



Long-distance attraction effects in subject-verb agreement processing

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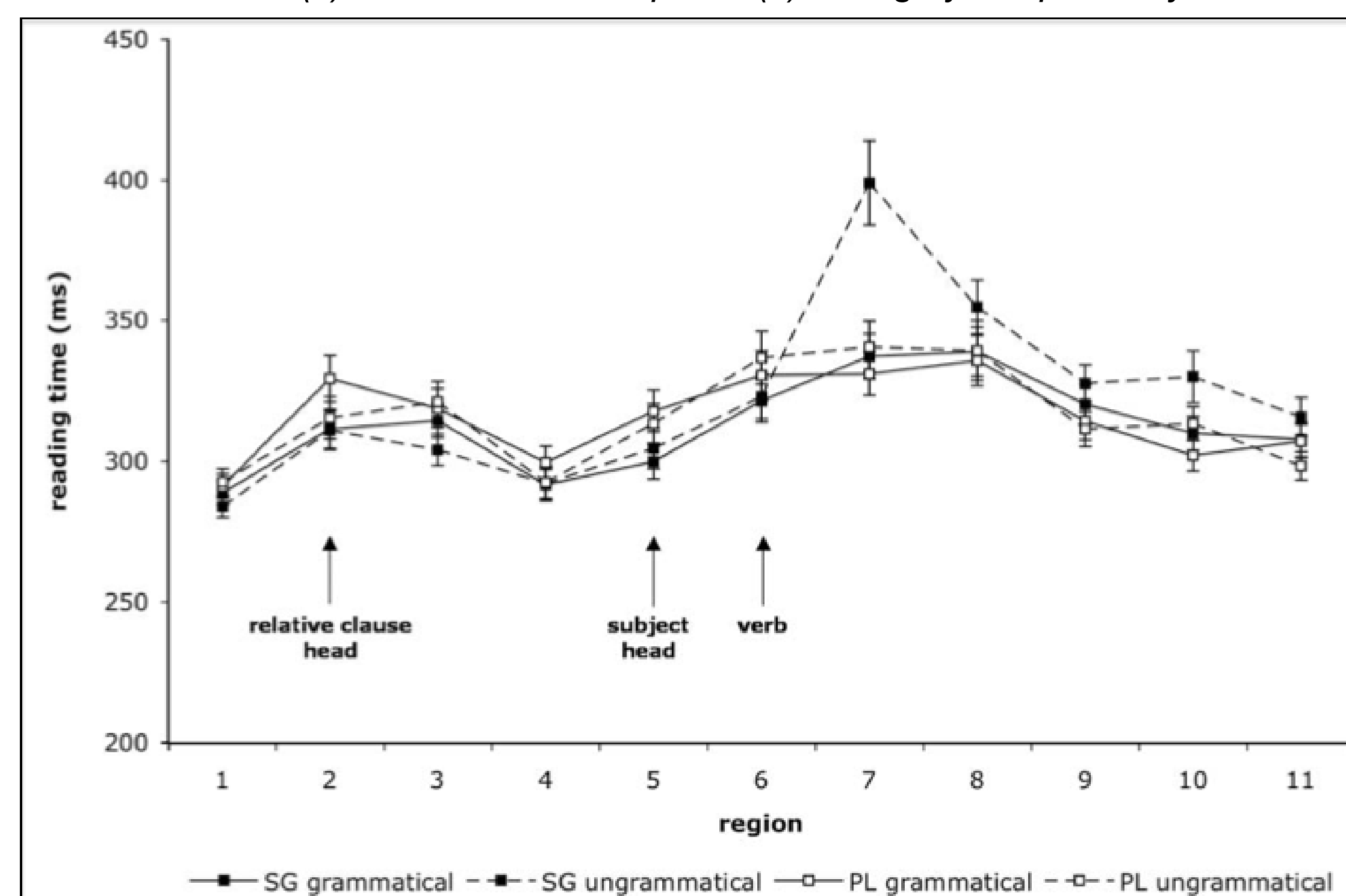
How is subject-verb agreement (SVA) computed during sentence comprehension?

