Scene context influences gaze orientation on objects in peripheral vision

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Context

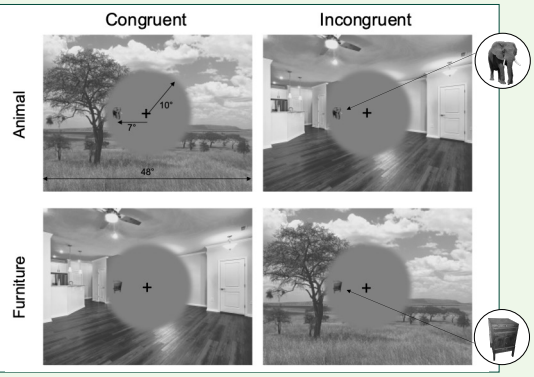
The ability of the visual system to efficiently recognize the environment is based on the extraction of a rudimentary representation of the scene, known as the gist (Oliva, 2005), associated with prior knowledge about the environment. Together, they could also be used to generate predictions about the objects it contains (Bar, 2007; Kauffmann et al., 2014). Previous studies suggest that predictions generated from peripheral vision improve the categorization of objects in central vision (Faurite et al., 2024; Roux-Sibilon et al., 2019; Trouilloud et al., 2022).

However, visual perception is a dynamic phenomenon which alternates between ocular fixations on an object of interest and saccades towards the periphery to fixate new objects of interest. Studies suggest that knowledge about the context influence the ocular movements in top-down mechanisms (Castelhano & Henderson, 2007; Eckstein et al., 2006). But they did not test how predictive mechanisms allow gaze orientation towards object in peripheral vision.

This study aimed to investigate how predictions based on the scene context in peripheral vision influence gaze orientation on objects in peripheral vision.

Methods

Participants: N = 25 (20 women, 20.9 ± 3.2 years old) with normal or corrected-to-normal vision.
Stimuli: An **object** (animal or furniture) displayed in peripheral vision, either on the left or right side of a central fixation. A **scene** background was either **semantically congruent with the target category** (outdoor scene/animal or indoor/furniture) or **incongruent** (outdoor scene/furniture or indoor/animal).
Procedure: In a stimulus onset asynchrony **SOA = 0 ms** condition, the object and the scene were displayed simultaneously during 400 ms. In **SOA = 33 or 150 ms** conditions, the scene was presented alone during 33 or 150 ms, then the object was displayed in the scene during 400 ms.
Task: Participants had to perform a **go/no-go saccadic task** on an object (animal or furniture). They were instructed to saccade towards the object belonging to a target category (animal or furniture), or maintain fixation at the centre when the object belonged to the distractor category. Conditions were counterbalanced across participants.
Measures: Saccade accuracy and correct saccade latency (ms).



Hypotheses

Semantic congruence effect:
- More correct saccades towards the target object when displayed on a scene congruent with the target category than on a scene incongruent with the target category.
- More error saccades towards the distractor object when displayed on a scene congruent with the target category than on a scene incongruent with the target category.
- Lower correct saccade latencies when the object is displayed on a scene congruent with the target category than on an incongruent scene.

Semantic congruence * SOA:
- If the information in peripheral vision is used to generate predictions that guide gaze towards an object in periphery, the semantic congruence effect should increase with the SOA (i.e., when information in peripheral vision can be accumulated).

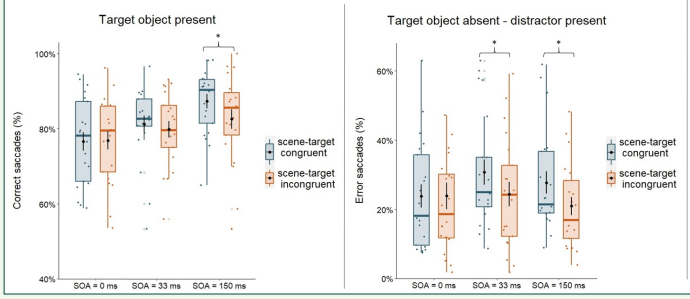
Results

Mean correct saccades rate:

- Significant congruence effect: β = 0.16, z = 2.48, p = .013.
- Significant Congruence x SOA interaction: β = 0.21, z = 2,65, p < .01.
- Linear and quadratic models to test whether the congruence effect increase linearly with SOA:
  - Significant linear model: t(24) = 2.12, p < .05.
  - Significant quadratic model: t(24) = 2.54, p < .05.
- Simple effects: congruence effect was significant only in the SOA = 150 ms condition: β = 0.41, z = 3.39, p < .01

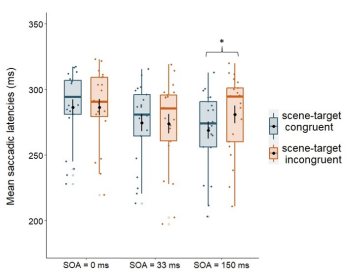
Mean error saccades rate:

- Significant congruence effect: β = 0.24, z = 3.95, p < .01.
- Significant Congruence x SOA interaction: β = - 0.17, z = - 2.31, p = 0.021.
- Linear and quadratic models to test whether the congruence effect increase linearly with SOA:
  - Significant linear model: t(24) = 2.46, p < .05.
  - Significant quadratic model: t(24) = 2.67, p < .05.
- Simple effects: congruence effect was significant only in the SOA = 33 condition (β = - 0.35, z = 3.53, p < .01) and in the SOA = 150 ms condition (β = 0.34, z = 3.22, p < .01).



Mean correct saccade latencies:

- Significant congruence effect: β = 3.83, t(5571.373) = 2.36, p = .019, dz = 0.51.
- Significant Congruence x SOA interaction: β = - 6.22, t(5571.77) = - 3.12, p < .01
- Linear and quadratic models to test whether the congruence effect increase linearly with SOA:
  - Significant linear model: t(24) = 3.86, p < .01.
  - Significant quadratic model: t(24) = 2.88, p < .05.
- Simple effects: congruence effect was significant only in the SOA = 150 ms condition: β = 12.13, t(5558.21), p < .01



Minimum saccade latency:

Saccade latencies were divided into 15-ms bins. For each congruence * SOA condition, we searched for bins containing **significantly more correct detections than false alarms** (Chi² test). The **minimum saccade latency** was the 1st of 5 consecutive bins with more correct than error saccades.

Conclusion & perspectives

- Scene context influences gaze orientation on objects in peripheral vision.
- Congruence effect increased with SOA: The more information is accumulated about the gist, the stronger the predictive signal would be, the more it would guide gaze towards the target in periphery.

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