

Making Sense Of Human Pheromones: Receptors, Physiology, and Behaviors

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## Abstract

Pheromones are the chemosensory molecules that animals species use to communicate with each other, which produces a specific reaction in the receptive animals. There are chemicals that have been identified as potential human pheromones. These chemicals typically come from a general class of human sex-derived hormones, such as the family of 16-androstenes, including the compounds androsterol and 4,16-androstadien-3-one (AND), which are derived from testosterone (Savic & Berglund, 2010), EST is also derived from estradiol, which is a female sex hormone. Interactions from the receptor and genetic levels of human pheromone studies provide us with the smallest possible scope of how odorants such as human pheromones can affect the nervous system, and thusly effect our social behaviors. How pheromones effect our brain regions can greatly influence our psychological state, our behaviors and our emotions. How pheromones affect the different sexes and their behaviors or cognitions as a result describes most of the controversy around this topic. Pheromones are a key player in our sexual behaviors, however the full interactions of how these all work together with your nervous system is still in question.

## Introduction

Pheromones are the chemosensory molecules that animals species use to communicate with each other, which produces a specific reaction in the receptive animals. Many pheromones are divided by their functions, particularly how they induce the receptive animals to react to the chemosensory stimulation. In animal sexual pheromones, both sexes release pheromones that advertise their sexual receptiveness, quality of their genes, and numerous other qualitative traits.

There are chemicals that have been identified as potential human pheromones. These chemicals typically come from a general class of human sex-derived hormones, such as the family of 16-androstenes, including the compounds androsterol and 4,16-androstadien-3-one (AND), which are derived from testosterone (Savic & Berglund, 2010). These testosterone derived compounds are touted to be male pheromones, as they are found in higher ratio in men than in women. Conversely, compounds such as 1,3,5(10),16-estratetraen-3-ol (EST) and oestra-1,3,5(10),16-tetraen-3-yl acetate are estrogen derivatives and are very close in nature to the compound estrogen (Savic & Berglund, 2001), and are found in high concentrations in women and an almost negligible concentration in men. These differences in chemical ratio between men and women began the notion that there was a difference between the sexes in chemical signaling that was potentially occurring. In other animals, the difference between female and male pheromones have been established and usually catalogued as coupled with very stereotyped behaviors after presented with pheromones. Animal sexual pheromones in general have already been well established as a mechanism through which animals of the same species seek each other out, and how many animals initiate and sustain sexual encounters. However, humans do not respond the same way that animals do when presented with sexual pheromones; the effect on humans is reported and shown to be more subtle.

## The Genetics and Receptors of Pheromones

### *Pheromone Receptors*

The mechanisms of pheromone perception start at the level of the receptor on the olfactory neurons. Typically receptors in the olfactory pathway are mediated by seven-transmembrane G-protein-coupled receptors that identify odorants and pheromones in humans and mammals. These transmembrane G-proteins are found primarily in the vomeronasal sensory epithelia and also in the main olfactory epithelia (Riviere et al, 2009). Four of the known olfactory types include odorant receptors, trace amine receptors, two types of vomeronasal receptors and potentially a fifth type of receptor that has a role in detecting pathogens in the olfactory cavity by way of olfaction. Riviere et al. (2009) discovered these receptors, called formyl peptide receptors, as a type of receptor that responded to the same olfactory stimuli as the already known stimuli, such as bodily fluids, but these new receptors were shown to induce an immunological response to these stimuli. The receptors are activated by compounds that are found in bodily fluids and urine, which are typically vectors for pheromone compounds. However it is suggested that these receptors respond particularly to compounds present in the bodily secretions of diseased animals. These new formyl peptide receptors are particularly interesting as a component of the olfactory cavity, as previous research has suggested a role of the olfactory epithelium in the immunological system especially when it involves mate choice (Chaix et al, 2008). Other receptors of the olfactory system are shown to enhance sensations by amplifying their transduction (Stephan et al, 2009), such as the AN02 receptors, which are also found on the olfactory epithelium, and act on the olfactory neurons.

