

Exam 1 study guide

I suggest you read the book and quiz yourself with the key terms at the end of each chapter. The following is a list of topics that we talked about in class. Beware – it is not necessarily all inclusive. It is only an outline of the topics we've covered so far.

Please feel free to email me questions any time. I'll get back to you as soon as I can.
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Chapter 1: (review the key terms on page 18 of the book)

Sensation vs. Perception

The nature of illusions

- What you perceive is not what is physically there
- Perception is an inference, and is rarely ambiguous
- Bottom up vs. top down influences

Measurement of perception

- Phenomenology
- Psychophysics
- Electrophysiology
- Brain Imaging

Psychophysics methods

- Method of limits
- Method of adjustment
- Method of constant stimuli
- Magnitude estimation

Types of measurements

- Matching
- Absolute threshold
- Just noticeable difference (JND)

Phenomena of behavioral measurements

- Weber's law
- Steven's power law

Sensitivity and Thresholds are inverses of each other (Sensitivity = $1/\text{Threshold}$)

Chapter 2: (review the key terms on page 42 of the book)

Light

- frequency vs. wavelength
- we're sensitive to 400-700 nanometers of wavelength

The Eye

- Refraction mostly done by the cornea
- The lens
 - Accommodation
 - Near sightedness, farsightedness, presbyopia
- The retina
 - Differences between cones and rods

- Shape
- Density from fovea to periphery
- Convergence
- Sensitivity to wavelengths (Purkinje shift)
- Notable regions/facts of the retina
 - The fovea
 - The blind spot
 - Photoreceptors point away from light
- Disorders of the retina
 - Glaucoma, Macular degeneration, Retinitis Pigmentosa

Sensitivity of the eye

- How sensitive is the human eye?

Adaptation

- How photoreceptors adapt to light

- The dark adaptation curve – switching from cones to rods over time

Basic neurophysiology

- The action potential – Na flows in, K+ flows out

- Neural response is coded by number of spikes per second (not by the amplitude, shape or speed of the spikes)

Synaptic transmission

- Excitatory vs. inhibitory connections

Chapter 3: (Key terms are on page 68)

More on the retina:

Cells in the retina

- Lateral connections: amacrine and horizontal cells

- Vertical connections: bipolar cells and ganglion cells

- More convergence by rods than cones

- Convergence good for sensitivity, bad for acuity

Lateral inhibition

- Early studies were on the limulus

- Basic neural circuit of excitatory and inhibitory weights

- Can explain Mach Bands, Hermann Grid, and Simultaneous Contrast

- Can't explain: Benary Cross, Adelson's (cylinder shadow) illusion, White's illusion

Receptive fields

- Ganglion/LGN cells: center/surround

- Sensitive to stimuli of a particular size

Beyond the retina

- Optic chiasm – LGN – V1

- Left-right visual field project to right/left hemisphere

- V1 cells: orientation selective cells

- Hubel and Wiesel's discovery of simple and complex cells

- Sensitive to stimuli of a particular orientation and spatial frequency

Orientation sensitivity

- Evidence of orientation-selectivity in humans:

- Orientation-specific adaptation, tilt illusion, tilt aftereffect

Spatial frequency sensitivity

The contrast sensitivity function

Spatial frequency adaptation, spatial frequency aftereffect

How the environment affects development

Selective rearing: leads to unbalanced distribution of orientation selective neurons.

Natural and man-made images tend to have more vertical and horizontal components – leading to the oblique effect (we're more sensitive to vertical and horizontal orientations)

Chapter 4: (Key terms are on page 91)

Structure of the LGN

Lateral penetration – retinotopic map

Vertical penetration – eye-dominance alternation

Magnocellular and parvocellular layers

Structure of the primary visual cortex (V1)

Lateral penetration –

retinotopic map

orientation selective columns

ocular dominance map

Vertical penetration – constant orientation and eye-dominance

Retinotopic maps

We have many retinotopic maps in the visual system (V1, V2, V3, etc)

V1 shows cortical magnification (over-representation of the fovea)

Over representation of fovea also found in cones, ganglion cells, and LGN

fMRI

Increase in metabolism – increase in blood flow and oxygenation – increase in image intensity.

Spatial resolution of about 3 millimeters, temporal resolution of a few seconds.

Good for measuring retinotopic maps – can show that large V1 correlates with better visual acuity, for example.

Note: the following sections have not been covered for the exam, so you will not be tested on these topics until exam 2.

Parallel pathways

Magnocellular projects to dorsal pathway

Parvocellular projects to ventral pathway

Ungerleider & Mishkin: ventral is 'what', dorsal is 'where pathway.

Evidence from lesion studies

Milner and Goodale: ventral is 'perception', dorsal is 'action' pathway.

Evidence from patient studies

Higher visual areas:

IT in monkeys, ventral lateral occipital lobe: object and face perception

FFA: Fusiform face area: damage leads to prosopagnosia

PPA: Parahippocampal place area

