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Communication

The position of the ears and tail, as well as the overall posture, are most indicative of the animal's immediate intentions. Flehmen (tonguing and gaping in carnivores) and the vomeronasal organ function in sexual behavior are discussed. Animals have the ability to recognize members of their own and other species.

Introduction

Communicating with animals, in particular learning to understand the messages the animal is sending, is a most important part of diagnosis. Communication is a vital part of animal husbandry and the art of veterinary medicine and a very useful adjunct to the science of veterinary medicine. Before ordering a complete blood count and liver function tests, the astute clinician already will know that a dog is suffering from abdominal pain because it assumes an abnormal posture with rump high and head low, or that a horse that paces in its stall and kicks at its belly is suffering from colic.

Another important aspect of communication between veterinarian and patient or between handler and stock is assessment of an animal's emotional state or temperament. Adequate restraint or, preferably, a quiet, tractable patient is necessary for thorough

examination and diagnosis. Most practitioners learn eventually to recognize animals that will be aggressive or fearful and, therefore, require tranquilization, muzzling, or more stringent methods. It would be helpful for agriculture and veterinary students to learn in advance how to recognize animals' moods. Learning by experience to recognize behavior problems may occur at the expense of a badly bitten hand or kicked leg. For their own safety, as well as for accuracy of diagnosis, clinicians should learn to listen to and watch for the messages their patients are transmitting both to them and to each other. Farmers can prevent injury to themselves and to their stock if they can interpret the animals' messages.

Animals communicate not only by auditory signals, as humans do, but also by visual and olfactory signals. Many olfactory messages cannot be detected by humans, although male odors, such as those contained in the urine of tomcats and the very flesh of boars and billy goats, are quite discernible to humans. Goats and cattle can distinguish conspecifics by means of urine. Male urine is more easily distinguished than is female urine.¹³⁸ We are all aware of vocal communication by animals, but many of these calls remain to be decoded. It is the visual signals made by ear, tail, mouth, and general posture that are of most benefit in gauging the temperament and the health of the patient.

Perception

Vision

Acuity

Communication in animals depends on their ability to perceive messages. The sensory abilities of domestic animals, with the exception of dogs and cats, have not been studied systematically. The perception of animals is almost always compared with that of humans. Dogs and cats have a higher critical flicker fusion (point at which a flickering light appears to be fused, or a steady light) than humans, which means that dogs and cats can see television, but in some cases the image may appear jerky to them.⁴³⁸

Cats respond to television, especially rapidly moving animations (mice, birds, or inanimate objects such as balls), and will spend 6% of their time watching the screen.⁶³⁴ Cats can discriminate illumination at one-fifth the threshold of humans, but their resolving power is only one-tenth that of humans.⁶⁵⁸ Cross-eyed Siamese cats do not have stereoscopic vision; other cats do.¹⁷⁵⁰ Environmental conditions affect visual acuity. Free-ranging cats have been shown to be hypermetropic, whereas caged cats are myopic.²²⁵ The visual acuity of cattle, measured by using a closed or partially opened circle at various distances from the cow, is inferior to that of humans.⁶³⁹ Bulls have fairly poor vision; they are able to discriminate a 36 cm solid black disc from a similar disk with a white center if the center is 1 cm or larger and the bull is within 1.5 m.¹⁹¹⁶ This indicates a visual acuity of only 23 degrees, similar to the horse (23 degrees) or the dog (10 degrees).¹⁵⁸⁸ The visual acuity of sheep is between 11.7 and 14.0 cycles/degree.

In some studies, pigs have been found to have poorer visual acuity than cattle – a hundredth or a thousandth of a human's. In the Snellen system, humans have 20/20 acuity, whereas horses have 20/30, dogs have 20/85, and cattle and pigs 20/200 acuity.²⁵²¹ This means that what a person could see from 200 feet a bull would have to be within

20 feet to see. Cattle can discriminate objects at 2 lux of illumination. Cattle are also poorer in brightness discrimination compared to humans. They have a brightness discrimination threshold of 66 lux in bright light and 4.8 lux in dim light, whereas humans have discrimination thresholds of 105 and 4.2 lux.¹⁸¹⁰ Horses can see in dimmer conditions than humans; they can make visual discrimination at a level of light equivalent to the illumination in a dense forest on a moonless night.⁸⁹⁹ They can discriminate a difference of 14% in circle size, which is worse performance than humans. They use length rather than area to discriminate size. They pay more attention to local components than to global shapes, in contrast to humans.²²⁷³

Within-Species Recognition

Sheep can recognize faces of other sheep and differentiate them on the basis of photographs. They can remember at least 25 different sheep faces for more than a year. Goats can discriminate familiar from strange goats, even if their horns are not visible.¹¹⁸⁹

Cattle can discriminate a photo of a cow from that of other ruminant species.⁴⁶⁰ They can recognize familiar cattle and learn to recognize unfamiliar ones, but have more difficulty learning to differentiate cattle of different coat patterns, especially all white cattle.⁴⁶¹ When presented with photographs of cow heads, they are more likely to explore and lick the images of familiar cattle than unfamiliar ones, and they never lick a photograph of a pony. Heifers rewarded for choosing images of unfamiliar conspecifics pointed their ears backward more frequently (indicating confrontation with unfamiliar stimuli).⁴⁶¹ In contrast, pigs do not appear able to discriminate between photographs of other pigs.⁸¹⁹

We do not use one sense alone to identify individuals, and neither do animals. We recognize people by their voice and their appearance. Horses are also able to match the neigh of another horse with its picture.^{1865,1866} Dogs can be taught to differentiate dogs of various breeds from other animals.¹¹⁴

Cross-Species Recognition

An important question is, “Can an animal tell the difference between different people?” The answer is definitely yes. Areas that respond to human or dog faces, in particular the temporal cortex in the brain, have been located in dogs, pigs, and sheep.^{488,1196}

Pigs can tell people apart, even if olfactory cues are masked, on the basis of visual cues such as height and facial appearance. They can even distinguish humans apart in dim (20 lux) light.¹²⁴² They can recognize familiar people and base their behavior on how that human treated them. Piglets will approach a stationary human even if that human has scared them, but will try to escape if that person or an unfamiliar person approaches them.

Cattle recognize people by their faces or the color of their coveralls, and use height to discriminate between people.^{1646,2012} Sheep are able to recognize human faces, but a photograph of a familiar stock person is not as effective as the stock person himself in calming an isolated lamb.²²²⁵

Dogs associate their owner’s voice with their face, and when a strange voice is played while the owner’s picture is displayed the dogs gaze longer, indicating that there is a mismatch. A dog can match a female voice by looking at a woman, but only if the dog lives with more than one person of each sex.¹⁹⁰⁴ They cannot distinguish the smiling face from a blank face of a stranger of the opposite sex from the owner.¹⁶⁶² They will look at their owners more often if they are retreating from a stranger. They will look sooner at a stranger, but are slower to approach.⁵⁹⁹ Dogs will gaze at photographs of humans and dogs interacting. They gaze longer at humans than at dogs, whereas people gaze more at dogs than at people. Both species gaze more at images in which the two subjects (human or dog) interact. Dogs will whine or whimper more often if their owners gaze at them, but are no more likely to approach or paw at them.¹⁷³⁰ They will approach their owner or even strangers when they cry.⁴⁹⁴ When approached by a

stranger in a threatening manner, dogs will avoid or threaten, but not if the stranger approaches in a playful manner. The owner is approached in a playful manner even when threatening.⁸⁷⁶

Canine domestication took place tens of thousands of years ago, and over the course of those centuries the two species have evolved a close relationship. Oxytocin is a neurohormone involved in mother and offspring bonding as well as the physiological effects of milk letdown and uterine contraction. When a dog gazes into the eyes of its owner, the human releases oxytocin and is more affiliative to the dog that in turn releases oxytocin. Both dog and owner release oxytocin in a positive feedback loop.¹⁶⁶³ Oxytocin does not always increase affiliative behavior. When owners approached their own dogs in a threatening manner, the dogs reacted more aggressively after oxytocin treatment.¹⁰⁰⁰

Whether dogs yawn empathetically when humans yawn is controversial. If someone yawns for five minutes with auditory as well as visual stimuli, dogs will also yawn, but if a person yawns without sound for three minutes the dogs do not yawn.^{1156,1729}

Cats show more positive behaviors (e.g., ears forward and relaxed body posture) when their owner exhibits a positive (smiling) rather than negative (angry) facial expression, but showed no significant difference when voices exhibited the same emotions.⁷⁸⁴ Cats recognize their owner’s voice in that they discriminate between strangers’ voices and the owner’s.²⁰¹⁵

Horses can learn to recognize human faces and are able to discriminate members of a pair of identical twins. They can transfer recognition from a two-dimensional photograph to a real person.¹⁰⁴¹ They can match the appearance and smell of a familiar person with his or her voice.¹²⁹⁹

All people don’t look the same to sheep, cattle, dogs, horses, or pigs, and probably this is true of most domestic animals. Therefore, the animals can remember who has treated them well or painfully.¹⁶⁴⁷

Color Vision

A question often put to a behaviorist is whether animals have color vision. All species of domestic animals have been shown to possess color vision in that they will make discriminations based on color, but color probably is not as relevant to these animals as it is to birds, fish, and primates. For example, teaching cats to discriminate between colors is very difficult, although they learn other visual discriminations with ease and have two types of cones that absorb green and blue. Nevertheless, cats,^{1936,2074} dogs,¹⁶⁸² horses,⁸⁶⁶ cattle,^{496,822} pigs,^{1237,1681} goats,³⁵² and sheep¹⁶⁴⁵ can all make discriminations based on color alone. Color vision in domestic animals is not identical to that in humans. In the most carefully conducted studies, dogs appear to see the world not in shades of gray but rather in shades of violet, blue, and yellow. Their vision is similar to that of color-blind or dichromat humans, who see the green traffic light as pale yellow, the yellow as yellow, and the red as dark yellow.

