

Examination 1

2/10/2004

1. For some functions, binocular vision is only marginally better than monocular vision. There are however, some aspects of vision that are clearly better with binocular than monocular vision. Name two such aspects, and describe the improvement provided by binocular vision. (4)

- Visual field – extends the peripheral visual field to about 180 degrees and large region of overlap for redundancy and binocular interaction
- Stereopsis – provides extremely good depth perception for close distances
- Spare eye – redundancy in case of loss of one eye

2. The NTSB report on the Delta Flight 554 accident concluded 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.*” Contrary to what they concluded, what facts about binocular vision would indicate that monovision was probably not the primary cause? (3)

- Stereopsis contributes little to depth perception at longer distance
- Monocular depth cues would have been more significant than stereopsis
- Monocular illusions were present that may have conflicted with and superceded stereopsis
- Adverse viewing conditions would have degraded stereopsis
- Stereopsis is degraded only slightly with monocular blur

3. What is the difference between egocentric and oculocentric localization? (3)

- Egocentric localization refers to direction with reference to the egocenter, which is a reference point in the head somewhere. (definition)
- It is the sense of visual direction that we are aware of.
- Oculocentric localization refers to visual direction in each eye based on the retinal location of an image relative to the fovea. Need to specify retinal, fovea, or 1° visual line direction.
- We are not conscious of oculocentric direction, but it must be taken into account when the brain computes egocentric direction. (definition)

4. When performing the cover test, the patient notices that the chart appears to jump vertically—as the paddle moves from OD to OS, the target appears to move down. When the cover moves from OS to OD, the target appears to move up. What kind of heterophoria is indicated? (1)

OD hyper or OS hypo

5. When performing the cover test in the case of an exophoria, the chart will appear to the patient to move

- a. in the same direction as the occluder and the eye.
- b. in the same direction as the occluder, but in the opposite direction as the eye.
- c. in the opposite direction to the occluder, but in the same direction as the eye.
- d. in the opposite direction to both the occluder and the eye.

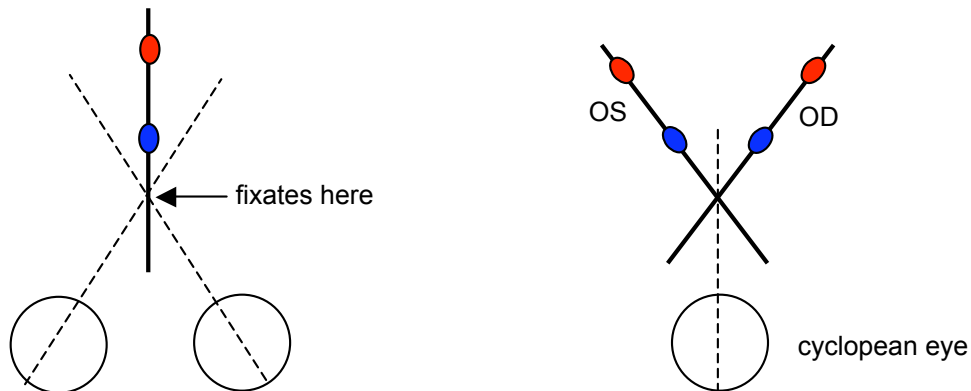
6. When performing the cover test in the case of an esophoria, the chart will appear to the patient to move

- a. in the same direction as the occluder and the eye.
- b. in the same direction as the occluder, but in the opposite direction as the eye.
- c. in the opposite direction to the occluder, but in the same direction as the eye.
- d. in the opposite direction to both the occluder and the eye.

7. When a golfer (with normal binocular vision) watches the ball that he drives straight ahead, he is using which of the following eye movements?

- a. version
- b. vergence
- c. conjunctive
- d. utrocular

8. Suppose a patient holds a Brock string to the bridge of his nose and extends it straight ahead. While attempting to fixate the near bead, his eye actually over converges to the point indicated by the arrow in the left figure below. Use the cyclopean eye (right figure) to illustrate his perception, assuming he is able to binocularly fuse the fixation point. Indicate which portions are seen by OD and OS. (3)



9. If a person fixates a far object, then shifts his attention to a near object, which of the following vergences does the primary work of bring the visual axes from parallel to near convergence on the object of interest?

- a. tonic vergence
- b. disparity vergence
- c. proximal vergence
- d. voluntary vergence

10. After the eyes have approximately converged on the near object, which of the following vergences completes the work by fine-tuning the alignment of the eyes?

