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Interaction of first-order and isodipole statistics in a texture segregation task

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Abstract

Image statistics are often classified as first-order (e.g., luminance), second-order (e.g., contrast, autocorrelation, power spectrum) and high-order (e.g., fourth-order isodipole). Many studies of visual texture processing have considered texture discrimination based on one kind of image statistic, but few have examined how these statistics interact.

To examine the interaction of isodipole statistics and luminance statistics, we construct a novel two-dimensional space of binary textures. One axis in this space, gamma, specifies the bias in luminance statistics (gamma= 1 for all white, 0 for a 50:50 mix, -1 for all black). The second axis, alpha, specifies the bias in local fourth-order statistics (alpha=1 for the “even” texture, -1 for the “odd” texture). Long-range statistics and statistics of other orders are determined by maximizing entropy. This uniquely defines the textures in terms of alpha and gamma (within a defined range), and thus generates a two-parameter perceptual space.

We examined the ability of subjects (N=2) to segregate textures with specified structure (alpha and/or gamma nonzero) from a fully random texture (alpha=0, gamma=0) in a 4-AFC paradigm. For subject CC, similar Weibull functions (shape parameter 2) provided good fits to the data along the luminance and fourth-order axes in this space. Sensitivity along the luminance axis was approximately four times the sensitivity along the fourth-order axis. For subject MC, sensitivities to the two statistics were in similar ratio, but Weibull functions along the fourth-order (alpha) axis were substantially steeper (shape parameter 4) than along the luminance (gamma) axis (shape parameter of 2).

Along oblique directions, performance of both subjects was significantly less than predicted by probability summation. For subject CC but not MC, performance was also significantly less than predicted by a Euclidean geometry within this texture space.

Victor, J. D., Conte, M. M., Chubb, C. F.(2003). Interaction of first-order and isodipole statistics in a texture segregation task [Abstract]. *Journal of Vision*, 3(9): 209, 209a, <http://journalofvision.org/3/9/209/>, doi:10.1167/3.9.209. [[CrossRef](#)] [[PubMed](#)]