

LET'S GET SCENT-I-MENTAL

By David Perez

Have you ever wonder how important your nose is? For some animals, sense of smell is the most important type of sense. Since a dog's sense of vision is awful, their sense of smell is incredible compared to humans. Dogs sense of smell is between 10,000 to 100,000 times more acute than humans.¹³ An analogy to vision of this would be, "what you and I can see at a third of a mile, a dog could see more than 3,000 miles away and still see as well."¹³ Even though our nose isn't as powerful as dogs, we need our nose to survive. Our nose is responsible for more than picking up odors from the air.

People who have lost the ability to smell lose more than just being able to smell things. Nick Johnson, a person that lost his sense of smell, can remember the exact day he lost his sense of smell, it changed his life forever. He was playing hockey with his friends and he fell and hit that back of his head on the ice. He made a rapid recovery, but a couple days later he found himself trying a new beer with his friends. "Can you smell the hops in the beer?" and he couldn't "It's got this pale biscuit flavor" and he couldn't taste it. He

then realized that his loss of smell hindered him from smelling and tasting. Dr. Rachel Hertz says that, "Sense of smell is essential to our humanity: emotionally, physically, sexually and socially". It's also clinically documented that acquiring anosmia often leads to anxiety and depression. Even knowing all this, people still ranking losing sense of smell at the bottom and people compare it to losing a big toe. Some people don't understand how important the nose truly is. Our nose is also necessary for our safety. Our noses can detect smoke, spoiled food and toxic gases.¹² The nose is also responsible for other things like humidifying the air, shaping the sound of your voice, and even helps you find a mate.¹² The nose is also important for something indirectly. Everyone knows the smell of freshly baked chocolate chip cookie. For me, I always remember baking them with my grandma when I was a kid. That memory always makes me happy and smile. By being in a good mood, I made good decisions based on my feeling because I didn't want to lose my current mood. There also therapy sessions that people can do that can alter one's mood by just using odors.

This line of succession shows that the nose can alter people moods and therefore could potential hinder their decision making through the memories that are evoked by odors.

Mechanism of Odor Detection

The exact mechanism behind odor detection is still rudimentary. Knowing the exact mechanism could unlock new ways people can alter their decision making. Odor molecules connecting to the olfactory receptors is the first step to odor detection. Olfactory receptors are responsible for the detection of compounds that have odor which gives us the sense of smell. The olfactory receptors are in the cilia synapses and the epithelium tissue of the human airway. The epithelium, a type of tissue that



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lines the cavities and surfaces of blood vessels and organs, is highly permeable and therefore, highly sensitive to various odor molecules and even various pathogens.¹ The location of the olfactory is unique to humans. In insects, the olfactory receptors are located on the antenna. In fruit flies, adults have about 1200 olfactory receptor neurons (ORNs) on each antenna.²

In the epithelium tissue, each ORN expresses only a single type of receptor. So only one gene is expressed by each receptor.⁴ According to the Human Genome Project, humans have about 400 genes that codes for olfactory receptors, the rest of the genes are pseudogenes. Pseudogenes means that the genes are similar enough to the 400 genes, so that the olfactory receptors will express them.⁵ So, each receptor has the capability to detect more than one odor. Even with the combining of genes, humans can distinguish hundreds of different smells. But other animals can smell more specific things than humans¹³.

After the odor molecules binds to the receptor, the receptor will send electrical signals through the ethmoid bone and to the olfactory bulb.¹⁵ The ethmoid bone separates the nasal cavity and the

brain. The olfactory bulb is the area where those signals are analyzed and processed.¹⁵ The olfactory bulb contains nerve tissues called glomeruli that are formed from branching ends of axons of the olfactory receptors and from dendritic branches of interneurons known as mitral cells.⁶ So overall, the axons of all the receptor cells that produce a specific chemical or range of chemicals with similar structures converge on a single glomerulus, where they connect to similar mitral cells and the mitral cells transfer the signals to the brain.⁶ This way, similar information from many receptors can be brought to the glomerulus together. The signals travel to different brain areas like the hypothalamus

