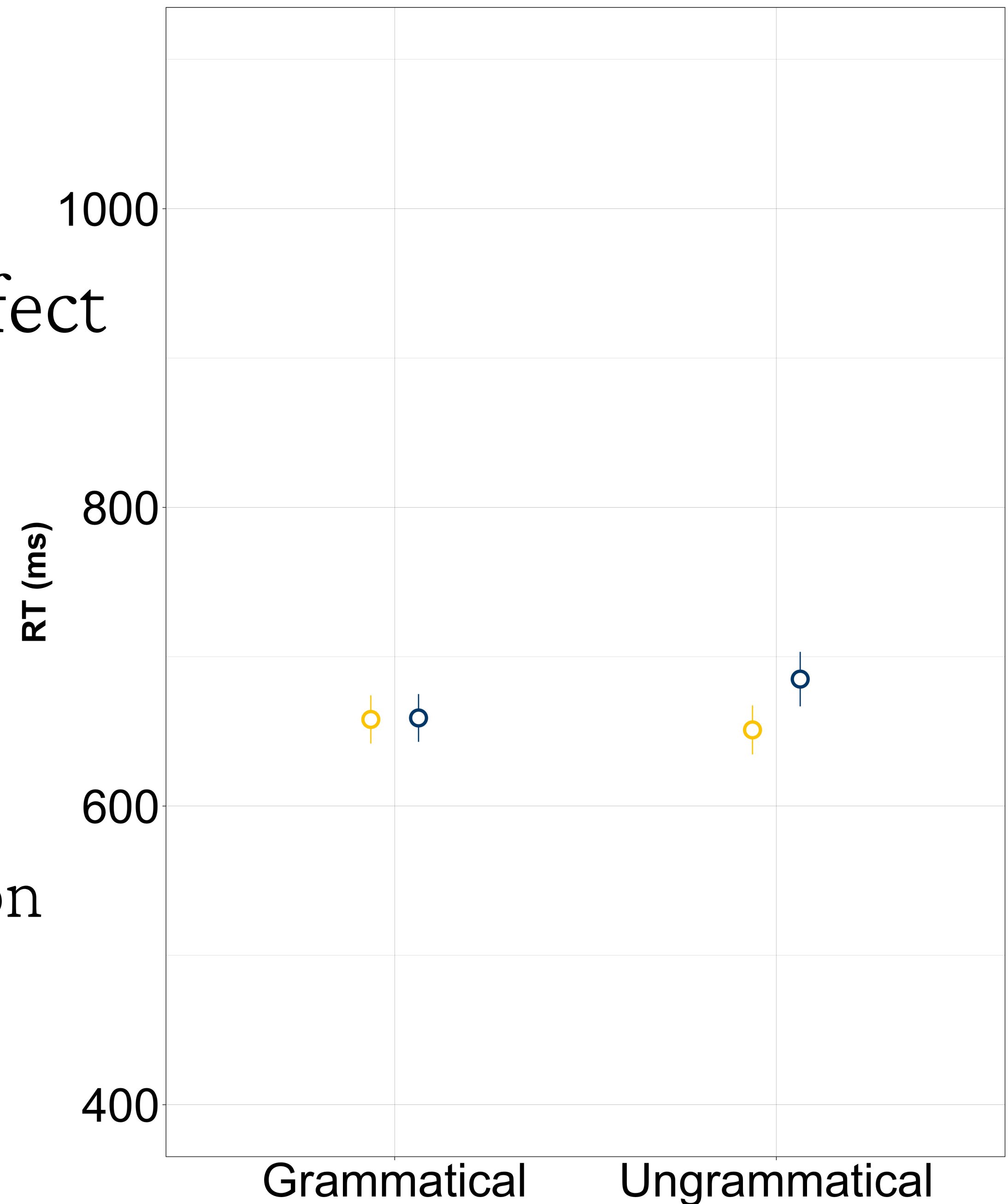
($M = .06$, 95% CrI $[-.04, .15]$, $\Pr(\beta > 0) = .89$)

- Ungram: Clear evidence for facilitation

($M = .06$, 95% CrI $[.02, .13]$, $\Pr(\beta > 0) = .98$)

- Gram: No evidence for facilitation

($M = .01$, 95% CrI $[-.06, .07]$, $\Pr(\beta > 0) = .59$)



