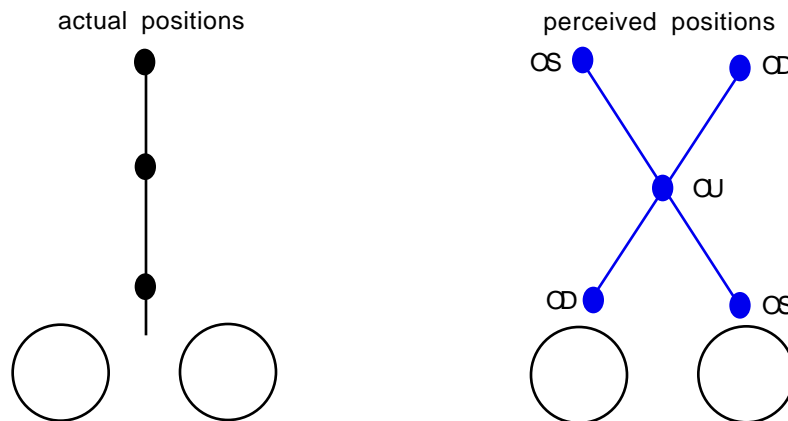


Vision Science III - Ocular Motility & Binocular Vision

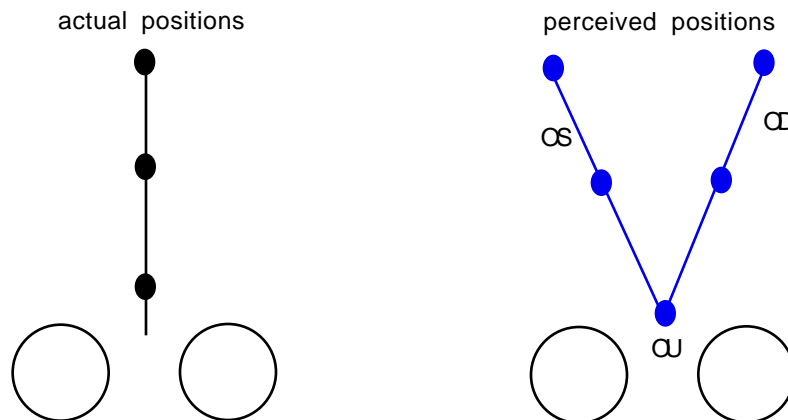
Examination 2

April 6, 2001

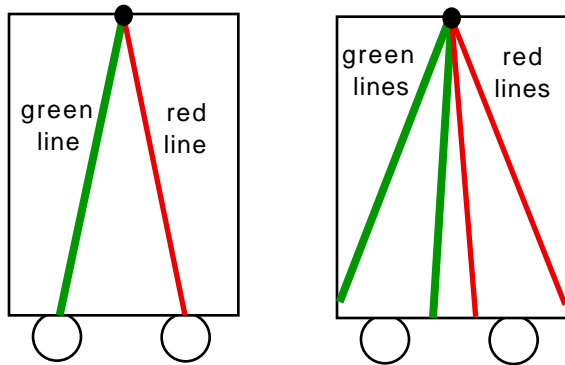
1. What is usually considered to be the most significant benefit of binocular vision? (1) **stereopsis**
2. Name two other benefits of binocular vision. (2) **Larger visual field, spatial summation, spare eye in case of loss of one eye**
3. Many people incorrectly believe that without two eyes a person has no depth perception. How is it possible for a person to have depth perception without binocular vision? (1)
We normally make use of many monocular depth cues when judging distances. These are available even without binocular vision.
4. Normally, all judgements about binocular visual direction are ultimately ... (1)
 - a. oculocentric.
 - b. egocentric.**
 - c. based on local sign.
 - d. based on the abathic distance.
5. A Brock string consists of a string threaded through several beads, and is a simple tool used to both evaluate and train binocular vision. As shown in the figure below, a patient might be instructed to extend the string straight outward from their nose and look at a bead. Assuming bifoveal fixation on the middle bead, complete the figure to illustrate the perception for a person with normal binocular vision. Indicate which portions are seen by the right and left eyes. (3)



6. Assuming bifoveal fixation on the near bead, draw a figure to illustrate the perception for a person with normal binocular vision. Indicate which portions are seen by the right and left eyes. (3)

