Study shows that color plays musical chairs in the brain (w/ Video)

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(PhysOrg.com) -- Color is normally thought of as a fundamental attribute of an object: a red Corvette, a blue lake, a pink flamingo. Yet despite this popular notion, new research suggests that our perception of color is malleable, and relies heavily on biological processes of the eye and brain.

The brain's neural mechanisms keep straight which color belongs to what object, so one doesn't mistakenly see a blue flamingo in a pink lake. But what happens when a color loses the object to which it is linked? Research at the University of Chicago has demonstrated, for the first time, that instead of disappearing along with the lost object, the color latches onto a region of some other object in view - a finding that reveals a new basic property of sight.

The research shows that the brain processes the shape of an object and its color in two separate pathways and, though the object's shape and color normally are linked, the neural representation of the color can survive alone. When that happens, the brain establishes a new link that binds the color to another visible shape.

"Color is in the brain. It is constructed, just as the meanings of words are constructed. Without the neural processes of the brain, we wouldn't be able to understand colors of objects any more than we could understand words of a language we hear but don't know," said Steven Shevell, a University of Chicago psychologist who specializes on color and vision.

Shevell's findings are reported in a paper, "Color-Binding Errors During Rivalrous Suppression of Form," in the current issue of Psychological Science. Wook Hong, who received his Ph.D. at UChicago and is now a post-doctoral fellow at Vanderbilt University, joined Shevell in writing the paper and conducting the research.

Their work expands the understanding of how the brain is able to integrate the multiple features of an object, such as shape, color, location and velocity, into a unified whole.

"An aspect of human vision that we normally don't appreciate is that different features of an object, including color and shape, can be represented in different parts of the brain," said Shevell, the Eliakim Hastings Moore Distinguished Service Professor in Psychology and Ophthalmology & Visual Science.

If a person sees a basketball coming, it is perceived as having a particular color, shape and velocity. "The knitting together, or what can be called 'neural gluing,' of all those different features so we see a unified object is a complex function done by the brain. Our research focused on how the brain does that," Shevell explained.

To study how the brain represents the color of objects, the researchers used a technique called binocular rivalry. The technique presents a different image to each eye and thus pits signals from the right eye against signals from the left.

"The brain has difficulty integrating the two eyes' incompatible signals. When the signals from the two eyes are different enough, the brain resolves the conflicting information by suppressing the information from one of the eyes," Shevell said. "We exploited this feature of the brain with a method that caused the shape from one eye to be suppressed but not its color."

The researchers first showed subjects vertically oriented green stripes in the left eye and a horizontally oriented set of red stripes in the right eye. "The brain cannot fuse them in a way that makes sense. So the brain sees only horizontal or vertical," Shevell said. For their study, the researchers developed a new form of the technique that allowed the horizontal pattern to be suppressed without eliminating its red color, which continued on to the brain.

At this point, the brain has a musical chairs problem. Both the red and green colors reach consciousness but with only the one vertical pattern—one object but two colors. The surprising result was that the "disembodied red, which originated from the unseen horizontal pattern in one eye, glued itself to parts of the consciously seen vertical pattern from the other eye. That proves the idea of neural binding or neural gluing, where the color is connected to the object in an active neural process," Shevell said.

"To us it seems automatic," Shevell added. "Every basketball has a color. Every shirt has a color, but the brain must link each object's color to its shape."

Source: University of Chicago (news : web)