Scientists visualize the connections between eye and brain

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Most of the human brain's estimated 86 billion nerve cells, or neurons, can ultimately engage in a two-way dialogue with any other neuron. To shed more light on how neurons in this labyrinthine network integrate information—that is, precisely how multiple neurons send and combine their messages to a target neuron—a team of researchers at BIDMC and Boston Children's Hospital (BCH) focused on a rare case in which information only travels in one direction: from the retina to the brain.

In this study published May 31 in the journal *Cell*, Mark Andermann, Ph.D., Chinfei Chen, MD, Ph.D., and colleagues developed a means of tracking the activity of the far-reaching ends of retinal neurons (called boutons) as they deliver visual information to the thalamus, a brain region involved in image processing.

As they relay discrete bits of visual information to the brain, different types of retinal neurons respond to distinct features of visual content such as an object's direction of motion, brightness, or size. Conventional wisdom held that these lines of information remained separated in the thalamus.

Instead, Andermann and Chen's team found that boutons from different types of retinal neurons were often organized in local clusters and that boutons in a cluster typically make contact with a common target neuron, leading to a mixing of different lines of information. However, this mixing was not random—boutons in a cluster tended to share a common sensitivity to one or more visual features.

"The selective mixing of information from this arrangement of nearby boutons may be the retina's version of Pointillism, the neo-expressionist art technique in which nearby dots of different colors are fused together to create new and diverse colors," said Andermann, a member of the Division of Endocrinology, Diabetes and Metabolism at BIDMC and an Associate Professor of Medicine at Harvard Medical School. "In this way, this first interface between eye and brain is surprisingly sophisticated." (May 2018)

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