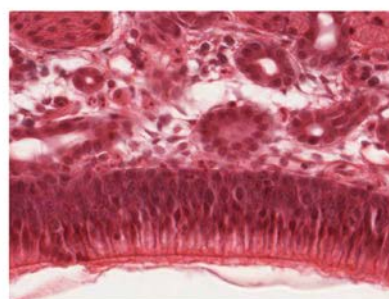
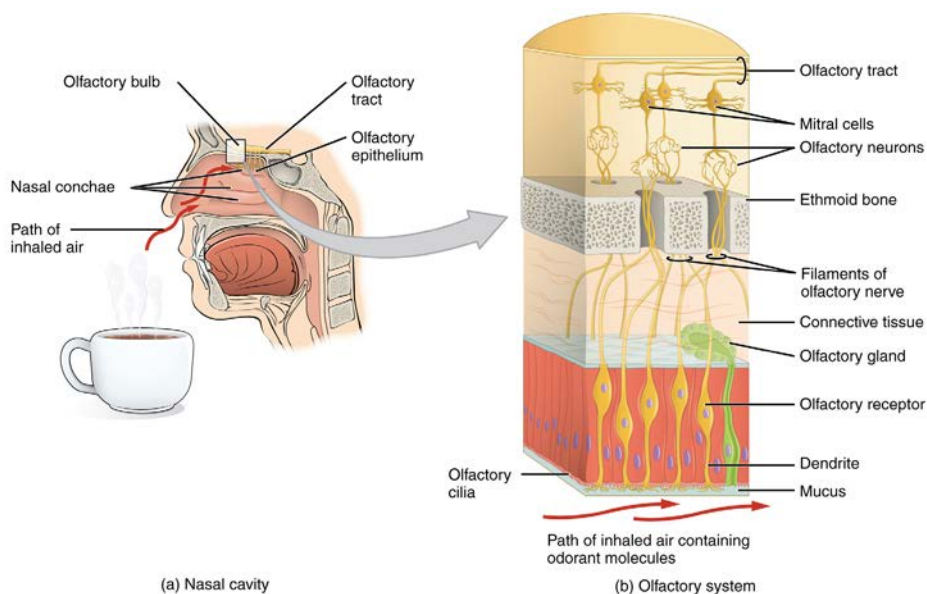
Did you know?

Sperm cells also express odor receptors, which is thought to be how sperm can locate the eggs.³

and the amygdala, which can result in bring up emotional memories. The human odor detection can discriminate between hundreds or even thousands of different odorant molecules. It is very important to discriminate these odors, especially for decision making because each odor could produce different memories.

Odors and Memories

Odors can evoke different types



(c) Olfactory epithelium

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Table 1. Odor preparations presented to the subjectsAdapted from Herz & Cupchik 1992.⁷

Odor ref. no.	Odorant	Typical name ^b	[Conc]	Rank pleas.	Rank fam.
1	iso-amyl acetate	banana	1%	3	4
2	aldehyde AA triplal	grass	1%	6	7
3	peppermint oil natural	peppermint	10%	2	1
4	dimethyl disulphide	faeces	1%	14	10
5	amyl vinyl carbinol	mushroom	pure	18	20
6	violet leaf ABS	mildew	10%	12	18
7	jasmine	jasmine	pure	4	6
8	NK pine 003 relaxing	pine	10%	7	8
9	<i>n</i> -butyric acid ^a	rancid butter	1%	19	17
10	iso-valeric acid ^a	dirty socks	1%	20	15
11	eugenol	honey-vanilla	10%	9	11
12	clove Bud oil usp	clove	10%	8	5
13	beech-wood creosote	tar	25%	17	14
14	myrrh coeur	vinegar	10%	11	16
15	heliotropin	lotion	25%	5	9
16	coconut	coconut	10%	1	2
17	cumin oil	curry	10%	16	12
18	vetiver oil bourbon	rotting leaves	pure	13	13
19	clean fresh pine	'Vicks'	10%	10	3
20	birch tar rect	smoke	10%	15	19
Practice odor:	lemon oil	lemon	pure		

Rank pleas. = pleasantness rating rank score out of 20 odors; rank fam. = familiarity rating rank score out of 20 odors.

^aObtained from Sigma, St Louis, MO.