- **Agreement attraction/interference:** an agreement bearing element (verb) does not agree with its controller (subject), but with a distractor element.

* *The key to the cabinets are on the table.*

- **Current models of this phenomenon**
 - **Predictive:** Feature Percolation [1] & Marking and Morphing [2] → due to "mismarking" of subject number
 - **Retrieval-based** [3] [4] → due to interference during cue-based retrieval (at the verb)
- Support for the retrieval-based model comes from **long-distance attraction effects** [3]

The musician(s) that the reviewer praise(s) so highly will probably win....



Wagers et al. 2009, p. 215

Purpose of the study:

to test for this attraction effect with inflected main verbs (*praise-s/∅*) [EX1] and with more salient free auxiliary verbs (*was/were*) [EX2, 3]

If this effect reflects core properties of SVA processing, it should be observed regardless of the form of the verbal agreement target.

Sentence Types

	EX 1	EX 2
Singular Attractor/Grammatical The musician that the reviewer praises was praising so highly won the prestigious award.	praises	was praising
Singular Attractor/Ungrammatical *The musician that the reviewer praise were praising so highly won the prestigious award.	praise	were praising
Plural Attractor/Grammatical The musicians that the reviewer praises was praising so highly won the prestigious award.	praises	was praising
Plural Attractor/Ungrammatical *The musicians that the reviewer praise were praising so highly won the prestigious award.	praise	were praising
	EX 3	
Singular Attractor/Grammatical The musician that the reviewers were praising so highly won the prestigious award.	were praising	so highly won the prestigious award.
Singular Attractor/Ungrammatical *The musician that the reviewer were praising so highly won the prestigious award.	were praising	so highly won the prestigious award.
Plural Attractor/Grammatical The musicians that the reviewers were praising so highly won the prestigious award.	were praising	so highly won the prestigious award.
Plural Attractor/Ungrammatical *The musicians that the reviewer were praising so highly won the prestigious award.	were praising	so highly won the prestigious award.

Attractor = main-clause subject; sing. (*musician*), plural (*musicians*)

EX1: grammaticality → 3rd singular –s grammatical (*praises*), ungrammatical (*praise*)

EX2: grammaticality → auxiliary number grammatical (*was*), ungrammatical (*were*)

EX3: grammaticality → RC subject number grammatical (*reviewers*), ungrammatical (*reviewer*)

