

What the Brain Sees After the Eye Stops Looking

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When we gaze at a shape and then the shape disappears, a strange thing happens: We see an afterimage in the complementary color. Now a Japanese study has observed for the first time an equally strange illusion: The afterimage appears in a “complementary” shape—circles as hexagons, and vice-versa.

“The finding suggests that the afterimage is formed in the brain, not in the eye,” the author, Hiroyuki Ito of Kyushu University, wrote in an email. More specifically, the illusion is produced in the brain’s shape-processing visual cortex, not the eye’s light-receiving, message-sending retina. The findings appear in an upcoming issue of [*Psychological Science*](#), a journal published by the [Association for Psychological Science](#).

Ito conducted three experiments with 82, 92, and 44 participants respectively. In the first two, he showed participants yellow circles or hexagons – outlined or filled, static or rotating on a gray ground. In each, after they observed the images for 10 seconds, the images disappeared, leaving only the blank gray field. The observers were asked to indicate which of seven shapes, on a piece of paper, the afterimage most resembled.

In the third experiment, Ito split the visual field between the two eyes. In the left eye, participants saw rotating circles and hexagons, as well as rotating asterisk-like “stars”—shapes that were neither round nor angular. The right eye viewed static circles in all conditions. When the circles, hexagons, and stars disappeared, the left field was black, which suppressed the formation of afterimages, and the right was white, which heightened it.

In Experiments 1 and 2, participants tended to see circles after hexagons and hexagons after circles. In the third, the right eye produced the most angular afterimages when rotating circles had been projected in the left eye; the most rounded ones after the rotating hexagons; and after the “stars,” images that were neither circular nor edged.

How did Ito infer that the brain, not the eye, was producing these afterimages? He eliminated the theory that the afterimage was a manifestation of “retinal bleaching”—when the photoreceptors on the retina become ineffective or fatigued through prolonged exposure to light. Viewing static circles or hexagons produce circular or hexagonal bleached areas on the retina. However, the afterimage shapes were not in the bleached shapes. A spinning circle or hexagon produces a circular trace of light on the retina, causing circular shape of retinal bleaching just as painting on the retina. However, spinning circles produced hexagonal afterimages and vice versa.

Retinal bleaching could not produce “an afterimage shape different from the [typical] retinal bleaching shape.” Neither could the retina transfer information taken in by the left eye to produce an afterimage in the right eye. “The only site that can happen is the brain.”

The research adds to science's understanding of the role of the brain in vision. "People tend to think that afterimages are meaningless by-products arising from the physiological characteristics of the eye," wrote Ito. "But I think that the afterimages reflect brain activities and provide us the means to know those activities in a directly visible form."