

A Sense of Luxury

The implications of smell and consequences of post traumatic anosmia

By Chase Davis March 17, 2014

Introduction

“...For I have learned
To look on nature, not as in the hour
Of thoughtless youth; but hearing oftentimes
The still, sad music of humanity...”
(William Wordsworth)[1]

The romantic period, what a wonderful time to be a writer. It was a movement in literature identified by its emphasis on sensual experiences and a heightened sensitivity to one's environment. Much of the poetry of William Wordsworth captures the sights, sounds, tastes, and feelings of nature. However, William Wordsworth was an anosmic. He could not smell and therefore his works only contain a metaphysical sense of smell. With each breath and the shifting of air around us along the heat waves of our very bodies, our sense of smell is stimulated and we are making judgments about the world around us. When asked which of your five senses you would be most willing to lose, most people assuredly decide that smell is least necessary for survival. It is a tragedy to lose any of one's senses, sight, hearing, touch, taste, or smell, but it is all too natural for us to desire to retain our noble senses above all.

Sight and hearing are known as our noble senses. Touch and taste are known as proximity senses. Smell, which relies on both an external and internal medium of transportation, escapes many of our classification systems and is thus often considered inferior. [2] Smell is often considered a sense of luxury. However, for those who are inexperienced in the trials of this physical disability it is difficult to understand the gravity of losing one's sense of smell.

Anosmia, the inability to smell, can be a crippling disorder with abstract side effects that are still the subject of research across the world. Wordsworth provides us one frame of context for the importance smell plays in our lives. He was a romantic writer who was perpetually separated from the world around him because he simply could not absorb scent. With the greatest respect for those who face daily hardships due to anosmia, this paper will attempt to highlight a sensation that escapes much of our understanding.

The goal of this paper is to discuss a historical perspective on the effects of post traumatic anosmia. From ancient and pre-modern views on the importance of smell both psychologically and biologically to modern elucidation of the olfactory system, readers will become aware of the great world of odors around them. In the light of the olfactory awakening, modern studies on anosmia will deeply contrast with the world of odors. The comparison of smell to total lack of smell will let readers experience the life of an anosmic, and specifically the effects of non-congenital, post-traumatic anosmia. The heart of this elucidation encompassing three main points: a short history of neuroscience, awareness about a less known condition, and information for the anosmic on some of the trials they may be experiencing.

The Olfactory System Structure

The history of smell in a structural sense will provide the background for discussing later studies focusing on post traumatic anosmia. Initially, the philosophical ideas regarding smell may seem shocking. Historically, the sense of smell has not been regarded as a vital system but rather frosting on our life experiences. Pre-modern and modern studies will describe how many discoveries about smell and the olfactory system have been the side topic of greater discussions

or research done on epilepsy or a much larger organization of the brain. The important themes that this history provides us with is a structural basis by which to view and understand findings on the function of smell and the consequences of inability to smell.

Anciently the sense of smell was more of a nuisance and obstruction to science than a subject of serious physiological inquiry. A more modern researcher Le Guerier, whom will be discussed at large later, references Aristotle's suggestion that the sense of smell lacks finesse and a quantifiable means of discernment. Le Guerier also references Saint Augustine saying "Are you not ashamed to believe that the nose is a means to find God?" [2] This statement was in response to a religious group known as the Manichaeans who believed that sensual, specifically olfactory, experience led one closer to their creator.[3] Aristotle's and Saint Augustine's views on olfaction were expressed most directly by Plato circa 400 B.C.. In *Timaeus*, Plato records a dialog attributing the following passage to the titular character:

"The faculty of smell does not admit of differences of kind; for all smells are of a half-formed nature, and no element is so proportioned as to have any smell. The veins about the nose are too narrow to admit earth and water, and too wide to detain fire and air; and for this reason no one ever perceives the smell of any of them; but smells always proceed from bodies that are damp, or putrefying, or liquefying, or evaporating, and are perceptible only in the intermediate state..." [4]

In the defense of Plato, he lived in a time void of modern standards of sanitation, plumbing, and hygiene. Smell for many ancient and pre-modern citizens may not have been a source of great beauty and enlightenment. For those who spent much time researching and dissecting dead organisms however, smell posed a particular unpleasant obstacle. Not knowing the concept of atoms and diffusion of molecules through the air, Plato was able to devise his own system for classification of perceivable smells which relied on the size of the particle directly deciding one's ability to absorb it. It would be centuries before the philosophy of the brain and

neuroscience combined forces in determining the function of the olfactory system and the function of smell.

