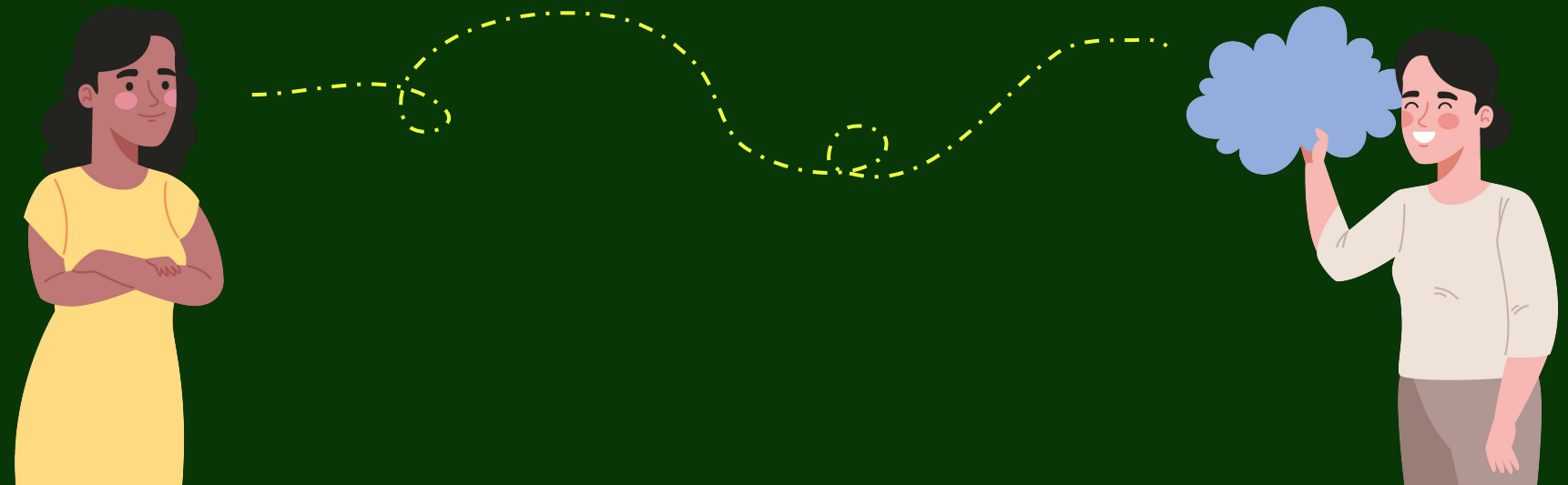
The model showed the garden paths deserved further investigation

Converting surprisals to reading times for garden-path sentences

Andrew Perun, Mandy Osuji, Rishika Veeramachaneni

The big picture!



Garden-path effects

The officer awarded the honor to the soldier received a standing ovation.

Main Verb/Reduced Relative (MVRR)

The actor who was paid the money became vain.

Noun Phrase/Sentence (NPS)

The mechanic observed that the truck needed repairing.

Noun Phrase/Zero (NPZ)

Once the new chef started, the restaurant flourished.

Surprisal theory

$$\text{surprisal}(w_i) = -\log P(w_i | w_1 \ldots w_i - 1)$$

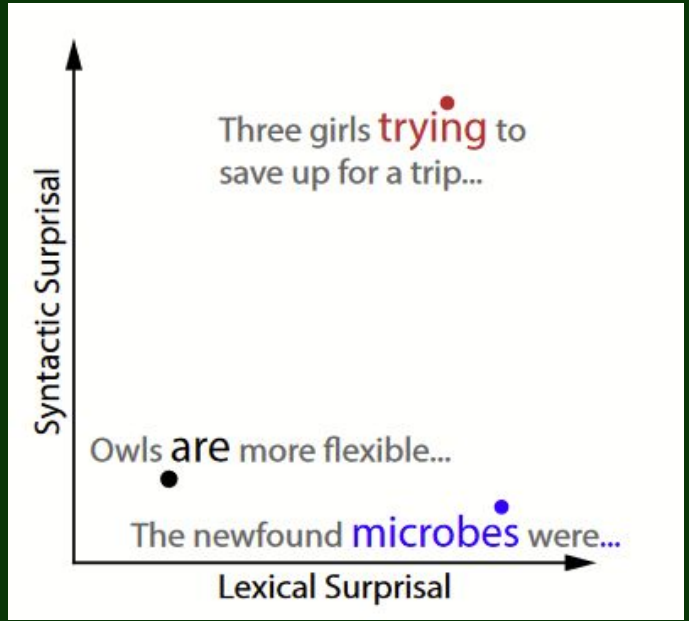
The operator observed the machine started working efficiently all of a sudden.

