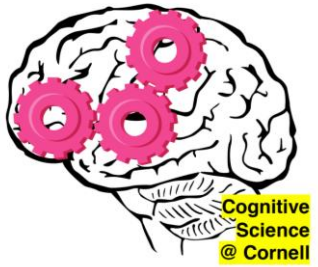
C.Psyd

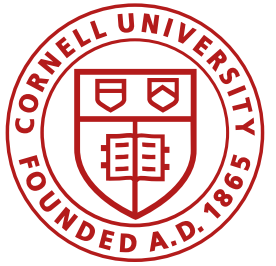
LiMe Lab

PLab



Trending Toward a Contextual Psycholinguistics

John R. Starr

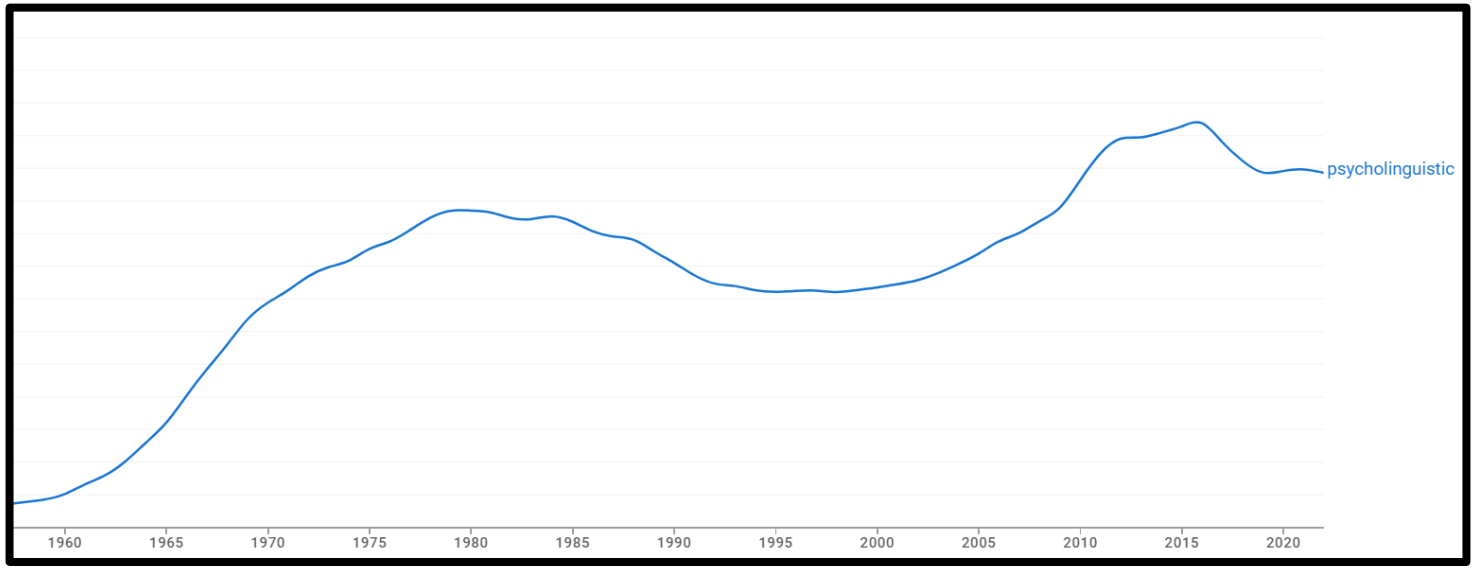


Breiss Lab

November 25th, 2024

Trending Toward a Contextual Psycholinguistics

Trending Toward a Contextual Psycholinguistics



Trending Toward a Contextual Psycholinguistics

Focusing on linguistic judgments!

Trending Toward a **Contextual** Psycholinguistics

Main Takeaway:

Testing many contexts – broadly defined – helps us understand:

1) … how our judgments generalize.
2) … how the grammar and other cognitive processes interact.

We’re very judgmental…

Who all went to the party?

Who went to the party all?*

*This second one is actually okay for me… but another story for another day!

… about a lot of different things!

The blim and blam of life…

The blam and blim of life…

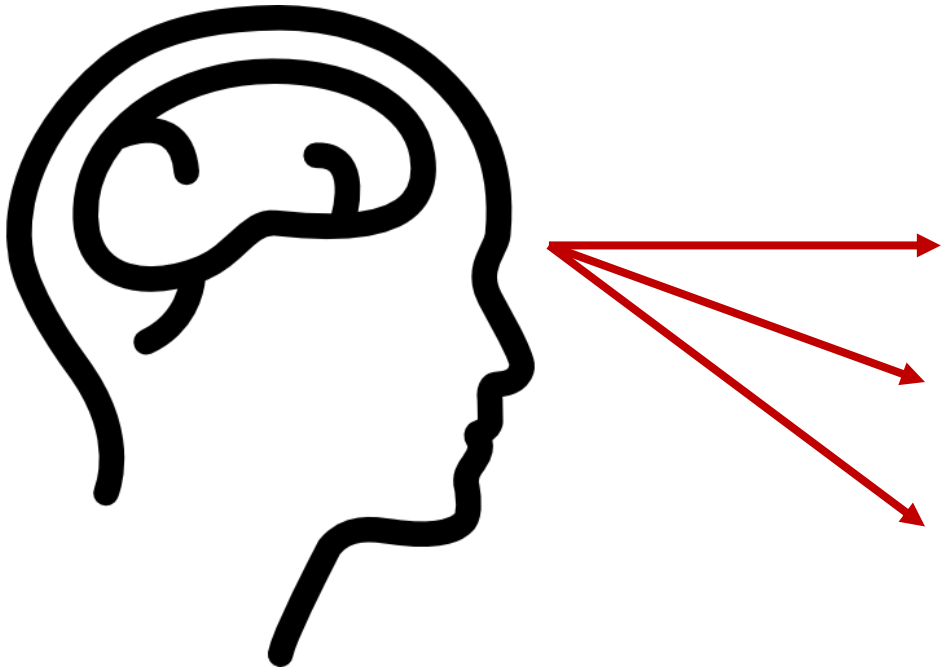
What kinds of judgments* do we create?

The key to the cabinets is... SYNTACTIC

Colorless green ideas sleep furiously. SEMANTIC

blick vs. *bnick PHONOLOGICAL

*Note that the colored words indicate the “primary” judgments that are claimed in the literature... more on this later...



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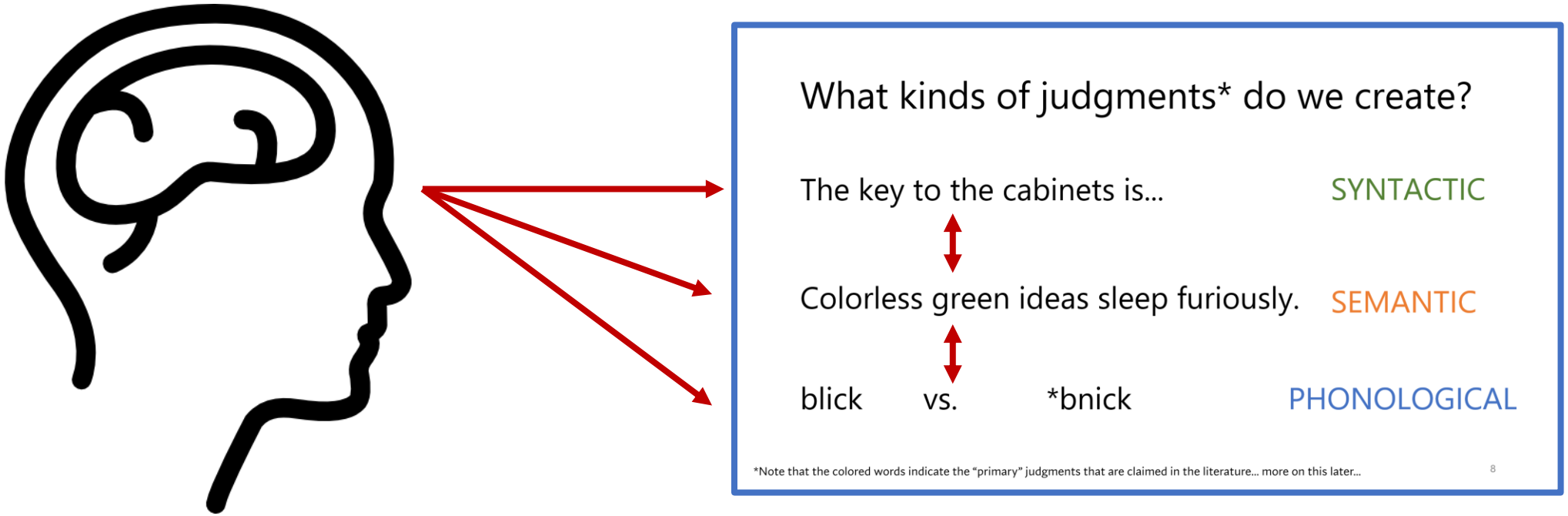


Do our judgments generalize to different contexts?

Testing judgments in context using…

a) … multiple paradigms.

b) … multiple structures.

c) … multiple interactions between structures.

Phonotactic distinctions between non-words

Word-order preferences for binomials

Phonotactic distinctions between non-words

Marten
van Schijndel

Draga
Zec

Helena
Aparicio

blick > bnick

The off-line story for phonotactics:

blick

bnick

Which word is more likely to be a word of English?

Shademan (2006); Coleman & Pierrehumbert (1997); Pizzo (2015); Scholes (1966); Albright (2009); *inter alia*

The on-line story for phonotactics:

blick

Altenberg & Cairns (1983); Coltheart et al. (1979); Vitevich et al. (1999); *inter alia*

The on-line story for phonotactics:

+

Altenberg & Cairns (1983); Coltheart et al. (1979); Vitevich et al. (1999); *inter alia*

The on-line story for phonotactics:

bnick

Altenberg & Cairns (1983); Coltheart et al. (1979); Vitevich et al. (1999); *inter alia*

The on-line story for phonotactics:

+

Altenberg & Cairns (1983); Coltheart et al. (1979); Vitevich et al. (1999); *inter alia*

… but is this how we process language?

The off-line story for phonotactics:

blick bnick

Which word is more likely to be a word of English?

The on-line story for phonotactics:

bnick

Missing the usual structure / context from everyday language.

What kinds of context might matter?

Embedded	vs.	Non-embedded	SYNTACTIC
Single sentences	vs.	Multiple sentences	DISCURSIVE
blick/*bnick	vs.	brift/*britf	PHONOLOGICAL

EXPERIMENT 1

How do phonotactic distinctions arise in different syntactic contexts?

Presented @ Human Sentence Processing (HSP) 2023 and Manchester Phonology Meeting (mfm) 2023!

Experiment 1 design

- Self-paced reading experiment, where participants (N=62) read 27 experimental sentences:

	1	2	3	4	5	6
			the	brick	smashed	through…
			the	blick	smashed	through…
			the	bnick	smashed	through…

- 3 TARGETS: {real word, viable word, unviable word}

Experiment 1 design

- Self-paced reading experiment, where participants (N=62) read 27 experimental sentences:

Critical region!

	1	2	3	4	5	6
MATRIX	Last	night	the	brick	smashed	through…
EMBEDDED	I	hoped	the	blick	smashed	through…
C-EMBEDDED	The	wall	the	bnick	smashed	through…

- 3 TARGETS: {real word, viable word, unviable word}
- 3 STRUCTURES: {MATRIX, EMBEDDED, CENTER-EMBEDDED}

Experiment 1 sample stimuli

Experiment 1 sample stimuli

Last _____ ___ _____ _____ _____ ___ _____

Experiment 1 sample stimuli

Experiment 1 sample stimuli

___ ____ the ___ _____ _____ __ _____

Experiment 1 sample stimuli

___ ____ ___ blick _____ _____ ___ _____

Experiment 1 sample stimuli

___ ____ ___ ____ smashed _____ ___ _____

Experiment 1 sample stimuli

___ ____ ___ ____ _____ through ___ _____

Experiment 1 sample stimuli

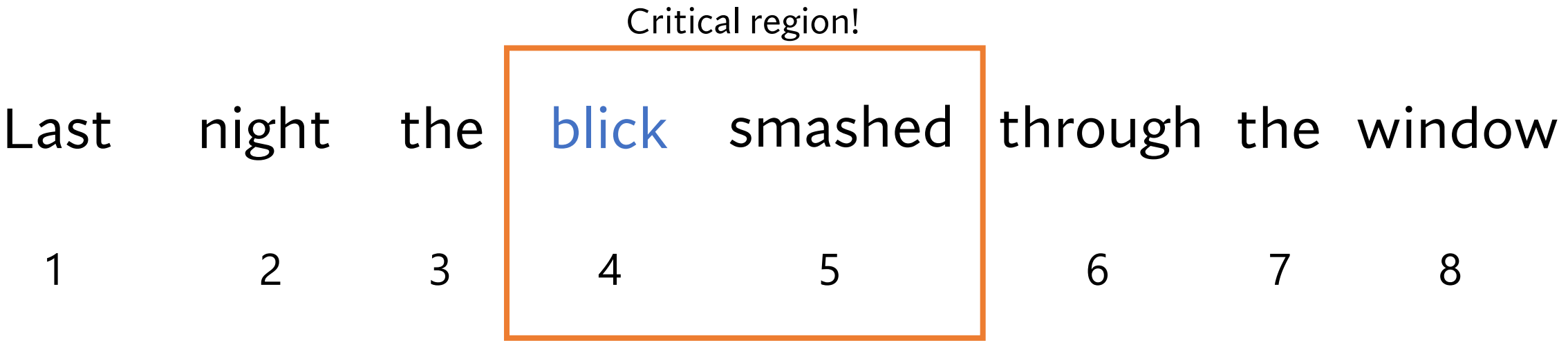
___ ____ ___ ____ _____ _____ the _____

Experiment 1 sample stimuli

___ ____ ___ ____ _____ _____ ___ window

This is an example of a MATRIX clause with a VIABLE target.

Experiment 1 sample stimuli



This is an example of a MATRIX clause with a VIABLE target.

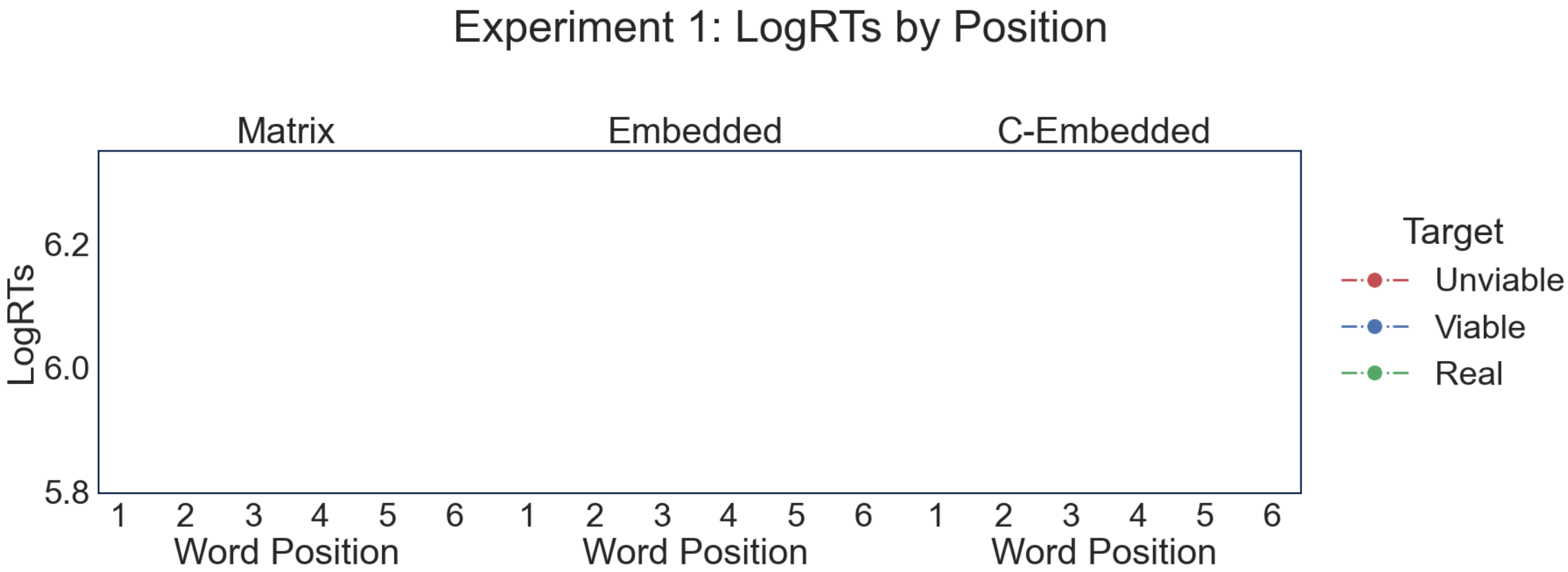
Answering two key questions:

1. How do we know when phonotactic distinctions surface?

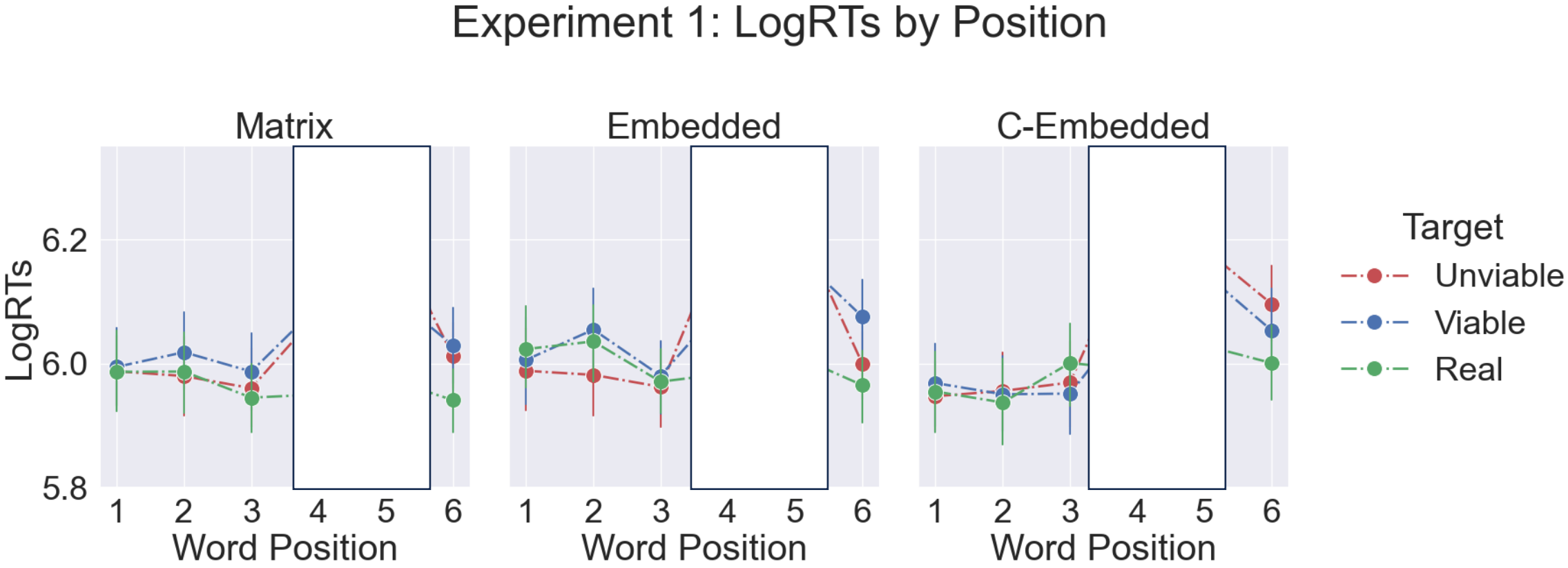
   A: We assume that distinctions surface when the viable non-word is read significantly faster than the unviable non-word.