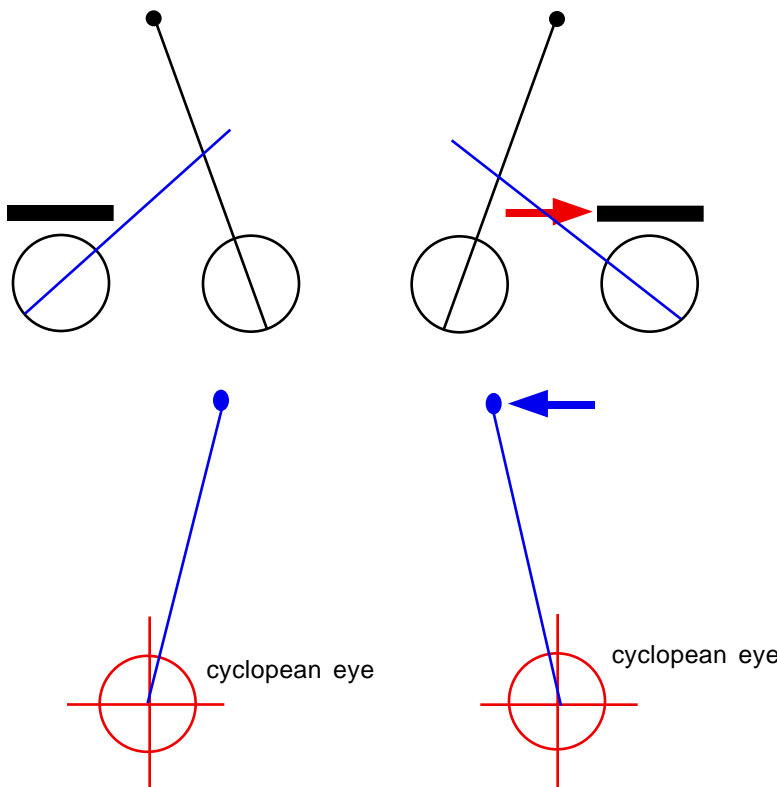


7. In the visual directions lab you viewed a pattern like that illustrated in the left figure. When fixating the intersection point (dot) many people saw four lines (right figure), when three were expected. Explain how each eye contributed to the appearance of four lines. (4)



The lines were probably not exactly aligned with the visual axis of each eye, so each eye saw a line very slightly to the side and a second line further in the periphery. The right eye saw a red line nearly straight ahead and the green line in the left field. Binocularly, these were seen as the middle red line and left green line. The left eye saw a green line nearly straight ahead and a red line in the right field. With binocular vision, there were seen as the green line in the middle and the right red line.

8. Based on the principles of visual direction written in your class notes, explain why a person with an esophoria perceives “against” motion during the cover test. Complete the figures below to illustrate your answer, and include a brief written summary. (4)



Both eyes are converged, but OS will turn inward more than OD when covered, so the net proprioceptive direction for the cyclopean primary visual line is slightly to the right. OD's local sign data indicates that the fixated object is on the primary visual line. The object therefore appears to be on the cyclopean axis, which is tilted to the right. The opposite occurs when the cover is switched to OD, so the object appears to be slightly to the left. Thus, when the cover is moved from the left to the right, the object appears to move from the right to the left; that is, against motion.

9. When adding base-in prism OU in the blur/break/recovery test, as long as both eye are fusing, the target appears to be straight ahead. In some cases, the patient never sees double, but begins to suppress during the test. When suppression begins, the target will appear to begin moving to the side. If the patient suppresses the left eye, in what direction will the target appear to move as base-in prism is added? (Assume no heterophoria.) (1) **To the patient's right.**

10. Referring to Question 9, explain why the target appears centered at first, but seems to move laterally with the onset of suppression. (4)

Equal amounts of BI prism causes both eyes to rotate outward equally, so the ocular orientation data (from proprioception) is equal and opposite from the two eyes. As a result, the cyclopean eye visual axis is straight ahead. Both are bifoveally fixating, so the local sign information from both eye is straight ahead. The combined cyclopean visual axis and local sign information indicates that the object is straight ahead. When suppression occurs, the left eye stops following the prism, but the right eye continue to follow the target since the prism makes it appears to move to the right. Proprioceptive data, coming now, only from OD causes the cyclopean axis to shift right, so the object appears to move right.