Paul Broca (1824-1880), a French physician who is most known for his work in language and the discovery of Broca's area, served as both a scientist and philosopher in the study of olfaction. Broca put olfaction at the center of his "limbic system" which included, but was not limited to, the olfactory lobe (olfactory bulbs), the colossal lobe (cingulate gyrus) and the Hippocampal lobe (hippocampus). Together these structures were part of the rhinencephalon or "nose brain". While author Francis Schiller, who wrote extensively on the findings of Paul Broca, notes that Broca never directly concluded that the olfactory nerves projected directly into the hippocampus, Broca is often attributed with this idea. Rather, Broca's more poignant ideas suggested that the olfactory nerves projected directly into the cortex without decussating.

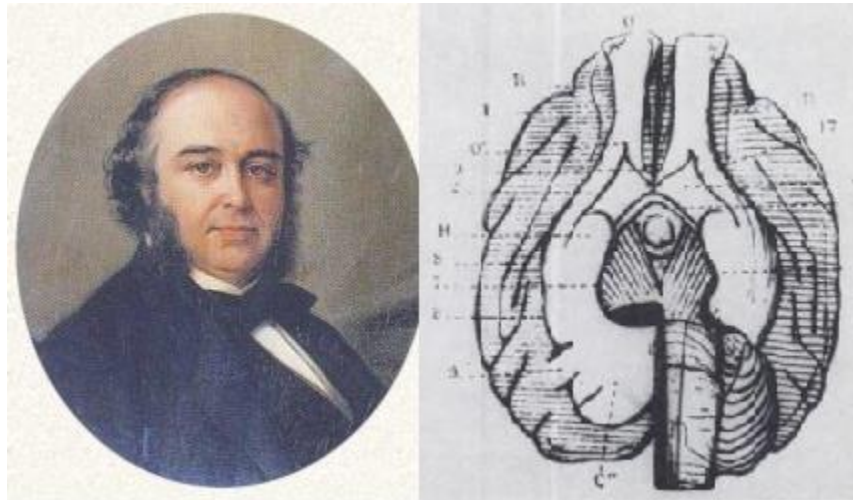


Figure 1 Broca (Left) and his drawing of the underside of an otter's brain (Right) [5]

Broca is attributed having said, "Far more than the sense of taste, the sense of smell makes us appreciate the qualities of our food, from the kind that may plunge the gourmet into profound pleasure to that which may provoke disgust, nausea, and even vomiting." Broca was tapping into the key idea of this paper. He believed that there was an unknown function of the olfactory system which would explain the connections he hoped to make between the hippocampus and the olfactory nerve. Experimentally, Broca found that dolphins, an aquatic

species that could not smell, had an overly developed cingulate gyrus. This furthered his idea that the limbic system and the rhinencephalon had an intrinsic function that was directly related to, but not restricted to the sense of smell. [5] Only much later would researches begin to investigate the connections and effects of olfactory connections to the cortex, the hippocampus, and the even the amygdala.

The projections from the olfactory nerves onto either the hippocampus or the cortex would become a debate including many well-known names in the history of neuroscience. David Ferrier (1843-1928), a Scottish neurologist and psychologist, would also come to support some form of connections between olfaction and the hippocampus. In his study of epileptic patients, Ferrier had access to direct brain stimulation. By stimulating areas of the brain and observing the results in the patient, Ferrier could decipher many localizations of function. In stimulating the hippocampus Ferrier recorded contraction of nose and lip muscles resembling a sniff. This lead Ferrier to support the claim that the hippocampus was somehow involved in olfaction. Ferrier did not continue to pursue this avenue as he was more directly interested in epilepsy. [8]

Broca's poke at anatomists, suggesting that no anatomist had yet been able to discern the projections and direction of information in the olfactory

