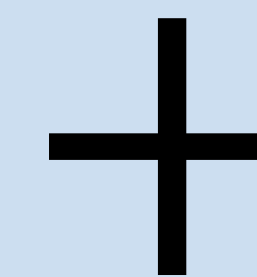
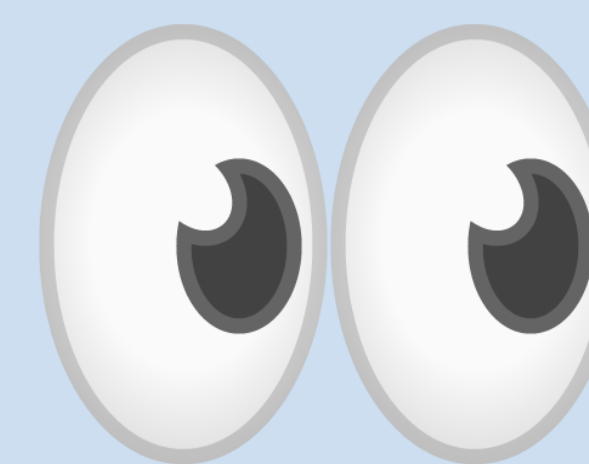


# Decoding Open-Ended Information Seeking Goals from Eye Movements in Reading

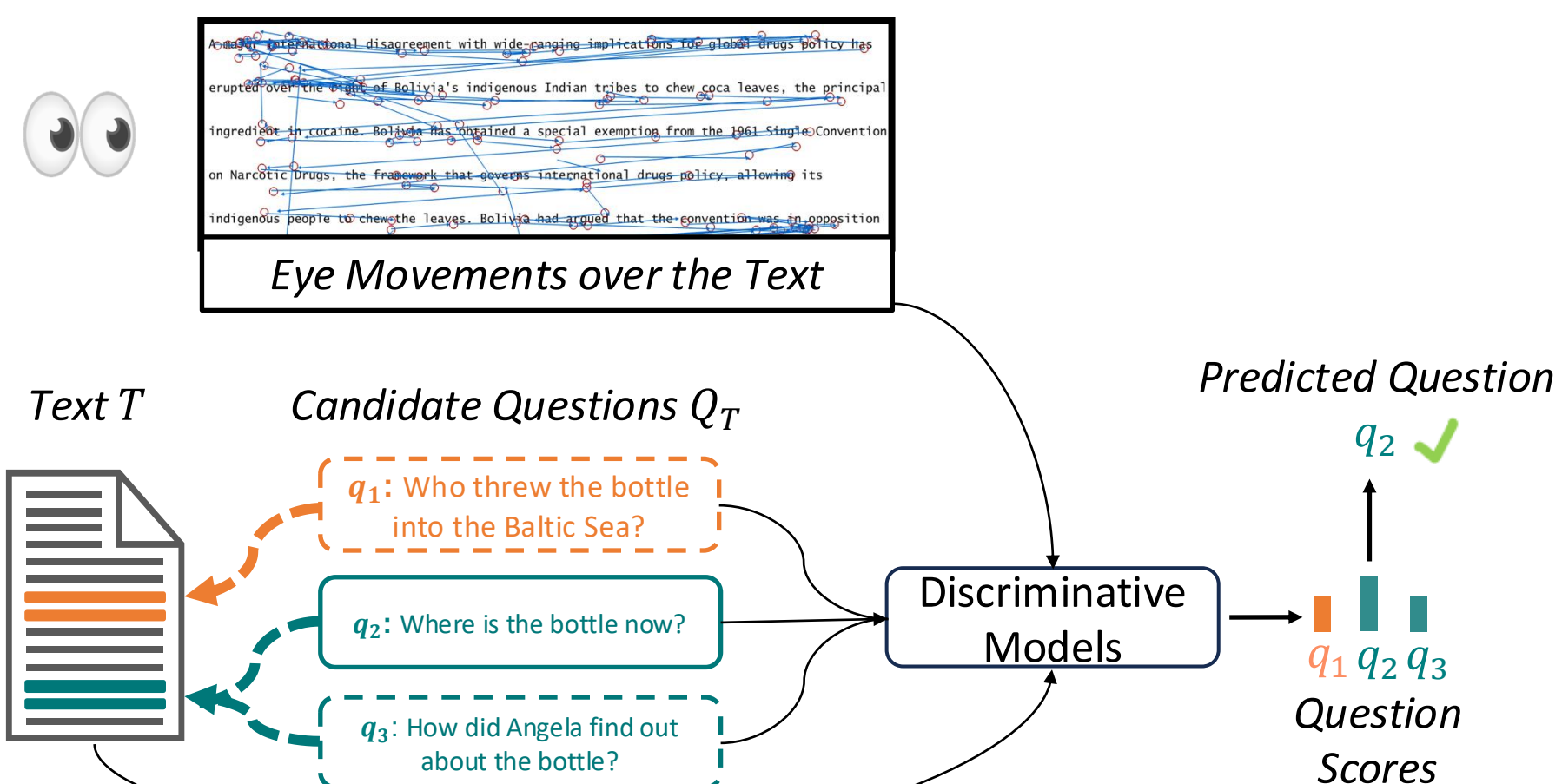
Cfir Avraham Hadar\*, Omer Shubi\*, Yoav Meiri, Amit Heshes and Yevgeni Berzak

