Reassessing the grammaticality asymmetry in agreement attraction: An ROC analysis

Christopher Hammerly[1], Brian Dillon[1] and Matt Wagers[2]

Motivation:

Does agreement attraction have an encoding or access based source?
Does this differ by construction? We use the *grammaticality asymmetry* to compare these sources with PPs and ORCs, applying methods from Signal Detection Theory.

Findings:

We can decompose attraction into two sources: an encoding source, which effects all trials, and an access source, affecting a subset of ungrammatical trials. This is the same for both PP and ORC configurations.

Encoding & Access in Attraction
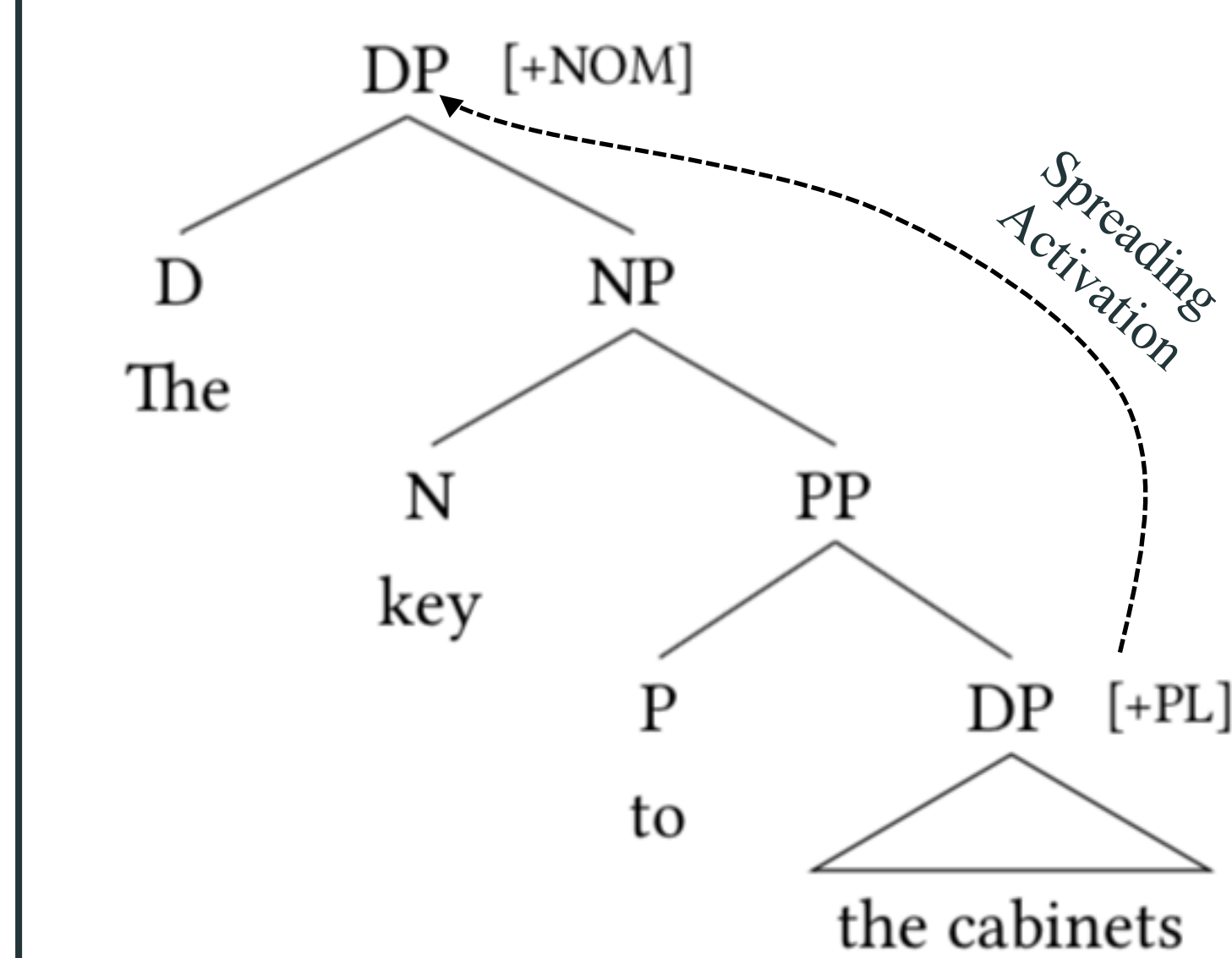
Encoding Source (e.g. Eberhard et al. 2005): Mismatching attractors influence the strength of the number representation of the subject.