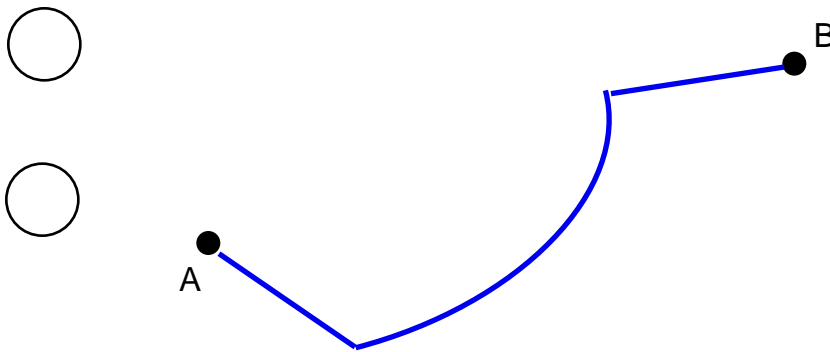
11. Which of the following are correctly matched? (1)

- a. Crossed disparity/ crossed diplopia/ nearer than the fixation point
- b. Crossed disparity/ uncrossed diplopia/ nearer than the fixation point
- c. Crossed disparity/ crossed diplopia/ farther than the fixation point
- d. Crossed disparity/ uncrossed diplopia/ farther than the fixation point

12. Which of the following best describes a situation in which a person would notice physiological diplopia? (1)

- a. After an isolated right sixth nerve palsy, the patient notices diplopia on right gaze.
- b. A person bifoveally fixates the center rod of a Howard-Dolman apparatus, with all other rods located on the horopter.
- c. While focusing on the middle bead of a Brock string, a patient notices that the far bead appears double.
- d. A person with a large astigmatism notices diplopia when he does not wear his correction.

13. On the figure below, show how the trajectory of combined version and vergence movements shifts fixation from a near object (A) to a far object (B). (1)



14. An average AC/A ratio is approximately ... (1)

- a. 10:1
- b. 1:10
- c. 4:1
- d. 1:4

15. An average CA/C ration is approximately ... (1)

- a. 10:1
- b. 1:10
- c. 4:1
- d. 1:4

16. Which of the following is **NOT** true about vergence adaptation? (1)

- a. After the eyes have maintained fixation at one distance for several minutes, vergence adaptation begins to replace disparity vergence and accommodative vergence, thereby avoiding fatigue of those systems.
- b. It is directly stimulated by retinal disparity.
- c. After wearing prism for several minutes, the patient's measured exophoria may become larger due to vergence adaptation.
- d. Both disparity vergence and accommodative vergence have a much more rapid onset than vergence adaptation.

17. A hospital laboratory technician with otherwise perfect vision complains that he sometimes experiences diplopia and eye strain when using a binocular microscope. Which of the following most likely explains his symptoms? (1)
- A Type IV fixation disparity response to forced vergence.
 - An unusually large gain in his disparity vergence mechanism.
 - Proximal vergence that stimulates excessive divergence with respect to the images located at optical infinity.
 - Proximal vergence that stimulates overconvergence with respect to the images located at optical infinity.

18. Summarize why a small amount of fixation disparity is beneficial to the visual system. (2)

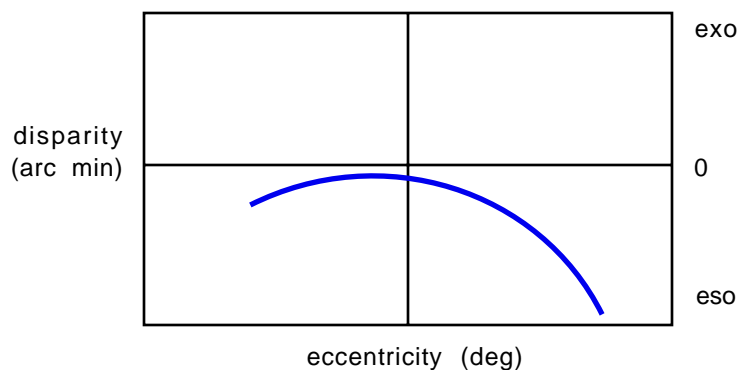
If the fixation disparity were zero, there would be nothing to stimulate disparity vergence and the visual axes would drift toward the phoria position until enough disparity were created to stimulate disparity vergence. Disparity vergence would bring the axes back into perfect alignment, but the process would repeat so the eyes would swing back and forth between alignment and misalignment. A small amount of fixation disparity allows enough disparity so that the fine disparity vergence mechanism could maintain stable alignment.

