# An impaired sense of smell can signal cognitive decline, but 'smell training' could help

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Credit: AI-generated image (disclaimer)

As we age, we often have problems with our ability to smell (called olfactory dysfunction). Older people might not be able to identify an odour or differentiate one odour from another. In some cases they might not be able to detect an odour at all.

Odour identification difficulties are common in people with neurodegenerative diseases, including Alzheimer's disease.

In the absence of a known medical cause, an impaired sense of smell can be a predictor of cognitive decline. Older people who have difficulty identifying common odours have been estimated to be twice as likely to develop dementia in five years as those with no significant smell loss.

Olfactory dysfunction is often present before other cognitive symptoms appear, although this loss can go undetected.

Beyond being a potential early indicator of Alzheimer's disease, olfactory problems can pose safety risks, such as not being able to smell gas, smoke, or rotten food.

Smell ability is also strongly linked to our ability to taste, so impairments can lead to decreased appetite and therefore nutritional deficiencies. In turn, olfactory deficits can decrease quality of life and increase the risk of depression.

But there is emerging evidence that olfactory or "smell training" can improve ability to smell. These findings may offer some hope for older adults experiencing olfactory difficulties and an associated decline in quality of life.

## How is our sense of smell linked to our brains?

The process of smelling activates the complex olfactory network in the brain. When we smell a rose, for example, receptors in the nose detect the many molecules that make up the rose's odour.

This information is then sent to the many areas of the brain (including the olfactory bulb and olfactory cortex, the hippocampus, the thalamus

and the orbitofrontal cortex) that help us process the information about that odour.

To name the rose, we access our stored knowledge of its pattern of odour molecules, based on past experience. So identifying the smell as belonging to a rose is considered a cognitive task.

## What is smell training?

Smell training has been studied in various animals, from flies to primates. Animals exposed to multiple odours develop an increased number of, and connections between, brain cells. This process has been shown to enhance learning and memory of odours.

In humans, olfactory training has typically involved smelling a range of robust odours representing major odour categories – flowery (such as rose), fruity (lemon), aromatic (eucalyptus) or resinous (cloves). Participants may be asked to focus their attention on particular odours, try to detect certain odours, or note odour intensities.

Generally, training is repeated daily for several months. Periods over three months are suggested for older adults.

This training has been shown to improve people's ability to identify and tell the difference between smells. To a lesser extent, it can help with odour detection in people with various forms of smell loss, including those with a brain-derived impairment such as a head injury or Parkinson's disease.

Importantly, one recent study of olfactory training in older adults found it not only improved performance on identifying smells, but was also associated with improvement in other cognitive abilities.

For example, those who undertook smell training had improved verbal fluency (improved ability to name words associated with a category), compared to control participants who completed Sudoku exercises.

## How does smell training work?

Neuroplasticity, our brains' ability to change continuously in response to experience, may be key to how smell training works.

Neuroplasticity involves the generation of new connections and/or the strengthening of existing connections between neurons (brain cells), which in turn may lead to changes in thinking skills or behaviour. We can see evidence of neuroplasticity when we practise a skill such as playing an instrument or learning a new language.

The olfactory network is considered particularly neuroplastic. Neuroplasticity may therefore underlie the positive results from smell training, both in terms of improving olfactory ability and boosting capacity for other cognitive tasks.

## Could smell training be the new brain training?

Brain training aiming to maintain or enhance cognitive function has been extensively studied in older people with dementia or at risk of it.

Established cognitive training approaches generally train participants to use learning strategies with visual or auditory stimuli. To date, formal cognitive training has not been attempted using smells.

However, using the considerable neuroplasticity of the olfactory network and evidence-based cognitive training techniques, both olfactory and cognitive deficits may be targeted, particularly in older adults at risk of

dementia. It seems possible we could train our brains through our noses.



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