A Benchmark Dataset for Evaluating Sentence Processing Models in German

Sentence Processing Workshop in Golm

May 27, 2025

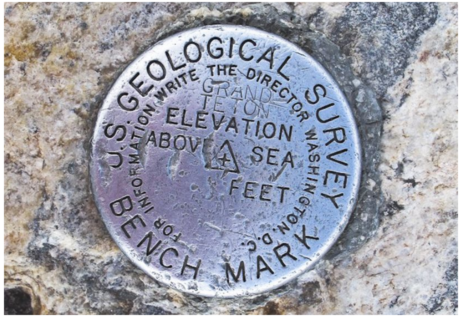
Michael Vrazitulis

1 Introduction

Benchmark data are essential for theory building and model testing.

In sentence processing, there is an **urgent need** for datasets covering multiple experimental designs in a single large participant sample.

One such dataset was created by Huang et al. (2024), covering several syntactic ambiguity phenomena in English (SAP Benchmark).



1 Introduction

Here, I present **ongoing work** on the creation of a **new benchmark dataset** for sentence processing in **German.**

It includes both **self-paced reading** and **eye-tracking** data.

2 The German Benchmark Dataset

osf.io/wpra9

GPSD (2×2): Garden Paths From Subject-vs.-Direct-Object Ambiguity Ambiguous/Unambiguous × S–O/O–S — closely replicating Meng & Bader (2000a)
GPSI (2×2): Garden Paths From Subject-vs.-Indirect-Object Ambiguity Ambiguous/Unambiguous × Active/Passive — loosely replicating Meng & Bader (2000b)
GPCA (2×2): Garden Paths From Coordination Ambiguity NP-/VP-Coordination × AP-/PP-Modifier — closely replicating Konieczny et al. (2000)
GPMI (2×2): Garden Paths From Modifier-vs.-Indirect-Object Ambiguity Modifier/No-Modifier × Ambiguous/Unambiguous — closely replicating van Kampen (2001)

2 The German Benchmark Dataset

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AGAT (2×2): Agreement Attraction in Grammatical Sentences
Singular-/Plural-Controller × Match/Mismatch — closely replicating Häussler (2009)

LOCO (2×2): Local Coherence
Coherent/Incoherent × Intervener/No-Intervener — closely replicating Paape & Vasishth (2016)

SBIN (2×2): Similarity-Based Interference
Subject-Cue [Yes/No] × Animacy-Cue [Yes/No] — closely replicating Schoknecht et al. (2025)

RCSO (2×2): Subject vs. Object Relative Clauses
Subject/Object × Double-/Single-Embedding — German adaptation of Hsiao & Gibson (2003)

2 The German Benchmark Dataset

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SYAA (3×1): Syntax-Based Attachment Ambiguity	
High-/Low-/Ambiguous-Attachment — closely replicating Logačev (2023)	
SEAA (3×1): Semantics-Based Attachment Ambiguity	
High-/Low-/Ambiguous-Attachment — German adaptation of Traxler et al. (2023)	

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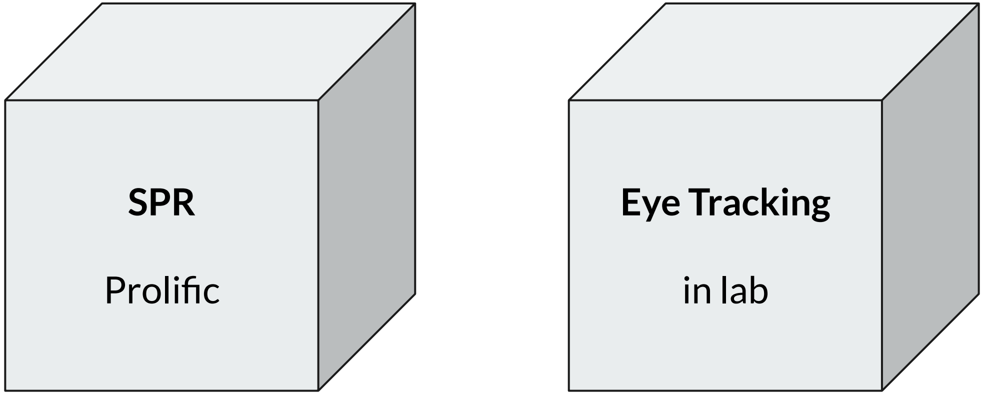

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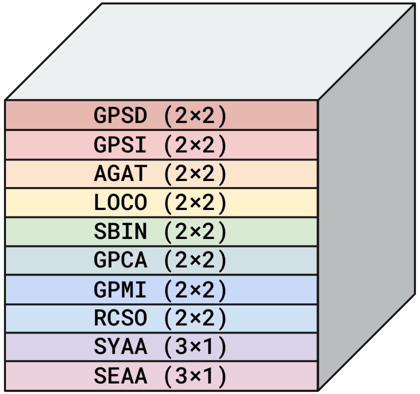

