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The Visual World of the Horse

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We have a tendency to anthropomorphize (attribute human qualities to our animals) when we think about the senses of animals. Therefore, it's natural to assume that the visual world of the horse is very much like our own. In fact, it may be quite different. Although the basic features of the equine eye are like those of most mammals, they differ in their details and that influences the way that they see. Here we summarize some of the major aspects of equine vision. A more detailed account of both vision and hearing in horses can be found in a review article by Brian Timney and Todd Macuda (2001).



Figure 1. The visual world of the horse may be quite different from that of humans.

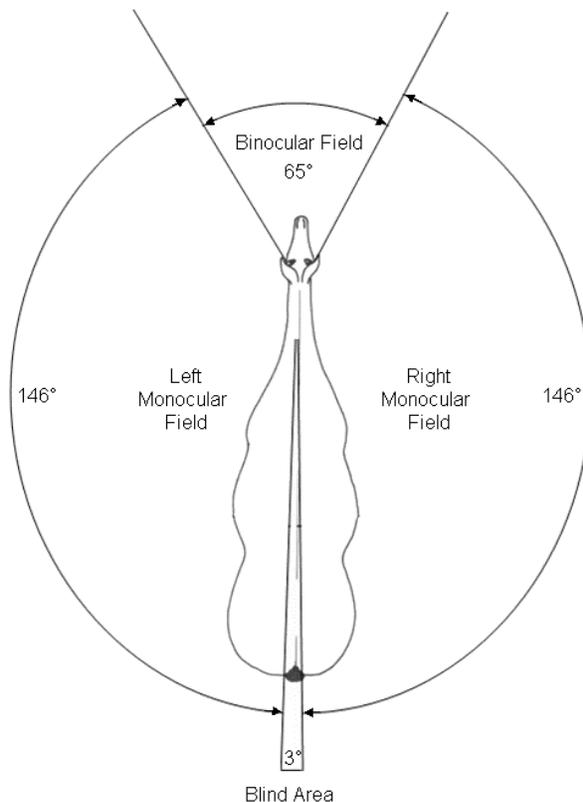


Figure 2. Visual Field of the Horse
 (Drawing by Gerrit Rietveld)

Anatomy of the Eye and Field of View

Horses have the largest eyes of almost any mammal, with a diameter about twice that of humans. The eyes are positioned laterally but they project forward. This gives them a panoramic view of the world. Each eye has a horizontal field of approximately 190° and a vertical field of about 180°. Vision with both eyes gives them an almost completely spherical field of view. However, they have two narrow blind spots, one directly behind the head and the other just in front of and below the nose. You need to be aware of these blind spots as you approach an animal, particularly from the rear. You shouldn't approach a horse directly from the rear. When you pass behind a horse, speak to let him know you are there. Because their eyes face forward, horses have an overlapping binocular field of view that can aid in their ability to see depth (see Figure 2).

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Focusing and Accommodation

For a long time it was thought that horses could not change the shape of the lens in their eye to adjust the focus for different distances. It was believed that they had a "ramped retina" in which different regions of the retina were at different distances from the lens. Focusing was thought to occur through raising and lowering the head, much as a human does with bifocal glasses. However, more recent research has shown that the retina is not ramped and that horses do have some limited ability to accommodate by changing the thickness of their lens.

Visual Acuity

Acuity, the ability to see fine details, depends on the size of the eye and the packing density of the individual visual receptors (the rods and the cones). In the horse, although the receptors are not as numerous as in humans, their very large eyes probably contribute to the fact that equine acuity is better than most mammals. A typical horse has a visual acuity approximately 2/3 as good as the average human (i.e. 20/30 vs. 20/20).

Depth Perception

Humans use both monocular and binocular cues to make judgments about distance, although the binocular cues give the most accurate information. The sense of "real" depth that we get from old-fashioned stereoscopes and 3-D movies relies on these binocular cues. Because of their lateral eyes, it was assumed that horses could only use monocular depth cues, such as relative size or perspective. However, their overlapping binocular field allows for the possibility of true stereoscopic vision, and research has shown that they do have stereopsis, three-dimensional vision (see Figure 3). They are not nearly as accurate as humans, but their stereoacuity is sufficient for them to be able to judge height and distance very well when they have to clear fences.