Ruminants can discriminate medium and long wavelengths (yellow, orange, and red) better than they can short wavelengths (violet, blue, and green). Cattle can discriminate red from blue and green but have difficulty discriminating green from blue. Animals can not only perceive colors but also be influenced behaviorally by color. For example, calves are more active in red light and less startled by loud noises in green light.¹⁸¹³ Bulls, indeed, can perceive the matador's red cape.¹⁹³⁸ Horses can discriminate red from blue, but some horses have difficulty distinguishing green or blue green (wavelength 480 nm) from gray.^{391,1438,1818,2144} Color may be a more important feature of the equine environment than previously thought because horses do not habituate to objects of different colors and shapes, but do habituate if all the objects are the same color. Apparently, one blue blob is similar enough to another blob that the horse realizes it is not a threat.⁴²³ Some colors – blue, black, white, and yellow – cause more reaction when the horse encounters them on the ground than others – brown, green, red, and gray.⁸⁸⁷

Monocular and Binocular Vision

Eye placement in the skull also affects vision. Horses have eyes set quite laterally and can, therefore, see to the side and far to the rear. They cannot see well right in front of their heads. Lateral vision is necessarily monocular, and horses see binocularly only in the 70° directly in front of the head. They can see objects at 132° to the side.⁹⁰⁰ Contrary to many popular and scientific sources, horses do not have a ramped or slanted retina; the retina is similar to that of other animals.²¹³⁴ Figure 1.1 illustrates the field of vision of the horse. The binocular overlap (areas where the horse is viewing objects with both eyes simultaneously) is down the nose and not straight ahead.

Horses can see clearly with their heads lowered, contrary to popular belief.¹⁷⁶ They do so by adjusting their eyeball to a horizontal position. When the horse lowers its head, the binocular field is directed toward the ground for grazing and the monocular fields are in position to scan the lateral horizon.

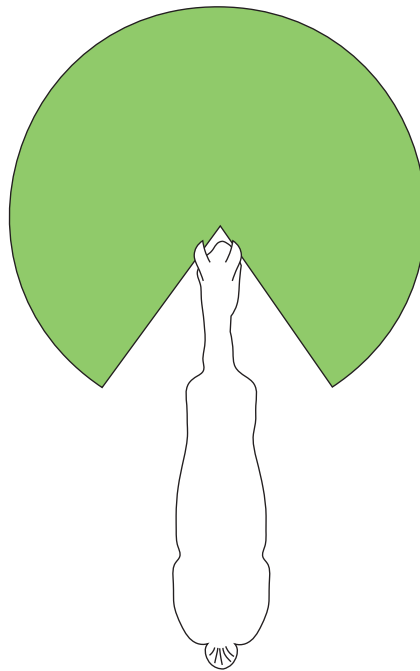


Figure 1.1 Field of vision of the horse. Source: Courtesy of Charles E. Houpt.

When the head is raised with the nose pointing forward, the horse uses the binocular field (both eyes) to scan the horizon, and the monocular (single eye) lateral vision becomes limited.⁹¹⁵

Cattle are capable of depth perception and have a fear of heights that can be demonstrated when they are first exposed to a milking pit.⁹⁶

Audition

Acuity

In hearing, as in vision, cats and dogs appear to perceive more than humans. Humans can hear 8.5 octaves; cats can hear 10. Cats have 40,000 cochlear fibers and humans have 30,000, although the range of hearing in cats is only 1.5 octaves greater than that of humans because higher frequency detection requires a disproportionate increase in cochlear nerve fibers; the number of fibers needed per octave is not constant but, rather, rises with the rise in frequency.¹⁹⁶⁵ Cats, despite their mobile pinnae, can discriminate between sounds 5° apart, whereas humans can discriminate sounds 0.5° apart. The pinnae significantly lower the auditory threshold in the cat. The absolute upper limit of hearing in cats is 60 to 65 kHz (kilohertz = kilocycles per second) and 45 kHz in dogs.⁹⁶⁵ Dogs and cats can discriminate one-eighth to one-tenth tones.^{658,1678} Sheep also appear to perceive higher frequencies than do humans.⁵³ The auditory acuity of dogs has been used in silent dog whistles and ultrasonic (but not to the dog) distracting devices.³⁷⁹ Dogs and adult cats are not known to produce ultrasonic calls, but rodents do make ultrasonic noises⁴⁷ that the carnivores use to locate them.

Practical Application

The importance of hearing to cattle is indicated by the fact that they will avoid the side of a maze where milking facility noises are played.⁹⁷ Dogs are quieter when classical music is played but more reactive when heavy metal is played.²⁴¹⁷

Olfaction

Acuity

Olfaction is to animals what writing is to humans – a message that can be transmitted in the absence of the sender. The sender must be present for auditory or visual signals to be sent, but an odor persists for minutes (or days) after the sender has gone. Olfactory acuity is probably the most important sense of domestic animal species because individual odor recognition and pheromonal release are important parts of their communication. There are breed differences in the number of olfactory receptors: Bloodhounds have 300 million receptors, and Dachshunds 125 million. Dogs can detect aliphatic acids at one-hundredth the concentration detectable by humans;¹⁶³⁸ the lowest concentration of amyl acetate that dogs can detect is 2 parts per thousand.²³⁷⁵ They can distinguish between the odors of identical twins¹¹⁶⁶ and detect the odors of fingerprints six weeks after the fingerprints were placed on glass.¹²²⁶ Dogs frequently are trained to sniff out drugs and natural gas leaks, and Bloodhounds have been used for centuries to track people; apparently, no modern invention is as reliable as the canine olfactory mucosa. However, when thermally stressed or physically tired, their rate of detecting explosives falls from 91 to 81%.⁸⁰⁴ They also have difficulty detecting an explosive in a mixture of odors following training on the pure explosive.²⁵⁸³ When administering drugs to odor-detecting dogs or those used in tracking, care must be taken by the veterinarian because a combination of corticosteroids can interfere with olfactory discrimination.⁶⁵⁹

Dogs can be trained to match a human scent from one part of the body, for example the hands, with another part such as the elbows, but it appears to be a difficult concept for them to grasp. This is probably because they can easily discriminate odors from different body parts.^{335,2089} The same dog can learn to detect at least ten different odors.²⁴⁵⁸ Dogs can be trained to detect cadavers and live scent. Dogs trained to do

both are less accurate – more distracted by cadaver odor when commanded to find a live human scent.¹⁴⁰¹ Dogs appear to be able to detect cancer in the exhaled breath of lung and breast cancer patients, but are poor in detection of cancer in urine samples from breast or prostatic cancer patients.¹⁶³⁶

Pheromones, chemicals secreted by one animal that affect the behavior of another animal of the same species, have been identified in the intermammary area of lactating sows, bitches, mares, and doe goats as well as the cheek glands of cats,¹⁷⁵³ and these may be of value in reducing aggression and fear and encouraging feeding. The use of synthetic versions of these pheromones and that of the feline cheek glands is discussed under the appropriate species.

The vomeronasal organ lies between the hard palate and the nasal cavity in all species except humans. It is a paired tubular organ into which nonvolatile material can be aspirated. Receptor neurons in the lining of the organ detect pheromones and send information more directly to the hypothalamus than neurons in the main olfactory system. In ruminants and horses, flehmen or lip curl accomplishes this by closing the nostril while the animal breathes deeply. Cats gape and dogs tongue, using their tongue to move material into the opening of the incisive ducts that open into the vomeronasal organ. Each neuron expresses only one pheromonal receptor gene. In mice, the vomeronasal organ allows recognition of sex. Individuals are recognized by combinatorial activation of neurons.⁹⁵⁸ Domestic animals are not as dependent as rodents on the vomeronasal organ for reproduction, but it still plays a role as will be discussed for each species.