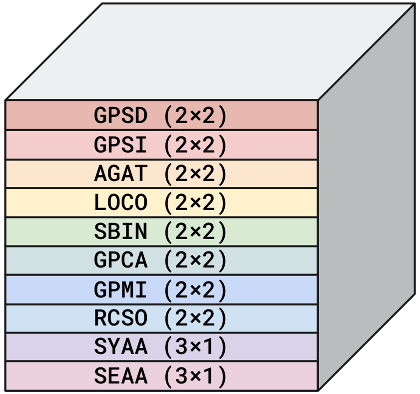

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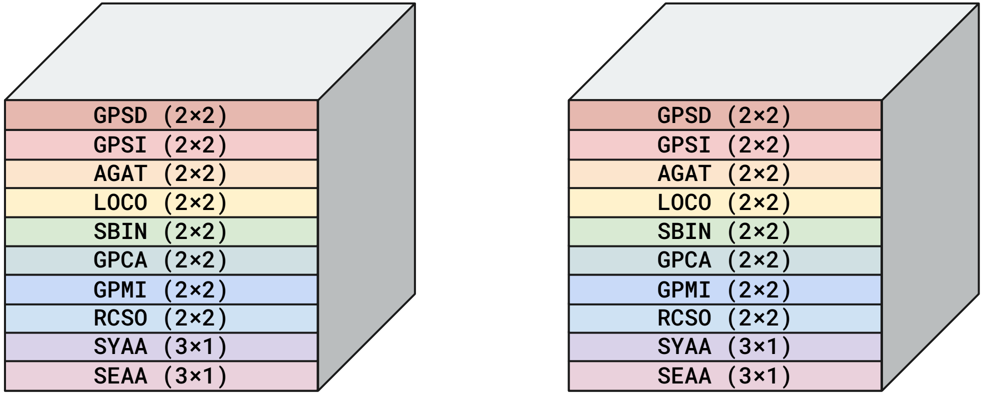
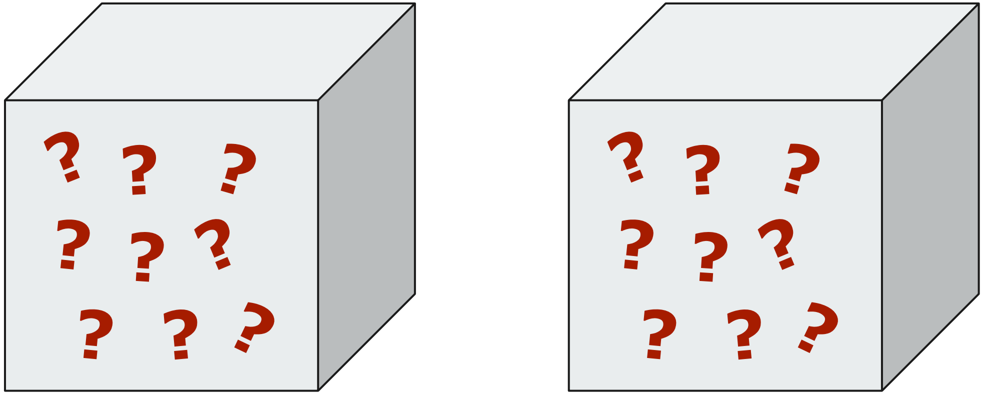


Three trials per condition per participant in a Latin square design

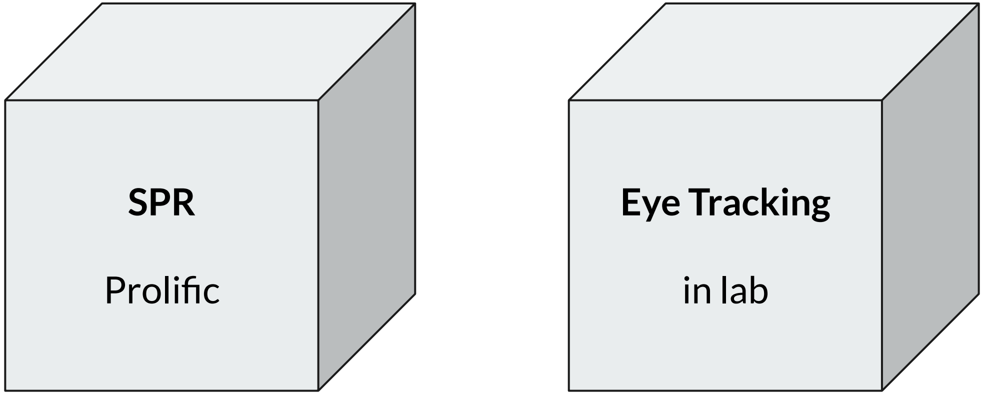
Overall trials per participant: **114** [= 8×3×(2×2) + 2×3×(3×1)]

2 The German Benchmark Dataset



Every trial is followed by a **comprehension question** with two response options, targeting the key syntactic dependency.