^bTypical names supplied here do not represent the only possible 'correct' name for each odorant.

of memories in humans. The type of odor is very important for the type of memories that is evoked. Memories evoked by odors tend to be emotional, very clear, specific and comparatively old.⁷ Odor-evoked memories are also thought of less and very emotional. This shows that the most familiar odors elicited the most memories. So, for example, Table 1 shows an experiment where Peppermint odor has the highest familiarity out of the other 20 odors and which increased the potency⁷. The ranking system isn't constant for everyone though. Even though coconut is ranked the most pleasant doesn't mean everyone in the world would

enjoy coconut. There also is a difference between the sexes. The females tend to use more emotion descriptors in their memory description than did males which, produced clearer memories⁷. Odors can evoke memories, but can other cues also produce the same memories?

We use our five senses every single day; sight, hearing, touch, smell, and tasting. We need these senses to thrive through the day. Some people are missing at least one sense which could hinder their way of living. These senses actually work together, so if one sense is not working, then the other senses will take over and

make up for the missing sense.¹⁴ Although our senses are important not all of them are able to evoke memories. A study was done to see which senses produced the most vivid memories, vision, smell, and hearing. The results showed that memories evoked from odors are talked about and thought about less than when its evoked from the other cues.⁸ Odors produce more pleasant and more intense emotions.⁸ In sum, this study shows that odor can evoke emotional memories that are old. One reason why these memories are not talked about as much could be because these memories are emotional. These emotional memories could

elicit a certain mood whether it would be happy or unhappy.

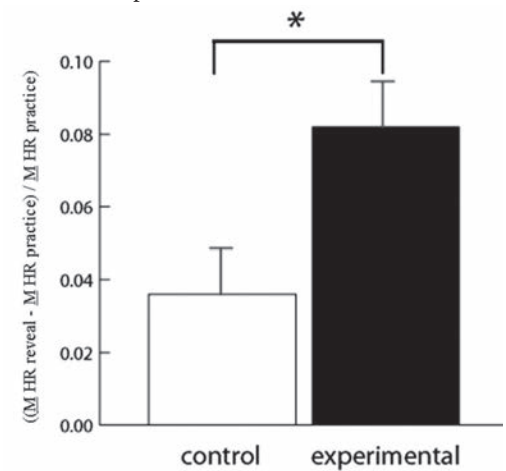
Another study was conducted to see what type of emotions would arise from different odors. The study used various odors, the odors were either pleasant or unpleasant. This test is interesting because people have different standards for what is pleasant and what is unpleasant. Some people might think a certain smell is pleasant when other people might think is unpleasant and vice versa. In the study, subjects that were given a pleasant odor produced happy memories and unpleasant odor produced unhappy memories. The odors that were given to them was shown to affect the retrieval process rather than the rating process.¹⁶ This shows that odors do evoke memories and not just how we rate them. These studies have shown that odor can evoke different memories for different people. Each person has different memories brought up from odors if they are familiar enough with them. The odors also produce an emotional memory that could eventually affect the person's mood and therefore their decision making.

Emotion and Decision Making

Once the odors recall a certain memory, the memory is going to evoke a certain emotional mood and then that certain mood is going to determine what decision you make.¹⁷ Decision making is a very important thing for humans. Wayne Dyer, an American philosopher, once said that, "Our lives

are the total of the choices we have made".¹⁷ Every day we are faced with choices that we must make. Some decisions are minor, and we don't think twice about them. Some decisions are major, and we must spend a lot of time thinking about them. Even though those minor decisions aren't going to affect our lives immediately, those decisions could add up quickly and become something bigger. To make all these important decisions, we must be in the right type of mood which is how our emotions come into play. For example, a person who feel anxious about an outcome of a risky choice may choose a safer option rather than the risky option.¹⁷ Emotions are an integral part of a person internal state and therefore has big influences on one's decision.¹⁷ There are many theoretical approaches that link emotions and decision making. The agreed steps to decision-making are; Asses the available options, the selection of option based on value that has been associated with it, and the outcome associated with the decisions is evaluated and incorporated into existing knowledge.¹⁸ Emotions come into play by modulating the assessment, selection, and the outcome evaluation of options. For example, A sad mood may result from an undesired outcome, but it can lead to an increased salience of negative attributes of options.¹⁸ The choices we make are also dependent on the type of option we are given, the degree of the affect associated with the option and the nature of the presentation of the option.¹⁸ Based on this, emo-

Adapted from Preston et al. 2007.²⁰



tions effect the value and weight computation of available options. Also, the choosing of options is based on the environment and the individuals internal state.¹⁸ That means the emotions of the person making the decision can alter their decision making. Some disorders hinder the ability of decision making effectively.

