

## Vision Science III - Ocular Motility &amp; Binocular Vision

**Examination I**

(2/1/2002)

1. Compared to other physiological functions, a large part of the brain is devoted to vision. This is evidence of the importance of vision. Which of the following best describes the extent to which the brain is involved in visual processing? (1)

- The entire superior colliculus processes vision.
- Visual centers extend as far as areas V1, V2 and V3 in the occipital lobe.
- Fifty percent of the cerebral cortex is involved in visual processing.**
- The entire frontal and occipital lobes are devoted exclusively to vision.

2. The National Transportation Safety Board Report, entitled *Descent Below Visual Glidepath and Collision with Terrain, Delta Air Lines Flight 554*, stated that, "the probable cause of this accident was the inability of the captain, because of his use of monovision contact lenses, to overcome his misperception of the airplane's position relative to the runway during the visual portion of the approach." Why would they think that monovision interfered with the pilots depth perception? (2)

They probably assumed that

- monovision reduced the pilot's stereoscopic depth perception
- without stereopsis, the pilot was not able to correctly judge distances, even for far objects.

3. Among the following, which is usually considered the most significant benefit of binocular vision? (1)

- better visual acuity
- larger field of view
- better hand-eye coordination
- stereoscopic depth perception**

4. Name one more VERY important benefit of having two eyes instead of one. (1)

**If one eye is injured, you still can see almost as well with the remaining eye (spare eye).**

5. How is it possible for a person to have depth perception if they lose one eye (lose stereopsis)? (1)

**We can still judge depth using monocular depth cues.**

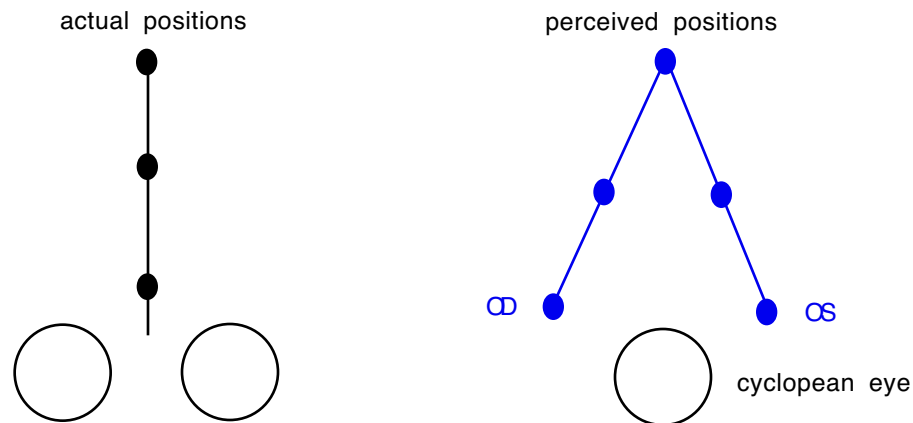
6. Which of the following best describes our normal conscious sense of visual direction? (1)

- egocentric.**
- oculocentric.
- local sign.
- Vieth-Müller Circle

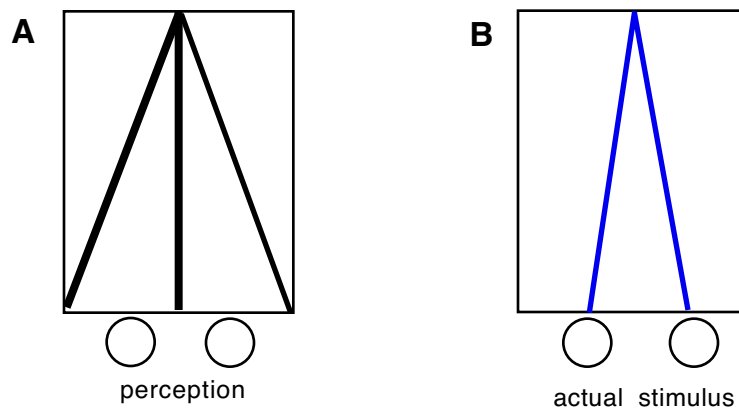
7. What is meant by the term local sign? (1)

