The effects of chromatic heterogeneity and spatial blocking on Glass Pattern detectability

Knoblauch, K[1], Mahler, E[1] and Dojat M[2]

[1] Inserm U846, Stem Cell and Brain Research Institute, Dept Integrative Neuroscience, Bron, France
[2] Inserm U836, Grenoble Institut des Neurosciences, Université Joseph Fourier, Grenoble, France

Glass Patterns (GPs) are composed of a field of locally-oriented pairs of dots (dipoles) distributed along a global flow. The perception of this flow is thought to require two stages: i) extraction of local orientation of individual dipoles at an early cortical stage, such as V1, ii) followed by extraction of the global flow at a higher cortical level, such as V4. We have previously shown using fMRI that a ventral region along the fusiform gyrus is differentially activated in the comparison of concentrically with randomly oriented dipoles, independently of whether the dipoles are specified by achromatic or chromatic contrasts. This was also true if the dipoles were different colors (cross-dipole, multi-chromatic) but not if the elements of the dipoles were different colors (within dipole, multi-chromatic), suggesting that early stage neural channels mediating local orientation detection have narrow chromatic bandwidths. Two hypotheses are possible for the second stage: i) orientation pooling independent of color; or ii) probability summation across chromatically narrowband, orientation channels. We tested these by measuring the threshold for detecting GPs as a function of the coherence of the dipole orientations. Coherence thresholds were obtained for 8 observers for 8 (uni-chromatic) color directions in an equiluminant plane and for two cross-dipole, multi-chromatic conditions: i) dipole chromaticity randomly distributed in space; ii) dipole chromaticity constrained within spatial blocks of the image. Using a criterion-free measure of sensitivity, we found that coherence thresholds for either of the multi-chromatic conditions did not differ significantly from the uni-chromatic conditions. These results support a second stage model in which the local orientations are pooled independently of color.