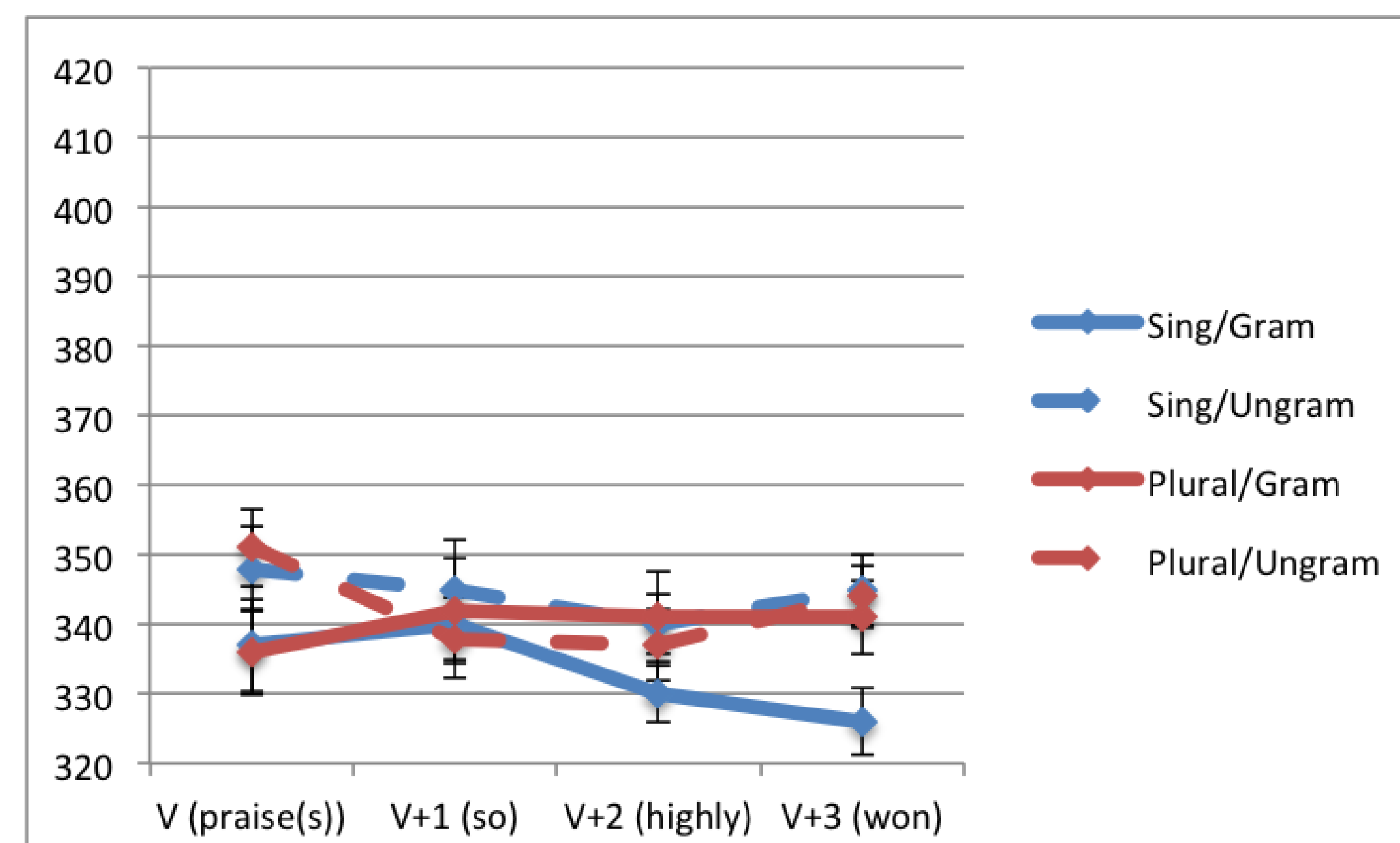
Method

Materials: 48 experimental sentences, 72 fillers (20% ungram.)

Task: moving-window self-paced reading; Y/N comprehension questions after each experimental item & 54 of the fillers

Participants: 120 UTA students; English NSs (40 per experiment)

Experiment 1: Results



V (*praise/praises*)

- marginal effect of grammaticality ($F1 p = .07$, $F2 p < .05$)
- effect approaches significance only for plural attractor sentences ($F1 p = .10$, $F2 p = .07$)

