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To perceive an object in a scene, the visual system needs to integrate local image elements together for a global percept. However, in a sufficiently complex scene, there are multiple possible ways to organize local image elements. Hence, it is a challenge for the visual system to find the right correspondence among local elements. To study this correspondence problem quantitatively, we used tripole Glass patterns (tGPs) which consist of randomly-distributed sets of three dots, or tripole. Each tripole contained one seed dot and two context dots. An observer would perceive either a clockwise (CW) or counter-clockwise (CCW) spiral global percept by grouping the seed with either one of the context dot. We systematically changed luminance contrast of the context dots and the seed-context distance. As shown in Figure 1, the probability of grouping the seed and a CW dot first increased and then decreased with the CW dot contrast, resulting an inverted-U function.

When the contrast of the second context dot, or CCW dot, increased, it not only decreased the peak of the U-shape function but also shifted the peak rightward.

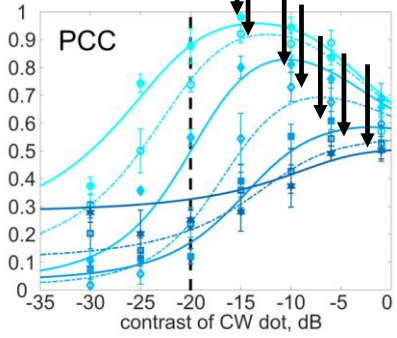

Figure 1. Contrast effect on grouping.

To explain such contrast effect on grouping, we proposed a generalized contrast gain control model. A dipole in a Glass pattern is picked up by an orientation selective filter whose excitation is determined by the product of its receptive field and the spatial profile of the dipole image. A linear global template sums the excitation of relevant local filters together. The excitation of the j-th global form detector, E_j, is the sum of the excitation of all relevant dipoles and thus a linear function of dot contrasts. In our tGP, there are three dots, and thus three possible dipoles, CW, CCW dipole and the irrelevant dipole (called irrelevant because observers were not asked to respond to it), as shown on the left of Figure 2. The inhibition toward the j-th global form, Ij is nonlinear sum of dipole excitations and thus a nonlinear sum of dot contrasts. The response of the j-th global form detector is then the excitation raised to a power and then divided by the sum of the inhibition and a constant. The probability of perceiving a global form is a cumulative Gaussian function of the response difference between two global form detectors.

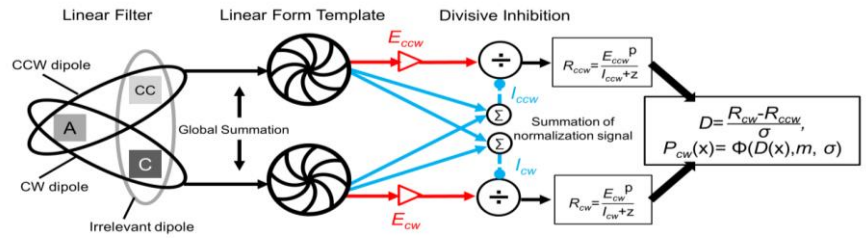

Figure 2. Diagram of the model