2. When should distinctions surface?

   A: Distinctions should surface at or after the non-word.

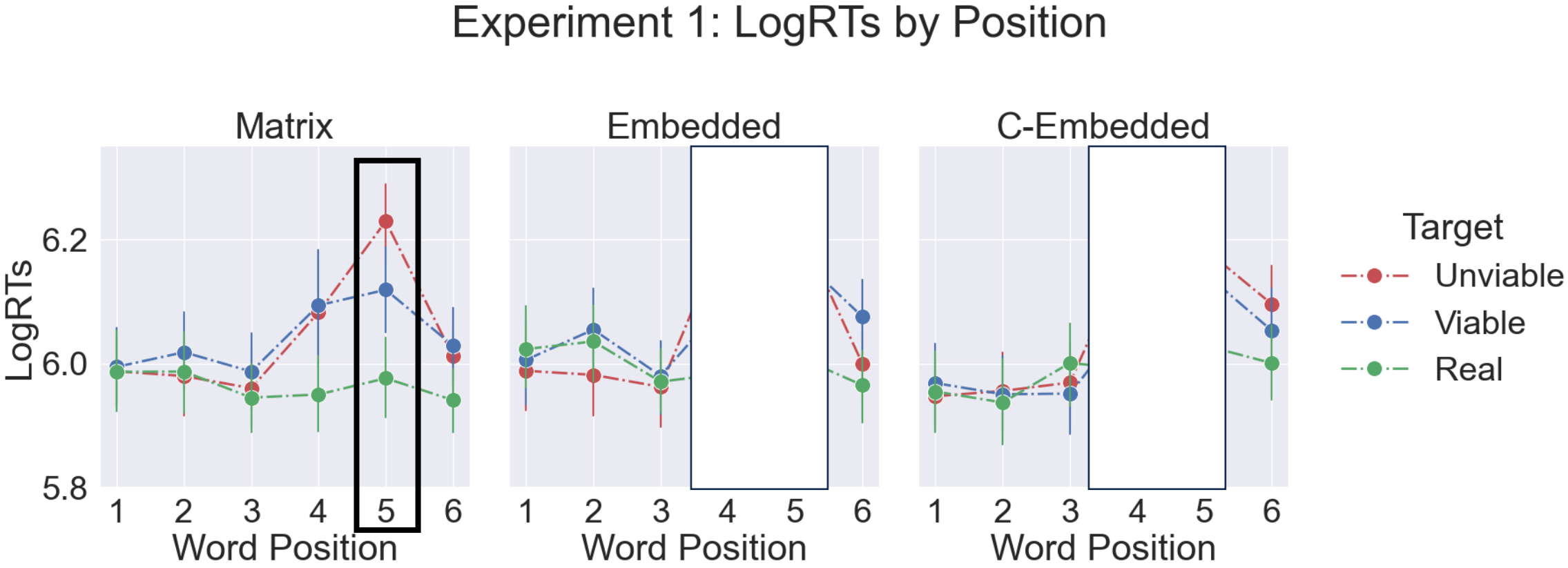


LogRT ~ Structure*Target*Position + (1 | Item) + (1 | Participant)



- Regions 1-3, 6 look identical across structures!

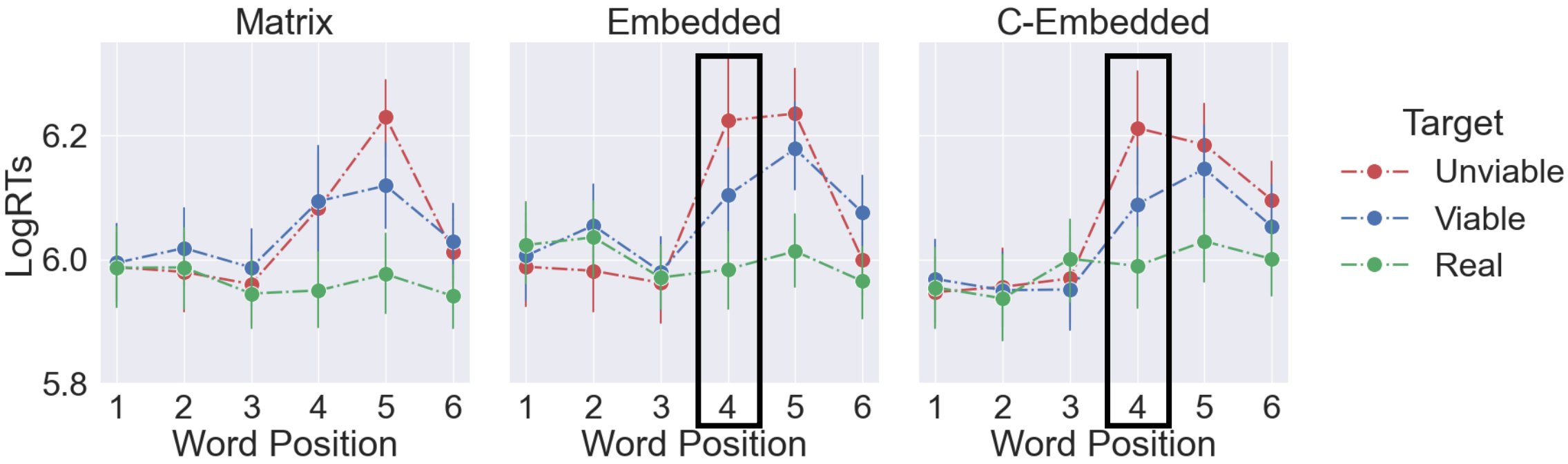
LogRT ~ Structure*Target*Position + (1 | Item) + (1 | Participant)



- Regions 1-3, 6 look identical across structures!
- *Delayed* phonotactic distinctions for MATRIX clauses.

LogRT ~ Structure*Target*Position + (1 | Item) + (1 | Participant)

Experiment 1: LogRTs by Position



- Regions 1-3, 6 look identical across structures!
- *Delayed* phonotactic distinctions for MATRIX clauses.
- *Immediate* phonotactic distinctions for EMBEDDED clauses.

LogRT ~ Structure*Target*Position + (1 | Item) + (1 | Participant)

Experiment 1 discussion

- Phonotactic distinctions arise across the board, but…

- Timing of these distinctions differ by complexity of syntax:
  - Simpler syntax (matrix clauses) -> delayed judgments
  - Harder syntax (embedded clauses) -> immediate judgments

EXPERIMENT 2

How do phonotactic distinctions arise in different discourse contexts?

(part 1)

Presented at the 2023 Annual Meeting on Phonology (AMP)!

Experiment 2 Design

- Participants (N=65) read a context sentence before the stimuli from Experiment 1:

[A] Discursive context:

	Context Type
Meaningful	There was a disagreement in the courtroom.
Random	There was a shimmer on the water.

Experiment 2 Design

- Participants (N=65) read a context sentence before the stimuli from Experiment 1:

[A] Discursive context:

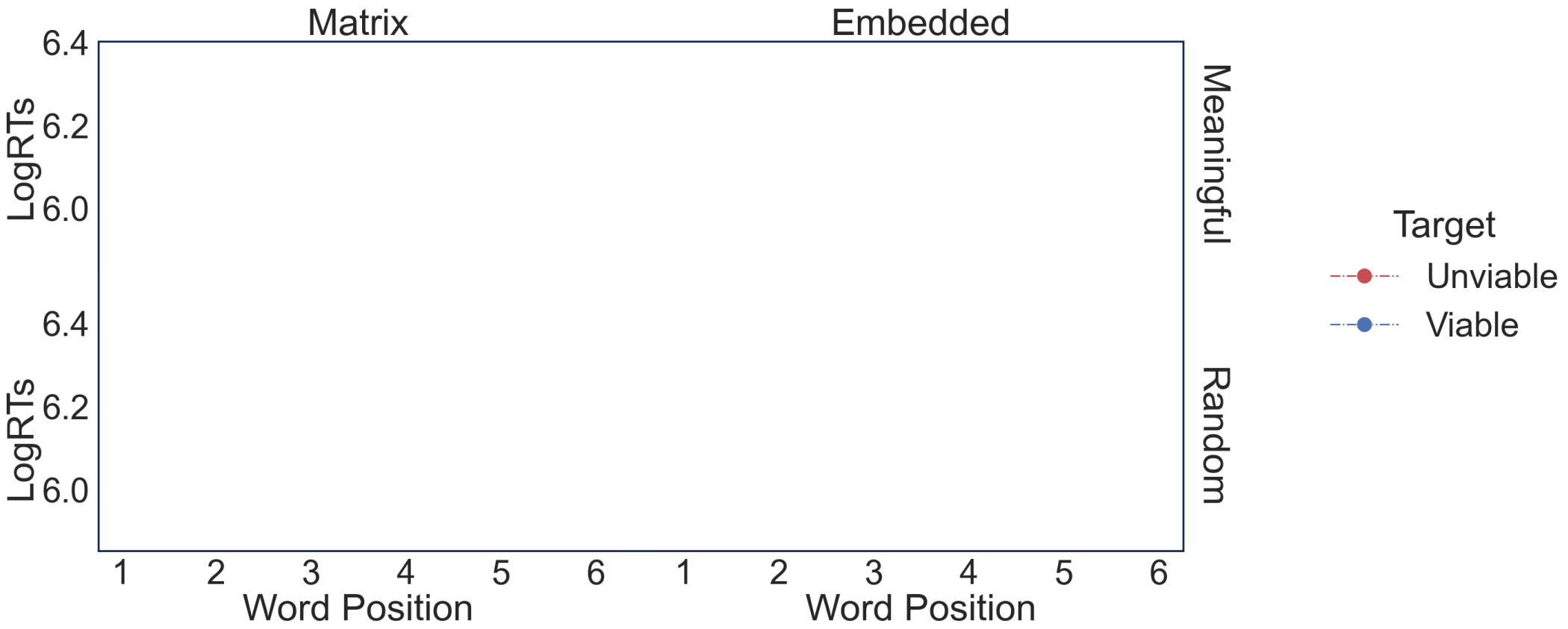
	Context Type
Meaningful	There was a disagreement in the courtroom.
Random	There was a shimmer on the water.

[B] Experimental stimuli:

	Matrix Subject	**Embedded Subject**
Viable	By evening the *spudge* made a…	You realized the *spudge* made a…
Unviable	By evening the *psudge* made a…	You realized the *psudge* made a…
	1 2 3 4 5 6	1 2 3 4 5 6

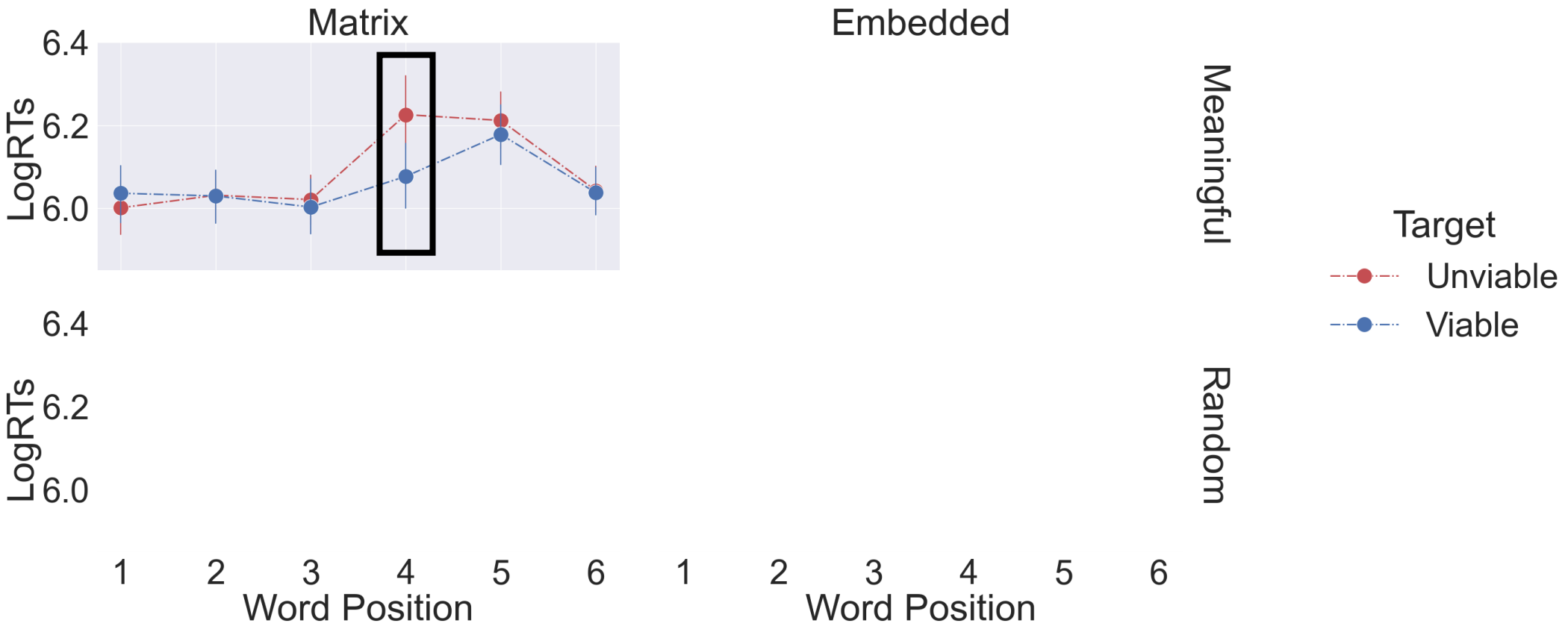
- 2 CONTEXTS: {MEANINGFUL, RANDOM}
- 2 TARGETS: {VIABLE, UNVIABLE}
- 2 STRUCTURES: {MATRIX, EMBEDDED}

Experiment 2: LogRTs by Position



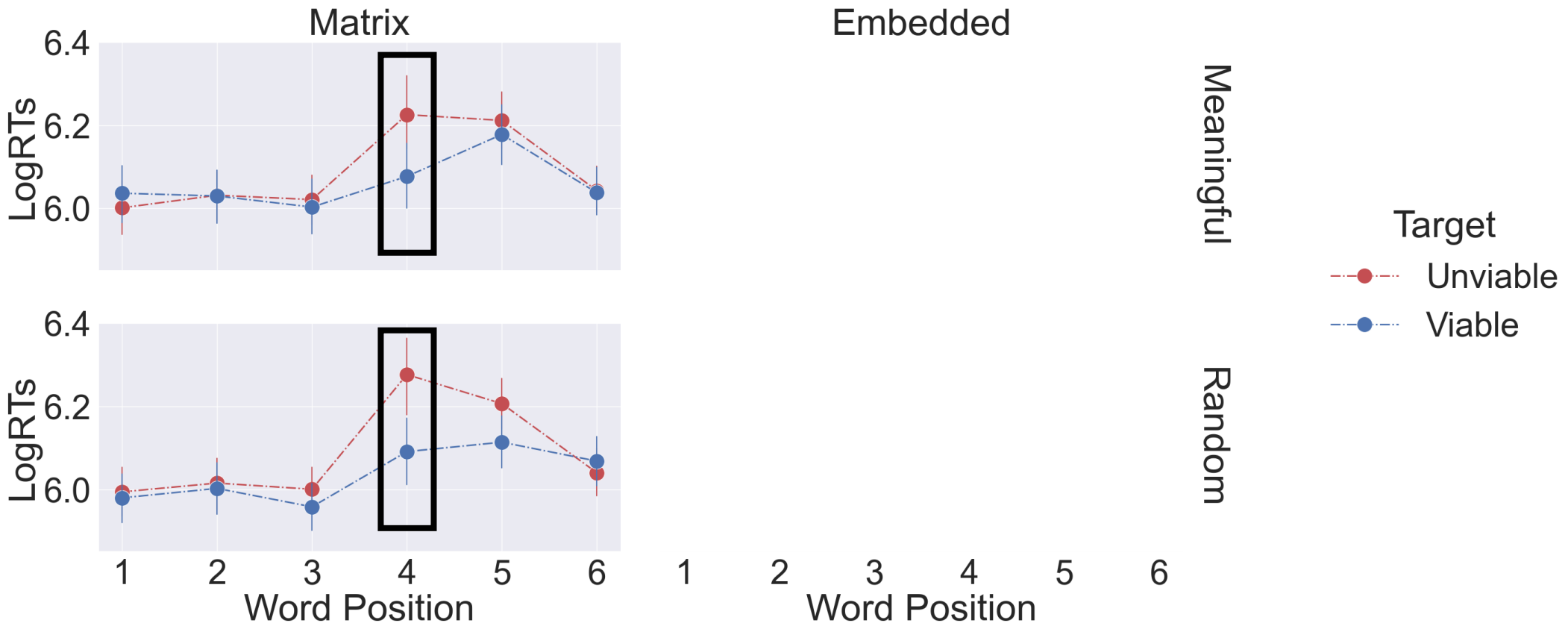
LogRT ~ Context*Structure*Target*Position + (1 | Item) + (1 | Participant)

