The Silent Dominance of Smell

Our sense of smell is as intimately connected to us as our significant other, both setting off multitudes of chemical reactions in our brains that give us a jolt of pleasure, disdain or neutrality. Through the use of all of our senses, the sense of smell is able to completely dominate the major facilities of our brain, becoming intrinsically linked to multiple places. Using the idea of capitalizing on these steadfast links, we can manipulate our feelings about places, people and our own memories.

How it Works

Smell is the unsung hero of our senses, the lone child who constantly hangs in the background, isolated and ignored. Despite this, the reactions that our senses of smell set off are beginning to receive notice.

In 2004, Linda Buck and Richard Axel won a Nobel Prize for their work in the neurological aspect of smell. The pair discovered 1,000 odor receptor genes that are used to recognize over 10,000 different smells, a feat that is currently being further researched. There are a certain amount of receptor types that can only detect molecules that are similar to their own encoding. Some molecules are detected more easily and they can elicit a larger reaction in the receptor. However, all of the molecule types can be detected.

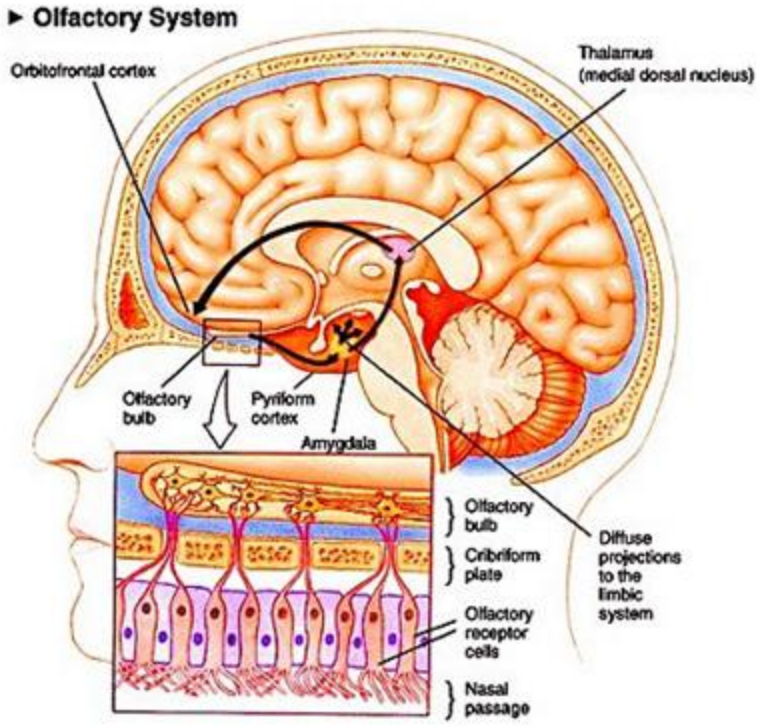

Figure 1: This is a picture of the Olfactory system and the processes involved ("*Aromasteam"*).

When the odor receptors detect these molecules, they send a two-dimensional image to the brain called an odour map. However, this relaying of the image is not a conscious act. In fact, when the image is sent to the brain, it interacts with a portion of the brain called the thalamus. The thalamus is responsible for consciousness, sleep, and alertness, therefore representing the "awake" portion of the brain. Recognizing the

patterns in these images is the key to our recognition of what we unconsciously smell, much like the recognition of a familiar face, and smell revolves around this principle.