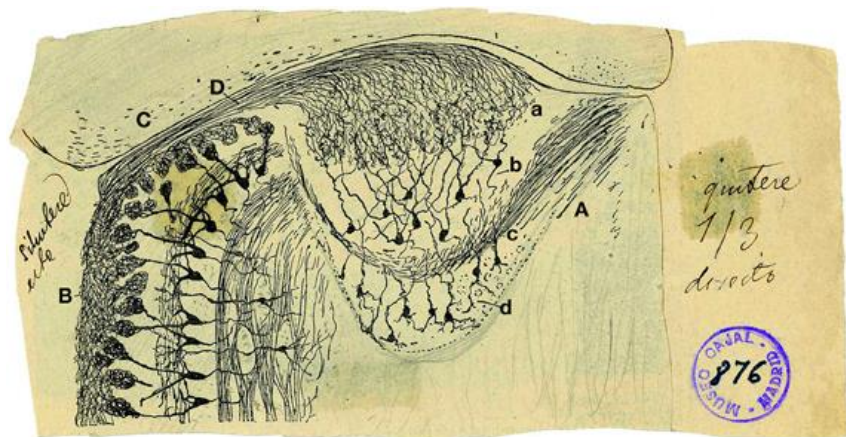


Figure 2 an original Cajal drawing of the nerves in the accessory olfactory bulb [8]

system, was picked up by none other than Raymon Cajal (1852-1934). Cajal, a famous Spanish anatomist, spent a large portion of his time staining neurons, observing them under a microscope,

and drawing his findings. In 1906 Ramon Cajal and Camillo Golgi, who made the stain that Cajal used, were awarded the Nobel Prize for elucidation of much of the structure of the brain. Their work included elucidation of the structures of Broca's rhinencephalon, the olfactory bulbs, and the olfactory projections. Cajal concluded that the olfactory system did not directly project onto the hippocampus. [7] As the hippocampus becomes more closely associated with memory in modern studies, the connection between scent and memory and connections between the olfactory tract and the hippocampus would become much more significant in the study of anosmia. The neuroscience and connections of the olfactory tract will be paramount in deciding the future of studies into anosmia.

Notwithstanding the substantial evidence that Cajal produced against the function of the hippocampus in olfaction, the hippocampus was continually acclaimed as an olfactory organ. It is supposed that this stigma was maintained until the middle of the 20th century through the work of Alf Brodal (1910-1988). Brodal was a Norwegian anatomist whose later writings have been regarded as "the bible of neuro-anatomical knowledge". [9] Brodal and his colleagues including Wilfrid Le Gros Clark (1895-1971) found no structure directly connecting the olfactory bulb or nuclei with the hippocampus. However, their findings did discover that the olfactory system was not as different from other sensory systems as was originally hypothesized. Brodal discovered commissural fibers connecting the olfactory nuclei suggesting that olfactory information was indeed shared across hemispheres of the brain. Gros Clark continued to develop these connections and discovered direct connections between the olfactory bulb, the periform cortex, and the amygdala. [10] The advent of decussation in the olfactory system would raise questions about the plasticity of the olfactory system in later studies, and the connections the olfactory tracts have with the amygdala offer another layer in the role of scent and memory.

Finally, in 2004 Linda Buck and Richard Axel received the Nobel Prize for their discoveries of “odorant receptors and the organization of the olfactory system”. Their work, which began in the early 90’s, notes that some 1000 genes are used to detect and differentiate over 10,000 different odors. 1000 genes composes approximately 2-3% of your DNA states Stuart Firestein, a colleague of Buck and Axel, in his web video series on the big think webpage. [11] Using this genetic basis of tracing, Buck and associates were able to trace neuron stimulation of odorant receptors, ORs, to cortical regions of the piriform cortex as discovered by Gros Clark almost fifty years before. In a study, prepared by one of the lab’s post-doctorates, where mice only expressed two ORs they found that each OR had a specific path to the cortex and information from each OR was organized topographically in the piriform cortex. Visualization of this data would have been impossible without the fMRI. Location within the piriform cortex was almost unanimous between individuals suggesting that each odorant makes a specific mark on the cortex. These marks or signatures are then used for differentiation. Buck and Axel also discovered much of the sensitivity of the olfactory system. Simultaneous stimulation of multiple odorants creates a lasting imprint on the cortex that are characterized by potency and quantity of each odorant in creating a new differentiable odor. [12]

Pheromones on the other hand are not received the same way as odorants. Pheromones are received by the vomeronasal organ, VNO, which is a different structure altogether within the nasal septum. Neurons carry information from the VNO to the medial amygdala and then to the hypothalamus where behavioral responses to pheromones are regulated. [12] As noted in the findings of Broca as well as Cajal and Brodal the connections will be significant factors of discussion in the analysis of post-traumatic anosmia. The genetic aspect of odorant detection however is equally significant in the effects of smell and congenital anosmia.