Grammatically symmetrical effects predicted. The representation of the subject is impacted regardless of the verb's features.
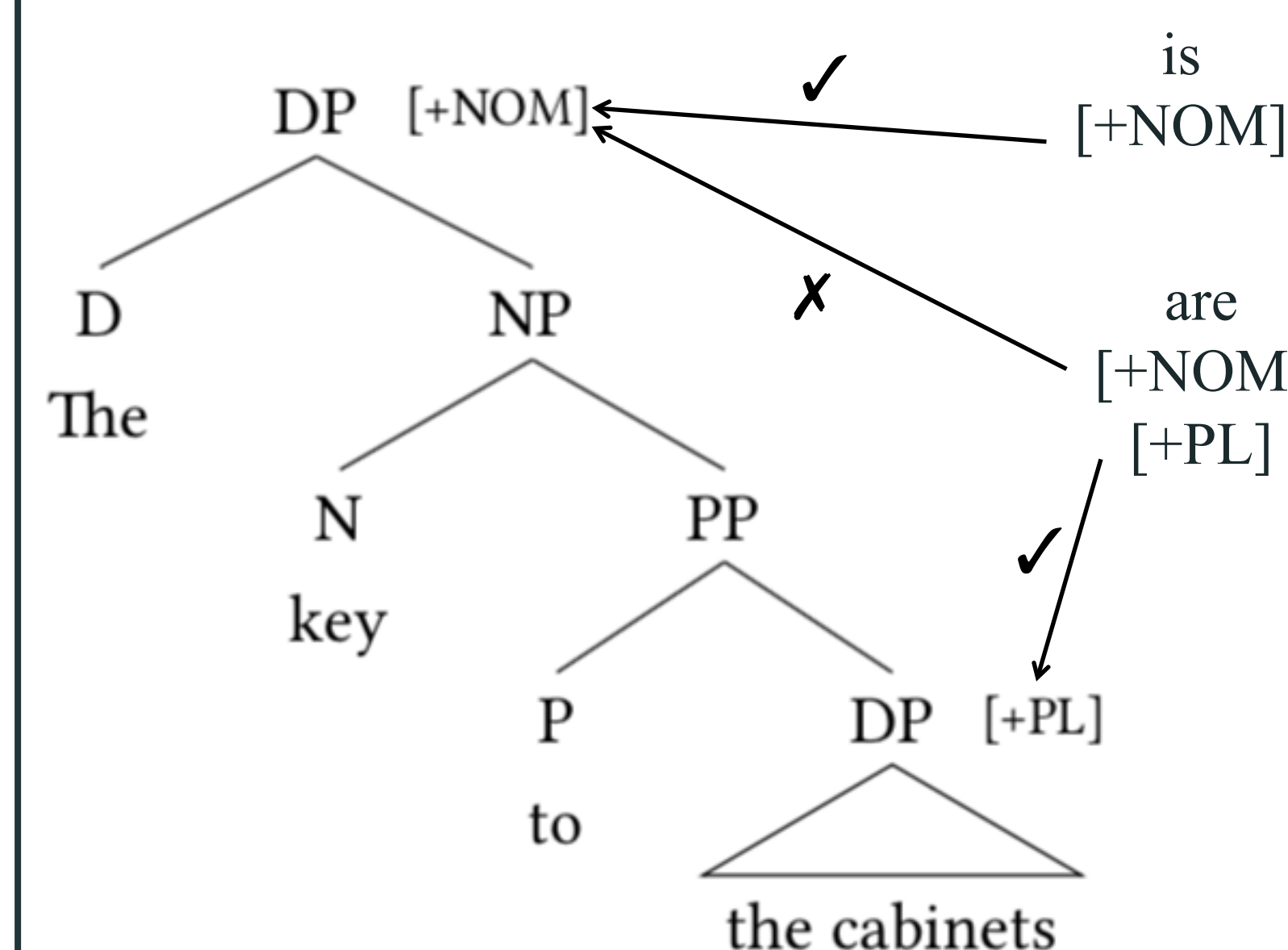
Access Source (e.g. Wagers et al. 2009): Mismatching attractors serve as lures when retrieval is initiated at the verb.

