

Variations in Sight Abilities Among Domestic Animals

Our topics for this week are animal vision:

- **Field of view**
- **Depth perception**
- **Acuity**
- **Perception of motion**
- **Color differentiation and night vision**

Vision is the primary sense used for detecting danger for many species. It is adapted for a species needs, particularly the needs of defense and communications. Impaired vision can affect an animal's tractability, such as diurnal birds being more easily handled in subdued lighting and blindfolds improving the ability to handle horses, raptors, and ratites.

Field of View:

The field of view for predators is narrower than in prey animals. Dogs have a horizontal field of view of approximately 240 degrees, slightly wider than in humans. Cats have a horizontal field of view similar to dogs (200 degrees) but a wider vertical field of view due to their vertical pupils.

The eyes of grazing/prey animals (horses, cattle, sheep, goats, rabbits) are located on the sides of their heads and protrude slightly in comparison to predator eyes. The side location and protrusion of their eyes allow grazing prey animals even greater horizontal peripheral vision. The horizontal vision of grazing animals is approximately 200 degrees, or more, with their heads raised and up to about 340 degrees, with their head lowered in grazing position.

The pupil of prey animals adapted to living on open grassland is often horizontally oval, which further enhances peripheral vision. Dog ancestors, lions, tigers, and birds of prey are predators that monitor their prey from a distance and hunt while moving. This type of hunting is facilitated by round pupils.

Small cats, like the domestic cat, venomous snakes, and lizards are low profile hunters. These animals have vertical pupils which may permit an enhanced ability to focus through thin vertical gaps in tall grass where they frequently hunt. They have large corneas and pupils for their body size.

Grazing animals, such as horses, cattle, and small ruminants, have horizontal pupils. The vertical vision (being able to see above or below) is less in grazing prey animals than in humans or predators. Prey animals' range of vertical vision is only about 60 degrees. To properly place their feet on unfamiliar ground or to step into unfamiliar water, they have to lower their head. Horizontal pupils enable prey animals to see vertical lines better than horizontal lines. Containment fencing with more vertical lines is a more effective psychological barrier for grazing animals than the more common fences that have long sections of horizontal planks or rails.

Depth of Vision

Depth perception (stereopsis, i.e., judgment of distances) requires overlapping fields of vision from each eye. Humans and predator animals have binocular vision, focusing on objects of interest with both eyes. The central overlap that permits depth perception in dogs and cats is about one-half that of humans, but better than prey animals. Cats binocular vision is 140 degrees.

Prey animals have a wider total field of view than predators but less is binocular. Horses binocular vision is 65 degrees which limits their depth perception.

Prey animals have monocular vision and can focus on objects on both sides of their body at the same time but with little depth perception to monitor for predators while grazing. When looking forward, prey animals can view the same object with both eyes using binocular vision which is needed for depth perception.

Horses and most other grazing prey animals have good distance vision, especially for moving objects, but their ability for depth vision and the ability to focus on near objects is slow and poor, requiring them to face the object of interest. In prey animals, shadows appear as holes, and water depth cannot be determined. Because of this, it is important to keep surfaces for them to walk on dry and lit by diffuse, shadow-eliminating lighting. Loading ramps that slant upward are easier for grazing prey animals to negotiate than steps. Consistent color, shading, and texture to prey animals' floors are important to keep them from balking. A change in the color, shading, or texture of the surface of flooring will cause the animals to stop to reassess if there might be a change in the depth.

Grazing animals have a cone shaped blind spot four feet directly in front of their face. They also cannot see directly below their jaw. Objects that suddenly appear from a blind spot may startle them, particularly horses.

Acuity and Perception of Motion:

Visual acuity (focus) is the ability to see details. Domestic mammals do not have the visual acuity of humans. Near vision is relatively poor. Normal humans have 20/20 acuity.