Decision Making with Anxiety and Stress

All of us have been in those situations where we have an important exam coming up and you have cram as much as possible. Do you remember feeling stressed or having anxiety about the exam? Well stress has been seen to enhance memory formation, but stress also impairs memory retrieval and it impairs the ability to update mem-

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The Iowa Gambling Task¹⁴

- There are 4 decks of cards (A, B, C, and D).
- Participants choose a total of 100 cards, one at a time.
- Each time they choose a card, they get feedback about winning and/or losing money.
- Participants did not know what each card would yield in advance, like a lottery.
- Participants started with a “loan” of \$2,000 and were told to make a profit.
- Decks A & B always yielded \$100. Decks C & D always yielded \$50.
 - For each chosen card, there is a 50% chance of having to pay a penalty. Decks A & B have a penalty of \$250, whereas decks C & D have a \$50 penalty.

ories in the light of new memory.¹⁹ Stress could hinder one’s ability to succeed on those exams. Stress can affect people’s ability to make decisions. This research ran an IGT and during their test, the experimental group was told that they had to give a public speech right after. This made the people in the experimental group to stress out.²⁰ The people that were stressed were slower to learn the task meaning it took longer to shift toward advantageous decision making in the IGT.²⁰ So far in this magazine, I have shown that odors can recall certain memories, which then could elicit certain moods and those moods could alter your decision making. Maybe odors could be used to de-stress people since it has been shown to hinder people

Individuals with anxiety disorders have shown to increase bias towards threat-related content and intolerance of uncertainty. That would mean that the individuals with anxiety disorders will lean towards bad content than the good content. Which for the large

negative consequences, individuals with anxiety make more sensitive and thus more aversive to the large negative consequences.¹⁸ This could be a good thing and a bad thing. This could hurt individuals with when a highly negative outcome is the best value. This situation could pop up when people are deciding from two negative outcomes and they must decide the lesser of the worse. By being more aversive to options with large negative consequences, individuals with anxiety perform better in the Iowa Gambling Task (IGT).¹⁸

Overall, these studies have shown that different emotional states can hinder human’s ability to make decisions which is a vital thing. Since decision making is a fundamental part of living, finding a way to control emotions arising during decision making is important. One form of therapy that has been shown to decrease stress and other mood using odors is aromatherapy.

Aromatherapy

Have you ever been anxious or stressed and wish there was an easy way to get rid of that? If only there was a simple way to fix that. Good thing there is aromatherapy to help that. Aromatherapy have been in use for therapeutic purposes for nearly 6,000 years.²¹ Aromatherapy is the art and science of utilizing naturally extracted aromatic essences from plants to balance, harmonize and promote the health of body, mind and spirit.⁹ Aromatherapy uses natural oils from flowers, barks, stems, leaves, roots, and other parts of the plant. This process has been shown to enhance an individual’s innate healing process, stimulate brain functions and has been shown to decrease stress.^{9,10} A study was conducted to examine the level of stress in nurses after aromatherapy using lavender oil. The results showed that the nurses stress symptoms dropped for three days and their stress dropped from 6.1 to 2.8 (a scale for job stress-related symptoms was used).²¹ By decreasing stress, this allows nurses to make quicker and better decisions which will help immensely in their line of work. Aromatherapy has also been shown to affect moods in a positive way.

A study was done to see how alert and how well participants can do in computational tasks after a treatment of aromatherapy. The aromatherapy used two different oils that have been shown to produce two different outcomes. Lavender oils have been shown to relax individuals while Rosemary oil has been shown to

increase alertness.²² The results of the study showed that lavender produced a less depressed mood therefore performed math computation faster and more accurately. The rosemary showed that the participants were more alert and showed faster math computations than lavender group but not more accurate.²² This shows that even though the rosemary increases alertness and therefore increases awareness, the rosemary participants performed worse than the group that was more relaxed. This also shows that different odors can evoke different moods and therefore lead to different results.