Other odorant receptors have been closely studied in terms of population variance since individuals perceive human odorants differently. Wysoki and Beaucamp (1984), began genetic

studies that tried to determine the genetic components of pheromone perception with numerous histological and genetic test, compared against threshold detection levels of many odorants including pheromones and non-pheromones. Continuing in this line of study, Keller et al (2007) studied if genetic variation was part of individual preference in odor perception. Keller et al (2007) selected the receptor OR7D4, which is involved in olfactory sensation. Correlating the different genotypes of the receptors, Keller et al found a difference in phenotype of smell perception of androstenone. These authors also showed that these receptors are sensitive to male pheromones and are most likely part of a larger network of receptors that are able to detect human pheromones.

### *The Vomeronasal Organ Receptors*

The vomeronasal organ (VNO) in humans is thought to be a vestigial, evolutionary holdover organ from our evolutionary past, however in animals, this organ is a very active organ in the olfactory system. This organ primarily detects pheromones that are released by animals and play a fundamental role in sex-specific behaviors and other social situations. In mice, this organ responds to the body secretions of mice, and certain subclasses of receptors will respond to these sex-oriented smells (Isogai, et al, 2011). Isogai et al (2011) demonstrated that two of the classes of vomeronasal receptors (VR1 and VR2) encode chemosensory information differently, and these different strategies allow for the differing responses of animals to pheromones. Humans, however, have “lost” many of the different receptors and genes that are activated in the VNO by mice. Giorgi et al (2000) estimate that humans have retained only 52%-59% of the same receptors in the VNO that mice possess. The rest of the genes in the human VNO have denigrated into pseudogenes, or inactive, non functioning genes. Giorgi et al (2000) have postulated that the sever reduction of the genes present in the VNO may point to why the VR1

receptors in the human VNO might be nearly non-functional or completely non-functional, however they remain positive that there are other pathways in the human olfactory system that can detect pheromones.

### *The MHC and HLA*

The MHC (major histocompatibility complex) is a supposed influencing factor in mate choice in mammal/vertebrates. The MHC locus has genes for acquired immunity and also for olfactory receptors and associated tissues. Speculation about this region of the genome include the idea that the difference in these MHC areas can be detected by olfactory processes and are used to determine the evolutionary fitness or attractiveness of a potential mate. Potential mates who are most attractive are thought to be individuals that have the least amount of acquired immunity in common with the other individual. This strategy would be evolutionarily advantageous, as the range of immunity abilities in potential offspring from the mating would be quite larger than other matings, potentially. Despite these conjectures, previous studies indicated that MHC really only predicts a low arousal response for very similar MHC's, not necessarily attraction to dissimilar MHC (Jacob et al, 2002). Derti et al (2010) cited that European-Americans who were mated were extremely dissimilar in MHC groups, however the effect is weak, as these results stem from a few extreme data points . In light of the earlier conjectures made, these findings still provoke an interesting rationale into why mated pairs would prefer to have dissimilar MHC types. Individuals with similar MHC's may likely be related, and thus may share many of the same genes. This pairing would be unadvantageous, as similar genes provide less variability and raise the chance for recessive genes to become more prominent in the potential offspring.

The purpose of Derti et al's (2010) experiment was to further support the effects of MHC locus in mate choice and found that the MHC dissimilarity between European couples was a weak interaction and further analyses proved to weaken the significance additionally. Derti et al explain that rather than the MHC being a locus that is selected for, it simply has a great amount of variance in mated pairs, it has more of a likelihood of just being highly variable throughout a population.

In humans, the MHC is referred to as the human leucocyte antigen (HLA), and as previously stated, there might possibly be a preference of MHC/HLA dissimilar individuals as potential mates. However, according to Pause et al (2006), the role of chemosignals in same- and opposite sex attraction has not yet been specified. Their research into EEG recordings and the smelling of body odors of both sexes, and they report a negative selection bias in how human couples attract one another, because of the similarity of the HLA axis.

These interactions from the receptor and genetic levels of human pheromone studies provide us with the smallest possible scope of how odorants such as human pheromones can affect the nervous system, and thusly effect our social behaviors. The interactions on the molecular and receptor level can be especially telling in our evolutionary history, and how we have changed over the course of time to lose much of our ability to perceive olfactory cues adequately. The differences between the human model of pheromone sensation and perception and other mammalian models can lend itself to help elucidate the more complex behaviors associated with human pheromone perception.

