

Vision Science IV - Binocular Aspects of Vision

Examination 1

(2/11/2000)

1. Currently, most lasers used in refractive surgery attempt to ablate a spherical correction into the cornea using a broad beam, while the patient stares at a fixation target. Name three kinds of improvements that must be made to refractive lasers, in order to consistently provide patients of the future with “supernormal “ vision. (3)

Active eye tracking to neutralize eye movement related error
Correction for the higher order aberrations of the eye in addition to the sphero-cylindrical refractive error.
A “flying spot” or small beam, capable of producing irregular ablation contours

2. Which of the following is **NOT** an advantage of binocular vision over monocular vision? (1)

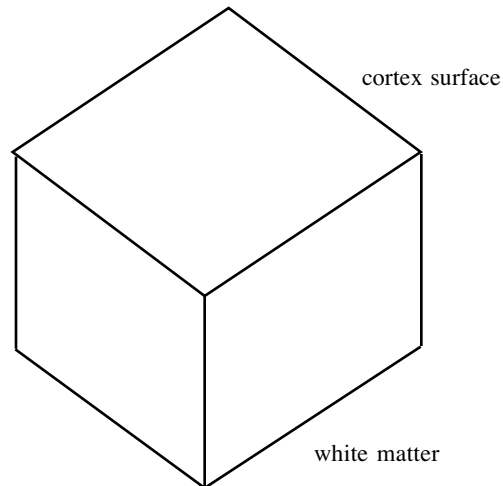
- A Superior depth perception at all distances
B An extra eye, in case one is injured
C Larger field of view
D Stereopsis
E Improved acuity and other visual functions due to the summation of data from two eyes

3. Following the example in the first row, for each topic in the left column, circle the word from either the middle and right column that best describes a feature of the magnocellular pathway. (8)

Predominant retinal location	fovea	periphery
Ganglion cell axon size	large	small
Speed of signal transmission	slow	fast
Associated LGN layers	1,2	3,4,5,6
V1 layer of initial synapse	IVC-beta	IVC-alpha
Associated extra striate areas	V5 (MT)	V4, IT
Neuron temporal response	sustained	transient
Sensory specialization	motion	color, form
Summary description	“Where “system	“What” system

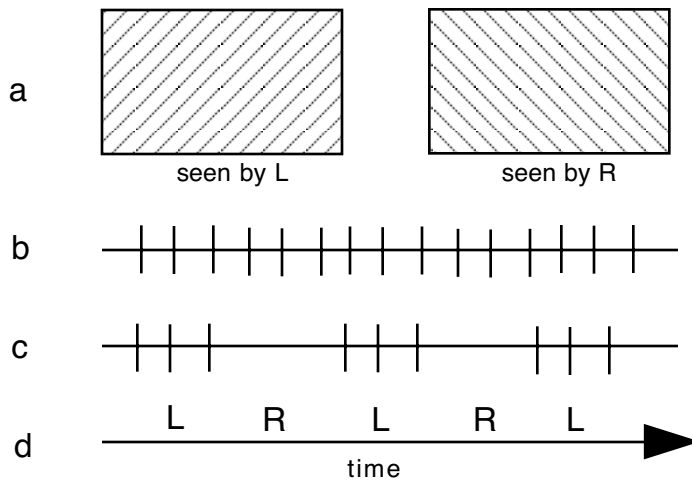
4. Complete the following three-dimensional block figure, schematically drawing and labeling the major parts of the primary visual cortex (area V1). It is not necessary to draw the LGN or area V2. (10)

Layers I-VI, including layers IVB, IVC α and IVC β
A right and left ocular dominance columns
Several orientation columns
A hypercolumn
Blob and interblob regions



See Adler's Fig. 23-22.

