Crowded houses: Why our peripheral vision may not be as random as we think

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This is an image of Cinque Terre, Italy, showing "crowding." Image 1 is the normal image. Image 3 includes patches of "noise." When focusing on the center of image 3, these patches appear oriented to their surroundings. Credit: John Greenwood and Steve Dakin, UCL

As you read this, you may notice that the word directly in front of you is clear, but all the surrounding words are hard to make out. For most people, this effect - known as 'crowding' - is not a problem. However, for the millions of people worldwide who have lost their central vision through eye disease such as macular degeneration, it can make everyday tasks such as reading or recognising friends a challenge.

Despite the fact that crowding affects more than ninety-five per cent of the visual field, we know very little about how it occurs, aside from the

fact that it happens not in the eye, but in parts of the brain that deal with seeing. With far fewer neurons processing inputs from the peripheral visual field in these regions compared to our central vision, the brain simplifies these areas to represent more efficiently what is in front of us.

Researchers had previously assumed that crowding makes us worse at recognising things by making our peripheral vision more random. Now, Wellcome Trust-funded researchers at UCL (University College London) and Harvard Medical School have reported in Current Biology that this process is anything but random.

The researchers asked volunteers to look out of the corner of their eye at a small patch of random visual noise (similar to the 'snow' seen when a TV loses its signal). When the patch of noise was surrounded by striped patches all oriented in a particular direction, the volunteers reported the 'noise' to be similarly oriented. The results suggest that crowding is actually a process that makes the world appear more regular by essentially 'blending' nearby objects together.

The researchers have used a real-world example to demonstrate the effect. Taking a photograph depicting a dramatic coastal village in Cinque Terre, Italy, the researchers 'scrambled' a large number of patches throughout the image by swapping individual pixels within each region. However, when one's eyes are fixed on the centre of the corrupted image (for example, on the centrally-located brown house), these 'noise' patches disappear and the image appears relatively undamaged. This image was recently named runner-up in the UCL 'Research Images as Art' competition.

"We believe that this tendency of our brains to assume that the world is regular may have evolved because fewer cells in the brain are devoted to the edges of our vision compared to the centre," explains Dr John Greenwood from the UCL Institute of Ophthalmology. "In other words,

the brain is not capable of delivering anything more than a simplified sketch using these resources."

The researchers believe that understanding crowding promises to reveal much about how the visual brain works, and will also reveal the best way to present television images, text and the internet for people with damage to their central vision, for example through eye diseases such as macular degeneration and amblyopia ('lazy eye').

With amblyopia, for example, it has been suggested that crowding in the 'lazy' eye may occur in central vision in addition to the normal crowding in the peripheral visual field. Similarly, in macular degeneration patients lose their central vision and must rely on their peripheral visual field.

"If we understand when crowding does and does not occur, then we could potentially create text and images that are less likely to cause crowding," says Dr Greenwood. "Similarly, if we can understand how things look when they are crowded, we could potentially generate text and images that could be recognised even when crowding has had an effect."

More information: Greenwood, JA, Bex, PJ & Dakin, SC. Crowding changes appearance. *Current Biology*. E-pub in advance 4 March 2010.

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