Experiment 2: LogRTs by Position



LogRT ~ Context*Structure*Target*Position + (1 | Item) + (1 | Participant)

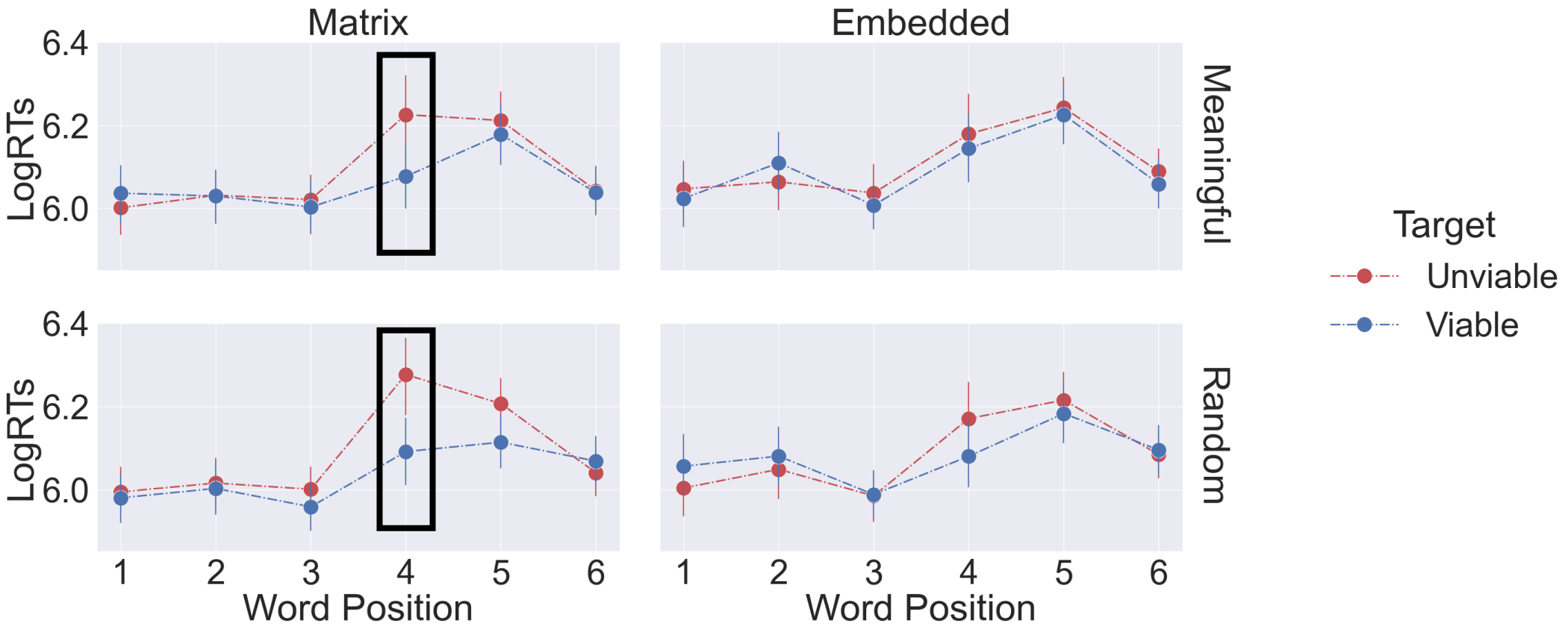
Experiment 2: LogRTs by Position



- *Immediate* phonotactic distinctions in MATRIX clauses

LogRT ~ Context*Structure*Target*Position + (1 | Item) + (1 | Participant)

Experiment 2: LogRTs by Position



- *Immediate* phonotactic distinctions in MATRIX clauses
- *No evidence* for phonotactic distinctions in EMBEDDED clauses

LogRT ~ Context*Structure*Target*Position + (1 | Item) + (1 | Participant)

Experiment 2 discussion

- Phonotactic judgments only surface in MATRIX clauses; no phonotactic judgments surface for EMBEDDED clauses

- The type of context doesn't matter, but the presence of context appears to modulate whether phonotactic judgments surface

- … or is this some artifact of reading two sentences (this Experiment) instead of one (Experiment 1)?

EXPERIMENT 3

How do phonotactic distinctions arise in different discourse contexts?

(part 2)

Presented at the 2023 Annual Meeting on Phonology (AMP)!

Experiment 3 design

- Participants (N=40) read an experimental stimuli from Experiment 1 before the context sentence

[B] Experimental stimuli:

	Matrix Subject	Embedded Subject
Viable	By evening the *spudge* made a…	You realized the *spudge* made a…
Unviable	By evening the *psudge* made a…	You realized the *psudge* made a…
	1 2 3 4 5 6	1 2 3 4 5 6

- 2 TARGETS: {VIABLE, UNVIABLE}
- 2 STRUCTURES: {MATRIX, EMBEDDED}

Experiment 3 design

- Participants (N=40) read an experimental stimuli from Experiment 1 before the context sentence

[A] Discursive context:

	Context Type
Meaningful	There was a disagreement in the courtroom.
Random	There was a shimmer on the water.

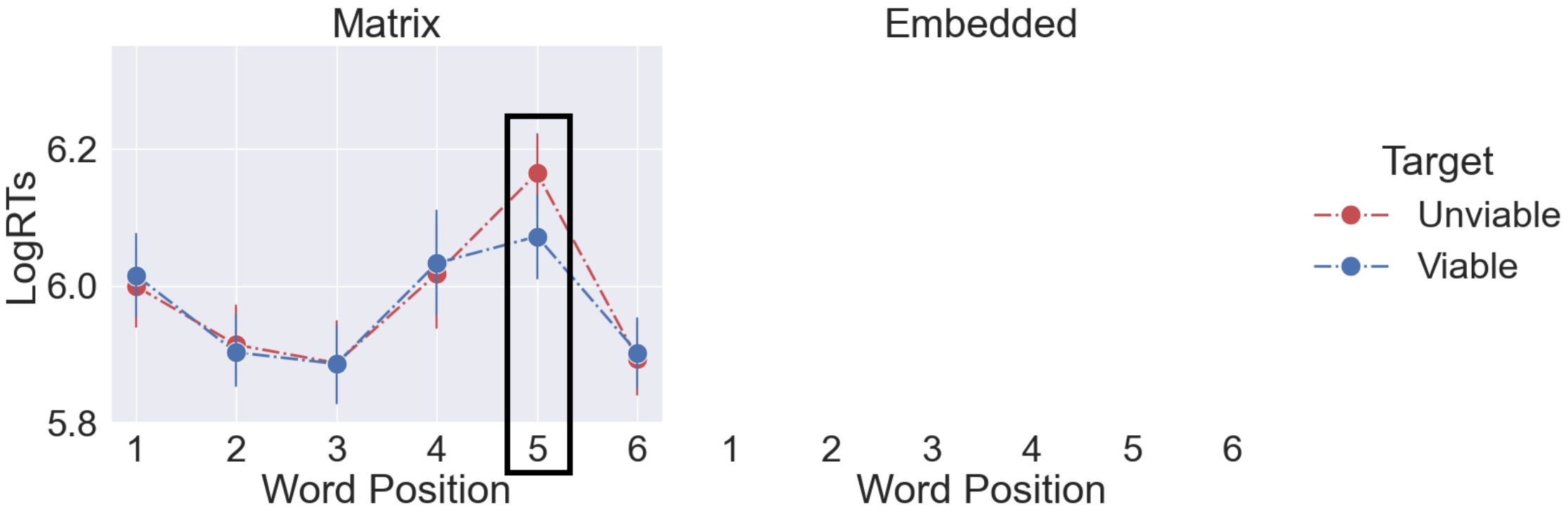
[B] Experimental stimuli:

	Matrix Subject	Embedded Subject
Viable	By evening the *spudge* made a…	You realized the *spudge* made a…
Unviable	By evening the *psudge* made a…	You realized the *psudge* made a…
	1 2 3 4 5 6	1 2 3 4 5 6

- 2 TARGETS: {VIABLE, UNVIABLE}
- 2 STRUCTURES: {MATRIX, EMBEDDED}
- 2 CONTEXTS: {MEANINGFUL, RANDOM}

The results *should* replicate Experiment 1, since there's no context!

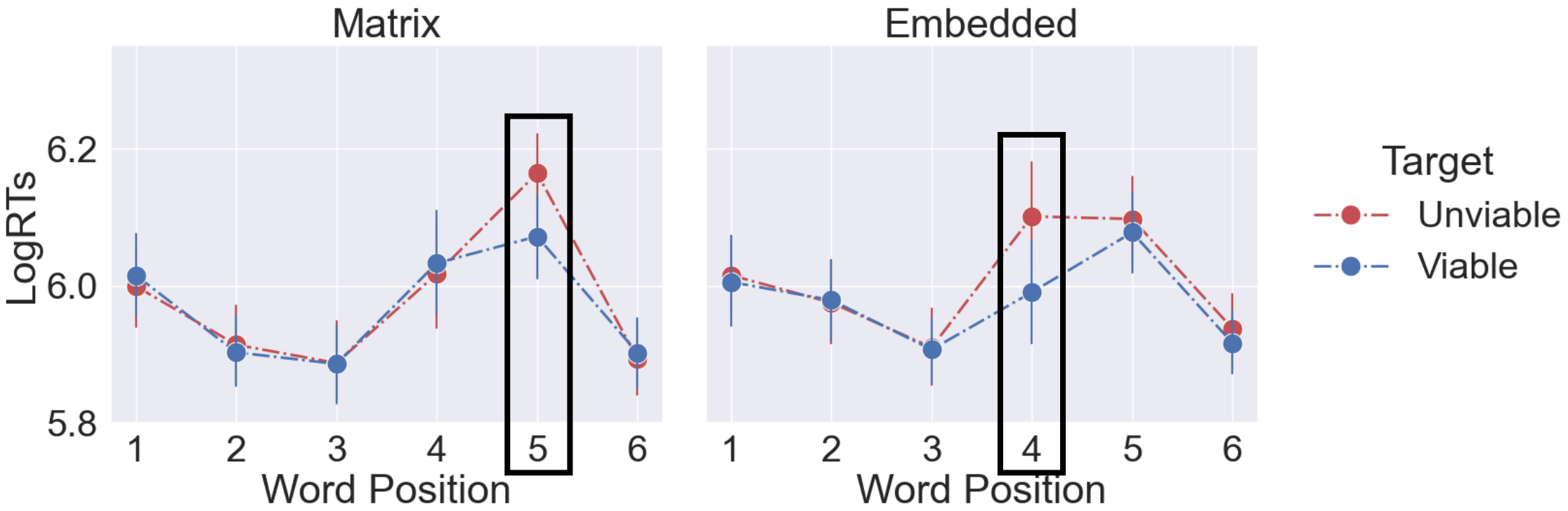
Experiment 3: LogRTs by Position



- *Delayed* phonotactic distinctions for MATRIX clauses.

LogRT ~ Structure*Target*Position + (1 | Item) + (1 | Participant)

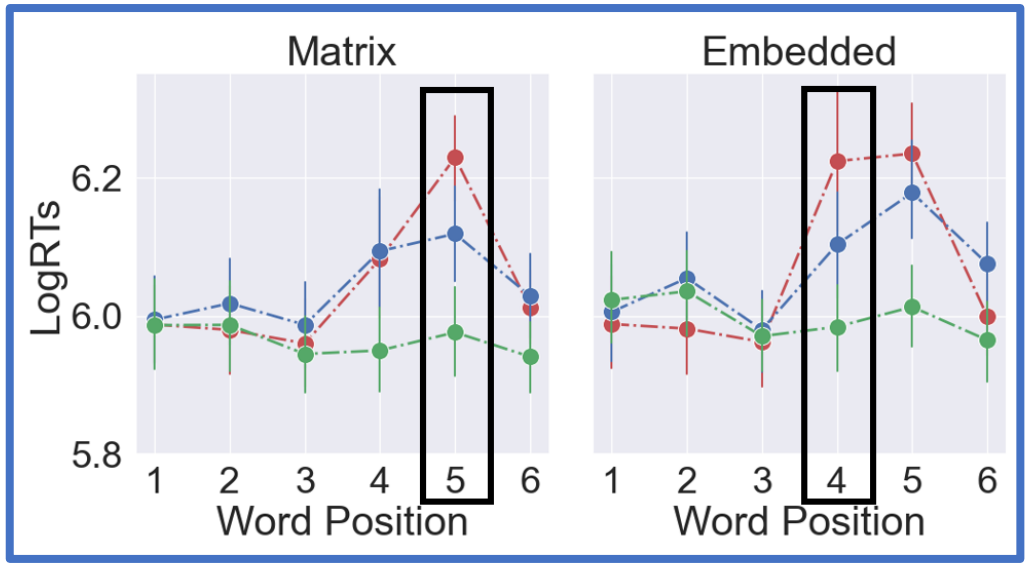
Experiment 3: LogRTs by Position



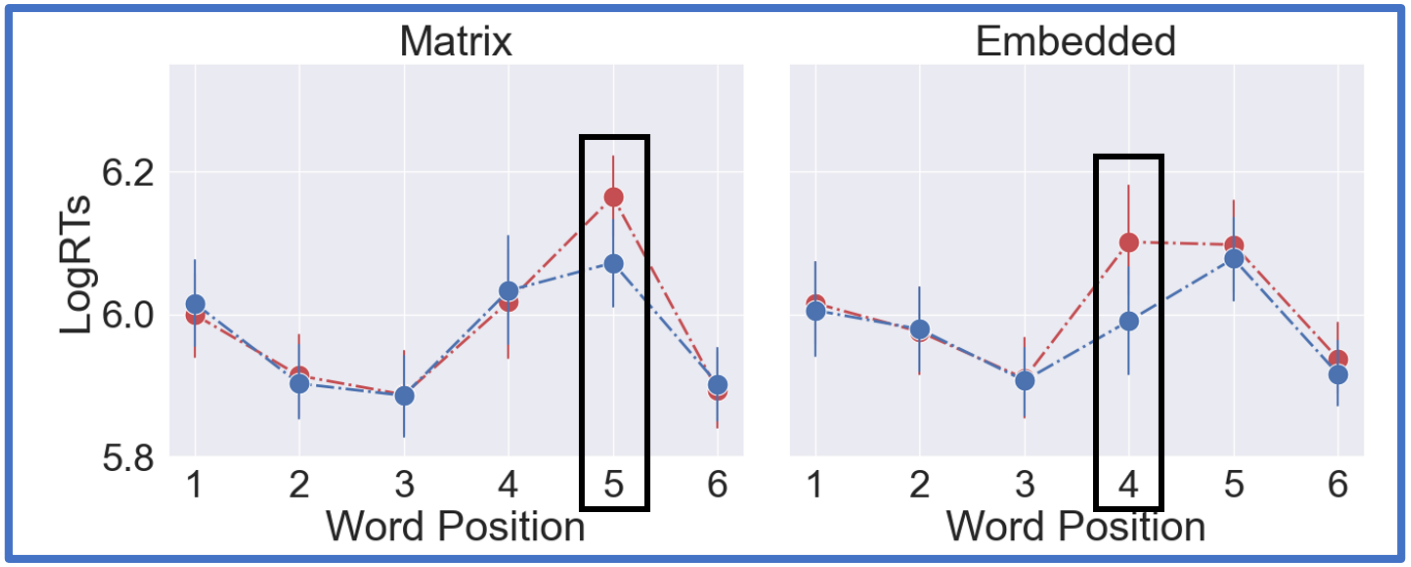
- *Delayed* phonotactic distinctions for MATRIX clauses.
- *Immediate* phonotactic distinctions for EMBEDDED clauses.

LogRT ~ Structure*Target*Position + (1 | Item) + (1 | Participant)

Experiment 1



Experiment 3



The judgment patterns from Experiment 1 re-emerge!

Experiment 3 Discussion

- Replicates our original findings from Experiment 1:
  - Simpler syntax (matrix clauses) -> delayed distinctions
  - Harder syntax (embedded clauses) -> immediate distinctions

- The presence of a context sentence modulates how phonotactic distinctions surface in Experiment 2.

… but is that the full story?

- Phonotactic distinctions appear, generally!

- But… is this just an onset thing?
  - Onsets are more resistant to modification
  - Onsets are more useful for disambiguation
  - Onsets are more salient to readers

King & Wedel (2020), Hall et al. (2018), Nooteboom (1981), Smith (2004)

EXPERIMENT 4

How do phonotactic distinctions arise in different phonological contexts?

Presented @ Human Sentence Processing (HSP) 2023 and Manchester Phonology Meeting (mfm) 2023!

