Sweet smell

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What makes one smell pleasant and another odious? Is there something in the chemistry of a substance that can serve to predict how we will perceive its smell? Scientists at the Weizmann Institute of Science and the University of California at Berkeley have now discovered that there is, indeed, such a link, and knowing the molecular structure of a substance can help predict whether we will find its smell heavenly or malodorous.

In sight and hearing, for instance, our perceptions are determined by the physical properties of waves – the length of light waves in sight, and the frequency of sound waves in hearing. But until now, there was no known physical factor that could explain how our brains sense odors. The new study, conducted by Prof. Noam Sobel of the Institute's Neurobiology Department and his colleagues, represents a first step in understanding the physical laws that underlie our perception of smell. Their results appeared last week in the *Journal of Neuroscience*.

To identify the general principles by which our sense of smell is organized, the researchers 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 (sweetish, smoky, musty, etc.). These data were then analyzed with a statistical program that analyzed the variance in perception among the smell experts.

The scientists found that the data fell along an axis that describes the 'pleasantness rating' of the odors – running from 'sweet' and 'flowery' at one end to 'rancid' and 'sickening' at the other. The same distribution

along this axis, they discovered to their surprise, closely describes the variation in chemical and physical properties from one substance to another. From this, the researchers found they could build a model to predict, from the molecular structure of a substance, how pleasing its smell would be perceived.

To double check their model, Sobel and his team tested how experimental subjects assessed 50 odors they had never smelled before for pleasantness. They found that the ratings of their test subjects fit closely with the ranking shown by their model. In other words, they were able to predict the level of pleasantness quite well, even for unfamiliar smells. They noted that, although preferences for smells are commonly supposed to be culturally learned, their study showed that the responses of American subjects, Jewish Israelis and Muslim-Arab Israelis all fit the model's predictions to the same extent.

Sobel: 'Our findings show that the way we perceive smells is at least partially hard-wired in the brain. 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.'

Source: Weizmann Institute of Science