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Expectations based on prior knowledge sharpen the perceived visual signal as its reliability decreases

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Abstract

Predictive coding theories of visual perception postulate that predictions based on prior knowledge modulate information processing by sharpening the representation of expected stimuli in visual cortical areas. Our recent findings showed that this is also associated with increased perceived sharpness of expected visual stimuli. According to recent accounts of the predictive processing scheme, this sharpening mechanism would predominate when sensory signals are noisy and ambiguous. Our study addressed this hypothesis by investigating whether the influence of expectations on the perceived sharpness of scenes increased as the reliability of the visual signal decreased. We used a perceptual matching task in which participants were presented with two blurred images depicting two versions of the same scene and asked to adjust the blur level of one scene to match that of the other one. We manipulated the initial blur level of scenes (i.e., signal reliability) and the predictability of scenes which could be either upright (i.e., compatible with expectations) or inverted (i.e., incompatible with expectations). Results revealed that at an equal level of blur, predictable scenes were subjectively perceived as sharper than unpredictable ones and this difference increased as signal reliability decreased. However, this effect stopped increasing when signal reliability was at the lowest. Our results support predictive coding theories postulating a larger influence of predictions on perception when the signal is noisy. When sensory signals are too noisy, predictions may however be too diverse and therefore too coarse to further sharpen the stimulus representation.