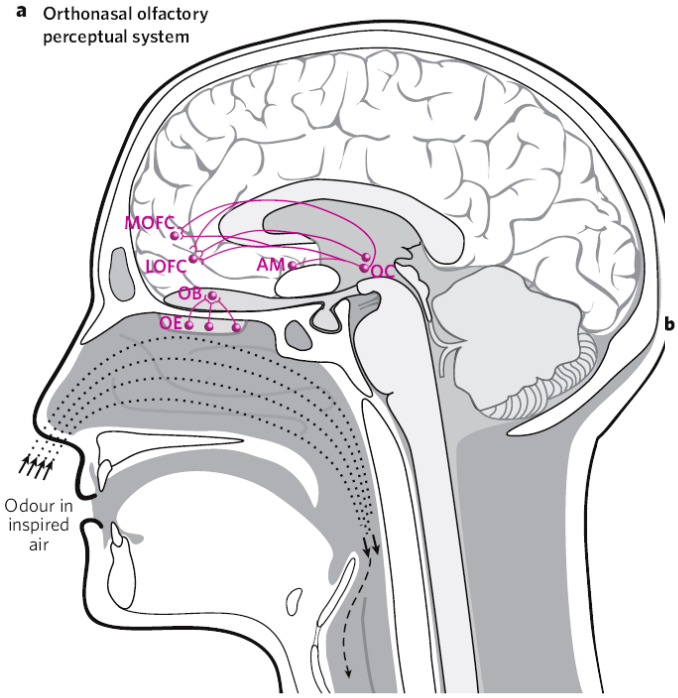

Figure 2: A diagram of the orthonasal olfactory system and the regions it affects in the brain. (Shepherd).

The sense of smell can detect two types of signals, those that come from outside of the body (orthonasal) and from inside the body (retronasal). Orthonasal perception is the one most people are familiar with when thinking of smell. It refers to the odors passing through the nose, and the signals from the nose being sent to the highest cognitive center of the brain (the orbitofrontal cortex). The retronasal olfactory system is the system we associate with our senses of taste. When we chew food, odors are sent from the back of our throats through the nasopharynx (an area located at the top of the mouth at the back of the throat) to our brains, and is processed from there as if the smells were a true function of flavor. Using this classification causes the process of retronasal perception to go unnoticed by the conscious brain.

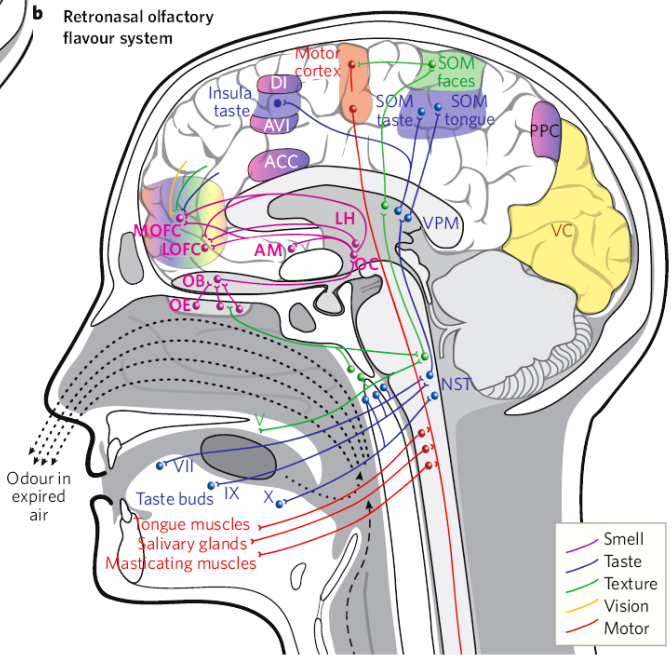

Figure 3: A diagram of the retronasal olfactory system and the regions it affects in the brain. (Shepherd).

Emotional Relativity

"We think our lives are dominated by our visual sense, but the closer you get to dinner, the more you realize how much your real pleasure in life is tied to smell. It taps into all our emotions." (Synott). Smell has been neglected, shoved aside by hearing and sight, the assumed dominant and most important senses. However, our senses of smell are far more useful than just being able to determine that the milk in the fridge is bad. The human sense of smell is intricately tied to our olfactory cortex, which contains the amygdala.

The amygdala is a region in the brain that is responsible for our emotions and memories. As such, whenever a scent is inhaled it runs through this area, and if the person has smelled the scent in the past, the amygdala will react, and bring up the memory of that time. For instance, when the smell of Christmas trees is inhaled, it constructs the images of Christmases past and the emotions felt during those times. For some, Christmas is a wonderful time of year, giving them a euphoric emotion when smelling these trees. However for others, Christmas may be considered as a depressing time, and when they inhale that scent, they become bombarded by those depressing feelings.

