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PRESS RELEASE (2026/11/03)

# No neuralyzer needed. Identifying the molecular pathways and the circuit that triggers forgetting in C. elegans

Researchers find the molecular and neural mechanisms that cause C. elegans to actively and selectively forget specific odors

**Fukuoka, Japan—**In the 1997 film *Men in Black,* one of the prominent pieces of alien technology the main characters use in their work to police extraterrestrial activity on Earth was the neuralyzer. This flashy handheld device would erase the witnesses' memories of their close encounter. For as long as human inquiry has existed, people have tried to understand how and why we remember and forget. As we have begun to understand how the brain works, researchers have slowly uncovered the biological mechanisms underlying memory.

Publishing in *Current Biology*, researchers from Kyushu University have found the key molecular and neural pathways that cause the nematode *C. elegans* to actively forget a specific odor it previously remembered.

Through extensive studies of the *C. elegans* nervous system, the team discovered that a peptide called NLP-47 triggers this process of active forgetting. NLP-47 is received by a different neuron further along the circuit, which in turn sends a signal to the neuron storing the memory of the odor, leading to its erasure. Most strikingly, when *C. elegans* memorized two different odors simultaneously, this circuit erased the memory of only one odor while leaving the other intact.

"Research on memory has focused on how it is formed and maintained. How memories are lost has received less attention," explains Professor Takeshi Ishihara from Kyushu University's Faculty of Science, who led the study. "We usually think of forgetting as a failure of memory. But forgetting is just as essential for adaptation and survival. This raises a question: How does the brain decide which memories to erase?"

To uncover the mechanism of active forgetting, the team has been studying the model organism *C. elegans,* a nematode with only 302 neurons. Because each neuron has been identified, it is possible to trace a memory and its erasure to specific neurons. *C. elegans* are blind but have an exceptional sense of smell. In 2013, Ishihara's team used *C. elegans* to identify the neurons that cause the active forgetting of a specific odor memory housed in another neuron.

However, at that time, the team could not identify the molecules that activate this pathway. First author and PhD candidate Yuuki Onishi set out to identify the responsible molecules. In their experiment, the researchers trained the *C. elegans* to learn a specific smell: diacetyl. After about four hours—the time it usually takes for the organism to forget a smell—diacetyl was administered again. If the *C. elegans* moved toward the diacetyl smell, it meant that it had forgotten the memory; if not, the memory had been retained.

In a previous study, Ishihara's team identified that AWA neurons store the memory of the odor, and that memory was erased by signals from AWC neurons. The team worked to identify the 'forgetting' signal released by AWC and identified the neuropeptide NLP-47 and its receptor GNRR-1. When they investigated which neural circuits these two factors affected, they discovered that AIZ neurons, which are located between AWC and AWA, were involved.

"First, AWC releases NLP-47 and activates the GNRR-1 receptor on the AIZ neurons. The AIZ neurons would then release glutamate, another neurotransmitter," continues Ishihara. "The glutamate then acts on the GLR-4 receptor on the AWA neurons that house the memory of the scent, leading to active forgetting. When we used optogenetics to suppress the activity of the AWC and AIZ neurons, we found that the nematodes were more resilient to forgetting."

Follow-up experiments revealed that this active forgetting was highly specific. When nematodes were trained to remember two odors—diacetyl and isoamyl alcohol—simultaneously, the NLP-47/GNRR-1 pathway only forgot the diacetyl smell. *C. elegans* in which NLP-47/GNRR-1 or glutamate did not function were more resistant to forgetting the smells.

"Discovering that this forgetting system is not indiscriminate and can target a specific memory is fascinating. At first, I was not expecting to find such a concrete mechanism of active forgetting with a remarkable specificity," explains Onishi. "I hope this research will lead to a deeper understanding of forgetting and eventually to more insights on conditions and pathologies involving memory."

"There are many diseases that involve memory loss. But before we can understand what goes wrong, we need to understand how forgetting works in the brain, and I hope this research will lead to a better understanding of such brain functions," concludes Ishihara. "Interestingly, receptors like GNRR-1 are found in other organisms, including humans. In rodents, these receptors are found in the hippocampus, the brain's center for memory, although their role there is not yet known. Our findings may also lead to an understanding of the mechanisms by which mammals forget specific memories."

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For more information about this research, see "Neuropeptidergic-glutamatergic circuit regulates selective forgetting of olfactory learning," Yuuki Onishi, Mary Arai, Noriko Sato, Miu Takamatsu, Jamine Hooi-Min Teo, Tomohiro Kitazono, Takeshi Ishihara, *Current Biology*, https://doi.org/10.1016/j.cub.2026.10.015

**About Kyushu University**

Founded in 1911, Kyushu University is one of Japan's leading research-oriented institutions of higher education, consistently ranking as one of the top ten Japanese universities in the Times Higher Education World University Rankings and the QS World Rankings. Located in Fukuoka, on the island of Kyushu—the most southwestern of Japan's four main islands—Kyushu U sits in a coastal metropolis frequently ranked among the world's most livable cities and historically known as Japan's gateway to Asia. Its multiple campuses are home to around 19,000 students and 8,000 faculty and staff. Through its VISION 2030, Kyushu U will "drive social change with integrative knowledge." By fusing the spectrum of knowledge, from the humanities and arts to engineering and medical sciences, Kyushu U will strengthen its research in the key areas of decarbonization, medicine and health, and environment and food, to tackle society's most pressing issues.