As views on the olfactory structure have changed over the course of history, implications at its function have similarly changed. The structure of the olfactory system will play a major role in later parts of this paper. The next section will discuss some of the possibly unexpected functions of the olfactory system. In the sections on anosmia the structure and connections of the olfactory system will act in determining the consequences of inactivity in the periform cortex as well as the amygdala and hypothalamus.

Smell Makes a Splash

Structurally, the history of the olfactory system has been laid out. The last piece of the puzzle before the discussion of anosmia lies within the functions of smell. The functions of smell on other brain systems as well as our daily lives is becoming increasingly emphasized in modern studies. Understanding where the field is at today in terms of determining the functions of smell, reviewing the history of anosmia will allow for more comparison and answer important questions such as: If smell has function X, does that mean that anosmics lack function X?

In 1997 Robert Baron, a psychologist at Rensselaer Polytechnic Institute, tested the effects of positive and negative ambient odors on mood and the willingness of individuals to offer assistance. Much of Baron's research previously has covered workplace aggression and he and his colleagues were in the process of testing the effects of environmental stimuli on mood and work efficiency. In discussing the results of his work he notes the difficulty of obtaining and interpreting non-invasive data. The study included three factors. 116 different individuals would be presented with an opportunity to help a stranger in a non-controversial manner. Some subjects were presented with this opportunity in the presence of either a positive or negative ambient odor. Finally, after being presented with the opportunity to help, each subject was asked

to rate their mood. Significant findings found that in the presence of an ambient odor, people felt in a much better mood and were more willing to offer assistance to strangers. It was difficult however to interpret all three variables together. In the nature of such studies it is nearly impossible to determine if the person was in a good mood because having just helped a stranger rather than an ambient odor they were occasionally unaware of. Baron still notes with fervor that more research must be done in these instances and that being unaware of a positive external stimulus does not negate its effect on your mood. [13]

Then, in 2004 an exciting article was published by Karl Grammer et. al., researchers at the Austria Human Cognitive Neuroscience Unit, further discussing the function of pheromones in reproductive behavior of animal and human subjects. The long-thought-dead function of pheromones in the world of human dating was established in three different settings. The first setting involved human correlates of animal effects and found the Lee-Boot effect that pheromones periodically placed on the upper lip of female subjects altered the menstrual cycle of the subjects significantly into a more synchronous cycle. Reportedly, this created a greater sense of bonding and empathy. In a laboratory setting, female subject data about the attractiveness of a photograph while exposed to synthetic pheromones was inconclusive due to the effects of menstrual cycle on the sense of smell. Women at the peak of their menstrual cycle placed more emphasis on the olfactory basis of attractiveness. Males in this study showed a significant increase in arousal when asked under influence of the pheromone. Finally, in real life situations, subjects exposed to opposite sex pheromones over prolonged periods of time showed significant changes in behavior. Women who were exposed overnight to male pheromones were no more likely to become sexually active, but did express a greater level of comfort around males and more familiar behavior. Men on the other hand did express a significant increase in sexual

activity including becoming more physical toward women, more confident in initiating dating scenarios, and even greater levels of masturbation. [14]

Brodal and Gros Clark almost 50 years before this study had drawn connections between the VNO, the amygdala and hypothalamus. These findings do not reflect the subject's personal level of confidence in areas that would also include instance of depression, but these findings were influential in showing that the animal instincts of Homo sapiens are still thriving in a modernized society. Neil Gaiman, a novelist, who said "Fear is contagious" in his book *The Graveyard Book*, is describing an idea that is by all means a very plausible deduction based on these findings. [15] An idea supported by a study about the chemosignals in human emotional communication. The researchers stated after finding compelling evidence that humans still communicate and receive communicate through pheromones, "These findings underline the neglected social relevance of chemosignals in regulating communicative correspondence outside of conscious access." A type of emotional connection in itself that is appreciated, and increasingly rare in scientific writing. [16]

Since 2011, studies have shown that false recognition of smells, or phantom smells, have a distinct neural signature differentiable from actual stimulation of ORs. Context is vital for the perception of smell and the way that a commonly negative odor is received. Perhaps most disconcerting is the fact that males and females (females more so than males) rely on olfactory cues in daily decision making, specifically socially conforming behaviors. [17-19] Knowing the real influence that can be tied between our olfactory perceptions and our behaviors, the peculiar problems of the anosmic seem much less than trivial.

