

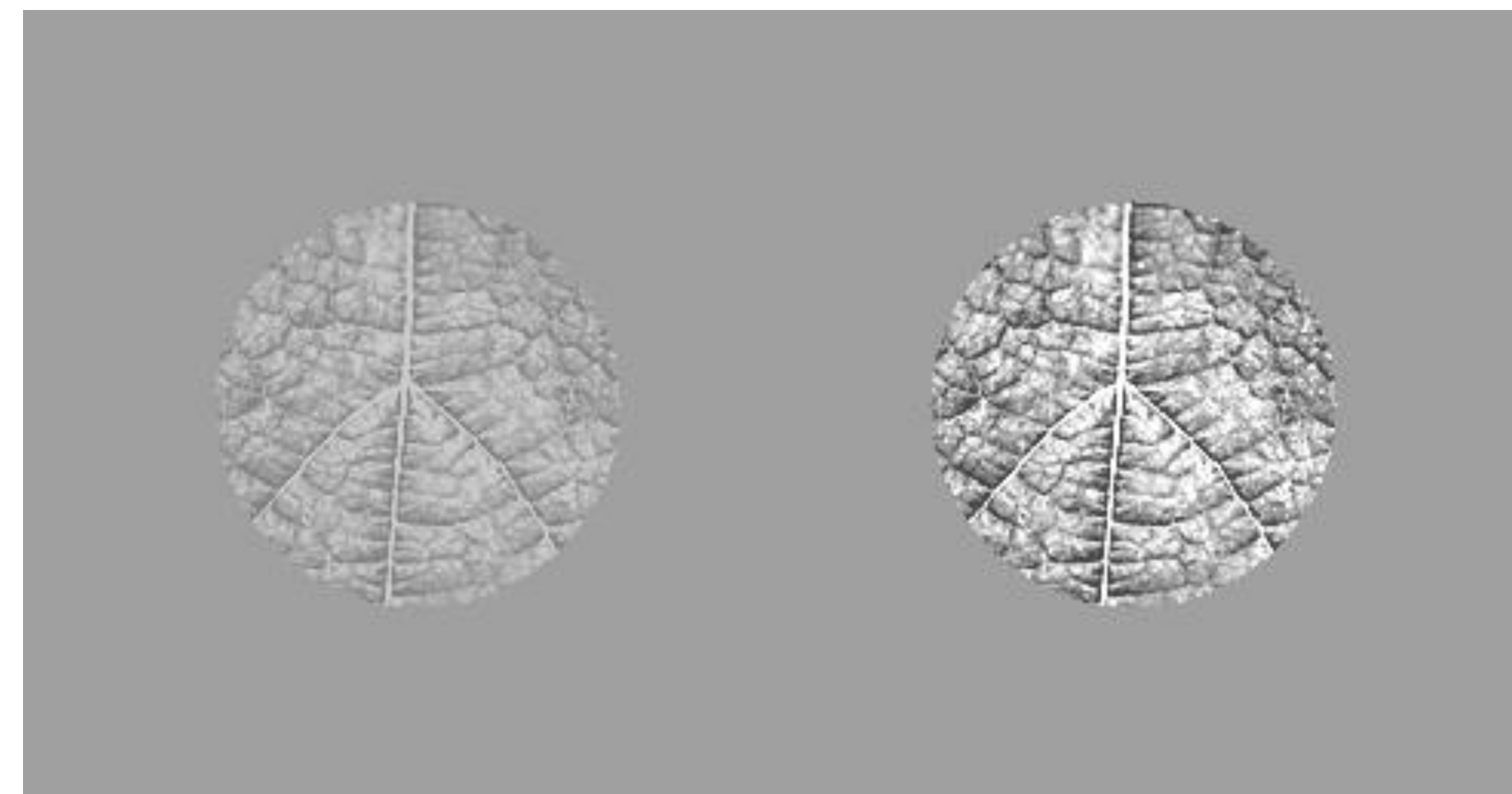
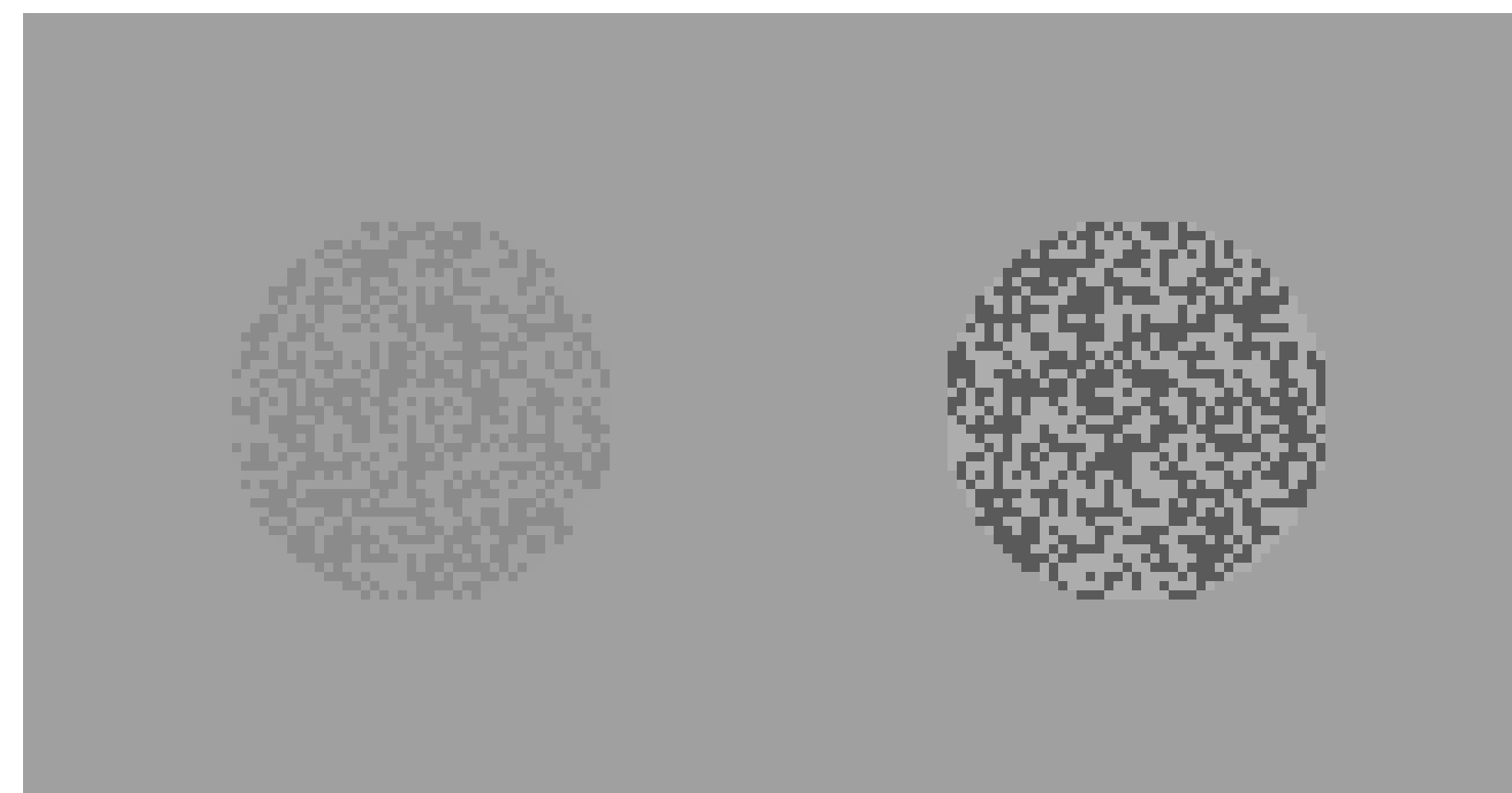
The Role of Contrast in the Perceived Depth of Monocular Imagery



