

# ***Visual Thought Stopping for Pain Stress and Depression***

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### ***Vision in Dogs, Horses, and Cats***

1. Small monocular visual fields of peripheral vision in dogs and cats (~80°) as compared to the horse (146°). The horse has a total field of vision of near 350°.
2. Large **frontal binocular** visual field of 85° in dogs and cats, and 65° in horses. The posterior blind spot of dogs and cats is ~80-120° while the blind spot of the horse is ~3°.
3. Dogs have cones that are receptive at 429 and 555 nm and are dichromats. All evidence suggests that the dog is dichromat with vision similar to a human who is red-green color blind.. Cats are weak trichromats. Feline cones peak at 450, 500 and 555 nm. They live in a world of fuzzy pastels

Dogs and cats appear to respond to the blue and yellow short-wave length colors the best, but appear to have trouble with green and red. Both are also rod-dominant animals. As rods do not function in daylight these animals are dependent on their few cones for spatial and temporal visual resolution, which probably means that their blue and yellow visual world is a fuzzy blue and yellow world. What appears red to us is simply dark to the dog and cat, and a part of the green spectrum is indistinguishable from white. Colors that would appear very rich to us are more pastel-like to the cat. The cat sees a green, grassy lawn as a whitish lawn, and a green rose-bush as a whitish bush with dark flowers.

4. Most dogs are emmetropic with a tendency for mild myopia in German Shepherds (-0.86D), Rottweilers (-1.77D) and Miniature Schnauzers (-0.66D). Myopia is associated with nuclear sclerosis in older dogs. Refractive errors are rare in cats, but when they do occur, they tend to be myopic (-1.5D).
5. Acuity is 30 cycles per degree (cpd) for humans, 18 cpd for horses, 12 cpd for dogs and 6 cpd for cats. Acuity in dogs is 0.4 times that of people, 0.67 times that of horses, and 2 times that of cats. Acuity in cats is 0.2 times that of people, 0.33 times that of horses, and 0.5 times that of dogs. If normal human vision is 20/20, then that of the dog is 20/50, the horse 20/33, and that of the cat is 20/100.
6. Aphakic condition in dogs and horses is hyperopic. Streak retinoscopy for air or spectacle correction is +14D in the dog and +10.5 D in humans. Pseudophakic emmetropia requires +41D intraocular lens to correct the hyperopic aphakic condition in the dog. Aphakic horses are 8-10 D hyperopic.

The pseudophakic cat requires a +55-65D IOL to correct aphakic hypermetropia. A small pupil would help correct some of the aphakic hypermetropia.

7. The preponderance of large diameter axons and large ganglion cells indicate that the dog should have good motion detection and high temporal contrast capabilities. Acuity is less than humans and horses, but greater than the cat.

8. Siamese cats have fewer ganglion cells, little stereopsis, less acuity and too much crossing over of optic nerve axons at the optic chiasm. This results in misrouting and suppression of the visual input from the nasal visual fields at the LGN. Cross-eyedness may be an adaptation to move the nasal retinas (and temporal visual fields) more anteriorly, as the more esotropia that is present the more misrouting of axons that has occurred.

9. The vertical stenopaic slit pupil of the cat allows for maximum light control and optically decreases astigmatic scatter in the horizontal meridian. The horizontal pupil of the horse would minimize scatter in the vertical meridian.

10. The lens of dogs and cats has weak accommodative ability and therefore they have limited near focus capability. The corneal curvature of both species (7.9 mm in dog, 9.1 mm in cat) is much greater than the human (7.0 mm) to compensate for this.

11. Adaptations for Dim Light: The minimum threshold of light for vision in cats is 6X lower than that of humans. The light threshold for dogs is > than cats. Central retina is predominantly rods in dogs while it is cones in humans.

The rhodopsin of dogs is of longer wavelength than humans (510 vs. 496 nm) and takes longer to regenerate.

The dorsal located tapetum increases vision in dim light. The feline tapetum reflects light 130X more than the human eye. Larger pupil and larger corneas permit more light to enter the eye. The more posterior location of the feline lens makes for a smaller and brighter retinal image.

12. Sensitivity to Flickering Lights: Canine rods can detect flickering light up to 20 Hz with cones able to detect flickering light up to 70 Hz. Because of this the dog would see a TV picture to flicker as the screen is updated 60 times/sec.

13. Equine Vision: Very good motion detection but poor acuity in the peripheral retina. The nasal extension of the retina, the laterality of the eyes, and the horizontal pupil facilitate tremendous peripheral vision for the horse standing with its head up. The horse utilizes both eyes until an object approaches within 3-4 feet when it is forced to turn its head continue to observe with one eye. Horses need accommodate < 2D to maintain a focused image on the retina.. There is no need for a "ramp retina". Mean refractive error of horses is -1.0D. Cones are present in the horse retina suggesting that they have the capacity for color vision. They may have more trouble with short wavelength colors such as blue, but this is controversial.