Anosmia

A 2012 Huffington Post article titled “Anosmia: No Sense of Smell Linked to Relationship, Sex Problems” highlighted research done by Ilona Croy and Thomas Hummel at the Dresden Smell and Taste Clinic. [20] This article leaves readers asking one question: How much does this condition have to influence one’s life before it becomes recognized as a more serious complication? Anosmia presents in many forms and is only one subset condition within the maladies of olfaction. These maladies range from hyperosmia, the heightened sense of smell, to dysnosmia, the impairment of smell, to anosmia which is the complete lack of smell. Although an official census has not been taken to accurately determine the amount of sufferers, a 2002 study calculated that approximately 2% of Americans suffer from anosmia. [21] That means nearly 14 million Americans are suffering from this condition and according to the anosmia foundation website, anosmics are arguing for disability rights as sufferers of this condition. The foundation website cites articles that sufferers of anosmia have severely inhibited emotionalism and even an inhibited memory as it is suggested that a familiar smell can bring to mind information learned while under the same influence of smell. [22] Is this claim justifiable? The last sections of this paper hope to dissect and discuss these two forms of anosmia culminating in the overall topic of this paper to discuss post-traumatic anosmia. The last step before discussing the history and effects of post-traumatic anosmia is to first discuss the non-post-traumatic, congenital anosmia.

Congenital Anosmia

Congenital anosmia, the condition of being born without the ability to detect odors, is arguably very different from post-traumatic anosmia. The alterations in development and possible genetic markers offer significant complications in studying of the effects of anosmia.

Most patients that enter the hospital inquiring about a lack of smell are not suffering from true anosmia but rather dysnosmia or hyponosmia (both describing an impaired sense of smell) isolated congenital anosmia (ICA) is a rare occurrence where the presented anosmia is not familial but rather only one individual in the family suffers from the condition. Familial anosmia was first reported by Otto Glaser, a radiologic physicist who worked extensively with X-ray technology, and is associated with many other conditions. The absence of olfaction was seen in association with “hernias, wide thumbs, excessive sexual interest, and considerable mental powers” [23]

Glaser was referenced in a 1997 case study on a five year old patient suffering from ICA. Richard Vowles, et. al. notes that acquired anosmics often lose their ability to taste as well. They lose interest in food altogether or overeat in an attempt to gain some taste from their food. Congenital anosmics on the other hand are often left with true taste. True taste is the ability to taste the four main groups, sweet, salty, sour, and bitter while leaving flavors undistinguishable. In most cases however, Vowles et. al. note that the patient in study as well as other congenital anosmics focus on texture of food rather than taste. In order to compensate for the lack of cortical stimulation, congenital anosmics tend to eat spicy foods which stimulate the trigeminal, glossopharyngeal, and vagus nerves which are usually intact. [24]

This need for neural stimulation traces back to the studies done by Broca, Cajal, and Brodal. The connections between the olfactory system, the amygdala, and the indirect connections to the hippocampus seem to contain some greater significance that is lacking in individuals without olfactory stimulation. One could imagine an emotional connection or memory that acts as a time stamp for dating memories that stems from periodically eating. It

could directly relate to eating habits and other neurosis such as anorexia or bulimia on a level much deeper than that of a direct smell taste relationship.

