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# ALDEHYDE



A publication for the perfume connoisseur

# THE SCIENCE OF SCENT

From human evolution to pheromones, Aldehyde investigates what makes smell such a powerful sense

Humans are capable of identifying over 10,000 scent molecules according to Richard Axel in *The Molecular Logic of Smell*, published in the *Scientific American* journal. The biological process behind scent is a straightforward and logical thing. When we inhale scent molecules through our nostrils, they are warmed, humidified and transported upwards. Once they reach the olfactory epithelium (a pair of dime-sized patches covered in mucous, comprised of millions of cells, some of which are sensory cells covered in hair-like cilia receptors which capture the molecules) at the roof of each nasal cavity below the brain, the receptors then switch on, sending signals to the olfactory parts of the brain in the limbic system of the cortex. But in reality, there is much more to scent than that.

The act of smelling notes or compositions is a subjective and ever-changing process, but what is the scientific explanation for certain scents being inextricably linked to personal memories and emotions?

According to Dr G. Neil Martin, director of the Human Olfaction Laboratory in the department of psychology at Middlesex University, "the ability of odour to evoke a memory from the past is due to context-reinstatement or context-dependent memory, as two stimuli have been paired together in a meaningful way". Citing this phenomenon as the Proust effect, Dr. Andreas Keller, Research Associate at Rockefeller University's Laboratory of Neurogenetics and Behaviour notes that "emotionally salient memories (car accidents, first kisses, etc.) are usually very vivid because when they are recollected, emotional brain centers, are activated. The effect is the same when it comes to smells

and odour-induced memories, but it is not clear if they are more accurate than other types of memories. It's an associative effect, so any type of odour can induce such nostalgic feelings," he comments.

This nostalgia, be it the smell of evergreen timber Christmas trees or the buttery sweet scent of our mother's baking, "is strongest for odours experienced in childhood, or for those associated with a major life-shift" says Avery Gilbert, scent scientist and author of *What the Nose Knows*. This effect can even extend to physical results, with certain scents such as lavender inducing relaxation and "an interaction between associations, the brain and the body. But the personal experience at the time the scent was first experienced is number one. You can interactively use this knowledge to improve something," according to Claudia de Vos, a Dutch artist and scent psychologist who helps patients overcome traumatic events linked to scent.

De Vos also speaks of a "collective unconsciousness": the idea of smelling something and unconsciously reacting to it with a certain behaviour. She links this unconsciousness to social, cultural and historical backgrounds. Two experiments which show the power of this reaction are a study by King's College London, in which spraying lavender scents prior to a dental appointment significantly reduced anxiety levels in a test of 340 patients, while in 2008, a scent experiment by a Netherlands police department proved that mixing an orange scent into the ventilation system reduced aggression in inmates, so much that the results predicted savings of approximately £540,000 a year in medication alone. "Exposure to scent can influence memory, cognitive performance, reaction



The perfume pill: the latest frontier in personal scent invented by body architect Lucy McRae and Harvard biologist Sheref Mansy

Photo courtesy of Lucy McRae

time, response to people's faces and so on, often without or believing or knowing it can have these effects," adds Martin.

On the other hand, Dr. Rachel Herz, Adjunct Professor in Department of Psychiatry and Human Behaviour at Brown University Alpert Medical School, argues that "there is no such thing as an odour which has any specific effect on anyone except the associations one has to it". There are culturally relevant odours, "but that is not a necessary and universal response, there are no consistent odours across the board because everyone has their own unique life," adds the author of *The Scent of Desire: Discovering Our Enigmatic Sense of Smell*.

Anatomically speaking on this matter, the sensory nerves in our noses are closely intertwined with the hippocampus, an area of the brain where our memories are developed, and the amygdala where our minds make 'love or hate' decisions within seconds. "We all smell the world with a different set of receptors and therefore it smells different to all of us," says Keller. "To me, this is an argument based on plumbing," argues Gilbert, pointing to laboratory tests which evidenced that odour memory and sight or sound memory are not superior or inferior to one another. So the idea that our noses are the strongest memory storage spaces within our bodies is likely to be exaggerated. "We never actively try to remember that smell; the associative links are buried and invisible. When the memory pops up it seems like magic. Smell-evoked memory flashbacks are real and powerful, but they are not the usual way the nose works," he further explains.

In the same way that certain scent associations can unite us, a universal appreciation or disregard for certain smells becomes evident. In experiments conducted by Dr Neil Martin, patients were exposed to various food odours while having their brain activity was recorded. The odour of chocolate was shown as the most relaxing and pleasant on the psychometric ratings, although Martin admits "there will always be individual differences", as in further experiments a lemon odour caused stimulation in some and a heightened sense of pain in other patients. While of course, every nose is different, and the scents we were exposed to when growing up play an important role, Keller explains that in an experiment by Rockefeller University's Laboratory of Neurogenetics and Behaviour, in over 60 odours, ethyl vanillin followed by vanillin, orange oil, and spearmint oil proved to be the most well-liked. These preferences were remarkably consistent across age groups, genders, and races. Specifically "vanilla has comfortable, cosy effect affirmations because we were all breastfed as children, and mother's milk contains extracts similar to vanilla in taste and scent," adds de Vos.

On the other hand, animal-like notes are generally disliked, "along with the usual suspects: anything smelling of urine, feces, rot or decay, the reason for this is probably deep in our genes an avoidance of infection or poison," Gilbert explains. However it is not only what scent, but how much of it that matters, as Dr. Martin notes that "pleasantness of scent is directly associated with intensity".

