# Early attention-related mechanisms integrate information about stimulus statistics and reward

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It is well established that visual discrimination performance can be improved by spatial attention, presumably due to an increased gain of neurons in sensory brain regions. In most of the studies, however, subjects are explicitly instructed to direct their attention to regions where stimuli are likely to appear. Hence it is still unclear how the visual system adapts itself *spontaneously* to the statistics of visual input and forms expectations in the absence of explicit instructive cues. Furthermore, it is not known how such expectations are modulated by the task outcome, e.g. by a reward that can be achieved by attending to the task-relevant regions of the visual field.

In order to address this issue, we investigated the modulation of visual attention in a probabilistic reward-based visual discrimination task in human subjects. First we found that behavioral performance is not Bayes optimal, but is consistent with a simple heuristic based on a moving average estimate that integrates stimulus predictability and expected reward. Second we found that the amplitudes of attention-related EEG signals recorded from early visual areas closely reflect the performance of this heuristic mechanism, and seem to be modulated by stimulus as well as reward-based expectancies. Thus, information about stimulus statistics and reward are already integrated by low-level attention-related mechanisms.

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