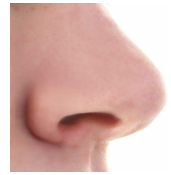


The sense of smell, also called olfaction, is the perception of odorant. It is a chemical sense, opposed to physical senses (hearing, touch, sight).



Two incoming ways for odorant molecules

- Direct inhalation (in yellow on figure 1)
- Retro nasal route during mastication (in blue on figure 1).

These 2 ways converge to a single zone of stimulation: the olfactory mucous located in the nasal cavities.

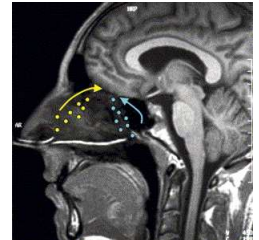


Figure 1 : olfaction ways

Physiology of olfactory system

The olfactory region contains millions of odor receptors.

Two nervous ways involved in olfaction:

- olfactory neuroreceptors
- trigeminal nerve that confers to the chemical stimulation a sensitivity linked to pain (pungency, heat, cold, etc).

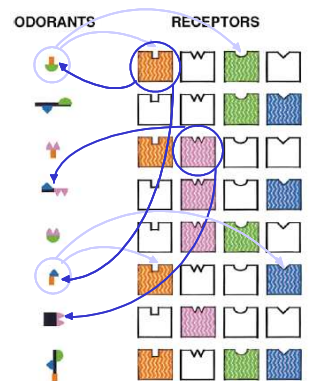
Olfactory neuroreceptors

They consist of bipolar neurons, that are very long cells that carry a detector in apical part and join olfactory bulb by means of the screened blade in the emitting part. These olfactory neuroreceptors deep into the mucous, which amplifies the signal. There are renewed permanently (approximately every 40 days) so as to assure the invariability of sensory images.

There is only one olfactory receptor per neuroreceptor. There exist around 10^3 types of olfactory receptors and 10^7 of olfactory neurons.

Neuroreceptor axons (the detecting cells) converge to olfactory bulb glomeruli (~ 10^3 of glomeruli in the olfactory bulb) and thus enable the detection of odorant molecules at low concentration.

Odorant molecules can activate several neuroreceptors. A neuroreceptor answers to a single stimulus or facet that consists of a spatial molecular combination. Therefore, a facet can be present on very different molecules (figure 2). Due to this multiple combination, human sensitivity is very important.



[de Malmic et al. Cell 1999]

Figure 2 : combinatorial receptor codes for odorants

Treatment of olfactory information in the brain

The signal is transduced to the brain where the information is processed (figure 3).

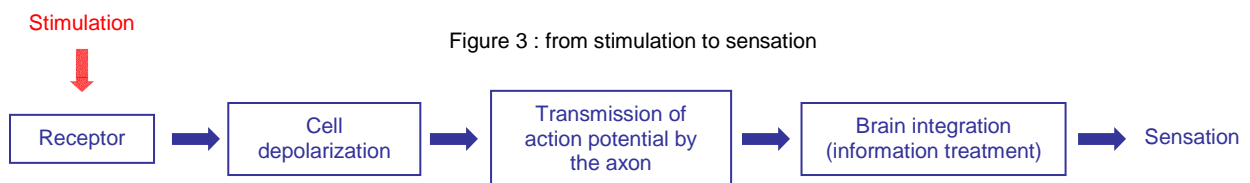
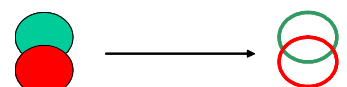


Figure 3 : from stimulation to sensation

The information is coded:

- qualitatively by mitral cells of the olfactory bulb that allow to differentiate odors
- quantitatively by modulating the frequency of electrical potentials.

The brain uses the outline extraction method to increase the message readability (removal of common information): for instance when we look at a picture, our brain analyzes the outline of the face and not each point of the face to recognize the person.



Two phenomena can occur:

- adaptation: after a lasting stimulation, receptors are inactivated. As an equilibrium is reached between activated and inactivated receptors, the sensation is diminished after a long stimulation
- habituation : the brain has the capacity to block every sensory entry if it is constant and strong at a cognitive level.

There is no known link between chemical structure and olfactory perception. However, research has highlighted the importance of tridimensional structure of molecules in odor identification.

For olfaction, as for taste, there is no possible transposition of our sensitivity from a molecule to another one, even if they belong to the same chemical family. In humans, odors memorization is always linked to a context.

Contrarily to tastes, odors have no scientific classification since the number of primary odors is very disputed.

Did you know that...

- Human sensory performance is stable until around 70 year-old. After this age, performance starts decreasing with a varying speed based on the brain functioning.
- Humans can detect and recognize up to 1000 different substances.
- One to many hundreds of substances compose an odor.
- On standard tests of smelling ability – including odour detection, discrimination and identification – women consistently score significantly higher than men.
- Tobacco consumption can affect smell and diminish sensitivity.