Grammatically asymmetrical effects predicted. Attractors are more of a lure when the verb is ungrammatical, and the subject head noun is not a perfect match

In principle, these sources are not mutually exclusive.
Our results favor a dual-source account.

PP (intervening) versus ORC (non-intervening)

The *key* to the <u>cabinet(s)</u> always rust(s)   PP (intervening)
Alex saw the <u>cabinet(s)</u> that the *key* open(s)   ORC (non-intervening)

PPs appear to have an encoding-based source (Hammerly et al 2019)
- Previous results (e.g. Wagers et al 2009) supported an access-based source based on the grammaticality asymmetry.
- Hammerly et al. (2019) showed that mismatch effects are underlyingly symmetrical. *Asymmetrical effects appear with response bias.*

ORCs are argued to have an access-based source (Staub 2010)
- Mismatch effects appear in the slowest trials, and are not associated with an overall shift in the distribution.
- Hammerly et al. (2019) did not test these constructions.

Predictions & Questions
- Does the bias effect with intervening PP attractors replicate?
- Do we see the grammaticality asymmetry with the non-intervening attractor in the head of the ORC? Do bias effects extend here?

Study Design

1. <u>Match</u>:   Alex lost the phonebook   that the *lawyer* for the company   often use(s)
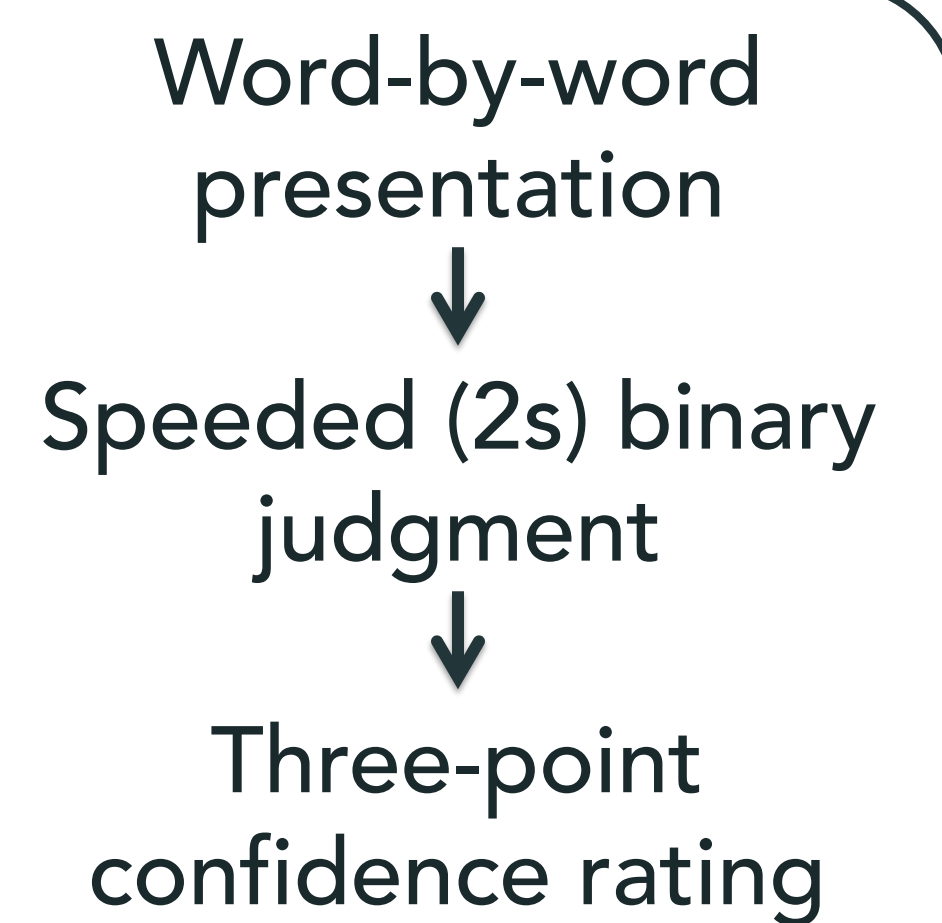2. <u>PP Mismatch</u>:   Alex lost the phonebook   that the *lawyer* for the <u>companies</u> often use(s)
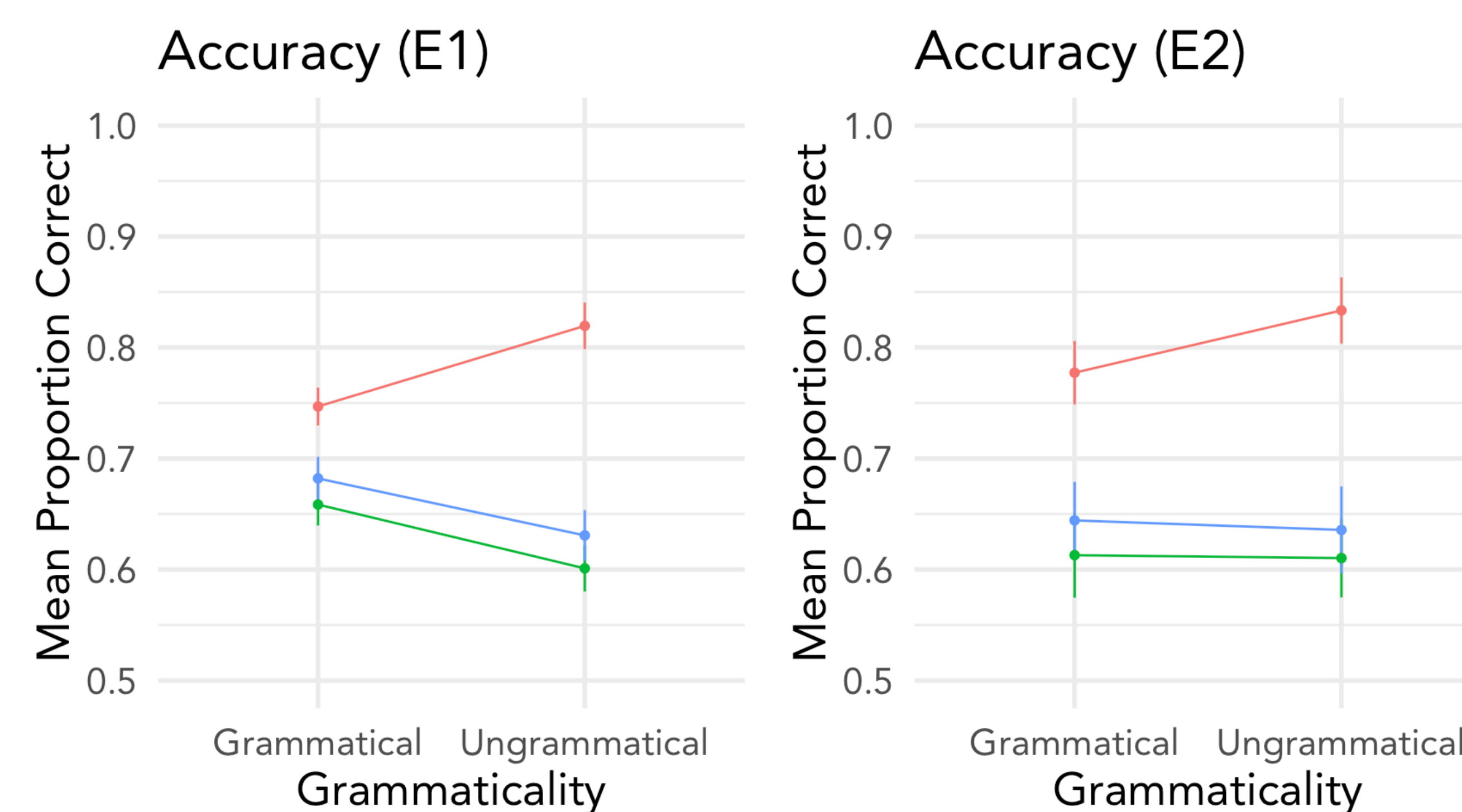3. <u>ORC Mismatch</u>:   Alex lost the <u>phonebooks</u>   that the *lawyer* for the company   often use(s)

