Eye Movements in Repeated Reading

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Introduction

Although in daily life we often read the same text more than once, repeated reading is understudied in psycholinguistics. How do our eye movements in repeated reading differ from first reading? We examine this question with respect to:

❑ The reader's goals (ordinary reading vs. information seeking).

❑ The amount of intervening material between the readings.

❑ The relevance of the information to the reader's goal.

Design

Data: OneStop [1], English eye-tracking dataset.

360 L1 participants, 30 Guardian articles, 156 paragraphs. Each participant is given a batch of 12 articles.
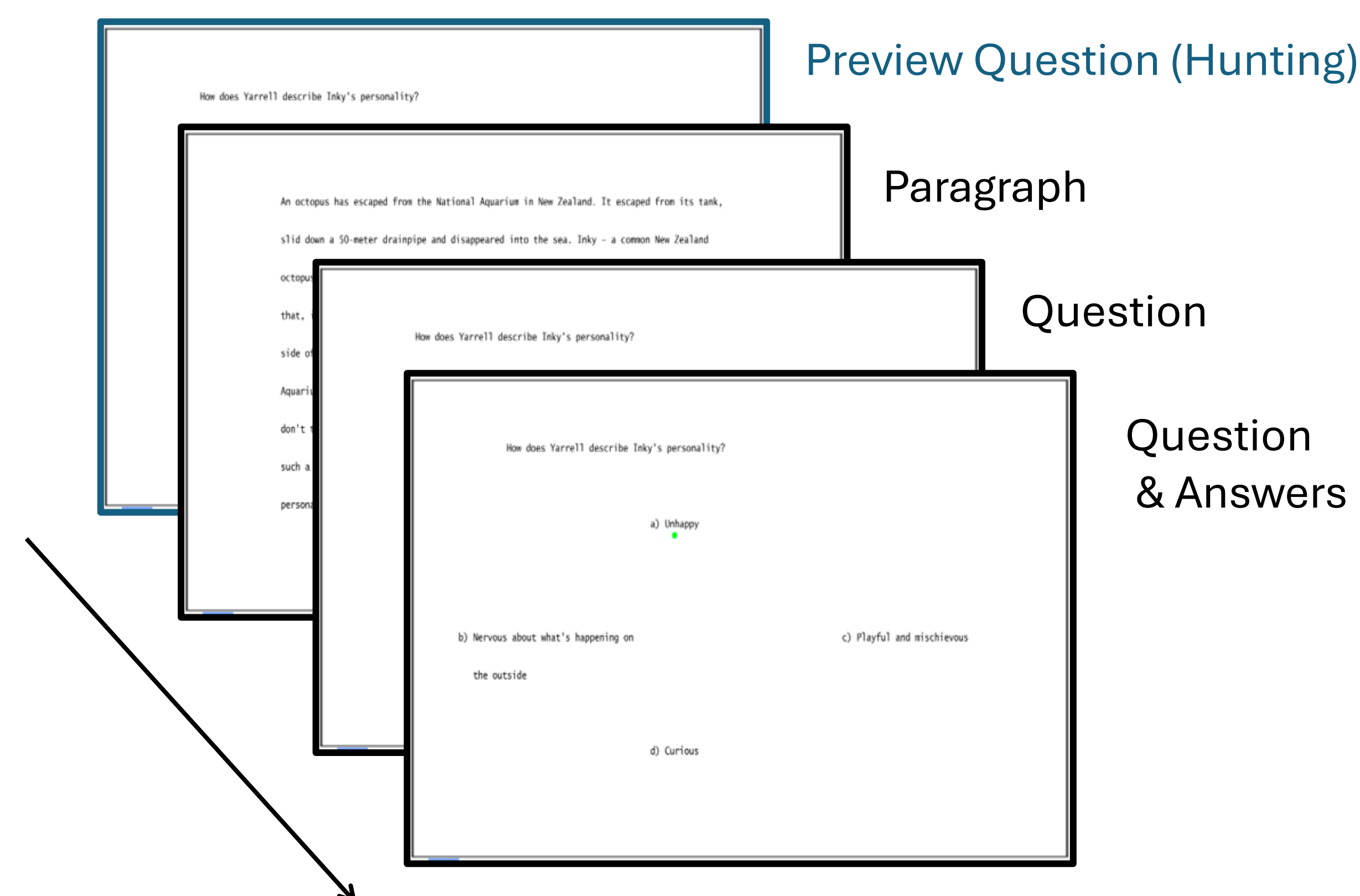
Articles 1-10: first reading.

