MedicalXpress

Shape encoding may start in the retina

September 12 2007

New evidence from the University of Southern California suggests that there may be dedicated cells in the retina that help compile small bits of information in order to recognize objects. The research was conducted by Ernest Greene, professor of psychology in the area of brain and cognitive sciences at USC. The study is published in the Public Library of Science journal, PLoS ONE.

It is well established that the images the observer sees are divided in half as they are sent to the two hemispheres of the brain. When a person looks at the center of an object, the image from the right half of the object will be sent to one hemisphere of the brain and the image of the left half is sent to the other. This is true whether a person uses one eye or two to look at the object. “Given that the primary visual areas in each hemisphere are seeing only half of the object, it has been assumed that communication between the hemispheres was needed to combine the information,” said Greene.

By using a high-speed LED array to display the images, Greene found evidence that the two sides of the retina interact to enhance the effectiveness of shape cues, which he describes as “linkage.” The cells in the retina appear to be coordinating their responses in a way that benefits shape recognition. Further, they do so with unexpected temporal precision.

The study was done by positioning dots around the outer boundaries of objects, forming stimuli similar to silhouettes. The dots were shown, in successive pairs, one pair after the other, and the observers were then

asked to identify each shape. Recognition was best if time intervals that separated pairs and pair members were in the submillisecond range. This was true whether both members of the pair were displayed on the same side of the object or on opposite sides. “This finding suggests that the responses from the two sides of the retina are being linked in some manner, and the process of joining the two halves of an object is not done only in the brain,” says Greene.

“It is unlikely that the nerve signal being sent from the eye to the brain can be precise enough to preserve submillisecond timing differences,” says Greene. Also, for the brain to coordinate nerve signals being sent from opposite sides of the retina, communication between the two hemispheres would be needed. “It strains credulity that these additional processing steps could be accomplished while preserving submillisecond precision in the responses to pair members,” Greene says. He thinks it is more likely that cell structures in the retina link the responses prior to sending the information to the visual cortex. The retina itself may be assessing global relationships among boundary locations, these operations being required for recognition of the shape.

Source: Public Library of Science