The empirical terrain in Tagalog

Generalization 1: Comprehenders attended to the number feature of the target

- Grammatical sentences were read faster than ungrammatical sentences
- Grammatical sentences with feature-mismatching distractors (i.e., SG) were interpreted correctly 70% of the time

The empirical terrain in Tagalog

Generalization 2: Comprehenders also attended to the number feature of the distractor

- Ungrammatical sentences with feature-matching distractors were read faster than ungrammatical sentences with feature-mismatching distractors
- Grammatical sentences with feature-matching distractors were also read faster than grammatical sentences with feature-mismatching distractors

Discussion

Generalization 2A: Ungrammatical sentences with feature-matching distractors were read faster than ungrammatical sentences with feature-mismatching distractors

- Consistent with the prediction of a simple model of retrieval (e.g., Lewis & Vasishth, 2005)
- Inconsistent with the prediction of a strong version of a syntactically guided model of retrieval (e.g., Dillon et al., 2013)

Claim 1: The weaker interference effects (a.k.a. Principle A-effects) in English could be a reflex of the language's word order







Discussion

Generalization 2B: Grammatical sentences with feature-matching distractors were also read faster than grammatical sentences with feature-mismatching distractors

- Inconsistent with the prediction of a strong version of a syntactically guided model of retrieval
- Inconsistent with the prediction of a simple model of retrieval (without any qualifications)

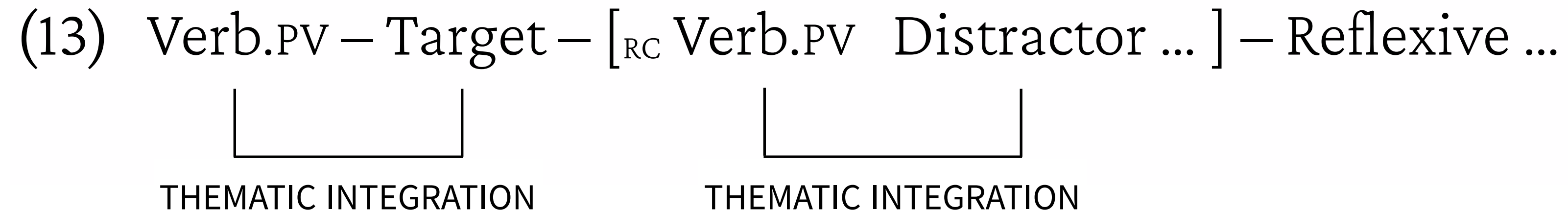
Claim 2: Interference effects in Tagalog could be a reflex of the language's word order

Discussion

	Generalization		
	1	2A	2B
Simple model of retrieval (e.g. Lewis & Vasishth, 2005)			
Strong version of syntactically guided retrieval (e.g., Dillon et al., 2013)			

Discussion

Claim 2: Interference effects in Tagalog could be a reflex of the language's word order



The shape of (13) could be a configuration where the distractor could be enjoying a high level of activation.

Take-away

Word order can influence how reflexives are processed

- In English, we saw what seems to be Principle A effects
- In Tagalog, we saw what seems to be anti-Principle A effects

Experiments in the pipeline

Interpretation judgments

Goal: See how robust the generalization that reflexives in Tagalog need to be locally bound (Richards, 2013; *inter alia*)

- Same items as our SPR experiment (grammatical conditions only)
- Presented as an entire sentence, instead of phrase-by-phrase
- Untimed

Two ways to probe their interpretation of the reflexive:

- *Sino ang pinupuri?* (who's being praised?)
- *Ang mga tambay/dalaga ang pinupuri.* (The loiterers/young women were praised)