- the mean direction of gaze of the cyclopean eye
- oculocentric visual direction**
- ocular dominance
- ocular disparity

8. 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 following figure, a patient might be instructed to extend the string straight outward from their nose and look at a bead. Assuming bifoveal fixation on the far 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. (2)



9. When viewing lines drawn on a board, the person perceives three lines, aligned as shown in A below. On Figure B, draw the actual configuration of the line or lines. (2)



10. During the cover test, a person with an exophoria perceives that the object moves in the same direction as the paddle, while an esophoric patient perceives against motion. This is because ... (1)

- a. the object appears to move in the same direction that the eye moves, for both eso and exo phoria.
- b. the object appears to move in the opposite direction that the eye moves, for both eso and exo phoria.
- c. the object appears to move in the same direction that the eye moves for exo, but opposite for eso phoria.
- d. the object appears to move in the same direction that the eye moves for eso, but opposite for exo phoria.

11. Explain why, during the cover test, a person with orthophoria, who fixates on an object in the midline, perceives no movement. (3)

- Local sign information from both eyes is foveal (straight ahead)
- Both visual axes are converged equally on the fixation point at all times.
- The mean of the two ocular tilts (orientation) is straight ahead.

12. During the cover test, when you move the paddle from the right eye to the left eye, the person perceives that the object jumps up. What kind of vertical phoria does the person have? (1)

OD hypo or OS hyper

13. Which of the following are correctly matched? (1)
- Crossed disparity/ crossed diplopia/ beyond the fixation point
  - Crossed disparity/ uncrossed diplopia/ nearer than the fixation point
  - Crossed disparity/ uncrossed diplopia/ beyond than the fixation point
  - Crossed disparity/ crossed diplopia/ nearer than the fixation point
14. What is physiological diplopia? (1)
- It refers to crossed, but not uncrossed diplopia.
  - The visual appearance of objects located on the horopter.
  - Diplopia normally seen for objects located outside Panum's space.
  - Haplopia normally seen for objects located inside Panum's space.
15. While standing at the north end of a field, you watch a distant flock of geese fly (perpendicular to your line of sight) from east to west. Which kind of movements are your eyes performing? (1)
- conversion
  - diversion
  - version
  - vergence
16. An average AC/A ratio is approximately ... (1)
- 1:4
  - 4:1
  - 1:10
  - 10:1
17. An average CA/C ration is approximately ... (1)
- 1:4
  - 4:1
  - 1:10
  - 10:1
18. Name the six kinds of vergence eye movements and mention what stimulates it. (12)

Type	Stimulus
disparity vergence	retinal disparity
accommodative vergence	accommodation
tonic vergence	basal innervation of the EOMs
vergence adaptation	disparity and accommodative vergence
proximal vergence	awareness that the object of interest is near
voluntary vergence	conscious effort

19. A fusional vergence system with an normal level of gain should provide a person with ... (1)
- zero fixation disparity
  - a small fixation disparity, well within Panum's area
  - a fixation disparity that is equal to Panum's area in magnitude
  - a large fixation disparity that exceeds Panum's area
20. What is a horopter? (1)
- The locations of points in space where an object must be placed to stimulate zero retina disparity.

21. At the abathic distance, the AFPP horopter ... (1)
- matches the objective fronto parallel plane.
  - matches the Nonius horopter.
  - matches the Vieth-Müller Circle.
  - rotates toward the dominant eye.

22. What is meant by the Hering-Hillebrand deviation? (1)

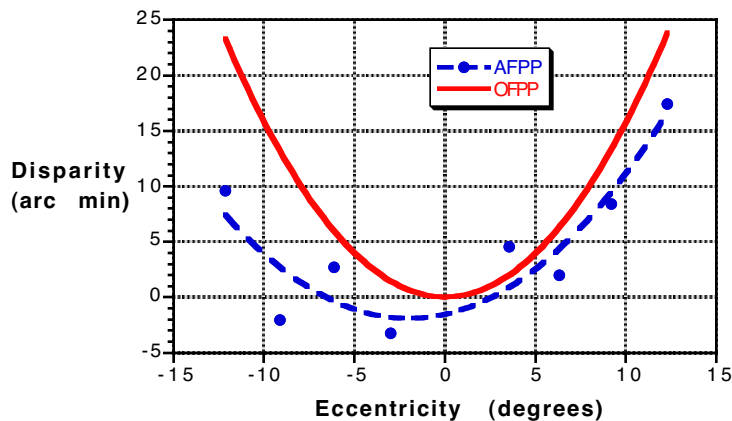
- deviation of the empirical horopter away from the Veith-Müller Circle

