

A Nose for News--Equine Sense of Smell

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A mare lies in the straw, devotedly licking dry her newborn foal. As she does so, she breathes deeply of the baby's scent, memorizing it so that ever after she can identify the foal as hers out of the herd.

A young gelding being turned out with a group for the first time trots optimistically towards his new pasturemates. Out of the herd swaggers the "alpha male" of the gelding group, neck arched and ears flicking back and forth. He meets the newcomer nostril to nostril, and both breathe deeply of the other's scent. After several seconds of breathe-snuffling, the pair shift to sniff each other's flanks, then under the tail. A couple of squeals ensue from the contact, then, introductions having been made, the alpha gelding accepts the new horse as a submissive youngster who won't be a threat to his position, and the youngster immediately acknowledges the elder as his new leader. With the pecking order thus established, peace reigns in the herd.

A group of feral horses grazes in a valley, enjoying the late summer sun on their backs. Some 50 yards away from the herd, even the stallion seems relaxed, until he suddenly flings up his head. Nostrils flaring, he's instantly on full alert, although his eyes can't perceive any visible threat. The faint predatorial scent of a cougar has registered in his olfactory sensors, and it's time to get his herd moving away from the danger.

All of these daily scenarios, and dozens more, show us that much of the information horses receive about their world is gained through their sense of smell. We humans, with our own feeble olfactory abilities, can hardly appreciate the extraordinary sensitivity and range of the equine nose, or the dozens of ways in which horses use their sense of smell to identify friends, seek sexual relationships, recognize territory, find appetizing meals, and sense danger. While we are vision-oriented, like most predators, horses rely far more on chemical messages in the air than on their relatively indistinct and largely monocular eyesight. Scent recognition plays such a large role in relationships that orphan foals are more readily accepted by nurse mares when they're rubbed with the sweat or manure of their new adopted dams, or draped with the skin of the mare's own dead foal. It's even suspected that the famous ability horses have to find their way home from unfamiliar territory stems largely from their talent for retracing their steps by sniffing out their own footprints and manure markers along the trail.

When you confound a horse's sense of smell, his social interactions are radically altered. For example, foals whose nostrils have been coated with something pungent, such as Vick's VapoRub, have difficulty recognizing their dams, often going to the wrong mare. (Handlers sometimes use this technique deliberately when unfamiliar horses are forced into close proximity, such as in a shipping van. A strong-smelling substance smeared on the nostrils temporarily cuts down on squabbles.)

According to David Whitaker, PhD, of Middle Tennessee State University, "Horses depend on their sense of smell the way we depend on language."

It's generally agreed that dogs are the domestic animals with the most sensitive noses, but horses aren't far behind. As prey animals, it behooves them to be able to detect even the slightest scent of danger on the wind. They're also quick to detect the "smell of fear" in other animals and in humans (probably an emanation of chemical signals we cannot detect). Many trainers over the centuries have agreed that horses also seem to be able to recognize the smell of death, sometimes reacting suspiciously to a spot where another horse has died, sometimes for months or years after the animal perished.

Perhaps because our own olfactory abilities are so limited, we have found it very difficult to study the intricacies of the horse's sense of smell. As equine behaviorist Bonnie Beaver, PhD, of Texas A&M

University notes, "Olfaction is difficult to study because humans have such a poor sense of smell and do not appreciate all the complications that can occur during such research."

Like asking a blind person to analyze a thousand different hues of color, appreciating the subtle and amazing scents that register in a horse's internal catalogue is likely forever impossible for us. As a result, there's much we don't understand about the actual range and acuity of a horse's sense of smell. But here's a little of what we do know.

Nasal Anatomy

What prodigious nostrils a horse has, like Red Riding Hood's wolf--all the better to smell you with. And beyond those nostrils-- which can flare to draw in more scents--lie long and cavernous nasal passages that facilitate the intake of large quantities of air during exercise, as well as all the chemical messages in the air (see page 84). The horse's olfactory receptors--millions of elongated nerve cells that are specialized to analyze smells--are located in the mucous membranes in the upper portion of the nasal cavity. When airborne odor molecules come into contact with the lipid and protein material of the mucous membranes, they interact with the microscopic tufts of hair protruding from the receptor cells. By sniffing, the horse can intensify the currents of air in the nasal passages, providing more contact between the odor molecules and the receptor cells and more time for analysis.

The olfactory cells send out two branches, one that extends over the surface of the olfactory mucosa and another that acts as a direct pipeline to the brain. The twin olfactory bulbs, distinct areas of the brain which are responsible for identifying scents, are located at the very front of the cerebrum--one on each lobe--and are connected via the main olfactory nerves to the receptors in the nasal passages. Interestingly, the olfactory bulbs are one of the only brain structures that do not cross over; the receptors in the left nostril are directly connected with the left olfactory bulb, and the right with the right.

The whole arrangement sounds fairly simple, but it's only half of the story. For as it turns out, horses really have two olfactory systems.

Olfactory Accessories

There's a second pair of olfactory organs lurking under the floor of the horse's nasal cavity--the vomeronasal organs (sometimes called Jacobson's organs, after the Danish anatomist Ludvig Jacobson who first described them in 1813). Almost all animals are equipped with vomeronasal organs (abbreviated VNO); in fact, humans and cetacean sea mammals (whales and dolphins) are among the few species which seem to be deprived. The structure and function of the VNO have been extensively studied in reptiles and rodents, so although there has been little research that's equine-specific, there's quite a bit we can extrapolate about the organ.