3 Data Collection Status and Goal



Already collected as of April 25, 2025:

N = 659

N = 119

3 Data Collection Status and Goal

SPR

Prolific

Eye Tracking

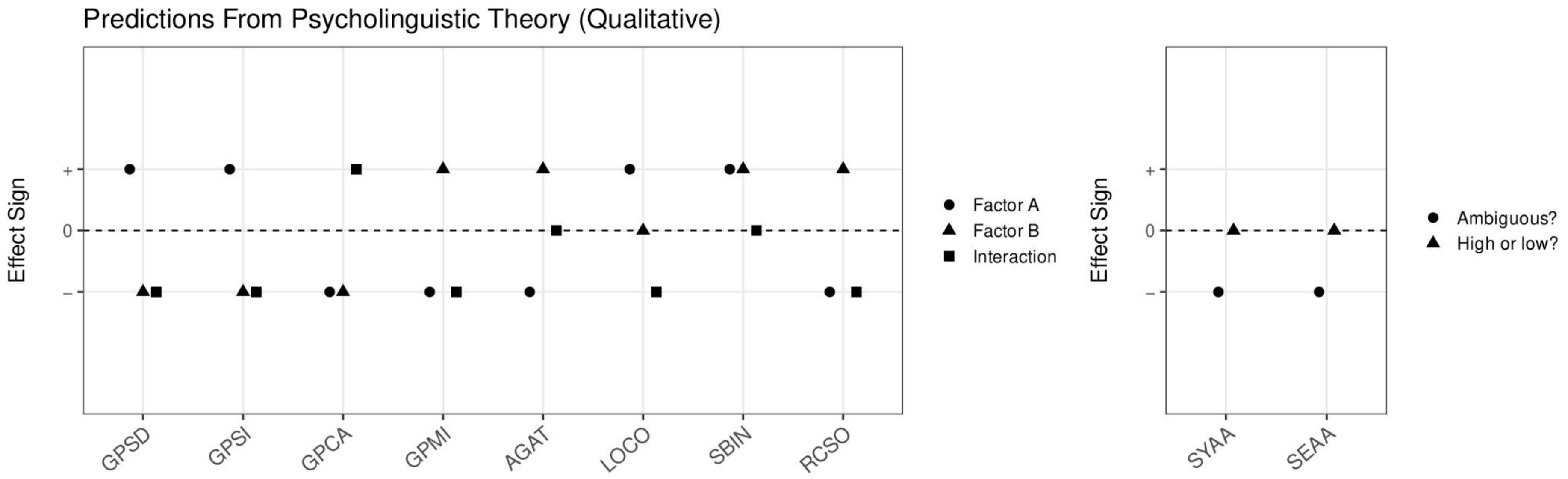
in lab

Goal:

***N* = 1,100**

Stop when *all* effect CrIs on TFTs range ±50ms or less.

4 Predictions and Observed Effects



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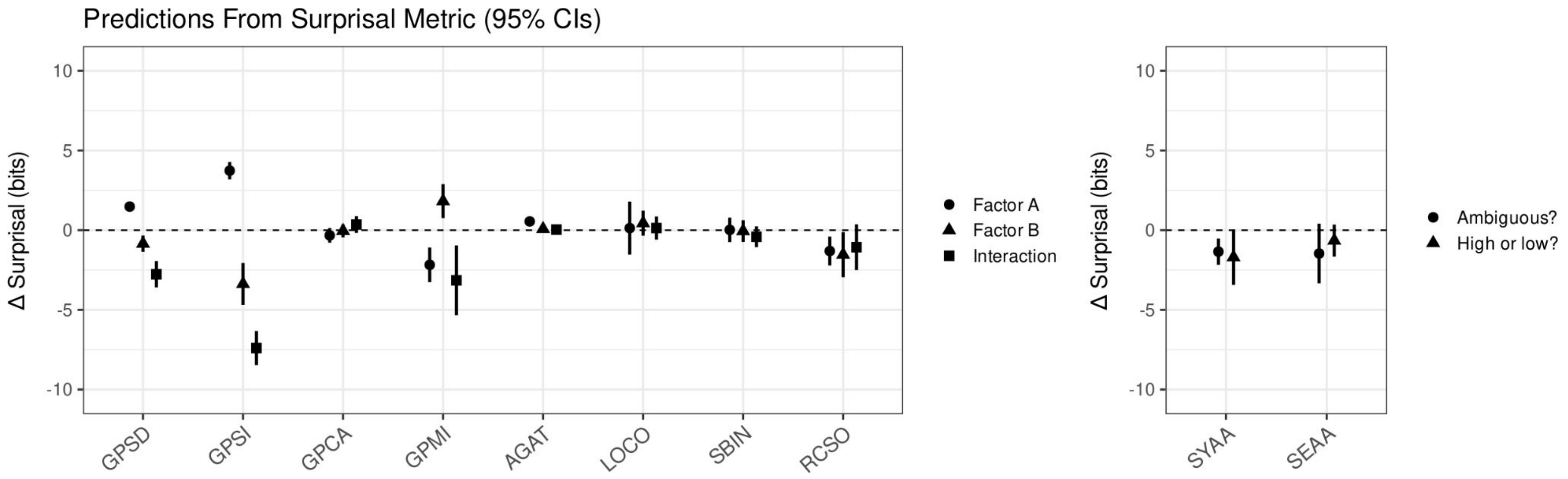