Experiment 4 Design

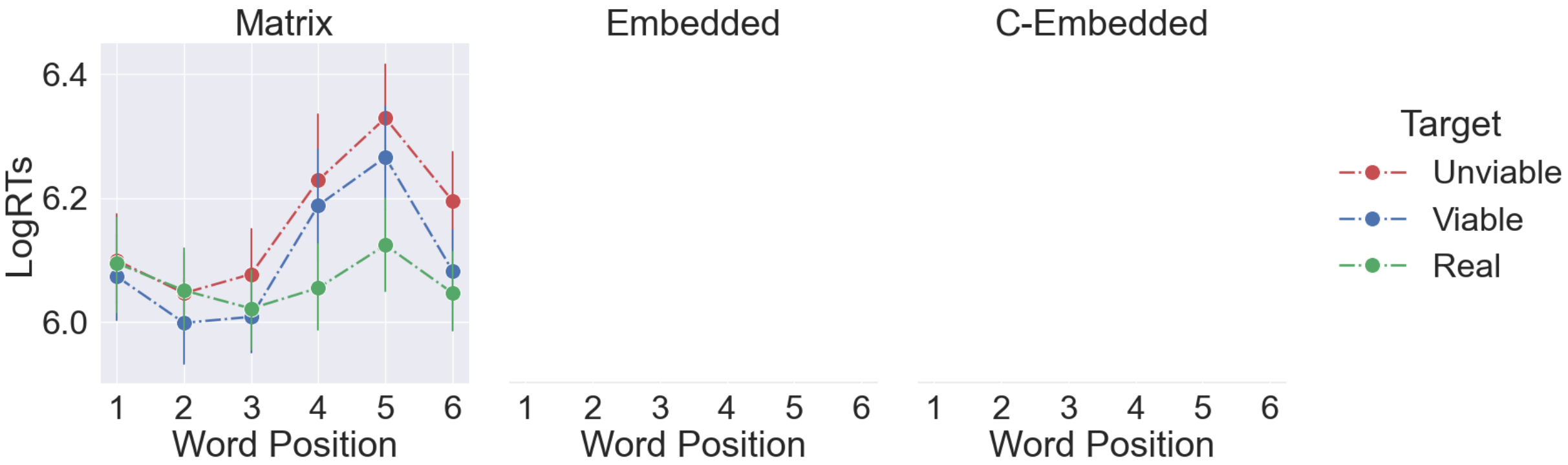
- Same design as Experiment 1 (N=48), but with word-final phonological modifications instead of word-initial ones:

Critical region!

	1	2	3	4	5	6
MATRIX	Last	night	the	brick	smashed	through…
EMBEDDED	I	hoped	the	brift	smashed	through…
C-EMBEDDED	The	wall	the	britf	smashed	through…

- 3 TARGETS: {real word, viable word, unviable word}
- 3 STRUCTURES: {MATRIX, EMBEDDED, CENTER-EMBEDDED}

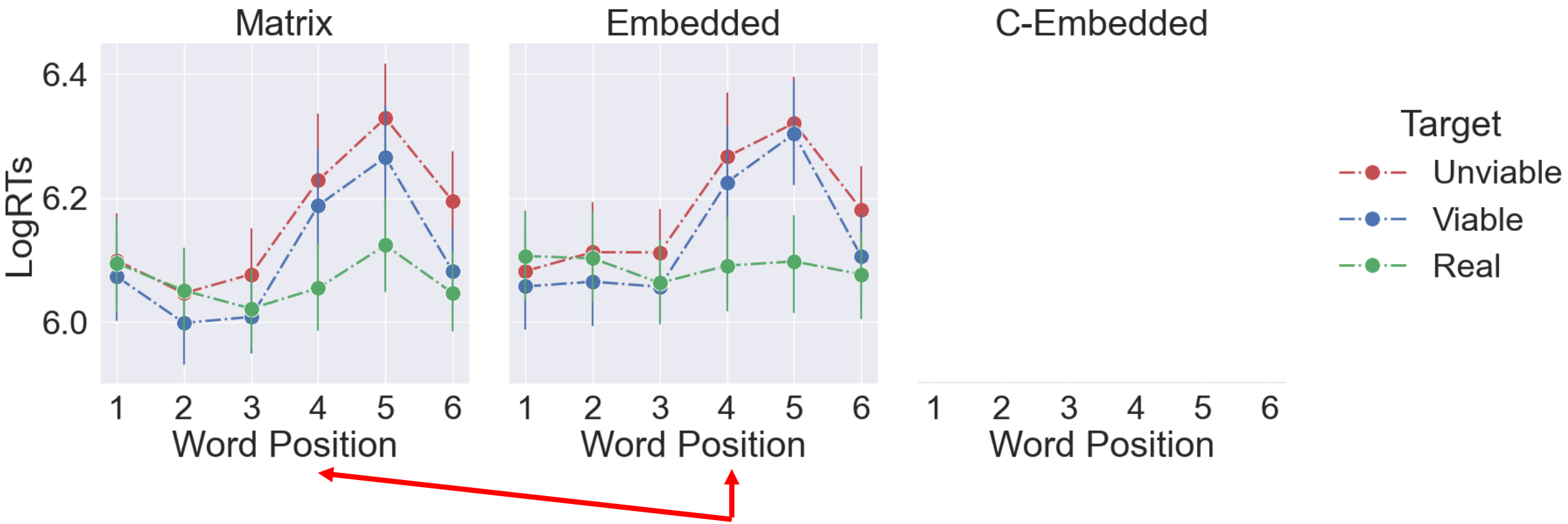
Experiment 4: LogRTs by Position



We find no evidence for phonotactic distinctions…!

LogRT ~ Structure*Target*Position + (1 | Item) + (1 | Participant)

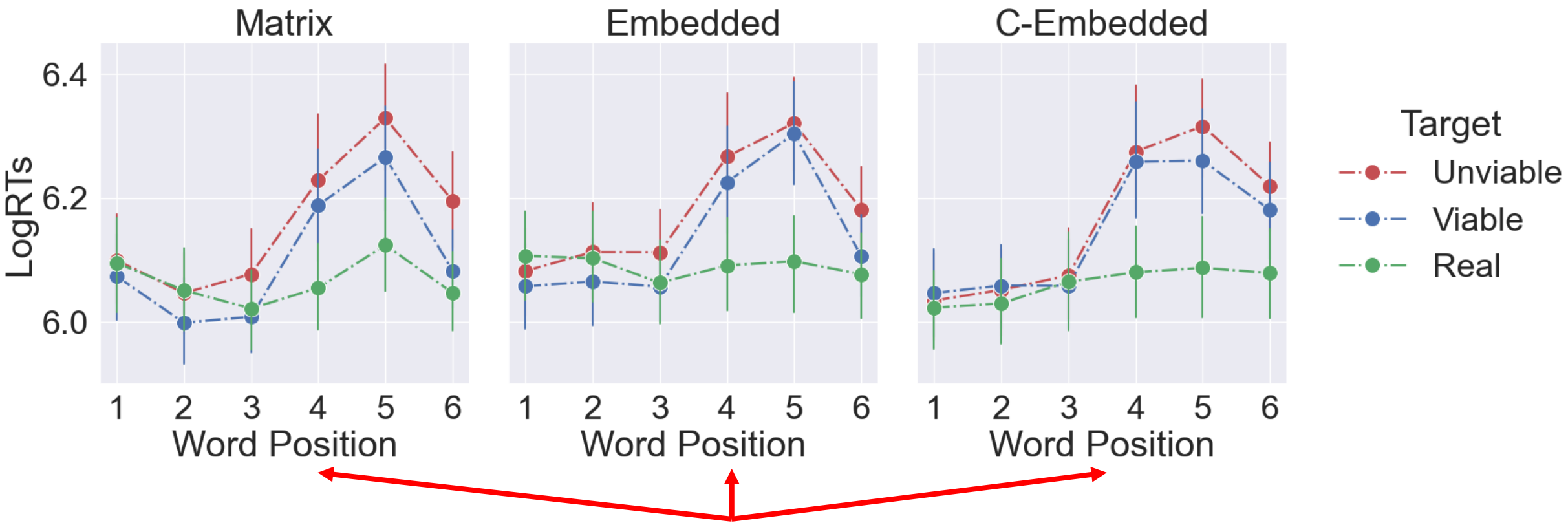
Experiment 4: LogRTs by Position



We find no evidence for phonotactic distinctions…!

LogRT ~ Structure*Target*Position + (1 | Item) + (1 | Participant)

Experiment 4: LogRTs by Position



We find no evidence for phonotactic distinctions…!

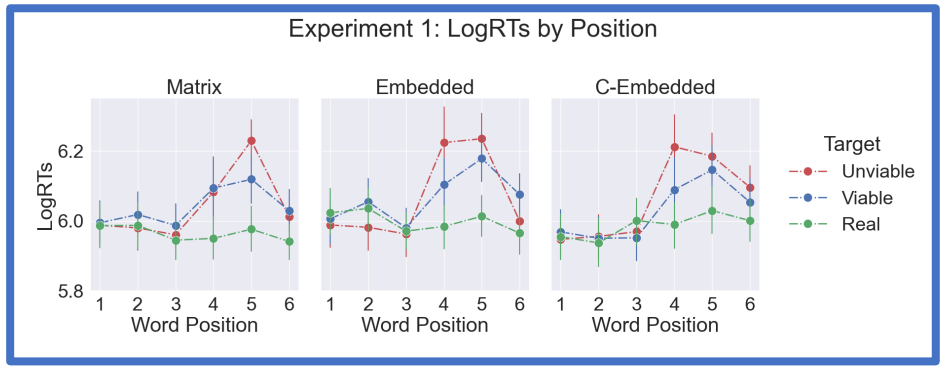
LogRT ~ Structure*Target*Position + (1 | Item) + (1 | Participant)

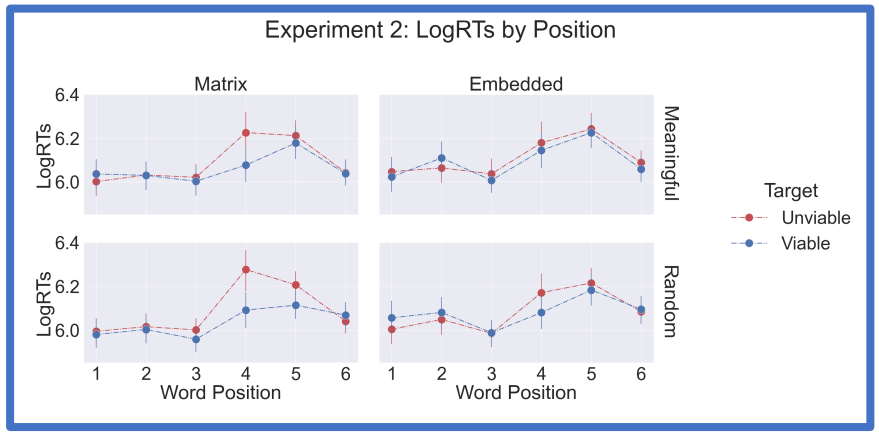
Experiment 4 Discussion

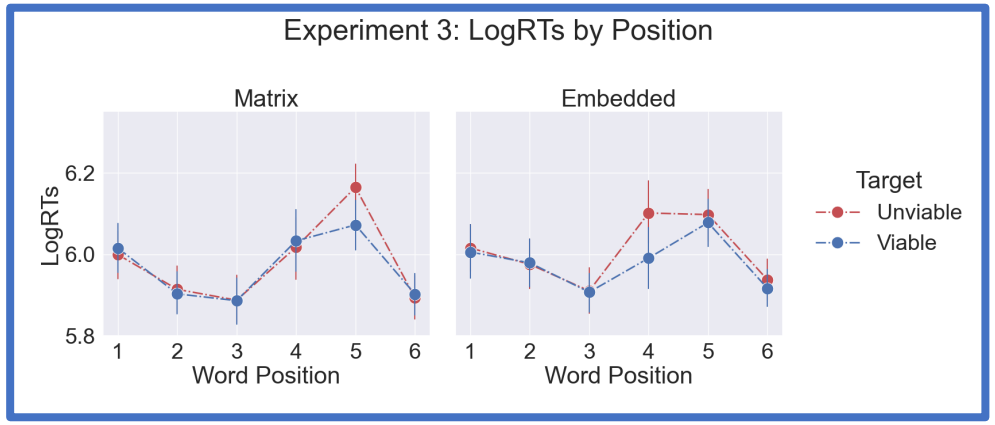
- No phonological distinctions surface between any TARGETS in any STRUCTURE, nor in any position.

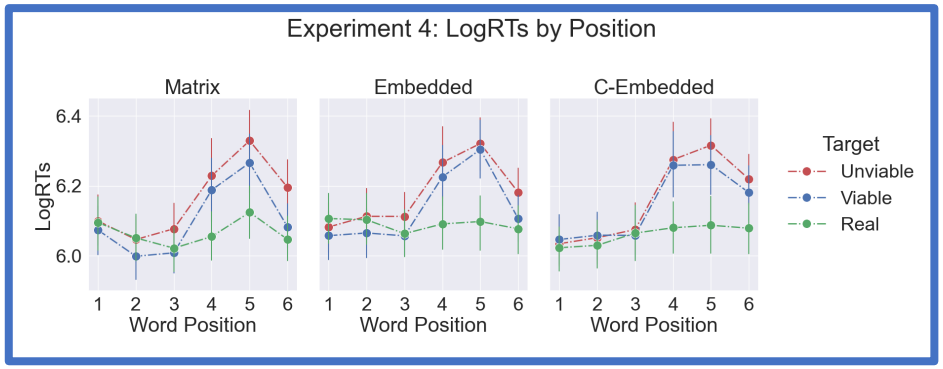
- Non-words (VIABLE, UNVIABLE targets) appear to behave distinctly from regular words (REAL targets)
  - Possible cause: word-final modifications create issues for lexical access

Interim summary



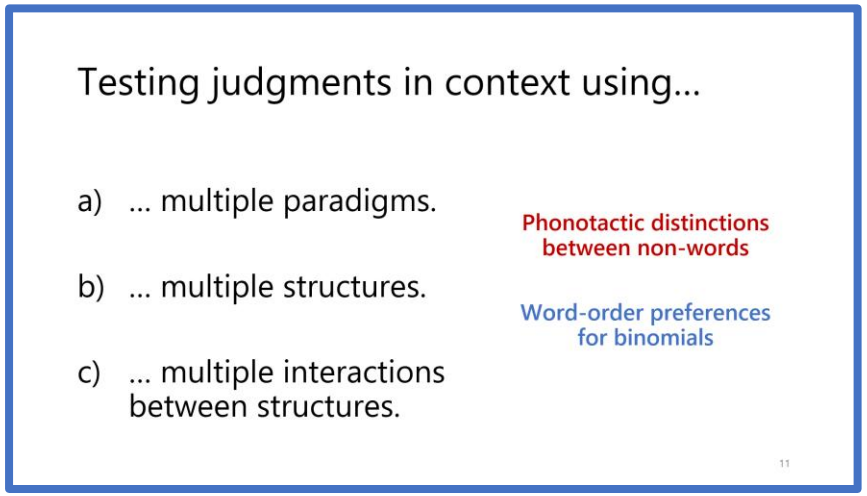






Interim summary

- Distinctions (generally) surface for onsets…
  - … but syntactic and discursive context greatly modulates how these distinctions pattern during processing.
- Distinctions don't surface for codas.
  - Maybe a result of lexical access issues?
- These results differ from the established literature.



Word-order preferences for binomials

Marten
van Schijndel

A game to start us off:

My favorite fruit is ….

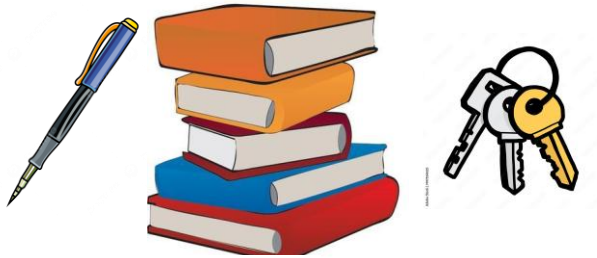
John forgot his …

Pass the salt and …

A game to start us off:

My favorite fruit is ….

John forgot his two …



A binomial!

Pass the salt and …

Binomial expressions, defined

- Broadly, an expression of either form:

  X and Y OR X-Y

- People (generally) have order preferences for binomials.

- Examples:

  black and white, alive and well, supply and demand

  hanky-panky, tick-tock, razzle-dazzle

Bolinger (1962); Cooper & Ross (1975); Pinker & Birdsong (1979); Benor & Levy (2005); Mollin (2012); Morgan & Levy (2016); Ryan (2019)

What motivates ordering preferences?

1. Phonological factors:
    1. Syllable count/weight, onset/coda complexity, metrical structure, etc.
2. Semantic factors:
    1. Animacy, proximity, concreteness, etc.
3. Syntactic factors:
    1. Phrasal category, phrasal complexity, etc.

The foci of this section!

4. Other factors:
    1. Word frequency, direct experience, etc.

Benor & Levy (2005); Mollin (2012); Morgan & Levy (2016); Ryan (2019)

Why study binomials?

What motivates ordering preferences?

1. Phonological factors:
   1. Syllable count/weight, onset/coda complexity, metrical structure, etc.
2. Semantic factors:
   1. Animacy, proximity, concreteness, etc.
3. Syntactic factors:
   1. Phrasal category, phrasal complexity, etc.

The foci of this talk!