- a. tonic vergence
- b. disparity vergence
- c. proximal vergence
- d. voluntary vergence

11. Briefly define the term, “horopter.” (1)

- The set of points in space, where an object must be placed to fall on corresponding points on the two retinas.
- Or, the set of points in space that lie at the intersection of corresponding visual lines from the two eyes, etc.

12. Briefly define, and describe the “Vieth-Müller circle.” (2)

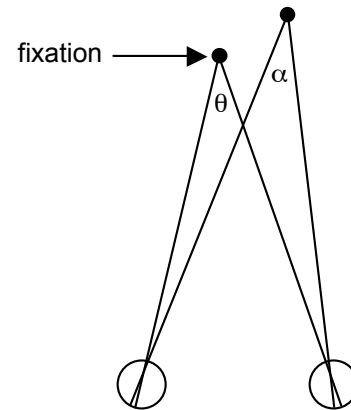
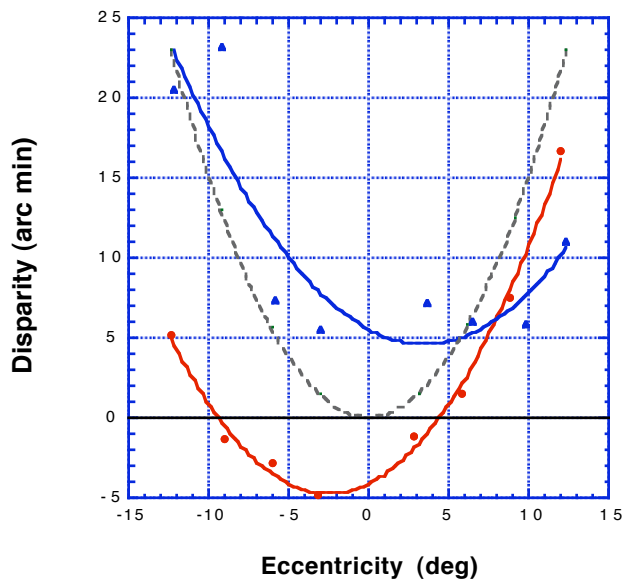
- The theoretical horopter based on assumptions about the geometry of the eyes and visual directions in the two eyes.
- It is a circle that includes the fixation point and two nodal points of the eyes.

13. Mention two techniques that can be used to measure a person's horopter. (2)

- Apparent fronto-parallel plane
- Nonius
- Midpoint of stereopsis
- Midpoint of Panum's area (diplopia threshold)

14. The figure below shows data collected from two members of your class in Lab 2. It plots disparity (relative to the Vieth-Müller circle) as a function of eccentricity (angle of gaze). Disparity is defined as the angle of convergence to fixation point (θ) minus the angle to the horopter rod (α), as shown on the right figure below. The dashed curve shows values for the OFPP. Which of the following best describes the other two curves?

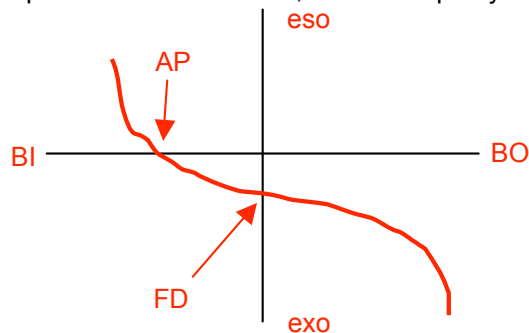
- a. The top curve has an eso fixation disparity and greater magnification for OS.
- b. The bottom curve has an exo fixation disparity and greater magnification for OS.
- c. The bottom curve has an eso fixation disparity and greater magnification for OD.
- d. The top curve has an exo fixation disparity and greater magnification for OD.