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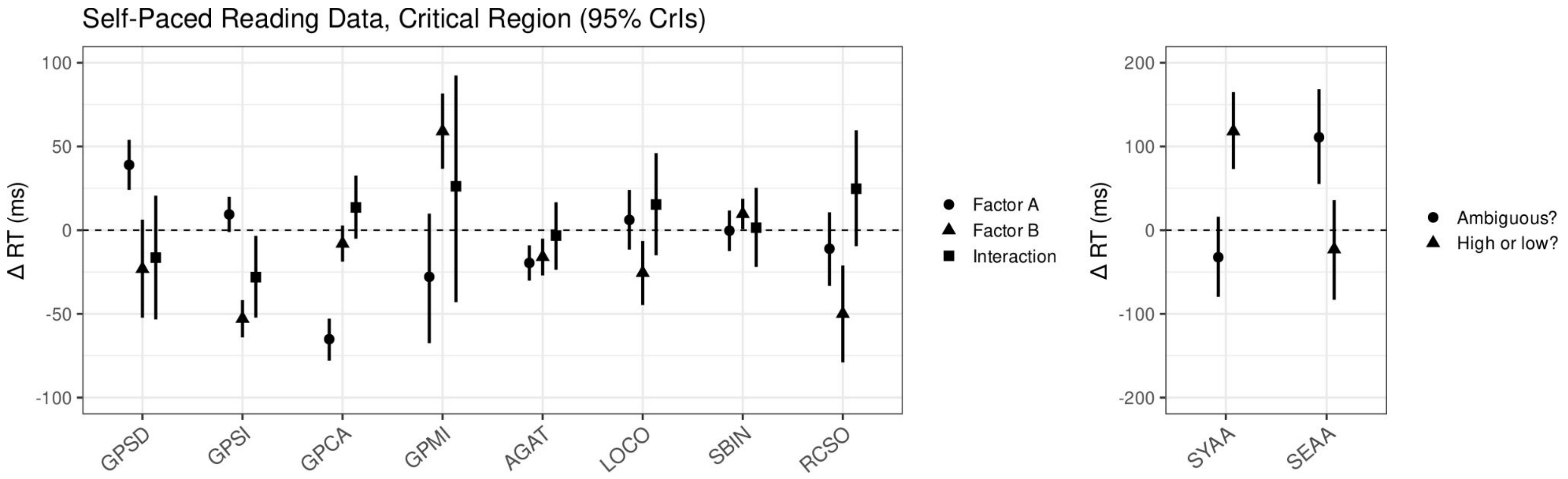

