

Questions to lectures April 26 and June 14, 2010  
(Schaeffel)

**1. Which statements are correct?**

- a. Light/dark adaptation has to occur at the first step of seeing, the phototransduction, because saturation has to be prevented
- b. if a photoreceptor is saturated, it can no longer signal changes in luminance
- c. during light adaptation, the photoreceptor response curve is shifted to a lower luminance range
- d. dark adaptation in the human eye can be psychophysically measured over time by locating the detection thresholds for dim light
- e. the major mechanism of light/dark adaptation represents adaptive changes in rhodopsin concentration in the photoreceptors
- f. the human eye can adapt to luminances over a range of 5 log units

**2. Which statements are wrong?**

- a. one of the major functions of the retina is information reduction, because too much information is encoded by the photoreceptors
- b. in the retina, about 125 Million photoreceptors are compressed into about 10 Million ganglion cell axons which leave the eye through the optic nerve
- c. because the visual system has to reduce information, it is optimized to process differences rather than static signals
- d. fixational eye movements are disturbing because one would like to keep the eye stationary when one looks at an object
- e. Troxler showed vision fades when the retinal image is stabilized
- f. one mechanism to make the visual system sensitive to edges and spatial changes in luminance is to generate receptive fields with ON-OFF structure

**3. which is correct?**

- a. receptive field sizes can change dynamically by changing horizontal cell coupling and coupling of amacrine cells
- b. horizontal and amacrine cell coupling is controlled by extracellular dopamine
- c. contrast adaptation refers to a shift in supra-threshold contrast sensitivity that depends on the contrast of the object
- d. humans have their highest contrast sensitivity at high spatial frequencies above 10 cyc/deg (where the details are very fine)
- e. underwater we cannot see sharply because we become very myopic
- f. testing the detectability of sine wave gratings with different spatial frequencies is a powerful way to measure visual acuity

**4. which is wrong?**

- a. one of the striking features of our visual pathways is the hemifield crossing in the optic chiasma. As a result of hemifield crossing, the temporal visual field of both eyes is imaged on one side of the visual cortex
- b. we have large binocular zone of about 170 deg (the part of the visual field into which both eyes can see) - but the nose precludes that we can see far out in the periphery of the visual field with both eyes

- c. the blind spot (optic disc) is usually not visible to us because of "filling in" by the cortex
- d. visual information is transmitted through the optic nerve, the optic chiasma, then through the optic radiation, lateral geniculate nucleus, and then the optic tract to the primary visual cortex (V1 or A17)
- e. information from both eyes remains strictly separated in the lateral geniculate nucleus
- f. in addition to the major afferent pathway through the lateral geniculate nucleus, some visual information is also transmitted to the cortex through the superior colliculus, and mediates "blindsight"

### 5. Which is correct?

- a. the visual system uses two major functionally different pathways, the M and P pathway. P cells (neurons in the P pathway) have higher acuity, lower contrast sensitivity, and less temporal resolution. M cells have lower spatial acuity but can respond to color contrast.
- b. the superior colliculus is a small nucleus on the roof of the midbrain. It contains a "movement map" for saccadic eye movements, but also topographic maps for other sensory inputs
- c. primates have strict coupling of pupil responses and accommodation in both eyes
- d. the "swinging flashlight test" (illuminating the pupils of both eyes one after the other and observing both pupil responses) is a powerful tool to test the integrity of the afferent and efferent pupillary pathways
- e. if patients complain of loss of vision in certain areas of the visual field, the underlying defect can be localized based on knowledge of the anatomy of the visual pathways. For instance, if vision is blocked in the temporal hemifields of both eyes, one can conclude that visual information is not transmitted through the sagittal plane through the chiasma opticum
- f. P and M pathways show extensive crosstalk in the lateral geniculate nucleus

### 6. Which is wrong?

- a. the layer in the visual cortex that receives the input from the lateral geniculate nucleus is layer 4
- b. Hubel and Wiesel discovered that cortical neurons can be divided into simple and complex cells. Simple cells have circular receptive fields but complex cells have more extended elliptical receptive fields
- c. a striking feature of the cortex is that neurons with the same orientation preference are clustered in columns
- d. while older studies used stimulation of the cortical neurons with stripe patterns of certain orientation, and subsequent histological processing with cytochrome oxidase activity measurements, more recently orientation columns could be detected by fMRI
- e. in the superficial layers of the primary cortex (V1/A17), peg-shaped areas can be found with higher cytochrome oxidase activity ("Blobs"). These areas have been shown to process motion vision.
- f. ocular dominance columns represent cortical areas that have input from one or the other eye. They have been shown to be a requirement for binocular vision.

### 7. Which is correct?

- a. Along the visual pathways to higher centers, receptive field sizes increase in diameter and the processed object feature become more and more selective/specific
- b. the binding problem refers to the question how visual and somatosensory information is brought together

- c. the dorsal pathway/ dorsal stream in visual processing is mainly concerned with object recognition
- d. face neuron are located in the dorsal stream and respond specifically to a face when the illumination comes from a certain direction
- e. to further restrict the amount of visual information that is processed at a time, attention provides a strong filter that can completely suppress some information
- f. self motion, causing "optic flow" on the retina is processed in the middle temporal area in the dorsal stream (area MT)