

Learning impacts how the brain processes what we see

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From the smell of flowers to the taste of wine, our perception is strongly influenced by prior knowledge and expectations, a cognitive process known as top-down control.

In a University of California, San Diego School of Medicine study published July 13 in the online journal *Nature Neuroscience*, a research team led by Takaki Komiyama, PhD, assistant professor of neurosciences and neurobiology, reports that in mouse models, the brain significantly changed its [visual cortex](#) operation modes by implementing top-down processes during learning.

"We found that when the mouse assigns a new meaning to a previously neutral visual stimulus, top-down control becomes much more influential in activating the visual cortex," said first author Hiroshi Makino, PhD, postdoctoral researcher in Komiyama's lab. "Top-down inputs interact with specific neuron types in the visual cortex to modulate its operation modes."

This [cognitive process](#) uses our thoughts and influences our senses. For example, when we see a word with missing letters, our brain is able to fill in the blank based on past experiences.

Researchers looked at activity in excitatory neurons and somatostatin-expressing inhibitory neurons in the visual cortex and top-down inputs from the [retrosplenial cortex](#) (RSC) during associative learning to see how these affected the top-down and bottom-up processing—when perception begins with the senses.

The findings indicate that intricate interactions of various circuit components effectively change the balance of top-down and bottom-up processing, with learning enhancing the contribution of top-down control. These results support the long-standing theory that the brain does not faithfully represent the environment but rather attempts to predict it based upon prior information.

"In addition to revealing circuit mechanisms underlying these learning-related changes, our findings may have implications in understanding the

pathophysiology of psychiatric diseases, such as schizophrenia, that generate abnormal perception," said Makino.

More information: Learning enhances the relative impact of top-down processing in the visual cortex, [DOI: 10.1038/nrn.4061](https://doi.org/10.1038/nrn.4061)

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