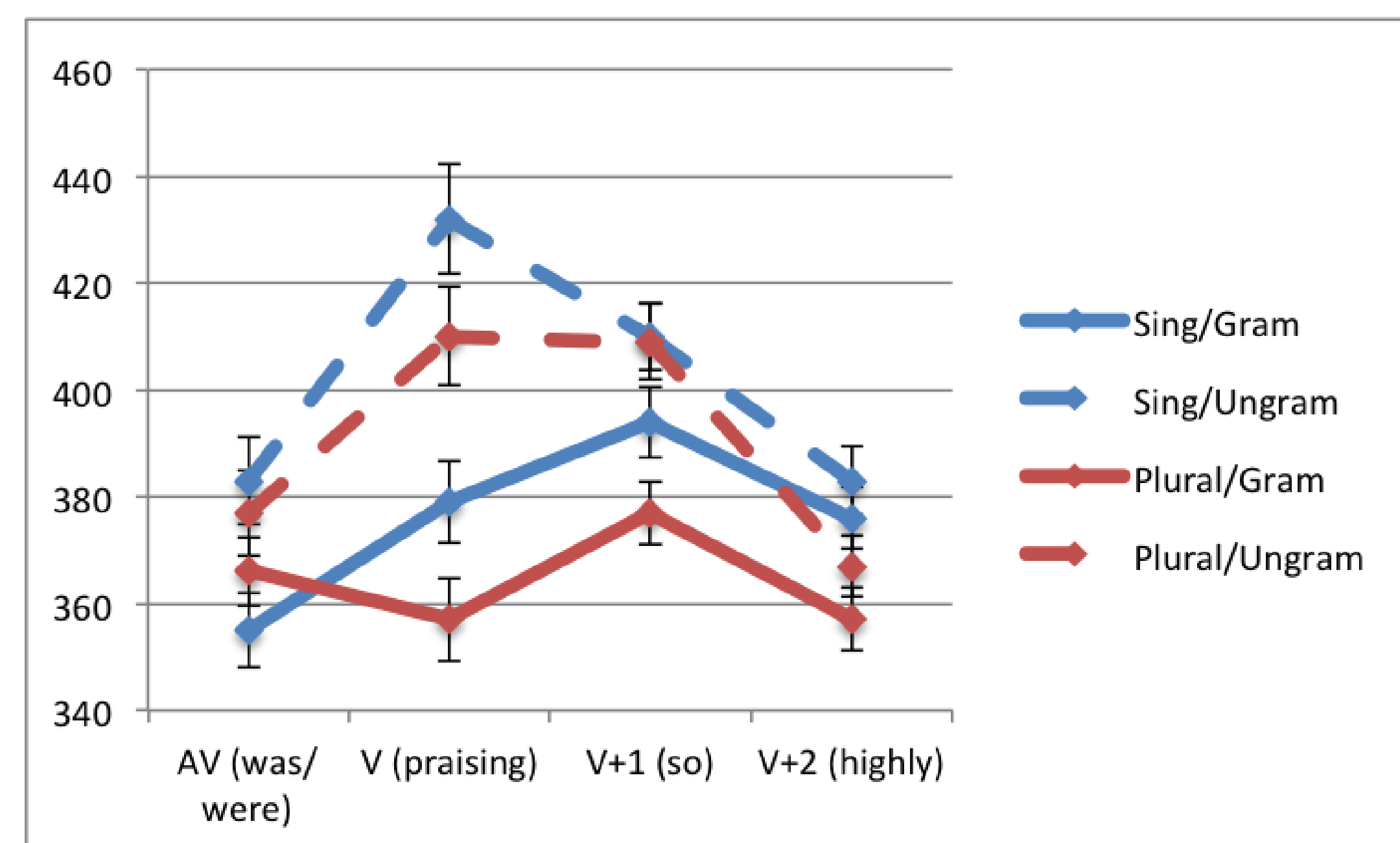
V+3 region

- trend toward the predicted interaction ($F1 p = .08$, $F2 p = .20$)
- grammaticality effect approaches significance only for singular attractor sentences ($F1 p < .05$, $F2 p = .09$)

Summary

- partial replication of Wagers et al. (2009)
- ungrammaticality indexed early for both singular and plural attractor sentences
- late attenuation of processing difficulty for plural attractor/ungrammatical sentences

Experiment 2: Results



AV (*was/were*)

- significant effect of grammaticality ($F1 p < .05$, $F2 p < .01$)
- effect significant only for singular attractor sentences ($F1 p < .05$, $F2 p < .01$)

V (*praising*)

- significant effect of grammaticality (both p 's $< .001$)
- effect significant for both singular and plural attractor sentences (all p 's $< .01$)

