

# Why odors trigger powerful memories

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Odors evoke powerful memories, an experience enshrined in literature by Marcel Proust and his beloved madeleine.

A new Northwestern Medicine paper is the first to identify a [neural basis](#) for how the brain enables odors to so powerfully elicit those memories.

The paper shows unique connectivity between the hippocampus—the seat of [memory](#) in the brain—and olfactory areas in humans.

This new research suggests a neurobiological basis for privileged access by olfaction to memory areas in the brain. The study compares connections between primary sensory areas—including visual, auditory, touch and [smell](#)—and the hippocampus. It found olfaction has the strongest connectivity. It's like a superhighway from smell to the hippocampus.

"During evolution, humans experienced a profound expansion of the neocortex that re-organized access to memory networks," said lead investigator Christina Zelano, assistant professor of neurology at Northwestern University Feinberg School of Medicine. "Vision, hearing and touch all re-routed in the brain as the neocortex expanded, connecting with the hippocampus through an intermediary—association cortex—rather than directly. Our data suggests olfaction did not undergo this re-routing, and instead retained direct access to the hippocampus."

The paper, "Human hippocampal connectivity is stronger in olfaction than other sensory systems" was published March 4 in the journal *Progress in Neurobiology*.

Epidemic loss of smell in COVID-19 makes research more urgent In COVID-19, [smell loss](#) has become epidemic, and understanding the way odors affect our brains—memories, cognition and more—is more important than ever, Zelano noted.

"There is an urgent need to better understand the olfactory system in order to better understand the reason for COVID-related smell loss, diagnose the severity of the loss and to develop treatments," said first author Guangyu Zhou, research assistant professor of neurology at Northwestern. "Our study is an example of the basic research science

that our understanding of smell, smell loss and future treatments is built on."

Below is a Q & A with Zelano about the importance of the sense of smell, olfactory research and the link to COVID-19.

## **Why do smells evoke such vivid memories?**

"This has been an enduring mystery of human experience. Nearly everyone has been transported by a whiff of an odor to another time and place, an experience that sights or sounds rarely evoke. Yet, we haven't known why. The study found the olfactory parts of the brain connect more strongly to the memory parts than other senses. This is a major piece of the puzzle, a striking finding in humans. We believe our results will help future research solve this mystery."

## **How does smell research relate to COVID-19?**

"The COVID-19 epidemic has brought a renewed focus and urgency to olfactory research. While our study doesn't address COVID smell loss directly, it does speak to an important aspect of why olfaction is important to our lives: smells are a profound part of memory, and odors connect us to especially important memories in our lives, often connected to loved ones. The smell of fresh chopped parsley may evoke a grandmother's cooking, or a whiff of a cigar may evoke a grandfather's presence. Odors connect us to important memories that transport us back to the presence of those people."

## **Loss of smell linked to depression and poor quality of life**

"Loss of the sense of smell is underestimated in its impact. It has

profound negative effects of quality of life, and many people underestimate that until they experience it. Smell loss is highly correlated with depression and poor quality of life.

"Most people who lose their smell to COVID regain it, but the time frame varies widely, and some have had what appears to be permanent loss. Understanding smell loss, in turn, requires research into the basic neural operations of this under-studied sensory system.

"Research like ours moves understanding of the olfactory parts of the brain forward, with the goal of providing the foundation for translational work on, ultimately, interventions."

**More information:** Guangyu Zhou et al, Human hippocampal connectivity is stronger in olfaction than other sensory systems, *Progress in Neurobiology* (2021). [DOI: 10.1016/j.pneurobio.2021.102027](https://doi.org/10.1016/j.pneurobio.2021.102027)

Provided by Northwestern University

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