19. At the abathic distance, the AFPP horopter is ... (1)
- parallel to the Vieth-Müller circle.
 - identical to the Nonius horopter.
 - convex away from the observer.
 - a straight line perpendicular to the cyclopean visual axis.

20. Why does the Nonius technique, in theory, provide the truest measurement of a person's horopter? (3)

This method allows a person to binocularly fixate a target, while upper or lower portions of the peripheral rods are seen by either the right or left eye only. The rods are moved until the upper and lower portions appear aligned. This will only occur when the rods have the same oculocentric visual direction in each eye. This is the definition of the horopter, so it directly measures the horopter without depending on intermediate assumptions such as those used in the AFPP method.

21. Complete the graph below to show an example of a horopter for a person with 1) a Hering-Hillebrand deviation, 2) greater magnification of the OD image, and 3) and eso fixation disparity. (3)

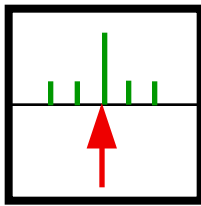


22. On the graph above, show how the Vieth-Müller circle would be plotted and label it. (1)

23. What probably best explains the Hering-Hillebrand deviation and the observation that the horopter usually changes shape with different fixation distances. (1)

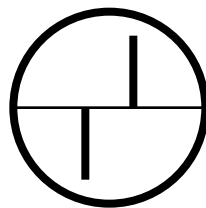
Nasal-temporal asymmetry of local signs on the retinas

24. Suppose you wanted to measure a patient's fixation disparity, but you did not have a Wesson card, Sheedy Disparometer, or other such device designed to measure fixation disparity. Draw a diagram and label the parts to show a Wesson card-type fixation disparity test of your own design. Assume you have only the following materials: anaglyph glasses (red-OD/green-OS), a desktop computer (preferably a Mac), and drawing software. Include dimensions, colors and other specific details. (5)



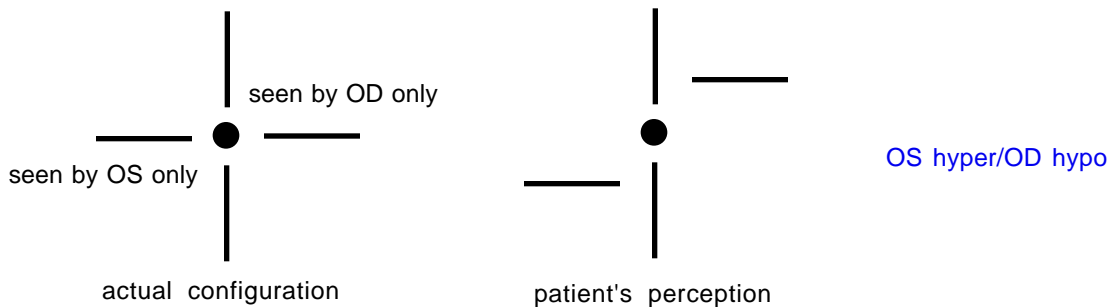
Black square fixation lock, 1 cm wide for an angle of 1.5 deg at 40 cm.
 Top green lines seen only by OD only.
 Bottom red arrow seen by OS only.
 Regularly spaced grid lines to gauge magnitude of the fixation disparity.
 Other designs are possible.

25. Draw a diagram to show how you would design one frame of a Sheedy disparometer to measure an 4 arc minute exo fixation for a patient with a PD of 60 mm and a fixation distance of 40 cm. Assume, as is standard practice, that the upper line is seen by the right eye. Show which direction the lines show be displaced **AND** label the correct distance between the lines to the nearest 0.1 mm. (4)

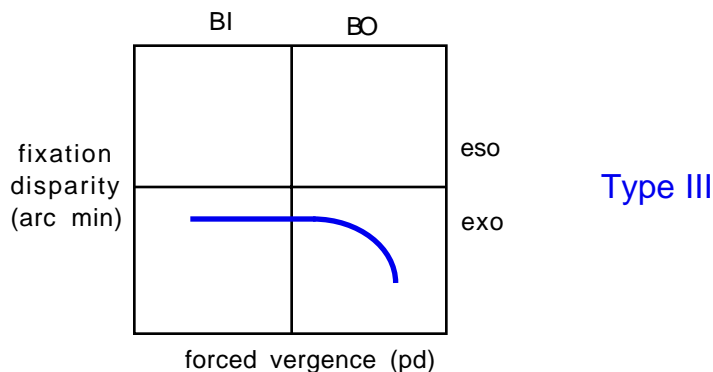


approximately 0.5 mm between the lines

26. If you measure a patient's vertical fixation disparity using a vectograph slide configured as shown in the left figure below, and the patient reports seeing the left line lower and right line higher (right figure), what kind of fixation disparity do they have? (2)

