

Pleasant odors perceived the same by different cultures

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A research subject hooked up to an olfactometer that delivers a whiff of scent to the subject's nose. (Rehan Khan/UC Berkeley)

Chinese, Africans and Indians may differ in what odors they find yummy, but they all perceive pleasantness in the same way, according to the findings of neurobiologists from the University of California, Berkeley, and the Weizmann Institute of Science in Rehovot, Israel.

The findings shed light on a long-standing philosophical as well as scientific question: Is the perception of what is "pleasant" universal to all people or determined by one's culture?

Not only are pleasant odors universal, the UC Berkeley and Israeli scientists say, but the pleasantness or unpleasantness of a chemical can be predicted with a degree of accuracy that may prove a boon to

perfume companies and other developers of new scents.

"A lot of people think that the perception of pleasantness is totally subjective, and you just learn it. They think that the food preferences you have are part of your upbringing and what your culture eats," said Rehan Khan, a research scientist in the Helen Wills Neuroscience Institute at UC Berkeley. "That is true, but a significant part of what people find to be pleasant and unpleasant turns out to be the same anywhere on the planet and may reflect something about molecules themselves."

Khan and his colleagues, including Noam Sobel, a former UC Berkeley professor of psychology now at the Weizmann Institute, reported their findings in the Sept. 12 issue of *The Journal of Neuroscience*.

"Our findings show that the way we perceive smells is at least partially hard-wired in the brain," Sobel said. "Although there is a certain amount of flexibility, and our life experience certainly influences our perception of smell, a large part of our sense of whether an odor is pleasant or unpleasant is due to a real order in the physical world. Thus, we can now use chemistry to predict the perception of the smells of new substances."

Certainly, perception is, in part, culturally determined, Khan said, noting that many Asians' love of fermented fish sauce and the Swedes' widespread appreciation of fermented herring are by no means universal. Yet, experiments have shown hard-wired, innate reactions to smells, for example, by rats when first exposed to the odor of cats and even by human newborns exposed to odors.

Efforts to find a chemical explanation for odor preference, akin to how the wavelength of light can explain most of our perception of color, have proved fruitless until now, he said. No chemical structure or composition had reliably been linked with perceptions of "sweetness" or

"floweriness" or "pleasantness."

To identify the general principles by which our sense of smell is organized, Khan, Sobel and their colleagues began with a database of 160 different odors that had been ranked by 150 perfume and smell experts according to a set of 146 characteristics, such as sweetish, smoky or musty. These data were then analyzed with a statistical program that maximized the variance in perception among the smell experts, in essence isolating a single factor that best distinguished the odors from one another.

The scientists found that single factor was a chemical's "pleasantness" rating, which ranks odors from "sweet" and "flowery" at one end to "rancid" and "sickening" at the other.

They did the same type of statistical analysis on a database of chemicals, taking account of more than 1,500 characteristics of each chemical, to come up with one factor or number that best distinguished them from one another.

To their surprise, the researchers found that these factors were correlated, allowing them to predict from the molecular structure of a substance how pleasing its smell would be perceived.

"What we found is the best number for describing the pleasantness of a molecule," Khan said. "In other words, your nose, in telling you whether a molecule is pleasant or unpleasant, is telling you the most useful number or summary of that molecule."

To check their model, Sobel and his team asked experimental subjects to assess 50 odors they had never smelled before. They found that the pleasantness ratings by their subjects fit closely with the rankings predicted by their model. Their subjects were Americans, Jewish Israelis

and Muslim-Arab Israelis who, despite their general preferences for different cuisines, perceived pleasantness in the same way.

"If, in fact, pleasantness really has a component that reflects something fundamental about molecules and their chemistry, then it should be similar for everybody," Khan added. "And, in fact, you might predict that is true not just for people but for animals, too. There is nothing special about humans in terms of our analysis of molecules; methane is methane for dogs as well as people."

Khan noted that pleasantness is an odor characteristic that dominates people's perceptions, evidenced by the fact that it takes less than a hundred milliseconds for someone to decide if an odor is unpleasant or pleasant, versus seconds to determine if, for example, an odor is sweet or flowery. And frequently, they are wrong in identifying an odor. Nevertheless, Sobel and his colleagues continue to look for ways to predict other perceptions, or "percepts," such as edibility.

Source: UC Berkeley

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