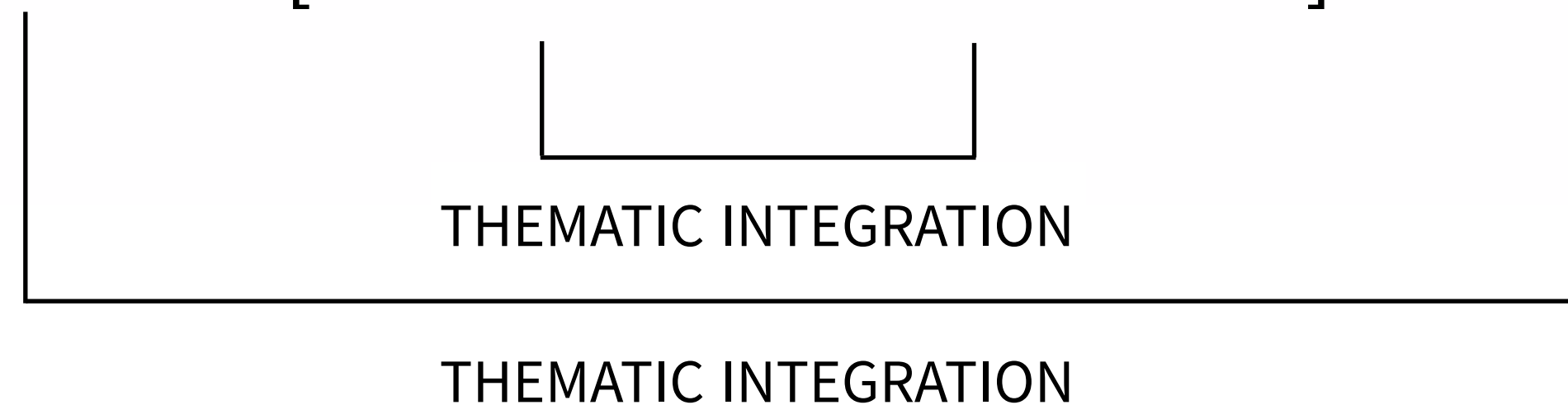
Recent activation of the embedded subject

Goal: See how tenable the claim is that the interference effects in Tagalog is a reflex of word order

(14) Verb.PV – Target – [_{RC} Verb.PV Distractor ...] – Reflexive ...

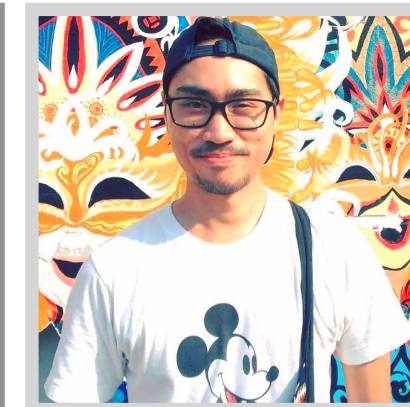
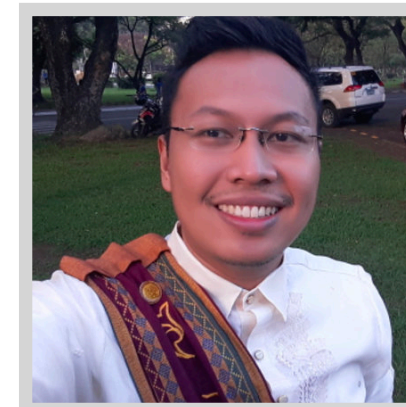
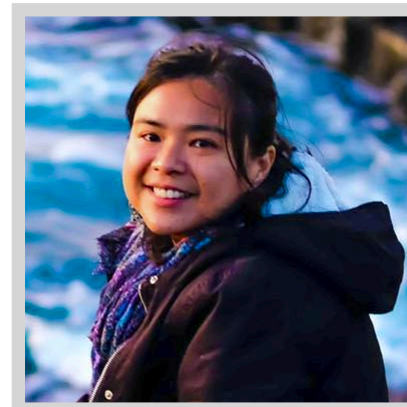
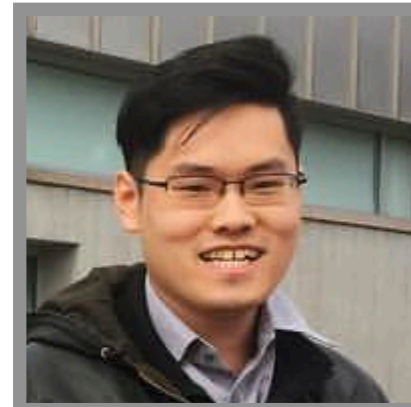


(14') Verb.PV – [_{RC} Verb.PV Distractor ...] – Target – Reflexive ...



Maraming salamat!

Thank you!



Brian Dillon (UMass), Henrison Hsieh (NUS), Kristina Gallego (ANU), Rowena Garcia (MPI), Ivan Bondoc (UH), Aldrin Lee and Michael Manahan (UP Diliman)