## The Anatomy and Physiology of Pheromone Perception

### *The Vomeronasal Organ*

As discussed in the previous section on vomeronasal organ receptors, the vomeronasal organ in humans has been considered to be a vestigial and non-functioning organ in human physiology. Previous studies have shown that if vomeropherin (a pheromone that directly modulates the vomeronasal organ in humans) is applied to the VNO, that there are changes in the autonomic nervous system, and changes in the release of hormones such as LH, and FSH (Berliner et al, 1996). Berliner et al (1996) delivered a vomeropherin directly to the VNO, the olfactory epithelium and the respiratory epithelium of the nasal septum in varied doses. There was significant electrical activity in the VNO measured by an electrovomerogram (a machine which recorded the evoked electrical potentials of the nasal epithelium), while there was no significant electrical activity in the nasal respiratory epithelium or the olfactory epithelium, when identical stimuli were delivered to these receptive epithelium. In males, these VNO stimulations changed male gonadotropin pulsatility and decreased LH and FSH plasma levels and pulsatility. There was found to be no effect in females. In all subjects, the VNO stimulation by vomeropherin induced decreased respiratory frequency, increased cardiac frequency, and changes in electrical conductivity of the skin.

### *Pheromone Processing in the Brain*

Androstenol is an axillary compound found in males, that is a part of the same chemical family of odorous 16-androstenes, like AND. This compound is shown to affect the hormonal, behavioral, and also social responses in humans in research conducted by Savic and Berglund (2010). They showed affect of androstenol is particularly apparent in the pulsatile secretion of

lutetizing hormones in human females, the effect of which is assumed to be mediated by the hypothalamic nuclei in the brain, as this region of the brain regulates sexual arousal and sex-related behaviors. Savic and Berglund (2010) wanted to find conclusively if smelling androstenol activates the human brain, and if the site of the activation corresponds to activations previously detected with ordinary odors. Researchers used PET measurements of regional cerebral blood flow (rCBF) conducted during the passive smelling of androstenol, four ordinary odors and odorless air. The four non-pheromone odors used were butanol, cedar oil, lavender oil and eugenol (clove). The results showed that the ordinary odors caused activation of the amygdala, piriform, anterior insular cortex and the ACC. In contrast, smelling of androstenol yielded activations in the anterior hypothalamus and the medial portion of the right amygdala. The piriform cortex also was also activated when certain corrections were made as it is the primary cortex for olfaction. Both the ordinary odors and the androstenol were perceived as fairly neutral odors via ratings of a scale of pleasant/unpleasant odors. This chemical, among others, and its potential role as a human pheromone have previously been questioned because of the lack of studies showing how androstenol affects the brain in a way different than any other odorant. However, this study as one of the first of its kind, shows that the touted human pheromones such as androstenol do in fact activate different areas of the brain than do other odorants.

Wang, Chen & Jacob (2003) studied the effects of the gradual enhancement or sensitization to olfactory stimuli and whether humans can acquire smell perception. Sensitization to odorants, much less brain plasticity in this sensation has been seen as an extremely unlikely event. However, Wang et al (2003) have been able to show that one odor that has been able to induce this effect of neural plasticity: androstenone. Most people cannot smell AND, however the small groups of people who can, fall into two groups. One group contains people who find

the odor as unpleasant and describe it as a sweaty or urinous smell, and another group of people who find the odor pleasant and describe it as sweet, or a musky, perfume-like smell. Of people who cannot detect AND, most can acquire sensitivity to it by repeated exposure, and even those who already detect AND, can lower their detection threshold for it. How this plasticity occurs is unclear, however, the authors observed the response of the olfactory system during the sensitivity training to AND, by measuring the evoked potentials of olfactory epithelium, and the event related potentials, along with the detection thresholds of the AND. A constant airtight, unidirectional stream of air flowed into the nasal cavity with one of the odors (either AND or amyl acetate, which has an apple-banana smell). The stimuli were presented at random at 20 pulses at a regular pace of 10s between stimuli. There were two experimental groups and a control, where the first experimental group was given a solution of AND to sniff three times daily for three minutes, the second experimental group was assigned to sniff amyl acetate three times daily for three minutes and the control group was a group of participants who did not sniff anything. Each group was monitored for thresholds of both androstenone and amyl acetate, evoked potentials of olfactory epithelium, and event related potentials, both measured by electrical recording devices, at a weekly interval for three weeks. Wang et al (2003) found that only nine out of the 58 tested were unable to detect androstenone at the highest concentration presented. The worst performers were given a solution of androstenone to sniff in the same method of three times a day three times daily. After a week, their detection ability had risen significantly from their previous recordings. To those participants who could not smell androstenone at the first session, the odor acquired a 'sweaty' quality to it as participants became sensitive. The control group had no change in their threshold detection of androstenone or amyl acetate over the course of the study. In the experimental group, while androstenone threshold