Horses

Vocalizations

Neigh

The neigh (or whinny) is a greeting or separation call that appears to be important in

maintaining herd cohesion. It is most often heard when adult horses or a mare and foal are separated.²⁴⁸⁴ Stallion neighs contain lower frequencies than those of mares or geldings. Horses appear able to discriminate between familiar and unfamiliar horses on the basis of their neighs alone.¹³³⁹

A separated mare and foal will neigh repeatedly. These neighs appear to be nonspecific distress calls, which the mare, but not the foal, may recognize individually.²⁴⁸³ The neighs of a mare separated from her foal can be distinguished from those anticipating feeding by analysis of their spectral frequencies.¹⁸³⁷

Nicker

The nicker, a low-volume call, is a care-giving (epimeletic) or care-soliciting (et-epimeletic) call. It is given by a mare to her foal upon reunion and probably is recognized specifically by each.²³⁰⁰ A horse may also nicker to its caretaker and a stallion to a mare in estrus.

Snorts, Squeals, and Roars

Nickers or neighs usually elicit a reply; other equine vocalizations, such as snorts, squeals, and roars, do not. The roar is a high-amplitude vocalization of a stallion and is usually directed to a mare. A sharp snort is an alarm call. More prolonged snorting or sneezing snorts appear to be a frustration call given when horses are restrained from galloping or forced to work. Snorts and nickers are sounds from the nostrils. The mouth is closed. Other calls are given with the mouth open.

When two strange horses meet, or when horses have been separated for some time, they greet each other by putting their muzzles together nostril to nostril (Figure 1.2). The nostrils are flared, but if any vocal signals are given, they are inaudible to humans. Usually one, the other, or occasionally both of the horses will squeal and strike or jump back, although neither has been bitten or threatened. The squeal is, therefore, a defensive greeting. It is heard frequently when horses are forming a dominance hierarchy and many bites are being exchanged. Mares that are not in estrus squeal and strike when a stallion

Figure 1.2 Greeting. Nostril-to-nostril investigation, in this case by a horse and pony.

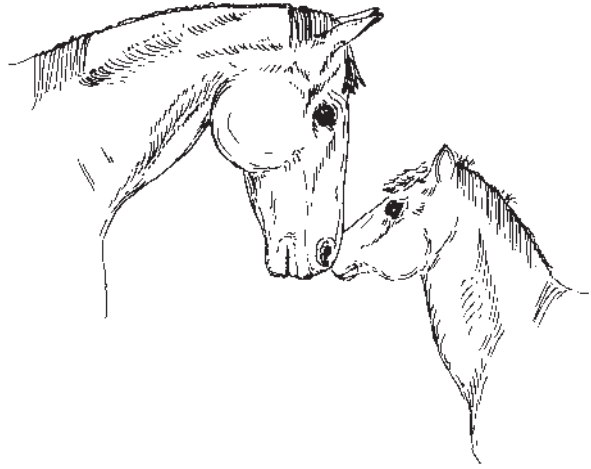


Figure 1.3 The aggressive and submissive postures of horses. The ears of the aggressive horse on the right are back, while those of the submissive horse on the left are pointed sideways.

approaches too closely. A squeal may also be a response to the sudden onset of pain.

Visual Signals

Expression

The horse's ears are probably the best indicator of its emotions. The alert horse looks directly at the object of interest and holds its ears forward. Ears pointed back indicate

aggression, and the flatter the ears are against the head, the more aggressive the horse.²²⁹¹ The submissive horse holds its ears to the side (Figure 1.3).

Other facial expressions of the horse are subtler; nevertheless, they can be used profitably to understand a horse's mood. A submissive horse turns its ears outward. Young horses (less than three years old) have a more dramatic display, snapping, also called

champing or tooth-clapping, in which the lips are retracted, exposing the teeth that are sometimes clicked together (Figure 6.10). This expression is shown by a yearling colt to an approaching stallion or toward an adult that is threatening him. The sexually receptive mare shows a unique expression, the mating face, in which her ears are swiveled back and her lips hang loose (Figure 1.4). She

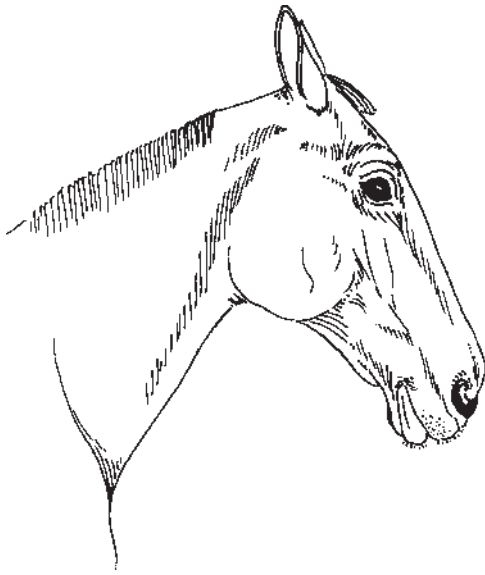


Figure 1.4 The mating expression of the mare.
Source: Houpt (1977).¹⁰⁴²

may also exhibit snapping. The flehmen response, or curled upper lip, of the courting stallion is discussed further in this chapter. A horse that sees but cannot reach food, or is anticipating food, makes chewing movements and sticks out its tongue (Figure 1.5). This may be a submissive signal, indicating that the horse is ambivalent and reluctant but motivated to approach.

More difficult to identify is the horse in pain. It is important for veterinarians and horse owners to recognize when the horse is in pain: the pain grimace in horses is characterized by ears laid stiffly back, orbital tightening, tension above the eye area, prominent strained jaw muscles, strained mouth and nostrils, pronounced chin, and flattening of the profile (Figure 1.6).⁴⁹⁹ Before a horse is in such pain with colic that it kicks at its belly, it will repeatedly swivel its ears back as if attending to its abdomen.

The various facial and postural expressions of horses have been illustrated by McDonnell.¹⁵⁰⁵ A very detailed description of equine facial expression has been made.²³⁹³ Horses tend to position their ears in the same direction in which they are looking. Thus, when the horse's ears are pointed straight ahead, it is looking straight ahead. This can be a clue that the horse is about to shy at an object. Usually, the rider can identify the



Figure 1.5 The food-anticipating expression of the horse.



Figure 1.6 The horse grimace scale. *Source:* Dalla Costa, <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0092281>. Used under CC BY 4.0 <https://creativecommons.org/licenses/by/4.0/>.

frightening object by looking where the horse's ears are pointing. The horse can then be coaxed to investigate and conquer its fear of the object. When the horse turns its ears to the side and back, it is looking to the side. There are signs of conflict in horses, in this

case conflict between what the rider wants and what the horse wants. Jumping horses will pull the reins from the rider's hands, and dressage horses lash their tails.

Horses are aware of other horses' facial expressions, so they will approach a feed

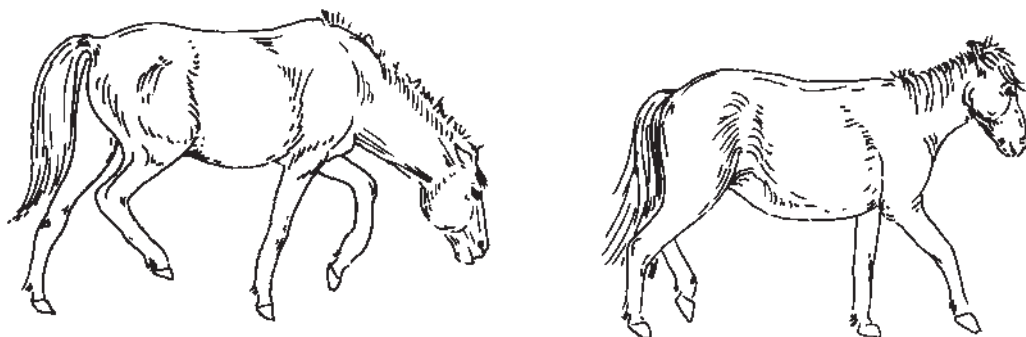


Figure 1.7 Driving posture of the horse. The stallion, left, drives a mare. This behavior is also called snaking, herding, or driving (rounding).

bucket toward which a photographic image of a horse is looking or pointing its ears toward the bucket.²³⁹²

Posture

The posture and bodily actions of the horse are also useful in interpreting its moods. The relaxed horse stands quietly, whereas its nervous counterpart prances and chafes at the least restraint. The aggressive horse, when threatening to kick, lashes its tail and may even lift one of its hind legs. The frightened horse tucks its tail tightly against its rump and stands with its feet close together. Muscle guarding is seen, especially if the animal anticipates pain. A few mares will urinate and lash their tails, splattering urine, as they are being chased, and it should not be confused with the frequent urination with deviated tail seen in estrous mares. The stallion moving his mares assumes a unique posture, called herding, driving, or snaking, with head down, nearly touching the ground, and ears flattened (Figure 1.7).