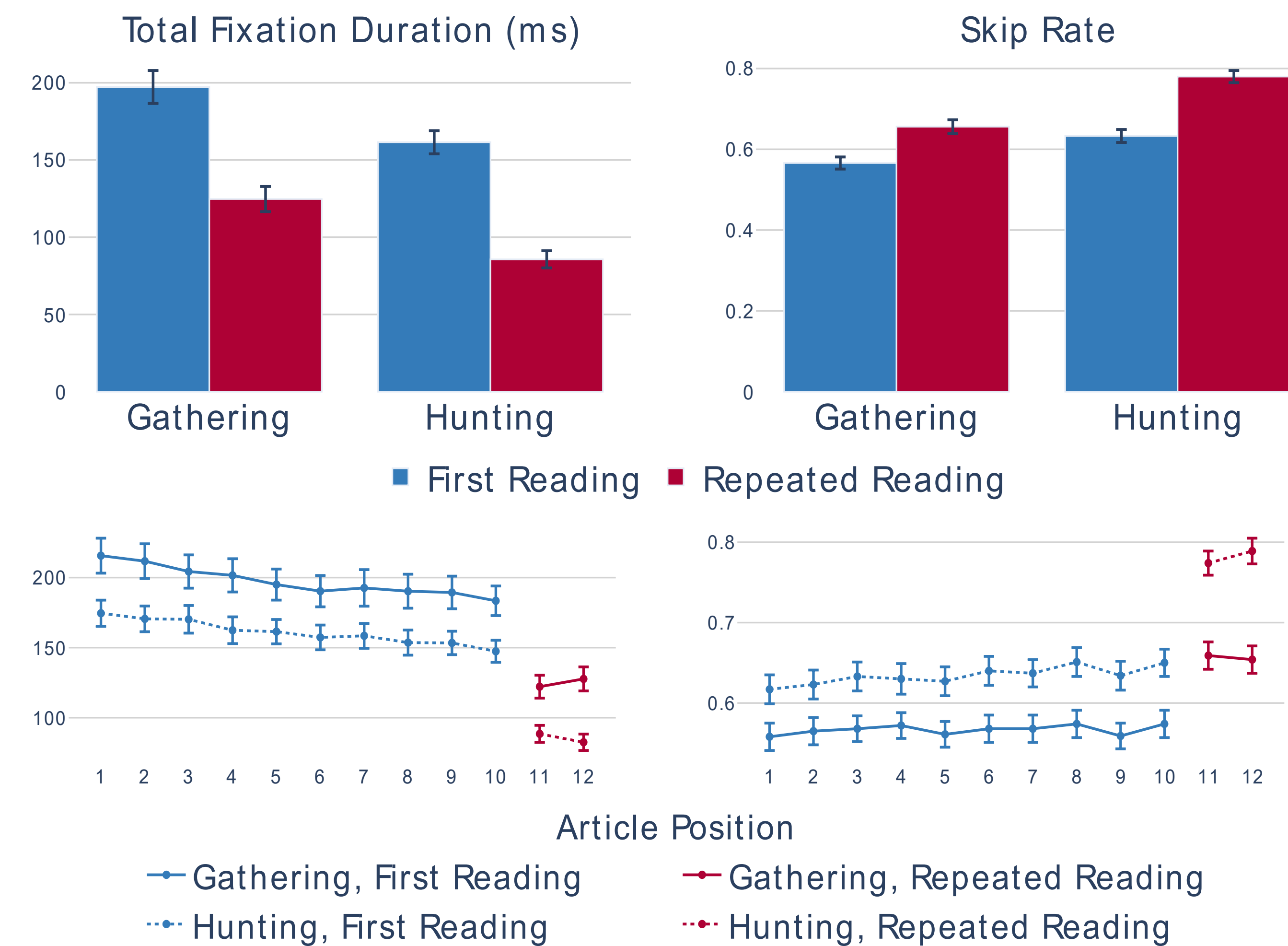Article 11: **second presentation** of the article in **position 10.**

Article 12: **second presentation** of an article in **positions 1-9**.

Two between-subjects conditions:

- **Information-seeking** (Hunting) – a question is presented to participants before the paragraph.