detection decreased, the participant's amyl acetate detection threshold remained constant. The group that was given amyl acetate also did not have any changes in their detection threshold of amyl acetate over the time of the experiment. In the electrophysiological recording done at the time of testing, the participants in the experimental groups showed results of an increase in evoked potential of olfactory epithelium as the threshold detection level decreased. The evoked potential of olfactory epithelium increases with the olfactory event related potentials until the event related potentials leveled off at around 14-16  $\mu\text{V}$ . There was no statistically significant effect of gender between the groups, however there was an increase of evoked potentials in women during the androstenone sensitization that did not reach statistical significance. The authors claim that due to low subject size, a significance would be hard to demonstrate effectively. The most interesting part of the experiment, was that androstenone seems to be the only odorant that can be induced to have the participant to become more sensitive to it as it is presented. This induced sensitivity has not been able to be extended to any other odorants in this or previous studies. This study has demonstrated for the first time the increase in the evoked potential at the olfactory epithelium, and measured peripheral plasticity in the human olfactory system.

### *Activation of Brain Areas Related to Pheromone Sensation and Perception*

Locating exactly what regions of the brain are activated by pheromone sensation can clarify exactly what these pheromones do to affect our behavior. Areas of the brain previously mentioned, were the hypothalamus and the piriform cortex. The hypothalamus is involved in the arousal of our sympathetic and parasympathetic nervous system, and specifically sexual arousal and initiating sexual behaviors. Savic et al (2003) have backed up these claims with their research of smelling sex hormones such as AND and EST. Savic et al (2003) conclusively

showed that women smelling AND activated the hypothalamus of women and that smelling EST caused men's hypothalamus to activate as well. This sex-specific hypothalamic activation suggests a potential physiological basis for a sex differentiated behavior response in humans. The piriform cortex is involved in the initial processing and perception of olfactory stimuli. Stettler and Axel (2009), showed that the piriform cortex processes the odor stimuli and then disperses throughout the other areas of the brain associated with smell. Researchers Zhou and Chen (2008) used fMRI studies to examine the right hypothalamus, which corroborates the previous findings of hypothalamic activation in the presence of human sexual sweat. Zhou and Chen (2008) also showed the activation of the right orbitofrontal cortex and also the right fusiform cortex to sexual sweat. Interestingly, Zhou and Chen (2008) showed that the response to sexual olfactory stimuli was entirely lateralized to the right side of the brain. These researchers explain that the right orbitofrontal cortex and the right fusiform are involved in the processing of human socioemotional information.

## **The Behavioral and Cognitive Aspects of Pheromone Perception**

### *Psychophysiological Effects of Pheromones*

How pheromones effect our brain regions can greatly influence our psychological state, our behaviors and our emotions. In Cutler et al's work, (1998) this study concluded that synthesized male pheromones increase in male sociosexual behavior where a woman's sexual interest and cooperation plays a role, and thusly suggests that the human male pheromones affected the sexual attractiveness of men to women, by either performing social actions that were more pleasing to the women or by intrinsically increasing their attractiveness to women by some

other means. However the male subjects were asked to report their sociosexual interactions with women during the 6-week period that they were either given the synthesized pheromone or the placebo. The categories of sexual interaction ranged from masturbation, to kissing, dates, and sexual intercourse, however the only statistically significant sociosexual categories from baseline to condition were “sexual intercourse” and the category of “sleeping next to a romantic partner” for the pheromone group compared to the placebo group. One of the only problems with this study is that the groups were not well matched between the subject groups in terms of relationship status of the subjects. The pheromone group had either a stable relationship or were married, whereas the placebo group had a much higher percentage of their subjects as single, which might skew the results as there was presumably a higher availability of romantic/sexual partner in the experimental group. However, the pheromone group showed the largest increase over baseline of sociosexual behavior, leading the researchers to believe that male pheromones the factor that were correlated with these increases.

