Biology home work (XIV)

班級 系 班
姓名 學號

1. 今天上課我學到了什麼?
2. 對於今天的上課內容我有什麼想法和感覺?
3. 分析一下，自己為什麼會有以上的想法和感覺?
4. 老師沒有說清楚或是應補充的建議。
5. 對指定閱讀碰到或想到的問題。
Editorial

The scent of emotion, sex, and evolution

If you search the Internet for human pheromones, you will likely be bombarded with products (scented and unscented) to attract the opposite sex. But, pheromones divulge rich secrets beyond sex...a pheromone can communicate fear, kinship, migratory paths, and even illness. The tricky thing is that the olfactory response is tied to memory and emotions causing one to react viscerally before (if ever) cognizing an odour (or pheromone).

An appropriate starting place for a discussion on pheromones is resolving the question of whether humans have the genetic and biological capacity to perceive them. Humans are part of the evolutionary lineage that derived the vomeronasal organ (VNO) for pheromone detection, but many humans lack the VNO. The VNO is a small organ located in the nasal passageway and detectable via endoscopy. Can humans detect pheromones without it? Well, fishes are an excellent evolutionary model for pheromone detection without the VNO. They regularly send and receive pheromones to avoid predators, identify male from female, and recognize kin (fish schooling, species aggregation, or migration). And, humans have olfactory receptor gene families associated with pheromone detection (V1R with 35 genes and V2R with 150 genes). Wysocki and Preti [1] suggest that the olfactory neuroepithelium (the mucosal lining inside the nasal passageways in which the olfactory sensory neurons lie) has taken on the task of the VNO in humans. Indeed, a recent study that combined functional Magnetic Resonance Imaging1 and olfactory psychophysics2 to test subjects with and without the VNO (detected using endoscopy) for pheromonal responses. The results confirmed that the VNO is not required for successful pheromone detection [2]. Perhaps humans are as creative with the sense of smell as our primate order was with our sense of sight – in both cases, we are returning to an earlier evolutionary ‘setting’: with sight, we are recapturing a richer color vision from our reptile heritage and with smell, we are recapturing the simpler physiology for pheromone detection from our fish heritage.

So, what are pheromones? A conservative definition is same-species chemical signaling of mutually beneficial information on the state of one individual to another. A less rigorous definition is evocative chemical signaling from one organism to another within or between/among species [1]. The simpler definition suggests that humans use all four types of pheromones (primer, signaler, modulator, and releaser).

The slowly released primer pheromones signal endocrine and reproductive states. The endocrine system is a major highway of chemical signaling (mainly hormonal) in the body between the brain and organs and is highly active during growth and development (particularly puberty when growth is 50% driven by hormones). Indirect examples of primer pheromones in humans include co-habitating women synchronizing menstrual cycles to a driver female, lactating women showing increased variation in menstrual cycling, and male hormones increasing sexual receptivity in females [1]. In other species, primers have been shown to influence ovulation timing – this has been anecdotally reported in ethnographic literature.

Signaler pheromones, often associated with the immune system, elicit a response or communicate information. Linked to certain olfactory receptor genes, the major histocompatibility complex (MHC) plays a major role in inter-individual variation in natural body odour [3]. At the base level, the scent of the MHC might aid in identification of the opposite sex. At the most evolutionarily meaningful level, the scent of the MHC might signal potential reproductive fitness: the more diverse the immune system of the parents, the greater the odds that the offspring survives and reproduces. This odour print allows kin and biological sex recognition (primarily between mother and child), social rank (e.g., dominance), mating compatibility for increased reproductive success, and possibly sexual orientation [1]. Modulator pheromones alter mood and emotional state (reviewed in [1]). Reminiscent of alarm signals used by fishes, humans watching a scary film appear to have emitted a chemical signal that led to increased anxiety in the next group of experimental subjects watching a comedy film in the same room. Another example is the effect of androstenedione (a steroid) on females. Males secrete greater concentrations of androstenedione in their sweat than females and tend to be less sensitive to it. Experimental responses in females to androstenedione are increased focus and feeling relaxed [1].

Releaser pheromones elicit immediate behavioral reactions. They are often associated with sexual attraction but the strongest evidence of releaser pheromones in humans is that of an infant to the mother’s milk/breast odour [4]. Since mother’s milk contains immunoglobulins (among other things), this suggests a possible relationship to the MHC as well.

So far, all the purported human pheromones exhibit a central theme of sex and reproduction. This has interesting implications for people suffering from damage to the olfactory epithelium (from cosmetic rhinoplasty, pollution, nasal polyps, allergies, or even a common cold). Will they be socially and sexually impeded by the inability to perceive pheromones?

Surely, there is more to life than sex though! Humans are long-lived social animals and a rare example of a species living beyond reproductive capacity (like pilot whales and elephants). Thus, the probability for human pheromones conveying more information than reproductive status is high. So, what human pheromones might exist but have yet to be described? Gilbert [5] informally

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1 MRI is a recently developed radiological technique that measures changes in blood flow related to neural activity in the brain and/or spinal cord.

2 A method in psychology for studying the relationship a stimulus and it’s sensation (detection, experience of sensation, perception, behavior, etc.).
Posited that humans emit social chemical signals that fly under the radar of perception but provoke behavioral responses, such as someone seeming quite normal but making others inexplicably uncomfortable. Is that person that everyone avoids sending some pheromonal cue of mental illness? Is that smell of cancer detectable by dogs and electronic noses signaling a warning of ill health to others? Are all the anecdotes of nurses identifying disease from smell and psychologists smelling schizophrenia just funny stories? I think not. The probability that humans are unconsciously responding either physiologically or behaviorally to chemical signals is high. We would do well to listen to our noses!

Provenance and peer review

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References


Kara C. Hoover*
310 Eielson Building, POB 757720, Fairbanks, AK 99709, United States

* Tel.: +1 907 474 6110; fax: +1 907 474 7453.
E-mail address: kara.hoover@alaska.edu

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