Prediction of visual content across eye movements and their modulation by inferred information in the blind spot

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The probabilistic view of brain function postulates that the brain operates by testing and refining predictions about the world. Here, we tested the existence of sensory predictive signals that could occur during eye movements. The local changes in acuity and global visual-field shifts of saccades could in principle be, at least partially, predicted. We analyzed whether these predictions are implemented differently for direct sensory information and for information that is exclusively inferred, as in the monocular blind spot area. This is performed by comparing the electroencephalogram (EEG) of responses after an eye movement to a peripheral visual stimulus, presented monocularly either inside or outside the blind spot. In some trials the stimulus remained the same pre and post eye-movement but in others it was exchanged. The EEG was analyzed using univariate general linear models, corrected for multiple comparison using threshold-free cluster based methods. We observe two main results: (1) early (~100 ms) and intermediate (~200 ms) lateralized EEG responses to saccade-contingent stimulus changes that suggest the occurrence of error signals to low and middle-level predictions within the visual modality. And (2), a late effect which was compatible in timing and topography with a P3 response, suggestive of violations of global constancy predictions. Remarkably, this late, change-related response was diminished when the change occurred in relation to a filled-in percept inside the subjects' blind spots. The results indicate that both sensory and associative predictive signals exist for transformations of visual input secondary to subjects' eye-movements. We show that these predictions occur across multiple levels of visual processing and are based on internal models that can differentiate between bottom-up input originating from the outside world or inferred from surrounding information.