4. Other factors:
   1. Word frequency, direct experience, etc.

Benor & Levy (2005); Mollin (2012); Morgan & Levy (2016); Ryan (2019)

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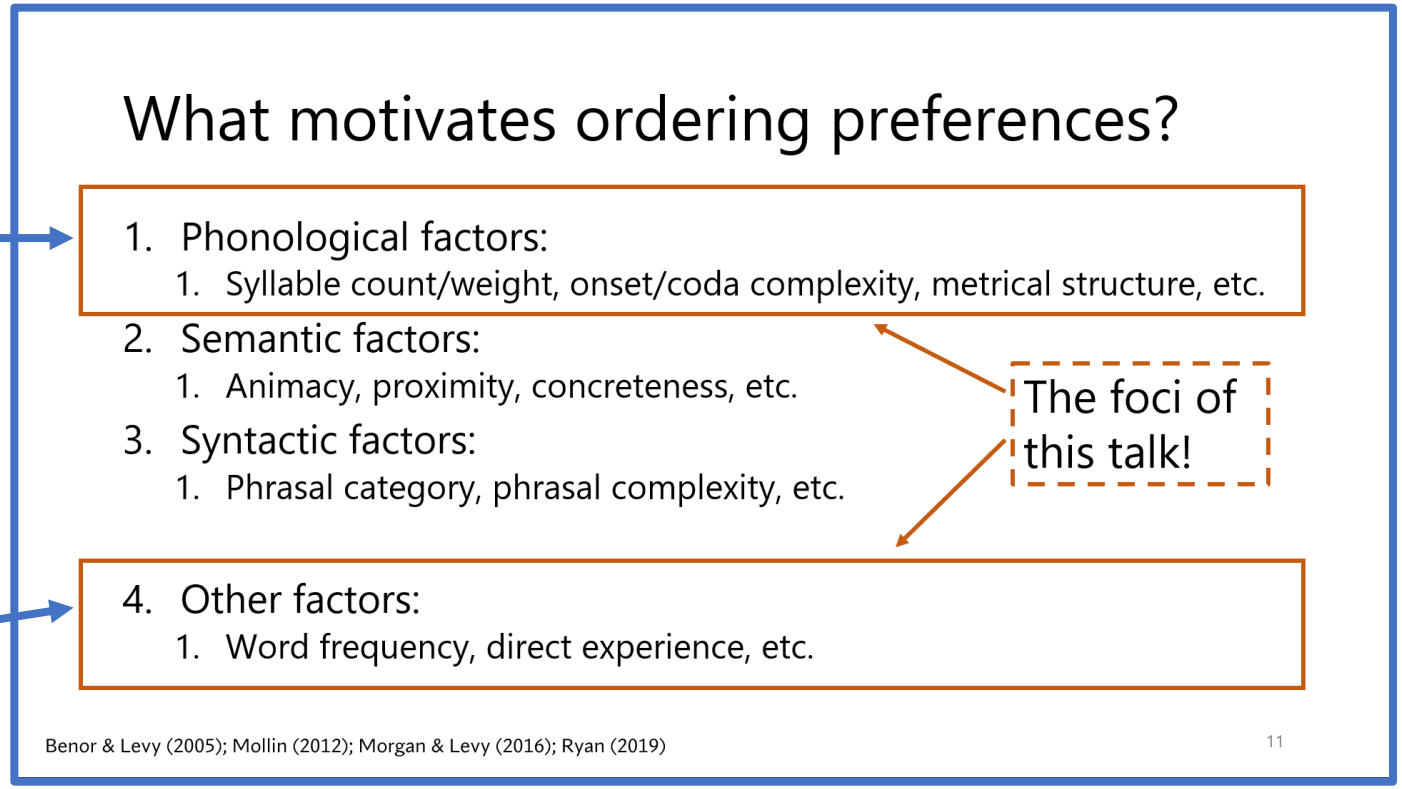
Binomials help us probe how people use both abstract linguistic constraints and statistical experience to process language.

What kinds of binomials will we study?

Non-word binomials
(abstract knowledge)

Irreversible binomials
(statistical experience)



How have people studied binomials?

- Mostly, in isolation or out-of-context:
  - Forced-choice tasks:

    salt and pepper pepper and salt

  - Rating tasks:

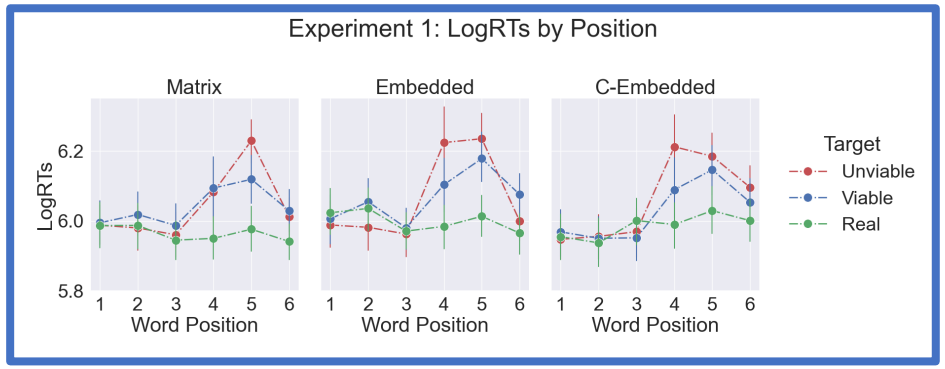
    How natural is the following expression?

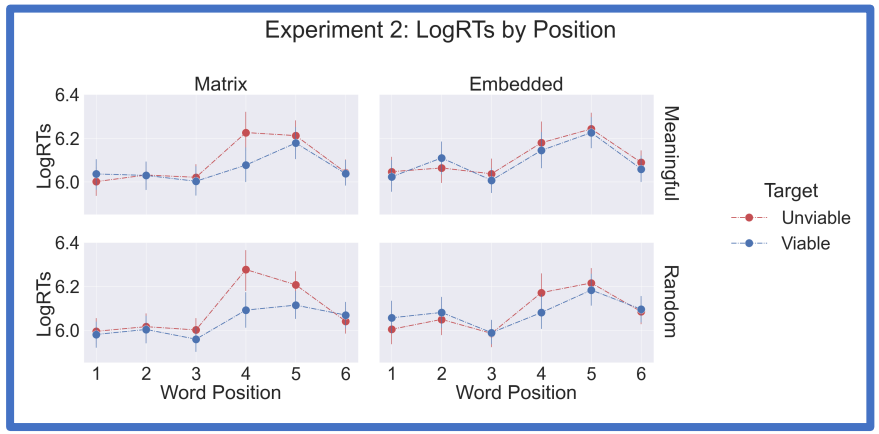
    pepper and salt

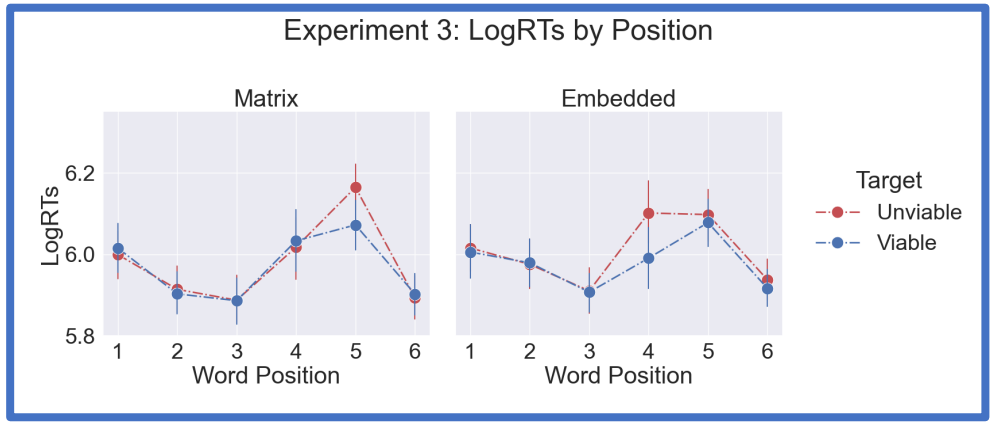
    1 2 3 4 5
- Some place binomials in uncontrolled linguistic structures:
  - Teaching children what is right and wrong is a difficult task for parents.
  - I like to mix and match my clothing to create new outfits.

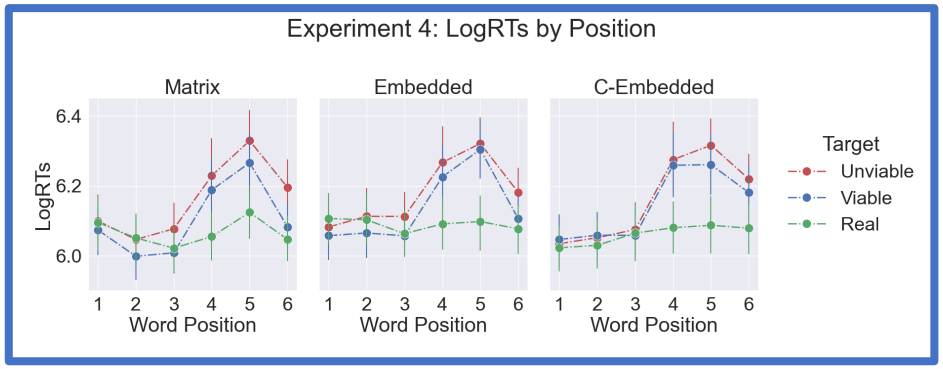
Bolinger (1962); Cooper & Ross (1975); Pinker & Birdsong (1979); Benor & Levy (2005); Mollin (2012); Morgan & Levy (2016); Ryan (2019)

… but context matters!









The gap we fill:

How have people studied binomials?

- Mostly, in isolation or out-of-context:
  - Forced-choice tasks:

    salt and pepper pepper and salt

  - Rating tasks:

    How natural is the following expression?

    pepper and salt

    1 2 3 4 5
- Some place binomials in uncontrolled linguistic structures:
  - Teaching children what is right and wrong is a difficult task for parents.
  - I like to mix and match my clothing to create new outfits.

Bolinger (1962); Cooper & Ross (1975); Pinker & Birdsong (1979); Benor & Levy (2005); Mollin (2012); Morgan & Levy (2016); Ryan (2019) 73

How does context influence binomial ordering preferences that are motivated by…:

1. abstract linguistic constraints?
2. statistical experience?

NORMING STUDIES

What are the baseline ordering preferences for binomials outside of context?

Presented at AMLaP 2024!

Design of norming studies

- Two forced-choice tasks, where participants (N=30 for both) selected the preferred order for either:
  - 28 attested nominal binomials (Norming Study 1)

    bread and butter butter and bread
  - 32 non-word nominal binomials (Norming Study 2)

    pag and frappy frappy and pag

Results of norming studies

- Attested binomials:
  - 18 of 28 displayed *irreversible* order preferences (>96%)
- Non-word binomials:
  - 24 of 32 displayed *strong* ordering preferences (>70%)
- For our self-paced reading experiments, we used the 16 binomials that showed the strongest ordering preferences from these norming studies.

EXPERIMENT 5

How do ordering preferences arise for irreversible binomials in different contexts?

Presented at AMLaP 2024!

Experiment 5 design

- Self-paced reading experiment, where participants (N=59) read 16 two-sentence passages:

There was a crash in the room.

Experiment 5 design

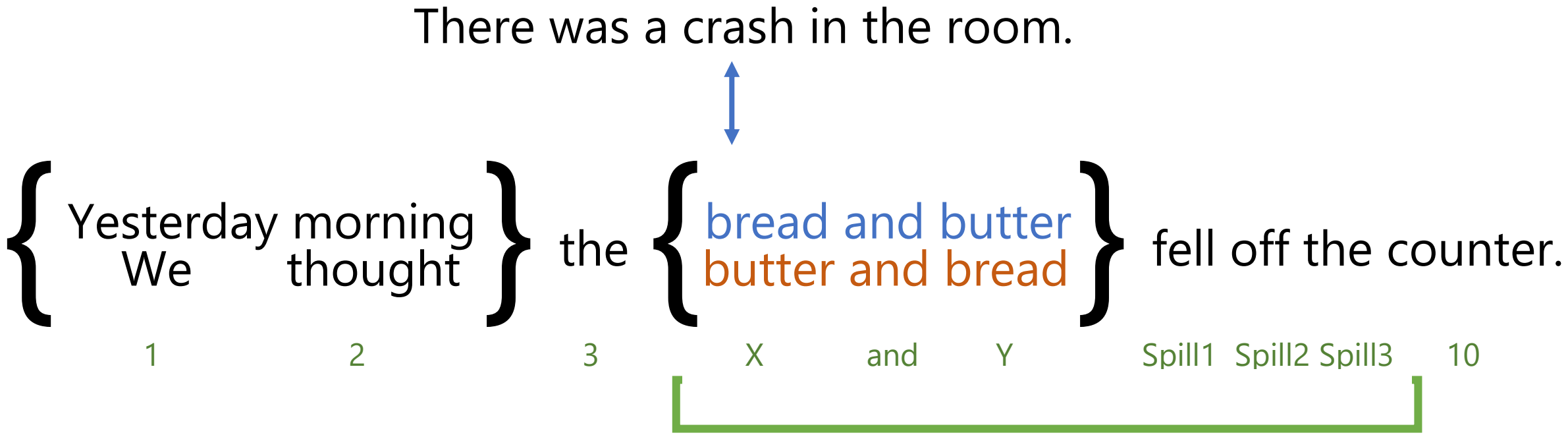
- Self-paced reading experiment, where participants (N=59) read 16 two-sentence passages:

There was a crash in the room.

the { bread and butter / butter and bread } fell off the counter.

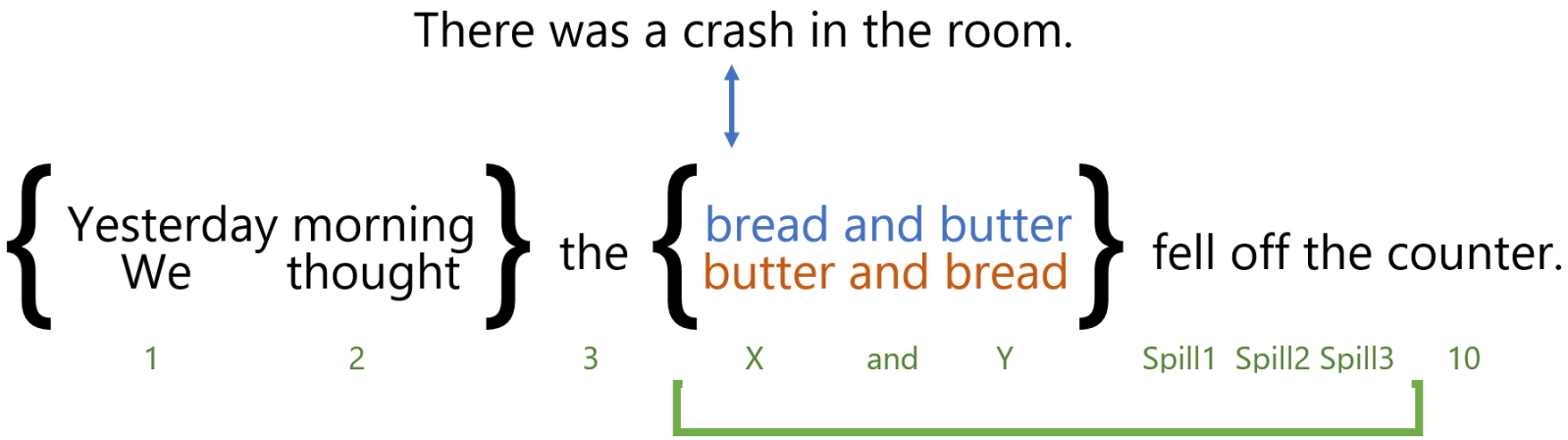
Experiment 5 design

- Self-paced reading experiment, where participants (N=59) read 16 two-sentence passages:



Experiment 5 design

- Self-paced reading experiment, where participants (N=59) read 16 two-sentence passages:



- 2 ORDERS: {preferred order, dispreferred order}
- 2 STRUCTURES: {MATRIX, EMBEDDED}
- 2 CONTEXTS: {No Context, After Context}

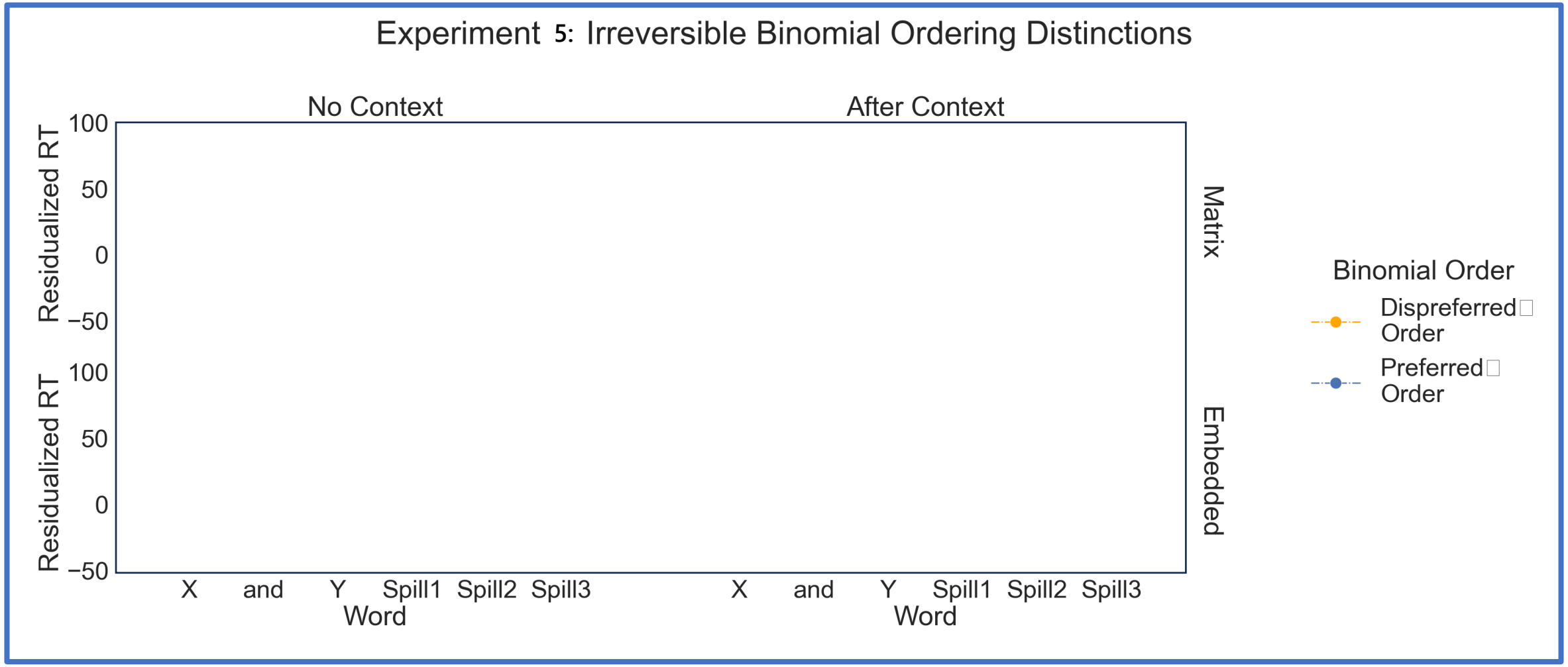
Answering two key questions, again:

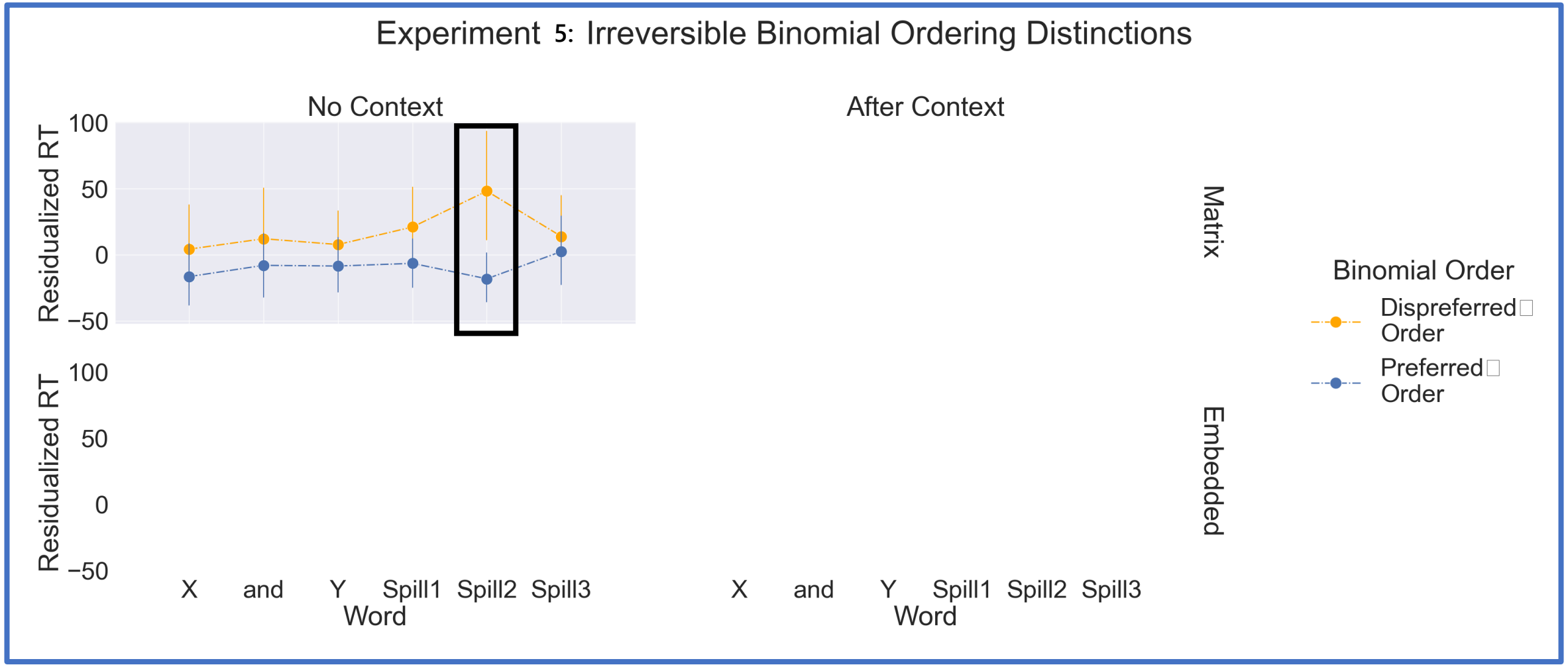
1. How do we know when ordering preferences surface?

   A: We assume that ordering preferences surface when the preferred order is read significantly faster than the dispreferred order.

2. When should ordering preferences surface?

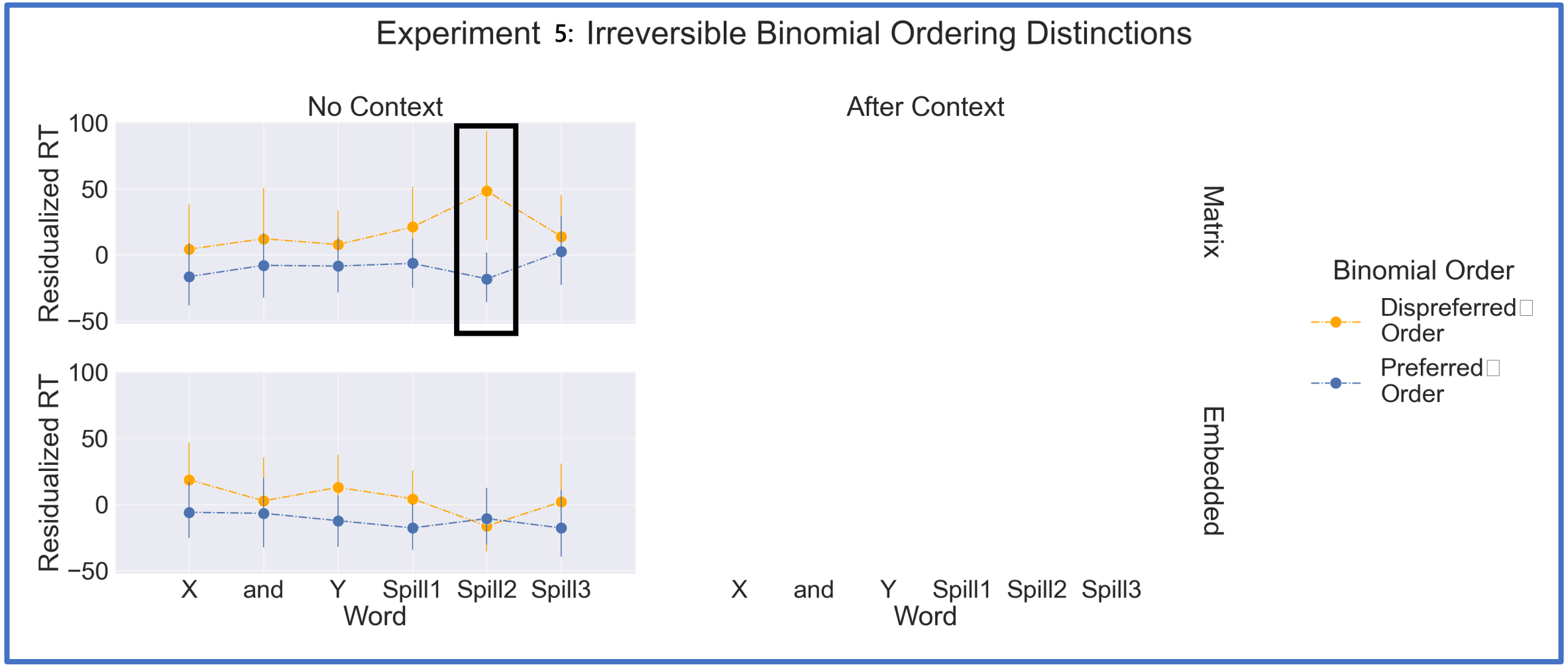
   A: Ordering preferences should surface after the conjunction of the binomial expression, as that is the earliest point of disambiguation.


Experiment 5: Irreversible Binomial Ordering Distinctions
No Context
After Context
Residualized RT
100
50
0
−50
Matrix
Embedded
X
and
Y
Spill1
Spill2
Spill3
Word
Binomial Order
Dispreferred Order
Preferred Order



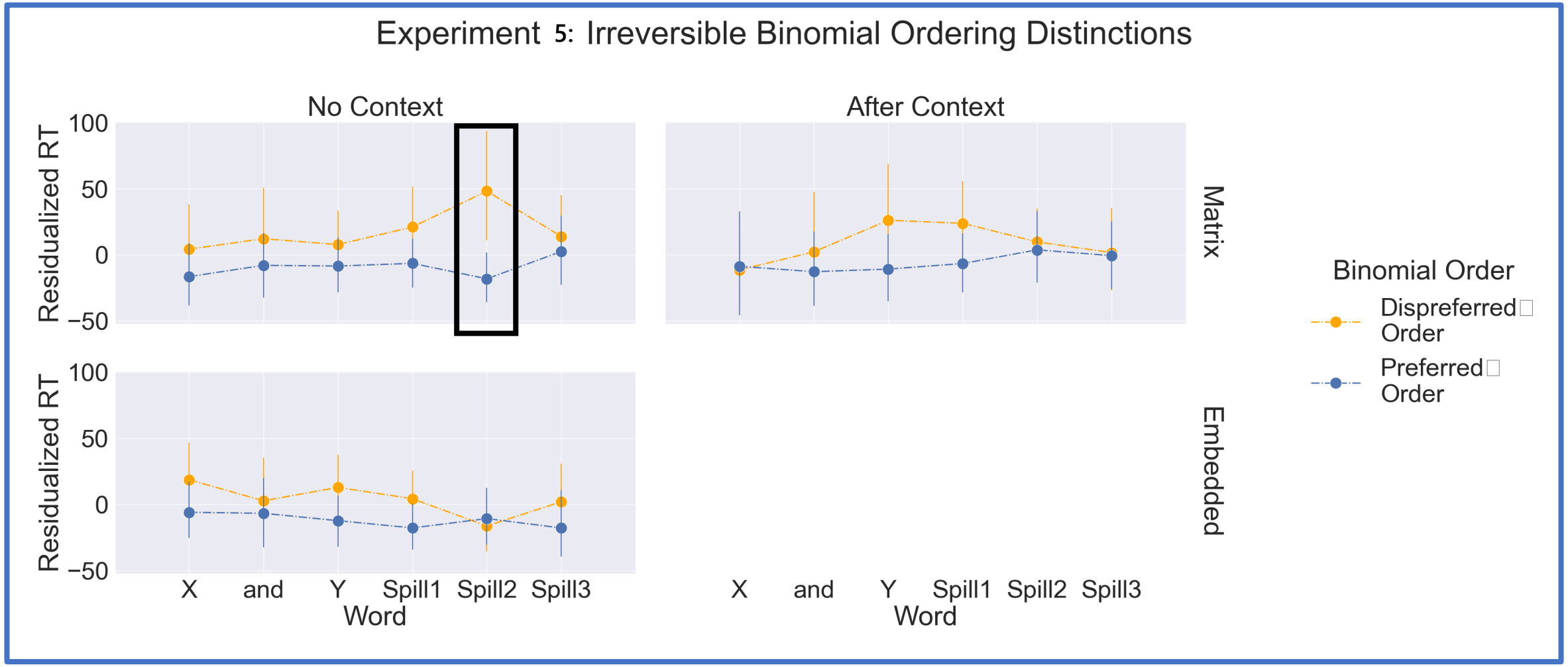
1. Ordering preferences on the second spillover word in MATRIX x No Context.

For each position in critical region: ResRT ~ Frame*Context*Target+ (1 | Item) + (1 | Participant)



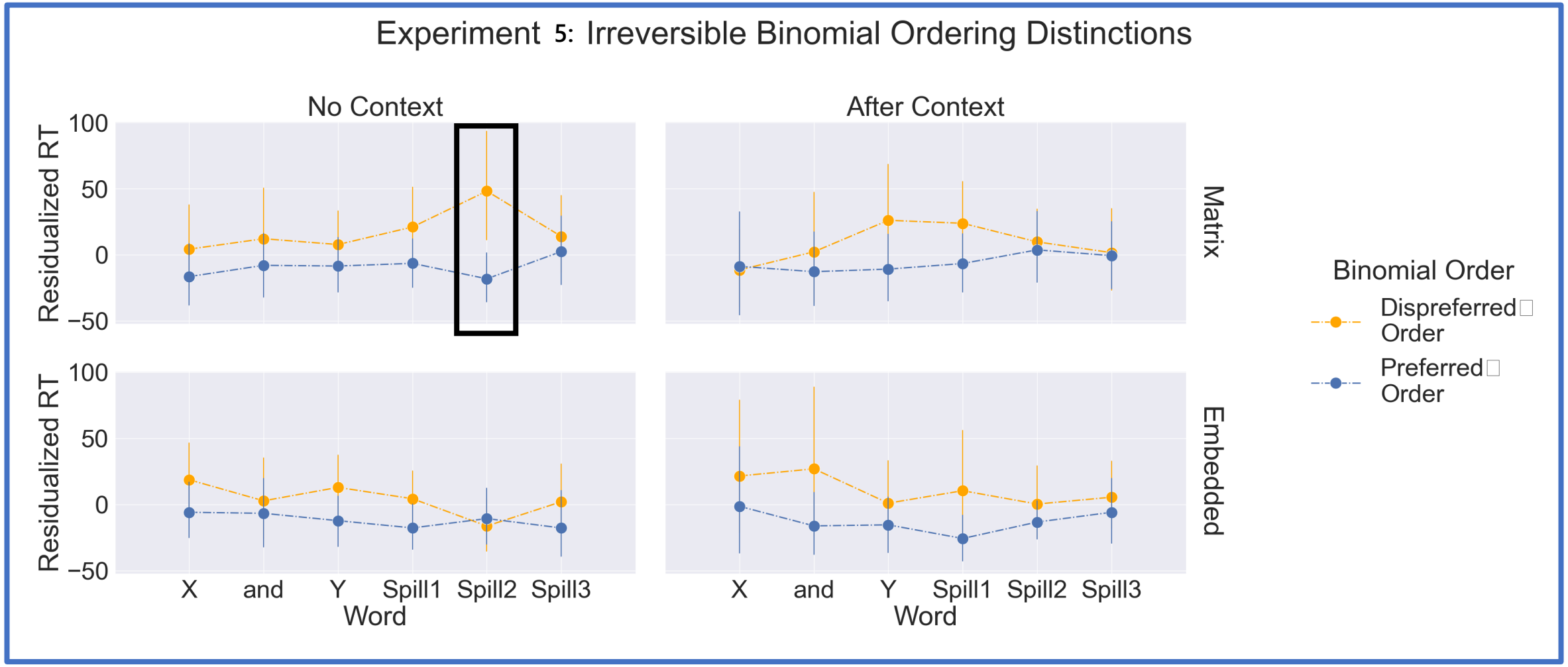
1. Ordering preferences on the second spillover word in MATRIX x No Context.

For each position in critical region: ResRT ~ Frame*Context*Target+ (1 | Item) + (1 | Participant)



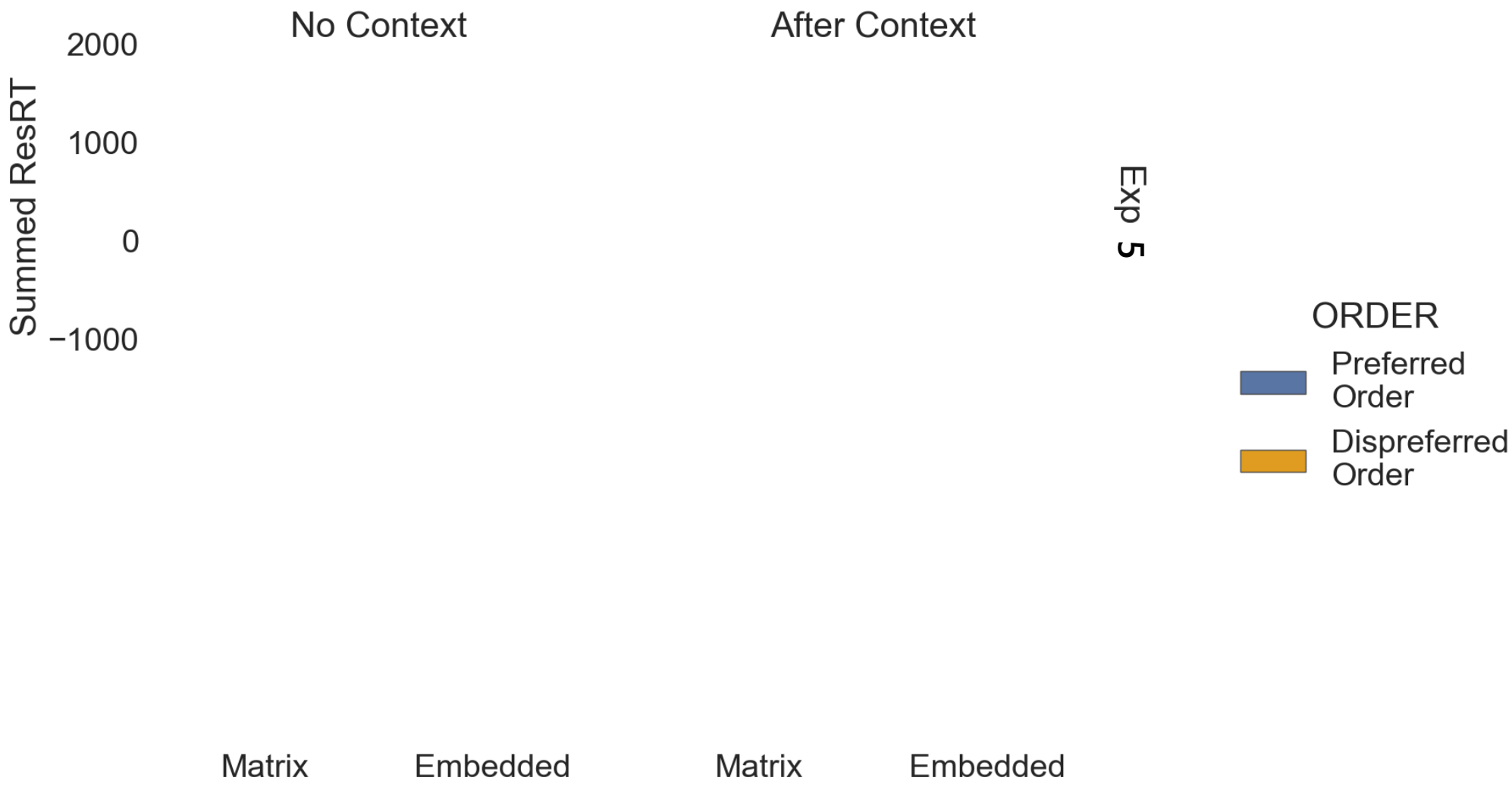
1. Ordering preferences on the second spillover word in MATRIX x No Context.