Dogs are estimated to be 20/75 (normal humans can see clearly at 75 feet with the clarity that dogs see at 20 feet). Cats have 20/100 acuity. Birds have exceedingly good visual acuity. Their lens is flexible which aids their ability to rapidly focus on objects. Visual acuity of reptiles is poor. However, reptile vision can vary with families depending on the species lifestyle. For example, arboreal snakes have better vision than terrestrial snakes that burrow.

The acuity of horses is 20/33, which means normal humans can see clearly at 33 feet with the clarity that horses see clearly at 20 feet.

In most predators the area of greatest acuity is a circular area in the retina, called the fovea or area centralis. To visually evaluate the greatest detail, predators have to hold their head still and concentrate the image on the fovea.

Grazing prey animals have a visual streak, an elongated band that runs horizontally across the retina. This permits grazing animals to better detect motion in their peripheral vision. Because of superior depth perception, predators and humans can perceive motion directly toward or directly away from them than grazing animals.

Color Differentiation and Night Vision:

Most animals see better in low light than do humans but perceive fewer colors.

The retina of the eye contains two types of light receptors: rods and cones. All mammals have more rods than cones and animals have more than humans. For example, humans have 9 rods/cone while horses have 20 rods/cone.

Cones perceive objects best in bright light and can differentiate colors. The area centralis or visual streak contains the highest concentration of cones and the lowest concentration of rods. Humans have three types of cones which permit trichromatic color vision (tones of red, green, and yellow). Predator and prey mammals have two types of cones, i.e. dichromatic color vision.

Reptiles and tropical birds have four types of retinal cones and may perceive more colors, or colors in dim light than humans can see. Birds can see ultraviolet, blue, green, and red (tetrachromatic vision). Bird vision peaks in the orange red portion of the spectrum.

Most domestic animals, that are active during daylight, have two types of retinal cones and dichromatic color vision (yellow and blue). Animals with dichromatic vision have trouble perceiving red and green. With dichromatic vision, red is dark and green is light gray. Dichromatic vision may aid in seeing sudden movements and objects in low light.

Dilation and constriction of the pupil are the primary means of accommodating to changes in lighting. Bird pupils and pupils in crepuscular and nocturnal animals, such as cats,

accommodate relatively rapidly. Livestock, which are diurnal species, have pupils that accommodate slowly compared to humans.

Species that are scopic (has vision in dim light) or nocturnal also have a tapetum lucidum (reflective structure in the retina that increases the gathering of light). This results in superior night vision and more intense differences in grays, plus better detection of motion. The tapetum increases light detection at night up to seven times in cats. Horses and most other grazing animals are believed to see approximately up to four times better at night, after accommodation to lighting, than can humans.

If you have comments or you're interested in particular animal handling subjects contact us at CBC@BetterAnimalHandling.com

Now let's recap the key points to remember from today's episode:

- 1. The field of vision is much wider in horses and cattle than in humans or predators.**
- 2. Depth of vision is much better in humans and predators than horses and cattle.**
- 3. Humans have better visual acuity than dogs, cats, horses, or cattle.**
- 4. Horses and cattle have better perception of motion to the side than humans or predators but poorer detection of motion directly toward or away from them.**
- 5. Humans can determine more colors than domestic mammals, but they cannot see in dim light as well as animals.**

More information on animal handling can be found in my book, *Animal Handling and Physical Restraint*, published by CRC Press and available on Amazon and from many other fine book supply sources. My new spiral-bound handbook, *Concise Textbook of Small Animal Handling* was recently published and available from all major science book supply sources.

Additional information is provided at: www.betteranimalhandling.com . This website has more than 150 past podcasts with notes on handling of dogs, cats, other small mammals, birds, reptiles, horses, cattle, small ruminants, swine, and poultry.

Don't forget, serious injury or death can result from handling and restraining some animals. Safe and effective handling and restraint requires experience and continual practice. Acquisition of the needed skills should be under the supervision of an experienced animal handler.