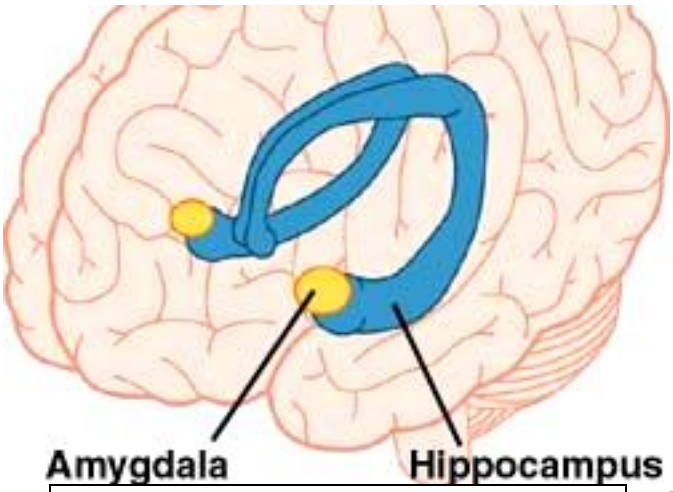

Figure 4: This is a picture of the amygdale and Hippocampus, two areas of the brain that deal with memory. (Kenyon).

The connection between these episodes of emotional memory and the smells of that time are tentatively linked. While some scientists recognize there may be a connection between the two, many do not want to make the leap and say that smells are intrinsically linked to emotions.

The smell sensory system is the only one that has direct access to the amygdale. For example, when a child is developing, the limbic system, the set of brain structures involved in the processing of smells grows out of the olfactory bulb. Humans are able to use smell to recall a memory just as accurately as if any of the other senses had been used, but with a drastically enhanced emotional response.

The Personal Connection

The sense of smell has become very intimate to humans, used in situations as different as cooking to clubbing. As humans, we are constantly giving off smells that uniquely define who we are and that that no two of us are alike, despite what our conscious brains would like to think. Scents are constantly being inhaled and given off, and tell us many things about another person, place, or thing.

These emotions are a result of our memories, which help shape what a person believes smells good, and what does not. Along with the guidance of parents, educators and society in general, our senses of smell have developed into an individual's little black book of everything we've ever done or seen. With such an intimate focus, it is not surprising that the smell of a lover or a food can be held within the brain's database for decades before being triggered when we stumble across the smell later in life (Wood).

The hippocampus, a member of the limbic system, is a key factor in the memory system. As previously stated, the limbic system is closely tied to olfaction, so close in fact that there is only one neuron receptor that separates the two systems. In comparison, the neurons between any other sensory system and the limbic system number approximately ten. Paired with the fact that the amygdale is right next door to the hippocampus in the brain, lines are constantly becoming blurred between the limbic system and olfaction.

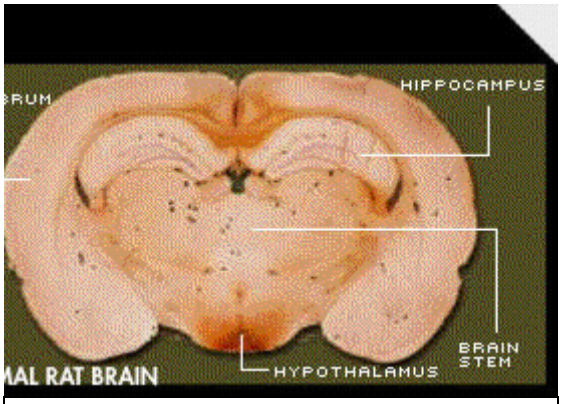

Figure 5: The Hippocampus and hypothalamus in a rat's brain are indicated and are proportionally larger than that in a human's brain ("*Another Company…"*).

Dominance of olfaction in memory is a direct result of the proximity of systems. In the time it takes a human to learn visual tasks, such as a reaction to a face, a rat can learn an olfactory task in a fraction of the time. Considering the fact that rats devote 48% of their brain to olfaction, this isn't surprising (Sapolsky). Other animals, excluding our primate cousins (in most situations), have enhanced senses of olfaction. This is due to the brain power they devote to that system unlike that of a human, and this significant difference can be seen by observing in the differences between ours and an animal's behavior.