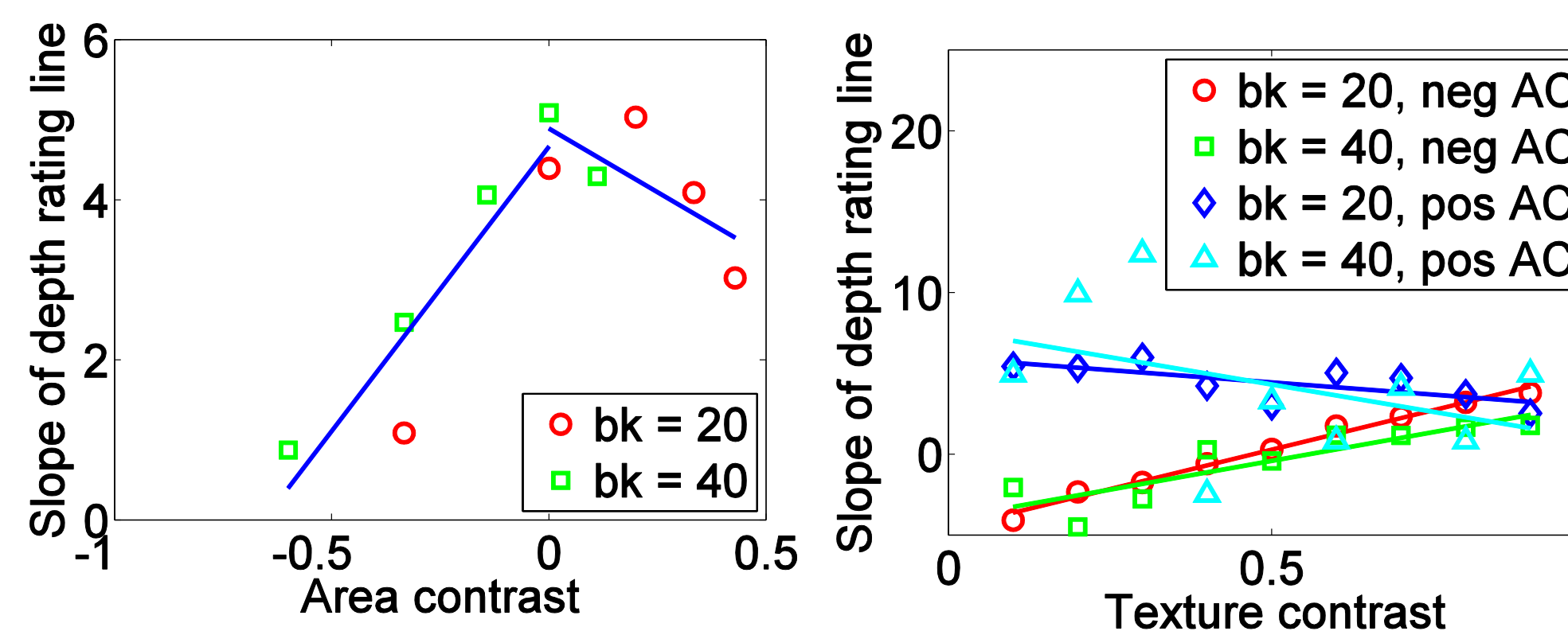
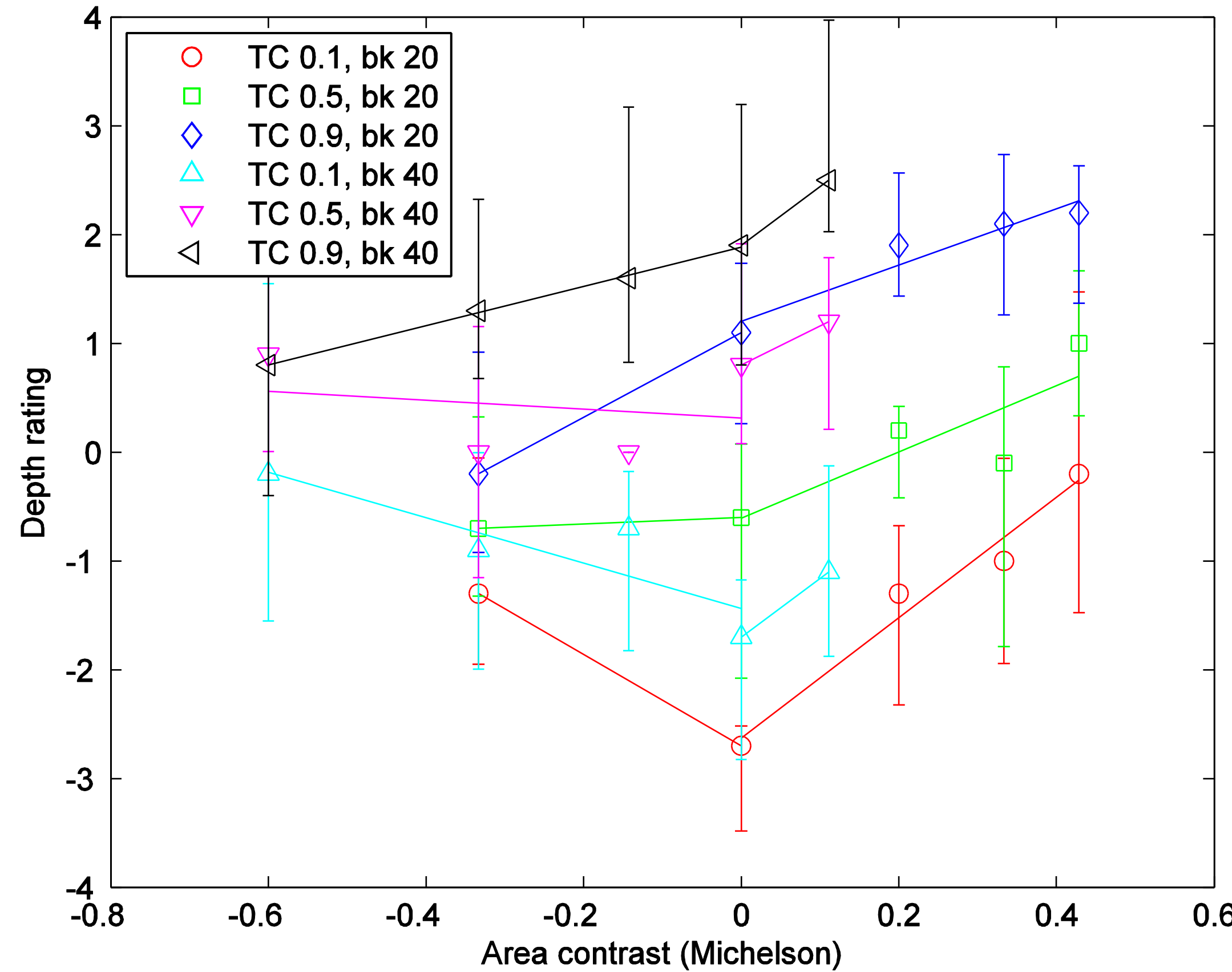