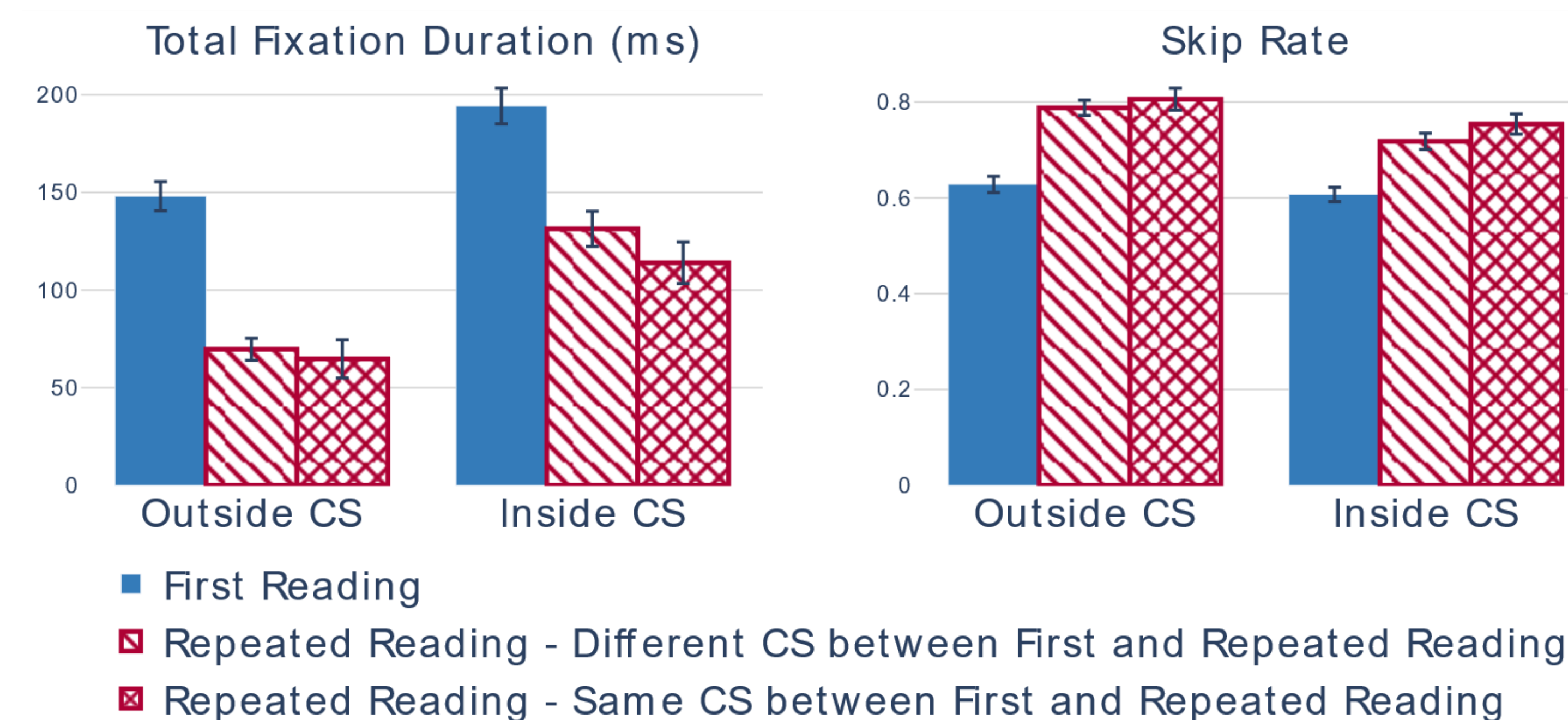- **Ordinary reading** (Gathering) - participants see the question only after reading the paragraph.

Preview Question (Hunting)
Paragraph
Question
Question & Answers

Global Eye Movement Measures

Total Fixation Duration (ms)

Skip Rate

■ First Reading ■ Repeated Reading

Article Position

Gathering, First Reading — Gathering, Repeated Reading
Hunting, First Reading — Hunting, Repeated Reading

❑ Reading Facilitation: In Repeated Reading Total Fixation (TF) sharply decreases, Skip Rate (SR) sharply increases compared to first reading.

❑ Effect of intervening material: In First Reading TF decreases and SR increases with article position. In ordinary reading, but not in information-seeking, TF increases in non-consecutive (article 12) relative to consecutive (article 11) Repeated Reading.

Information Seeking – Information Relevance

Critical Span (CS): manually annotated textual span in the paragraph containing the essential information for answering the question [2].

Total Fixation Duration (ms)