We do know that the VNOs in horses are tubular and cartilaginous, and are about 12 centimeters long. (Despite their size, they're so carefully concealed that it's little wonder anatomists before Jacobson completely missed them.) They're lined with mucous membranes; they contain more sensory fibers of the olfactory nerve; and they're connected to the main nasal passages by a duct called the nasopalatine duct. (In some animals, the nasopalatine duct also makes a connection with the mouth, making it possible for scents to be drawn in through more than one entrance, but in horses, which aren't mouth breathers, the VNOs communicate only with the nasal passages.) The VNOs seem to expand and contract like a pump with stimulation from strong odors, and they have their own pathways to the brain, functioning almost as completely separate sensory organs.

Why do horses have two olfactory centers?

The VNOs have a separate job description from the "main" olfactory apparatus. The VNOs' main purpose is the detection and analysis of pheromones, the chemical signals emanating from other horses (and, on occasion, from humans). And the main purpose of pheromones is to indicate an animal's sexual status. In a way, then, the VNO is really a sex organ, helping stallions to identify when a mare is in heat and receptive to breeding, when she is out of season and likely to reject his advances, and when there might be a rival stallion in the area ready to steal his mares.

In some species, horses included, stimulation of the VNOs has a profound influence on the animal's endocrine system. Depending on the message the pheromones bear, a creature might significantly adjust its reproductive behavior. In bees, for example, pheromones exuded by the queen will stall the sexual development of all of the surrounding female bees. Pheromones from male mice can promote the sexual maturation of young female mice, or even induce abortion (presumably as a form of genetic competitiveness with other breeding males).

No Laughing Matter

Most of us, at one time or another, have witnessed a horse tilt up his head and curl his upper lip in a "horse laugh." Although the expression is amusing, it actually has a practical purpose. The posture is called "flehmen" (roughly translated, it means "testing"), and it appears to help horses trap pheromone scents in the VNOs so they can be analyzed more closely. After a horse draws in the organic odor (by several seconds of olfactory investigation), he curls his lip up to temporarily close the nasal passages and hold the particles inside. Then an upward head tilt seems to help the airborne molecules linger in the VNOs. A horse performing a flehmen is giving you an outward demonstration of a stimulated vomeronasal organ.

Flehmen is not a uniquely equine behavior. Many ungulates (hooved mammals) exhibit very close variations of the same lip curl--cattle, deer, sheep, antelope, and goats, just to name a few. And it's not even exclusively a behavior of herbivores; many species of cats also flehmen.

Stallions are, by far, the most enthusiastic equine practitioners of the flehmen posture. In the presence of a mare in estrus, for example, they might flehmen several times an hour. Mares also will flehmen, although not as frequently; the smell of birthing fluids on a newborn foal often triggers the response.

Geldings seem to flehmen the least. In fact, it's theorized that the process of gelding seems to compromise a male's ability to detect and analyze pheromones, making him sexually ineffectual in more ways than one.

But while sex pheromones are definitely the most likely flehmen trigger, they're not the only ones. Occasionally, horses also will react with an upper lip curl when they come in contact with an unusually strange or pungent inorganic odor--smoke from a fire or fresh paint, for example.

We know that pheromones are present not only on horses themselves, but also on their bodily fluids and their manure. Like many animals, horses use droppings and urine to help advertise their sexual status and to mark their sexual territories. For example, a stallion will create a "stud pile"--successive passings of manure carefully piled one upon the other--to serve notice to other stallions that this is his turf.

Mares in estrus will pass small amounts of urine several times an hour. Its pungent odor is a red flag to every sexually active male in the area (not to mention the occasional gelding!).

Interestingly, studies in which stallions were presented with urine, manure, or vaginal swabs from mares both in estrus and out of estrus indicated that most of the time, the stallions didn't flehmen any more frequently for the samples from mares in heat. In other words, they were unable to detect which mares were in estrus by scent alone. This means visual and vocal cues probably also play a role in courtship. However, it's been noted that stallions in the presence of mares in estrus flehmen several more times an hour than stallions in the presence of pregnant mares. That's probably because mares in estrus urinate much more frequently, triggering the flehmen response. Flehmen doesn't always lead to mating, although its incidence certainly rises as mares become more receptive.

There's still much we don't understand about the way pheromones are secreted and the way in which they influence behavior, but one thing is for sure--the equine nose knows when they're there.

A horse's olfactory systems never rest. He is analyzing smells every second of the day--barn smells and herd smells, water smells, plant smells, and the smells of the humans, dogs, and cats that enter his environment every day. In a domestic setup, a horse's olfactory senses might be overwhelmed with artificial odors like liniments, fly sprays, and deworming drugs, a situation that Whitaker thinks "may

warp our horse's sense of smell and change the emphasis on his senses.

"I think feral horses likely have a less confused, if not keener, sense of smell," he adds. "They have fewer scents to sort out."

Nonetheless, a domestic horse's sense of smell is still a marvel, capable of identifying his owner at 100 paces; helping to bring him (and you) home from the woods even when the trail has disappeared; and alerting him to the presence of yucky medications in his sweet feed even though you've doctored them with applesauce and molasses. A bloodhound he might not be, but he's still privy to a whole world of olfactory "colors" we can only imagine.

**Readers are cautioned to seek the advice of a qualified veterinarian
before proceeding with any diagnosis, treatment, or therapy.**



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