More predictive, easier to detect? Contrast sensitivities in different predictability contexts

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Top-down information such as prediction can aid sensory processing, since bottom-up signals can often be dynamic, ambiguous, and even low in salience (Bar, 2004). Our previous study showed higher contrast sensitivity to targets matching the predictive information, suggesting enhancements in human low-level perceptual performance due to predictive processing (Song et al., 2023). Building on this, we explored whether this enhancement effect can be modulated by the degree of predictability. The task was to report the orientation of the target Gabor patch, whose contrast level was adaptively manipulated with the 1-up-1-down staircase procedure. Three conditions existed: prediction-regular, prediction-irregular, and control. For the prediction-regular and irregular conditions, a stream of three Gabor patches appeared whose orientations sequentially differed to induce the impression of rotation, followed by a target Gabor patch of orientation matching the rotation direction. Compared to the uniform step angles of 30˚ in the regular condition, the irregular condition introduced an irregular 60˚ step of rotation in the middle to weaken the predictability and reliability of the preceding information. The preceding and target stimuli in the control condition were in random angles. Results showed enhanced contrast sensitivities in both prediction conditions compared to the control, replicating the previous study. Of more relevance to the present study, the group difference between the regular and irregular conditions was insignificant, seeming to suggest against the modulatory effect of predictability. However, a subset of participants showed difference in contrast sensitivity between the two conditions, giving hints of potential predictability effects. This inter-individual variability in the results might stem from the tendency discovered from many participants to find their own rules in the preceding stream, possibly leading to additional predictive information of confounding influence. Considering this variance in further investigations, we aim to provide extensive evidence of predictive processing in low-level visual perception performance.

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