Horses paw the ground not in aggression but rather in frustration when they are eager to gallop or, more commonly, when they want to graze and are restrained by rope or reins. Pawing to eat may be a behavior derived from pawing through snow for grass and might be considered a form of displacement behavior. Tail lashing and pawing can be signs of discomfort.¹¹⁸³

Tactile Sense

Horses can detect a fly on their skin and respond by either moving their skin or swishing their tails. Riders make use of the horse's ability to perceive a slight pressure on his flank in order to signal dressage movements. Very light pressure on the skin is used to calm a horse.²²³⁸ Another use of the horse's tactile sense (or, more likely, pain receptors) is the twitch. When the horse's upper lip is twisted with a chain or rope, endorphins are released and analgesia is produced.¹²⁹⁶

Olfactory Signals

Scent Marking

Olfactory communication plays an important part in the sexual behavior of horses. Stallions curl their upper lip in the flehmen or "horse laugh" position when they smell the urine of a mare (Figure 1.8). Estrous urine alone does not stimulate more episodes of flehmen by stallions than does non-estrous urine, but the frequency of flehmen by a stallion toward a particular mare in his herd increases as she approaches estrus, perhaps because the mare urinates more frequently.^{1461,2167} After the stallion investigates urine by putting his lips in it, his lips are raised in the flehmen position, the nostril opening is partially blocked, and the horse, by breathing deeply, aspirates the urine into the vomeronasal organ. Although stallions

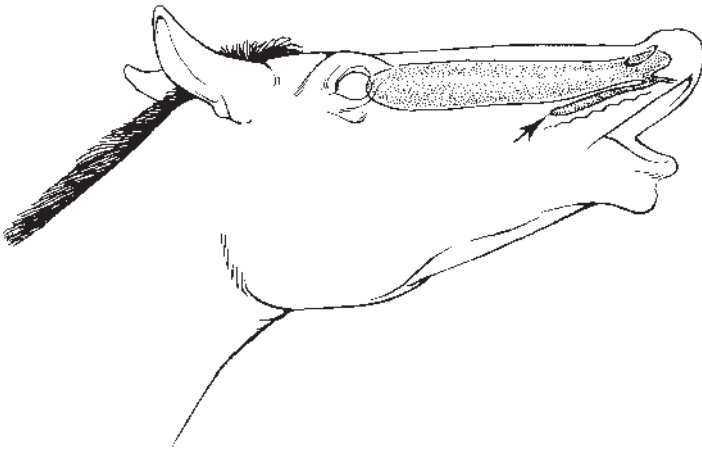


Figure 1.8 The flehmen response, or lip curl. The location of the vomeronasal organ is indicated by the arrow.

flehmen most frequently, geldings and mares also exhibit the behavior in response to olfactory or gustatory stimuli. Cough medicine or a new bit often causes the horse laugh, or flehmen – but it is obviously not a sign of amusement. Stallions usually urinate on the urine (scent mark) as they are exhibiting flehmen.

Horses can distinguish the skin odors of one horse from another.¹⁷⁹⁸ Although they can distinguish their own feces from that of other horses, they do not distinguish those of familiar from unfamiliar horses. They sniff most at feces from horses that are aggressive to them.¹²⁷² Mares can discriminate the urine of different individuals.¹⁰⁴¹

Wild stallions use manure piles, or stud piles, along well-used pathways, possibly to scent mark.⁶⁷⁷ These piles may separate bands of horses both spatially and temporally. Even in a pasture, stallions and some geldings select one place to defecate and then back into the pile to eliminate, so the pile does not grow much wider. On the other hand, mares and most geldings face outward, gradually increasing the diameter of the pile. Because horses do not eat grass contaminated with feces, a pasture containing mares and geldings rapidly becomes “horsed out” or inedible.¹⁷²¹ Despite the discrimination of older horses against feces, foals show coprophagia, as discussed in more detail in Chapter 6,

“Development of Behavior.” Horses respond to predator odor by increased sniffing, but only seem frightened (refuse to eat and increase heart rate) when the odor is combined with the sound of a plastic bag being dragged over the ground.⁴¹⁸ Horses have individual sensitivities. Some are more reactive to odors, others to tactile or auditory stimuli, but there is no general sensory sensitivity. A horse that responds strongly to a sound is not necessarily going to respond strongly to a spicy taste.¹³⁰⁸

Artificial Pheromones

The equine appeasing pheromone, from the intramammary sulcus of the lactating mare, can reduce the signs of fear and the elevation of heart rate in response to a novel stimulus – a bridge.⁶⁶⁴

Dogs

Vocalizations

The common vocal communications of dogs are the bark, whine, howl, and growl.

Bark

Barking is a territorial call of dogs. It is used to defend a territory and to demarcate its boundaries. Stray dogs, whose resting places

may be quite temporary, rarely bark.²¹³ As a stray dog passes the yards of owned dogs, however, it precipitates territorial barking. The observant owner can recognize various types of barks. The bark to be let in the house differs from that directed at human intruders, which may differ from that directed at canine intruders.¹⁰ People obtain dogs because they bark and can serve to warn their owners of the approach of intruders. Unfortunately, dogs are much more likely to bark in response to another dog's bark than to the sound of a human intruder.^{11,12} The barking trait can become a problem in a highly urbanized environment. Two thousand two hundred complaints about barking are filed in Los Angeles per year.²⁰⁸² For this reason, a dog's barking can be a problem for the owner. A more acute problem is the barking of kennelled or caged dogs in a veterinary clinic. The noise level generated by barking can exceed the 90-decibel limit of the Occupational Safety and Health Act (OSHA).¹⁵ Animal hospitals must, therefore, be constructed with very good sound insulation.

Whine and Howl

Whining is an et-epeimeletic or care-soliciting call of the dog. It is first used by puppies to communicate with the mother, who provides warmth and nourishment. Mature dogs whine when they want relief from pain or are in even a mildly frustrating situation, such as when they want to escape outdoors or reach a rabbit for which they are digging.

Howling is a canine call that has not been deciphered well. It occurs more frequently in some breeds of dogs, such as Huskies, Malamutes, and to a lesser extent hounds, often in response to auditory stimuli or when isolated.

Growl

Growling is an aggressive or distance-increasing call in dogs, but there are distinctions between play growls and growls directed at a threatening stranger. Play growls have a higher fundamental frequency and a pulsing rhythm.⁶⁶⁵

Acoustic signals are more important than visual signals, and dogs react by either retreating, approaching, or not responding to the sound. Dogs that retreat have higher levels of salivary cortisol.²⁴⁸⁷ Dogs look at a picture of a normal-sized dog when they hear an aggressive growl, but at the picture of a larger than normal dog if they are hearing a play growl.¹⁵⁸

Visual Signals

A dog's emotional state can be determined by observation of its ears, mouth, facial expression, tail, hair on its shoulders and rump, and overall body position and posture (Figure 1.9). The calm dog stands with ears and tail hanging down. When it becomes alert, its tail and ears are pointed upward. The dog may point with one front leg; this can be a sign of anxiety. As the dog becomes more aggressive, the hair on the shoulders (hackles) and the rump rises and the lips are drawn back. The ears remain forward, and the tail may be slowly wagged. With increasing aggression, the lips are retracted and the teeth exposed in a snarl. The dog stands straight. As the dog becomes frightened, the ears go back until they are flattened against the head and the tail descends until it is between the legs. Dogs are more apt to exhibit displacement or appeasement behaviors after a familiar person (rather than an unfamiliar one) pets their head or holds their paw. Because dogs communicate more openly with familiar than unfamiliar people, the unfamiliar person may be unaware of the dog's distress and therefore more likely to be bitten.¹²⁸²

Posture

The posture of the fear-biting dog, the one most likely to injure a veterinarian, is that of a frightened dog with tail and ears down and the body leaning away from the source of fear. It will have raised hackles and lips retracted in a snarl, which may expose the molars as well as the canines. Care must be taken when approaching a dog to notice any