Skip Rate

Outside CS   Inside CS

■ First Reading
▨ Repeated Reading - Different CS between First and Repeated Reading
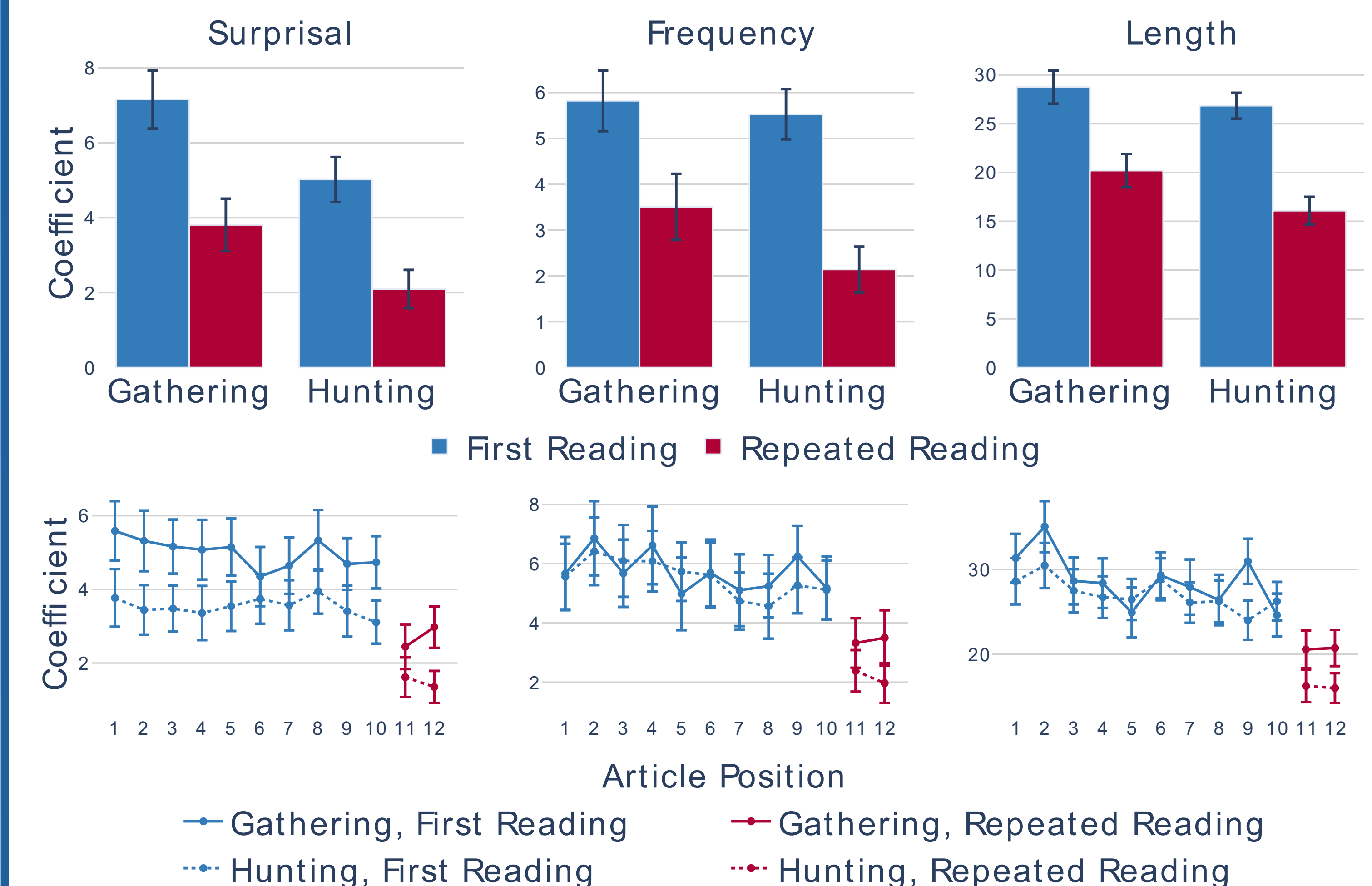▩ Repeated Reading - Same CS between First and Repeated Reading

❑ Reading facilitation both inside and outside the CS with a larger effect outside.

❑ Facilitation is larger when the two readings shared the same CS.

Response to Linguistic Word Properties

Current word coefficients from a mixed-effects model predicting TF reading times from frequency, surprisal (GPT-2), and length of the current and previous words. We used the following model:

$$TF \sim freq * len + surp + freq_{prev} + len_{prev} + surp_{prev}$$
$$+ (freq + len + surp \mid subj) + (freq + len + surp \mid parag)$$

Surprisal   Frequency   Length

Gathering   Hunting

■ First Reading ■ Repeated Reading

Coefficient

Article Position

Gathering, First Reading — Gathering, Repeated Reading
Hunting, First Reading — Hunting, Repeated Reading

❑ Results are in line with the global eye movement measures analysis.

Discussion

❑ Large and robust reading facilitation in repeated reading, exhibited in shorter reading times, fewer fixations and smaller word property effects.

❑ In information seeking, the effects are larger for task irrelevant information, and larger when the division to task relevant and irrelevant information is identical across the two readings.

❑ In ordinary reading, repeated reading benefits are attenuated in the presence of intervening material between readings.

❑ Empirical findings can guide future models of eye movements in reading that will accommodate both first and repeated reading scenarios.

References

[1] Malmaud, Levy, and Berzak, CoNLL 2020.
[2] Berzak, Malmaud, and Levy, ACL 2020.