15. What is the difference between a fixation disparity and a heterophoria? (2)

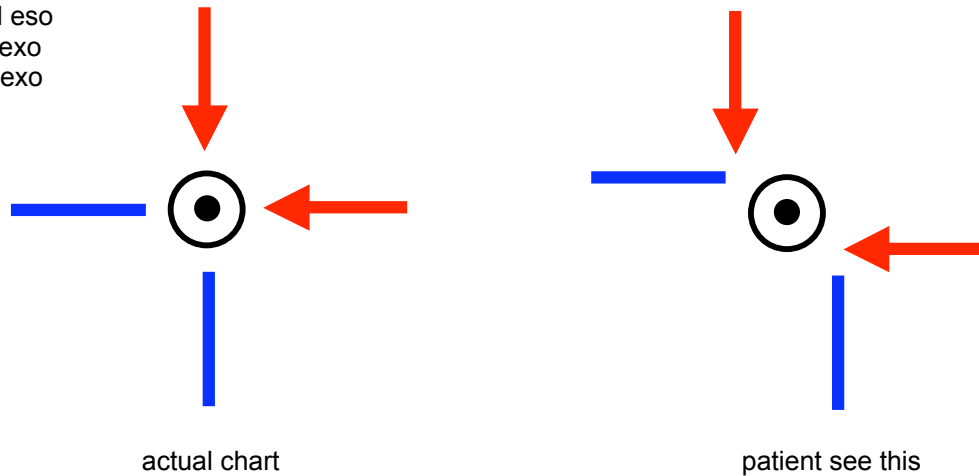
- Fixation disparity is a misalignment that occurs during binocular fusion.
- Heterophoria is the misalignment of the eyes after you interrupt fusion.

16. Draw an example of a disparity/forced-vergence graph for an Ogle Type I pattern, with an exo fixation disparity and BI associated phoria. Label the axes, fixation disparity and associated phoria. (5)



17. The new computerized charts at the Phieffer Optometry clinic have fixation disparity tests that use red arrows and blue lines on a white background (left figure below). Assume that the patient wears a red filter over OD and a blue filter over OS, and see the lines deviated as shown in the right figure below. What kind of fixation disparity does he have?

- a. OS hyper and eso
- b. OD hyper and eso
- c. OS hypo and exo
- d. OS hypo and exo

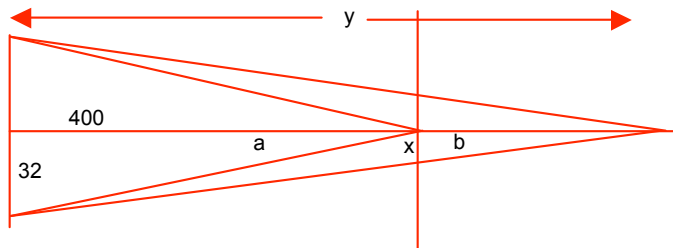


18. Using a standard Wesson card with standard polarized spectacles (top line seen by OD), you can measure a vertical fixation disparity by rotating the card 90 degrees. Assume that the patient continues to wear the same polarized glasses, but you rotate the card 90 degrees clockwise. If the patient now reports that the right line is above center, and the left line is below center, what kind of fixation disparity does he have?

- a. OD hyper
- b. OS hyper

19. If you were going to design a Sheedy Disparometer to measure an 8 arc minute exo 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)

- Calc convergence angle a to center of faceplate. Angle $a = \text{atan}(32/400) = 4.5739^\circ$
- Convert to arc minutes and subtract 4 for angle b. Angle $b = 270.43' = 4.5073^\circ$
- Compute distance y to intersection of visual axes: $y = 32/(\tan(b)) = 405.94 \text{ mm}$
- By similar triangles solve for half-separation, x: $x/5.94 = 32/405.94 = 0.468$
- Double this for the answer: 0.94 mm.



20. If binocular summation were due to probability summation alone, you would expect binocular sensitivity to be better than monocular sensitivity by factor of about ...

- a. 0.7
- b. 1.0
- c. 1.4
- d. 2.0

21. Based on what we learned about binocular contrast sensitivity, briefly explain why monovision would be more acceptable for a patient with a +1.50-diopter near add, than for a patient with a +2.50 add. (2)

- Binocular contrast sensitivity is normally better than monocular contrast sensitivity.
- However it is degraded with monocular blur.
- For blur greater than about +1.50 diopters, the binocular contrast sensitivity may fall monocular contrast sensitivity. That is, they will see worse with two eyes than with one.

22. Imagine that you are looking into the Synoptophore with no slides in place. The light for OS is turned off, but the white background seen by OD has a luminance of 30 apostilbs. You then turn on the light for OS, with a setting of 15 apostilbs. Assuming normal binocular vision, what should happen to the binocular perception of brightness?

- a. The brightness should increase slightly.
- b. The brightness should appear the same as that seen by OD alone.
- c. The brightness should appear the same as that seen by OS alone.
- d. The light should appear to get slightly dimmer (less bright).

23. The scenario described in Question 21 is a demonstration of

- a. the Pulfrich phenomenon.
- b. Fechner's paradox.
- c. the Hering-Hillebrand deviation.
- d. facilitation.