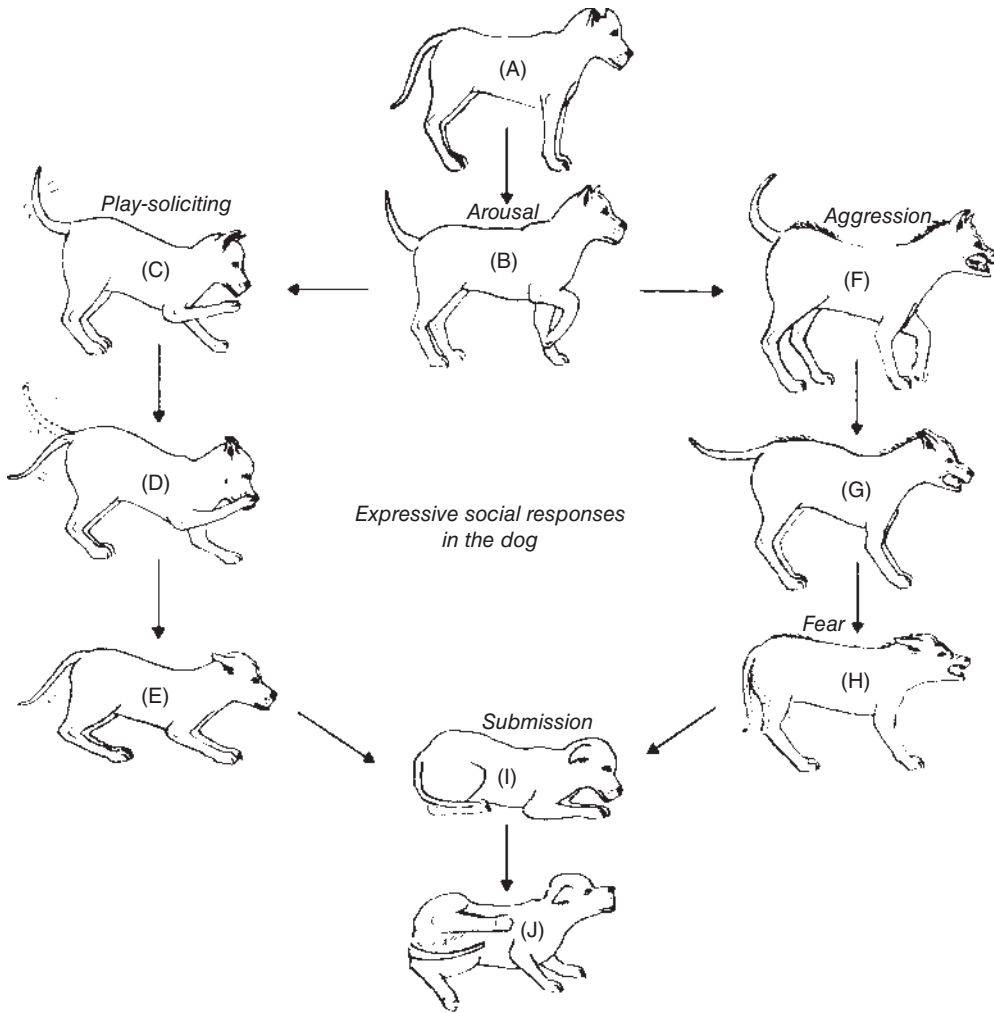


Figure 1.9 Body postures of the dog. (A, B) Neutral to alert attentive positions; (C) play bow; (D, E) active and passive submissive greetings – note tail wag and shift in ear position and in distribution of weight on fore and hind limbs; (F–H) gradual shift from aggressive display to ambivalent fear-defensive aggressive posture; (I) passive submission; and (J) rolling over and presentation of inguinal-genital region.⁷²⁴

lifting of the lip, because this may be the only prediction of defensive aggression or fear biting. The fearful biter will escape if possible; but if it is approached within its critical distance, which may be a yard (approximately a meter or less) from it, it will attack.

More common, fortunately, is a dog in which fear is not mixed with aggression. The fearful dog crouches with its tail between its legs and its ears flattened down. If the dog is abjectly submissive, it will lie on its side and lift its hind leg, displaying the inguinal area.

It may also make licking intention movements, that is, sticking its tongue out but not contacting anything. Finally, it may urinate. This behavior probably represents a reversion to puppy habits in which the puppy lies down on its side, presents the inguinal area to the mother (who is, of course, dominant over the puppy), and allows her to lick and clean it.

General posture is also a good indication of the dog's mood. A lowered body posture with depressed tail is associated with fear and fear-based aggression, and a tall (especially rigid)

posture with stiff, raised tail is associated with offensive aggression.⁹⁴⁸ See Chapter 9, in which the laterality of tail wagging is discussed.

During a submissive approach, dogs curve their bodies, wiggling toward the superior, whereas a dominant dog stands straight and walks stiffly with tail and ears erect. This stiffening of posture can be used to predict when an initially friendly greeting is about to become an attack. There is considerable debate about whether dogs display guilt when they have transgressed. There is neither a difference in the behavior of guilty versus innocent dogs nor in the owner's estimation of the dog's guilt.^{963,1742}

Dogs greet their owners as they did their mothers: by licking their faces. As puppies, dogs lick their mothers' faces to beg for regurgitated feed. Although wild canids frequently regurgitate food for their pups, not all domestic dogs do so; nevertheless, the begging behavior is shown by domestic puppies. The behavior persists in the adult dog who either licks the owner or, if prevented by discipline or its small stature, makes licking intention movements. Licking their own lips, yawning, and even falling asleep sitting up are all signs of ambivalence in dogs. A few dogs will "grin" as a submissive greeting. They show their teeth with flattened ears.

Dogs have a play signal; it is necessary to signal that the action that follows is play because, otherwise, the recipient of the playful act will consider it genuine aggression or sexual activity and respond in kind. A bowing with the forequarters lowered and the hindquarters elevated and topped by a rapidly wagging tail is the signal for canine play.²²³ Often, one paw is waved or rubbed at the dog's own muzzle. Interspecific communication is important, too. People use various motions and vocalizations to signal that they want to play with a dog. The most successful are lunging or bowing toward the dog while whispering or speaking in a high-pitched voice.¹⁹⁶⁰

Olfactory Signals

The legendary olfactory acuity of dogs has already been mentioned. Because dogs can smell so well, it is not surprising that dogs use odors as a means of communication.

There are applied uses of canine olfactory abilities too. Although olfactory repellents are seldom effective in dogs, odors can have a positive effect. Lavender oil reduces canine vocalization and locomotion during car travel.²⁴¹⁶ A chemical has been synthesized from the epithelial cells of the bitch's mammary sulcus and is available commercially as Adaptil®. It has been used for a variety of behavior problems, but the studies of its efficacy were not well controlled.⁷³⁶

Urine

The importance of olfactory communication to dogs is exemplified by the diligence with which male dogs scent mark vertical objects by urinating. Dogs are believed to be capable of identifying species, sex, and even individuals from the odor of the urine. Dogs scent mark much more frequently in areas where other dogs have marked. The record may be 80 markings by one dog in 40 hours.²¹⁶² Even though male dogs rarely empty their bladders completely, such efforts exhausted this dog's supply; the last urinations were dry.

The most powerful means of olfactory communication in the canine species is the urine of an estrous bitch. Male dogs are more strongly attracted to the urine of an estrous bitch than to vaginal or anal sac secretions.⁵⁶⁸ Dogs "tongue," that is, flick their tongues against the palate just behind their incisor teeth, introducing estrous urine into the vomeronasal organ. This is the canine equivalent of flehmen.

There is a marked preference by an estrous bitch for male urine as compared with either estrous or non-estrous urine.⁵⁸⁸ The urine contains pheromones. In estrous urine, these compounds are probably estrogen metabolites. The urine of a bitch in heat can attract males from great distances.

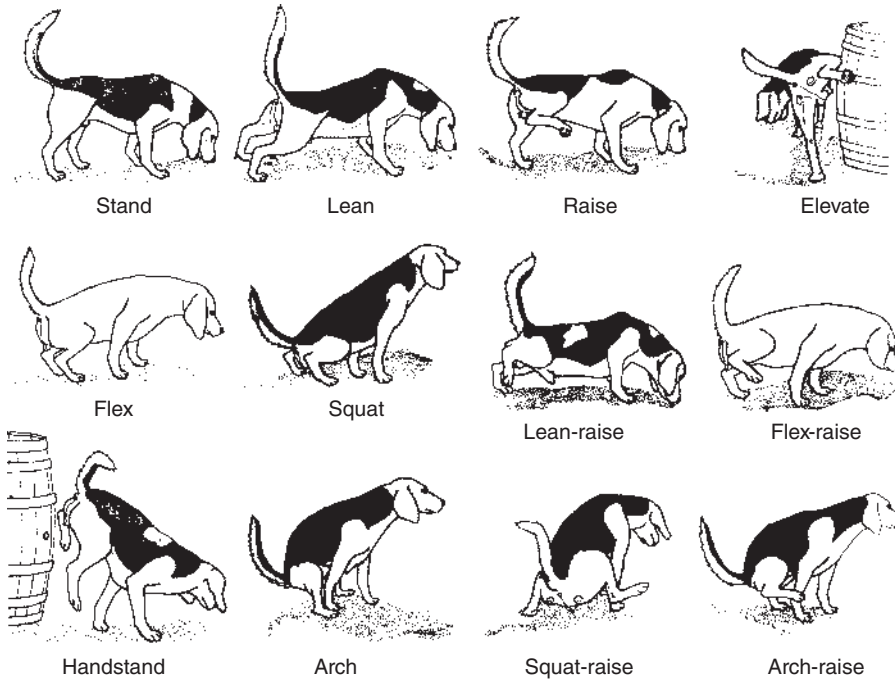


Figure 1.10 Elimination postures of the dog.²¹⁶² Copyright 1973, with permission of E.J. Brill Publishers.

