

Smell your armpits: They are trying to tell you something
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Consider the rank odor from the old man perspiring beside you on the bus, the fresh smell of newly cut grass, the foul odor of the passing garbage truck, or the appetizing odors wafting out of the bakery you walk by. Odors surround us in countless forms, both positive and negative, but few of us stop to think about them. Scientists and laymen alike have long considered humans “microsmatic animals”, meaning that for us, the olfactory sense plays a minor role compared to the other senses. However an increasing number of studies have begun to paint a different picture, one that suggests that olfactory information plays a very significant role in our everyday decisions. This article reviews recent insights into how the human brain processes body odors and the implications this may have both for our lifestyle and for our use of perfumes and personal hygiene products.

Information within our armpits

Body odors carry informational cues of great importance for the individual across a wide variety of animal species. That humans might be counted among these species was, for a long time, dismissed outright. However, we now know that humans, much like our fellow animals, are able to extract biological and social cues from conspecific body odors (i.e. odors from our own species) that provide information and direct our behavior. Our unique odor reflects information related to our genetic makeup and also about personal environmental variables such as diet and hygiene. For example, studies have demonstrated that our body odor conveys information that allows us to identify individuals, directs us toward a partner with an advantageous genetic makeup, and informs us of the health status of others (Lundstrom, Boyle, Zatorre, & Jones-Gotman, In press; Penn & Potts, 1998; Yamazaki & Beauchamp, 2007).

Body odors and the brain

The percept, or mental impression, of a body odor commonly includes an emotional character that evokes a strong valence of liking or disliking. For example, the body odor from a lover may be a very pleasant percept, whereas the same percept from the person sitting next to you on the bus may be highly negative. When we hear the two words ‘body odor’, most of us think about a foul percept that unwashed individuals may emit. This consciously-perceived bad odor is in fact due to a small subset of the numerous chemicals (about 120) that comprise our body odor. In contrast, the chemical within our body odor that serves as social signals are generally perceived with low conscious awareness. In a recent study, we demonstrated that body odors are processed mainly outside brain areas that have long been considered to be the primary processing centers for olfaction (Lundstrom, Boyle, Zatorre, & Jones-Gotman, 2008). We found that body odors are primarily processed in areas responsible for emotional and attentional processing. What does this tell us? First, that body odors are processed more similarly to emotional stimuli

than are odors not of bodily origin (general odors). More importantly, this differential processing indicates a separation between the conscious percept of body odors and the social signals they contain. Our studies indicate that this separation is automatic; when we try to fool the system by presenting 'fake' body odors comprised of chemicals that do not originate from the human body, these fake body odors are still processed by the brain as general odors. Remarkably, even when subjects mistakenly identify the fake body odor as real body odor, the brain processes the odor as though it is a general odor. These results lead one to ask: Why has the brain developed these special processing networks in addition to the general olfactory pathway? What are the behavioral implications?

Sniffing out a stranger

When trying to understand a phenomenon in one sensory modality, it is often instructive to examine how similar phenomena have been handled by other modalities, such as vision or audition. Indeed, the separate brain processing we demonstrated for body odors vs. general odors is mirrored in the visual system, where visual stimuli of high survival value, such as images of a snakes or spiders, receive heightened attention and prioritized access to brain processing areas compared to less threatening visual stimuli. Thus, the brain sends social (or environmental) information down a specialized pathway, which is faster and capable of accessing action centers; in contrast, general information is sent through a separate sensory pathway that is slower but more accurate. Imagine a scenario in which Adam and Eve walk down a garden path heading to their shed for some gardening tools. Suddenly, Adam catches a glimpse of a snake lying in the grass to his right. His visual system alerts him and his body, now controlled by non-conscious processes triggered by the fast pathway, starts to turn away from the snake as his fear network is activated. Meanwhile, the slow but more accurate visual pathway has had time to process the "snake" and reports that what he's seeing is just the garden hose that Eve left out overnight. The arrival of this information, however, cannot prevent the evasive action set into motion by the high-priority pathway, and after taking a quick jump to the left and emitting a high pitched scream, Adam is left with a rapid heartbeat and a slight feeling of embarrassment. This prioritized system and its effects are commonly referred to as pre-attentive processing. We have all experienced system 'misfires', courtesy of a system that operates under the principle that errors are better than omissions. Put in perspective, it's safer to react fearfully to the zebras ten times in error than to miss the lion once.

This knowledge about the visual system's special processing of stimuli with biological importance lead us to speculate that body odors similarly possess a high level of inherent relevance for the perceiver. To test the hypothesis that body odors are processed in a more direct fashion, we recently measured how fast the brain processes a body odor compound relative to a general odor of similar valence and intensity. We discovered that the body odor compound was processed by the brain up to twenty percent faster than the general odor indicating that our olfactory system functions similarly to the visual system for biologically relevant stimuli (Lundstrom, Olsson, Schaal, & Hummel, 2006).

In the visual system, these biologically important stimuli have prioritized access to the brain's fear network, which resides in deeper, more primal regions. To investigate whether body odors are also capable of activating the fear network, we presented body

odors originating from strangers while measuring their brain activity. The body odor from a stranger elicited activation in the fear network - the amygdala and the insular cortex - thus demonstrating that the mere smell of a stranger elicits similar cerebral patterns to visual images of a snake. Thus body odors are processed in a pre-attentive manner, similar to the prioritized processing of visual images that are important for survival. In contrast, our new research suggests that exposure to body odors of friends or lovers can produce a soothing effect. Exactly what this means for our everyday interactions is not known and is currently under investigation.

Future for hygiene- should one stop showering?

Though it is true that body odors contain signals that aid individuals in selecting a partner whose genetic makeup compliments their own, the observed effect is quite small. Nonetheless, body odors are consistently listed as one of the more important criteria used to select a partner, although they are typically cited as reasons to reject a potential mate rather than as an attractant. Based on the scientific evidence to date, it probably is unwise to try to spread personal chemical signals by refraining from showering before social activities. It also is not clear whether deodorants and antiperspirants mask or eradicate body odor signals. Also unknown is the identities of the specific chemicals responsible for these signaling effects or which gland(s) emits them. The apocrine glands are suspected to be involved because they become active around puberty and are concentrated in pubic and underarm areas. Until we know the origin and nature of the volatile chemicals responsible for biologically important odors, we can only speculate about the impact of hygienic products and behavior on the biological message conveyed in our body odors.

Since this essay will be read primarily by those involved in industry, let me leave you with some thoughts beyond the scope of basic research. It is reasonable to begin pondering ways to enhance the positive emotional and informational signals hidden within body odors while simultaneously reducing the negative conscious odor percept also occurring. And, because smelling the odor of someone we love or someone we are related to can be a soothing, pleasant experience, perhaps a therapeutic potential in these types of odors could be identified. Finally, wouldn't it be wonderful if we could one day eliminate those awkward first dates and instead sniff out our future partner using samples of refined body odor?

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