Image-based gaze analysis in free-viewing barn owls

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Introduction

Attention is a process that serves to allocate limited resources to potentially important sensory information. In humans, for example, attentional mechanisms help to detect salient targets, while other, unimportant but fully visible information is disregarded. The classical pop-out effect in visual search tasks and inattentional blindness phenomena exemplify the selective nature of the human visual system. It is however unclear in how far similar attentional processes exist in other species. We here studied visual behaviour of free-viewing barn owls with a head mounted, miniaturized video camera, the OwlCam. Barn owls move their head and not the eyes in order to look at visual targets. Thus, the view of a camera that is rigidly attached to the owl's head will stay in register with the animal's gaze.

640x480 CMOS 5.5 g

The **OwlCam** is a tiny and lightweight wireless video camera mounted onto the head of a barn owl. Images from the OwlCam align with the animal's gaze because barn owls lack eye movements

Results & Conclusion

In all but one experimental conditions, the owls looked significantly longer (⏱), more often (#), and earlier (1ˢᵗ) at odd target items, although no particular task was given. Visual saliency based on orientation contrast, for example, is a perceptual product attributed to the functional organization of the mammalian brain. The results therefore suggest that attentional strategies play a critical role in avian vision, too.

Contrast +   Orientation jitter   Shape simple
Contrast -   Orientation regular   Shape complex
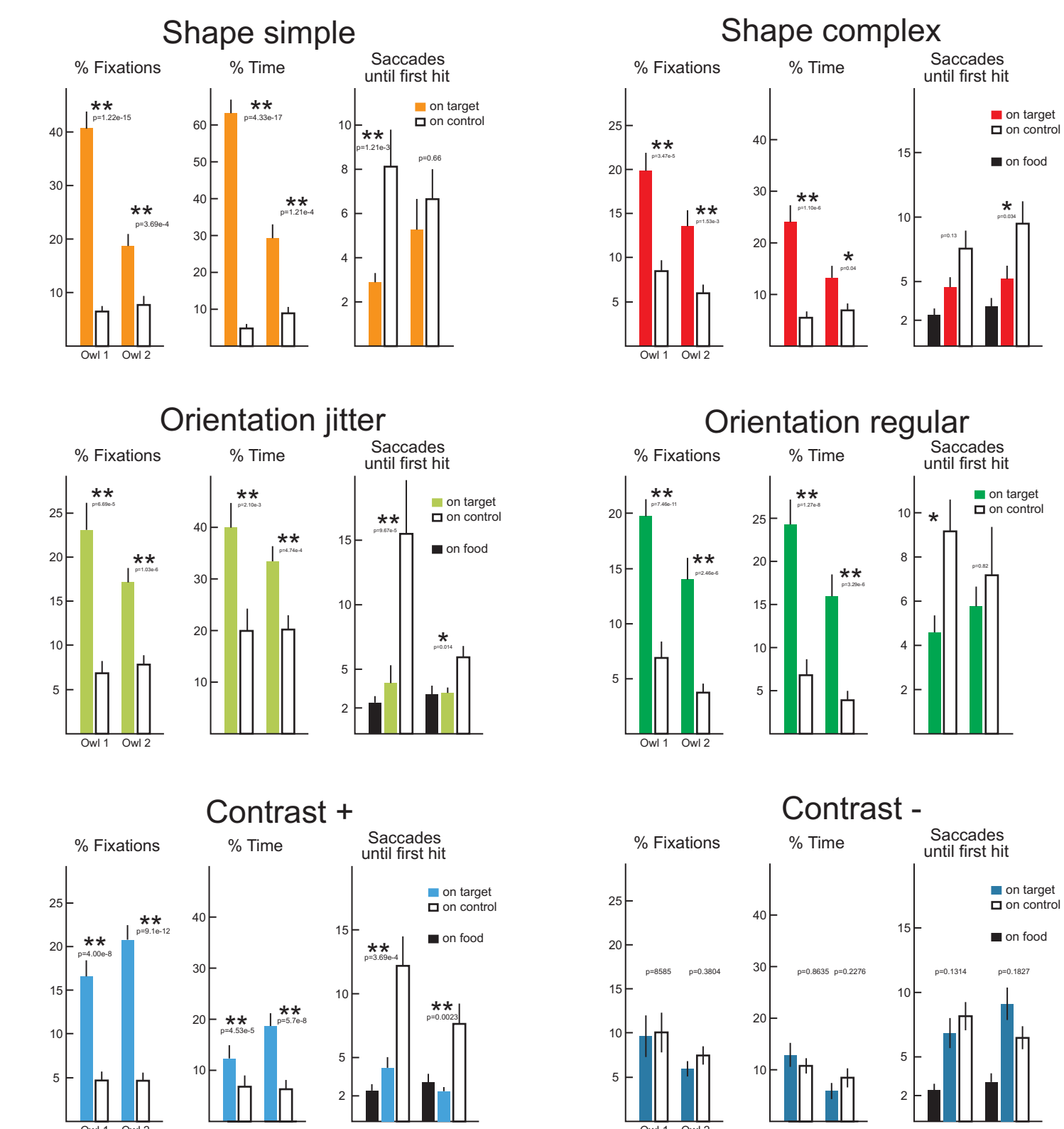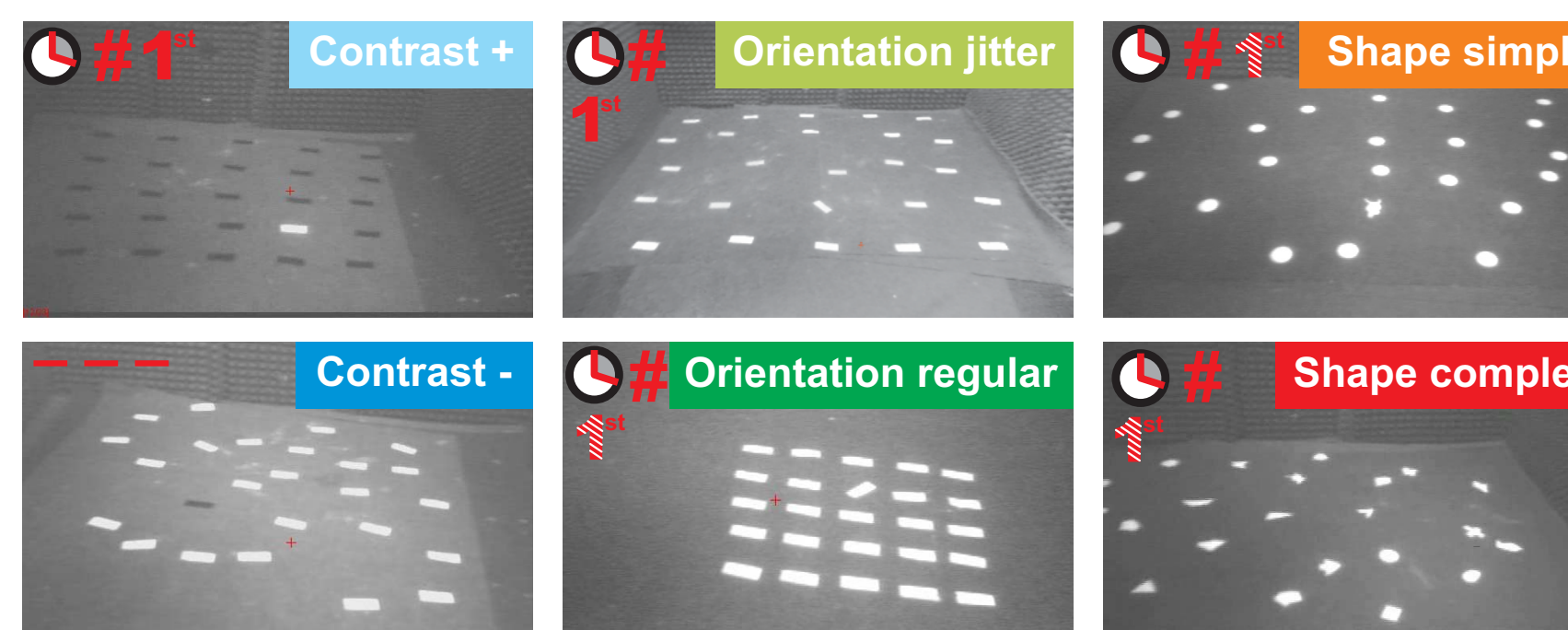
Methods
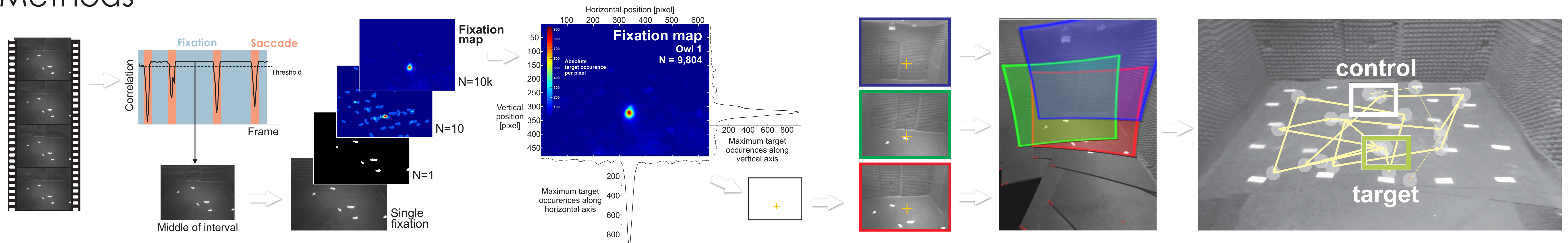