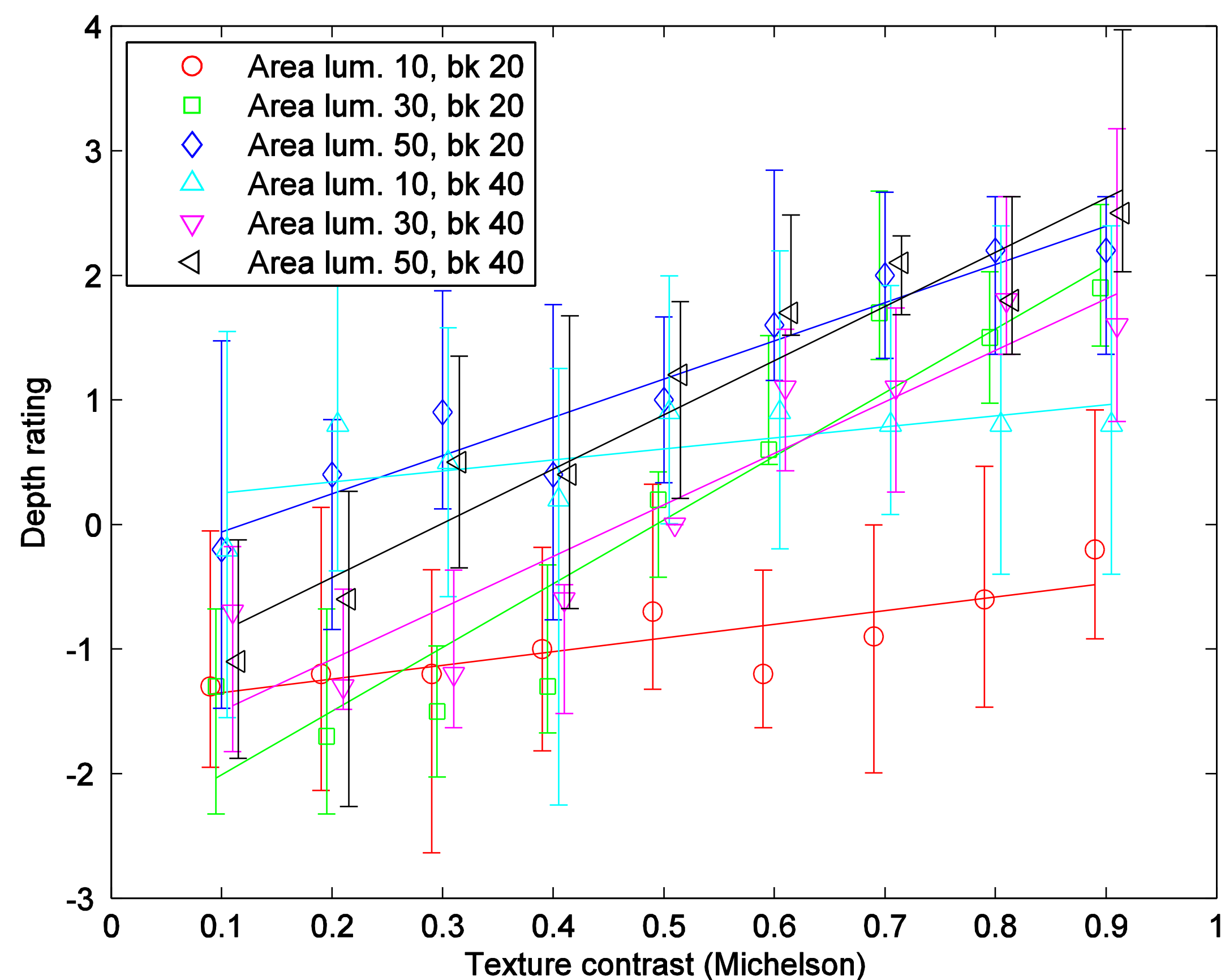
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Abstract