The operator observed that the machine started working efficiently all of a sudden.

Arehalli

Surprisal
- Syntactic Surprisal
  - Enriched POS Tagger

- Surprisal Theory
  - Linear to RT



Mapping Surprisal: Mixed-Effect Models

Predictors → RT

Surprisal Metric			
Only Syntactic	Only Lexical	Both	Neither

Non-Surprisal: Unigram frequency, Word Position, Word Length

Word N, N-1, N-2

Mapping Surprisal: Mixed-Effect Models

Train

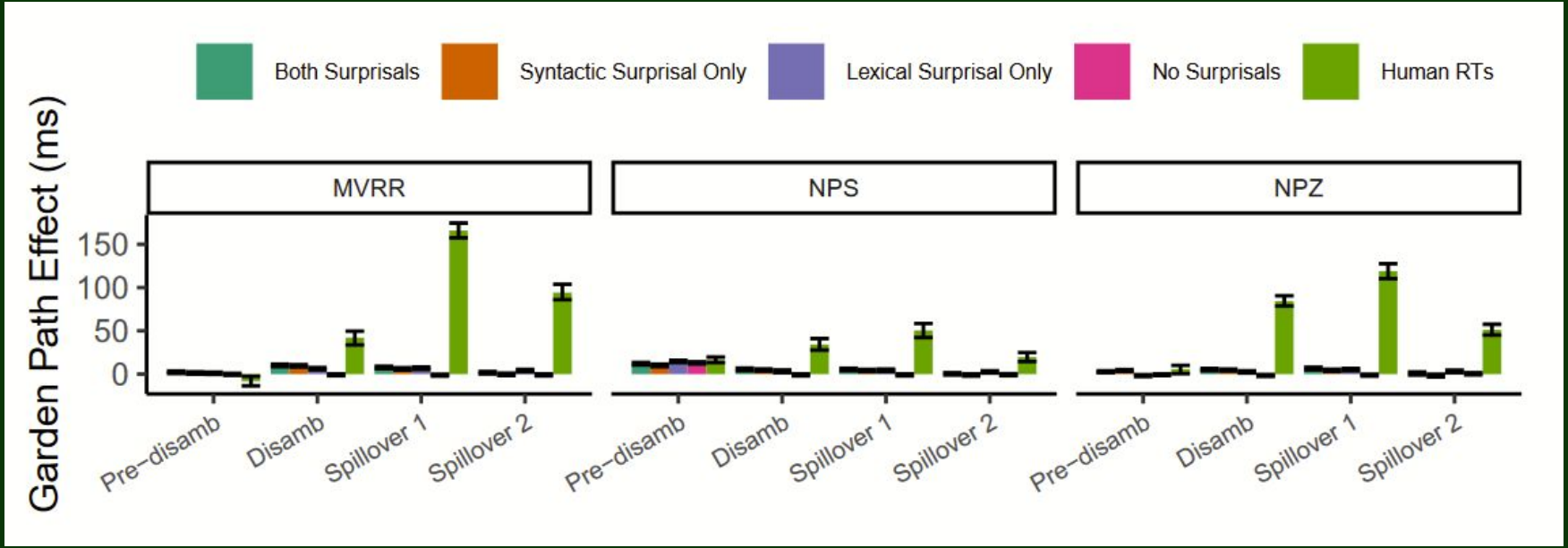
Filler (Unambiguous)