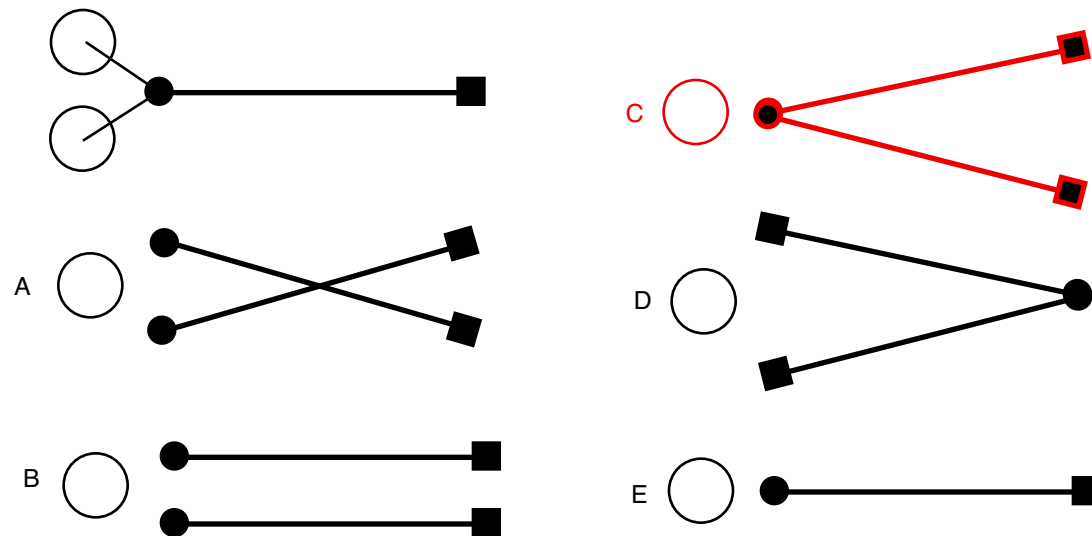
5. The figure below, redrawn from Schwartz Fig. 15-5, illustrates the time trace of action potentials from neurons in a monkey's striate cortex (b) and area V4 (c), while it views the targets shown in a, in a haploscope. The images seen by each eye are labeled. Since they are different, they cannot be fused, but the monkey perceives, first one image, then another. The R and L labels above the time line (d) indicate when the monkey perceives the image seen by the right or left eye. What does this show about the visual system? (4)



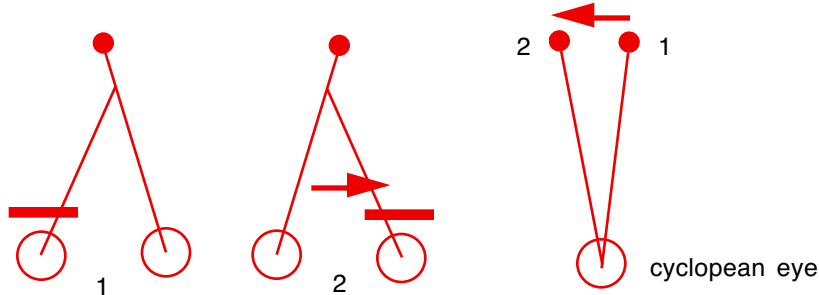
The response of striate cortex neurons corresponds closely with the retinal image, but the response of higher level neurons such as those in V4 are more closely correlated with the perceived image.

6. Which of the following statements about egocentric and oculocentric direction is **NOT** correct? (1)
- A Normally our sense of binocular direction is egocentric rather than oculocentric.
 - B Egocentric direction is often described using a cyclopean eye, but oculocentric directions are referred to either the right or left eye alone
 - C Oculocentric direction is sometimes referred to as "local sign."
 - D They are equivalent term that mean, the binocular sense of visual direction.**
 - E Egocentric direction is computed based on local sign data plus the proprioception from the extraocular muscles.

7. The upper left figure illustrates bifoveal fixation of the near end of a Brock string. From among the other drawings, circle the letter beside the one that best depicts what the cyclopean eye should normally see? The single circles represent cyclopean eyes. (1)

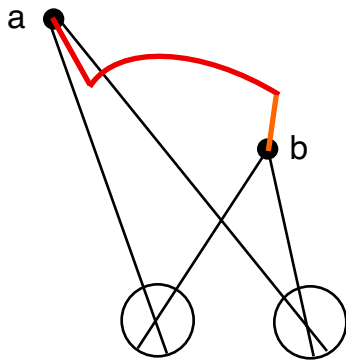


8. Based on the integration of local sign and eye position data, why does a person with esophoria perceive against motion with the alternate cover test? Draw diagrams to help explain your logic. (5)