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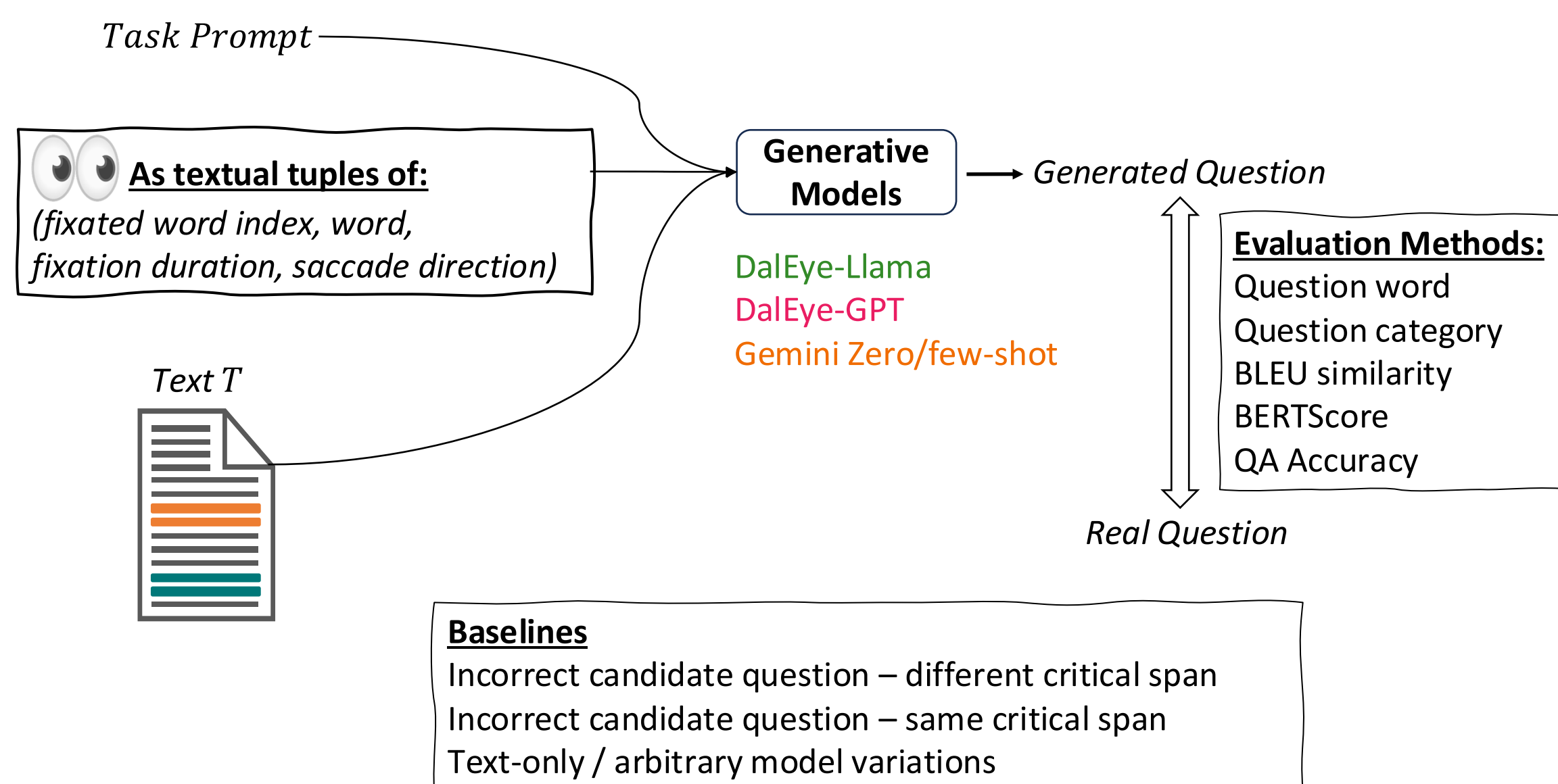
## Task #1 - Goal Selection

