Explaining crypsis and information content in the visual pathway using statistical properties of animal camouflage and natural scenes

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Abstract

In nature, the co-evolution of cryptic coloration and predatory vision has “optimized” each system for survival. This study investigates the statistical similarities between animal camouflage and natural environments. Images from a database of animals in their natural environments were manually segmented into “animal” and “environment” regions. Using luminance and coloration, pixel- and Fourier-based statistics were calculated for these regions. We found that, for luminance, the mean and skewness between animals and their environments are significantly more correlated than variance or kurtosis. For coloration, we found that the mean chrominance between animals and their environments were highly correlated. In animals, red and green coloration is less likely to vary than in the environment, but blue and yellow coloration is more likely to vary. Additionally, Fourier analysis revealed that the power spectrum of camouflaged animals is similar to that found in natural scenes. We compare these results to human detection performance and quantify the extent to which ratings can be explained by statistical similarities. The implications of these findings toward efficient coding in the mammalian visual pathway are also discussed in the context of recent measures of the information content in natural scenes [Chandler & Field, JOSA A, 2007].