24. Which of the following Synoptophore slide pairs would stimulate Worth Grade 1 fusion only?

- a. Slide 1: cat's body with ears but no tail; Slide 2: same cat's body with a tail, but no ears.
- b. Two nearly identical photos of an optic nerve, taken from slightly different positions
- c. Slide 1: just a fish; Slide 2: just an empty fish bowl
- d. None of the above.

25. Which of the following Synoptophore slide pairs would stimulate Worth Grade 1 and 2 fusion?

- a. Slide 1: cat's body with ears but no tail; Slide 2: same cat's body with a tail, but no ears.
- b. Two nearly identical photos of an optic nerve, taken from slightly different positions
- c. Slide 1: just a fish; Slide 2: just an empty fish bowl
- d. None of the above.

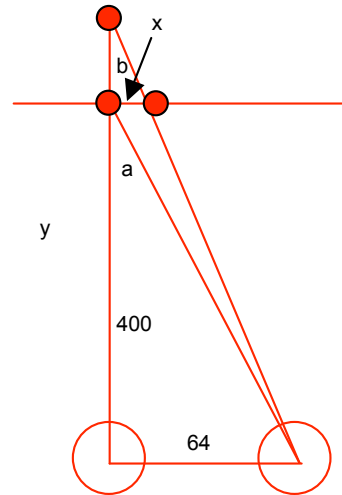
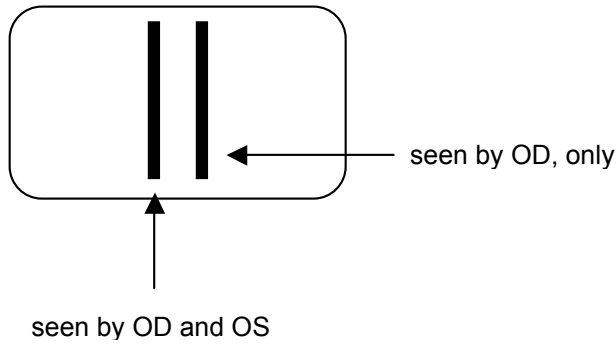
26. Which of the following Synoptophore slide pairs would stimulate Worth Grade 1, 2 and 3 fusion?

- a. Slide 1: cat's body with ears but no tail; Slide 2: same cat's body with a tail, but no ears.
- b. Two nearly identical photos of an optic nerve, taken from slightly different positions
- c. Slide 1: just a fish; Slide 2: just an empty fish bowl
- d. None of the above.

27. When doing direct ophthalmoscopy, you notice an opacity in the pupil that seems to move in the opposite direction as your head. The opacity is probably located in/on the ...

- a. vitreous
- b. posterior lens
- c. anterior lens
- d. cornea

28. Based on the principle of Panum's limiting case, you can create a sense of stereoscopic depth using polarizers and a vectograph target such as the one shown below. The right line is polarized so that only OD sees it, but both eyes see the left line. If these are fused in such a way to create an uncrossed disparity of 60 arc seconds, what is the distance between the two lines? Assume that it has been designed for a PD of 64 mm and a viewing distance of 40 cm. (4)



1. Convergence angle $a = \text{atan}(64/400) = 9.09^\circ = 32,725''$
2. Subtract $60''$ for angle $b = 32,665 = 9.07^\circ$
3. Find distance y : $y = 64/\tan(9.07) = 400.75 \text{ mm}$.
4. Using similar triangles, solve for $x = (64/400)*(0.75) = 0.12 \text{ mm}$

29. If a person with glaucomatous damage to OD has a delay in the signal sent from OD to the brain, how would a pendulum swinging from left to right in his fronto-parallel plane appear to move?
- a. Away from the person, or in a clockwise elliptical path if seen from above.
 - b. In the opposite direction, that is, right to left in the fronto-parallel plane.
 - c. In a circle that contains the fixation point and nodal points of both eyes.
 - d. **Closer to the person, or in a counter-clockwise elliptical path if seen from above.**

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Bonus Question. (4 points)

When using the Synoptophore, many people notice that the target appears to become smaller when you make the eyes converge. This is sometimes referred to as the SILO effect. Based on the principle of size constancy (like the moon illusion), explain this happens?

- When the eyes converge you sense that the object is coming closer.
- Normally when objects come closer, retinal image size increases.
- Since retinal images don't increase in size, your brains assumes the object must be getting smaller, and it creates the illusion.