Information-seeking reading: Question > Text > Question > Answers



Questions are tied to a **Critical / Distractor Span**: Information essential for answering the question

## Task #2 - Goal Reconstruction



**Baselines**  
 Incorrect candidate question – different critical span  
 Incorrect candidate question – same critical span  
 Text-only / arbitrary model variations

## What makes the task harder?

Linking model performance to cognitive indicators of information-seeking:

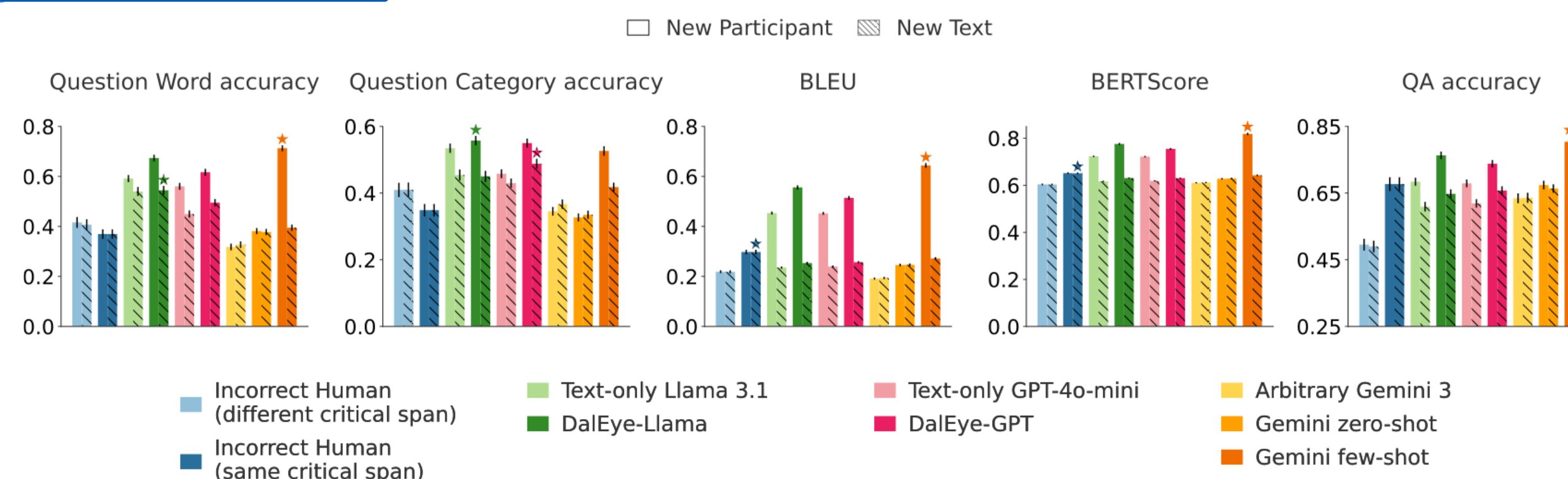
$$P(\text{Correct}) \sim \text{Metadata} + (1|\text{item}) + (1|\text{participant})$$

- Text**
  - ✓ Paragraph Length
  - ✗ Paragraph Difficulty
- Question**
  - ✓ Critical Span Length
  - ✗ Question - Critical Span
  - ✗ Lexical Overlap
  - ✗ Question Difficulty
- Interaction**
  - ✓ Position in the Experiment
  - ✓ Reading Time Before / In / After the Critical Span
  - ✓ Answered Question Correctly

## Evaluation

Accuracy	Chance/Majority	Q Similarity	RT Similarity	Haller RNN	RoBERTa Eye
All	33.0	33.4	34.2*	41.8***	<b>49.3***</b>
Different Spans	55.3	55.1	54.8	65.6***	<b>70.9***</b>
Same Span	49.9	50.0	51.1	52.1**	<b>57.3***</b>

## Evaluation



Legend for charts:  
 - Incorrect Human (different critical span)  
 - Incorrect Human (same critical span)  
 - Text-only Llama 3.1  
 - DalEye-Llama  
 - Text-only GPT-4o-mini  
 - DalEye-GPT  
 - Arbitrary Gemini 3  
 - Gemini zero-shot  
 - Gemini few-shot

The Eye Movements version of each model beats the Text-only / Arbitrary version.

## Take-Aways and Conclusions

- Human eye movements encode robust signals of open-ended reading goals.
- Eye movements support both discriminative goal selection and generative goal reconstruction.
- Gaze-informed models consistently outperform strong text-only baselines.
- Findings position eye movements as a powerful window into latent cognitive goals during reading.

RoBERTaEye (Shubi et al., 2024): best-performing model across all settings.