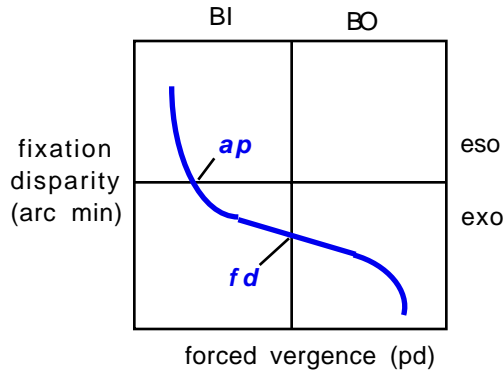


27. Draw a fixation disparity plot that shows an increasing exo fixation disparity with large BO prism, but a constant exo fixation disparity with low BO and BI prism. What type is this? (2)



Type III

28. Draw a graph of the most common fixation disparity type with a fixation disparity of 3 exo, associated phoria of 3 prism diopters BI and a very robust system that maintains nearly the same amount of fixation disparity over a wide range of forced vergence values. Label the fixation disparity, associated phoria and curve type. (4)



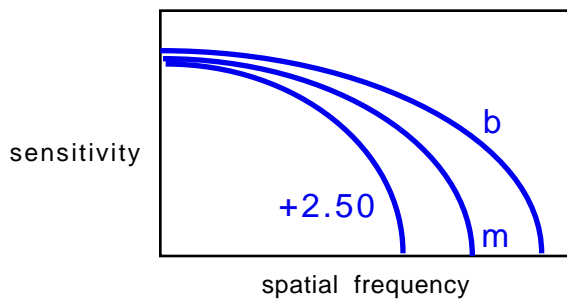
29. If binocular summation is strictly due to the increased probability of detection because two rather than one eye is used (probability summation), how much would you expect binocular sensitivity to improve over monocular sensitivity? (1)

It should be about 1.4 times greater.

30. With respect to brightness perception, Fechner's paradox suggests that visual integration of data from the two eyes is based upon ... (1)

- a. independence
- b. linear summation
- c. adaptation
- d. averaging

31. Draw a graph comparing the contrast sensitivity functions for the following three conditions: 1) Binocular best-corrected, 2) monocular best corrected, 3) binocular for a monovision fit with a +2.50 add over one eye. Label the curves. (3)



32. What specific questions should you ask a patient to see if they experience symptoms of a vertical phoria? (2)

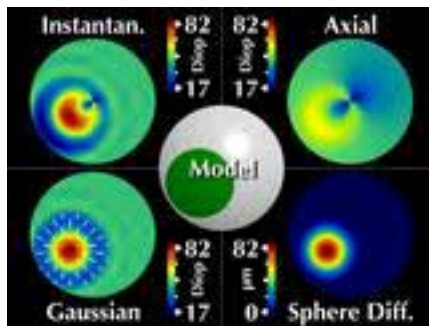
Do they lose their place when reading, skip lines, or use their finger to follow the lines they read?

33. What clinical test did Steinman mention in Chapter 1 that would detect a disrupted sense of oculocentric visual direction in a patient with central serous maculopathy? (1)

- a. Amsler's grid
- b. visuoscopy
- c. interferometry
- d. peripheral visual fields test

BONUS POINTS from LECTURE 36 (3/16/2001)

1. The video describing the UC Berkeley OPTICAL Project proposed a new type of corneal topographic map, the Gaussian power map. Mention one theoretical advantage of using the Gaussian power map over more conventional topographic plots. (5)



relatively shape invariant with different angles of gaze or measurement

2. The other video described some of the research that is being conducted at the US Army Aeromedical Research Laboratory in Fort Rucker, Alabama. Name one of the research topics that is of interest to scientists at this laboratory. (5)

refractive surgery, contact lenses, eye protection, etc. for Army aviators