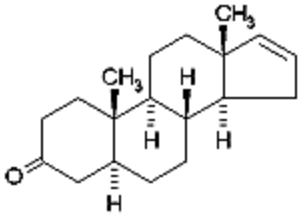

Figure 6: This is a picture of the pheromone Andrstenone (*"All About Pheromones"*).

As an example, any dog owner can confirm that when dogs get together, they sniff each other. While to us this seems like an inherent "dog thing", the actions involved in this ritual can be seen in humans to an extent. The reason behind this excessive sniffing is to detect the pheromones being excreted from the animal's anal gland. Pheromones can tell another dog gender, age, genetic appeal, and general mood.

In contrast, human need to ask others for this information, and the existence of pheromones within humans had remained a major question mark until the last few decades. In 1986, scientists at the Chemical Senses Center in Philadelphia discovered human pheromones ("What are Pheromones"). Pheromones are an odorless substance excreted by most living things on this Earth to attract the opposite sex. Detected by members of the same species, they are one of the key communication tools that are used today in sexual attraction.

Much like a dog's, a human's pheromones contain the information necessary when looking for a partner; however, due to the slight deficiency of our olfactory abilities, the conscious smelling of pheromones is not pleasant. Instead, humans have come to rely heavily on visual attraction and leave our subconscious to deal with the pheromones. Despite this, the "chemistry" felt between two people is dictated by these chemicals being detected and the immediate response from the hypothalamus, the body's regulator. If the right pheromone is detected, a body's heart rate will increase and sweat, a carrier of pheromone, will accumulate. The question of why attraction must rely on our subconscious is one that is troubling. In fact, it has been found that humans devote 1% of their total brain capacity to olfactory senses (Sapolsky). This fact is staggering, when compared to the 48% of brain power that is devoted to olfaction in rats (Sapolsky).

Recently, the Human Genome Project set out to decode human DNA after success with other animals. It was previously discovered that humans share 98% of their DNA with our primate relatives, and one of the project's missions was to discover what makes up the 2% difference (Sapolsky). Instead of a genetic answer as to why we have conscious thought, emotions, literary arts, or what makes us essentially human, the project discovered that the major difference is olfaction. We differ in body hair, reproduction, and immune system capabilities, but the biggest difference comes from our olfactory receptors. Our differing olfactory receptors account for half of the 2% difference (Sapolsky). Whereas primates have full use of these receptors that are genetically encoded into both

primates and humans, humans have the use of only half of these receptors, as the other half have become pseudogenes; in other words, these genes are encoded into our DNA, but are never used in the development of human beings in the womb.

In light of this, our other senses have been able to grow in importance, and yet they are still inferior to those of other animals. Birds of prey can see better than a human can, and any nocturnal animal can hear better than we can (Sapolsky). Humans have developed conscious thought, the ability to look back and reflect upon an event in its entirety, and yet we have lost the ability to live in the moment as was originally intended for all animals (Sapolsky). Instead, this difference between animals and ourselves is the most important in making us and our olfactory system, uniquely human.

Conclusion

Life without smell would be nearly impossible to imagine. Of all the five senses, it is the one that's been taken the most for granted, and we can only wonder 'why'. Smell's unique link to the largest centers of our brain, coupled with the fact that smell also dictates our interactions with others, makes it hard for it to remain the underdog of the senses, let alone to be ignored.

References

Aggleton, John P., and Louise Waskett "The ability of odours to serve as state-dependent cues for real-world memories: Can Viking smells aid the recall of Viking experiences?. "*British Journal of Psychology* 90.1 (1999): 1. *Advanced Placement Source*. EBSCO. Web. 11 Nov. 2009.

Bates, Jane "Sanitary tale." *Nursing Standard* 23.25 (2009): 25. *Advanced Placement Source*. EBSCO. Web. 11 Nov. 2009.

Bradbury, Jane "Genetic and Behavioral Investigations into Odor Discrimination and Memory." *PLoS Biology* 3.11 (2005): 1852. *Advanced Placement Source*. EBSCO. Web. 11 Nov. 2009.