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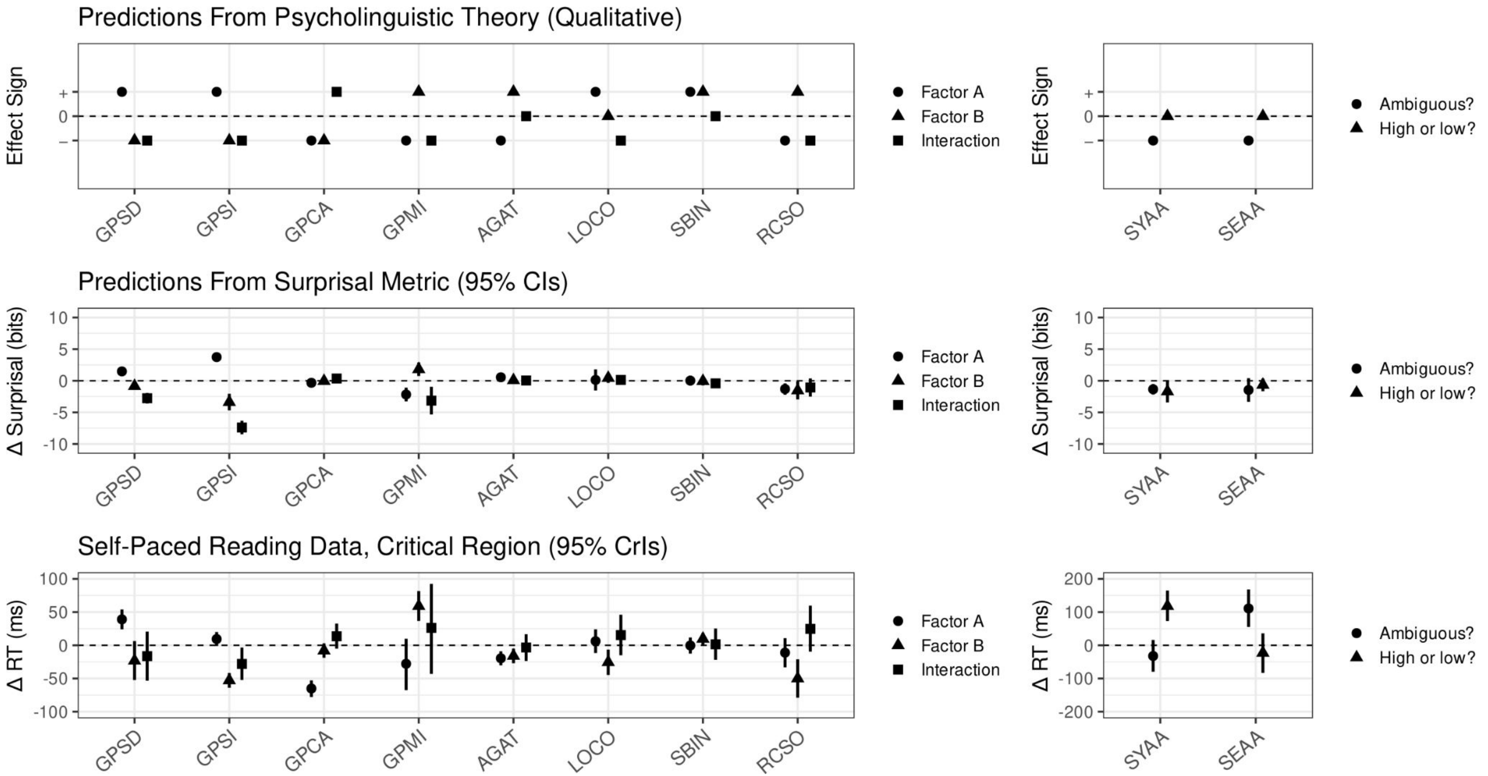
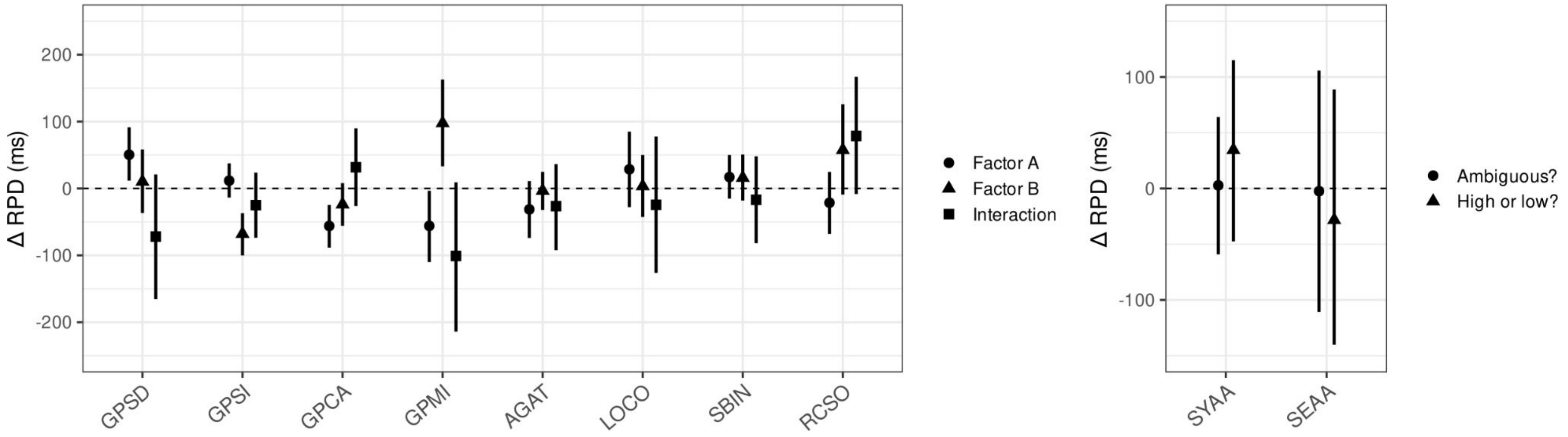


4 Predictions and Observed Effects

Regression Path Durations (RPD), Critical Region (95% CrIs)



