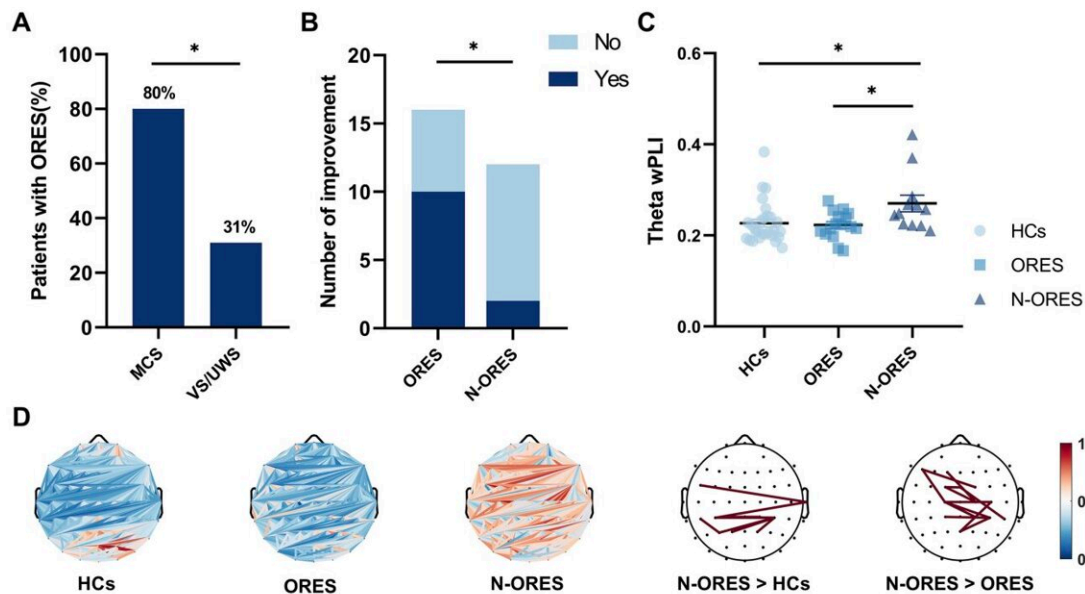


Are the olfactory responses of patients in a coma or vegetative state signs of consciousness?

May 31 2023, by Ingrid Fadelli



Behavioral results and global connectivity among HCs, ORES, and N-ORES. (A) The proportion of olfactory response among MCS and VS/UWS patients. A relationship was observed between the presence of olfactory response and level of consciousness ($\chi^2(1) = 6.892$, $*p = 0.020$). (B) The consciousness improvement outcome in the ORES and N-ORES patients (at 3-month follow-up). Patients with olfactory response had higher improvement rates (at 3-month follow-up) than those without response ($\chi^2(1) = 5.882$, $*p = 0.023$). (C) Scatter plot of global wPLI values in theta bands after pleasant stimulus. N-ORES patients showed higher theta connectivity measures compared to ORES patients and HCs ($*p = 0.029$; $*p = 0.027$, after Bonferroni correction). (D) The top

panel shows average connectivity (the first three panels) and significantly altered connectivity in different groups. The red line means significantly increased connectivity (the last two panels). Credit: Wu et al. (*Frontiers in Neuroscience*, 2023).

Severe brain injuries or head traumas in humans can lead to various stages of so-called disorders of consciousness (DoC). These are states in which consciousness is either partly or entirely absent, such as a coma; unresponsive wakefulness syndrome, also known as a vegetative state; and minimally conscious state.

Accurately evaluating [patients](#) who have lost consciousness is of crucial importance, as it allows doctors to determine what treatments to administer and how to facilitate the re-emergence of consciousness. Typically, to clinically evaluate consciousness, doctors observe the behavior of patients in response to [sensory stimuli](#), such as sounds or images.

For instance, while patients in a [vegetative state](#) are awake but continue to be unresponsive to [external stimuli](#), patients with MCS exhibit some behaviors that indicate that they are conscious. So far, most methods to assess the consciousness level of patients rely on sounds or [visual stimuli](#), yet olfactory stimuli could potentially prove useful too.

Researchers at Southern Medical University in China recently carried out a study investigating the responses of patients in a coma or vegetative state to smells, to understand whether they could be used to evaluate consciousness. Their findings, published in *Frontiers in Neuroscience*, appear to highlight the potential of olfactory stimuli for assessing consciousness in [clinical settings](#).

"This study aimed to explore whether olfactory response can be a sign of consciousness and represent higher cognitive processing in patients with disorders of consciousness (DoC) using clinical and electroencephalogram data," Wanchun Wu, Chengwei Xu, and their colleagues wrote in their paper.

As part of their study, the researchers evaluated the responses of 28 patients at different stages of DoC to olfactory stimuli. Out of these patients, 13 were in a vegetative state (UMS) and 15 in MCS. The study participants were divided into two groups based on whether they responded to olfactory stimuli or not.

"We recorded an olfactory task-related electroencephalogram (EEG) and analyzed the relative power and functional connectivity at the whole-brain level in the patients with DoC and healthy controls (HCs)," Wu, Xu and their colleagues wrote. "After three months, the outcomes of DoC patients were followed up using the [coma](#) recovery scale-revised (CRS-R)" [i.e., a standard assessment used to measure DoC in clinical settings].

When Wu, Xu and their colleagues analyzed the data they collected, they found that there was a relationship between the patients' olfactory responses and their levels of consciousness. They also found that patients in the no-olfactory responses group showed higher theta functional connectivity than patients in the olfactory response group after they were presented with the vanillin scent, and lower alpha and beta relative powers than healthy participants with no DoC.

The follow-up data collected three months later showed that 10 out of 16 of the patients who responded to olfactory stimuli during the study had recovered consciousness, while only 2 out of the 12 participants who did not respond to olfactory stimuli did. This suggests that a brain response to olfactory [stimuli](#) is typically a sign that patients with DoC are

gradually recovering and regaining consciousness.

In the future, the work by this team of researchers could inform the development of new methods to evaluate the level of consciousness of patients with varying DoC. In addition, it could inform additional studies investigating the relationship between consciousness and brain responses to smells.

"Olfactory responses should be considered signs of consciousness," Wu, Xu and their colleagues explained in their paper. "The differences in olfactory processing between DoC patients with and without olfactory responses may be a way to explore the neural correlates of olfactory consciousness in these patients. The olfactory response may help in the assessment of [consciousness](#) and may contribute to therapeutic orientation."

More information: Wanchun Wu et al, Olfactory response is a potential sign of consciousness: electroencephalogram findings, *Frontiers in Neuroscience* (2023). [DOI: 10.3389/fnins.2023.1187471](https://doi.org/10.3389/fnins.2023.1187471).

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