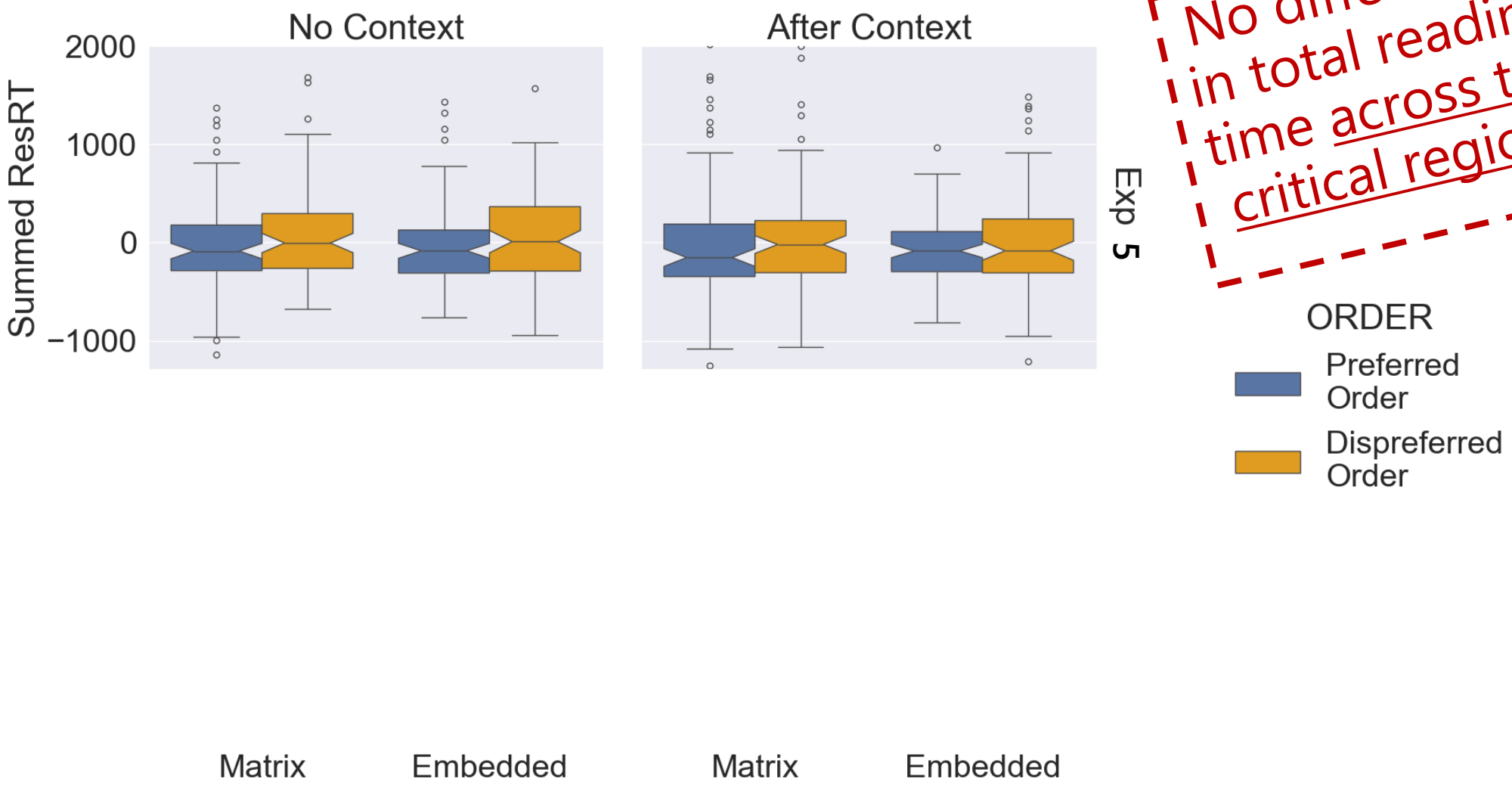
For each position in critical region: ResRT ~ Frame*Context*Target+ (1 | Item) + (1 | Participant)



1. Ordering preferences on the second spillover word in MATRIX x No Context.
2. No evidence for ordering preferences elsewhere for *irreversible binomials*.

For each position in critical region: ResRT ~ Frame*Context*Target+ (1 | Item) + (1 | Participant)


No Context
After Context
Summed ResRT
2000
1000
0
−1000
Exp 5
ORDER
Preferred Order
Dispreferred Order
Matrix
Embedded
Matrix
Embedded



No differences in total reading time across the critical region!

Experiment 5 takeaway

- Despite strong ordering preferences for these expressions (>96%) in isolation, no evidence for ordering preferences arise when the expressions are embedded syntactically or discursively.

- … so maybe these binomials are more reversible than we thought?

… but is that the full story?

- No evidence for ordering preferences based on statistical experience.

- What about ordering preferences based on abstract linguistic constraints?

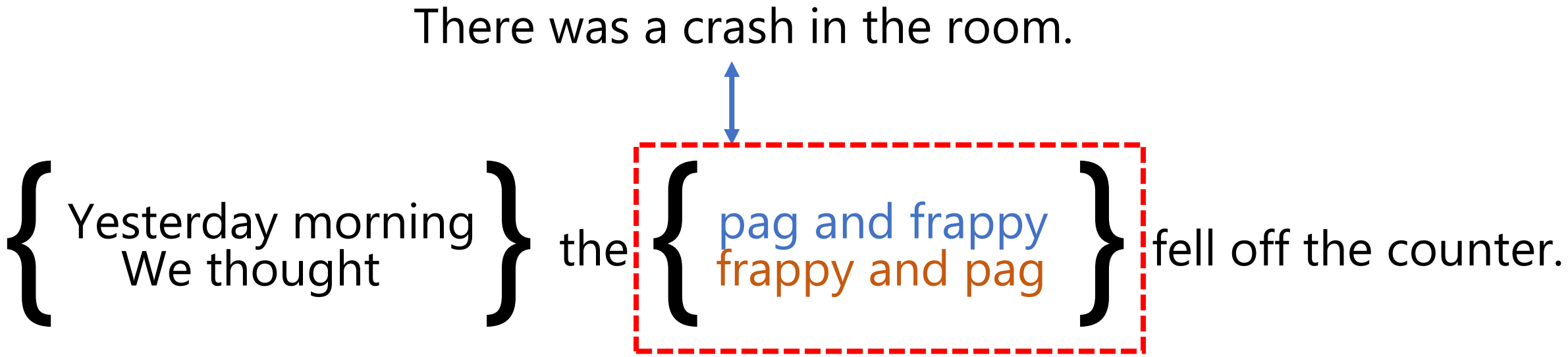
EXPERIMENT 6

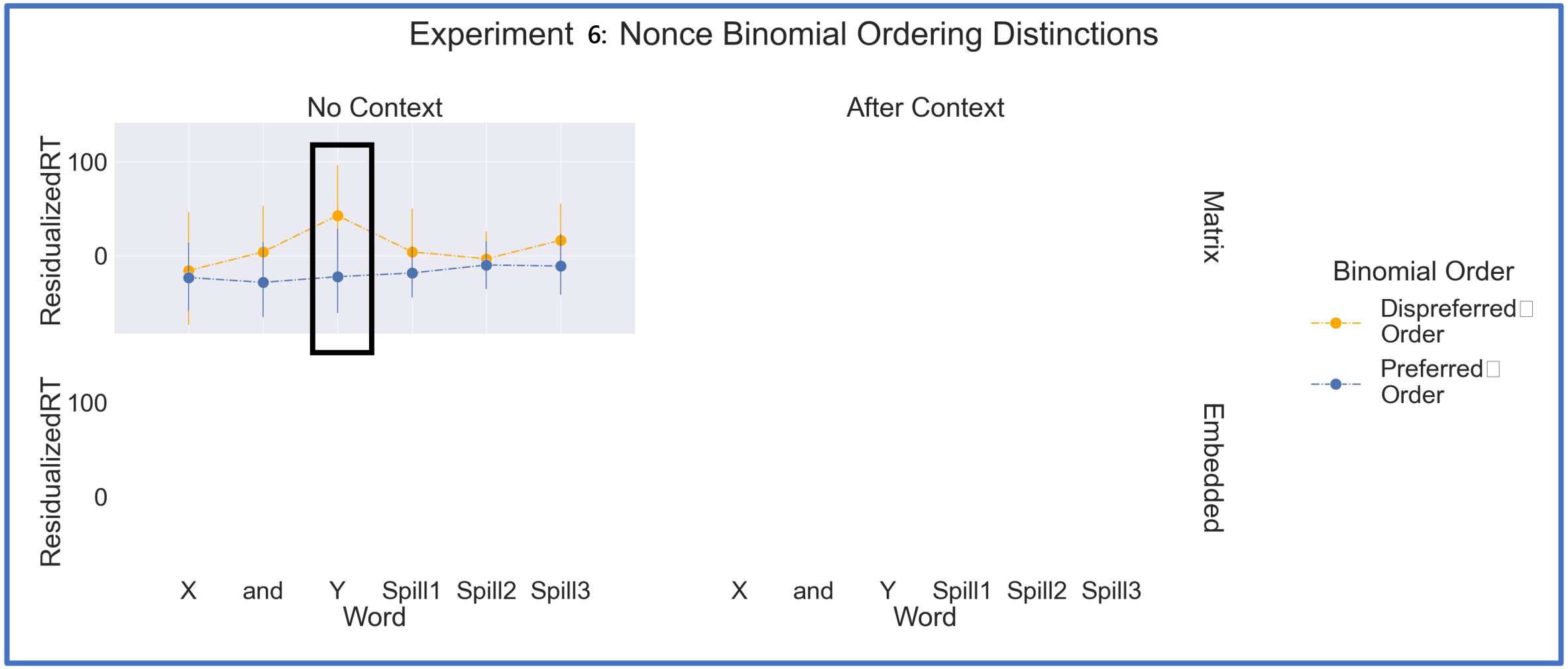
How do ordering preferences arise for non-word binomials in different contexts?

Presented at AMLaP 2024!

Experiment 6 Design

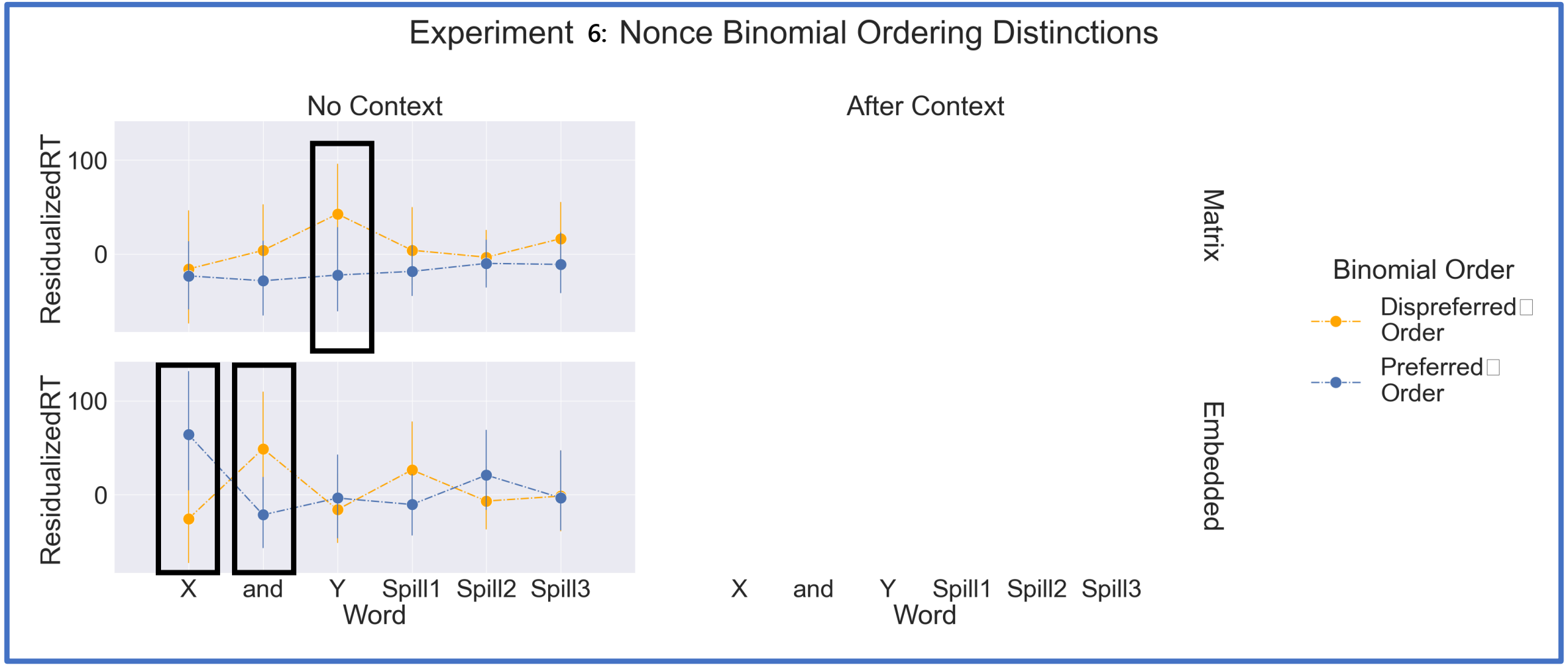
- Self-paced reading experiment, where participants (N=36) read 24 two-sentence passages:





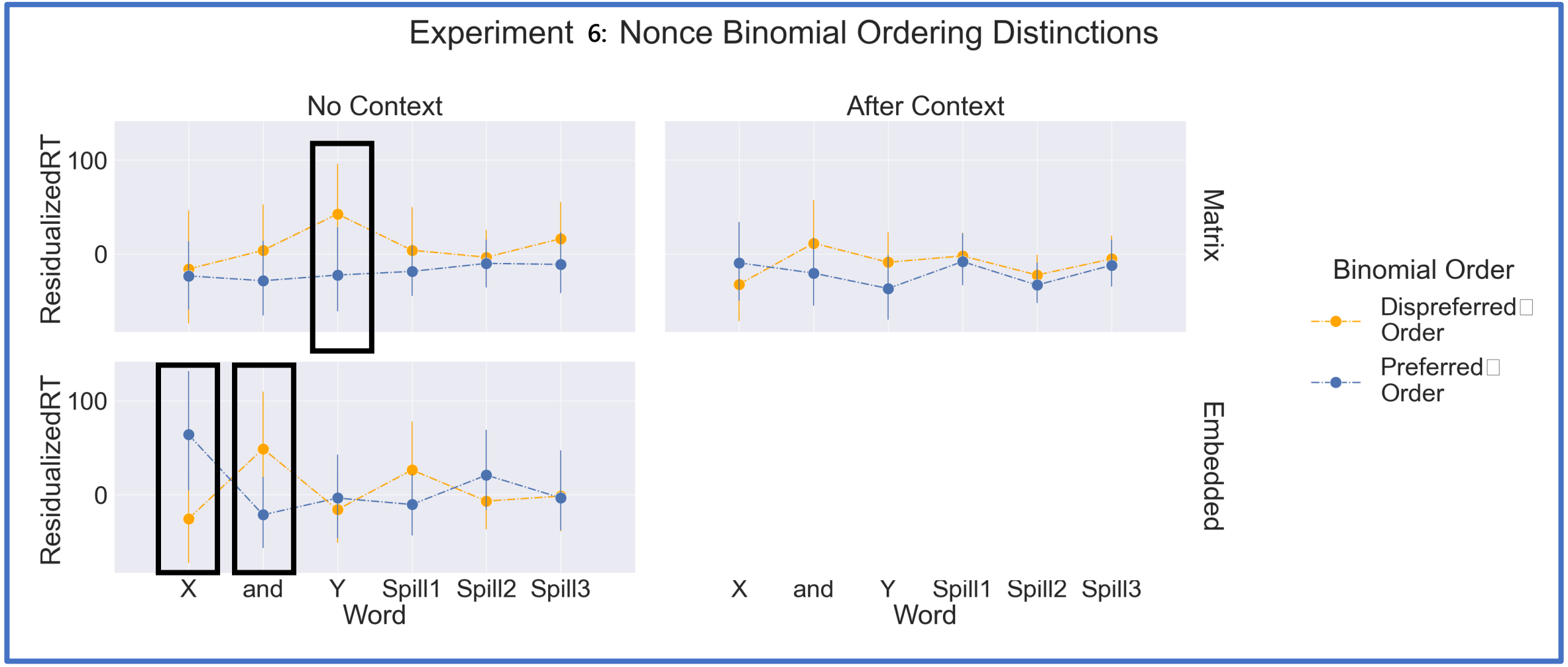
1. Ordering preferences on the second noun in MATRIX x No Context.