Evaluate

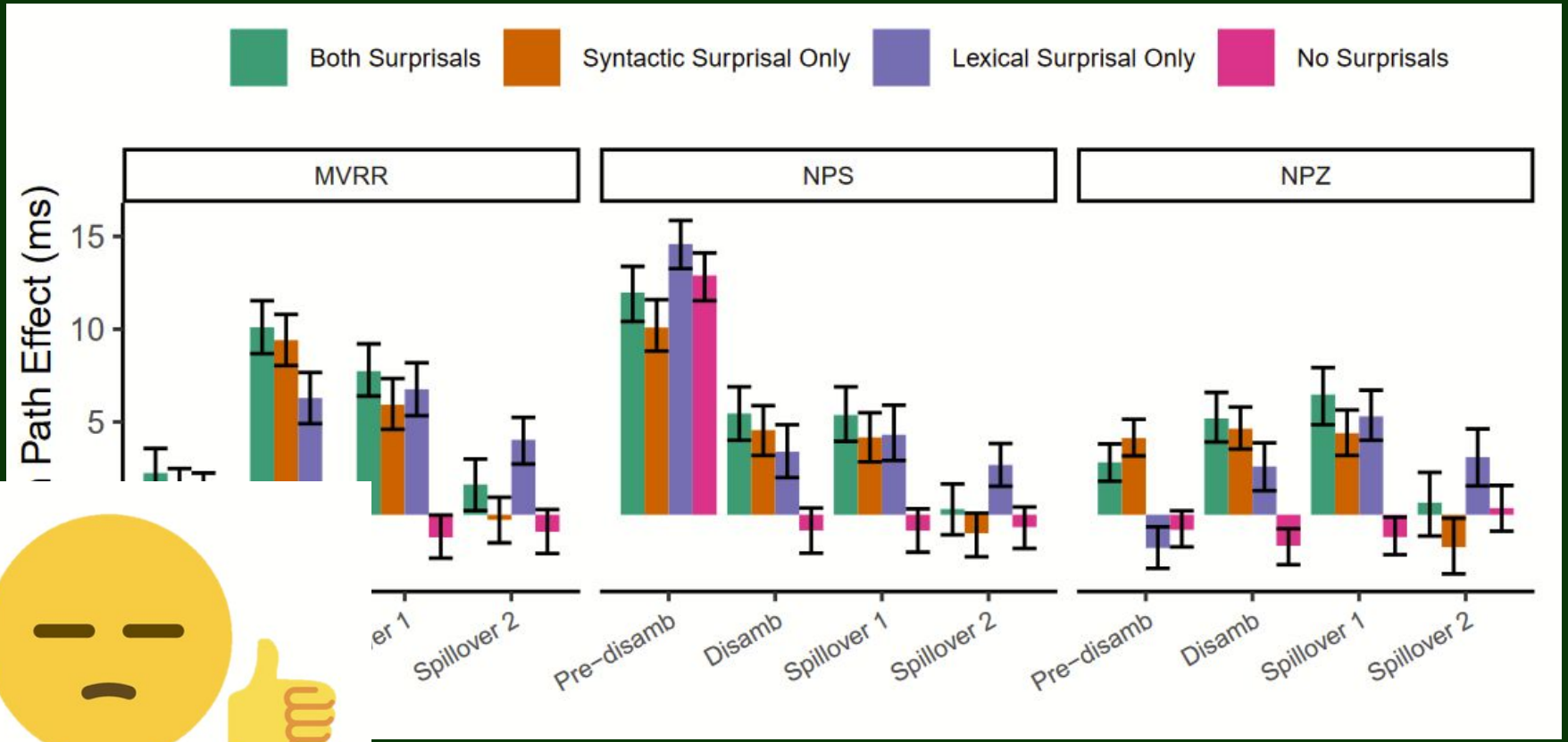
Garden Path

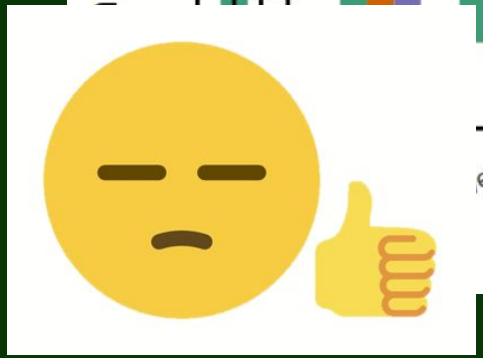
Model Predictors → RT → RT Differences/GP Effect

Their Results:



Their Results:





Why did they fail to capture the magnitude of empirical garden path effects?