Since high dynamic range (HDR) displays have been shown at conferences, they have been confused with 3D displays by some observers. In this work, we explore this perceptual connection by conducting a series of experiments to examine the effect that contrast has on depth perception. In particular, we consider the contrast both of large-scale features and of small-scale features, both independently and in concert. We found that in each of three experiments, subjects perceived increases in contrast to correspond with increases in perceived depth. Our findings indicate that we can simulate sensations of depth by manipulating contrast, particularly that of highlights within images, and that modern high-contrast displays can simulate greater sensations of depth.

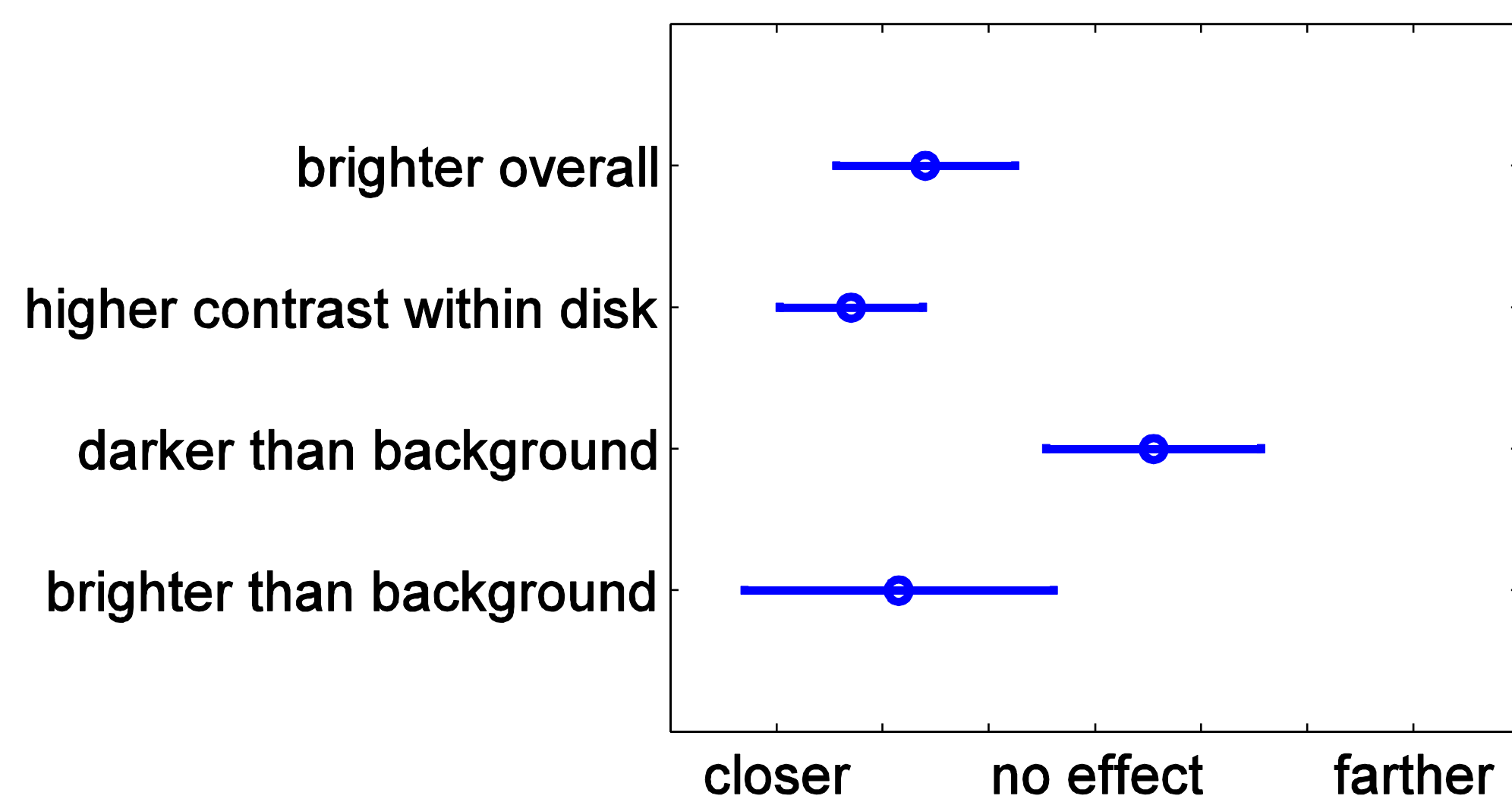
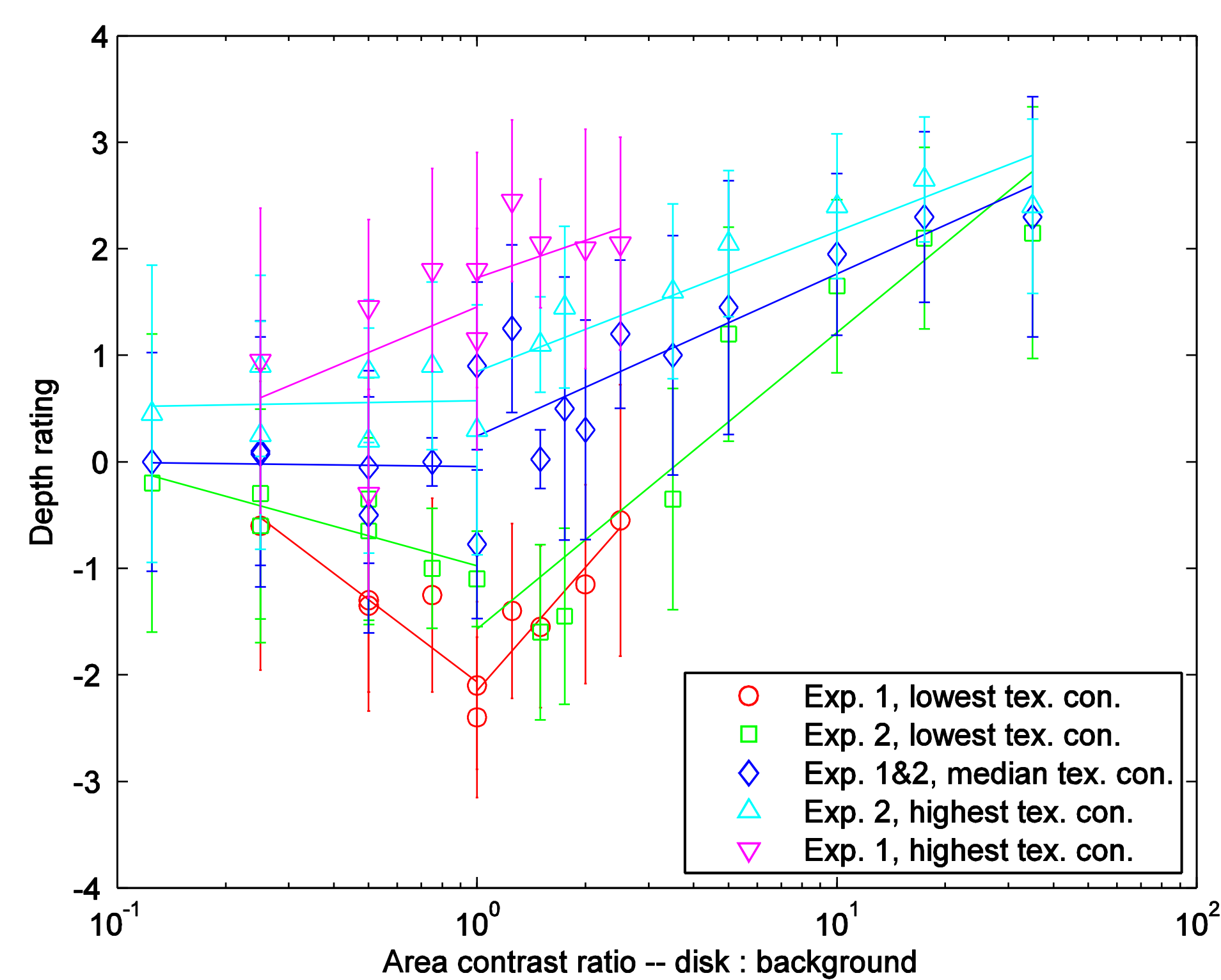