- E1: N = 84 in lab at UMass; E2 (replication): N = 42 online using Prolific
- 120 experimental items (15 obs/cond/Ss) with 70 fillers with a variety of agreement errors
- Preregistration and full details can be found at https://osf.io/chm6y/

Word-by-word presentation
↓
Speeded (2s) binary judgment
↓
Three-point confidence rating

Grammaticality Asymmetry + Bias


Accuracy (E1) — Accuracy (E2)

- <u>Attraction effects:</u> Mismatch effects in both ORCs and PPs in both grammatical and ungrammatical sentences
- <u>Grammaticality asymmetry:</u> Larger effects in ungrammatical compared to grammatical sentences
- <u>Little bias on average:</u> Match conditions are comparable, but a correlation can be observed between bias and the grammaticality asymmetry:

Grammaticality Asymmetry vs. Bias (E2)
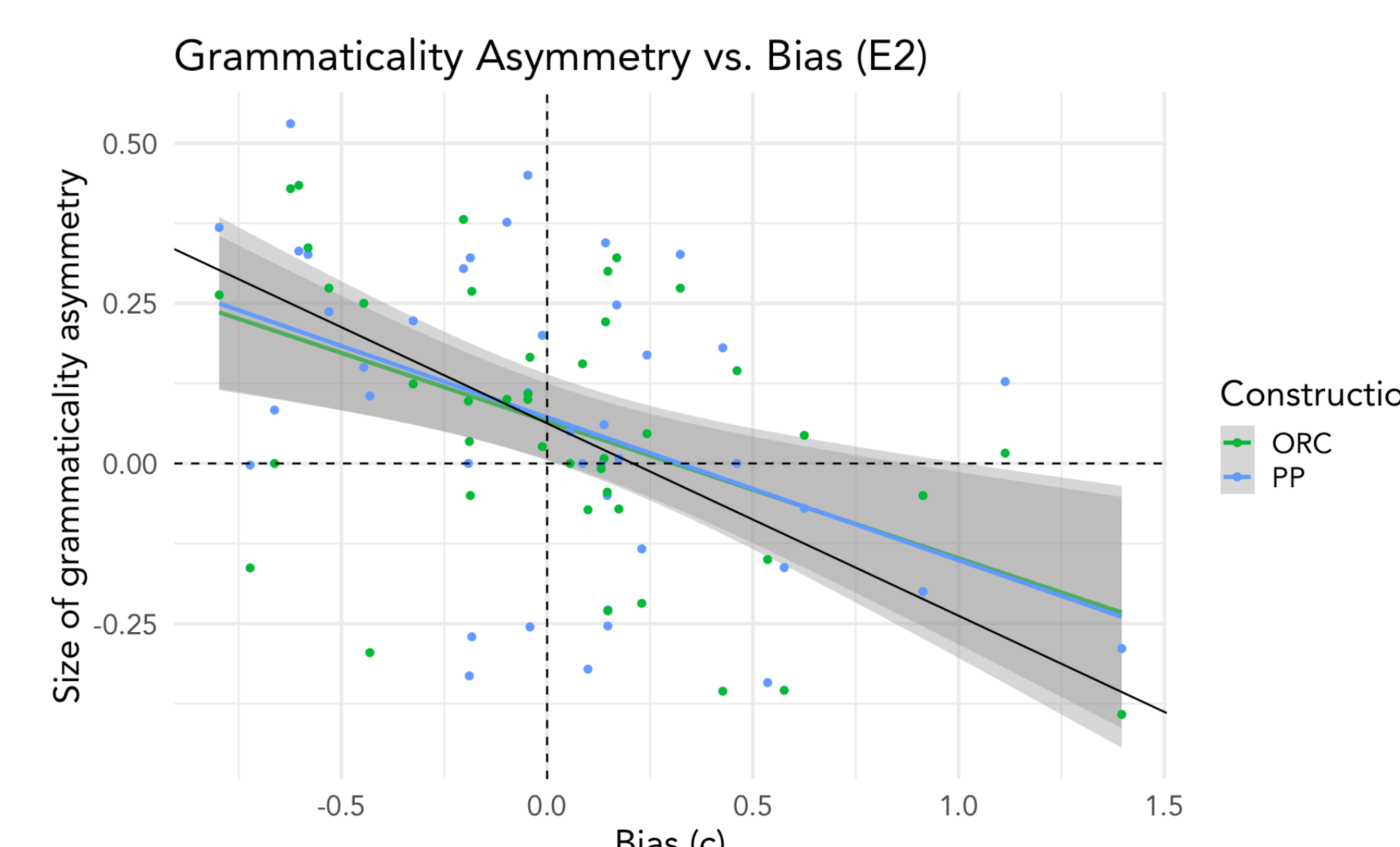
- <u>Replication of Hammerly et al (2019), shown in black:</u> The more grammatical bias (negative c), the bigger the mismatch effect in ungrammatical conditions. The reverse is also true.
- <u>The grammaticality asymmetry persists:</u> With unbiased responders (c = 0), a small asymmetry exists.
- <u>PPs and ORCs show the same pattern</u>

