The five senses of a horse

Eyesight

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In our everyday experience, trying to understand how someone else sees the world is not a rare occasion. Besides, this is at the basis of the phrase "putting yourself in someone else's shoes". In other words, it is normal to concede that the way we perceive reality varies from person to person.

Where does this weltanschauung come from? Certainly from history, from our own experience and from the way our body interact with reality. Low temperatures, for example, are perceived in a different way depending on the speed of our metabolism (usually faster in men than women: hence the ongoing rows between married couples on the number and thickness of blankets), the thirst sensation changes with age, and so on.

When we approach an individual of a different species this becomes even more difficult, because their "vision of the

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world" comes about via different tools. For a horse, smell has an importance that is completely unknown to humans and, by the same token, dusk provides useful information to our four-legged friends. The ability to "feel with the horse's senses" is a prerogative of the great horsemen and represents the basis on which you can build a constructive relationship with these animals, characterized by a thousand and one different signals.

Understanding how a horse sees the world is therefore paramount. But what tools does a horse have to interpret reality? This is easily said because the information coming from outside the body – the so-called exteroception – is all mediated by highly specialized nerve terminations which all together form the ultra famous five senses: eyesight, smell, hearing, taste and touch.

Now, if horses and humans have the same senses and basic structures, evolution has ensured that these structures would perfectly adapt to the various organisms creating differences that, albeit minor from a functional point of view, become very important when it comes to mutual understanding.

In other words, the horse does not see the same things that a man does (it sounds like Rutger Hauer in Blade Runner when he says he has "seen things you people wouldn't believe") and this generates different behaviors in the two species. Let's see this in more detail.

The field of vision of a horse

The eyes of the horse are large and placed out on the corners of its head giving it a larger field of vision of a human, even though its perception of depth is not as accurate as ours. On the horizontal plane, horses can see almost at 360 degrees except for a blind spot at the back of the horse of about 5 degrees, which coincides almost perfectly with the area where the rider sits. The horse can see this area by twisting its head. Given the presence of this blind spot, it is good practice to "warn" the horses when we approach them from behind because these animals can be easily startled by something they do not see where it is coming from. This large field of vision is very advantageous for prey animals, as they can see the oncoming predators early; it also means that they can keep a more watchful eye on the rest of the team.

Each eye can see at up to 215 degrees, but this measure is more often around 190-95 degrees. There is obviously an overlap in their sight and so the brain receives two images of an area (one for each eye). This is known as "binocular vision", the only area where the horse has a correct tridimensional vision and can judge the distance correctly. This is an arch of about 70 degrees in front of the horse. On the vertical plane each eye has a 180-degree field of vision.

The eyes of some horse breeds such as English thoroughbreds or trotters are placed out on the corners of their head and therefore give a smaller binocular vision and a lower stereoscopic ability. Those breeds whose eyes are placed further down on the head and a bigger eyeball, for example purebred Arabians, have probably a wider binocular vision with which they can determine distance more accurately.

The horse's vision at dusk

Horses need less light than men to see.
They have a layer of specialized fibers underneath the retina that covers the internal part of the eye. This structure is called tapetum lucidum and reflects light on the retina. Therefore a horse makes better use of the available light and so can see better in the dark than men. But this implies that horses are also more easily dazzled by bright light and partially justifies the fact that they sometimes have difficulty in adapting their eyesight when going from a dark area to a lighted one. This does not mean that the horse is a nocturnal animal even though horses in the wild tend to be more active at dawn and dusk. Other structures that help the horse in low light are the sensitivity of the pigments in photosensitive cells and the relatively large size of their eyeballs.
Most of the light that goes into the eye comes from high in the sky; however, having no winged predators, horses do not need to know much about what is happening above them. The efficiency of the eye is therefore enhanced by the partial shading of this incoming light. The horse can do this in different ways: first of all, eyelashes act as a sun screen; secondly, inside the eye and protruding with respect to the upper margin of the pupil are some structures that look like large cysts. These are called corpora nigra or granula iridica and it is assumed that they act as internal screens or protector inside the eye; finally, also the shape of the pupil help in this activity by being wider than higher: this decreases the quantity of light from above and below but keeps the visual field on the horizontal plane.

