Natural illumination, shadows, and primate colour vision

Tom Troscianko, C. Alejandro Parraga, P. George Lovell, D.J. Tolhurst, R. Baddeley, U. Leonards

Previous research has established that the red/green opponent system in primate colour vision is optimised for encoding the spatio-chromatic properties of scenes containing red or yellow fruit/leaves on a background of green leaves. The efficient detection of such items is based on the fact that the red-green system removes shadows. This shadow-removing process operates even when the shadow has a blue or green tint from scattered light. In addition, information from the red-green system has been shown to be stable against changes in natural illumination. The invariance of the red-green system to shadows and changes in natural illumination, and its orthogonality to the yellow-blue system, imply that the yellow-blue system should be particularly efficient at encoding the difference between light directly reflected from the ground, and light which has undergone Rayleigh scattering. We present data obtained in Kibale Forest, Uganda, and in UK locations, which support the idea that the red-green system removes shadows, and the yellow-blue system responds particularly to the difference between scattered and direct light. The data are based both on a computational analysis and on psychophysical measures of scene segmentation over distances of several kilometres, in which Rayleigh scattering has a strong effect on cone responses.