Dulay, Mario F., Robert C. Gesteland, Paula K. Shear, P. N. Ritchey, and Robert A. Frank. "Assessment of the influence of cognition and cognitive processing speed on three tests of olfaction." *Advanced Placement Source*. EBSCO. Web. 5 Nov. 2009. <http://web.ebscohost.com/ehost/detail?vid=4&hid=107&sid=f04ac88d-ce74-4890-82cd-7ec092c0fb5a%40sessionmgr112&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=aqh&AN=31029083>.

Grubb, Blair P. "Fragrance of Things Past." *Pacing & Clinical Electrophysiology* 23. 11P1 (2000): 1686. *Advanced Placement Source*. EBSCO. Web. 11 Nov. 2009.

Holden, Jan "Just follow your nose." *Nursing Standard* 20.41 (2006): 30-31. *Advanced Placement Source*. EBSCO. Web. 11 Nov. 2009.

"HowStuffWorks "How Smell Works"" *Howstuffworks "Health"* Web. 05 Nov. 2009. <http://health.howstuffworks.com/smell.htm>.

Larkin, Marilynn "Sniffing out memories of holidays past." *Lancet* 354.9196 (1999): 2142. *Advanced Placement. Source*. EBSCO. Web. 11 Nov. 2009.

Marks, Laura U. "Thinking Multisensory Culture." Advanced Placement Source. EBSCO. Web. 5 Nov. 2009. <http://web.ebscohost.com/ehost/detail?vid=4&hid=108&sid=b9202d57-d0fc-4252-a827-149adf0f2466%40sessionmgr104&bdata=JnNpdGU9ZWhvc3QtbG12ZQ%3d%3d#db=aqh&AN=34452630>.

Olfaction, taste, and cognition. Cambridge: Cambridge UP, 2005. Print.

Rubin, David C. "A Basic-Systems Approach to Autobiographical Memory." *Current Directions in Psychological Science* 14.2 (2005): 79-83. *Advanced Placement Source*. EBSCO. Web. 11 Nov. 2009.

Sapolsky, Robert M. "The Olfactory Lives of Primates." 86-90. Virginia Quarterly Review, 2006. *Advanced Placement Source*. EBSCO. Web. 13 Dec. 2009.

Shepherd, Gordon M. "Smell images and the flavour system in the human brain." *Nature* 444.7117 (2006): 316-321. *Advanced Placement Source*. EBSCO. Web. 11 Nov. 2009.

Synnott, Anthony "A sociology of smell." *Canadian Review of Sociology & Anthropology* 28.4 (1991): 437-459. *Advanced Placement Source*. EBSCO. Web. 11 Nov. 2009.

"What are Pheromones." *Bellarmine College (The Home of the Arts & Sciences): Bellarmine University*. Web. 14 Dec. 2009. <http://cas.bellarmine.edu/tietjen/Human%20Nature%20S%201999/what_are_pheromones.htm>.

Wood, Heather "In The News: Making sense of smell." *Nature Reviews Neuroscience* 5.11 (2004): 824. *Advanced Placement Source*. EBSCO. Web. 11 Nov. 2009.

Images

Kenyon, Dr. C.A.P. This is a picture of the Amygdala, a system in the brain that deals with emotions and memory.

Digital image. *Approaches to the Study of Aggression*. 1994. Web. 13 Dec. 2009. <http://www.flyfishingdevon.co.uk/salmon/year2/aggression/aggression.html>.

This is a picture of Androstenone, the first identified mammalian pheromone. Digital image. *"All About Pheromones"* Pherone, 2003. Web. 4 Jan. 2010. <http://www.pherone.com/pheromones.html>.

This is a picture of the Olfactory System and the processes involved. Digital image. *Aromasteam*. 2007. Web. 1 Jan. 2010. <http://www.aromasteam.net/health-benefits/benefits-of-hydrotherapy.html>.

This is a picture of a rat's brain and a few labeled parts. Digital image. *Another Company Goes for the Kids*. Powerwatch, 12 Feb. 2005. Web. 4 Jan. 2010. <http://www.powerwatch.org.uk/news/20051128_children_phones.asp>.