Aromatherapy has also been shown to help patients with anxiety and depression. A study done by Louis and Kowalski 2002, measured the responses of 17 cancer hospice patients to humidified essential lavender oil aromatherapy. The results showed that there was a positive change in blood pressure, pain, anxiety, depression and sense of well-being when treated by lavender aromatherapy.²³ The study also showed that water humidification treatment caused a positive change.²³ The results showed that repeated lavender treatment sessions could increase beneficial effects. Interesting enough, the caregivers also experienced relaxation due to the calmer atmosphere and environment after the lavender treatment. This was not observed at the end of the water humidification treatment.²³ Aromatherapy, in general, has a lot of potential of being a valuable treatment of anxiety, depression and stress.

Odors are important for many things because odors can alter one's decision, and it isn't a huge secret either. The fragrance industry spends up to millions of dollars trying to figure out what type of scent would people like most. Looking at what type of memories arise from certain smells could help those fragrance company figure out the perfect scent. You might not know this but stores around the world are already taking advantage of your sense of smell. One store that takes advantage is Cinnabon. Cinnabon's cinnamon rolls has an infamous scent that can persuade customers to buy a cinnamon roll. Cinnabon knows that their smells can lure people into their store, so they use many tactics to do so. One thing Cinnabon does is that they purposely put their ovens near the front of the store.²⁴ That way the smell will linger out of the store and into the hallways of the mall. Kat Cole, the president of Cinnabon, told WSJ that sales dropped significantly when the ovens were moved to the back of the store.²⁴ They also buy the "weakest hood possible" that is legal for their ovens.²⁴ That way the smell can seep through the oven and linger through the halls. These are some of the ways Cinnabon uses their notorious smells. They know what the power of scent and they use it to their advantage. Cinnabon isn't the only company that uses smells, Nike showed that adding scents to their stores increased sales by 80 percent.²⁵ Many companies are already using odors to their advantage. It's time for us to use odors

to our advantage. Odors have a lot of power and has to ability to help many individuals.

References:

- [1] Rinaldi, A., 2007. EMBO Reports. 8 (7): 629–33.
- [2] Gu X et al., 2014. American Journal of Respiratory Cell and Molecular Biology. 50 (3): 637–46.
- [3] Hallem E.A. et al., 2006. Annual Review of Entomology. 51: 113–35.
- [4] Saylor.org., 2011. Saylor. Website?
- [5] Gilad Y et al., 2003 PubMed. 3: 307-14
- [6] Chapman R. et al., 2017. Encyclopedia Britannica.
- [7] Herz RS, Cupchik GC., 1992. Chemical Senses. 17: 519-528
- [8] Rubin D.C et al., 1984. The American Journal of Psychology. 97: 493-507
- [9] Naha.org, 2017. NAHA. website
- [10] aromatherapy.com. 2017. Aromatherapy. website
- [12] Benninger M., 2015. Cleveland Clinic.
- [13] Tyson P., 2012. NOVA
- [14] Bechara, A. et al., 1994. Cognition, 50, 7-15.
- [15] Farbiszewski R. et al., 2013. Elsevier. 20: 51-55
- [16] Ehrlichman H et al., 1988. Journal of Personality and Social Psychology, 55:769–779.
- [17] Konnikova, Maria. "Memory, Preferences, and Choices: How Our Noses Impact Our Decisions." Big Think, 30 June 2011, bigthink.com/artful-choice/memory-preferences-and-choices-how-our-noses-impact-our-decisions
- [17] Konnikova, Maria. "Memory, Preferences, and Choices: How Our Noses Impact Our Decisions." Big Think, 30 June 2011
- [18] Paulus M.P. et al., 2012 Trends in Cognitive Sciences, 16:476–483
- [19] Vogel S. and Schwabe L., 2016. NPJ. 10:1-10
- [20] Preston S.D. et al., 2007 American Psychological Association. 121: 257-263
- [21] Chen M.C. et al., 2013 Wiley. 21: 8-93
- [21] Ehrlich, S., 2011. UMMC.
- [22] Diego MA. et al., 2009. International Journal of Neuroscience. 96: 217-224
- [23] Louis M. et al., 2002. SAGE Journals. 6:381-86
- [24] Shah K., 2014. EATER.
- [25] White C., 2011. Independent.