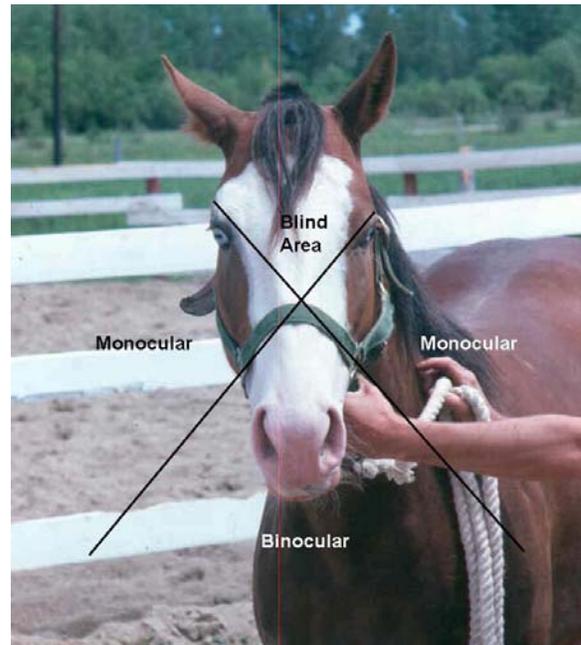


Figure 3. Monocular and Binocular Visual Fields of the Horse

Colour Vision

There is a common misconception that most domesticated animals cannot see colour. This is not true, although their colour vision is not as good as ours. The ability to see colour depends on having several different kinds of cone receptors in the retina. Most humans have three different kinds of cones that allow us to see the range of colours that we do. Colour-deficient humans are typically missing one of these cones and, although they can still see colour, they will confuse, say, reds and greens and browns. Horses only have two cone types, so they probably see the world in the same way that a red-green colour-deficient human would. They can easily discriminate red or blue from grey, but find greens and yellows much more difficult to distinguish. Greens and yellows probably look more or less the same colour, but they will appear to be lighter or darker than each other. The horse's world will not be as colourful as ours, but it is not black and white. Colour is important because it allows us to distinguish objects from the background. Poor colour vision reduces this ability. So, a sitting rabbit or bird may be seen readily by the rider, but may remain invisible to a horse until it moves, causing the horse to spook.

Night Vision

The rods and the cones are the receptors in the eye. The cones are specialized for vision in bright light and the rods only function when the light is very dim. Humans have about 20 cones for every rod, while in horses the ratio is about 9:1. However, horses have an advantage over humans in dim light because they also have a *tapetum lucidum*, a reflective coating on the back of the eye that bounces back light that might otherwise be lost, so that it can be absorbed by the rods. It is the *tapetum* that gives the "eye shine" that

you see when a horse is caught in car headlights at night. Although no formal studies have been done, it is almost certain that horses can see to some extent in very dim light, but they would not be able to make out details. In daylight, the rods stop working; so, when a horse is faced with entering an enclosed trailer, all it may see is a black hole. The trailer may be perceived as a dark cave and the horse has no idea what might be inside. It is important for handlers to consider what the trailer might mean for the horse when trying to persuade it to enter.

Conclusions

It is impossible to see through another person's (or animal's) eyes, but it is possible to get an understanding of what they might be seeing if we understand their visual systems. We can assume that most humans see the world in more or less the same way because we all have the same visual apparatus. But the visual world of a horse, with its large eyes, panoramic field of view, and different organization of the retina, will not be quite the same as ours. For those who work with horses, it is important to keep this in mind. For example, many horse owners have commented that an animal will spook at an object when it passes it going in one direction, but not when coming back in the opposite direction. There is no anatomical basis for this separation of information between the two eyes, but it is the case that each eye has a quite different view of the world and the horse's brain must combine this information in a way that could not happen in the human visual system. Similarly, the head position of an animal doing dressage may be such that it does not have a clear view of objects directly in front, because they fall into that blind region below the nose. When working with and training horses, keep in mind their limitations. If we understand more about how they might be experiencing their environment, through their eyes, ears, nose and every other sense, then it becomes much easier for us to develop effective training programs for them.

Reference

Timney B, Macuda T. Vision and hearing in horses. J Amer Vet Med Assoc 2001; 218 (10): 1567-1574.

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