The perceived depth of an object varies with the contrast between the object and the background, and within the object itself.



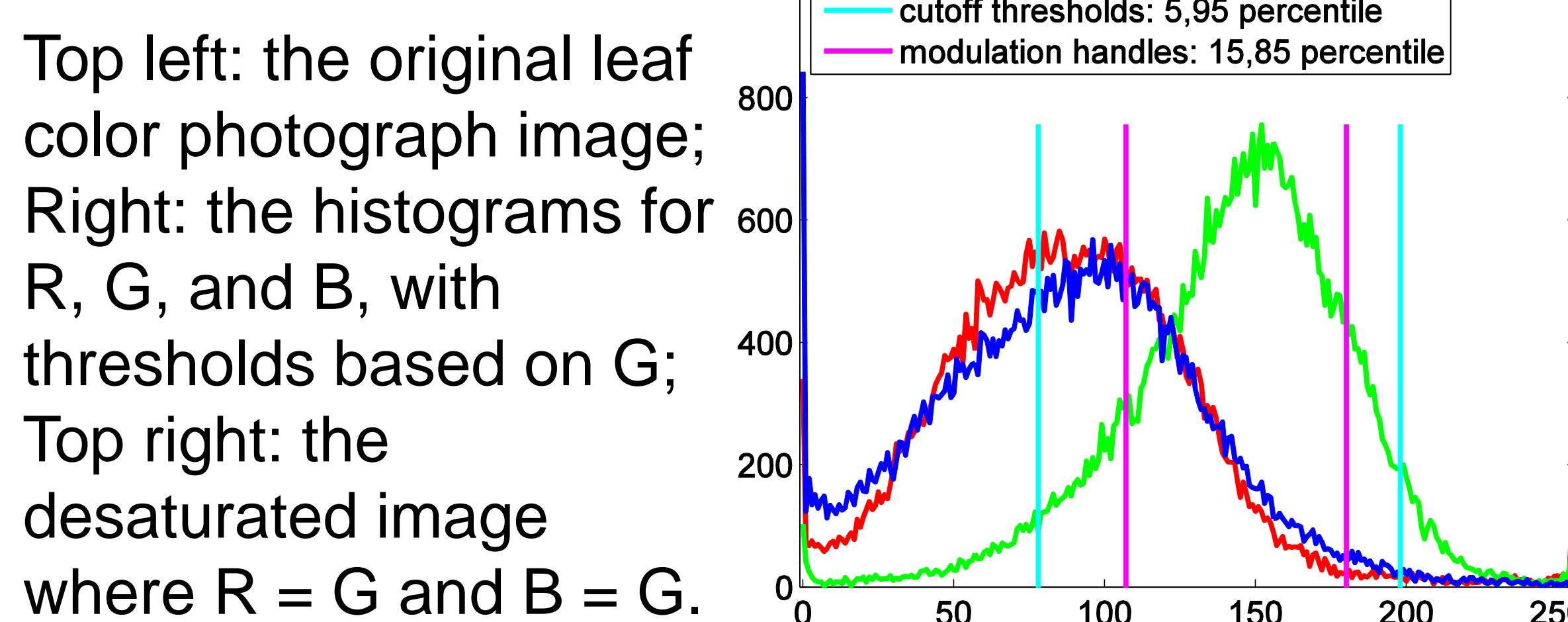
Random-dot disk images: Mean depth judgments as a function of texture contrast (left) at different levels of average disk luminance (10-50 cd/m²), and area contrast (right) at different levels of texture contrast (0.1-0.9), at two levels of background luminance (20,40 cd/m²). The solid lines show best fit using least-squares approximation, while the error bars show the standard deviations at each point. The points are offset slightly to improve clarity.