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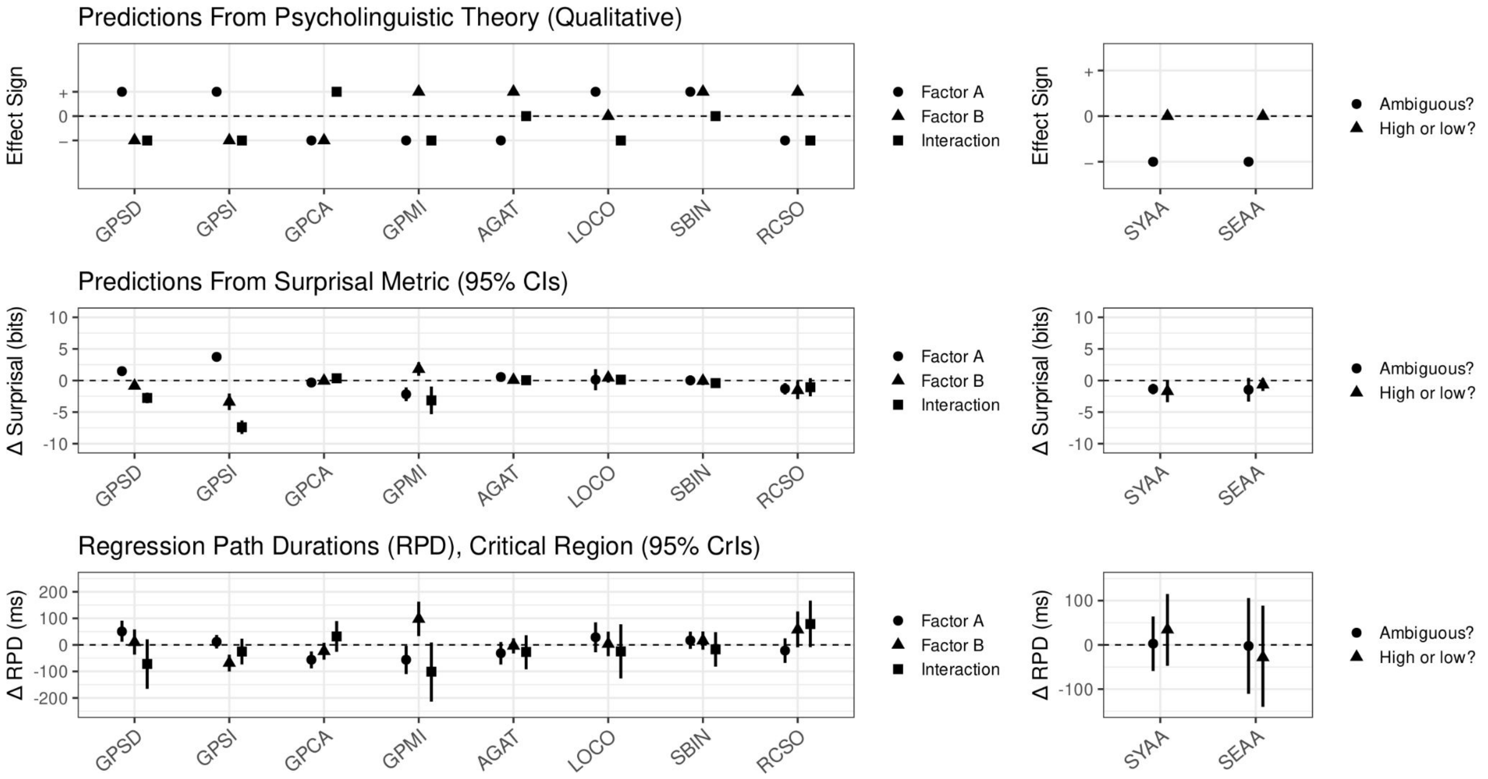

5 Model Evaluation and Comparison

Models with single linear predictor …

1. **Qualitative predictions** based on psycholinguistic theory (preregistered at osf.io/wpra9), encoding each predicted main effect / interaction as a 1-unit difference on the predictor

2. **Surprisal** (Hale 2001; Levy 2008) from GPT-2 (Radford et al. 2019)

3. **Lossy-context surprisal** (Futrell et al. 2021) from GPT-2, after probabilistic reconstruction of distorted context with BERT (Devlin et al. 2019) and Gibbs sampling

Evaluation method: Pareto-smoothed importance sampling (PSIS-LOO)

5 Model Evaluation and Comparison

Self-paced reading ($N_{included}$ = 615), reading times (RT) on critical region:

```
log(critical_RT) ~ predictor + (predictor | subject) + (predictor | phenomenon) + (predictor | phenomenon:item)
```

