Dramatically different percepts between foveal and peripheral vision

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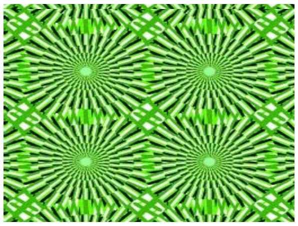
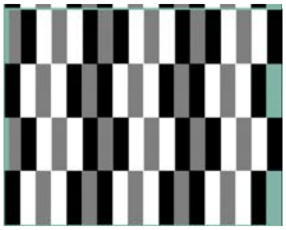
The phenomenon of visual crowding illustrates that vision in the periphery is not just a scaled version of vision in the fovea. One important theoretical hypothesis on visual crowding suggests that peripheral vision may contain less precise spatial and temporal phase information than foveal vision. To test this hypothesis, we created displays for which the percept depends critically on the internal representations of the spatial or temporal phase in the input stimuli.

The result is a series of illusions that create drastically different percepts for foveal and peripheral vision. These different percepts cannot be explained by simple differences in their spatial resolution because, for a number of the illusions, blurring does not alter the different percepts. The illusions therefore imply that processes that produce visual crowding may also lead to many other—and perhaps more dramatic—types of visual phenomena.

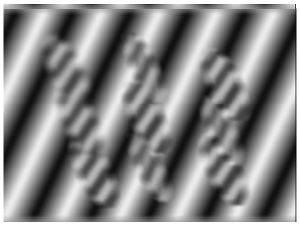
We present five of these illusions in the attached demonstration program. The program can also be found at www.shapirolab.net/Periphery.



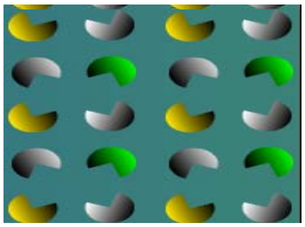
1. The elusive dollar: a very strong demonstration of visual crowding. Each intersection of the diagram contains a dollar sign tilted 45 deg to the left. When the mask is present, the dollar signs are visible at all intersections; when the mask is removed, the dollar signs are difficult to see in the periphery but easy to see in the fovea. The extra “visual clutter” makes it hard to see the intersections peripherally.



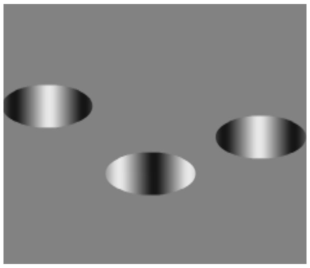
2. Foveal-winks/peripheral-blinks illusion. Identical 3 Hz modulating fields are surrounded by white or black borders. The contrasts of the fields surrounded by white modulate in antiphase relative the fields surrounded by dark. In the fovea, the fields appear to modulate asynchronously (i.e., wink), because the fovea can discern the difference in the temporal phase. In the periphery, where temporal phase is poorly represented, the lights appear to modulate synchronously (i.e., blink).



3. The peripheral escalator. Columns of ovals drift in front of a tilted grating. In the fovea, the columns are perceived to drift horizontally. In the periphery, the columns appear to move obliquely. The effect occurs because without phase discrimination, the moving columns are less likely to be defined as an object; in the periphery, the degraded shapes produce a barber poll illusion.



4. Disappearing squares illusion. A 16x12 array of Kanizsa pacmen rotate in opposite directions so as to continually assemble/disassemble arrays of Kanizsa squares. As the rotation rate increases, the peripheral range over which the squares can be seen decreases, until, at fast rotations, the squares appear instantly at the point at which the observer fixates, but not at all in the periphery.



5. The giddy-up illusion. Ovals drift from left to right across the screen. Inside each oval is an internal gradient that moves independently of the surround. In the periphery, it is difficult to follow the internal motion. Perhaps more striking is the sudden change in speed that occurs when eye movements bring the ovals from the visual periphery to central vision.