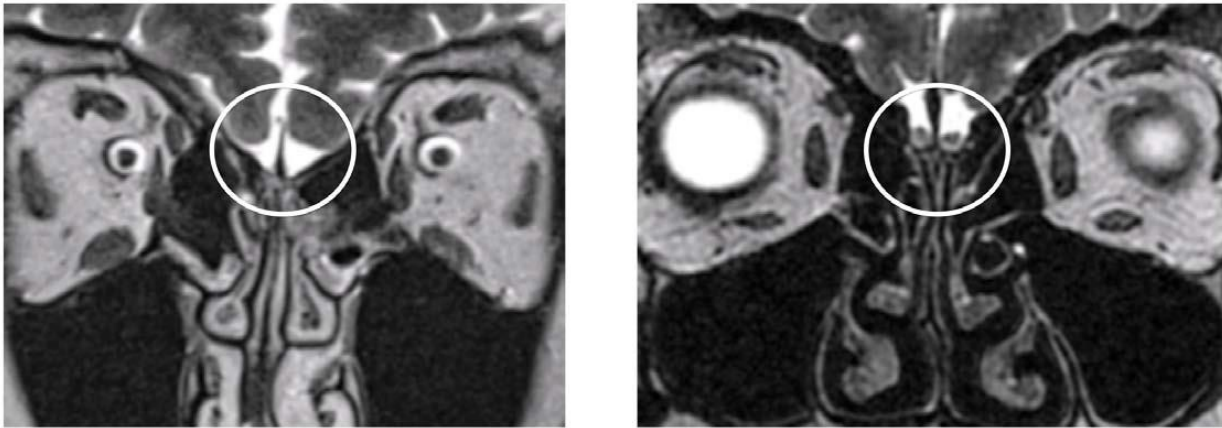


Figure 3 MRI image of a congenital anosmic brain (Left) with the undeveloped olfactory bulbs (circled) and a normal brain (Right) with the olfactory bulbs developed (circled)

Ilona Croy and Thomas Hummel, cited in the fore mentioned Huffington Post article, have published many papers from the Dresden Smell and Taste Clinic. In an article published in 2012, Croy, Hummel, and associates' data suggested that ICA patients did not show any significant differences in bathing habits, sexual satisfaction, or attachment towards their partner. They did show significant differences in reported household accidents, number of sexual partners, a significant increase in worries associated with social situations and their own body odor, trouble interacting with others, avoiding eating with others, and depression. [25]

These effects of anosmia are associated with but not limited to congenital anosmia or ICA. Many similar studies have been conducted on post-traumatic anosmics and have come to similar conclusions. To enter the realm of post-traumatic anosmia, we must return in time once again.

Post-traumatic Anosmia

The first recorded case of post-traumatic anosmia was documented in 1864 by Hughlings Jackson (1835-1911) in his patient notes in the London Hospital Gazette. "This case I received

after the whole of this article was in type. As it is an exceptional one, I gladly make room for it. It is supplied to me by Mr. Robert Rudall, of Sheepwash, Devon. In the month of September, 1837, the patient, a gentleman, 50 years of age, fell from his horse, probably from a blow by some person or persons who intended to rob him. A very large quantity of blood was lost from the right ear, and there were two wounds, one just below the occipital ridge, the other under the chin. I considered, at the time, that they might both have resulted from a blow with a hammer, or an iron attached to a whip or a stick, or even a stirrup; as one of the stirrups was detached from the saddle, and found about forty yards from the place where the blood was found on the road. All the worse results of concussion resulted; smell and taste never returned.” Discovering these articles is a treasure and as I progress through this study it would be a crime not to provide the full account from the perspective of the scientist. Given at this time Jackson had no intention of pursuing the results of loss of smell, the rest of the article continues to describe two patients with similar brain trauma and their individual paralysis. Regardless, these lines were the first time in modern science that post-traumatic anosmia had ever been documented. [26]

Following this example less than twenty years later, Julius Althaus (1833-1900), the senior physician at the London hospital, published an article in 1881 on the physiology and pathology of the olfactory nerve. In this article, Althaus speaks very frankly on the importance of smell and all the possible effects of anosmia caused by damage to the olfactory nerve. The quality of the writing within this article is transcendent and embodies a personal interaction with the research that much of today’s science is lacking. Althaus notes, “If Prince Bismarck and M. Gambetta were to become suddenly blind and deaf, the destinies of Europe would no doubt be changed; while if these two men were to lose their smell and taste, things would probably go on much in the same manner as they do now.” While understanding that smell has long taken the

back seat to some considerably more pressing maladies, Althaus does justice to the sense of smell in his in depth depiction of life in modern England without smell. He describes the social status of gala events and dinners, turtle soup, the entire perfume industry in Europe, and smoking and how the pleasure of each experience would be utterly lost. Effortlessly moving between French and English, Althaus proclaims that the fabric of upper class Europe at the time would become vain conceit. [27] In the Althaus paper, he also recounts a short history of olfaction from his perspective and cites many notable and great leaders of science. The paper is entertaining and I highly recommend it for further reading on this topic.

