Neuronal activity in the visual cortex controlled by both where the eyes are looking and what they see

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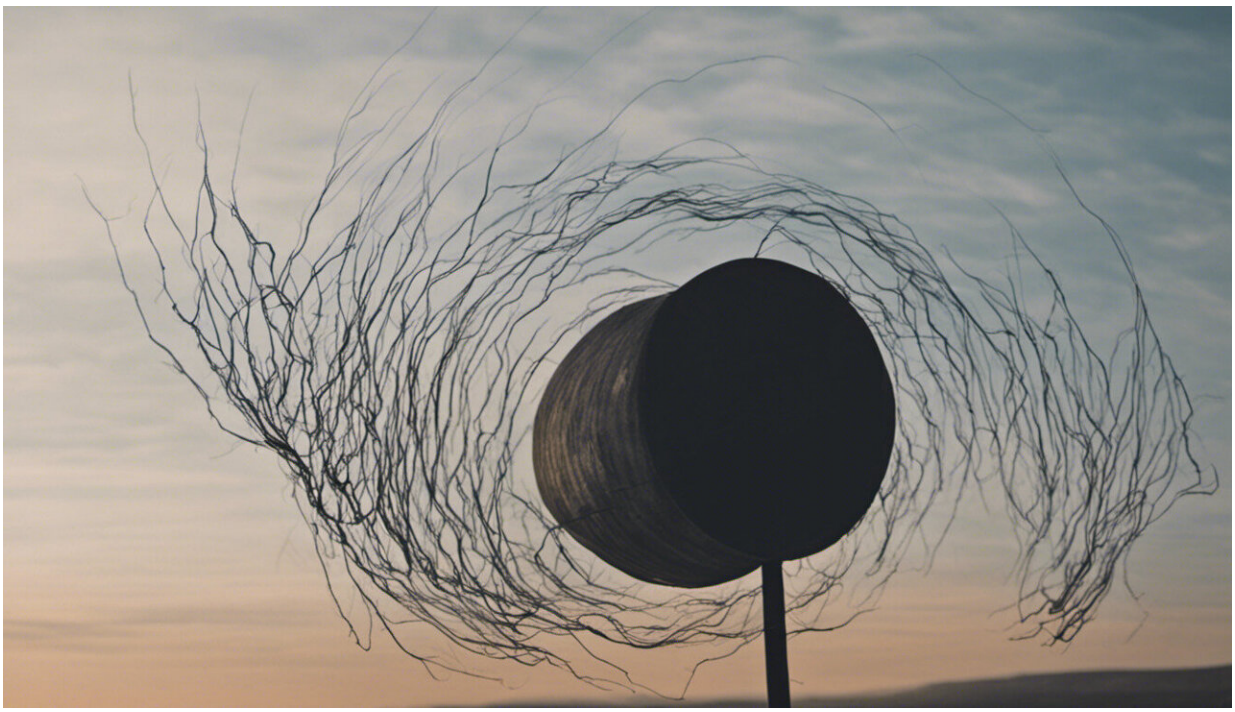

Credit: AI-generated image (disclaimer)

Even though our eyes are constantly moving, the brain perceives the external world as stationary—a feat achieved by integrating images acquired by the retina with information about the direction of the gaze. An international team of investigators including Justin Gardner from the

RIKEN Brain Science Institute in Wako has now found that neuronal activity in the visual cortex of humans depends on both the nature of the visual stimulus and the position of the eyes' gaze.

The researchers conducted a series of experiments in which five subjects were shown a screen displaying eight evenly spaced crosses. For each trial run, the subjects fixed their gaze on one of the crosses while a wedge of dots moved around that cross. This test was repeated for each of the crosses, and the activity within the visual cortex in response to the visual stimulus was continuously monitored using non-invasive functional magnetic resonance imaging.

The team found that the response of neurons in the visual cortex to visual stimulation was modulated by both the position of the wedge of dots and by the direction of the subjects' gaze. For example, one area of the visual cortex would become active when the wedge of dots was in a particular location within its rotation, having a stronger response when that wedge was on the cross in the upper right of the screen and a weaker response when it was on the cross in the lower left of the screen. In this way, the neurons in the visual cortex simultaneously encoded not only the nature of the visual stimulus but also its location in space.

Gardner and his colleagues interpret their findings to mean that neurons in the visual cortex respond selectively to visual stimuli that impinge on a given section of the retina in the eye but don't directly encode the locations of the stimuli in the world. Instead, the neurons in the visual cortex alter the amplitude of their responses based on eye position.

"Our research shows that every time we move our eyes, the population of neurons representing the stable outside world changes dramatically—a whole new set of neurons will become active to represent an object that has not moved," explains Gardner. "We've found that humans maintain both a retinal location response and an amplitude modulation with eye

position to create a stable representation of the world and to locate objects in the environment."

More information: Merriam, E. P., Gardner, J. L., Movshon, J. A. & Heeger, D. J. Modulation of visual responses by gaze direction in human visual cortex, *The Journal of Neuroscience* 33, 9879–9889 (2013). dx.doi.org/10.1523/JNEUROSCI.0500-12.2013

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