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Lost in the periphery

Visual grasp of scenes goes AWOL around the edges

By Laura Sanders
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ENLARGE

When staring at the cross in the center of the image, the scrambled image (top) is difficult to distinguish from the original scene of a fountain in Rostock, Germany (bottom).
J. Freeman and E. Simoncelli

A new kind of visual illusion confirms that people are not masters of perception. Observers are oblivious to peripheral visions of a woman's face dissolving into a fountain, a stroller becoming a blob, and windows melding into trees, researchers report online August 14 in *Nature Neuroscience*.

By studying these visual oversights, scientists hope to understand how the brain culls the flood of visual data that constantly streams into the eyes.

Jeremy Freeman of New York University and Howard Hughes Medical Institute investigator Eero Simoncelli, also of NYU, started the project by developing a mathematical description of how information moves through the visual system in the brain. Their model predicted that the visual system tosses unnecessary information that comes from the periphery. "Your visual system is giving you the information that you need, and it's throwing away information that you really don't need," Simoncelli says.

To see whether this information loss actually happens, the team showed eight people quick flashes — a fifth of a second — of various scenes, scrambled in a way the math model predicted would be undetectable to humans. While fixating on a point in the middle,

people couldn't tell the difference between two very different van Gogh-esque scrambles of a normal scene of a crowd at Washington Square Park in New York City, for example. These scrambles went undetected even when people were allowed to stare at the images for nearly half a second, the team reports.

"It's sort of striking when you go to do it," says Freeman. "I was surprised when I would say the two things looked the same, and then see later … that they are actually very different."

The researchers classified these indistinguishable images as "metamers." (Another kind of visual metamer comes from color perception: Two kinds of green can have very different spectral compositions but appear exactly the same to human eyes, for instance.)

These perceptual flaws shouldn't make anyone feel inadequate. "The fact that we're failing in these ways may sound horrible, but you have to remember that those failures aren't affecting your ability to see or survive," Simoncelli says. "You walk around just fine despite the fact that all this stuff in your periphery is jumbled."

The results may explain why people are worse at identifying peripheral objects surrounded by other objects, a phenomenon known as crowding, says visual neuroscientist Dennis Levi of the University of California, Berkeley.

Crowding happens when the brain pools peripheral information, losing some bits and retaining others. The new study suggests that this data-pooling — and by extension, crowding — occurs in a particular location in the brain, a part of the visual system known as V2. "A lot of people have tried to figure out where crowding occurs in the brain, and so far, no one has really come to a conclusive result," Levi says. "What this paper has done is made V2 a big contender."

Crowding can slow down readers, so understanding exactly how the process works might also lead to the development of more reader-friendly fonts and displays, Freeman says.

SUGGESTED READING :

B. Bower. Vision gets better with the right mind-set. Science News Online, April 27, 2010.

L. Sanders. Primate vision puts pieces together. Science News Online, April 6, 2009.

CITATIONS & REFERENCES :

J. Freeman and E. Simoncelli. Metamers of the ventral stream. Nature Neuroscience. doi:10.1038/nn.2889.