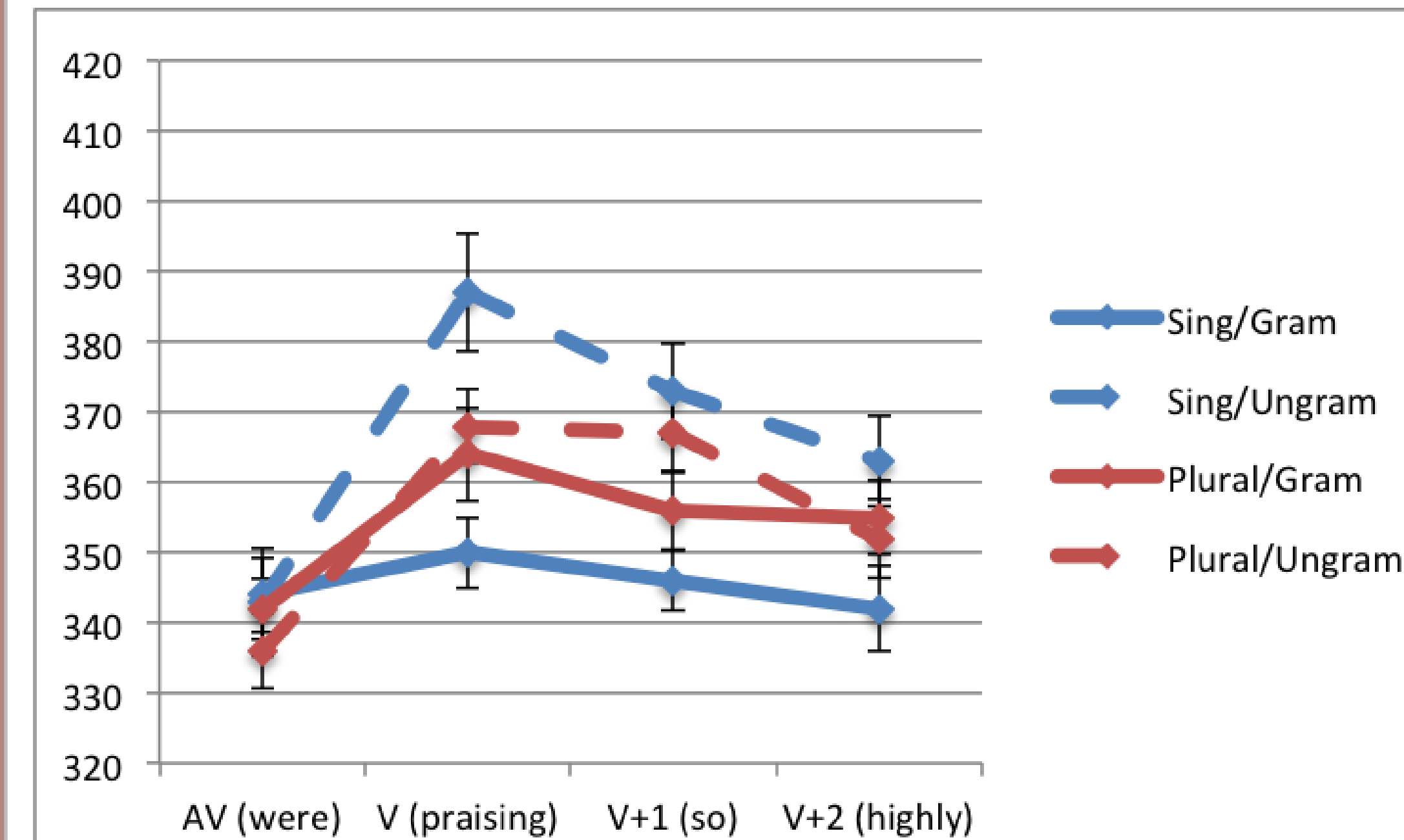
V+1 region

- significant effect of grammaticality (both p 's $< .01$)
- effect significant only for plural attractor sentences ($F1 p < .01$, $F2 p < .05$)

