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Spatial patterns of fixation: bottom-up effects

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Abstract:

The choice of where to direct one's saccadic eye movements demands the integration of bottom-up image salience with top-down information of goals, motivation and past experience of reward. We previously described an eye movement search task that offered control of the subject's top-down drive for saccade choice (Chukoskie, et. al. SFN 2005). Here, we manipulate the visual image to similarly control bottom-up drive for saccade choice.

Subjects were instructed to find the rewarded target location as quickly as possible while we measured their eye movements with a video-based eye tracker (ISCAN). Subjects learned the location of rewarded targets by sampling the distribution of possible targets over the course of a session. The rewarded target locations were drawn from a distribution with a Gaussian profile, one target per trial. Subjects searched for the rewarded target location on a background image (1/f, pink noise), although the location of the rewarded target did not correspond to any element in the image.

When we lowered the contrast of the image, the subject's search was less influenced by bottom-up cues. We also generated pink noise images with equalized luminance histograms and then compared the spatial pattern of fixations for both normal and inverted luminance profiles. Subjects tended to bias their fixations toward the dark regions of the image in both the normal and inverted images. This finding is intriguing since most models of image-based salience do not consider luminance as a determinant of salience, but instead focus on image contrast.

Lastly, we suggest a Bayesian model as a conceptual framework in which the rewarded target distribution serves as a prior and frequently fixated image features comprise a likelihood map. The combination of these two components qualitatively predict the spatial distribution of subjects' fixations.

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