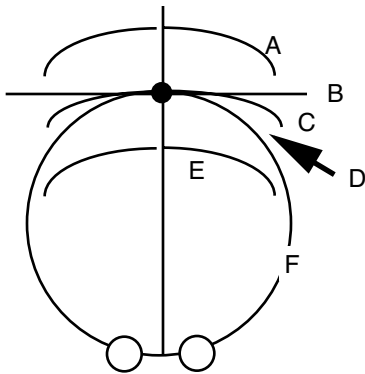
At first, the eye behind the cover (OS) turns in, while the other eye (OD) fixates the target. Local sign data from the uncovered eye indicates that the object lies on the cyclopean primary visual line, but the net EOM proprioceptive data indicates that the cyclopean eye primary visual line should be oriented slightly to the right. The object therefore appears to be on the cyclopean visual axis, which is tilted slightly to the right. When the cover is shift to the other eye (OD), the situation is reversed and the object appears to be on the visual line of the cyclopean eye, which is tilted slightly to the left. Thus, when the cover moves from left to right, the object appears to move from the right to the left.

9. On the diagram below, illustrate how vergence and version subsystems work to change fixation from point a to point b, when both the distance and direction change. Do this by drawing the trajectory of the intersection point for the visual axes. (3)



10. A medical laboratory technician who uses a binocular microscope several hours each day complains of eye strain and occasional double vision during work. Assuming that they are emmetropic, this may be due to (1)
- A a conflict between ego and oculocentric visual directions
 - B meridional amblyopia
 - C an exo fixation disparity
 - D poor stereo acuity
 - E proximal vergence and overconvergence
11. Which of the following statements about disparity vergence is **NOT** correct? (1)
- A It is the only vergence sub-types that is stimulated by retinal disparity.
 - B It makes the major contribution to the total angle of convergence, when shifting fixation from far (20+ ft) to near (40 cm).
 - C It can be subdivided into coarse and fine disparity vergence, each of which is controlled by different neurological centers.
 - D In many cases, it fine tunes vergence by bring the visual axes close to but just short of perfect fixation.
 - E It is synonymous with fusional convergence.
12. What is the horopter?
- It is the collection of points in space at which an object must be located to stimulate corresponding points on the two retinas.

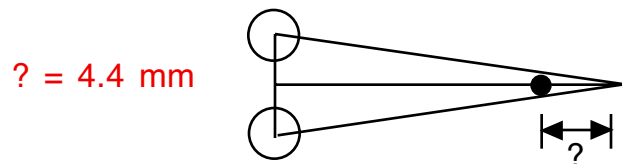
13. Using the diagram below, assign the appropriate letter (A-E) to the following items. (5)



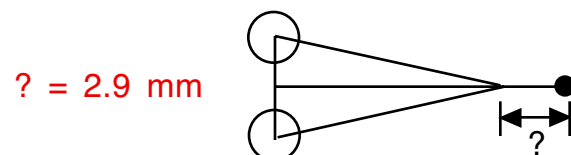
F	Vieth-Müller circle
B	Objective fronto parallel plane
C	Empirical horopter of a subject with no fixation disparity
E	Empirical horopter of a subject with eso fixation disparity
D	Hering-Hillebrand deviation

14. At the abathic distance, the AFPP horopter is (1)
- A inside the Vieth-Müller circle and concave toward the observer.
 - B on the Veith-Müller circle.
 - C concave toward the observer, but beyond the Veith-Müller circle.
 - D coincident with the objective fronto-parallel plane.
 - E convex away from the observer.

15. Assuming a person with a PD=64 mm and a fixation point located 40 cm from the egocenter (midway between the nodal points), calculate where (to the nearest 0.1 mm) the visual axes intersect in the case of a 6' exo fixation disparity. For example, 3.5 mm beyond the fixation point. (2)



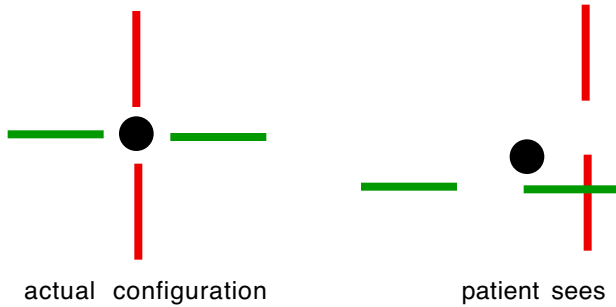
16. Make a similar calculation as in the previous question, but for the case of a 4' eso fixation disparity. For example, 2.5 mm proximal to the fixation point. (2)



17. Name four important features which must be included in any test that will diagnose the direction and magnitude of a fixation disparity. (4)