Summary

- ungrammaticality clearly indexed for both singular and plural attractor sentences
- early indication of attenuated processing difficulty for plural attractor/ungrammatical sentences

Experiment 3: Results



V (*praising*)

- significant effect of grammaticality ($F1 p < .05$, $F2 p < .01$)
- trend toward the predicted interaction ($F1 p < .05$, $F2 p = .11$)
- grammaticality effect significant only for singular attractor sentences (both p 's $< .01$)

V+1 region

- significant effect of grammaticality (both p 's $< .01$)
- effect significant only for singular attractor sentences (both p 's $< .01$)

V+2 region

- trend toward the predicted interaction ($F1 p = .08$, $F2 p < .05$)
- grammaticality effect significant only for singular attractor sentences (both p 's $< .05$)

Summary

- persistent indications of attenuated processing difficulty for plural attractor/ungrammatical sentences

Discussion

- Indications of attenuated processing difficulty for plural attractor/ungrammatical sentences across experiments, with differences in the strength, timing, and persistence of this effect.
- Typical pattern of RT results in verbal and post-verbal regions: (singular attractor/ungrammatical - singular attractor/grammatical) > (plural attractor/ungrammatical - plural attractor/grammatical)
- These results...
 - ...indicate that long-distance agreement attraction effects apply to both bound and free agreeing verbal morphology.
 - ...provide additional support for the involvement of cue-based retrieval processes in SVA during sentence comprehension.
- What role do cue-based retrieval processes play in SVA?
 - (1) underlie normal agreement processing?
 - (2) part of reanalysis/recovery after ungrammaticality has been indexed? (see [3] for more on these possibilities)
- The present results support a "retrieval-as-recovery" model.
 - Although there was attenuated processing difficulty for plural attractor/ungrammatical sentences, there were few indications of an "illusion of grammaticality" for these items.

singular attractor/ungrammatical >
 singular attractor/grammatical ≅
 plural attractor/ungrammatical ≅
 plural attractor/grammatical

→ In fact, in verbal and post-verbal regions, RTs were never significantly longer for singular attractor/ungrammatical than for plural attractor/ungrammatical sentences.

- Is cue-based recovery characteristic of other agreement attraction effects? Does it also apply when the attractor intervenes between the subject and verb (i.e., when the attractor is part of the controlling subject NP)?

Possibly....

→ Dillon et al.'s (2013) eye-tracking study

The new executive who oversaw the middle manager(s) apparently was/were dishonest....

- clear effect of ungrammaticality for both plural and singular attractor sentences in early reading measures
- attenuated disruption for plural attractor/ungrammatical sentences only in late (total time) measure

→ Xiang et al.'s (2013) self-paced reading study [5]

The receptionist who the boss(es) depend(s) on never fail(s) to....

- ungrammaticality effects for singular and plural attractor sentences; attenuated disruption with plural attractors

References

- [1] Nicol, J. L., Forster, K. I., & Veres, C. (1997). Subject-verb agreement processes in comprehension. *Journal of Memory and Language*, 36, 569–587.
- [2] Eberhard, K. M., Cutting, J. C., & Bock, K. (2005). Making syntax of sense: Number agreement in sentence production. *Psychological Review*, 112, 531–559.
- [3] Wagers, M. W., Lau, E. F., & Phillips, C. (2009). Agreement attraction in comprehension: Representations and processes. *Journal of Memory and Language*, 61, 206–237.
- [4] Dillon, B., Mishler, A., Stoggett, S., & Phillips, C. (2013). Contrasting intrusion profiles for agreement and anaphora: Experimental and modeling evidence. *Journal of Memory and Language*, 69, 85–103.
- [5] Xiang, M., Grove, J., & Giannakidou, A. (2013). Dependency-dependent interference: NPI interference, agreement attraction, and global pragmatic inferences. *Frontiers in Psychology*, 4.