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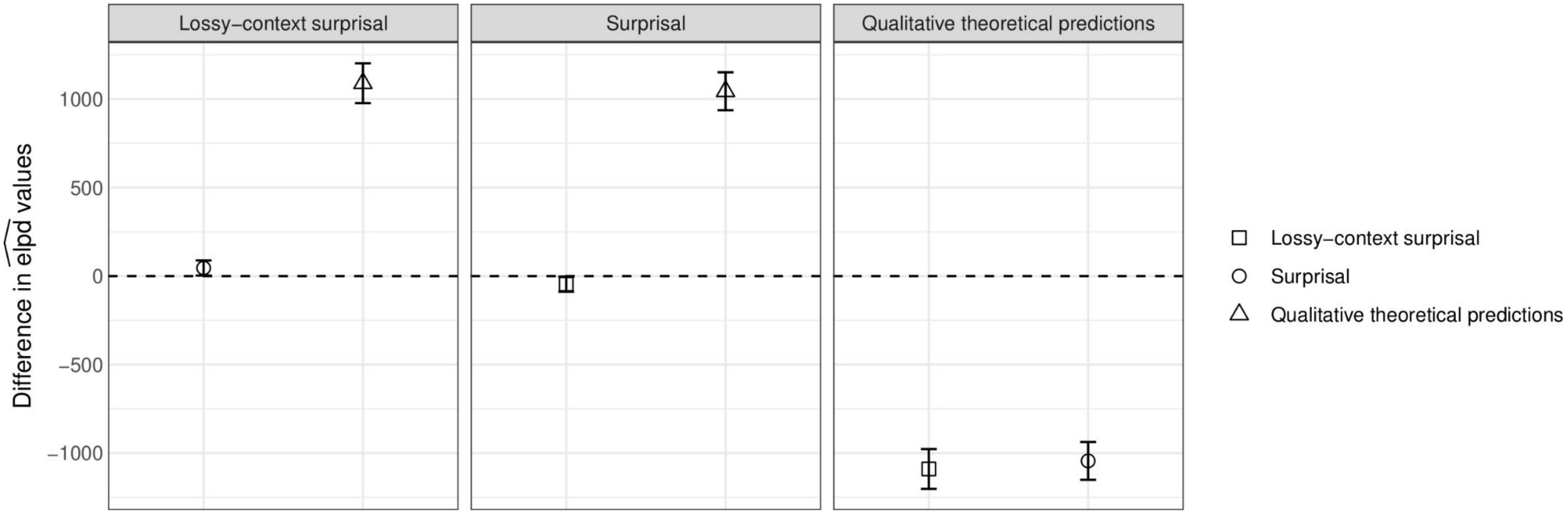

5 Model Evaluation and Comparison

Small, but significant edge of **lossy surprisal over plain surprisal.**

Huge edge of **both surprisal variants over classical qualitative theory.**

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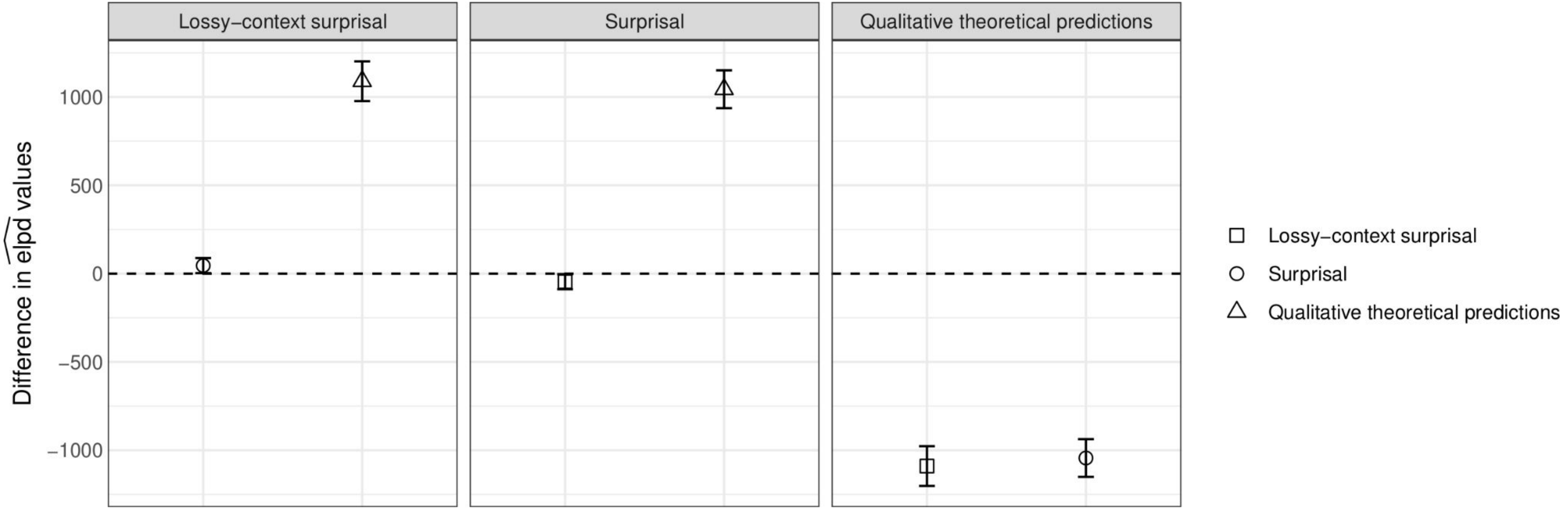