A study by Cornwell et al( 2004) tried to elucidate the correlation between pheromone preference and attractiveness of potential mates in the context of long term relationships. This would presumably convey information about the genetic quality of potential mates through olfactory and visual information. The researchers looked at the pleasantness of a reputed set of sex pheromones (4,16-androstadien-3-one,  $5\alpha$ -andros-16-en-3-one, and 1,3,5(10), 16-estratetraen-3-ol) and also compared the facial attractiveness of faces, with the dimension of relationship context (such as length or seriousness of the relationship). Researchers found that the men correlated the pleasantness of the female pheromone (1,3,5(10),16-estratetraen-3-ol) with the highly feminized facial features that were presented with the pheromone, when judging a long-term partner. Likewise, the females found the male pheromone  $5\alpha$ -andros-16-en-3-one the

most pleasant in context of highly masculinized faces when judging long term partners. Overall the study showed that there was a general preference for the opposite sex pheromones and also a preference for highly gendered faces of the opposite gender in correlation with the pheromones presented, except for 4,16-androstadien-3-one, which showed no significant effect of preference for either men or women. The two male pheromones 4,16-androstadien-3-one and 5 $\alpha$ -andros-16-en-3-one are structurally similar, however they are found in different concentrations in the body, where 5 $\alpha$ -andros-16-en-3-one is found more abundantly in underarm secretions and semen.

Bensafi et al (2004) studied the effects of the putative sex pheromones AND and EST on mood, memory and autonomic nervous system responses, thereby trying to find if the effects of sex-pheromones are context dependent. The researchers induced different moods in subjects by having the subjects watch film segments in neutral, sexual arousing, sad, and happy contexts and introduced the pheromone smells to the subjects during these clips. During the neutral film clip, neither AND or EST elicited a response in mood or autonomic system arousal, however in arousing contexts such as the sexual arousing film segments and the sad film segments. Both AND and EST increased sexual arousal during the sexually arousing context significantly. In unpleasant contexts, such as the sad film clip, the AND exposure increased negative mood in men and impaired memory during the memory tests. In the sexually arousing contexts, AND was shown to decrease respiration in men, and increase skin temperature in both men and women. Might give clues into how AND acts as a mood modifier and how its perception affects physiology.

A follow up study by Bensafi et al (2004) dealt exclusively with AND and its affect on mood and autonomic arousal based on the concentrations that subjects were exposed to in the

study. The researchers wanted to study if there was a specific reaction to AND was similar to their previous findings (Bensafi 2004a) except it was trying to find a dose- dependent effect of behavior in humans. They found that at high concentrations of AND exposure, participants had their negative mood decreased and their positive mood increased. These results still raised questions about how AND is transduced and how exactly it produces these effects.

Lundstrom et al (2003) further investigated the modulatory effects of AND, a putative male pheromone found in the axillary sweat, skin, hair and blood plasma in males and in small concentrations, in females, therefore making AND a seemingly likely male pheromone. Previous research has shown that the effects of AND tend to be sex (and orientation) specific. In other studies, AND has been shown to make women feel more positively stimulated and had higher rating of general positive mood than did women in control situations. Even using an odor mask to cover the potential scent of the pheromone, the women exposed to AND and the mask experienced a higher rating on mood, and felt more “stimulated” than did their control counterparts (Lundstrom et al, 2003). In concordance with these studies, Jacob, et al (2001) found that under the influence of androstadienone, participants performing visual tasks had more activity in the neurological regions associated with vision, emotion and attention. From these studies, Lundstrom et al (2003) sought to study the effects of AND on women’s moods, and also investigated whether the presence of the mood effects were tied directly to the detectability of AND.

In the first experiment of the effect of AND on women’s moods, results showed only a statistical effect on one of the eight mood scale dimensions, the dimension of “focus”. Participants who were in the experimental control showed a statistically significant difference of feeling “focused” than the control group. No other effects were found in the first experiment.

In the second experiment participants were tested during their time of ovulation and were scheduled accordingly, and were tested using the same procedure as Experiment 1. However, these participants were tested twice with a month between their testing times. The results of the second experiment again showed a statistically significant difference in the level of “focus”. In the discrimination portion of the two experiments, the results showed that there were a few individuals in each experimental group who could accurately discriminate between the presentations of the experimental stimulus and the control stimulus (Experiment 1, there were two participants who could identify the AND as a sweaty, urinous smell, and in Experiment 2, there were 4 participants who could correctly identify the stimuli). However, the removal of these AND sensitive participants yielded no change on the statistical significance of the mood effects determined in Experiment 1 and 2.