The attractant effect of the bitch's pheromone is usually considered a nuisance, but it has practical applications. For instance, the pheromone could be used to attract stray dogs that could then be easily captured. One might expect that male dogs would inevitably be attracted to the urine of a receptive female, but a dog without mating experience does not investigate estrous urine in preference to anestrus urine, whereas sexually experienced dogs do.¹⁹⁵

Elimination Postures

Although standing and lifting the hind leg are typical innate male behaviors mediated by testosterone, males urinate in other positions 3% of the time.²³⁶ Bitches assume not only the squatting position (68% of the occasions that they urinate) but also lift their hind legs (2%) and use various combinations of the two postures.

Urine marking is the most common form of scent marking in dogs, but vertical objects

may also be marked with feces; this behavior is termed middening. Again, males are more likely than females to mark with feces (Figure 1.10).²¹⁶² Castration reduces scent marking in male dogs.⁹²³ Dogs that cannot smell (anosmic) and that, therefore, cannot identify other dogs' urine mark less frequently and, in contrast to intact dogs, do not urinate on the urine of other dogs. When dogs scratch after eliminating, they are not making rudimentary burying movements but are spreading the scent and possibly adding the odor of secretions from interdigital sebaceous glands. Intact male dogs mark more during the breeding season; lactating bitches mark around their nest area.¹⁷⁵⁶

Anal and Aural Secretions

Urine is not the only olfactory means by which dogs communicate. The anal gland secretions normally are eliminated with the feces and, no doubt, give them a unique

odor.⁵⁶⁸ Dogs, on meeting, usually sniff under each other's tails. This behavior is probably one of identifying the individual by its smell. A very frightened dog can express its anal sacs forcefully; the resulting odor is pungent enough to be smelled by humans and may function as a fear pheromone.⁵⁶¹ The secretions of the ears are also believed to function in individual identification,⁷³⁰ and investigation of one another's ears is a common greeting behavior of dogs.

Submissive Urination

Submissive urination is a frequent behavioral problem. It occurs more often in young dogs and small dogs. Punishing the dog for urinating in fear or excitement aggravates the problem. The dog is already afraid, and punishment only confirms and reinforces that fear. The wisest course is to avoid overexciting the dog. Submissive urination often declines as the dog matures.

Cats

Vocalizations and Audition

Many more feline vocalizations exist than those described in Table 1.1; some of these vocalizations may not be recognized by every owner.³¹⁷ The wild ancestor of cats, *Felis silvestris lybica*, is less vocal and meows in fewer contexts; its call is longer and lower in frequency and deemed less pleasant by humans.¹⁶⁸⁸ Apparently, we have selected cats to communicate with us in "pleasant" voices. Humans can distinguish positive and negative affect in feline vocalizations.¹⁶⁸⁹ Purring can be a pleasure vocalization or, when a higher frequency is incorporated, a food-soliciting call.¹⁴⁹⁷ Agonistic calls are longer in duration and lower in frequency than affiliative calls. Because cats can hear ultrasound, it has been used to deter cats from entering an area, and, although the technique is only moderately effective, the efficacy increases with time.¹⁶⁸⁴

Visual Signals

Posture

The postures and facial expressions of the cat are shown in Figure 1.11a and 1.11b. A cat carries its tail high when greeting, investigating, or frustrated. The tail is depressed and the tip wags during stalking. When walking or trotting, the tail is held out at a 40° angle to the back, but as the cat's pace increases, the tail is held lower.¹²¹³ A relaxed cat, as does a relaxed dog, usually stands with tail hanging, but the cat's ears are usually forward. When the cat's attention is attracted, the tail is raised and both ears are pointed forward and held erect. The aggressive cat walks on tiptoe with head down. Because the cat's hind legs are longer than its front legs, it appears to be slanting downward from rump to head. Its tail is held down but arched away from the hocks; it is partially piloerected. Its ears are held erect and swiveled, so the openings point to the rear. Its whiskers are rotated forward, and its claws are protruded. Subordinate cats crouch in the presence of a dominant cat.

The frightened cat crouches with ears flattened to its head, and it salivates and spits. The pupils of the aggressive cat are constricted; as the animal becomes more defensive, the pupils dilate. The light-colored iris of the cat's eye makes an especially prominent signal of the cat's mood; it is probably an important intraspecific signal and should be used also to advantage by the veterinarian. The eyes of an excited cat appear red because the retinal vessels can be seen through the dilated pupils. Contrary to popular belief, the "Halloween cat" is not the most aggressive one; this cat, with arched back, erect tail, and ears flattened, which is piloerected and hissing, corresponds to the fear-biting dog. The cat is fearful but will become aggressive if its critical distance is invaded. One clue to the cat's emotions is that the hind feet appear to be advancing while the front feet retreat; the paws are gathered close together under the cat.

Table 1.1 The vocalizations of cats.

Murmur	A soft, rhythmically pulsed vocalization given on exhalation. Murmurs are the request, or greeting call, which can vary from a coax to a command; and the acknowledgment, or confirmation call, which is a short, single murmur with a rapidly falling intonation.
Chirp	A vocalization given by a queen to her own kittens when approaching the nest or nursing.
Purr	A soft, buzzing vocalization that is easy to recognize. It occurs only in social situations and may indicate submission or a kitten-like state. Remmers and Gautier ¹⁵⁹⁶ have shown that purring is associated with rapid contraction of the muscles of the larynx. The laryngeal muscles are driven by a central pattern generator with a cycle of contraction every 30 to 40 ms. ⁶⁴⁰
Growl	A harsh, low-pitched vocalization, ³⁰⁹ usually of long duration and given in agonistic encounters.
Squeak	A high-pitched, raspy cry given in play, in anticipation of feeding, and by the female after copulation.
Shriek	A loud, harsh, high-pitched vocalization given in intensely aggressive situations or during painful procedures.
Hiss	An agonistic vocalization produced while the mouth is open and teeth are exposed. This vocalization is probably defensive and can be used to gauge whether a cat is defensively or offensively aggressing.
Spit	A short, explosive sound given before or after a hiss in agonistic situations. Saliva is expelled.
Chatter	A teeth-chattering sound made by some cats while hunting or, more commonly, when restrained from hunting by confinement.
Estrus call	A call of variable pitch, lasting a half-second to one second. The mouth is opened and then gradually closed. It is given repeatedly by queens in estrus, which is termed calling because the vocalization is so characteristic.
Howl and yowl of an aggressive cat	These are loud, harsh calls.
Mowl, or caterwaul, of the male cat	A variable-pitch call, usually given in a sexual context.
Mew	A high-pitched, medium-amplitude vocalization. Phonetically it sounds like a long “e.” It occurs in mother–kitten interactions and in the same situations as the squeak.
Moan	This is a call of low frequency and long duration. The sound is “o” or “u.” It is given before regurgitating a hair ball or in epimeletic situations, such as begging to be released to hunt.
Meow	This characteristic feline call, “ee-ah-oo,” is given in a variety of greeting or epimeletic situations just as the mew and squeak are. Anyone who has tried to restrict a cat’s food will not be surprised to know that cats can be trained to meow twice a minute for two hours when the reward is food. ⁶⁴⁷

In general, tail up is directed to higher ranking cats and may precede rubbing.³⁶⁸ There are many tail positions and actions: (a) tail extended straight, but end curled over; (b) tail extended, and the tip moves forward or backward, or to one side; (c) tail held upright, and entire tail “vibrates” from the base to the tip; (d) when the cat is lying down or sitting, tail moves from side

to side; (e) rhythmic movement of tail backward and forward; (f) tail erect and points straight up, skyward; and (g) in any position, the tail becomes tightly wrapped around the body or the handler. Positions (b) through (d) are negative reactions.⁶³⁵

Cats roll on their backs, but sex differences appear in this behavior. Most female rolling