For each position in critical region: ResRT ~ Frame*Context*Target+ (1 | Item) + (1 | Participant)



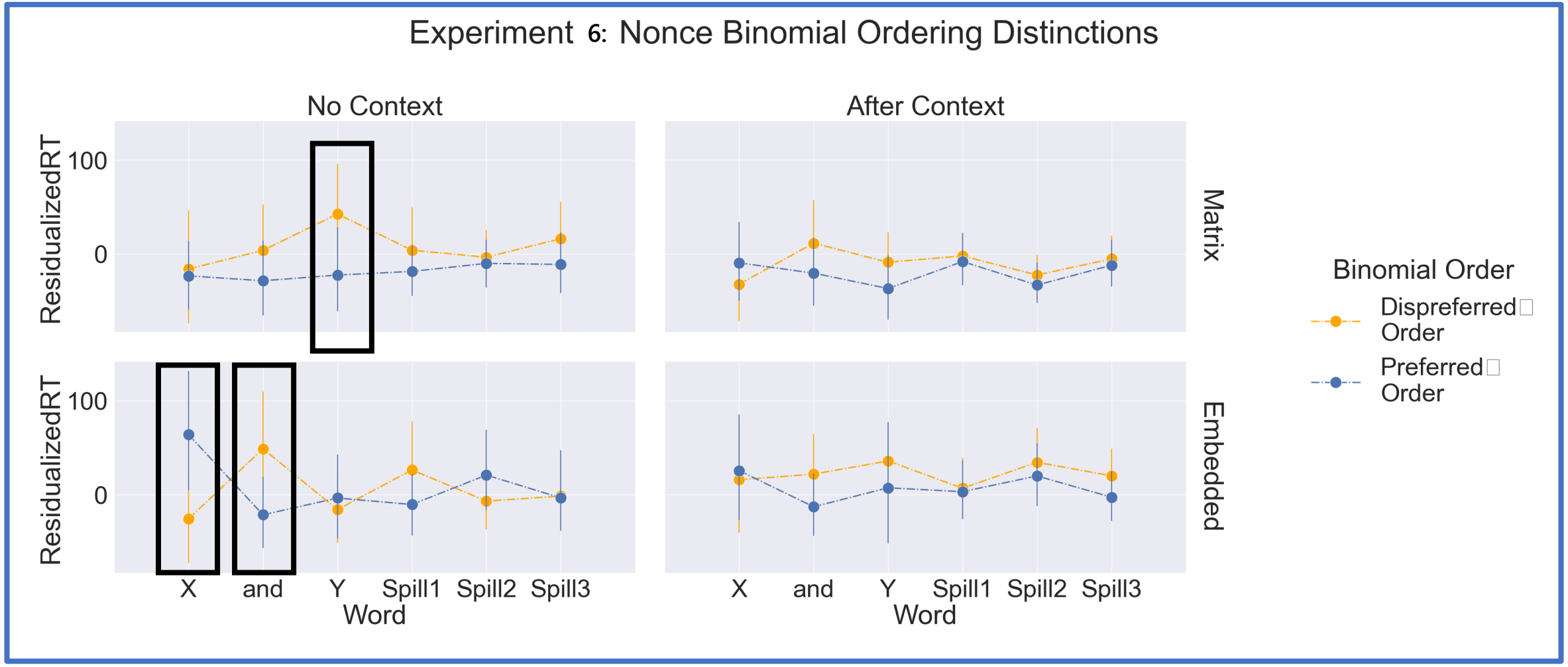
1. Ordering preferences on the second noun in MATRIX x No Context.
2. Some weak effects that appear unrelated to any ordering preferences

For each position in critical region: ResRT ~ Frame*Context*Target+ (1 | Item) + (1 | Participant)



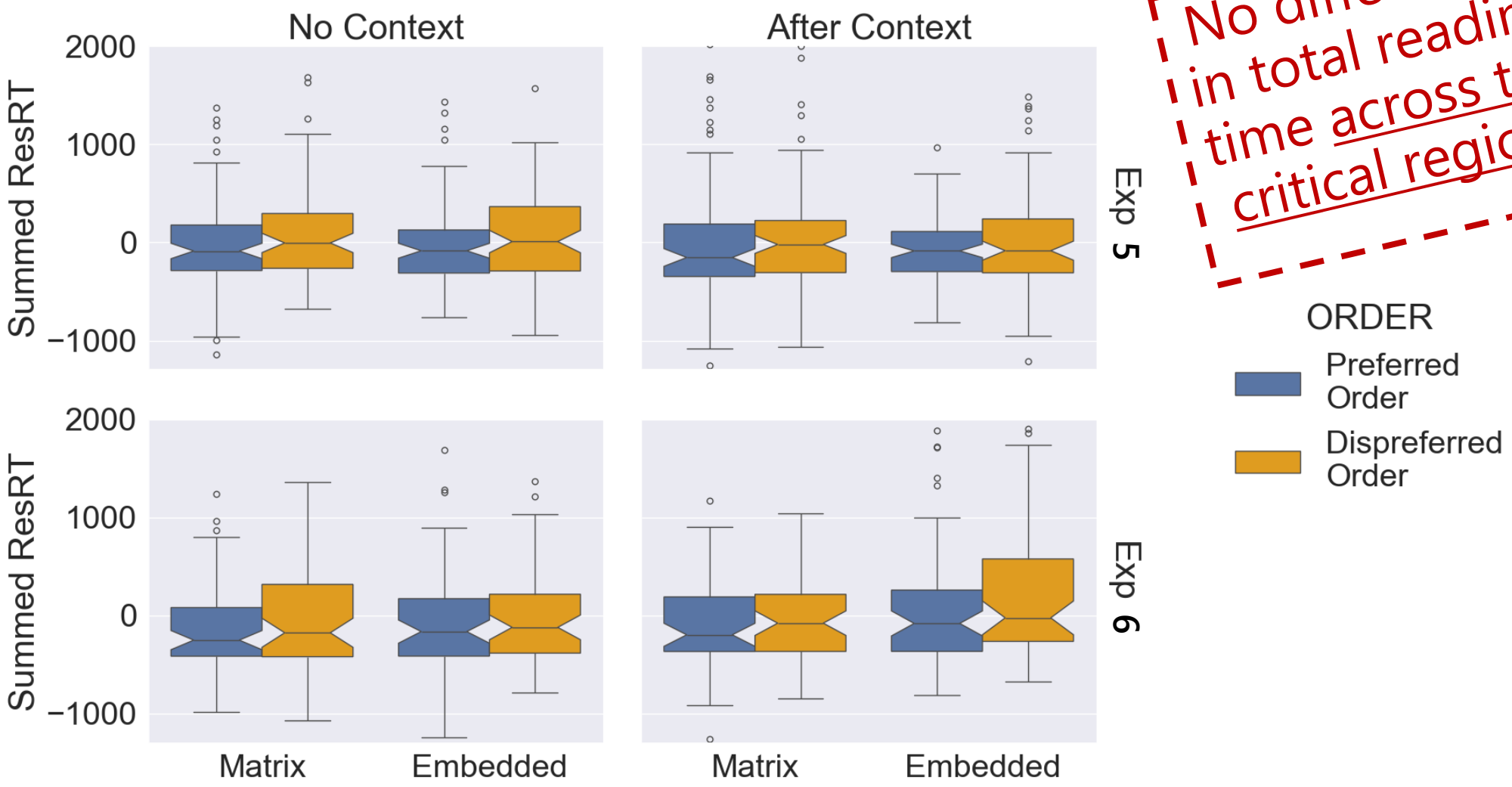
1. Ordering preferences on the second noun in MATRIX x No Context.
2. Some weak effects that appear unrelated to any ordering preferences

For each position in critical region: ResRT ~ Frame*Context*Target+ (1 | Item) + (1 | Participant)



1. Ordering preferences on the second noun in MATRIX x No Context.
2. Some weak effects that appear unrelated to any ordering preferences

For each position in critical region: ResRT ~ Frame*Context*Target+ (1 | Item) + (1 | Participant)



No differences in total reading time across the critical region!

Experiment 6 takeaways

1. Despite ordering preferences for these expressions (>70%) in isolation, no evidence for ordering preferences arise when the expressions are embedded syntactically or discursively

2. Processing costs of reading dispreferred orders from *abstract linguistic constraints* do not arise

DISCUSSION

Summary of phonotactic results:

- Experiment 1: Phonotactic distinctions are robust in different syntactic contexts, though their timing varies…
- Experiment 2, 3: … but they don’t arise in all cases, especially if syntax is complicated and a discourse is present.
- Experiment 4: Phonotactic distinctions do not arise for non-words with modified codas.

Summary of binomial results:

- Experiment 5: No evidence for ordering preferences when *irreversible binomials* are embedded syntactically or discursively.

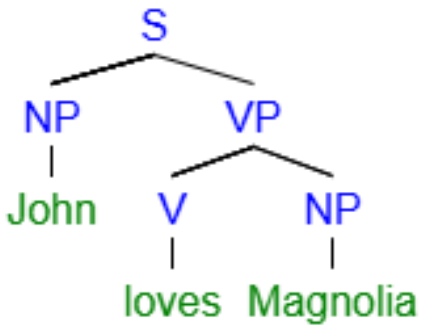
- Experiment 6: No evidence for ordering preferences when *non-word binomials* are embedded syntactically or discursively.

What does all this mean?

- This goal of this talk is not to cast doubt on prior work.
  - These judgments have been robustly investigated for decades!*
- We show how context modulates established judgments.
  - Differences between experimental paradigms
  - High-level structure interacts with low-level structure
  - … and there are often multiple interactions!
- What might be going on?

*Almost over a century for binomials, actually; see Behaghel's laws.

dʒɑn lʌvz mægˈnoʊljə



Ferreira & Patson (2007); Traxler (2014); Christianson (2016); *inter alia*

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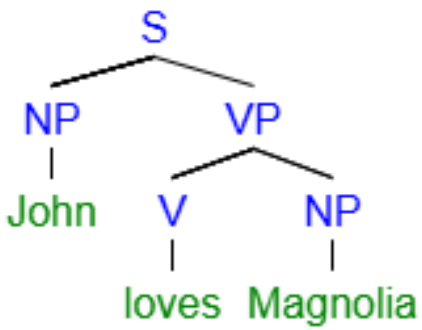

Ferreira & Patson (2007); Traxler (2014); Christianson (2016); *inter alia*

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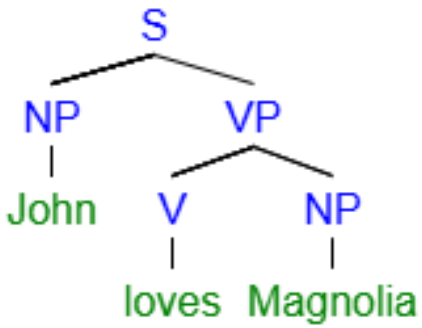

Ferreira & Patson (2007); Traxler (2014); Christianson (2016); *inter alia*

Through pixel panes, their eager faces glow,
A distant stage where voices still unite.
Though space divide, the shared ideas still flow,
And thought ignites from computer lights.

Through pixel panes, their eager faces *glow*,
A distant stage where voices still unite.
Though space divide, the shared ideas still *flow*,
And thought ignites from computer lights.

Through pixel panes, their eager faces *glow*,
A distant stage where voices still unite.
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Through pixel panes, their eager faces *glow*,
A distant stage where voices still unite.
Though space divide, the shared ideas still *flow*,
And thought ignites from computer lights.

Jon talk Calforna in Sowth.

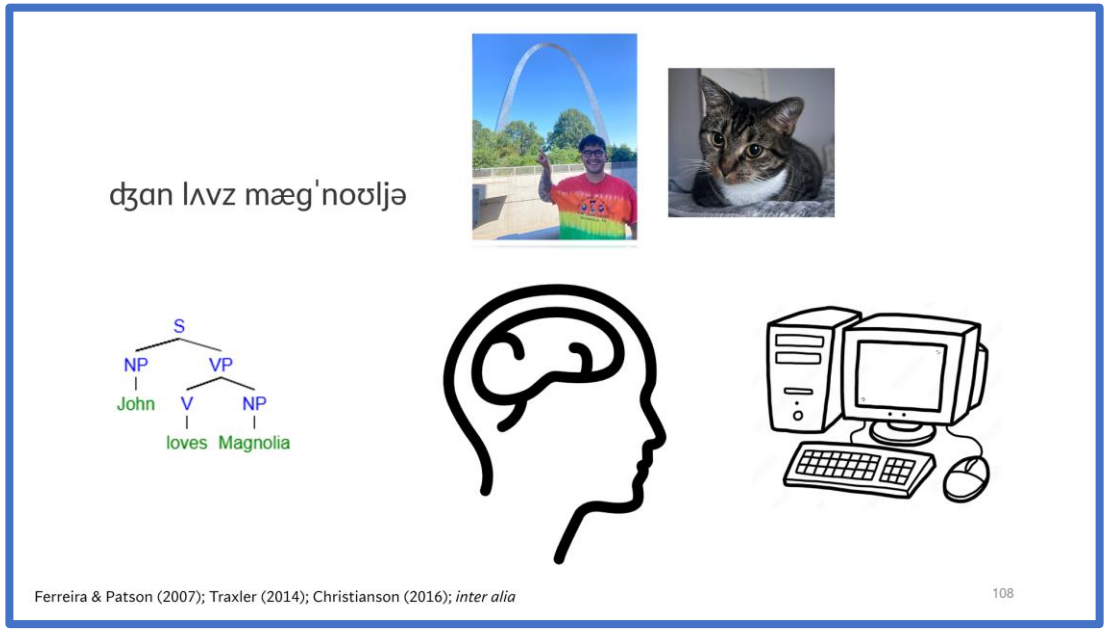
Testing ~~judgments~~ in context using…

linguistic processes

a) … multiple paradigms.

b) … multiple structures.

c) … multiple interactions between structures.



Acknowledgements

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PLab

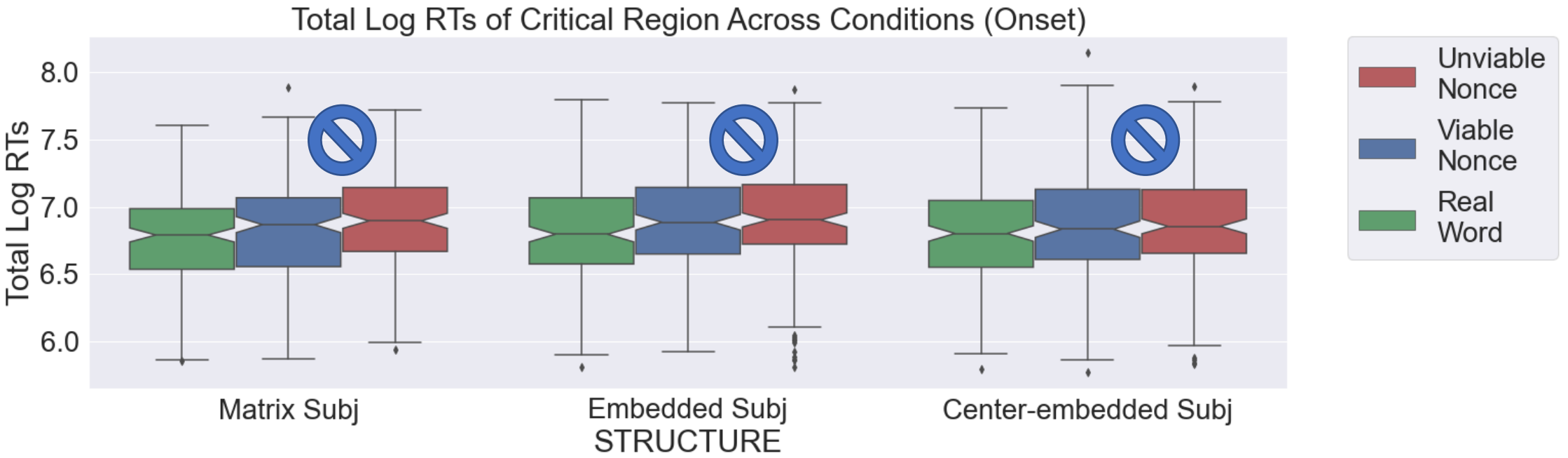
Cognitive Science @ Cornell

30 mtm fəˈnɒlədʒi

30th AMLaP EDINBURGH, 2024

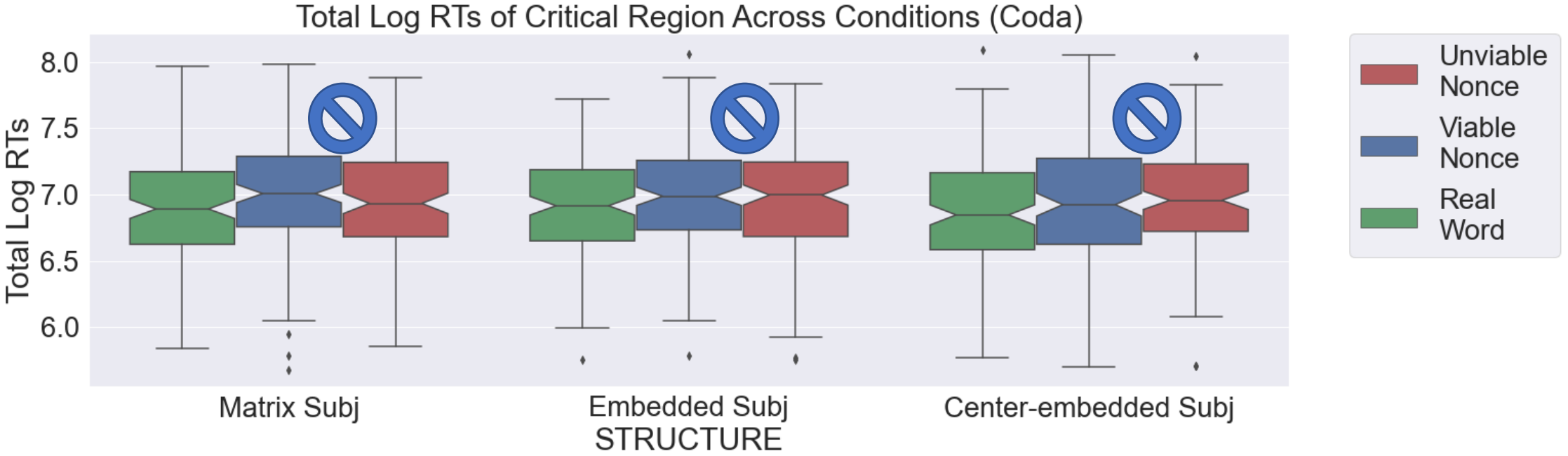
Thank you!

Processing time across total critical region (Experiment 1)



No significant differences in total processing!

Processing time across total critical region (Experiment 2)



No significant differences in total processing!