These findings corroborate the findings previously on AND exposure and mood effects. The authors note that rarely the results of one study are replicated in another study in the field of putative human pheromones. This study also, interestingly, further contributes to the idea that some people are more sensitive to the odor of AND than others, which might mean, like PROP tasters in taste, there could be “Supersmellers” which are better able to detect and discern smells than others, and are genetically determined and highly variable in the population. However because the removal of the supersmeller’s data did not affect the mood ratings from their significant effect, which suggests that there are underlying, unconscious mechanisms of how AND affects mood. The mood effects were also not affected by the menstrual cycle of the participants and can directly attributed to the effect of AND.

### *Sexual Orientation and Pheromones*

Sex differentiation is an issue at the heart of pheromone research. How pheromones affect the different sexes and their behaviors or cognitions as a result describes most of the controversy around this topic. Research in these studies previously have described small effects, or even contradictory results to what was predicted. However, no effect in human pheromone research that pertains to human sexuality and arousal has more of a clear-cut set of results than does the research of Ivanka Savic, Hans Berglund, Per Lindström. In an earlier research endeavor by the aforementioned (Berglund, Lindstrom, and Savic, 2006), the researchers studied AND and EST, which are candidates for possible human pheromones, and both compounds already are reported to have effects on the autonomic nervous system, mood, and context-dependent sexual arousal. Previous studies have shown in PET scans of cerebral blood flow in heterosexual men and women that smelling AND and EST activated the anterior hypothalamus in a gender-differentiated manner. The purpose of the study was to find if the chemosensory processing of AND and EST is related to sexual orientation, and that activation in the brain will differ in response to these chemicals between heterosexual women and homosexual women. This research studied 36 subjects (heterosexual men, heterosexual women, and lesbian women). Each of the subjects smelled AND, EST and other non-pheromonal smells, rated the smells during a PET scan session, and were also measured respiratory rate of the subjects. All women were measured during their 2<sup>nd</sup> and 3<sup>rd</sup> week of their menstrual cycles. Results showed that in heterosexual women the AND was processed by the anterior hypothalamus and EST activated the olfactory regions. The heterosexual men had a reciprocal reaction than the heterosexual women. The authors conclude that the lesbian women differed from the heterosexual women as they did not show an activation of the preoptic hypothalamus with AND. Furthermore, the lesbian women shared hypothalamic cluster with heterosexual men while smelling EST. The data

suggests that lesbian women process AND and EST more congruently with heterosexual men than heterosexual women.

Savic, Berglund, and Lindstrom's (2005) study comparing homosexual men, heterosexual men and heterosexual women and their reactions to AND and EST because they are reputed to be sex pheromones in humans. Savic et al's (2005) purpose of study was to support whether the pattern of activation induced by AND and EST could be related to sexual orientation rather than to the biological sex. They compared the different activation by PET scans and measurements of hormone levels in the blood after a stimulus of AND, EST and other odors as controls in differing sexual orientations in the sexes. Found that homosexual men and heterosexual women processed AND similarly which differs from the heterosexual men (who exhibited pronounced activation in the preoptic ROI). Amygdala and piriform cortex were activated for homosexual men when smelling EST. This idea can be generalized to the claim that smelling the sexual pheromones for a preferred sex, the hypothalamus is activated, but when smelling the sex pheromones of the non-preferred sex, the piriform cortex and the amygdala are activated. Analysis showed the involvement of olfactory areas even when the hypothalamic pathway was activated. The maximal activations with AND and EST were separable and reproducible. The difference between homosexual males and the heterosexual males could reflect a genetic, variant differentiation of the anterior hypothalamus in homosexual men, resulting in the altered response pattern of reaction to AND and EST.

## **Discussion**

Pheromones have such a wide and varied impact on our daily lives without us knowing. The interactions of pheromones and our olfactory system in our sexual lives is a vast and varied web of interactions. Our anatomy, our genes and our behaviors are all governed at least partially

or subconsciously by pheromones and other factors. The way we perceive and smell and even the genders we are attracted to are governed by our perceptions of pheromones and their interactions with our central nervous system. Humans may have evolved beyond the ability of our olfactory powers, however we are still an organism that is governed by this mysterious sensation and we have yet to understand all of the possible implications of our pheromones on our sexual lives.

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