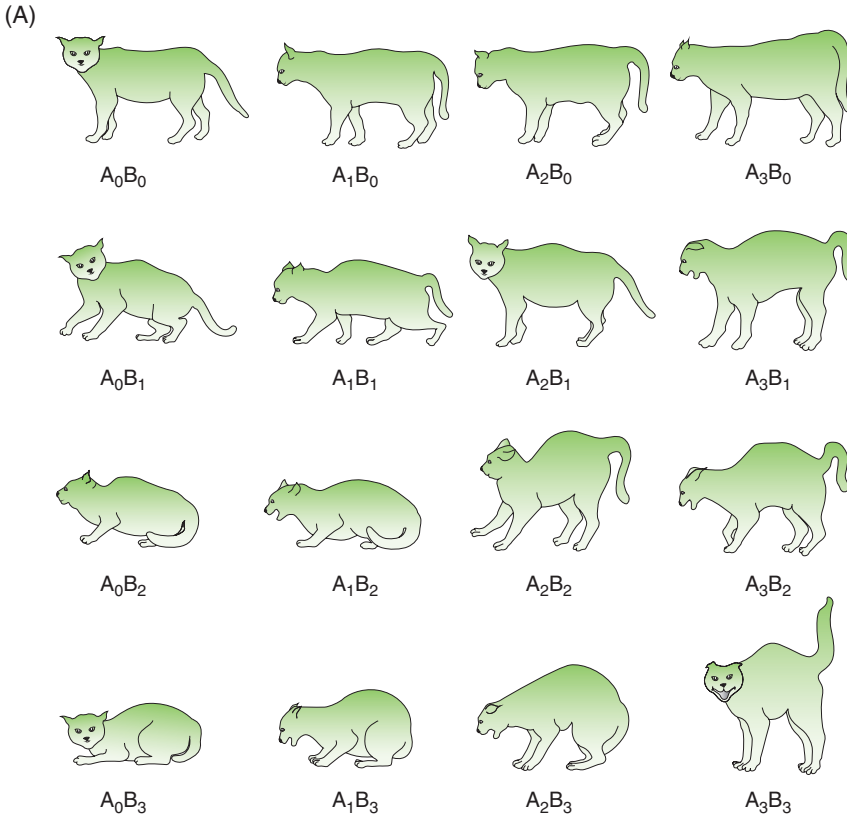


Figure 1.11A Body postures of the cat. Aggressiveness is increasing from A₀ to A₃, fearfulness from B₀ to B₃. A₃ B₀ is the most aggressive cat, A₀ B₃ the most fearful, and A₃ B₃ the defensively aggressive cat¹³⁶⁰ from Overall¹⁷⁴⁵ with permission Elsevier.

occurs during estrus and is directed toward males, whereas most rolling exhibited by young males is toward adult males and is presumably a sign of submission.⁶⁷⁹

The gape is a response to a strange smell. This expression is most commonly seen when the cat smells a strange cat's urine, and it is the feline equivalent of the flehmen response of the ungulates. The mouth is opened, and the tongue is flicked behind the upper incisors where an opening in the hard palate communicates with the vomeronasal organ (Figure 1.12). At the same time, an autonomic response to the odor occurs whereby the urine brought to the hard palate is aspirated into the vomeronasal organ during parasympathetic stimulation. Fluid is flushed from the vomeronasal organ during sympathetic stimulation.⁶¹⁶

Olfactory Signals

Scent Marking

Male cats scent mark – that is, spray urine – more than females, but both sexes do it. They spray trees along their most frequently traveled path. Spraying is also done by cats that are subjects of aggression.¹⁶⁷¹ Free-ranging tomcats spray a dozen times per hour.²²⁹⁸ Queens spray once an hour and are more likely to spray when they are in heat. Cats probably also use scent marking to arrange their activity temporally with other cats. Much of the signal value of urine is lost within 24 hours, as evidenced by a comparison of interest in fresh and older urine marks by male cats.⁵²⁰ Cats can apparently distinguish the urine of familiar cats from that of strange

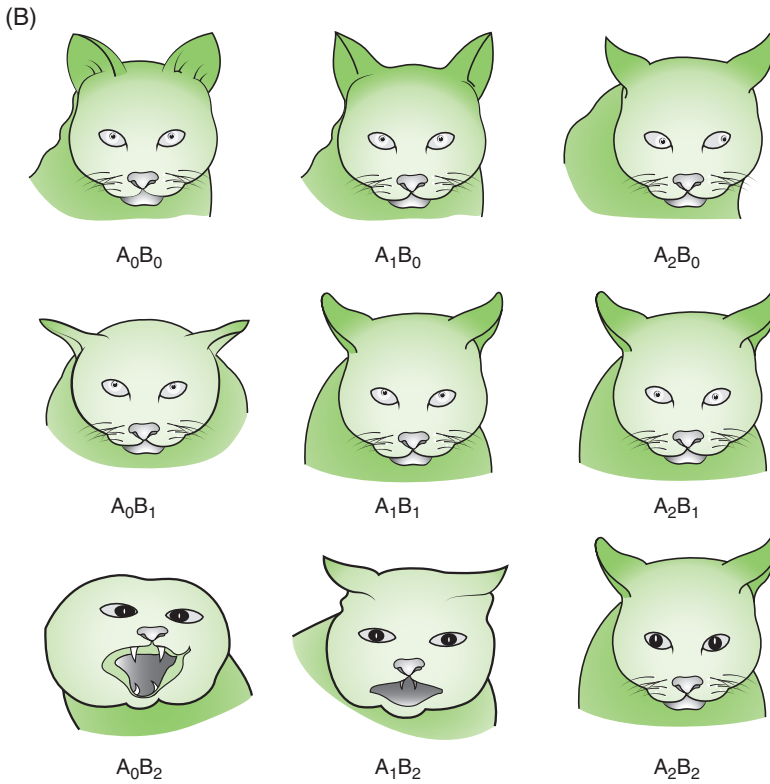


Figure 1.11B Facial expressions of the cat.¹³⁶¹ A₂ B₀ is offensively aggressive; A₀ B₂ is defensively aggressive. from Overall¹⁷⁴⁵ with permission Elsevier.

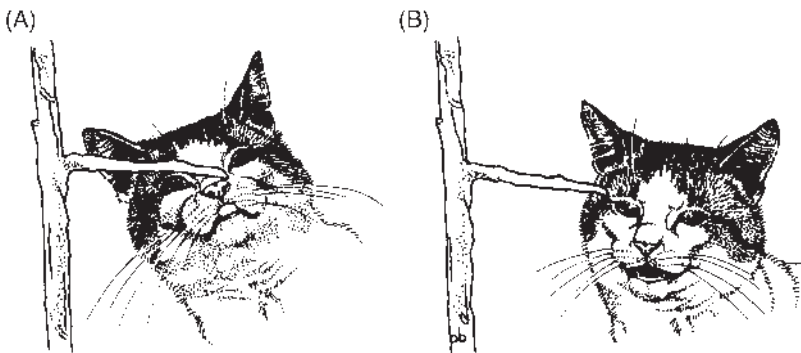


Figure 1.12 The gape expression of a cat. (A) The cat touches the investigated object with its nose and may lick its nose; then (B) it opens its mouth while gazing in a preoccupied fashion. Source: Courtesy of Priscilla Barrett, Cambridge, UK.

cats.¹⁶⁶⁹ The smell of male cat urine is quite detectable by humans and usually objectionable to them. The smell of tomcat urine is probably caused by the sulfur-containing

amino acid, feline, which is present in highest quantity in tomcat urine and may be an important olfactory component in territorial spraying.⁹⁹⁴

Anal Secretions

Cats are well known for their fastidious covering of their feces, but in some situations, such as outside their core living area, cats may leave their feces uncovered. This may be a form of middening, marking with feces. Cats probably use fecal and anal sac odor for communication; two strange cats spend considerable time circling one another, attempting to sniff in the perianal area. If the cats are not too antagonistic, they will eventually permit each other to sniff.

Rubbing

Cheek rubbing (bunting) behavior may also be a form of olfactory communication in that glandular secretion from the cat's face is deposited on the object bunted. Cats bunt the objects to which they respond with a gape. Urine up to three days old can elicit these responses.²³⁴⁸

Cats also rub each other. In general, the subordinate cat rubs the dominant one. This behavior serves to exchange odors among all the cats in a group, that is, they all smell the same.

Communication with Humans

Dogs and cats appear to interpret each other's signals correctly even when the behaviors have opposite meanings in the two species, for example tail wagging, which signals annoyance in cats and pleasure in dogs.⁶⁸⁸

Pigs

Vocalizations

Vocal signals are probably the most important means of communication in pigs. Twenty calls have been identified, and half a dozen are easily recognizable to humans.⁸⁸¹ The vocalizations of ungulates have been analyzed in depth.¹²¹¹

Grunt, Bark, and Squeal

The common grunt is 0.25 to 0.4 seconds long and is given in response to familiar sounds or while a pig is rooting. The staccato

grunt or short grunt is, as the name implies, shorter (0.1–0.2 seconds); it is given by an excited or investigating pig and may precede a squeal. A crescendo of staccato grunts is given, for example, by a threatening sow and may precede an attack on anyone who disturbs her litter. In a milder form, it can be a greeting. The bark is given by a startled pig. Pigs respond to an adult sow's bark by freezing or fleeing, but not to juvenile pig barks.⁴⁰⁷ The long grunt (0.4–1.2 seconds) may be a contact call and is associated with pleasurable stimuli, especially tactile ones.¹⁴⁵⁶ The squeal is a more intense vocalization indicating arousal, and a pig that is hurt will scream.