ROC Analysis

- Judgment + confidence rating transformed to 6-point scale
- <u>Empirical zROC:</u> z-transformed response proportion for each point on the scale for each condition (y-axis) against response proportions for ungrammatical match (x-axis)
- <u>SDT Model Fit:</u> Fit separately to PP and ORC conditions (dotted line and "+" signs)
- From model, get measure of *sensitivity* to acceptability, d_a (roughly equal to area under curve) and variability (slope)
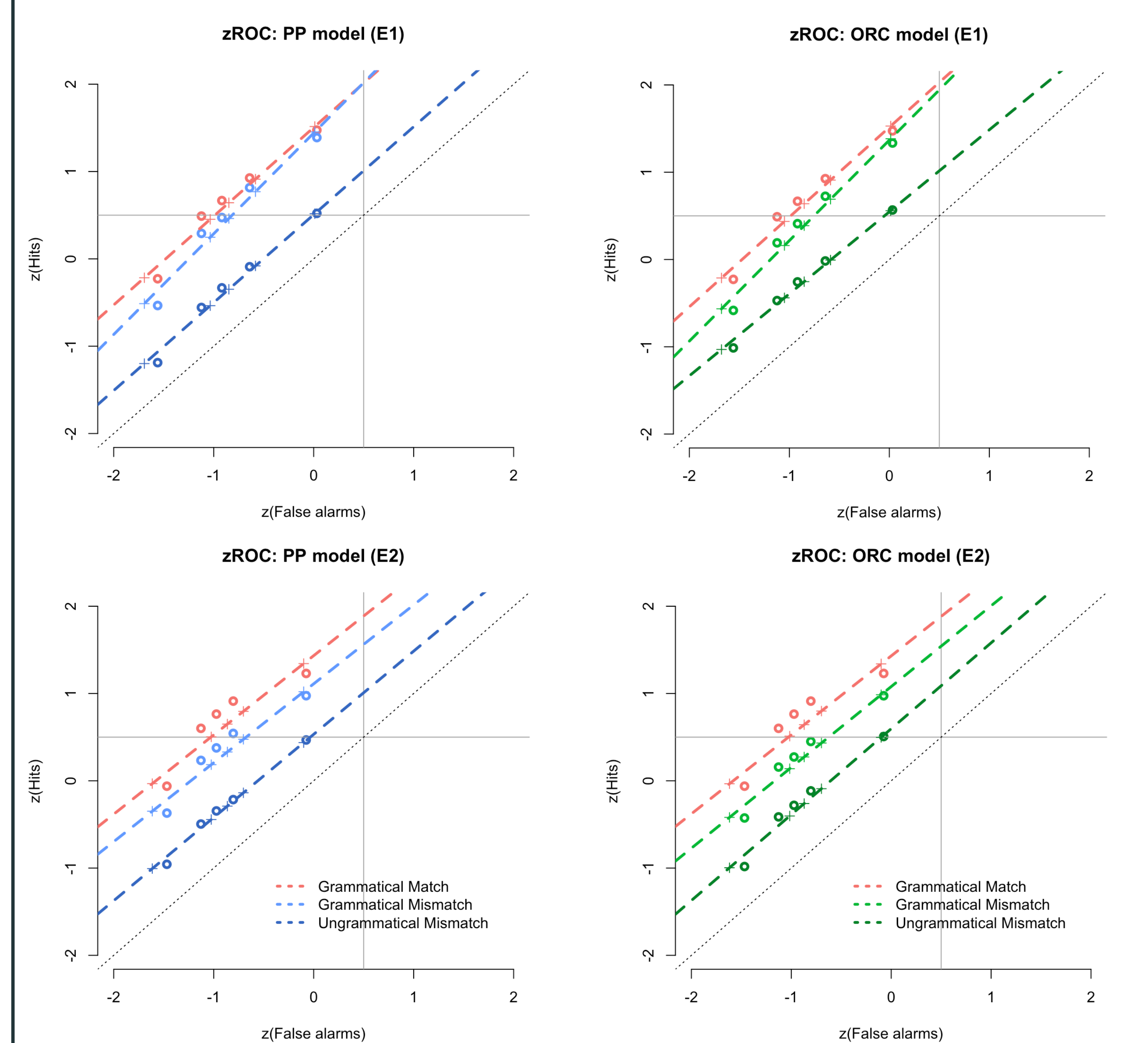
	Gram Match	Gram Mismatch	Ungram Mismatch	Gram Match	Gram Mismatch	Ungram Mismatch
E1 d_a	1.49	1.33	0.50	1.49	1.27	0.56
E2 d_a	1.50	1.16	0.54	1.50	1.12	0.60

- <u>Similar effects of mismatch</u> on d_a and for PPs and ORCs
- <u>ROC analysis reflects accuracy result:</u> Mismatch effect in grammatical and ungrammatical, but larger in ungrammatical

Acknowledgments + References

Discussion:
- Agreement attraction can be attributed to encoding (it occurs with grammatical and ungrammatical sentences) and access (the effect is larger with ungrammatical)
- Even if the subject is correctly retrieved, its number representation is equivocal. This occurs regardless of grammaticality. More attraction occurs in ungrammatical sentences due to the matching lure, which is not present in grammatical sentences.

Future Directions:
- Test PP and ORC configurations in separate constructions. Do the same results obtain?
- Form an explicit model where both encoding and access-based sources exist.