5 Model Evaluation and Comparison

Eye tracking (N_{included} = 118), regression path durations (RPD) on critical region:

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log(critical_RPD) ~ predictor + (predictor | subject) + (predictor | phenomenon) + (predictor | phenomenon:item)
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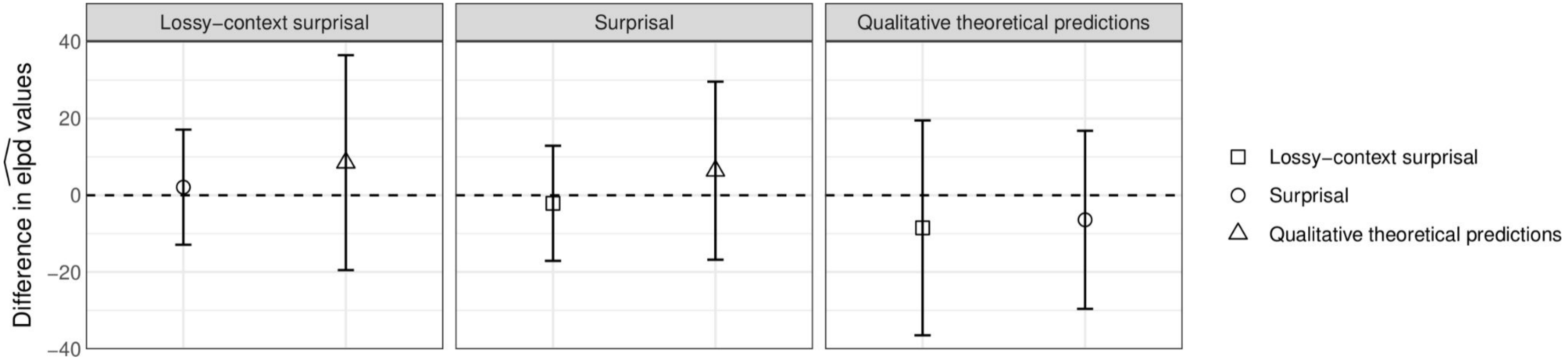

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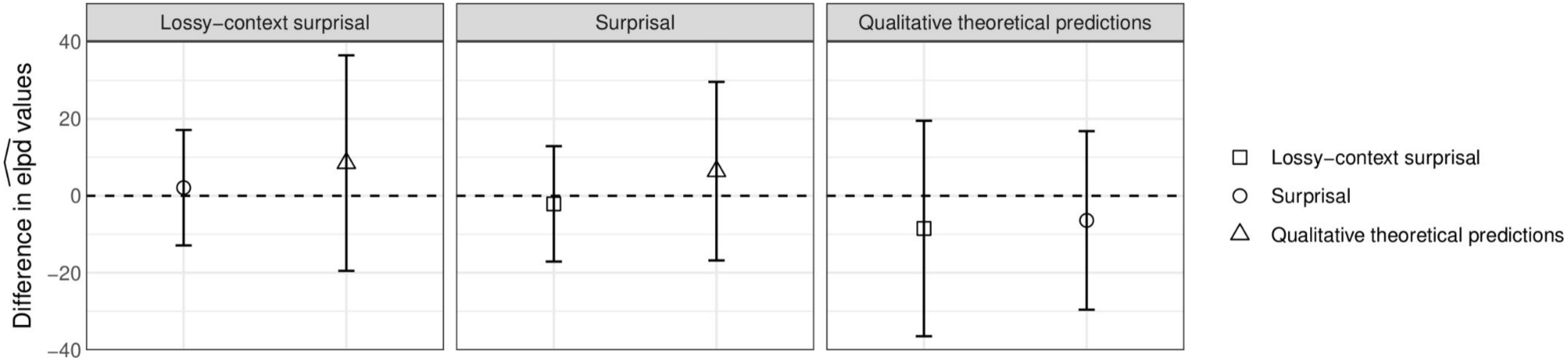
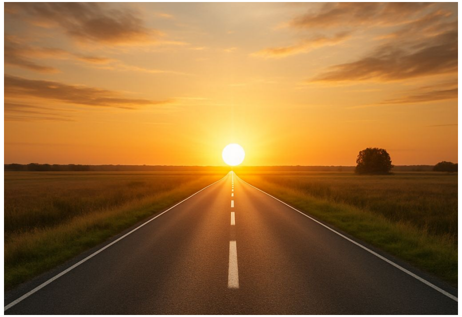


There is no evidence yet favoring one model over the others.

6 Future Directions

The **final dataset** will be **openly available.**

More **model evaluations** are planned, e.g, on resource-rational lossy surprisal (Hahn et al., 2022) or cognitive process models.



Thanks for your attention!

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