Study shows sense of smell is influenced by cues from other senses

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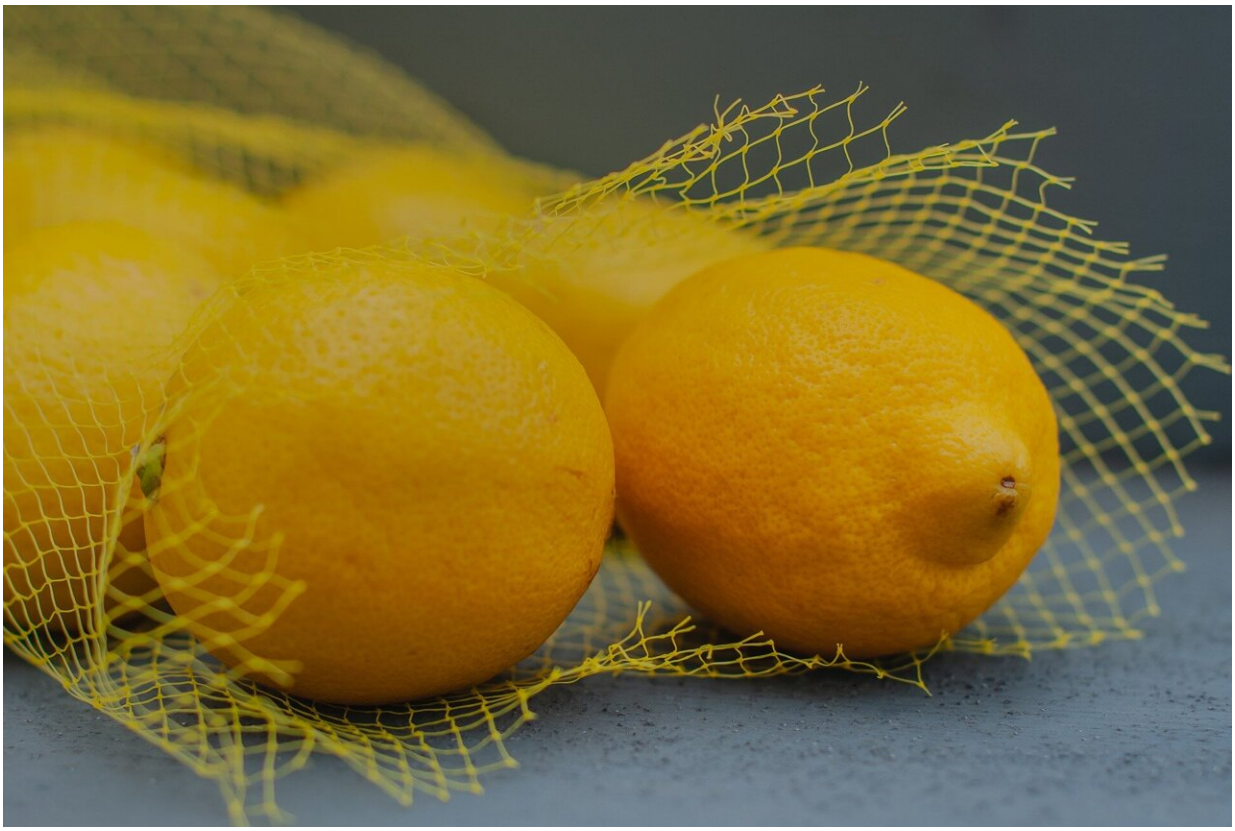

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The sense of smell is highly influenced by the cues from other senses, while the sense of sight and hearing are affected to a much lesser extent, shows a new study in *Journal of Neuroscience*, titled "Olfactory categorization is shaped by a transmodal cortical network for evaluating perceptual predictions."

A popular theory of the brain holds that its main function is to predict what will happen next, so it reacts mostly to unexpected events. Most research on this topic, called predictive coding, has only focused on what we see, but no one knows if the different senses, such as smell, work in the same way.

To figure out more about how smell relates to how we handle different sensory impressions, the researchers conducted a study with three experiments, two behavioral experiments, and one experiment using the brain imaging method fMRI at Stockholm University Brain Imaging Center (SUBIC).

"The main finding is that smelling was much more dependent on predictions than vision was. This is interesting because many people think that smell is primitive and reactive, when our research shows it is in fact quite sophisticated and proactive," says Stephen Pierzchajlo, Ph.D. Student at the Department of Psychology, and main author of the study.

The study shows how important it is for our different senses to be able to use correct cues when we classify different sensory impressions.

"We have all experienced that we react to when an unexpected smell appears, for example when we enter someone's flat and encounter a new smell. Our research shows that the sense of smell is highly influenced by

the cues from other senses, while the sense of sight and hearing are affected to a much lesser extent," says Jonas Olofsson, professor at the Department of Psychology, and co-author of the study.

The researchers also show that when the brain tries to identify odors that it had not expected, both the olfactory and visual brains are activated, despite the absence of visual cues in the task.

"The olfactory brain thus has a completely unique way of processing smells and it is about whether the smells are expected or not. The sense of smell warns us of smells that we had not expected, and engages the visual brain, perhaps to be able to see what it is that smells. It's a smart function because we humans are so bad at recognizing smells if we don't get clues," says Jonas Olofsson.

In the experiments, participants listened to spoken word cues, such as "lemon," and then received a picture or smell, and participants quickly decided whether it matched with the cue, for example with a lemon picture or smell, or did not match, for example with a rose picture or smell.

"We noticed that overall, the expected pictures and smells led to quicker decisions, which fits well with predictive coding theory. We used the difference in response speed to compare the senses with each other—a bigger delay for unexpected stimuli means that the sense relies more on predictions," says Stephen Pierzchajlo.

The study is the first concluded part of his Ph.D. research.

"The human sense of smell is not a reactive, but a proactive sense. It uses a unique brain strategy to process unexpected smells in order to understand what the smells are," says Stephen Pierzchajlo.

More information: Stephen Pierzchajlo et al, Olfactory categorization is shaped by a transmodal cortical network for evaluating perceptual predictions, *The Journal of Neuroscience* (2024). DOI: 10.1523/JNEUROSCI.1232-23.2024