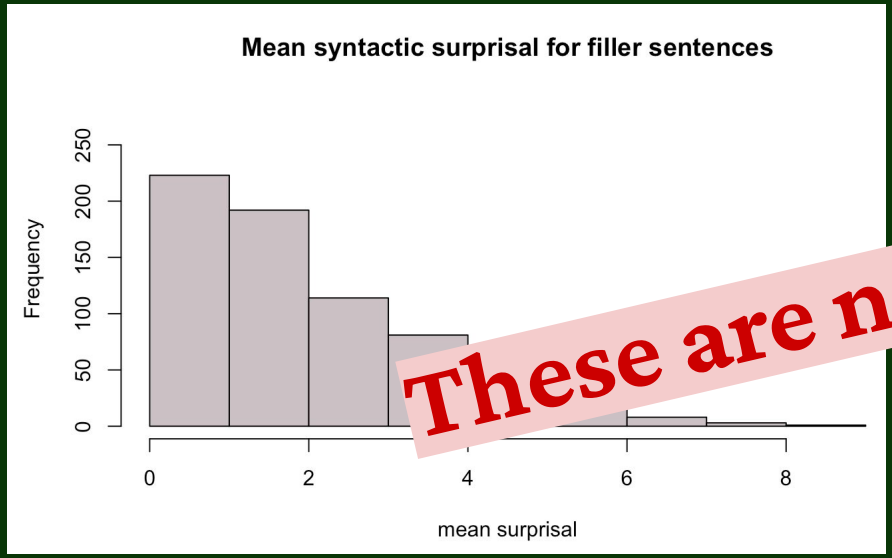
Surprisal to RT Model?

Could we improve their results?

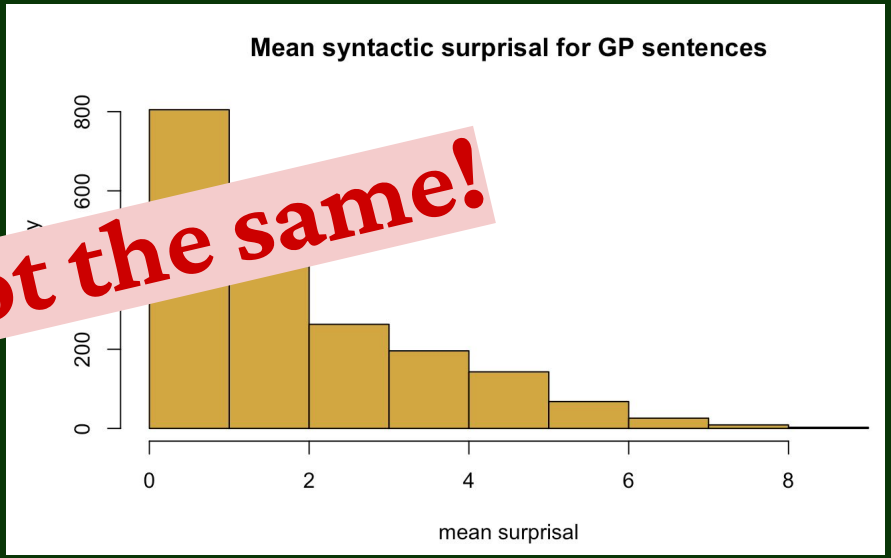
Arehalli's Model Mistakes:

Trained to translate Surprisals to RTs

Training Data



Test Data



These are not the same!