1 **Data reduction**: Continous video frames were recorded. The following processing stages were performed offline. First,the video was automatically segmented into sequences of image motion (induced by head saccades) and non-motion (fixations). A single video frame, defined as the middle frame of a fixation interval, was used for further analysis.

2 **Fixation spot calibration**: The owls were confronted with their preferred food (dead chicken) placed among chick-look-alike distractors. Owls could move and fly freely in this environment. Usually, the owls would sequentially scan targets until the real chicken was found and flewn towards. Fixation frames were binarized with respect to the position of food objects within the image frame. Several thousand of such binary frames were superposed to form a probability map, the location where targets appeared most likely (fixation map). The locus of peak probabilty is regarded as a functional fovea = locus of gaze in camera coordinates.

3 **Panoramic scene reconstruction**: In experimental conditions, targets were yellow pieces of cardboard, cut in different shapes and placed in certain configurations (see Results and Conclusion). Fixation frames were spatially transformed and positioned to form a panoramic view of the original scene, via freely available panoramic photo stitching software: http://hugin.sourceforge.net/

4 **Gaze maps**: Based on the fixation map and spatial transformation coordinates of the single fixations, gaze shifts within the whole experimental scene could be reconstructed (circles: fixation spots, arrows: linear catenation of successive fixations). Gaze maps were analyzed with respect to the total number of fixations and the total time spent on target and control objects. Additionally, the number of saccades until these objects were first looked at was recorded.

PDF at http://tinyurl.com/**owlGaze**   **wolf@bio2**.rwth-aachen.de