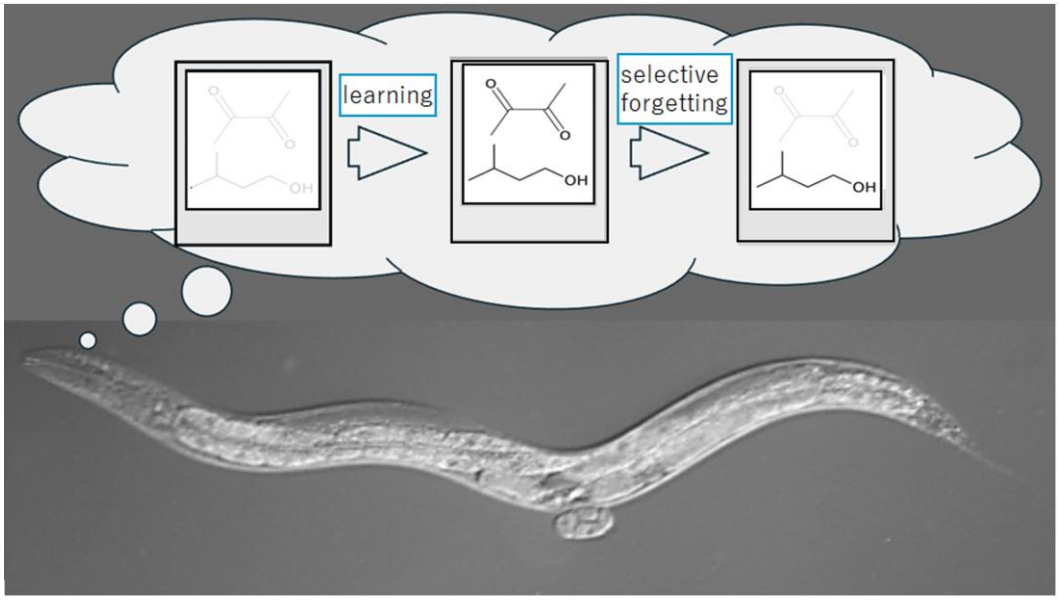



FIG.1 Selective forgetting of diacetyl smell in C. elegans. When C. elegans learns two odors at the same time, the two memories do not share the same fate. Four hours later, the memory of diacetyl has faded while the memory of isoamyl alcohol remains. The researchers identified the neuropeptide and the neural circuit that direct this selective forgetting. (Takeshi Ishihara / Kyushu University)

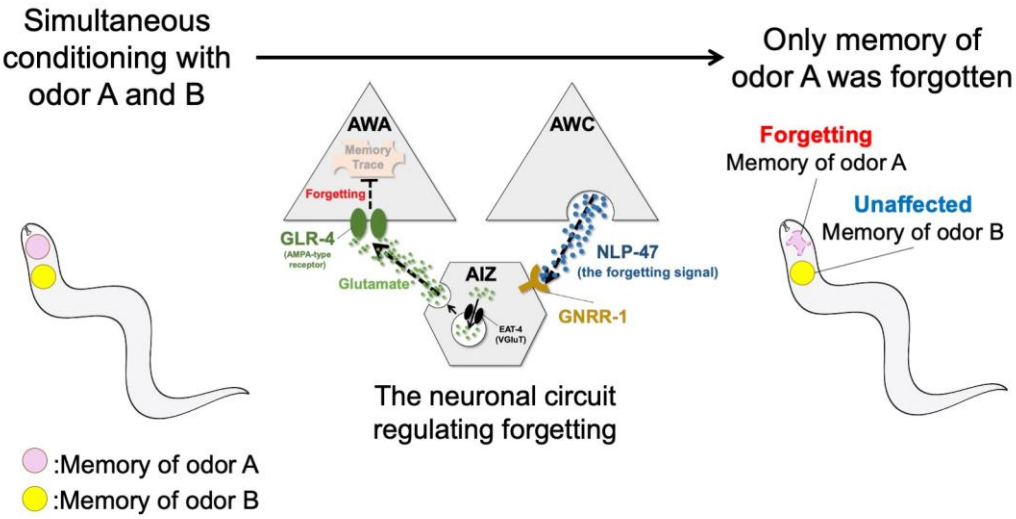



FIG.2 The neural circuits and signaling molecules that cause selective forgetting. The researchers identified the circuit that drives selective forgetting. AWC neurons release a “forgetting signal” that acts on AIZ neurons, which in turn release glutamate onto AWA neurons, where the memory of odor A is stored. The memory of odor B, learned at the same time, is left unaffected. (Takeshi Ishihara / Kyushu University)

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