Characteristics of a horse's eyesight

Horses see more clearly at far distances than men. This derives probably from natural selection, because horses, when grazing in wide meadows, are more interested in detecting distant objects and, if necessary, identifying them as predators. If this happens when the object is closer, it is probably too late!
Horses are also very good at spotting moving objects on the edge of their field of vision. It is likely that movement along the edge of their field of vision is more easily recognized. This is particularly due to an enhanced sensitivity of the peripheral retina cells. Under natural circumstances, horses respond to the presence of predators if they come too close or if they move fast, and so, being particularly sensitive to spotting movement is a useful way to stay alive. The ability to recognize movement helps also identify a potential predator in disguise.
Rapid or jerky movement can scare the horse and make them spook. This sensitivity can also cause problems to people the horse already knows if they appear suddenly or move fast within the horse's field of vision. However, we can turn this characteristic to our advantage: fast and rigid movement can be employed in certain type of training to stimulate the horse to focus on the trainer.
The sharpness of a horse' eyesight (a measure of the degree to which details and color contrasts are perceived) is lower than in humans but better than that of other animals. The quantity of details that can be detected is influenced by a series of factors, including the density of photoreceptors. A higher density means that more details can be perceived. We can compare this with the sharpness of computerized images, which depend on the number of pixels.
Horses tend to suddenly lift their head in order to see close-by objects better, especially when they are scared. This is probably done because they are trying to bring the object into clearer vision at the level of the strip in their eye, so as to get

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An eye consists of a layer of photoreceptors, a system of lenses that direct light onto these receptors and a system of nerves moving information from the receptors to the brain. Eyes are rotated and moved thanks to the action of seven muscles attached to the eyeball.
The eyes of a horse are about 5 x 6.5cm and are some of the biggest eyes among living mammals. This immediately leads to think that the horse relies heavily on eyesight to receive information on the outside world.
The rays of light go through several structures before reaching the photoreceptors. The first one is the cornea, which tends to curve light rays towards the center. Subsequently the rays go through the aqueous humor, which fills the space between the cornea and the crystalline lens. While passing through the crystalline lens, the rays of light are once again curved towards the inside so that the ray themselves, initially parallel, are all diverted towards a point called the focal point. Behind the crystalline lens is the vitreous humor, a transparent substance that helps the eyeball keep its shape.

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Colors

Horses cannot distinguish colors as well as men.
In order to have a complete vision, an animal needs three different pigments; they are located in the photoreceptors called cones. Each cone responds maximally to different colors but react in a less pronounced way also at a wider wavelength interval. Basically, there are receptors that are highly activated by one color, less by another and not at all by a third. There can be a certain degree of overlap between the sensitivity interval of a pigment and that of a different one. Men have three different types of pigments, corresponding to blue, green and red. Therefore, having one type of cones alone would not be very useful, as color perception is produced by recording the different response of each cone type to the stimulus. If there are only two pigments, it is likely that there is also the inability to recognize some colors. This area of study is very complex and if not carefully checked might easily lead to the wrong conclusions.
According to recent studies, horses can certainly recognize different colors and 27 shades of gray. The most easily identifiable color seems to be yellow, followed by green, blue and red – thus suggesting that this animal has three different pigments, as in men.
Other studies suggest that horses, having just two pigments, cannot see green, as this color only slightly stimulates the cones adapted to red and blue. As a result, green cannot be distinguished from the same shades of white or grey. ❑

Photoreceptors

There are two types of photoreceptors, rods and cones, which are found on the sensitive layer of the eye called retina.
Rods are more sensitive than cones to low light, but can only send information on their activation or non-activation. As a result the brain can only produced black and white images using the information received from the rods. They enable night vision but not color recognition in low light.
Cones have various substances (pigments) that respond to different wavelengths, hence to different colors. Each color that is visible in the outside world generates a unique combination of activity among pigments and provides a code to the brain which can then recognize the colors. These pigments are less sensitive than the one – the only one – found in rods and so color vision is possible only with more light.