# On-line contributions of peripheral information to visual search in scenes:
## Further explorations of object content & scene context

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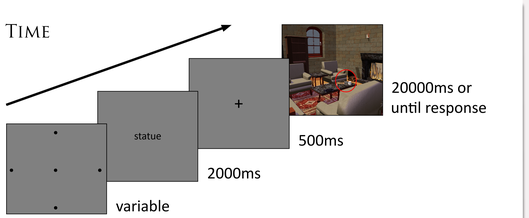
## Background

- Past research has established that when searching for a target in a scene, eye movements are guided by scene context (Castelhano & Henderson, 2007; Ehinger et al., 2009; Neider & Zelinsky, 2006; Torralba et al., 2006).
- When no immediate visual information is available in the periphery, scene context typically dominates search strategies (Castelhano & Henderson, 2007; van Diepen, Wampers & d'Ydewalle, 1998; Võ & Schneider, 2010).
- In contrast, other studies have shown that when peripheral information is available, object content plays a significant role in the selection of potential target locations (van Diepen & Wampers, 1998).
- Studies examining image statistics suggest that this object selection corresponds to high spatial frequency information within a scene (Oliva et al., 2003; Parkhurst, Law & Niebur, 2002).
- The present study examined how eye movements are affected by immediately-available information in the periphery and how search strategies are differentially affected by scene context and the placement of object content.

## General Methods

- In order to control the availability of scene information in the periphery, participants searched for a target through a 2° radius gaze-contingent moving-window (Castelhano & Henderson, 2007; Henderson et al., 1997; van Diepen, Wampers & d'Ydewalle, 1998).
- The original search scene was shown foveally (inside the window), while the scene information was manipulated extrafoveally across four conditions (varying across the two experiments).
- Stimuli consisted of computer-generated scenes (4 practice and 60 experimental trials) displayed on a 21" 100Hz CRT monitor at an 800 x 600 pixel resolution, subtending 38.1° x 28.6°.
- Eye movements were tracked using an EyeLink 2000 Eyetracker (SR Research) at a sampling rate of 2000Hz.

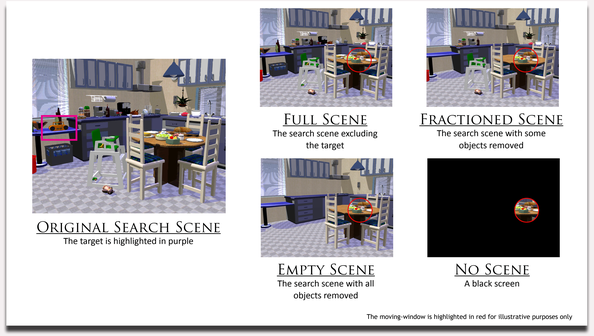



Trial sequence for the Empty Scene extrafoveal condition.

## Experiment 1

### Methods

- 28 Queen's University undergraduates, with normal or corrected-to-normal vision.




### Results

- Average accuracy was 87% and did not differ significantly by scene condition.


- When Fractioned and Empty scenes were shown extrafoveally, participants performed better across all measures than when No scene was presented.
- Even though the Fractioned scenes contained extra information about objects that did not overlap with the target, there were no differences between the Fractioned and Empty scenes in measures of attentional guidance.
- The pattern suggests a prioritization of object information based on scene context. In the next experiment, we examined the role of object information in guiding search when the target was absent or present in the periphery.

## Experiment 2

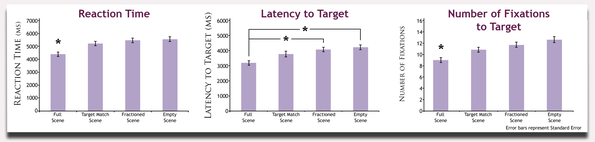
### Target Absent in Periphery

#### Methods

- 28 Queen's University undergraduates, with normal or corrected-to-normal vision. None participated in the other experiment.


#### Results

- Average accuracy was 91% and did not differ significantly by scene condition.




- When the target was not present in the periphery, there were no differences between Full and Target Match scenes in Latency, implying that object information may guide eye movements towards possible targets locations.

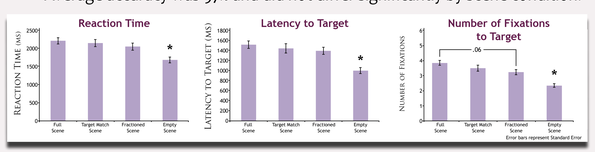
### Target Present in Periphery

#### Methods

- 28 Queen's University undergraduates, with normal or corrected-to-normal vision. None participated in the other experiment.


#### Results

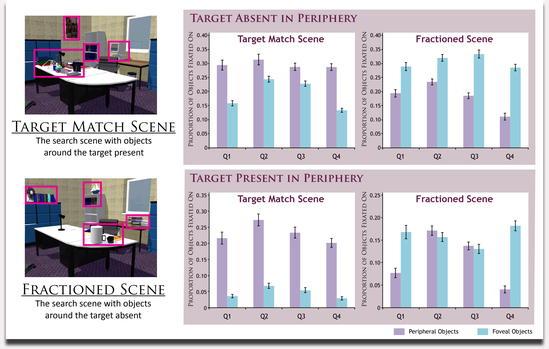
- Average accuracy was 97% and did not differ significantly by scene condition.




- When the target was present and easily discernable in the periphery, search was more efficient.
- Although no differences were found between the Target Match and Fractioned scenes, the pattern suggests that object content may benefit attentional guidance to the target (i.e., number of fixations to target).

## Region Analysis

- We examined whether objects within the Target Match or Fractioned scenes were more likely to be fixated in the periphery and fovea.




- Region analyses showed that regardless of whether certain objects were visible in the periphery, participants fixated on the same groups of objects; the pattern suggests that scene context played a primarily role regardless of object content.

## Conclusions

- When object information is available in the periphery, it plays a central role in directing eye movements towards probable target locations.
- Although object content was preferentially-selected during visual search, scene context mediates the selection of objects and acts as a framework to guide eye movements.
- Current findings suggest that object-based features interact with scene context to dictate search strategies.

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This research was supported by grants from the Natural Sciences and Engineering Research Council of Canada, the Canadian Foundation for Innovation, the Ontario Ministry of Research and Innovation and the Advisory Research Council to MSC. All questions and comments can be directed to effie.pereira@queensu.ca or monica.castelhano@queensu.ca.