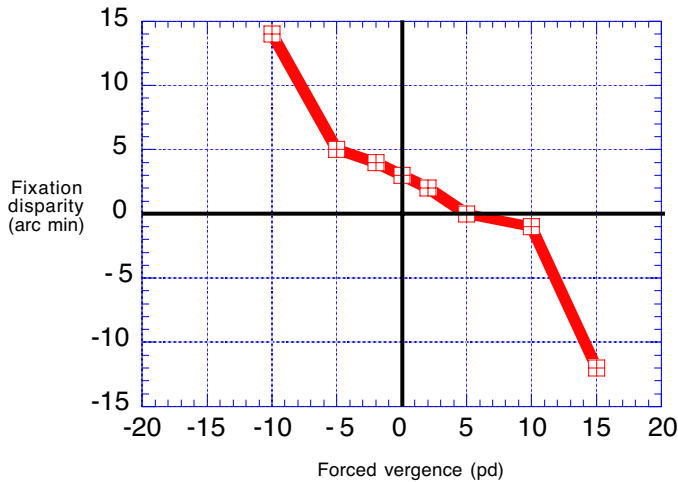
A fixation lock seen binocularly, a portion seen by OD only, by OS only and some way to measure the magnitude of the deviation.

18. Suppose you were measuring fixation disparity using a red-green slide with the configuration shown below (left). When the patient wears anaglyph spectacles (red/green glasses), they see the vertical line with OD only and the horizontal line with OS only. The dot is the fixation point seen by both eyes. If the patient sees the pattern shown on the right, what kind of fixation disparity do they have? (4)



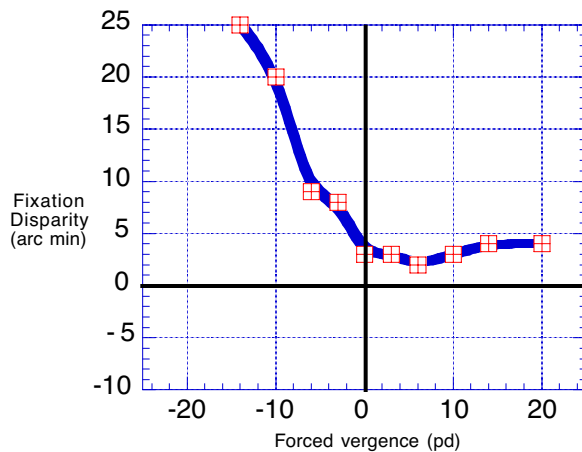
Eso, left hyper (right hypo)

19. On the graph below, plot a Type I disparity/forced vergence response for a patient with a normal amount of eso fixation disparity, an associated phoria of 5 BO and an average slope.



Show an eso disparity of 1-4', Type I sigmoid, correct associated phoria, and slope of less than 1.0.

20. Suppose you measured the forced vergence/fixation disparity function of a patient and plotted the data, as shown below. Summarize how you would interpret the results. (2)



This shows a 3 eso fixation disparity, Type II response.

21. Which of the following is **LEAST** likely to be associated with a large fixation disparity? (1)
- A Asthenopia
 - B Headaches
 - C Poor reading skills
 - D Heterophoria
 - E Diplopia**
22. On a plot of fixation disparity a function of the power of base-in (left side of graph) or base-out (right side of graph) prisms, most subjects exhibit (1)
- A a sigmoid function with increasing eso fixation disparity with BO prisms and exo fixation disparity with BI prisms.
 - B increasing eso fixation disparity with large BI prisms, but a constant amount of eso fixation disparity with low BI and BO prisms
 - C a sigmoid function with increasing eso fixation disparity with BI prisms but increasing exo fixation disparity with BO prisms.**
 - D Increasing exo fixation disparity with large BO prisms but a constant amount of exo fixation disparity with low BO and BI prisms.
23. The AFPP horopter is an indirect way to measure the empirical horopter, since it depends on certain assumptions about space perception. On the other hand, the Nonius technique is considered a more “pure”, direct method. What features of the Nonius technique should make it a more direct way to measure the true horopter? (4)

While binocularly fusing on a fixation target, the Nonius method allows different parts of each rod (i.e., upper and lower halves) to be seen by one or the other eye only. The upper and lower halves will appear aligned only when the rod is located where it will stimulate corresponding points, in each eye. This is the basic definition of the horopter, so it is a direct way to measure what the true horopter.