In: *Goettingen Neurobiology Report 1996*, eds. Elsner, N. & Schnitzler, H. Stuttgart:Thieme Verlag, p. 340

IS COLOR CONSTANCY BIOLOGICALLY RELEVANT? CONSEQUENCES OF DIFFERENT COLOR CONSTANCY ALGORITHMS FOR SIMULATED BEE FORAGING PERFORMANCE

Laurence T. Maloney[1] **Lars Chittka**[2]

[1u]Center for Neural Science, Psychology, New York University, 6 Washington Place, 8th Floor, New York, NY 10003 USA.
[2u]Ecology & Evolution, SUNY Stony Brook, Stony Brook, NY 11794 USA.

It is commonly assumed that the visual systems of bees have evolved so as to maximize the insects' ability to detect and discriminate floral food sources (Chittka & Menzel, 1992). The honeybee, in particular, is known to be able to reliably estimate surface color despite changes in illumination and background (Werner, Menzel, & Wehrhahn, 1988), and this *color constancy* is hypothesized to contribute to its foraging efficiency and fitness.

Tests of this hypothesis run into two complications. First, there are several different models of computational color vision, each of which depends on different assumptions about the physical properties of illuminants and surfaces in a scene, and each of which proposes a different method (' color constancy algorithm') for computing color-constant color descriptors (See Maloney, 1992, for review). Second, the relative foraging advantage attributable to a particular color constancy algorithm can only be assessed using realistic models of the physical environment of the bee and of its foraging behavior.

We compare and report the results of simulations of the foraging behavior of hypothetical bees with different color vision systems and different degrees of color constancy. These include (a) the *UBG Bee* which performs no color correction or color constancy computation on its photoreceptor excitations, (b) the *Retinex Bee*, and (c) the *Ideal Bee* which computes color descriptors that are completely color constant. The dependent variable is always the rate of nectar accumulation.

The simulated environments are matched as closely as possible to previously-surveyed physical environments. In these surveys, the identities of different flower species and their density and spatial distribution were recorded at two-week intervals in specific North German environments. Spectrophotometric measurements were taken of the surface spectral reflectances across the UV and visible spectrum of all flowers observed. Additional measurements of spectral power distributions of typical daylight illuminants, bee foraging patterns, and bee visual acuity were taken from previous empirical studies.

Chittka. L., & Menzel, R. (1992), The evolutionary adaptation of flower colors and the insect pollinators' color vision. *J. Comp. Physiol. A*, **171**, 171-181.

Maloney. L. T. (1992), Color constancy and color perception: the linear models framework. In Meyer, D. E., and Kornblum, S. [Eds.], *Attention & Performance XIV.* Cambridge, Massachusetts: MIT Press, 59-78.

Werner, A., Menzel, R., & Wehrhahn, C. (1988), Color constancy in the honeybee. *J. Neuroscience*, **8**, 156-159.