Random-dot disk images: The relationship between area contrast and the degree to which texture contrast affects depth perception (left), and between texture contrast and the degree to which area contrast affects depth perception (right).



The effect of varying area contrast ratios on the perceived depth of disks, at low, medium, and high levels of texture contrast.

The degree to which subjects perceived disks of different characteristics to be closer or farther.

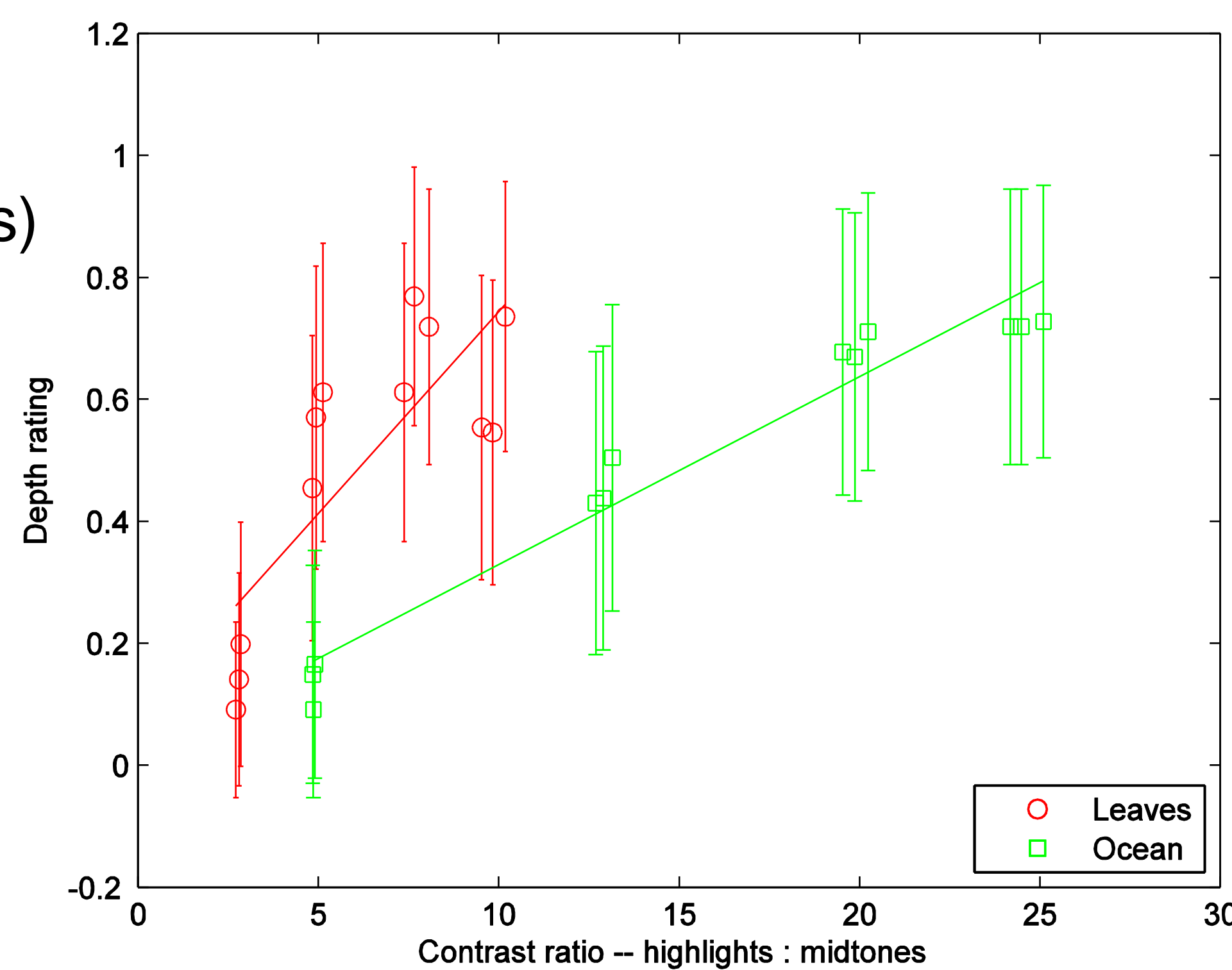


Top left: the original leaf color photograph image; Right: the histograms for R, G, and B, with thresholds based on G; Top right: the desaturated image where R = G and B = G.

Subjects' perception of the comparative depth of scenes with different levels of highlight contrast. The depth rating indicates the probability (based on our experimental results) that a viewer would identify that image as having greater depth than other images within the range of our study.



HDR images (above) and regions from those images (at left) whose highlights were adjusted to achieve varying sensations of depth within the image.



References

1. Ichihara, S., Kitagawa, N., Akutsu, H. 2007. Contrast and depth perception: Effects of texture contrast and area contrast. Perception 36, 686–695.
2. Rempel, A. G., Heidrich, W., Mantiuk, R. 2011. The role of contrast in the perceived depth of monocular imagery. Tech. Rep. TR-2011-07, The University of British Columbia.