From (dis)like to lust, the spheres of scent would not be complete without the rules of sexual attraction. When it comes to this side



Photograph by Zachary Zavislak

role in the daily life in an industrialised nation in the 21st century for two reasons. First, we shower too often for significant amounts of any odour produced by the body to accumulate. Second, because of our cultural conventions we do not explore each other olfactorily anymore," notes Keller. It is the age old idea of sex sells, hence pheromones' popularity "but the research done on them is mostly done by the producers, so how neutral is the outcome of those researchers," questions de Vos. She adds that "the pheromones in these trials were smelled consciously, but pheromones work unconsciously. If it was all this simple, we would be manipulated like marionettes". There is not only the case that pheromones may not have any smell, but also that "there is no good evidence in humans that pheromones operate or have any functional effect on behaviour," Herz points out. Even the theory of a heightened sexual attraction of males to females during the middle of their menstrual cycle has been seriously called into question, with evidence refuting it entirely. It becomes evident that, as in all aspects of smell, there is no simple answer.

Additionally, there are differences in odour perception between genders, with women having a consistently higher perception of scent than men, and "electrical potentials evoked in the brain by odour in women are larger than they are in men," according to Martin, although Dr. Herz is quick to note that once again, there are fluctuations in smell sensitivity as "women are especially sensitive to smell when they are ovulating, but less sensitive to smell when they are menstruating".

Where we live also hugely influences our sense of smell. "People who live close to nature have a much more developed wider sense of smell than we do in the west," says de Vos, adding that the more primitive the culture, the more vital scent becomes. "Scent is used to find their prey, to identify disease, to find their partners, it's more basic instincts in how they integrate and interpret smells. Scents are connected with Gods and their religion. The more you go west, the more it gets thinner and thinner. But in a way, we have made our own religion with scents in perfume," she says.

Furthermore, our bodies perceive odours differently as we age, with a noticeable decline starting in the forties. Scientists are only beginning to uncover the full spectrum of biological changes our scent perception goes through with evolution and age. As Gilbert notes: "We've lost genes that, for example, help us scent gazelles a mile away, and gained ones that let us appreciate the up-close subtleties of cooked and fermented grains. These evolutionary trends are still happening." Keller explains that "there is very strong variability in the perception of scents. The perception of the same smell by the same person at different times is variable (intra-individual variability) and the perception of the same smell by different persons is also variable (inter-individual variability)". When it comes to our sense of smell, there is a stronger deterioration than in any other sense, with approximately 20% of the geriatric

of scent there are two components according to Gilbert: one on a basic biological level and another in the cultural realm. He adds: "There is good evidence that our personal body odour is a function of sex men and women have distinct, but sometimes overlapping scents and also a function of genetics, specifically of our HLA or autoimmune genes. At a fundamental level we are drawn to partners with a certain class of body scent, and repelled by others." Once again, here the subjective tastes and personal associations come into play. Fetishists of certain materials such as latex are an example.

In her book *Scent Of Desire*, Herz reports on a female patient of the psychiatrist Havelock Ellis, who orgasmed in response to the smell of leather because of an early childhood masturbation episode associated with it, but this is an exceptional case. On the other hand, "it is definitely true that women find a man's body odour to be extremely sexually appealing. The body odour and/or fragrance exuding from a man is an extremely potent trigger for sexual attraction for a heterosexual woman, and in fact is the most potent feature among all physical and social attributes other than his personality for her to be attracted to him as a possible lover," she says.

Specifically important in the discussion of physical attraction through scent are pheromones, odours produced by each gender to attract the other, that have been employed as marketing gimmicks by companies in the hopes of advertising 'sexy' fragrances. However, science proves that pheromones actually have no scent. "Even if they exist, they cannot play an important

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population having entirely lost their sense of smell, which Martin cites as due to a loss of tissue, loss of receptor neurons and dysfunction in the olfactory apparatus. But this decline also varies from person to person, with a loss of smell also being an early warning sign for neurological diseases such as Alzheimer's, head tumours and trauma and nervous disorders according to the NY Times website. Nonetheless, our memory of scents are a precious commodity that should be trained. "In my view, when you build up a scent library in your mind, you build knowledge of all the things that you smell. As you get older you will be able to remember those scents that you enjoyed, but you really have to work hard at it," advises de Vos.

This ability not only changes with age. In fact "the greatest dent to the importance of the sense of smell in humans came when we became bipedal and raised our noses from the ground," notes Martin. If our sense of scent is forever evolving, it begs to question: what does the future hold? In the realm of perfumery, body architect Lucy McRae and Harvard biologist Sheref Mansy have come up with the ultimate futuristic solution: a perfume pill. Upon swallowing the capsule, a unique odour is emitted through one's sweat glands, making it a highly individual fragrance concept affected by the wearer's bodily reactions to factors such

as temperature, stress, exercise or sexual arousal. The body becomes the atomiser so to speak.

In the development of the actual human olfactory experience over time, "certain environmental exposures can turn on genes for olfactory receptors that might otherwise not have been activated," says Herz. Interestingly enough, "the majority of the genes for our olfactory receptors are actually coding for non-functioning receptors," she explains. However, at least some of these receptors can be turned on just by being exposed to certain odours over a period of time, which is not down to evolution (in fact our olfactory organs have practically remained the same throughout history) but "actual experience modulating the genetics of our olfactory receptors and that in itself moderating our perception of smells".

Ultimately, scent isn't just a wonderful portal to times past, but also a highly fascinating scientific field in its own right. Uniquely individual, highly evolved and partially uncharted territory, smell might just be our most precious sense of all.

In the west we degrade and decrease our smelling capacity because the need to use their nose is stronger in these more primitive cultures because they use their noses to find their prey, to identify disease, to find their partners, it's more basic instincts how they integrate and interpret smells. Scents are connected with Gods and their religion. The more you go west the more it gets thinner and thinner, but in a way, we've have made our own religion with scents in perfume."

- Claudia de Vos, scent psychologist



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