Position of the head is not associated with changes in horse vision

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Summary

It has become accepted that the horse cannot see directly in front when the nose is lowered and must therefore rely on the rider. We tested the hypothesis that this conclusion would be correct only if the horse did not adjust the eyeball horizontal axis to changes of the head position. The results of the present study suggest that it is unlikely that horses have limited vision in relation to their head position when driven by the rider, and that the horse maintains the optimal horizontal eyeball position regardless of head position relative to the ground.

Introduction

Harman et al. (1999) examined the eye of the horse and concluded that the horse cannot see directly in front when the nose is lowered as during riding ‘on the bit’, and that therefore the horse must rely on the rider. These conclusions have been generally accepted as innovative information. Images showing the suspected monocular and binocular visual fields and the blind region can be found on internet pages for riders and horse lovers and in respected books (e.g. McGreevy 2004).

Head posture is one of the most important variables in nonvocal communication among horses (McGreevy 2004). For example, a stallion approaching vigorously another male typically arches the neck with the head below the horizontal during aggressive interactions. Similar postures are displayed by frightened horses (McGreevy 2004). The questions arise as to why horses handicap themselves during stressful social interactions that can lead to a fight causing injury or death or in an uncertain situation that might be dangerous for the subject (Feh 1999).

Horse vision appears to have evolved more for detection of predator approach from any angle than for accurate visual identification of stationary objects, especially those seen at a distance (Saslow 2002). In order to obtain the clearest possible picture of the visual stimuli, the image must be projected onto the area of the retina with the highest ganglion cell density. This area has been found to coincide with the area responsible for binocular vision, the temporal end of the visual streak (Harman et al. 1999; Guo and Sugita 2000; Ehrenhofer et al. 2002). Harman et al. (1999) related the visual field to the axis of the head, not of the eyeball. If this were true, then a grazing horse on a pasture with lowered head would be vulnerable to predators and their way of grazing should be interruptive. In reality, however, it often appears that the natural activity of horses is to walk a few steps and forage with the head down before walking again (Houpt and Ogilvie-Graham 2002).

Horses have 4 rectus (musculus rectus dorsalis, r. ventralis, r. medialis, r. lateralis) and 2 oblique (obliquus dorsalis and o. ventralis) muscles that move the eyeball (Ashdown and Done 1996). The horse therefore has the potential to keep the eyeball in an optimal position of the visual streak enabling vision in any position of the head. The present study involved the position of the horizontal eyeball axis in response to lowering and raising the head, and tested the hypothesis that the conclusions of Harman et al. (1999) are correct only if the horse cannot adjust the eyeball horizontal axis to changes of the head position.

Materials and methods

Horses

The subjects were 16 riding horses (11 geldings and 5 mares) of different age (range 5–14 years) and breed (10 European bred Warmblood horses, 4 Oldkladruby horses and 2 Thoroughbreds) stabled at 2 riding facilities (school farmstead in Humpolec, n = 12, and riding-school of the University in Prague, n = 4).

Experimental procedure

The experiment was designed as a topic for 3 classes of Czech University of Life Sciences undergraduate students (n = 57) who were split into groups of 3 or 4 students. Each group tested one horse held on a halter in a well illuminated location. The students stood by the horse and observed the position of the oval pupil at a distance of several centimetres and recorded the angle of the pupil in reference to the ground 10 times for each eye in 3 situations: 1) when the student lowered the horse’s head to the ground by pulling the halter; 2) when the horse was being ridden ‘on the bit’, i.e. with the neck and back arched and the nose just in front of the vertical (see Harman et al. 1999, Figs 6a and b) with one of the students being in the saddle; and 3) when the horse lowered its head spontaneously (e.g. as offered a bait on the floor). Change in the oval pupil angle towards the ground and time delay for this change following a stimulus were also recorded.

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Results

Thirty records of oval pupil position for each eye for each horse (total 960 records) were obtained. No variation between horses, sex, or laterality of the eyes was detected and no statistics were therefore calculated (all combinations of comparison fulfilled the criterion of the Sign test for P<0.001). In all cases, including when grazing, the horses rotated the eyes smoothly keeping the oval pupil axis permanently in the horizontal position (zero angle) in reference to the ground. Figure 1 shows 3 positions of the head and magnified detail of the eye with visible position of the oval pupil. In Figure 2 the horse is being ridden ‘on the bit’.

Discussion

The horizontal axis of the eyeball of the horses was invariably similar when the head position was raised (Fig 1 top left) or lowered (Fig 1 bottom left). This suggests that the horse has identical vision conditions in terms of morphology regardless of head position. According to Harman et al. (1999), the horse rotates the nose up high in order to observe distant objects because binocular overlap is oriented down the nose, with a blind area directly in front of the forehead. Nevertheless, it is necessary to take into account the rather poor spatial acuity of the horse (Carroll et al. 2001; Timney and Macuda 2001). Elevation, as well as lowering the head when observing a close object, may enable an optimal combination of the visual, acoustic and olfactory perception (Saslow 2002). In addition, the riding horses may also maintain balance while galloping and/or jumping by stretching the neck and elevating the head.

In general, arching of the neck with dropping of the head below the horizontal, as displayed in various social interactions among horses (McGreevy 2004) does not change visual perception of the individual involved. By keeping the position of its eyeball, the horse, as potential prey, retains the permanent benefit of being able to scan the lateral horizon for potential threats with its monocular, fields even when grazing.

In conclusion, it seems unlikely that horses would have limited vision in relation to their head position when driven by the rider. If a showjumping horse is to see and judge the distance of a fence that it approaches, it need not have the ability to raise its head and direct its binocular field in the forward direction as recommended earlier (Harman et al. 1999). Instead, the horse maintains the optimal horizontal eyeball position regardless of head position.

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References


**Author contributions** All authors contributed to the initiation, conception, planning and writing for this study. The statistics were by L.B.