The various grunts and combinations do not appear to have specific meanings, but the intensity of the vocalization varies with the intensity of the situation. A common sequence is to proceed from common grunts to staccato grunts to repeated grunts without interruption to grunt squeals to screams as the animal is approached, chased, picked up, and injected. Staccato greeting grunts are given by pigs that are reunited after a separation, and a series of 20 grunts with no pause may be given by the hungry pig. Nursing calls are described in Chapter 5, "Maternal Behavior." Changes in the frequency and length of calls can indicate need. When separated from the sow, hungrier piglets call more frequently and at a higher frequency than do satiated ones.²³⁹⁶ Sows can discriminate the calls of their own piglets from those of others. When reunited with the sow, piglets emit a contact call.²³⁹⁶

Isolation in a strange place causes pigs to vocalize. Short grunts are followed by screams. At the same time, the rate of defecation increases.⁷⁴⁵ They do not react behaviorally or physiologically to recordings of distress calls of unfamiliar pigs.⁵⁹⁷ When anticipating an aversive event (e.g., climbing a ramp), pigs will emit a high-pitched vocalization.¹¹⁰⁸ Mature pigs often react to restraint by tantrum behavior accompanied by very loud calls, but with no increase in heart rate.¹⁴⁵⁸ When disciplining a subordinate pig, a dominant pig will give a sharp bark as it feints with its snout. The pig in chronic pain grinds its teeth.

Posture

Possibly because the vocabulary of swine is so large, visual signals do not appear to be as important. One can learn something about pig thermoregulatory problems, if not about their moods, by observing their posture. Newborn pigs are relatively deficient in fur or fatty insulation, and their surface-to-volume ratio is large; therefore, maintaining body temperature is difficult. Pigs have compensated for their poor physiological abilities with several behavioral strategies to reduce heat loss. A warm piglet lies sprawled out, but a cold one crouches with its legs folded against the body. The surface area is thus reduced, and contact with a cold floor is minimized.

Tail Position

The tail, particularly in piglets, is a good index of general well-being in most breeds. Although Vietnamese mini pigs do not curl their tails, a tightly curled tail indicates a healthy pig in most breeds, and a straight one indicates some sort of distress. The pig's tail is elevated and curled when greeting, when competing for food or chasing other pigs, and during courting, mounting, and intromission. The tail straightens when the pig is asleep or dozing, but curls again when the pig rouses unless the animal is isolated, ill, or frightened. The tail will twitch when the skin is being irritated. Amputation of pigs' tails removes a valuable, if crude, diagnostic aid.

Group Behavior

Group behavior is important among pigs. Pigs, especially newborn ones, huddle when they are cold. They thereby convert several small bodies into one large one, both decreasing their surface area and using one another for insulation. Pigs can select an optimal temperature when a gradient is present, both in the laboratory and on the farm. Therefore, heat lamps are provided, and newborn pigs, except those brain-damaged by anoxia at birth, stay under the lamp at a comfortable 29 °C (85 °F). Adult pigs still huddle when they are cold, but their thermoregulatory

problem is more apt to be one of hyperthermia. Pigs do not sweat, and although they pant, it is not sufficient for cooling. Again, behavioral thermoregulation takes over and pigs wallow in mud, which is more effective than plain water for evaporative heat loss.¹⁶⁴⁰

Olfactory Signals

Boars may use behavioral signs more than pheromones to determine the sexual receptivity of the sow. Boars are the only male ungulates that do not exhibit flehmen. Instead, they gape as a cat does when they encounter sow urine. Females can identify intact males, probably by the strong boar odor produced by the androgen metabolites present in both the saliva and preputial secretions of boars.²¹²³ Sex differences exist in the ability to detect androstenone.⁵⁶⁶ Boars may habituate to this odor because it is present in their saliva. Females can detect the pheromone at one-fifth the concentration that intact boars do.⁵⁶⁶

Olfactory stimuli serve to identify pigs individually, for pigs can distinguish conspecifics by means of odor, including urine odor.^{1563,1547} When visual, auditory, and olfactory stimuli were available separately and together, olfaction appeared to be the most important sense in individual recognition.¹⁵³⁹ Pigs investigate any newcomer or any pig that has been temporarily removed by nosing it. The ventral body surface is a preferred site for sniffing. The ability of pigs to form a dominance hierarchy while blindfolded indicates that olfactory and auditory, rather than visual, signals are important to pigs.⁶⁵⁶

Cattle

Visual Signals

Cattle posture indicates alertness, aggression, and submission (see Chapter 2). A subtle sign, the showing of the whites of the eyes (>15% of the eye), can be elicited even by mild frustration such as visible but unreachable food or by social frustration such as removal of the cow's calf or anticipation

of food.^{2020–2022} Treatment with diazepam several hours before the frustrating experience decreases the percentage of visible eye white.²⁰²³ Pain in cattle is characterized by ears that are tense and backward or held low, and eyes that may have a tense stare or a withdrawn appearance. Tension of the muscles above the eyes may be seen as “furrow lines.” The muscles on the side of the head may be tense, the nostrils may be dilated, and there is increased tonus of the lips.⁸²⁶ The typical aggressive and submissive postures of cattle are described in Chapter 2, “Aggression and Social Structure.”

Vocalizations

The moo is low pitched.¹²¹¹ The other common vocalization – the call, hoot, or roar – is higher pitched and consists of repeated brief calls, usually by a distressed cow. A threatening bull gives a roar of high amplitude. A very hungry calf will give a high-intensity “menh” call. During copulation, grunting sounds are heard. Some humans can recognize cows by voice, so it would not be surprising if cattle were able to recognize one another. Cattle appear to respond to a vocalization with a vocalization of similar intensity. An excited call is answered by excited calls. Calves have a special moo, almost a baa, or play call.³⁴⁷

Vocal communication in a prey species such as cattle may be most important in transmitting information about general safety or danger. It may have been more important for cattle (and horses) to be alert and ready to flee than to communicate more precise information in their calls.

Sheep

Visual Signals

The ears of sheep can be pointed forward, backward, or horizontal (hanging passively and loosely). The horizontal posture

corresponds to a neutral state. Sheep point their ears backward when they face unfamiliar and unpleasant uncontrollable situations, hence likely to elicit fear; they point their ears up when facing similar negative but controllable situations. The ears are in asymmetric posture in very sudden situations likely to elicit surprise.²⁷⁸ The auricle can point backward or downward. Frequent ear-posture changes are associated with situations inducing negative states, and a high proportion of passive ear postures or axial ears (perpendicular to the head–rump axis) are associated with situations likely to induce positive emotional states. A raised tail is seen when sheep are isolated – a very stressful situation for the species.¹⁹¹⁴ The eye’s aperture is wider in a fearful sheep.¹⁹¹⁵

Submissive postures are the lowered neck and the headshake given mostly by small sheep in the presence of larger ones. Sheep have a visual signal for defensive aggression: they stamp. Threats in sheep are the foreleg kick, often repeated several times and sometimes actually contacting the opponent. The horn threat is movement of the head sharply downward. The twist and low stretch involves stretching the neck and twisting the head with accompanying tongue flicks. Some rams threaten by standing stiffly with their heads up, which causes their necks to bulge. Rams rub their horns on one another’s face, probably spreading pre-orbital secretions. The other visual signals used in courting behavior are discussed in Chapter 4. Sheep rarely will huddle facing one another; head-to-head orientation is aggressive behavior in this species.

Adult sheep continue to use vocalizations as contact calls. Sheep also are able to distinguish conspecifics by means of olfaction.¹⁴⁷

Communication with Humans

Sheep are aware of human visual activity. They look at a staring human more than a non-staring human, and they are more active and urinate more often.²⁰⁷

Vocalizations

Vocal communication in sheep consists of bleating in distress or to initiate contact. Ewes rumble to their newborn lambs (see Chapter 5), and rams make a similar call while courting. The snort is an aggressive communication in sheep.

Goats

Visual Signals

When goats are aroused, their ears point forward more and to the side less, and they emit higher frequency calls. Their ears are oriented backward less often and their tails are up in positive (food-anticipating) situations compared to when they are isolated.³³¹

Vocalizations

Goats stamp and produce a high-pitched sneeze when threatened. Kids have a distress call and an isolation bleat. The unique behaviors of caprine courtship are discussed in Chapter 4, and the ontogeny of goat “language” is in Chapter 6.

Olfactory Signals

Olfactory communication is very important for sexual activity in ruminants. The flehmen response is shown by all male ruminants in response to female urine. Goats have pedal glands on only two feet and a tail gland. Aspiration of nonvolatile material into the vomeronasal organ has been demonstrated in goats.¹²⁹⁵