Anosmia became increasingly present in scientific literature throughout the latter half of the 1800's. In 1887 a scientist by the name of Hendrik Zwaardemaker (1857-1930), a Dutch professor of experimental physiology at the University of Utrecht, created the first apparatus by which smell could be directly tested and quantified, as cited in the book *The Origin of Neuroscience* by Stanly Finger. The apparatus or "olfactometer" added to the access researchers had to diagnose and then design

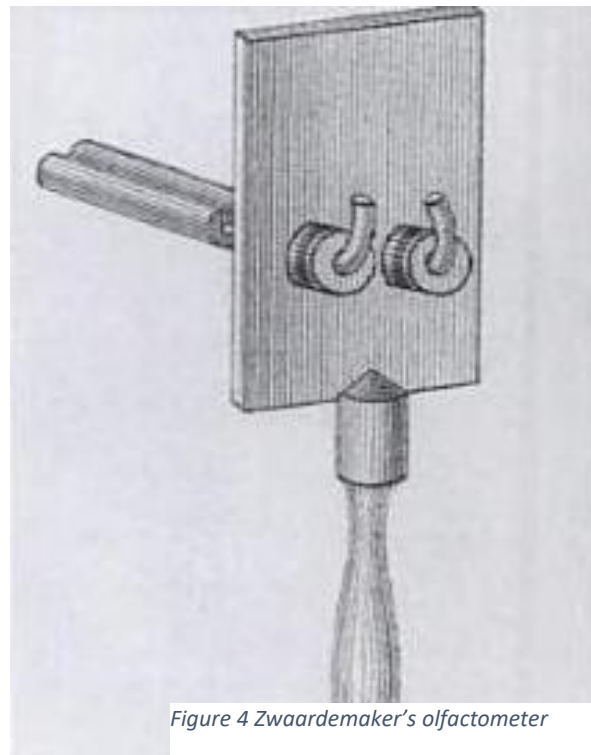


Figure 4 Zwaardemaker's olfactometer

treatment for anosmia. Unfortunately, Zwaademaker also remarked that the data he received from his new device was inconclusive and hard to interpret. [28]

By 1888, only nine years later, a British neurologist William Gowers (1845-1915) published a manual of diseases of the nervous system. Gowers clearly outlines many causes and

a single case study that lead to a total, irreversible anosmia. The prognosis of post traumatic anosmia was dismal and involved snuffing olive oil into the nose or “[stimulation] by voltaic electricity” of the fifth nerve of which he noted “the application is very painful unless the nose is filled with water or a weak saline solution”. Electrical shock of the fifth (touch) nerve often showed that the nerve itself was intact. It would be some time before scientists discovered that the first cranial nerve was the olfactory nerve rather than the fifth. Voltaic stimulation, electric shock, proved useless in most cases, and Gowers attributed most cases of anosmia to “syphilitic origin”. [29] The effects and prognoses of anosmia in this age are still ambiguous despite the recent interests.

Fast forward a century and the developments in understanding the effects of post-traumatic anosmia are remarkable. In 1995 Richard Doty published the Handbook of Olfaction and Gustation which depicted the great success of CT scans and MRI in identifying the location and severity of trauma resulting in anosmia. These new imaging techniques are viewed in comparison in his handbook and ultimately create a much clearer picture than the 1880’s models. The CT scan and MRI together found at length a series of contusions, hemorrhages, and specific brain areas outlined in the previous section on olfactory structures that were associated with anosmia. The CT scan was also able to find a direct correlation between anosmia, Alzheimer’s disease, and Parkinson’s disease. [30]

A 1999 article by Steven Van Toller, a researcher in the department of psychology at the University of Warwick, cited Doty’s 1995 handbook and followed up with a psychological profile of those suffering from post-traumatic anosmia. The intention of the review, Toller states, was to “...educate, inform, and help sufferers...” and “to comment upon what anosmics say about their condition...” Responses to the study by those suffering from anosmia “reflected

the lack of sympathy that anosmics encounter concerning their condition.” Toller quotes and ENT medical report in 1996 containing the statement “the patient was able to detect odours because they were able to detect ammonia”. Anosmics are frequently doubted when they claim to be able to sense a different texture in the air. Toller shamefully admonishes the quality of care provided by ENT specialists and their awareness concerning the fifth (trigeminal) nerve for touch and the first (olfactory) cranial nerve for smell. Anosmics who have experienced a greater intervening time between their loss and assessment also reported fewer problems relating to their condition due to this lack of sympathy in their initial assessment; similar to evaluations of paraplegics that received negative initial assessment experiences.

