



Title:

Do the eyes tell the truth? Mechanisms of peripheral-vision usage and practical implications

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Abstract:

In team sports, attention must be divided to multiple players in order to monitor their movements and to initiate the correct motor response at the right time. To solve such tasks, experienced athletes seem to make use of their peripheral vision by using a task-dependent gaze behavior (Vater, Williams, & Hossner, 2019). In a series of three experimental studies, this monitoring functionality has been investigated to propose ways for sport-specific investigations on peripheral vision. For the experimental studies, we chose the Multiple-Object Tracking (MOT) task, a task with high experimental control in which we could expect that peripheral vision would naturally be used for target monitoring (i.e., without the instruction to locate gaze on a fixation cross). The task requires one to monitor 4 initially highlighted targets moving together with 6 distractors (10 square objects in total). In this task, gaze seems predominantly not be located on individual targets, but rather on the virtual center of mass (“centroid” of the targets). Thus, it can be expected that peripheral vision is used for target monitoring. In Study 1, the validity of the MOT paradigm was tested to make sure that peripheral vision was indeed used for target monitoring as well as to examine the motion sensitivity of peripheral vision. In Study 2, we tested if this motion sensitivity holds true in dual task situations with a concurrent monitoring and detection tasks. In Study 3, we systematically manipulated visual and attentional demands to analyze the influence of these factors on gaze behavior during monitoring and change-detection performance. Considering the results of all three studies, the functionality of peripheral vision allows for the monitoring of multiple moving objects, the (simultaneous) detection of motion changes and the avoidance of saccade-related costs (because saccades would interrupt visual information processing). It could further be shown that capabilities of the visual and the attentional systems affect the gaze anchoring location and peripheral monitoring and detection performance. In a theoretical paper, we link our fundamental results to sports situations, for example, the monitoring of multiple players in soccer and the peripheral detection of a crucial player’s movement, and discuss how a sport-specific functionality could be tested in future experiments. In field- and laboratory experiments, we already tested this proposed functionality and found, for example in martial arts, that national athletes anchor their gaze on the opponent’s chest to detect attacks from arms and legs. In a beach-volleyball defense situations, experts seem to anchor their gaze between the ball and the attacking player (i.e., in free space and not on an actual visual cue). This suggests that peripheral vision is used to monitor both movements. In current studies, we make use of virtual reality applications to examine the functionality of peripheral vision with a higher degree of experimental control but at the same time a high ecological validity. Our final aim is to train expert’s peripheral vision in sport specific settings to improve visual information pick-up outside the fovea.

References:

Vater, C., Williams, A. M., & Hossner, E.-J. (2019). What do we see out of the corner of our eye? The role of visual pivots and gaze anchors in sport. *International Review of Sport and Exercise Psychology*. <https://doi.org/10.1080/1750984X.2019.1582082>