23. What is the most accurate method for measuring the horopter and why? (2)

- Nonius method
- It directly finds the points in space that have identical visual directions in the two eyes.

24. On figure below, the AFPP horopter seems to be rotated to the left. What would best explain this? (2)

- greater magnification before the left eye



25. A circle through the two nodal points and the fixation point is the ... (1)

- circle of least confusion
- Veith-Müller circle
- the Hering-Hillebrand deviation
- the empirical horopter

26. If the horopter, determined by the nonius method, lies closer to the observer than the fixation point, this indicates that the subject has ... (1)

- an associated phoria
- an exo fixation disparity
- an eso fixation disparity
- physiological diplopia

27. Briefly describe the important features you would include in a standard Wesson-type horizontal fixation disparity test created on a computer using a drawing program. (Continue writing on back.) (6)

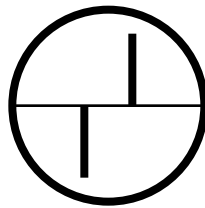
- draw a fusion lock that could be seen by both eyes; for example, a black circle about 1.5° in diameter
- an upper line seen by OD only, for example drawn in green, but seen using a red lens over OD

- similarly a lower line seen by OS only, for example drawn in red, but seen using a green lens over OS
- a scale to indicate the magnitude of the apparent deviation.

28. If you were going to design a Sheedy Disparometer to measure a 2 arc minute eso fixation disparity, how far apart should the bars be separated (to the nearest 0.1 mm)? Assume a PD of 64 mm and a viewing distance of 40 cm. Show your work. (4)

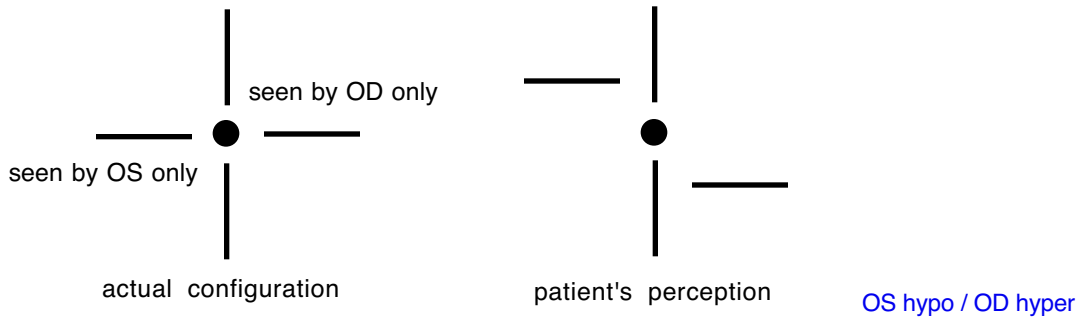
- Calculate convergence half-angle in arc minutes: 274.435'
- Add 1 arc minute: 275.435'
- Compute the distance to the intersection point: 398.542 mm
- Using similar triangles, compute the separation: 0.234 mm

29. Suppose a patient with an eso fixation disparity uses your disparometer (Sheedy principle), and he aligns the lines so that they look like the figure below, which eye sees the top line and which sees the bottom? (1)



OD sees bottom, OS sees top

30. 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 higher and right line lower (right figure), what kind of fixation disparity do they have? (1)



31. Draw four small plots showing Ogle's four fixation disparity types. Label the axes to match the plots we discussed in class, and as shown in our reference books. Also label each fixation disparity and associated phoria, as appropriate. (14)