Almost all of the patients in this study that suffered total anosmia had significant vocational problems within the first two years they were medically cleared to return to work. Unlike the studies of congenital anosmia, this study found that a large portion of anosmics suffered feelings of vulnerability, relationship/sex problems, disinterest in sex and dating, and obsession with bodily hygiene. Toller also found that many anosmics

suffered from depression. Toller employs Maslow’s hierarchical system of human needs and systematically describes how anosmics as a part of his study have been adversely affected at every level. “There is large variation,” Toller states, “in the way that individuals react to loss of



Figure 5 Maslow's hierarchical system of human needs as cited by Toller

the ability to detect odours”, but Toller is clearly a strong advocate for awareness about the various consequences of losing one’s sense of smell. [31]

Studies today rely on the same sampling techniques as those almost ten years ago. A study performed in 2013, focusing on the psychological results of anosmia, reaffirmed many of the findings of the 2005 article. The more recent article did provide more extensive responses from sampled individuals and added a new key effect of anosmia. “...individuals are often not aware of the connection between their olfactory dysfunction and the reduced enjoyment of formerly enjoyable activities. Although the mechanism is unknown, there is a correlation between smell loss and depressive symptoms and mood changes.” [32] It seems as though the one thing that anosmia research is lacking in modern studies is the emergence of neuroscience correlates to psychological impairments. The connection studies done by Broca and Cajal have still not been applied to the effects of anosmia the way that Broca’s area and Wernicke’s area have illuminated the study of speech aphasia and the neuroscience of language.

Conclusion

The fifth sense, the luxury sense, smell has been seen as an accessory function of humans since ancient times. In the discovery of the history of smell, many well-known figures have contributed to our understanding and acceptance of smell as a vital facet of modern society. However, as seen in the history of anosmia, there is still so much that is misunderstood about the role that the ability to smell plays in our quality of life. The structure of smell is outlined in the research of great scientists like Broca, Cajal, and Buck. This research is responsible for the discovery of the connections that the olfactory system makes with other neurological structures such as the amygdala, the piriform cortex, and the hypothalamus. The psychological effects of

the ability to smell include but are not restricted to our mood and willingness of assist others, our dating and sexual behaviors, our personal confidence, and various levels of emotional communication. Many of these functions of smell are more than likely associated with the connections that the olfactory system makes structurally, but the gap between psychology and neuroscience still prevents the production of a full picture scope of the uses of smell. The behavioral deficits of congenital anosmics are historically documented reflecting not only the loss of smell but also many of the wider range effects attributed to smell.

Historically, studies of anosmia have not been as productive as suspected, despite our understanding of the olfactory system. Studies as late as 1888 proved that scientists were still far from discovering the difference between smell which is achieved through the olfactory nerve and detecting the texture of the air which is done with the trigeminal nerve. As our ability to quantify and visualize smell progressed technologically, so did our understanding of the psychological impairments of those suffering from anosmia. Today, the picture of the struggles of the average anosmic remains blurred and incomplete. Awareness of the condition seems limited, sympathy from healthcare providers as well as the public seems scarce, and the prognoses seem dismal. However, with the growing prevalence of support groups and information available to those suffering the condition makes one hopeful for greater insight in the future of neuroscience.

At the age of fifteen in the process of “bombing a hill” on my longboard skateboard, I was hit by a car that resulted in the complete loss of my sense of smell. Though I disagree, some may argue that I still have true taste (sweet, sour, salty, bitter) but I spent over a year in Taiwan under the impression that soy paste, a thicker, very salty version of soy sauce, was a sweet syrup that I poured graciously over my morning meals. I have on multiple occasions had milk that was

days from the labeled expiration date only to find out within minutes that it had long gone sour. This has lead me into multiple cases of food poisoning and ridicule from roommates and friends who seem incapable of wrapping their minds around the idea that the date on the container is the only source of assurance that is provided to me. When I was in high school my mother arrived home multiple times traumatized at the apparent odor of gas that had probably been filling our house for several hours while I sat completely unawares surrounded by fumes that could have easily leveled neighboring houses if it had been ignited. I suffer from insecurity related to feeling perpetually separated from my surroundings. I, more often than not, am incapable of gauging what I have come to determine is a mood that is somehow implied by body language or emotional communiques that escapes me without direct explanation. If it was not the case that I remember slowly forgetting each and every olfactory sensation from before my accident I would not be able to imagine what it would be like for the world to rush back into my being and connect me once again with my environment. I am an anosmic. I know first-hand the importance of smell and seek eagerly for the next study that will not only confirm the experiences that I have as a result of losing my sense of smell but also provide a more hopeful prognoses for anosmics across the world.

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