Experiment 1

3 Models:

Train

Syntactic Surprisals from Filler & 2 from {MVRR, NPS, NPZ}

Evaluate

Syntactic Surprisals from Excluded Garden Path Case

Syntactic Surprisal → RT

Experiment 2

3 Models:

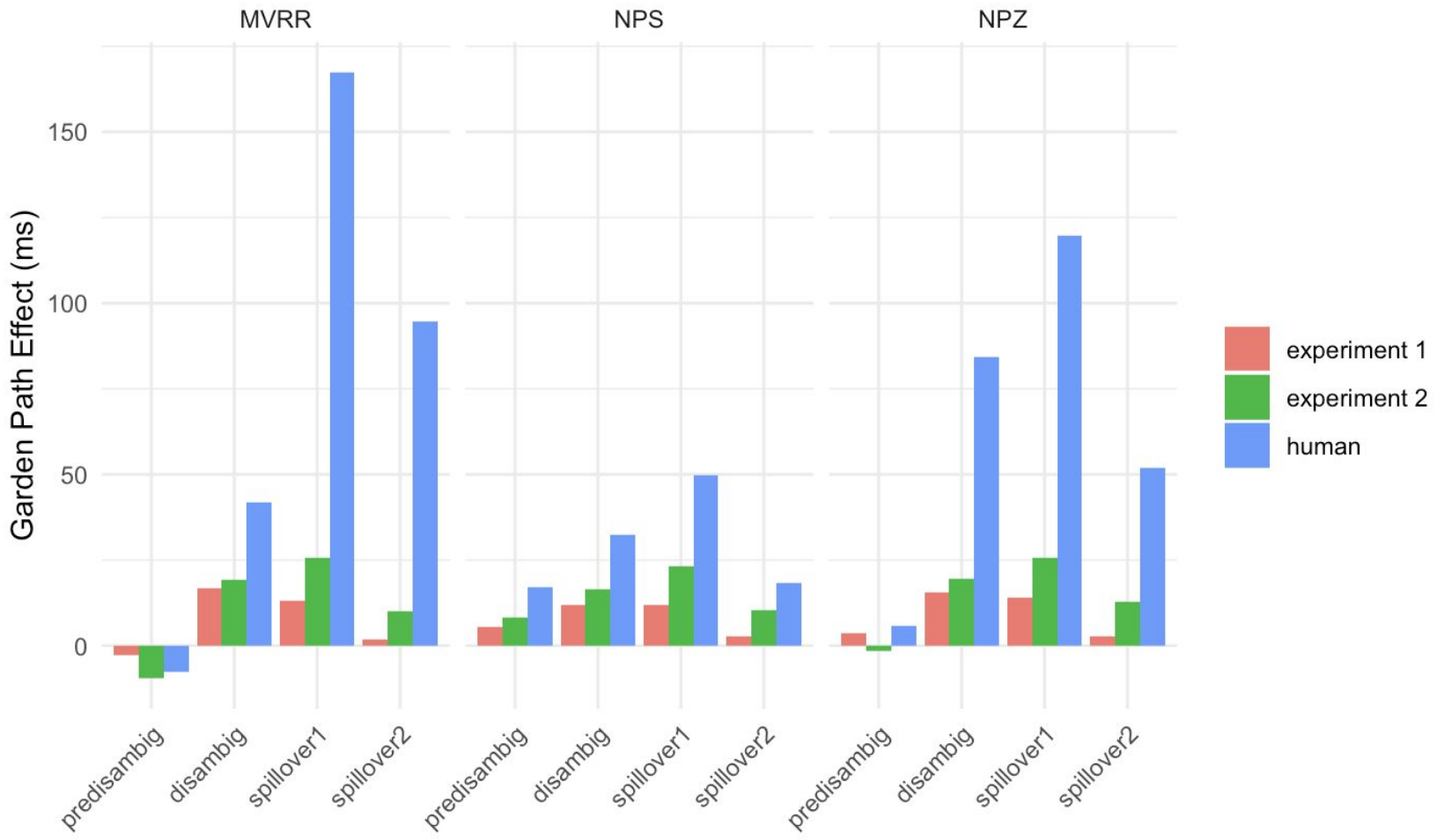
Train

Syntactic Surprisals from 2 of {MVRR, NPS, NPZ}

Evaluate

Syntactic Surprisals from Excluded Garden Path Case

Syntactic Surprisal → RT


MVRR
NPS
NPZ
Garden Path Effect (ms)
150
100
50
0
predisambig
disambig
spillover1
spillover2
experiment 1
experiment 2
human

Conclusions & Discussion

- Incorporating GP cases improves RT predictions, but not as desired
- The relationship between syntactic surprisal & RT is not preserved between GP cases
- Surprisal theory may not fully explain the human GP effect
- No good method for prediction across cases